



## REGULATORY GUIDE

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### REGULATORY GUIDE X.XXX

## RISK-INFORMED, PERFORMANCE-BASED FIRE PROTECTION FOR EXISTING LIGHT-WATER NUCLEAR POWER PLANTS

### A. INTRODUCTION

This regulatory guide provides guidance for use in complying with the requirements that the U.S. Nuclear Regulatory Commission (NRC) has promulgated for risk-informed, performance-based fire protection programs that meet the requirements of Title 10, Section 50.48(c), of the *Code of Federal Regulations* (10 CFR 50.48(c)) and the referenced 2001 Edition of the National Fire Protection Association (NFPA) standard, NFPA 805, "Performance-Based Standard for Fire Protection for Light-Water Reactor Electric Generating Stations."

In accordance with 10 CFR 50.48(a), each operating nuclear power plant must have a fire protection plan that satisfies General Design Criterion (GDC) 3, "Fire Protection," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities." In addition, before the adoption of 10 CFR 50.48(c), plants that were licensed to operate before January 1, 1979, needed to meet the requirements of 10 CFR Part 50 Appendix R, "Fire Protection Program for Nuclear Power Facilities Operation Prior to January 1, 1979," as stated in 10 CFR 50.48(b). Plants licensed to operate after January 1, 1979, were required to comply with 10 CFR 50.48(a), as well as any plant-specific fire protection license condition and technical specifications.

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Section 50.48(c) incorporates NFPA 805 by reference, with certain exceptions, and allows licensees to voluntarily adopt and maintain 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 the plant-specific fire protection license conditions. Licensees who choose to comply with NFPA 805 must submit an application for license amendment to the NRC, in accordance with 10 CFR 50.90. Section 50.48(c)(3) describes the required content of the application.

The Nuclear Energy Institute (NEI) developed NEI 04-02, "Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c)," Revision 0, dated April 2005, to assist licensees in adopting NFPA 805 and making the transition from their current fire protection licensing basis to one based on NFPA 805. This regulatory guide endorses NEI 04-02, Revision 0, because it provides acceptable methods for implementing NFPA 805 and complying with 10 CFR 50.48(c), subject to the additional positions contained in Section C of this regulatory guide and the approval authority NFPA 805 grants to the authority having jurisdiction (AHJ). The regulatory positions in Section C include clarification of the guidance provided in NEI 04-02 as well as any NRC exceptions to the guidance. The regulatory positions in Section C take precedence over the NEI 04-02 guidance. All references to NEI 04-02 in this regulatory guide refer to Revision 0 of the NEI guidance document. All references to NFPA 805 in this regulatory guide refer to the 2001 Edition of NFPA 805. The NRC is the AHJ for nuclear power plant fire protection programs.

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## **B. DISCUSSION**

### **Background**

The *Code of Federal Regulations*, Title 10, Section 50.48(a), requires that all operating nuclear power plants implement a fire protection program that satisfies GDC 3 of Appendix A to 10 CFR Part 50. In addition to the requirements of 10 CFR 50.48(a), plants licensed to operate before January 1, 1979, must meet the requirements of Appendix R to 10 CFR Part 50, to the extent described in 10 CFR 50.48(b). Nuclear power plants that were licensed to operate after January 1, 1979, must comply with 10 CFR 50.48(a), as well as any plant-specific fire protection license conditions and technical specifications. Fire protection license conditions typically reference NRC safety evaluation reports (SERs), which are the products of the staff's initial licensing reviews against either (1) Appendix A to Branch Technical Position (BTP) Auxiliary Power Conversion Systems Branch (APCSB) 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants," and the criteria of certain sections of Appendix R to 10 CFR Part 50; or (2) Section 9.5.1, "Fire Protection Programs," of NUREG-0800, "Standard Review Plan for the

Review of Safety Analysis Reports for Nuclear Power Plants” (SRP). The SRP closely follows the structure and requirements of Appendix R to 10 CFR Part 50.

The fire protection requirements of GDC 3, Appendix R, the BTP, and the SRP are considered deterministic requirements. The industry and some members of the public have described these requirements as prescriptive and creating unnecessary regulatory burden. The NRC has issued approximately 900 plant specific exemptions to the requirements of Appendix R, and approved numerous deviations from the licensing requirements for post-1979 plants.

In SECY-98-058, “Development of a Risk-Informed, Performance-Based Regulation for Fire Protection at Nuclear Power Plants,” dated March 26, 1998, the staff proposed to the Commission that the staff work with the NFPA and industry to develop a risk-informed, performance-based consensus fire protection standard for nuclear power plants. This consensus standard could be endorsed in future rulemaking as an alternative set of fire protection requirements. In SECY-00-0009, “Rulemaking Plan, Reactor Fire Protection Risk-Informed, Performance-Based Rulemaking,” dated January 13, 2000, the NRC staff requested and received Commission approval for proceeding with a rulemaking to permit reactor licensees to adopt NFPA 805 as a voluntary alternative to existing fire protection requirements. On February 9, 2001, the NFPA Standards Council approved the 2001 Edition of NFPA 805 as an American National Standard for performance-based fire protection for light-water nuclear power plants.

Effective July 16, 2004, the Commission amended its fire protection requirements in 10 CFR 50.48 to add 10 CFR 50.48(c), which incorporates the 2001 edition of NFPA 805 by reference, with certain exceptions, and allows licensees to apply for a license amendment to comply with NFPA 805. [See Volume 69, page 33536 of the *Federal Register* (69 FR 33536)]. The NRC cannot adopt future editions of NFPA 805 without rulemaking. However, licensees may request to use specific risk-informed or performance-based alternatives included in future additions of NFPA 805 by submitting a license amendment, in accordance with 10 CFR 50.48(c)(4).

In parallel with the Commission’s efforts to promulgate a rule endorsing risk-informed, performance-based fire protection provisions of NFPA 805 and to follow the provisions of the Federal Advisory Committee Act which are designed to encourage the public and industry to have more meaningful involvement in the regulatory process, NEI worked with industry and the staff to develop implementing guidance for the specific provisions of NFPA 805 and the rule. The NEI published such guidance in NEI 04-02, Revision 0, in April 2005. This regulatory guide provides the NRC’s position on NEI 04-02 and offers additional information and guidance to supplement the NEI document and assist the licensees in meeting the Commission’s requirements.

## **Fire Protection Program Transition**

The staff endorses a “safe-today, safe-tomorrow” approach consistent with NFPA 805 for plants that transition to a risk-informed, performance-based fire protection program in accordance with 10 CFR 50.48(c). With this approach a licensee is not required to re-assess the acceptability of license amendments, exemptions or deviations that have been previously

approved by the NRC for the plant. However, a minimal review should be performed by the licensee to ensure that the conditions described in the original exemption or amendment request are still relevant and representative of the current plant operations and configuration. The overall objective of this approach is to enable licensees to transition to a risk-informed, performance-based fire protection program without undue burden, while enhancing plant safety and providing a clear licensing basis.

To enhance plant safety, licensees are encouraged to disposition any noncompliances identified by the licensee during the transition process. To accommodate licensees during this transition period while they evaluate the implication of 10 CFR 50.48(c) and the original licensing basis remains in effect, the NRC will grant, under specific circumstances, enforcement discretion for issues identified by the licensee during the transition, unless they are highly risk-significant (i.e., greater than  $1 \times 10^{-4}$ /year in core damage frequency increase).

As discussed in the background information above, licensees must submit an application for license amendment to change their fire protection licensing basis to adopt 10 CFR 50.48(c). As stated in 10 CFR 50.48(c)(3)(ii), the licensee must implement the methodology in Chapter 2 of NFPA 805 and modify the fire protection program required by 10 CFR 50.48(a) to reflect compliance with NFPA 805 before changing its current program or modifying the plant. The modified fire protection program cannot be implemented until the approved license amendment is received by the licensee. The rule does not require the licensee to submit the revised fire protection program for NRC review or approval.

The NFPA 805 standard is structured to allow licensees to transition much, if not all, of their existing programs, with modification to address additional or new elements of NFPA 805 that are not addressed by current regulations. Licensees need to address the basic elements of NFPA 805 as they transition their fire protection programs. These new elements include (1) the nuclear safety performance criteria for all modes of operation, (2) the radioactive material release performance criteria that, (3) compliance with the fundamental fire protection program and design elements, and (4) the specific documentation, quality, and configuration management provisions of the NFPA standard. The NEI implementation guide, NEI 04-02, and the positions contained in this regulatory guide present guidance to assist the licensee in this transition.

Certain aspects of the plant's fire protection program may not have been specifically approved by the NRC, e.g., through a Safety Evaluation Report or approved 10 CFR 50.12 exemption request. Consequently these aspects of the program are not part of the fire protection plant licensing basis (see 10 CFR 54.3(a) for guidance on documents that are included in the plant licensing basis). Licensees may elect to submit a detailed description of key elements of the plant fire protection program that are inadequately defined in the current licensing basis in order to obtain explicit approval of these elements for the NFPA 805 licensing basis. NEI 04-02 recommends specific issues that licensees should address in the license amendment request, such as crediting operator manual actions as NFPA 805 recovery actions and circuit analysis selection and evaluation methodology for the evaluation of fire induced consequences. The submittals addressing these issues should include sufficient detail to allow the NRC to adequately assess whether the licensee's treatment of these issues demonstrates that the performance criteria of NFPA 805 have been met.

Section 50.48(c) does not include a specific schedule for implementing a fire protection program meeting the provisions of NFPA 805. However, licensees who wish to take advantage of the Commission's interim enforcement discretion policy for fire protection will need to establish an implementation schedule consistent with the enforcement policy.

### **Transition Identified Noncompliance and Interim Enforcement Discretion Policy**

The NRC report, NUREG-1600, "General Statement of Policy and Procedure for NRC Enforcement Actions," updated on August 13, 2004, describes the Commission's general enforcement policy. In SECY-04-0050, "Final Rule: Revision of 10 CFR 50.48 to Allow Performance-Based Approaches Using National Fire Protection Association (NFPA) Standard 805 (NFPA 805), 'Performance-Based Standard for Fire Protection for Light-Water Reactor Electric Generating Plants,' 2001 Edition," the NRC staff requested that the Commission approve, for public notice, an interim enforcement policy for licensees that adopt NFPA 805, in accordance with 10 CFR 50.48(c). The SECY paper provides the underlying basis and criteria for enforcement discretion. The Commission approved and published the interim enforcement policy in the *Federal Register* on June 16, 2004 (see 69 FR 33684). The most current enforcement policy and the interim enforcement policy on discretion may be found at <http://www.nrc.gov/what-we-do/regulatory/enforcement/enforce-pol.html>.

The enforcement discretion begins upon receipt of a letter of intent from the licensee stating its intention to adopt NFPA 805 and providing a schedule for completion of the plant assessment. The enforcement discretion period would be in effect for up to 2 years, and if the licensee submits a license amendment request, would continue until the NRC completes its approval of the amendment request, which could potentially extend beyond the 2-year period. In addition, for licensees that submit a letter of intent prior to December 31, 2005, enforcement discretion would be applied to cover corrective action implementation for existing and identified noncompliances, until the licensee completes its transition to 10 CFR 50.48(c).

For those plants that submit a letter of intent, but subsequently decide not to complete the transition to 10 CFR 50.48(c), the enforcement policy requires the licensee to inform the NRC of this decision and withdraw its letter of intent. Any violations that are identified and corrected before the date of the withdrawal letter would be unaffected by the withdrawal. The staff will consider the continuation of enforcement discretion for violations that are identified before the withdrawal on a case-by-case basis to ensure that timely corrective actions are taken commensurate with the safety significance of the issue. Any violations occurring after withdrawal of the letter of intent would be dispositioned in accordance with normal enforcement practices.

## **Fire Protection Program Changes**

Prior to the promulgation of 10 CFR 50.48(c), plants typically have adopted a standard fire protection license condition. Under this condition, the licensee can only make changes to the approved fire protection program, without prior Commission approval, if the changes would not adversely affect the plant's ability to achieve and maintain safe shutdown in the event of a fire. This license condition would be changed for plants that adopt NFPA 805. The NFPA 805 standard contains specific requirements for evaluating changes to the program. See Regulatory Position 2.1 in Section C of this regulatory guide for an acceptable fire protection license condition for plants adopting NFPA 805.

## **Appendices to NFPA 805**

As discussed in the Statements of Consideration for the proposed rulemaking (see 67 FR 66578), and restated in the comment resolution for the final rulemaking that amended 10 CFR 50.48 to incorporate NFPA 805 by reference (see 69 FR 33536), the appendices to NFPA 805 are not considered part of the rule. However, Appendices A, B, C, and D provide useful information for implementing the requirements of NFPA 805. The staff finds the specific guidance contained within the appendices to be acceptable to the extent that this guidance is specifically endorsed within the positions contained in Section C of this regulatory guide.

## **C. REGULATORY POSITIONS**

### **1. NEI 04-02**

The guidance in NEI 04-02, Revision 0, provides methods acceptable to the staff for adopting a fire protection program consistent with the 2001 edition of NFPA 805, subject to the regulatory positions contained herein.

The NRC's endorsement of NEI 04-02 excludes Section 6.0, Implementing Guidance for Use of Tools and Processes Within Existing Licensing Basis, which provides guidance for using the risk-informed methods without adopting NFPA 805. The purpose of NEI 04-02 and this regulatory guide is to provide guidance for implementing a fire protection program that complies with 10 CFR 50.48(c). Neither the regulatory requirements of 10 CFR 50.48(c) nor NFPA 805 include provisions to use the methods and approaches of NFPA 805 within an existing fire protection licensing basis.

Conversely, there are also no regulatory prohibitions or limitations on analytical methods used in developing the safety case for license amendments or exemptions, as long as they are technically valid, justified, and defensible as demonstrating adequate protection of the public. In making changes to the existing fire protection program, the licensee shall follow the change process allowed under the standard fire protection license condition and should provide the necessary technical basis to support the change, regardless of the methods

employed. In addition, the NRC's endorsement of NEI 04-02 does not imply its endorsement of the references cited in NEI 04-02.

## **2. Transition Process**

### **2.1 Standard License Condition**

Section 4.6.1 of NEI 04-02 provides acceptable guidance for submitting license amendment requests to allow the adoption of NFPA 805. As specified in 10 CFR 50.48(c)(3)(i), the license change amendment request must identify any license conditions to be revised or superseded. The following license condition is an acceptable fire protection license condition for plants adopting NFPA 805:

(Name of Licensee) shall implement and maintain in effect all provisions of the approved fire protection program that comply with 10 CFR 50.48(a), 10 CFR 50.48(c), and NFPA 805 (2001 Edition) as specified in the licensee amendment request dated \_\_\_\_\_ and as approved in the safety evaluation report dated \_\_\_\_\_ (and supplements dated \_\_\_\_\_). Except where NRC (AHJ) approval for changes or deviations is required by 10 CFR 50.48(c) and NFPA 805, the licensee may make changes to the fire protection program without prior approval of the Commission if those changes are evaluated and determined to be acceptable as provided for in NFPA 805, 2001 Edition.

### **2.2 Existing Engineering Equivalency Evaluations**

NFPA 805, Section 2.2.7 describes the application of Existing Engineering Equivalency Evaluations (EEEE's) when using a deterministic approach during the transition to an NFPA 805 licensing basis. One type of EEEE, commonly referred to as a "Generic Letter 86-10 (GL 86-10) evaluation," allows licensees who have adopted the standard fire protection license condition (under their current licensing basis and in accordance with GL 86-10) to make changes to the approved fire protection program without prior NRC approval if those changes would not adversely affect the ability to achieve and maintain safe shutdown in the event of a fire. With the exception of evaluations of certain recovery actions and any deviations from NFPA 805 requirements, a GL 86-10 evaluation showing no adverse affect on safe shutdown and permitted under the licensee's current licensing basis is one acceptable means of meeting the NFPA 805 EEEE acceptance criteria of "an equivalent level of fire protection compared to the deterministic requirements." EEEE's (including GL 86-10 evaluations) that have not been approved by the NRC are not considered part of the plant licensing basis and are subject to review by the NRC.

Recovery actions credited for protection of redundant trains in Appendix R, III.G.2 areas do not meet the deterministic requirements of Chapter 4 of NFPA 805. Consequently, these recovery actions that have not been specifically approved by the NRC should be addressed as a plant change in accordance with Section 2.4.4 of NFPA 805.

In accordance with 10 CFR 50.48(c), EEEE's which support deviations from the requirements of NFPA 805 must be submitted to the NRC for approval as a license amendment request.

NEI 04-02, Section 4.1.1, Transition Process Overview, notes that the licensee will review EEEE's during the transition process to ensure the quality level and the basis for acceptability are still valid. Except as noted above, satisfactory results from this review will provide adequate basis to transition EEEE's for the deterministic requirements of Chapter 4 of NFPA 805. Guidance for performing EEEE's is provided in NUREG-0800, Section 9.5.1, Fire Protection, and in Regulatory Guide 1.189, Fire Protection for Operating Nuclear Power Plants.

### **2.3 Transition of Circuit Analyses**

An acceptable approach to circuit analyses is described in Regulatory Position 3.3. If the existing licensing basis is vague or silent on the methodology for post-fire safe-shutdown circuit analysis, including the criteria for identification of circuits requiring protection; the failure assumptions (e.g., single failure, any-and-all, one-at-a-time, sequential/concurrent, cumulative effects); and the prescribed methods of protecting circuits from fire, a licensing basis should be established during the transition against which changes can be assessed post-transition. A licensee may choose to submit a summary of its licensing basis on circuits with the license amendment request for NRC review and approval. At a minimum, the summary must contain sufficient information relevant to methods, assumptions, tools, acceptance criteria, and protection of required circuits to enable the staff to determine the acceptability of the licensee's approach.

The NRC does not prescribe how a licensee should establish its licensing basis for circuit analysis. The options to establish a licensing basis include (1) crediting a well documented design basis which meets minimum AHJ expectations, or (2) using other methods approved by the AHJ for selection of circuits and for using risk insights to evaluate the consequences.

### **2.4 Transition of Recovery Actions**

Operator manual actions and repairs should be transitioned as "recovery actions" as defined in Paragraph 1.6.52 of NFPA 805. The transition summary for each fire area that credits recovery actions should indicate whether the recovery actions were previously reviewed and approved by the NRC and the transition report should include the documentation that demonstrates NRC approval (inspection reports are not recognized as NRC approval documentation for this purpose). Operator manual actions credited for compliance with Appendix R Section III.G.2 that have not been previously reviewed and approved by the NRC should be addressed for acceptability during the transition to NFPA 805 using the change evaluation process described in NFPA 805 and Chapter 5.3 of NEI 04-02.

Where recovery actions are credited for protection of redundant trains in an Appendix R, III.G.2 area, eliminating an existing suppression system required by Appendix R, III.G.2 or similar commitments (e.g., section 5.b of Standard Review Plan 9.5.1) is unacceptable with respect to defense-in-depth (DID). Similarly, eliminating an existing electrical raceway fire barrier system (ERFBS) from an area with no suppression system and crediting a recovery action is unacceptable with respect to DID. Converting an existing automatic suppression system in the III.G.2 area from automatic actuation to manual actuation does not defeat DID as long as the recovery actions available are feasible and reliable with respect to early detection, suppression of fires, and fire confinement. Early detection, suppression, and confinement of fires should be evaluated based on postulated realistic fires and fire growth rates.

## **3. NFPA 805 Fire Protection Program**

### **3.1 NFPA 805 Fire Protection Program Change Evaluation Process**

Prior to implementing a change to the fire protection program or a change to a plant feature that could impact the fire protection program, the licensee should evaluate the change to determine whether it is acceptable. Existing 10 CFR 50.48(c) noncompliances identified after the transition to an NFPA 805 licensing basis, should also be evaluated for acceptability in accordance with the plant change evaluation process. In accordance with Section 2.4.4, Plant Change Evaluation, of NFPA 805, plant changes should be evaluated using an integrated assessment of the acceptability of risk, defense-in-depth, and safety margins, regardless of the methods or approaches used to evaluate the change.

Section 5.3 of NEI 04-02 addresses the evaluation of changes to a licensee's fire protection program. In addition to addressing change process considerations, Section 5.3 of NEI 04-02, describes methods and tools for evaluating changes to the fire protection program. Regulatory Position 4 describes the NRC staff positions related to these methods and tools. The following regulatory positions are also applicable to the process of evaluating and implementing changes to the fire protection program following completion of the transition to an NFPA 805 license condition.

NEI 04-02 references NEI 02-03, "Guidance for Performing a Regulatory Review of Proposed Changes to the Approved Fire Protection Program," as providing a generic regulatory review process that may be used to determine if a change to the approved fire protection program can be made without prior NRC approval. The version of NEI 02-03 currently available to the NRC has not been reviewed and endorsed by the NRC for application to a risk-informed performance-based fire protection program.

#### **3.1.1 *Change Screening***

A licensee may use an appropriate screening process to screen out changes that do not require additional evaluations for fire protection program impacts and acceptability. An appropriate screening process may include the following types of changes that do not need to be further evaluated prior to implementation:

- plant changes that have been determined not to impact the fire protection program
- changes to elements of the fire protection program that have been determined to be clearly equivalent to existing elements of the fire protection program (e.g., functionally identical or superior replacements of fire protection equipment described in the fire protection program)
- changes to the fire protection program that are clearly insignificant with respect to meeting nuclear safety and radioactive release performance criteria (e.g., descriptive or editorial changes to the fire protection program documentation)

10 CFR 50.59(a)(1) and Appendix J of NEI 04-02 provide additional guidance and screening criteria for changes that are acceptable to the NRC.

### 3.1.2 Fire Protection Program Change Evaluations

For changes that have not been screened, the licensee should perform an engineering evaluation to demonstrate the acceptability of the change in terms of the plant change evaluation criteria and compliance with the fire protection requirements of 10 CFR 50.48(a) and NFPA 805, as endorsed in 10 CFR 50.48(c). Section 5.3.1 of NEI 04-02 provides useful information for evaluating changes in the context of NFPA 805 plant change evaluation criteria.

**[This para has been included in the revised NEI 04-02. Ray has comments that should be incorporated. If we reach agreement with NEI, can delete this para from the reg guide]**

While the risk impact must be evaluated for all changes to a risk-informed fire protection program, the scope and depth of the risk evaluation should be commensurate with complexity of the plant change, the technical issues involved, and the potential risk associated with the change. A graded approach can meet the requirements of NFPA 805 for the assessment of the acceptability of risk. A simple risk evaluation (e.g., a qualitative check-off, a structured screening process, or an order-of-magnitude quantification) can be performed for relatively low risk-significance changes. Potentially higher risk changes may require a quantitative evaluation spanning a spectrum from traditional approaches, such as FIVE<sup>1</sup>, through more recent developments, such as the Fire Protection Significance Determination Process (NRC Inspection Manual Chapter MC 0609F), up to a fire probabilistic safety assessment (PSA). **Section 4.3 of this regulatory guide provides additional guidance with respect to the use of risk evaluation tools.**

The risk evaluation should use the methods and tools described in Regulatory Position 4.3, as appropriate. Section 5.3 of NEI 04-02 contains a detailed discussion useful in evaluating changes in risk when using quantitative risk assessment methods and tools. The evaluation shall also demonstrate that adequate defense-in-depth and safety margin will be maintained. Section 5.3.2.2 of NEI 04-02 provides useful information regarding the assessment of DID and identifies acceptable industry guidelines that are consistent with the approach to assessing DID as described in Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decision on Plant-Specific Changes to the Licensing Basis."

As applicable to the fire protection program change being evaluated, the evaluation should address the following items:

- (a) For changes that impact the protection of plant structures, systems, and components necessary to meet performance criteria in the event of a fire, the evaluation should demonstrate that nuclear safety and radiological release performance criteria will continue to be met considering all relevant plant modes and configurations using, as appropriate for the change being evaluated, the approaches provided in NFPA 805.

The licensee shall demonstrate reasonable assurance that at least one success path necessary to achieve and maintain nuclear safety performance criteria remains free from fire damage, as defined in NFPA 805, Section 1.6.29, considering the effects of the fire and fire suppression activities.

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<sup>1</sup> EPRI TR-100370, Fire-Induced Vulnerability Evaluation (FIVE) Methodology Plant Screening Guide, Professional Loss Control, April 1992.

When using fire modeling (see NFPA 805, Section 4.2.4.1) to demonstrate that at least one success path remains free from fire damage, the evaluation shall demonstrate that the margin between the maximum expected fire scenario and the limiting fire scenario is sufficiently large to bound any uncertainties in the fire model engineering analysis. Section 2.4.7 of Appendix D to NEI-04-02 contains a detailed discussion that is useful in evaluating the margin between the maximum expected fire scenario and the limiting fire scenario.

- (b) For changes to the fire protection program that involve fundamental program and design elements, the evaluation should address how the change affects compliance with the requirements of NFPA 805, Chapter 3.
- (c) Section 5.3.2.1 of NEI 04-02 defines a Region IV that is not included in Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decision on Plant-Specific Changes to the Licensing Basis," Revision 1, dated November 2002, and notes that tracking of changes in Region IV is not required. Although the risk increases that meet the criteria of the NEI 04-02 Region IV do not need to be individually tracked, the plant design changes associated with the Region IV risk increases should be tracked and included in subsequent change evaluations to assess the cumulative risk.
- (d) Change evaluations crediting recovery actions should consider the guidance provided in Regulatory Position 2.3 for transitioning recovery actions.

### **3.1.3 *Monitoring Fire Protection Program Changes***

The licensee should evaluate changes with respect to their impact on the monitoring program required by NFPA 805. This evaluation should address any changes to the monitoring program that are necessary to ensure that the assumptions made in the engineering evaluations for fire protection program changes are maintained and remain valid.

### **3.1.4 *Approval of Fire Protection Program Changes***

Changes to the fire protection program that have been screened, as described in Regulatory Position 3.1.1, or evaluated and determined to be acceptable, as described in Regulatory Position 3.1.2, may be implemented without NRC approval with the following exceptions:

- (a) Any changes to the fire protection program that affect fundamental program and design elements (NFPA 805, Chapter 3) and that do not conform to the requirements of NFPA 805, Chapter 3, and that are not addressed by a previously approved fundamental fire protection program and design element, require NRC approval. The licensee shall submit a request for approval to the NRC for such a change to the fire protection program, pursuant to 10 CFR 50.48(c)(2)(vii) and 10 CFR 50.90 or 10 CFR 50.12, using the licensee's license amendment or exemption request process, as appropriate.

NFPA Chapter 3 requires compliance with applicable NFPA fire codes. The edition of each NFPA standard that is the licensee's code of record will determine whether deviations from these referenced NFPA standards must be submitted for AHJ approval (some code editions allow "alternate arrangements" without AHJ approval).

Some NFPA codes required by Chapter 3 did not exist when plants were originally licensed. Licensees' amendment requests to transition to NFPA 805 should describe their level of compliance with NFPA fire codes that have not been committed to in the current licensing basis. The description should be in sufficient detail to permit an adequate evaluation. These commitments will become part of the licensing basis and, consequently, future changes/deviations may require submittal to the NRC for approval as determined by the license condition and the specific NFPA standard.

- (b) The following changes to the fire protection program that deviate from the requirements of 10 CFR 50.48(c), other than fundamental program and design elements, also require NRC approval:
- changes to the fire protection program that do not meet the risk acceptance criteria described in Regulatory Position 3.1.2(a)
  - changes that have been evaluated using performance-based methods other than those described in Regulatory Position 4
  - use of a risk-informed or performance-based alternative to compliance with NFPA 805

The licensee shall submit a request for approval to the NRC for such a change to the fire protection program, pursuant to 10 CFR 50.48(c)(4) and 10 CFR 50.90 or 10 CFR 50.12, using the licensee's license amendment or exemption process, as appropriate.

- (c) Changes to the fire protection program that involve, or require conforming changes to, a license condition or the plant's technical specifications require NRC approval. The licensee shall submit such a change pursuant to 10 CFR 50.90, using the licensee's license amendment process.

The licensee may self-approve changes to the fire protection program that do not require prior NRC approval, in accordance with applicable licensee procedures. The licensee may implement changes to the fire protection program that require prior NRC approval following NRC issuance of the license amendment, in accordance with 10 CFR 50.90 or granting of an exemption request, in accordance with 10 CFR 50.12.

### **3.1.5 *Documentation of Changes***

The licensee should document descriptions of changes made to the fire protection program, reasons for the changes, and engineering evaluations related to the changes and retain them until termination of the license. The licensee should organize its change documentation so that changes can be readily identified and the associated documentation retrieved for inspection by the NRC.

Documentation should (1) clearly describe the assumptions, identify the methods, and present the results of the evaluation in a manner that is easily understood and in sufficient detail to allow future review of the entire analyses, and (2) conform to the quality requirements of NFPA 805, Section 2.7.3.

## **3.2 Fire Protection Program Documentation**

NEI 04-02, Section 5.1.1.1, "Program Documentation," generally allows the licensee to define the appropriate format and content of the fire protection program documentation. The documentation approach described in NEI 04-02 is acceptable to the staff with the exception that Section 2.7.1.2 of NFPA 805 requires a document that contains, at a minimum, fire hazards identification and nuclear safety capability assessment, on a fire area basis, for all fire areas that could affect the nuclear safety or radioactive release performance criteria defined in NFPA 805, Chapter 1. This minimum standard for program documentation is not reflected in the NEI 04-02 guidance. Licensee documentation should meet the minimum standard of NFPA 805, Section 2.7.1.2. Also note that design basis documentation or fire protection program documentation may not necessarily be part of the plant-specific licensing basis documentation. The documentation which defines the plant licensing basis is described in 10 CFR 54.3(a).

### **3.3 Circuit Analysis**

Industry guidance document NEI 00-01, Revision 1, "Guidance for Post-Fire Safe Shutdown Circuit Analysis," used in conjunction with NFPA 805 (including Appendix B) and this regulatory guide, provides one acceptable approach to circuit analysis. Where the deterministic requirements of NFPA 805 Chapter 4 for the protection of required circuits cannot be met, circuit analysis assumptions regarding the number of spurious actuations, the manner in which they occur (e.g., one-at-a-time or simultaneous) and the time between spurious actuations should be supported by performance-based evaluations.

The nuclear safety circuit analysis should address possible equipment damage and the inability to restore equipment operability caused by spurious actuation, including the types of failures described in NRC Information Notice (IN) 92-18, "Potential for Loss of Remote Shutdown Capability During a Control Room Fire," dated February 1992 and Regulatory Guide 1.106, "Thermal Overload Protection for Electric Motors on Motor-Operated Valves," dated November 1975.

The risk evaluation of circuit analysis changes performed post-transition should use the criteria in RG 1.174. However, applying this criteria on a circuit-by-circuit basis or even an area-by-area basis may not adequately consider the cumulative effects. Therefore, in order to maintain reasonable assurance that cumulative effects of individual changes do not exceed the high-level acceptance criteria established in RG 1.174, a licensee may (1) consider all circuit analysis changes during the transition and post-transition as a single change, (2) perform plant or procedure changes that make the change risk neutral or decreases risk, or (3) apply an AHJ approved threshold for individual changes.

NRC Inspection Manual Chapter 0609, Appendix F can also be used within the appropriate context for circuit analysis risk evaluations. If this appendix is used, the licensee must determine the applicability of the referenced data to the licensee's facility.

### **3.4 Applicability of 10 CFR 50.69**

10 CFR 50.69, "Risk-informed categorization and treatment of structures, systems and components for nuclear power reactors" allows certain SSCs to be treated in a risk informed manner. 10 CFR 50.69 is not applicable to 10 CFR 50.48, "Fire protection" since 50.48 is not included in Section (b) of 50.69. 10 CFR 50.48(c) allows the voluntary application of a performance-based fire protection rule. The treatment of SSCs under 10 CFR 50.48(c) should be in accordance with the rule, the referenced NFPA standard, and the applicable licensee's licensing basis.

## **4. NFPA 805 Analytical Methods and Tools**

### **4.1 General**

Engineering analyses and associated methods that the licensee applies to demonstrate compliance with the nuclear safety and radioactive release performance criteria should have the requisite degree of technical and defensible justification, as dictated by the scope and complexity of the specific application. Persons qualified in the specific analytical methods should perform these analyses which should include any necessary verification and validation of methods used in the specific applications.

### **4.2 Fire Models**

Section 2.4.1.2 of NFPA 805 requires that only fire models acceptable to the AHJ (NRC) be used in fire modeling calculations. Further, NFPA 805, Sections 2.4.1.2.2 and 2.4.1.2.3, state that the fire models shall be applied within their limitations and be verified and validated.

To the extent that the NRC finds certain fire models and calculational methods acceptable for use in performance-based analyses, licensees should justify that the models and methods are applied within their limitations and verified and validated. These analyses may use simple hand calculations or more complex computer models, depending on the specific conditions of the scenario being evaluated. Appendix C to NFPA 805 and Appendix D to NEI 04-02 contain detailed discussions that are useful in determining what fire models to use and applying those fire models within their limitations.

The NRC's Office of Nuclear Regulatory Research (RES) and the Electric Power Research Institute (EPRI) are currently developing verification and validation (V&V) documents for specific fire models. The specific fire models documented are (1) NUREG-1805, "Fire Dynamics Tools (FDT<sup>s</sup>)," (2) Fire-Induced Vulnerability Evaluation (FIVE), Revision 1, (3) the National Institute of Standards and Technology (NIST) Consolidated Model of Fire Growth and Smoke Transport (CFAST), (4) the Electricité de France (EdF) MAGIC code, and (5) the NIST Fire Dynamics Simulator (FDS).

Licensees may propose the use of fire models that have not been specifically verified and validated by the NRC; however, licensees are responsible for providing verification and validation of these fire models. These V&V documents are subject to NRC review and approval, in accordance with 10 CFR 50.48(c)(4). Licensees' analyses will be subject to review by NRR to determine if the models and methods used are appropriate for the specific scenarios and to make certain that the safety goals are met. Any fire model applied to the change evaluation process should conform to NFPA 805 requirements, and the licensee should ensure that the applied model meets those requirements.

### **4.3 Fire Probabilistic Safety Assessment/Risk Analysis**

Section 2.4.3.3 of NFPA 805 requires that the probabilistic safety assessment approach, methods, and data be acceptable to the AHJ. Methods previously reviewed by the NRC for the fire PSA should continue to be acceptable when used within the appropriate bounds and limitations of the particular method. To the extent that the NRC finds certain PSA methods acceptable for use in meeting NFPA 805 requirements, licensees should justify the methods that are appropriate for the specific applications. These analyses may use screening methods or more complex quantitative PSA methods, depending on the specific conditions of the scenario being evaluated. Appendix D to NFPA 805 provides useful information for implementing the requirements of NFPA 805; specific guidance contained within this appendix is acceptable to the staff for the use and application of PSA, when applied in accordance with the positions presented in Section C of this regulatory guide.

When licensees choose to rely on information in an internal events-based PSA/probabilistic risk assessment (PRA) model to quantify risk associated with fires, they should review the analysis to ensure that the model addresses applicable NFPA 805 requirements, including the engineering analysis requirements of NFPA 805, Section 2.4.2. Section D.3.4 of Appendix D to NFPA 805 provides useful guidance regarding fire-specific issues that should be addressed when applying internal events-based analyses to the assessment of risk from fires. Based on the review, the licensee should modify its internal events-based PSA/PRA model, as necessary, to meet applicable NFPA 805 requirements. The conditional core damage probability demonstrated by a plant's individual plant examination of external events (IPEEE), or the internal events PRA model supporting the plant's IPEEE, may be conservative since, in some cases, credit may not be taken for potential safe shutdown/core damage avoidance paths beyond Appendix R.

Where licensees choose to rely on past fire protection PSA (e.g., IPEEE for fires), the licensees should review these past analyses to determine their continued applicability and adequacy (e.g., inputs, assumptions, data) in meeting the NFPA 805 requirements. Licensees may reconsider scenarios previously screened from analysis, if changes associated with NFPA 805 implementation or compliance alter the scope of the original analysis or the screening conclusions. Some detailed fire PRAs implicitly model failure of fire detectors and manual/automatic suppression per fire area and scenario when assigning the fire initiation frequency to that particular scenario. If so, any "modification factor," typically called a "severity factor" and employed to compensate for the fire initiation frequency not implicitly accounting for detection or suppression, should not include considerations of these to avoid any non-conservative double-counting.

RES and the EPRI are currently developing fire PRA methods, tools, and data to support risk assessments. This work is currently documented in draft NUREG/CR-6850 and EPRI 1008239, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities," and is undergoing public review and appropriate revision. The revised version of this document will provide an acceptable basis to perform fire risk analyses, subject to final review, if needed, and approval by the NRC's Office of Nuclear Reactor Regulation. The NRC plans to revise this regulatory guide in the future to endorse specific risk assessment methods for use in implementing NFPA 805.

## **D. IMPLEMENTATION**

The purpose of this section is to provide information to licensees regarding the NRC's plans for using this regulatory guide.

Except in those cases in which a licensee proposes or has previously established an acceptable alternative method for complying with specified portions of the NRC's regulations, the NRC staff will use the methods described in this guide to evaluate licensee compliance with the requirements of 10 CFR 50.48(c).

### **Regulatory Analysis**

The NRC staff did not prepare a separate regulatory analysis for this regulatory guide. The regulatory basis for this guide is the regulatory analysis prepared for the amendments to 10 CFR Part 50, "Voluntary Fire Protection Requirements for Light-Water Reactors; Adoption of NFPA 805 as a Risk-Informed, Performance-Based Alternative," issued on June 16, 2004 (see 69 FR 33536), which examines the costs and benefits of the rule as implemented by this guide. A copy of this regulatory analysis is available for inspection and may be copied for a fee at the NRC's Public Document Room located at One White Flint North, 11555 Rockville Pike, Room O1-F15, Rockville, Maryland.

### **Backfit Analysis**

As stated in the backfit analysis for the rulemaking (see 69 FR 33536), the rulemaking does not involve a backfit because it does not impose new regulatory requirements. Further, the adoption of NFPA 805 by a licensee is voluntary. Similar to the rule, this regulatory guide does not involve a backfit because it does not impose requirements on the licensees.

## REFERENCES

- BTP APCS 9.5-1**, "Guidelines for Fire Protection for Nuclear Power Plants," Branch Technical Position, Auxiliary Power Conversion Systems Branch, U.S. Nuclear Regulatory Commission, May 1, 1976.
- GL 86-10**, "Implementation of Fire Protection Requirements," Generic Letter, U.S. Nuclear Regulatory Commission, April 24, 1986.
- IN 92-18**, "Potential for Loss of Remote Shutdown Capability During a Control Room Fire," Information Notice, U.S. Nuclear Regulatory Commission, February 1992.
- NEI 00-01**, "Guidance for Post-Fire Safe-Shutdown Analysis," Revision 1, Nuclear Energy Institute, January 2005.
- NEI 04-02**, "Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c)," Revision 0, Nuclear Energy Institute, April 2005.
- NFPA 805**, "Performance-Based Standard for Fire Protection for Light-Water Reactor Electric Generating Stations," 2001 Edition, National Fire Protection Association, Quincy, MA.
- NUREG-0800**, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Section 9.5.1, "Fire Protection Program," October 2003.
- NUREG-1600**, "General Statement of Policy and Procedure for NRC Enforcement Actions," May 1, 2000.
- NUREG-1778**, "Knowledge Base for Post-Fire Safe-Shutdown Analysis," Draft for Comment, January 2004.
- NUREG-1805**, "Fire Dynamics Tools (FDT<sup>s</sup>) Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program," Draft Report for Comment, Volumes 1 and 2, June 2003.
- Regulatory Guide 1.106**, "Thermal Overload Protection for Electric Motors on Motor-Operated Valves," November 1975.
- Regulatory Guide 1.174**, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decision on Plant-Specific Changes to the Licensing Basis," Revision 1, November 2002.
- Regulatory Guide 1.189**, "Fire Protection for Operating Nuclear Power Plants," April 2001.
- RIS 2004-03**, "NRC Regulatory Issue Summary 2004-03: Risk-Informed Approach for Post-Fire Safe-Shutdown Associated Circuit Inspections," March 2, 2004.
- SECY-98-058**, "Development of a Risk-Informed, Performance-Based Regulation for Fire Protection at Nuclear Power Plants," March 26, 1998.

**SECY-00-0009**, "Rulemaking Plan, Reactor Fire Protection Risk-Informed, Performance-Based Rulemaking," January 15, 2000.

**SECY-02-132**, "Proposed Rule: Revision of 10 CFR 50.48 to Permit Light-Water Reactors to Voluntarily Adopt National Fire Protection Association (NFPA) Standard 805, 'Performance-Based Standard for Fire Protection for Light-Water Reactor Electric Generating Plants,' 2001 Edition (NFPA 805), as an Alternative Set of Risk-Informed, Performance-Based Fire Protection Requirements," July 15, 2002.

**SECY-04-0050**, "Final Rule: Revision of 10 CFR 50.48 to Allow Performance-Based Approaches Using National Fire Protection Association (NFPA) Standard 805 (NFPA 805), 'Performance-Based Standard for Fire Protection for Light-Water Reactor Electric Generating Plants,' 2001 Edition," March 29, 2004.

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

**U.S. Code of Federal Regulations**, Appendix A, "General Design Criteria for Nuclear Power Plants," to Title 10, Part 50, of the *U.S. Code of Federal Regulations*.

**U.S. Code of Federal Regulations**, Appendix R, "Fire Protection Program for Nuclear Power Facilities Operation Prior to January 1, 1979," to Title 10, Part 50, of the *U.S. Code of Federal Regulations*.

**U.S. Code of Federal Regulations**, Title 10, Section 50.48, "Fire Protection."

**U.S. Nuclear Regulatory Commission**, "Voluntary Fire Protection Requirements for Light-Water Reactors; Adoption of NFPA 805 as a Risk-Informed, Performance-Based Alternative," Proposed Rule, *Federal Register*, Vol. 67, No. 212, November 1, 2002, pp. 66578–66588.

**U.S. Nuclear Regulatory Commission**, "Voluntary Fire Protection Requirement for Light-Water Reactors; Adoption of NFPA 805 as a Risk-Informed, Performance-Based Alternative," Final Rule, *Federal Register*, Vol. 69, No. 115, June 16, 2004, pp. 33536–33551.

**U.S. Nuclear Regulatory Commission**, "NRC Enforcement Policy," Policy Statement: Revision, *Federal Register*, Vol. 69, No. 115, June 16, 2004, pp. 33684–33685.

## GLOSSARY

NFPA 805, Section 1.6, contains definitions applicable to terminology used in the standard. Regulatory Guide 1.189 also contains a substantial list of definitions of fire protection terminology applicable to nuclear power generating stations. Where potential differences or conflicts exist between definitions in NFPA 805 and other fire protection regulatory documents, and where these definitions are important to the licensing basis, the licensee's documentation should clearly identify the definition that is being applied.