

Fire Protection Regulatory Guides and NFPA 805 Overview

Briefing to the Advisory Committee on Reactor Safeguards
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Outline

- Fire Protection Regulatory Guide Revisions
 - Revision 4 to 1.189 “Fire Protection for Nuclear Power Plants”
 - Revision 2 to 1.205 “Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants”
- Overview of Risk-Informed, Performance-Based Fire Protection Program [10 CFR 50.48(c)]
- Specific Technical Topics for Implementation of 10 CFR 50.48(c)
- Summary

Changes in RG 1.189, Revision 4

Purpose of revision was to include updated guidance

- Incorporates guidance on fire-induced circuit failures
 - Endorses portions of Nuclear Energy Institute (NEI) 00-01, “Guidance for Post Fire Safe Shutdown Circuit Analysis,” Revision 4
 - NUREG/CR-7150, “Joint Assessment of Cable Damage and Quantification of Effects from Fire (JACQUE-FIRE),” Volumes 1, 2, and 3
- Organizational changes to align with current regulatory guide format

Changes resulting from public comments

- 25 public comments received
- Expanded discussion of circuit analysis details from NUREG/CR-7150, Volume 3 and NEI 00-01
- Various clarity edits

Unincorporated comments

- Revise definition of “not adversely affect safe shutdown” to remove discussion of “sufficient safety margins”
 - Current text included since RG 1.189, Revision 1, published in 2007
 - Has not prevented successful use of RG 1.189 by the industry and the staff
- Expand guidance to include passively safe advanced reactor designs
 - Beyond the scope of the current revision
 - Part 53 is under development and will have separate guidance

Changes in RG 1.205, Revision 2

Purpose of revision was to include updated guidance

- Endorses NEI 04-02, “Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c),” Revision 3
 - Incorporation of remaining NFPA 805 Frequently Asked Questions
- Latest guidance on fire-induced circuit failures
 - Endorses portions of NEI 00-01, “Guidance for Post Fire Safe Shutdown Circuit Analysis,” Revision 4
 - NUREG/CR-7150, “Joint Assessment of Cable Damage and Quantification of Effects from Fire (JACQUE-FIRE),” Volumes 1, 2, and 3

Changes from public comments

- 6 public comments received
- Expanded discussion of NFPA 805 Section 1.7 equivalency for closer alignment with issued license condition text

Features of a Fire Protection Program Under 50.48(c)

10 CFR 50.48(c) background

- Endorses NFPA 805
 - Rule issued June 16, 2004
 - Incorporates by reference the 2001 Edition of NFPA 805 with exceptions, clarifications, and supplementations
 - Risk-informed, performance-based fire protection program is a voluntary alternative to the existing prescriptive, deterministic fire protection regulations (i.e., “Appendix R”)

NFPA 805 Features

- Requirements are applied during all phases of plant operation
- Establishes fundamental fire protection program elements and design requirements for fire protection systems and features
- Allows the nuclear safety performance criteria to be satisfied deterministically or using a performance-based approach
- Implementation of the performance-based approach includes an integrated assessment of risk, defense-in-depth, and safety margin
- NFPA 805 allows licensees to self approve certain changes to their fire protection program using performance-based methods

Differences from “Appendix R”

NFPA 805

- All phases of operation
- Achieve & maintain fuel in safe and stable condition
- One “success path” free from fire damage

Appendix R

- Power operation
- Hot shutdown and cold shutdown requirements
- One “train” free from fire damage

Differences from “Appendix R” (continued)

NFPA 805

- No deterministic emergency lighting requirements
- Feasible recovery actions allowed for compliance in performance-based approach
- Radiological release criteria are explicit

Appendix R

- Deterministic requirements for emergency lighting
- Operator manual actions cannot be used to demonstrate compliance with III.G.2
- Radiological release criteria are implicit

NFPA 805 License Condition

Major Elements

Self-approval of program changes

- Risk-informed changes to FPP without prior NRC approval
 - Risk assessment of the change shows acceptance criteria are met:
 - risk decrease, or
 - Δ CDF less than 1×10^{-7} /year (yr) and Δ LERF less than 1×10^{-8} /yr
 - Acceptance criteria were developed starting from RG 1.174 guidelines
 - Consistent with defense-in-depth and maintains sufficient safety margins
 - Risk assessment approach, methods, and data shall be acceptable to the NRC
 - methods used in the peer-reviewed fire PRA model
 - methods that have been approved by NRC for use in NFPA 805 applications
 - methods that have been demonstrated to bound the risk impact

Self-approval of program changes (continued)

- Other changes that may be made without prior approval
 - Changes that Have No More than Minimal Risk Impact
 - Changes to Chapter 3 fundamental requirements
 - Functionally equivalent to the corresponding technical requirement
 - Adequate for the hazard; only applies to 4 sections of Chapter 3:
 - “Fire Alarm and Detection Systems” (Section 3.8);
 - “Automatic and Manual Water-Based Fire Suppression Systems” (Section 3.9);
 - “Gaseous Fire Suppression Systems” (Section 3.10); and,
 - “Passive Fire Protection Features” (Section 3.11).

Transition license condition

- Cannot self-approve risk-informed changes unless there is no more than a minimal risk impact
- Modifications and programmatic implementation items
 - Necessary for full compliance
 - Committed schedule for completion
- Maintain appropriate compensatory measures in place until completion of the modifications

Specific Technical Topics for Implementation of 10 CFR 50.48(c)

Success Path

What is a “success path”?

- A comprehensive list of systems and equipment and their interrelationships
- The components required to achieve the nuclear safety performance criteria
- Components required to achieve and maintain the nuclear safety functions and components whose fire-induced failure could prevent the operation or result in the maloperation of those components needed to meet the nuclear safety performance criteria

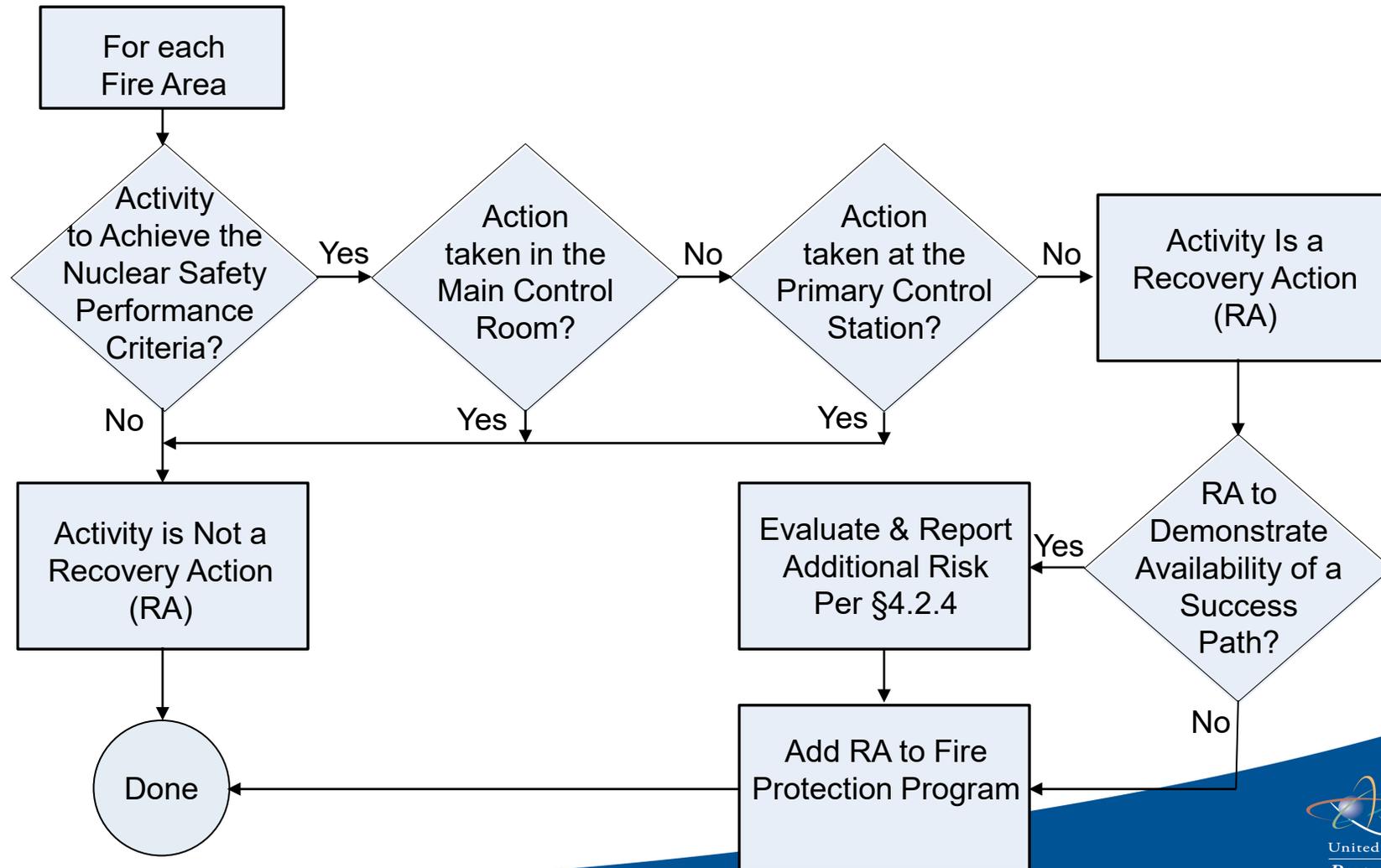
“Success path” approach

- Identify plant systems required to achieve each of the nuclear safety criteria
- Also consider the essential mechanical/environmental support and essential electrical systems
- Equipment identification
 - Identify equipment required to achieve the nuclear safety objectives
 - Identify equipment whose spurious operation could prevent achieving the nuclear safety objectives
 - Performance-based
- All system and equipment identification includes related cables

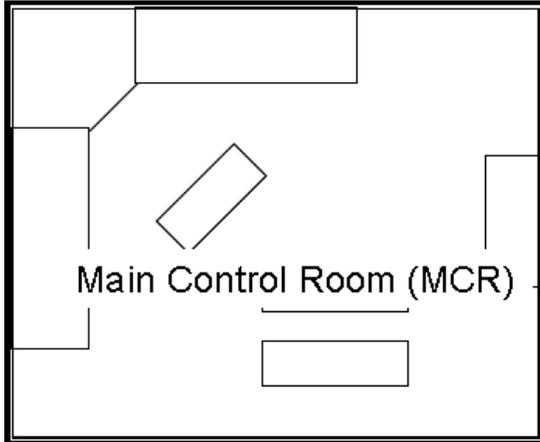
Recovery Actions

Formerly “Operator Manual Actions”

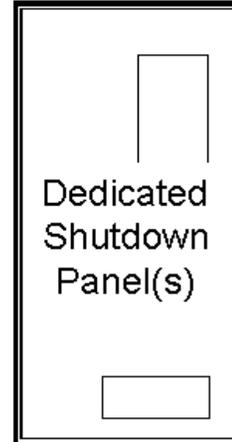
Recovery Actions in NFPA 805



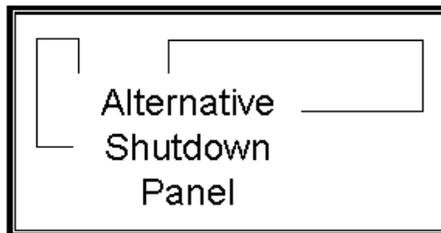
Primary control station



Control Room actions are not recovery actions



Dedicated Shutdown Panel actions are not recovery actions*



Alternative Shutdown actions are not recovery actions* provided:

- Primary command & control
- Requisite controls, indications, & communications
- Multiple components controlled from location

* When command and control is shifted from the MCR

Performance-Based Analysis

Performance-based approach overview

- If a fire area has a variance from the deterministic separation requirements, the licensee may
 - Modify the plant
 - Use fire risk evaluation approach
 - Use fire modeling approach (shows risk is negligible)
- If a success path recovery action is involved, the additional risk (compared to deterministic compliance) must be assessed
 - May use fire modeling or fire risk evaluation approaches
 - May be qualitative or quantitative; bounding is allowed

Plant Change Evaluations

- Risk-informed evaluation of a change to a previously approved fire protection program element:
 - integrated assessment of risk, defense-in-depth, and safety margins
- Ensures public risk from fire-induced nuclear fuel damage accidents is low and that adequate defense-in-depth and safety margins are maintained
- Similar to Fire Risk Evaluation performance-based approach

Summary

- Revisions to RG 1.189 and 1.205 reflect latest guidance
- No substantial objections or alignment issues from public comments
- NFPA 805 provides the framework for a risk-informed, performance-based fire protection program

Acronyms

- AHJ – Authority Having Jurisdiction
- CDF – Core Damage Frequency
- CFR – Code of Federal Regulations
- FAQ – Frequently Asked Question
- FPP – Fire Protection Program
- GDC – General Design Criteria
- IEEE – Institute of Electrical and Electronics Engineers

Acronyms (continued)

- JACQUE-FIRE – Joint Assessment of Cable Damage and Quantification of Effects from Fire
- LERF – Large Early Release Frequency
- MCR – Main Control Room
- MSO – Multiple Spurious Operation
- NEI – Nuclear Energy Institute
- NFPA – National Fire Protection Association
- NRC – Nuclear Regulatory Commission

Acronyms (continued)

- PRA – Probabilistic Risk Assessment
- PSA – Probabilistic Safety Assessment
- PWR – Pressurized Water Reactor
- RA – Recovery Action
- RG – Regulatory Guide
- UFSAR – Updated Final Safety Analysis Report