U.S. NUCLEAR REGULATORY COMMISSION

REGULATORY GUIDE 1.191, REVISION 1

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FIRE PROTECTION PROGRAM FOR NUCLEAR POWER PLANTS DURING DECOMMISSIONING

A. INTRODUCTION

Purpose

This regulatory guide (RG) describes methods acceptable to the U.S. Nuclear Regulatory Commission (NRC) staff for complying with the NRC's regulations for fire protection programs for licensees that have certified that their plants have permanently ceased operations and that the fuel has been permanently removed from the reactor vessels. The NRC describes these certifications for decommissioning in 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities" (Ref. 1), Section 50.82, "Termination of license" (Ref. 2), and 10 CFR 52.110, "Termination of licenses" (Ref. 3).

Applicability

This RG applies to reactor licensees subject to 10 CFR Part 50 and 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants" (Ref. 4). Because not all of the fire protection regulations promulgated by the NRC apply to all plants, licensees should refer to their plant-specific licensing bases to determine the applicability of a specific regulation to a specific plant.

This guide applies to fire protection structures, systems, and components (SSCs) necessary to protect the spent fuel storage enclosure and pool and the spent fuel pool cooling and makeup systems licensed under 10 CFR Part 50. This RG does not apply to independent spent fuel storage installations (ISFSIs), except for the fire exposure risk to an ISFSI from a reactor during decommissioning.

Applicable Regulations

- 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities." The regulations in this part pertain to the licensing of production and utilization facilities pursuant to the Atomic Energy Act of 1954, as amended, and Title II of the Energy Reorganization Act of 1974.
    - 10 CFR 50.48(a), "Fire Protection" (Ref. 5), requires each operating nuclear power plant to have a fire protection plan that satisfies Criterion 3, "Fire Protection," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50 (Ref. 6). The

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Electronic copies of this RG, previous versions of RGs, and other recently issued guides are also available through the NRC's public Web site in the NRC Library at https://nrcweb.nrc.gov/reading-rm/doc-collections/reg-guides/, under Document Collections, in Regulatory Guides. This RG is also available through the NRC's Agencywide Documents Access and Management System (ADAMS) at http://www.nrc.gov/reading-rm/adams.html, under ADAMS Accession Number (No.) ML20287A199. The regulatory analysis may be found in ADAMS under Accession No. ML20078K925. The associated draft guide DG-1370 may be found in ADAMS under Accession No. ML20078K920, and the staff responses to the public comments on DG-1370 may be found under ADAMS Accession No. ML20287A198.

regulation specifies the contents of a fire protection plan and lists the basic fire protection requirements for the plan. The regulation also requires licensees to retain the fire protection plan and each change to the plan as a record until the Commission terminates the reactor license.

- 10 CFR 50.48(f) requires licensees that have certified the permanent cessation of operations and the removal of fuel from the reactor vessel under 10 CFR 50.82(a)(1) to maintain a fire protection program to address the potential for fires that could cause the release or spread of radioactive materials (i.e., result in a radiological hazard). A fire protection program that complies with 10 CFR 50.48(c) (Ref. 7) incorporates by reference, with exceptions, modifications, and supplementation, National Fire Protection Association (NFPA) Standard 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants" (Ref. 8) is deemed to be acceptable for complying with the requirements of 10 CFR 50.48(f).

Related Guidance

- RG 1.189, "Fire Protection for Nuclear Power Plants" (Ref. 9) provides guidance to licensees for decommissioning nuclear power reactors licensed under the provisions of 10 CFR Part 50.

- RG 1.184, "Decommissioning of Nuclear Power Reactors" (Ref. 10), provides guidance to licensees for decommissioning nuclear power reactors licensed under the provisions of 10 CFR Part 50.

- RG 1.185, "Standard Format and Content for Post-Shutdown Decommissioning Activities Report" (Ref. 11), identifies the type of information that the post-shutdown decommissioning activities report (PSDAR) should contain and establishes a standard format for the PSDAR that the NRC staff considers acceptable.

Purpose of Regulatory Guides

The NRC issues RGs to describe methods that are acceptable to the staff for implementing specific parts of the agency's regulations, to explain techniques that the staff uses in evaluating specific issues or postulated events, and to describe information that the staff needs in its review of applications for permits and licenses. Regulatory guides are not NRC regulations and compliance with them is not required. Methods and solutions that differ from those set forth in RGs are acceptable if supported by a basis for the issuance or continuance of a permit or license by the Commission.

Paperwork Reduction Act

This RG provides voluntary guidance for implementing the mandatory information collections in 10 CFR Part 50 that is subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et. seq.). These information collections were approved by the Office of Management and Budget (OMB), approval number 3150-0011. Send comments regarding this information collection to the Information Services Branch (T6-A10M), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to Infocollects.Resource@nrc.gov, and to the OMB reviewer at: OMB Office of Information and Regulatory Affairs (3150-0010), Attn: Desk Officer for the Nuclear Regulatory Commission, 725 17th Street, NW Washington, DC 20503; e-mail: oira_submission@omb.eop.gov.

Public Protection Notification

The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless the document requesting or requiring the collection displays a currently valid OMB control number.

B. DISCUSSION

Reason for Revision

This revision of the guide (Revision 1) addresses new information identified since Revision 0 of this guide was issued. While the guidance in the Revision 0 of the RG remains adequate for plants licensed under 10 CFR 50.48(b), Revision 0 does not include guidance for plants that licensed under 10 CFR 50.48(c). This guide is being revised to include guidance for plants licensed under 10 CFR 50.48(c).

Background

During the initial implementation of the U.S. nuclear reactor program, the broad performance objectives of Criterion 3 in Appendix A to 10 CFR Part 50 formed the basis for regulatory acceptance of fire protection programs at nuclear power plants. In 1976, after a major fire at the Browns Ferry Nuclear Power Plant, Unit 1, the NRC staff asked existing licensees to compare their fire protection programs to newly published guidance, Branch Technical Position (BTP) Auxiliary and Power Conversion Systems Branch (APCSB) 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants" (Ref. 12), and shortly thereafter modified the BTP and added Appendix A to BTP APCSB 9.5-1 (Ref. 13). A number of plants had fire protection programs approved under these guidance documents.

In 1980, the NRC issued 10 CFR 50.48, which specified broad performance requirements, as well as Appendix R to 10 CFR Part 50, which contained detailed regulatory requirements for resolving the disputed issues. As issued, 10 CFR 50.48 allowed plants licensed to operate prior to January 1, 1979, to retain fire protection programs approved under BTP APCSB 9.5-1 and its Appendix A, except in three areas: safe-shutdown capability (including alternative or dedicated shutdown systems), emergency lighting, and the reactor coolant pump oil system.

After several years of interaction with licensees implementing fire protection programs under 10 CFR 50.48, the NRC issued Generic Letter 86-10, "Implementation of Fire Protection Requirements" (Ref. 14). Among other things, GL 86-10 included a standard license condition on fire protection, which could be adopted by license amendment. Under the standard condition, a licensee may make changes to the approved fire protection program, without prior NRC approval, if the changes do not adversely affect the plant's ability to achieve and maintain safe shutdown in the event of a fire. Most licenses have been amended to include the standard condition on fire protection.

In 2004, the NRC amended its fire protection rule in 10 CFR 50.48 to incorporates by reference the 2001 Edition of NFPA 805 with exceptions, modifications, and supplementation. 10 CFR 50.48(c) allows nuclear power plant licensees to submit a license amendment request to adopt a fire protection program that meets the requirements of NFPA 805 as an alternative to meeting the requirements of 10 CFR 50.48(b) or any plant-specific fire protection license conditions (Ref. 15).

Licensees that have an approved NFPA 805 program under 10 CFR 50.48(c) can use Chapter 5 of NFPA 805 to comply with 10 CFR 50.48(f).

The glossary includes terms used in this guide. These definitions have been obtained from existing regulatory documents, industry fire protection standards, or defined by the NRC staff. Appendix A to this guide provides guidance on the level of fire protection that is acceptable to the NRC staff for spent fuel areas, radioactive waste storage areas, and other plant areas where a fire could potentially affect SSCs required to maintain spent fuel integrity.

Criterion 3 of the General Design Criteria, 10 CFR 50.48, and Appendix R to 10 CFR Part 50 provide the fire protection requirements for operating reactors. Before the decommissioning rule was published on July 29, 1996 (Ref. 16), 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 SSCs important to safety, to ensure the capability to safely shutdown the reactor, and to ensure the capability to maintain it in a safe-shutdown condition. For an initial period following shutdown, accidents that can challenge the dose guidelines in 10 CFR Part 20, "Standards for Protection Against Radiation" (Ref. 17), remain credible. The fire protection program should continue to protect against these events. The primary fire protection concern for permanently shutdown plants is protecting the integrity of the remaining spent fuel in spent fuel pool 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 apply to plant personnel and members of the public for fire incidents at permanently shutdown nuclear power plants. In addition, the requirement of 10 CFR 20.1101(b) to achieve dose as low as reasonably achievable, continues to apply, and licensees should ensure that dose resulting from a fire remains 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 for 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 elements reduces both the probability and consequences of fire events, and it ensures 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 have 60 years to complete radiological decommissioning and may choose from to immediate dismantling, DECON, or deferred dismantling, SAFSTOR.

- Under DECON (immediate dismantling), soon after the nuclear facility closes, equipment, structures, and portions of the facility containing radioactive contaminants are removed or decontaminated to a level that permits release of the property and termination of the NRC license.

- Under SAFSTOR (long-term safe storage), often considered "deferred dismantling," a nuclear facility is maintained and monitored in a condition that allows the radioactivity to decay. Afterwards, the plant is dismantled, and the property is decontaminated.

The licensee may also choose to adopt a combination of the first two choices in which some portions of the facility are dismantled or decontaminated, while other parts are left in SAFSTOR. The decision may be based on factors other than radioactive decay, such as availability of waste disposal sites.

The fire protection requirements may differ considerably, depending on the licensee's approach to decommissioning. Reactors that have permanently ceased operations and have no fuel in the reactor vessel present a significantly reduced risk to public health and safety compared to operating reactors. The risk posed to the public by permanently shutdown nuclear plants is expected to be much reduced because of lower inventories of releasable radionuclides and lower energy densities available for the breach of

barriers. Although the barriers to the release of radionuclides in the shutdown plants are less numerous and less robust, the frequency of fire and combustible loading may actually increase as a result of plant and operational changes during decommissioning. Therefore, the required fire protection program will evolve commensurate with the changes to fire hazards.

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.

Consideration of International Standards

The International Atomic Energy Agency (IAEA) works with member states and other partners to promote the safe, secure, and peaceful use of nuclear technologies. The IAEA develops Safety Requirements and Safety Guides for protecting people and the environment from harmful effects of ionizing radiation. This system of safety fundamentals, safety requirements, safety guides, and other relevant reports reflects an international perspective on what constitutes a high level of safety. To inform its development of this RG, the NRC considered IAEA Safety Requirements and Safety Guides pursuant to the Commission's International Policy Statement (Ref. 18) and Management Directive and Handbook 6.6, "Regulatory Guides" (Ref. 19).

The following IAEA documents provide similar guidance to Regulatory Guide 1.191:

- IAEA Specific Safety Guide No. SSG-47, "Decommissioning of Nuclear Power Plants, Research Reactors, and Other Nuclear Fuel Cycle Facilities" (Ref. 20)

- IAEA Reports Series No. 77, "Safety Assessment for Decommissioning" (Ref. 21)

Even though these international standards are consistent with the basic safety principles considered in developing this RG, this revision of RG 1.191 does not endorse any of these IAEA standards.

Documents Discussed in Staff Regulatory Guidance

This RG endorses the use of one or more codes or standards developed by external organizations, and other third-party guidance documents. These codes, standards, and third-party guidance documents may contain references to other codes, standards, or third-party guidance documents ("secondary references"). If a secondary reference has itself been incorporated by reference into NRC regulations as a requirement, then licensees and applicants must comply with that standard as set forth in the regulation. If the secondary reference has been endorsed in a RG as an acceptable approach for meeting an NRC requirement, then the standard constitutes a method acceptable to the NRC staff for meeting that regulatory requirement as described in the specific RG. If the secondary reference has neither been incorporated by reference into NRC regulations nor endorsed in a RG, then the secondary reference is neither a legally-binding requirement nor a "generic" NRC-approved acceptable approach for meeting an NRC requirement. However, licensees and applicants may consider and use the information in the secondary reference, if appropriately justified, consistent with current regulatory practice, and consistent with applicable NRC requirements.

C. STAFF REGULATORY GUIDANCE

1. FIRE PROTECTION PROGRAM

1.1 Objectives

This RG describes a fire protection program that is acceptable to the NRC staff for meeting the requirements of 10 CFR 50.48(f) for fire protection for permanently shutdown nuclear power plants. Because of the dynamic nature 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 RG. If a licensee chooses to use fire protection methods different from those discussed in this guide, the licensee should provide an equivalent level of fire protection. The licensee should demonstrate the equivalency of proposed alternative methods in an engineering evaluation.

The fire protection program should address the following performance objectives:

a. **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.

b. **Rapidly detect, control, and extinguish fires that do occur and could result in a radiological hazard.** "Rapidly" means detecting fires quickly and suppressing those fires that occur, thereby limiting damage. This can be achieved by preventing significant fires from occurring, given the inadvertent or purposeful introduction of an ignition source. In the event of a significant fire, its spread might be limited by early human detection and manual suppression, provision and maintenance of adequate fire detection and automatic fire suppression systems, and a combination of manual and automatic detection and suppression systems. 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.

c. **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. Decommissioning plant personnel should be adequately trained in emergency response procedures for fire events.

1.2 Fire Protection Program Codes and Standards

The fire protection program for decommissioning reactors should be based on sound engineering practices and established industry codes and standards, such as those provided by the NFPA. Established codes and standards provide tools to ensure fire protection is addressed in a comprehensive manner. This RG refers to several codes and standards related to implementing various elements of the fire protection program. These codes and standards are cited as potential sources of information for licensees, not as guidance for compliance with NRC requirements. Licensees must ensure that whatever codes and standards they use are consistent with the NRC's regulations.

An individual plant's standards of record are generally established in the operating plant's fire protection program. When operating nuclear power plants were originally licensed, the licensees

generally committed to complying with a specific edition of applicable industry codes and standards, such as the NFPA fire codes. The specific edition to which a licensee is committed in its licensing basis is still the "code of record." Licensees are not expected to comply with later editions of these codes and standards, except when they specifically adopt a later edition in accordance with regulatory guidelines or install new fire protection systems protecting SSCs important to safety. The code of record for the new fire protection system should be the edition that is in effect when the system is designed or when a commitment to add the system is made to the staff. The code of record for any unchanged fire protection systems will not change. In general, for modifications to an existing fire protection system that are permitted by the code of record the system will not be required to be brought into compliance with the most recent edition of the code.

The existing fire protection program for a given nuclear power plant may include additional NFPA and industry codes and standards.

1.3 Transition from Operating Plant Fire Protection Program

Operating plants are required to have a fire protection program in accordance with the requirements of 10 CFR 50.48 and Criterion 3 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 shutdown the reactor and maintain it in a safe-shutdown condition. As the plant enters decommissioning, the needs for fire protection change. Most notably, the safe-shutdown objective is not applicable during decommissioning, because the reactor permanently shuts down and the fuel is removed from the reactor vessel as the final step before the plant enters decommissioning. However, many of the elements of the operating plant fire protection program continue to be relevant in decommissioning; unless specifically authorized by regulation or an approved fire protection programs, the elements apply during decommissioning until the licensee revises them. The operating plant fire protection program provides the baseline for the decommissioning fire protection program: analysis and description of plant fire hazards, administrative controls, physical protection features, and emergency response capabilities. As described in the next section, under 10 CFR 50.48(f), licensees are expected to revise their fire protection programs as appropriate for the various stages of decommissioning.

Typically, a licensee will submit requests for licensing actions based on the reduced risk profile after it notifies the NRC that it plans to permanently cease operations. Licensees seek amendments to their licenses, as well as exemptions from certain regulatory requirements that they have determined to have no beneficial contribution to safety or security when the reactor is permanently shut down and defueled. Licensees will also use the 10 CFR 50.59, "Changes, tests, and experiments," process and other specific change processes to make additional changes to the plant that do not require NRC approval. Such changes to the decommissioning design-basis analyses, SSCs, and licensee organizations, processes, and procedures would be reflected in the licensee's defueled technical specifications, post-shutdown decommissioning activities report, and defueled safety analysis report.

1.4 Fire Protection Program for Decommissioning Plants

10 CFR 50.48(f)(2) states, "The licensee shall revise the plan as appropriate throughout the various stages of facility decommissioning." Under 10 CFR 50.48(f)(3), licensees may make changes to their fire protection programs without NRC approval if 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 decommissioning plant conditions and activities." Initially, with spent fuel removed from the reactor and stored in the spent fuel pool, a decommissioning fire protection program should ensure that the probability of fires affecting the remaining 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 ISFSI or a 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 RG 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 should determine the fire protection requirements for plant areas that the licensee's fire hazards analysis has shown to have property loss concerns.

Under 10 CFR 50.48, the licensee must maintain a fire protection program until the 10 CFR Part 50 license is terminated and the site is released for restricted or unrestricted use. The operating license cannot be terminated until the licensee has demonstrated to the NRC that it has met the applicable regulatory criteria for site release. The licensee must demonstrate that the facility has been radiologically decontaminated in accordance with the NRC-approved license termination plan. Before terminating the operating license, the NRC will determine if the plant has been dismantled according to the approved termination plan and will verify the licensee's final radiation surveys by reviewing the surveys, conducting separate surveys, or both.

1.5 Changes to the Decommissioning Fire Protection Program

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, considering the plant conditions and activities during decommissioning. An engineering evaluation can be performed and conclude that the change has not affected the alternative functionally and its equivalent to the fire protection of SSCs described in Regulatory Positions C.2 through C.5 of this guide.

For NFPA 805 plants, a licensee can change the fire protection program without prior NRC approval if an engineering evaluation demonstrates that the alternative is either functionally equivalent to the NFPA 805 Chapter 5 requirements, which are discussed in Regulatory Position C.6 of this guide, or provide an equivalent level of effectiveness to the current program for the decommissioning plant conditions and activities. NFPA 805 provides guidance on a performance-based approach that allows the use of risk insights or fire modeling to develop fire scenarios to evaluate and determine the fire protection for SSCs needed to meet the nuclear safety objectives. A licensee may use a low power/shutdown fire probabilistic risk assessment (PRA) model that has been reviewed and approved by the NRC to perform quantitative risk assessments to quantify the change in fire risk during different stages of decommissioning activities. NUREG/CR-7114, "A Framework for Low Power/Shutdown Fire PRA" issued September 2013, describes an approach that licensees can use to develop a fire PRA for use during decommissioning (Ref. 22). NFPA 805 plants may also use qualitative methods in the plant's previously approved NFPA 805 nonpower operations analysis to evaluate risk during decommissioning activities. Licensees should document how the change to the fire protection program either reduces the fire risk to the plant or meets the risk acceptance criteria described in the approved NFPA 805 fire protection program. An engineering evaluation or risk assessment should be used to demonstrate that the change maintains safety margins and fire protection defense in depth (e.g., fire prevention, fire detection, fire suppression, mitigation, and postfire nuclear safety performance criteria as described in Chapter 1 of NFPA 805).

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 during 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 items discussed below.

2.1 Fire Hazards

The fire hazards should be specifically identified, 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 laydown 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 affect 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 affect fire protection program elements.

2.3 Fire Protection Program Elements

The fire hazards analysis should describe the administrative controls, physical protection features (fire detection, suppression systems, and fire barriers), smoke exhaust systems, emergency response capabilities, 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 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 limits 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 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; the analysis should reflect significant changes.

2.4.1 Spent Fuel

The fire protection 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 A to this guide provides guidance on the level of fire protection acceptable to the NRC staff for spent fuel areas and other areas where a fire could potentially affect SSCs required to maintain spent fuel integrity.

2.4.2 Contaminated Plant Areas and WasteStorage

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 due to migration in smoke, hot gases, and fire suppression activities. Appendix A to this guide contains guidance on 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 multiunit sites and to the potential for fires to propagate from one facility to another.

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 meet the fire protection objectives. 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 decommissioning 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:

a. management of the overall fire protection program;

b. development, maintenance, updating, and verification of compliance of the fire protection program;

c. 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); and

d. 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 codes and 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. Pre-fire plans should identify the firefighting strategy to be used according to the fire location and the hazards involved. Coordination with offsite responders and the fire response leadership and command structure for 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 by the fire protection staff, plant personnel, and decommissioning contractors. For this reason, the fire protection program should be integrated with work control processes and should provide for proper review and authorization of work activities involving fire hazards or fire protection system inspection, 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 in 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 firefighting. 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. NFPA 1, "Fire Code" (Ref. 23), provides additional guidance and information.

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. Chapter 16, "Safeguarding Construction, Alteration, and Demolition Operations," and Chapter 41, "Welding, Cutting, and Other Hot Work," of NFPA 1 and Chapter 5, "Fire Prevention Precautions," of NFPA 51B, "Standard for Fire Prevention During Welding, Cutting, and Other Hot Work," give additional information and guidance (Ref. 24).

3.3.3 Fire Brigade and Offsite Support

Plant personnel who are assigned manual firefighting 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, pre-fire plans, firefighting equipment, radiation hazards, and health physics relevant to firefighting 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 Facility Fire Brigades" (Ref. 25), NFPA 801, "Standard for Fire Protection for Facilities Handling Radioactive Materials" (Ref. 26), and NFPA 1500, "Standard on Fire Department Occupational Safety, Health, and Wellness Program" (Ref. 27), 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 19, "Combustible Waste and Refuse," and Chapter 63, "Compressed Gases and Cryogenic Fluids," of NFPA 1 and Chapter 5, "Processes and Hazards," of NFPA 241, "Standard for Safeguarding Construction, Alteration, and Demolition Operations" (Ref. 28), provide information and guidance on the control of combustible materials. NFPA 30, "Flammable and Combustible Liquids Code" (Ref. 29), and NFPA 55, "Compressed Gases and Cryogenic Fluids Code" (Ref. 30), 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 the hazards should be removed promptly upon completion of the activities. In particular, the following practices should be followed:

a. 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.

b. 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.

c. 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 Propagation of Textiles and Films" (Ref. 31), provides additional guidance.

d. 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.

e. Oil-soaked rags, which are susceptible to spontaneous combustion as the oil oxidizes, release heat. If the heat is not dissipated, it can build up and ignite the rags. Oil-soaked rags should be stored in a listed disposal container and should be removed daily from areas containing radioactive materials or contamination.

f. 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 any plant area, including 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. 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. Underwriter Laboratories listed heat-producing equipment should be used. Temporary heating devices should be secured to prevent tip-over and be 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 codes and standards. The use of portable heat-producing equipment should be controlled in areas with radiological hazards or significant quantities of combustible material that present an exposure hazard to radioactive materials or systems important to safety. Chapter 41 of NFPA 1 and Chapter 5 of NFPA 241 present additional guidance and information.

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 firefighting 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 a fire.

3.6.2 Inspection, Testing, and Maintenance of the Operability of Fire Protection Systems and Features

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 penetration 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 in 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. Chapter 15, "Impairments," of NFPA 25, "Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems" (Ref. 32), provides additional guidance and information. 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, floors, ceilings, or fire enclosures should be developed and implemented to ensure these passive barriers 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 High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls" (Ref. 33), 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 as specified in Regulatory Position C.3.4 in this guide. Chapter 4, "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" (Ref. 34), 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. NFPA 80A presents additional information.

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 plant's fire hazards and the potential of these hazards to result in the release or spread of radioactive materials govern the need for physical protection features.

4.1 Fire Detection and Alarms Systems

Detection systems in operating reactor facilities are generally placed where fire hazards present

an exposure threat to safety-related equipment. Alarm systems are provided to alert plant staff to 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 the fire hazards of decommissioning are adequately addressed.

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 and Signaling Code" (Ref. 35). The fire alarm system should meet the following criteria:

a. The operation of an automatic fire suppression system initiates a fire alarm.

b. Automatic fire detection systems using smoke, heat, or flame detectors, as appropriate, are maintained for early detection of fires.

The alarm system maintains supervision of automatic fire suppression system control functions, as appropriate.

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 Other Opening Protectives" (Ref. 36), NFPA 221, and NFPA 801. The fire hazards analysis should identify and justify any unprotected openings in a fire barrier.

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 firefighting. 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:

a. reliability of the water supply source;

b. availability of tanks or other water sources, pumps, fire hydrants, and distribution system;

c. adequate flow and pressure to meet water flow demands of automatic or manual fire suppression, or both, at the point of delivery; and

d. 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 are 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.

When temperatures cannot reliably be maintained at or above 4 degrees Celsius (40 degrees Fahrenheit), water-based fire suppression system components should be protected against freezing in accordance with NFPA 13, “Standard for the Installation of Sprinkler Systems” (Ref. 37).

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 multiunit 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 Stationary Pumps for Fire Protection” (Ref. 38); NFPA 22, “Standard for Water Tanks for Private Fire Protection” (Ref. 39); NFPA 24, “Standard for the Installation of Private Fire Service Mains and Their Appurtenances” (Ref. 40); 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 kept operable based on the fire hazards analysis; these systems should be able to protect plant egress routes for evacuation of plant personnel in 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. 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 SSCs in the area. The design, installation, and operation of automatic fire protection systems should be based on NFPA 11, "Standard for Low-, Medium-, and High-Expansion Foam" (Ref. 41); NFPA 12, "Standard on Carbon Dioxide Extinguishing Systems" (Ref. 42); NFPA 12A, "Standard on Halon 1301 Fire Extinguishing Systems" (Ref. 43); NFPA 13; NFPA 15, "Standard for Water Spray Fixed Systems for Fire Protection" (Ref. 44); NFPA 16, "Standard for the Installation of Foam-Water Sprinkler, and Foam-Water Spray Systems" (Ref. 45); NFPA 17, "Standard for Dry Chemical Extinguishing Systems" (Ref. 46); NFPA 17A, "Standard for Wet Chemical Extinguishing Systems" (Ref. 47); and NFPA 75, "Standard for the Fire Protection of Information Technology Equipment" (Ref. 48).

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:

a. 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" (Ref. 49).

b. 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.

c. Outside hydrants and hose houses should be maintained to support manual fire suppression of internal fires and to protect against 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

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

a. the magnitude and complexity of potential fires in and around plant areas where radioactive materials or contamination are present;

b. the availability of onsite staffing for a fire brigade at any time;

c. 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; and

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

Firefighting equipment should be provided for manual firefighting, including hoses, nozzles, protective clothing, self-contained breathing apparatus, communications equipment, salvage equipment, ladders, smoke removal equipment, portable lighting, portable radiation monitoring equipment, fire extinguishers, and miscellaneous tools (see Regulatory Position C.3.6.1.).

The onsite fire brigade and offsite emergency services should perform periodic fire drills and exercises. See Regulatory Position C.3.3.3 for information on 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, "Life Safety Code" (Ref. 50), 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 fire hazards and the potential for those hazards to involve radioactive material should determine the necessary fire emergency response capability.

The fire protection program should identify the responsibilities of the licensee's organization and of offsite responders in 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. Offsite agencies may provide this fire service if the offsite responders have the necessary qualifications and capabilities, as described in Regulatory Positions C.3.1, C.3.2, C.3.3, and C.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.

6.0 NFPA 805 PERFORMANCE-BASED FIRE PROTECTION PROGRAM

This section provides guidance for licensees with approved NFPA 805 fire protection programs for use during plant operation to transition their programs to meet 10 CFR 50.48(f) requirements by demonstrating compliance with NFPA 805, Chapter 5, "Fire Protection During Decommissioning and Permanent Shutdown." As decommissioning progresses and the spent fuel is moved to an ISFSI or permanent repository, the fire protection programmatic controls, systems, and features used to satisfy the nuclear safety performance criteria of NFPA 805, Chapter 1, may be scaled down commensurate with the changes in fire hazards and the potential release of hazardous and radiological materials to the environment.

The regulations in 10 CFR 50.48(c) provide for a performance-based fire protection program using NFPA 805 (2001 Edition) that can readily be modified during the decommissioning process to address residual hazards. However, the NRC has not incorporated subsequent editions of NFPA 805 or any appendices to NFPA 805 into the rule. Where this RG refers to compliance with, or meeting, the requirements of NFPA 805, the staff means compliance with a plant's previously approved NFPA 805 licensing basis before decommissioning. Compliance with Chapter 5 of NFPA 805 and other applicable portions of NFPA 805 provides an acceptable performance-based fire protection program.

Chapter 5 of NFPA 805, applies to the power block areas of nuclear power plants that have permanently ceased operations. The power block areas are defined in the licensee's approved NFPA 805 fire protection program. The power block comprises structures that have equipment required for nuclear plant operation. These structures generally include the containment, auxiliary building, service building, control building, fuel building, radwaste, water treatment, turbine building, and intake structure. However, the buildings that make up the plant's power block areas during decommissioning may change commensurate with the SSCs required to meet the nuclear safety performance criteria during decommissioning. As indicated in the guidance in Regulatory Position C.1.4 of this guide, the power block may also include facilities that contain radiological hazards or ancillary facilities that directly support the decommissioning process (e.g., onsite waste storage).

6.1 NFPA 805 Nuclear Safety Performance Criteria

During decommissioning, NFPA 805 fire protection program elements should be maintained commensurate with the changes in fire hazards and the potential release of hazardous and radiological materials to the environment. The fire protection systems and features required to protect SSCs to meet the nuclear safety performance criteria of Section 1.5.1, "Nuclear Safety Performance Criteria," of NFPA 805 should continue to be maintained during decommissioning.

Decay heat removal systems (e.g., the spent fuel pool cooling system) should be capable of removing sufficient heat from the spent fuel such that fuel is maintained in a safe and stable condition. Vital auxiliaries, such as ventilation systems, electrical power supplies, service water systems, component cooling water systems, and instrument air, should be capable of supporting the spent fuel pool cooling system functions required for decay heat removal from the spent fuel.

Process monitoring should be capable of providing the necessary indications to ensure that decay heat removal from the spent fuel has been achieved and is being maintained (e.g., spent fuel pool water level monitors, radiation monitors, diagnostic instruments).

Recovery actions required should be evaluated in accordance with the licensee's licensing basis. The changing plant configuration during decommissioning activities should consider the emergency lighting and access and egress routes required to perform the recovery action.

Appendix A to this guide presents guidance to consider for fire protection for the spent fuel areas and radioactive waste storage areas for licensees with a previously approved NFPA 805 fire protection program.

6.2 Fire Protection Plan

The licensee's NFPA 805 fire protection program should be consistently updated to remain commensurate with the changes in fire hazards and the potential release of radiological materials to the environment during decommissioning activities. The fire protection program should establish administrative controls, such as the following, as described in the licensee's licensing basis, which is described further in applicable parts of Regulatory Positions C.2 and C.3 of this guide:

a. controls governing the identification of fire hazards and changes in fire mitigation strategies resulting from decommissioning;

b. controls governing fire area boundaries or barriers used to isolate areas with significant hazards;

c. controls governing the testing, maintenance, and operability of fire protection systems and features;

d. administrative controls governing general fire prevention activities such as control of combustibles and ignition sources;

e. controls governing plant features important to life safety and plant evacuation in a fire; and

f. controls governing fire detection and notification, firefighting capability, and emergency response.

6.3 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 firefighting capability. In accordance with Section 5.3.1 of NFPA 805, the onsite fire protection water supply and distribution systems should be evaluated to ensure compliance with Section 3.5, "Water Supply," of NFPA 805. Regulatory Position C.4.3.1 of this guide describes the factors considered in determining the adequacy of the fire water supply, including the protection from freezing for firefighting water supply, distribution, and delivery systems (e.g., sprinklers and standpipes).

6.4 Automatic and Manual Fire Suppression Systems

NFPA 805 operating fire protection programs identify automatic and manual fire suppression systems that are credited to meet the nuclear safety performance criteria of Chapter 1 of NFPA 805 or for defense-in-depth. During decommissioning activities, licensees should continuously evaluate plant areas to determine the automatic and manual fire suppression systems needed to meet the nuclear safety performance criteria described in their licensing basis and to ensure fire protection programs remain commensurate with the changes in fire hazards and the potential release of hazardous and radiological materials to the environment. The design of automatic and manual water-based fire suppression systems should meet Section 3.9 of NFPA 805, and the design of gaseous fire suppression systems should meet Section 3.10 of NFPA 805.

6.5 Portable Fire Extinguishers

As described in Section 5.3.3 of NFPA 805, portable fire extinguishers are should remain in plant areas described in the decommissioning plan until combustibles and ignition sources have been removed. Additional extinguishers should be installed commensurate with the changes in fire hazards, plant conditions, and necessary manual firefighting activities as discussed in Section 3.4.4 of NFPA 805. The licensee should maintain the fire extinguishers as described in Section 3.7 of NFPA 805.

6.6 Standpipes and Hose Stations

As described in Section 5.3.4 of NFPA 805, existing hose and standpipe systems should remain functional to support the decommissioning plan. Regulatory Position C.4.3.3 of this guide describes other considerations for maintaining standpipe and hose stations. The licensee should maintain the hose station and standpipe systems as described in Section 3.6 of NFPA 805.

6.7 Onsite and Offsite Firefighting Response

Chapter 5 of NFPA 805 requires an onsite industrial fire brigade consistent with Section 3.4

The licensee should continue to maintain pre-fire plans and onsite industrial fire brigade equipment consistent with Sections 3.4.2 and 3.4.4 of NFPA 805. The licensee should revise the pre-fire plans when the occupancy or fire risk for the area has substantially changed because of decommissioning conditions and activities.

The licensee should continue to maintain the industrial fire brigade drills and training, including the interface with offsite fire departments, as described in Sections 3.4.3 and 3.4.5. The level of training, type of drills, and level of offsite fire department support should continue commensurate with the hazards during the decommissioning activities.

When the nuclear safety and the radioactive release criteria of Chapter 1 of NFPA 805 no longer apply to the power block, a plant industrial fire brigade and the provisions of Sections 5.3.5.2, 5.3.5.3, and 5.3.5.4 of NFPA 805 will no longer be needed.

6.8 Fire Detection and Alarms

The licensee should maintain the fire detection and alarm systems described in the approved NFPA 805 licensing basis to provide a reliable means of detecting a fire, providing notification to a constantly attended location, and alerting the industrial fire brigade and plant personnel of the pending condition. During decommissioning activities, the licensee should determine whether fire detection or alarm systems should be installed or removed as required to protect SSCs to meet the nuclear safety performance criteria described in Regulatory Position C.6.1 of this guide or commensurate with the changes in fire hazards and the potential release of hazardous and radiological materials to the environment. The design of fire detection and alarm systems should meet Section 3.8 of NFPA 805.

6.9 Fire Confinement and Fire Barriers

Because of plant changes during decommissioning conditions and activities, the licensee should evaluate the need for fire barriers and fire area boundaries to isolate fire hazards; aid in the ability to effectively contain, fight, and control a fire; protect plant personnel evacuation routes; and minimize the spread of radioactive contamination. Fire barriers identified to be maintained should meet Section 3.11 of NFPA 805 for the design of passive fire protection features.

6.10 Life Safety

Egress and evacuation routes should be established and maintained. The changing plant configurations during decommissioning activities should be considered when determining the adequacy of egress routes and emergency lighting requirements.

D. IMPLEMENTATION

The NRC staff may use this RG as a reference in its regulatory processes, such as licensing, inspection, or enforcement. However, the NRC staff does not intend to use the guidance in this RG to support NRC staff actions in a manner that would constitute backfitting as that term is defined in 10 CFR 50.109, "Backfitting" (Ref. 519), and as described in NRC Management Directive 8.4, "Management of Backfitting, Forward Fitting, Issue Finality, and Information Requests" (Ref. 52). The staff also does not intend to use the guidance to support NRC staff actions in a manner that constitutes forward fitting as that term is defined and described in Management Directive 8.4. If a licensee believes that the NRC is using this RG in a manner inconsistent with the discussion in this Implementation section, then the licensee may file a backfitting or forward fitting appeal with the NRC in accordance with the process in Management Directive 8.4.

REFERENCES[1]

1. *U.S. Code of Federal Regulations* (CFR), "Domestic Licensing of Production and Utilization Facilities," Part 50, Chapter 1, Title 10, "Energy."

2. CFR, "Termination of License," Section 50.82, Chapter 1, Title 10, "Energy."

3. CFR, "Termination of licenses," Section 52.110, Chapter 1, Title 10, "Energy."

4. CFR, "Licenses, Certifications, and Approvals for Nuclear Power Plants," Part 52, Chapter 1, Title 10, "Energy."

5. CFR, "Fire Protection," Section 50.48, Chapter 1, Title 10, "Energy."

6. CFR, Criterion 3, Fire Protection" "General Design Criteria for Nuclear Power Plants," Appendix A to Part 50, Chapter 1, Title 10, "Energy."

7. CFR, "National Fire Protection Association NFPA 805," Section 50.48(c), Chapter 1, Title 10, "Energy."

8. National Fire Protection Association (NFPA),[2] Standard 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," 2001 Edition, Quincy, MA.

9. U.S. Nuclear Regulatory Commission (NRC), RG 1.189, "Fire Protection Program for Nuclear Power Plants," Washington, DC.

10. U.S. Nuclear Regulatory Commission (NRC), RG 1.184, "Decommissioning of Nuclear Power Reactors," Washington, DC.

11. U.S. Nuclear Regulatory Commission (NRC), RG 1.185, "Standard Format and Content for Post-Shutdown Decommissioning Activities Report," Washington, DC.

12. BTP APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, DC, May 1, 1976.

13. BTP APCSB 9.5-1, Appendix A, "Guidelines for Fire Protection for Nuclear Power Plants Docketed Prior to July 1, 1976," U.S. Nuclear Regulatory Commission, Washington, DC, February 24, 1977.

14. NRC Generic Letter 86-10, "Implementation of Fire Protection Requirements," Washington, DC.

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[1] Publicly available NRC published documents are available electronically through the NRC Library on the NRC's public Web site at http://www.nrc.gov/reading-rm/doc-collections/ and through the NRC's Agencywide Documents Access and Management System (ADAMS) at http://www.nrc.gov/reading-rm/adams.html. The documents can also be viewed online or printed for a fee in the NRC's Public Document Room (PDR) at 11555 Rockville Pike, Rockville, MD. For problems with ADAMS, contact the PDR staff at (301) 415-4737 or (800) 397-4209; fax (301) 415-3548; or e-mail pdr.resource@nrc.gov.

[2] NFPA codes and standards may be purchased from the National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471 (telephone 1-800-344-3555), or they are available at: http://www.nfpa.org/codes-and-standards/document-information-pages

15. NRC, "Voluntary Fire Protection Requirements for Light Water Reactors; Adoption of NFPA 805 as a Risk-Informed, Performance-Based Alternative," *Federal Register*, Vol. 69, No. 115, June 16, 2004, pp. 33536–33550.

16. NRC, "Decommissioning of Nuclear Power Reactors," *Federal Register*, Vol. 61, No. 146, July 29, 1996, pp. 39278–39304.

17. CFR, "Standards for Protection Against Radiation," Part 20, Chapter 1, Title 10, "Energy."

18. NRC International Policy Statement, Federal Register Vol. 79, page 39415, July 10, 2014, ADAMS Accession No. ML14132A317.

19. NRC Management Directive and Handbook 6.6, "Regulatory Guides" ADAMS Accession No. ML16083A122.

20. International Atomic Energy Agency (IAEA) Specific Safety Guide No. SSG-47, "Decommissioning of Nuclear Power Plants, Research Reactors, and Other Nuclear Fuel Cycle Facilities," Vienna, Austria, 2018.[3]

21. IAEA Reports Series No. 77, "Safety Assessment for Decommissioning," Vienna, Austria, 2013.

22. NRC, NUREG/CR-7114, "A Framework for Low Power/Shutdown Fire PRA," September 2013, ADAMS Accession No. ML13260A155.

23. NFPA, Standard 1, "Fire Code," Quincy, MA.

24. NFPA, Standard 51B, "Standard for Fire Prevention During Welding, Cutting, and Other Hot Work," Quincy, MA.

25. NFPA, Standard 600, "Standard on Facility Fire Brigades," Quincy, MA.

26. NFPA, Standard 801, "Standard for Fire Protection for Facilities Handling Radioactive Materials," Quincy, MA.

27. NFPA, Standard 1500, "Standard on Fire Department Occupational Safety, Health, and Wellness Program," Quincy, MA.

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

29. NFPA, Standard 30, "Flammable and Combustible Liquids Code," Quincy, MA.

30. NFPA, Standard 55, "Compressed Gases and Cryogenic Fluids Code," Quincy, MA.

31. NFPA, Standard 701, "Standard Methods of Fire Tests for Flame Propagation of Textiles and Films," Quincy, MA.

32. NFPA, Standard 25, "Standard for the Inspection, Testing, and Maintenance of Water-Based Fire

[3] Copies of IAEA documents may be obtained through their Web site: WWW.IAEA.Org/ or by writing the International Atomic Energy Agency, P.O. Box 100 Wagramer Strasse 5, A-1400 Vienna, Austria.

Protection Systems," Quincy, MA.

33. NFPA, Standard 221, "Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls," Quincy, MA.

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

35. NFPA, Standard 72, "National Fire Alarm and Signaling Code," Quincy, MA.

36. NFPA, Standard 80, "Standard for Fire Doors and Other Opening Protectives," Quincy, MA.

37. NFPA, Standard 13, "Standard for the Installation of Sprinkler Systems," Quincy, MA.

38. NFPA, Standard 20, "Standard for the Installation of Stationary Pumps for Fire Protection," Quincy, MA.

39. NFPA, Standard 22, "Standard for Water Tanks for Private Fire Protection," Quincy, MA.

40. NFPA, Standard 24, "Standard for the Installation of Private Fire Service Mains and Their Appurtenances," Quincy, MA.

41. NFPA, Standard 11, "Standard for Low-, Medium-, and High-Expansion Foam," Quincy, MA.

42. NFPA, Standard 12, "Standard on Carbon Dioxide Extinguishing Systems," Quincy, MA.

43. NFPA, Standard 12A, "Standard on Halon 1301 Fire Extinguishing Systems," Quincy, MA.

44. NFPA, Standard 15, "Standard for Water Spray Fixed Systems for Fire Protection," Quincy, MA.

45. NFPA, Standard 16, "Standard for the Installation of Foam-Water Sprinkler, and Foam-Water Spray Systems," Quincy, MA.

46. NFPA, Standard 17, "Standard for Dry Chemical Extinguishing Systems," Quincy, MA.

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

48. NFPA, Standard 75, "Standard for the Fire Protection of Information Technology Equipment," Quincy, MA.

49. NFPA, Standard 14, "Standard for the Installation of Standpipe and Hose Systems," Quincy, MA.

50. NFPA, Standard 101, "Life Safety Code," Quincy, MA.

51. CFR, "Backfitting," Section 50.109, Chapter 1, Title 10, "Energy."

52. NRC, Management Directive 8.4, "Management of Backfitting, Forward Fitting, Issue Finality, and Information Requests," September 20, 2019, ADAMS Accession No. ML18093B087.

GLOSSARY

The following definitions have been taken from existing regulatory documents and industry fire protection codes and 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 firefighting tools, equipment, and fire suppression capability.

Fire area. A part of a structure that is separated from other areas by space, fire barriers, walls, floors, ceilings, or other means to contain fire within that area.

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 prevent the spread of heat and fire, restrict the movement of smoke, and 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 firefighting 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 affect 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 model. Mathematical prediction of fire growth, environmental conditions, and potential effects on structures, systems, or components based on the conservation equations or empirical data.

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 scenario. A description of a fire and any factors affecting or affected by it from ignition to extinguishment, including, as appropriate, ignition sources, nature and configuration of the fuel, ventilation characteristics and locations of occupants, condition of the supporting structure, and conditions and status of operating equipment.

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 formal 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.

Laydown areas. Locations 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 list 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 that, 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 American Society

for Testing and Materials (ASTM) E-84 (1997), "Standard Test Method for Surface Burning Characteristics of Building Materials."[4]

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 stopped or will permanently stop 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.

Power block. For plants that are licensed to use NFPA 805, the power block is defined as structures that (1) contain equipment required to meet the nuclear safety performance criteria in Chapter 1 of NFPA 805, (2) have radiological hazards, and (3) directly support the decommissioning process, such as ancillary facilities that will store onsite waste.

Pre-fire 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 a fire and that exceeds the dose limits to plant personnel and members of the public as specified in 10 CFR Part 20.

Recovery Action. Activities to achieve the nuclear safety performance criteria that take place outside of the main control room or outside the primary control station(s) for the equipment being operated, including the replacement or modification of components.

Safe and stable conditions. For fuel in the spent fuel pool, maintenance of $K_{eff}<0.99$ and fuel coolant temperature below boiling.

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

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[4] A copy of ASTM E-84 is available from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

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

Turnout gear. Protective clothing for firefighting such as coats, pants, boots, helmets, gloves, and self-contained breathing apparatus.

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 A

LIMITED GUIDANCE ON CONSIDERATIONS OF FIRE PROTECTION FOR SELECTED FIRE AREAS, STRUCTURES, SYSTEMS, AND COMPONENTS

The following guidance describe acceptable fire protection for selected plant areas that may contain radiological hazards. This guidance is generic and does not encompass all possible areas that contain radiological and fire hazards for a plant undergoing decommissioning. This guidance is applicable to a decommissioning fire protection program that implements protection methods described in this guide for plants that implement a performance-based or previously approved National Fire Protection Association (NFPA) 805 fire protection program. The methods of protection described in this appendix are not requirements of the U.S. Nuclear Regulatory Commission.

Spent Fuel Pool Area and Other Plant Areas

The fire hazards in the spent fuel pool area and other plant 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 affect radioactive materials, including the spent fuel, should be evaluated.

The radiological hazards in this area that could contribute to a radiological release if exposed to fire should be quantified, including hazards of the spent fuel and any radioactive waste or contamination. 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 Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, "Standards for Protection Against Radiation."

Cables and equipment associated with structures, systems, and components (SSCs) that are necessary to protect 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. NFPA 805 plants can use previously approved methods in the nonpower operations analysis to determine the fire protection needed for SSCs required to meet the nuclear safety performance criteria described in Regulatory Position C.6.1 of this guide. The use or storage of combustible materials should be minimized and controlled, and hot-work processes should be limited or restricted in or near the area).

If a fire in the spent fuel pool area or other plant areas 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 firefighters, are not exceeded.

Procedures should be developed that describe equipment configurations and necessary operator actions (e.g., recovery actions for NFPA 805 plants) in response to a fire in the spent fuel pool area or in

other plant areas where a fire may affect redundant trains of SSCs required to maintain spent fuel pool cooling functions. 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. Consider that 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 performed according to established 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, as evaluated in the licensee's fire protection program. 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 standpipes 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.

Pre-fire plans should be developed for the spent fuel pool area and other affected areas. Pre-fire plans should identify:

- 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-fire plans and general fire attack strategy for the spent fuel pool area.

Radioactive Waste Storage and Accumulation Areas, Including Temporary Structures

Decommissioning activities may involve the generation of solid and liquid radioactive waste. 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 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 affect 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 firefighting and evacuation efforts should be evaluated. Confinement measures should be provided as necessary to mitigate release of

radioactive materials entrained in the smoke, gases, and fire suppression activities. NFPA 805 plants should maintain radioactive release assessments for nonpower conditions and continue to meet the radioactive release performance criteria during implementation of decommissioning activities.

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 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 from the direct effects of smoke, hot gases, and fire suppression activities. 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, and hot-work processes should be limited or restricted in or near the area.

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 due to smoke, hot gases, and fire suppression activities. 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 the demands of automatic (if applicable) and manual suppression systems.

Procedures should be established for administrative controls for housekeeping, transient combustibles, and hot work in radioactive waste storage and accumulation areas.

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. The waste storage area layout and the availability of standpipes (i.e., to avoid hose lays through doors) to allow firefighting activities, and at the same time maintain adequate confinement, should be considered.

Pre-fire plans should be developed for the radioactive waste storage and accumulation areas. The pre-fire 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-fire plans and general fire attack strategy for the radioactive waste storage and accumulation areas.