Duke Energy
H. B Robinson Steam Electric Plant
Unit No. 2

Transition to 10 CFR 50.48(c) - NFPA 805
Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants, 2001 Edition

Transition Report
Revision 1

May 27, 2016

TABLE OF CONTENTS

Executive Summary

Duke Energy will transition the H. B. Robinson Steam Electric Plant Unit No. 2 (HBRSEP) fire protection program to a new Risk-Informed, Performance-Based (RI-PB) alternative per 10 CFR 50.48(c) which incorporates by reference NFPA 805. The licensing basis per License Condition 3.E will be superseded.

The transition process consisted of a review and update of HBRSEP documentation, including the development of a Fire Probabilistic Risk Assessment (PRA) using NUREG/CR-6850 as guidance. This Transition Report summarizes the transition process and results. This Transition Report contains information:

- Required by 10 CFR 50.48(c).
- Recommended by guidance document Nuclear Energy Institute (NEI) 04-02 Revision 2 and appropriate Frequently Asked Questions (FAQs).
- Recommended by guidance document Regulatory Guide 1.205 Revision 1.

Section 4 of the Transition Report provides a summary of compliance with the following NFPA 805 requirements:

- Fundamental Fire Protection Program Elements and Minimum Design Requirements
- Nuclear Safety Performance Criteria, including:
    - Non-Power Operational Modes
    - Fire Risk Evaluations
- Radioactive Release Performance Criteria
- Monitoring Program
- Program Documentation, Configuration Control, and Quality Assurance

Section 5 of the Transition Report provides regulatory evaluations and associated attachments, including:

- Changes to License Condition
- Changes to Technical Specifications, Orders, and Exemptions,
- Determination of No Significant Hazards and evaluation of Environmental Considerations.

The attachments to the Transition Report include detail to support the transition process and results.

Attachment H contains the approved FAQs not yet incorporated into the endorsed revision of NEI 04-02. These FAQs have been used to clarify the guidance in RG 1.205, NEI 04-02, and the requirements of NFPA 805 and in the preparation of this License Amendment Request.

Acronym List

AC	Alternating Current
ADAMS	Agency wide Documents Access and Management System
AFW	Auxiliary Feedwater
AHJ	Authority having jurisdiction
ANS	American Nuclear Society
AO	Auxiliary Operator
APCSB	Auxiliary Power Conversion Systems Branch
ARC™	Safe Shutdown Analysis software package
ASME	American Society of Mechanical Engineers
BNP	Brunswick Nuclear Plant
BTP	Branch Technical Position
CAFTA	Computer Aided Fault Tree Analysis
CAT	Capability Category
CC	Capability Category
CC I	Capability Category I
CCDP	Conditional Core Damage Probability
CCW	Component Cooling Water
CDF	Core Damage Frequency
CFAST	Consolidated Model of Fire and Smoke Transport
CFR	Code of Federal Regulation
CO_2	Carbon Dioxide
CP&L	Carolina Power and Light
CR3	Crystal River Unit 3 Nuclear Power Plant
CSDB	Component Selection Database
CST	Condensate Storage Tank
CT	Current Transformer
CV	Containment Vessel
CVCS	Chemical and Volume Control System
DBD	Design Basis Document

DC	Direct Current
DID	Defense-in-Depth
DSDG	Dedicated Shutdown Diesel Generator
EC	Engineering Change
EDB	Equipment Database
EDG	Emergency Diesel Generator
EEE	Engineering Equivalency Evaluations
EEEE	Existing Engineering Equivalency Evaluations
EOOS	Equipment Out of Service
EPRI	Electric Power Research Institute
ESP	Engineering Support Personnel
F&O	Facts and Observations
FA	Fire Area
FAQ	Frequently Asked Question
FC	Fire Compartment
FDT	Fire Dynamics Tools
FHA	Fire Hazards Analysis
FHB	Fuel Handling Building
FMEA	Failure Modes and Effects Analysis
FP	Fire Protection
FPIP	Fire Protection Initiatives Project
FPP	Fire Protection Program
FPRA	Fire Probabilistic Risk Analysis or Assessment
FRE	Fire Risk Evaluation
FRN	Federal Register Notice
FSA	Fire Safety Analysis
FSS	Fire Scenario Selection
FSSPMD	Fire Safe Shutdown Program Manager Database
FTL	Fault Tree Logic
FZ	Fire Zone
GDC	General Design Criterion

HBRSEP	H. B. Robinson Steam Electric Plant Unit No. 2 (i.e., RNP)
HEAF	High Energy Arcing Fault
HNP	Shearon Harris Nuclear Power Plant
HRE	Higher Risk Evolutions
HSS	High Safety Significance
HVAC	Heating, Ventilation and Air Conditioning
INPO	Institute of Nuclear Power Operations
ISFSI	Independent Spent Fuel Storage Installation
KSF	Key Safety Function
kV	Kilovolt
LA	Licensing Action
LAR	License Amendment Request
LERF	Large Early Release Frequency
LFS	Limiting Fire Scenario
LOCA	Loss of Coolant Accident
LSS	Low Safety Significance
MCA	Multi-Compartment Analysis
MCC	Motor Control Center
MCR	Main Control Room
MDAFW	Motor Driven Auxiliary Feedwater
MEFS	Maximum Expected Fire Scenario
MHIF	Multiple High Impedance Fault
MSO	Multiple Spurious Operation
MTC	Moderator Temperature Coefficient
NEI	Nuclear Energy Institute
NFPA	National Fire Protection Association
NFPA 805	National Fire Protection Association Standard 805
NGG	Nuclear Generation Group
NPO	Non-Power Operations
NRC	Nuclear Regulatory Commission
NSCA	Nuclear Safety Capability Assessment

NSEL	Nuclear Safety Equipment List
OL	Operating License
OMA	Operator Manual Action
OOS	Out-of-Service
PAP	Personnel Access Point
PB	Performance Based
PORV	Power Operated Relief Valves
POS	Plant Operational State
PRA	Probabilistic Risk Assessment or Analysis
PSA	Probabilistic Safety Assessment or Analysis
PVC	Polyvinyl-chloride
PWR	Pressurized Water Reactor
PWROG	Pressurized Water Reactor Owners Group
PWST	Primary Water Storage Tank
QA	Quality Assurance
RA	Recovery Action
RAB	Reactor Auxiliary Building
RA-DID	Recovery Action – Defense-in-Depth
RAI	Request for Additional Information
RAW	Risk Achievement Worth
RCA	Radiologically Controlled Area
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
RG	Regulatory Guide
RHR	Residual Heat Removal
RI-PB	Risk-Informed Performance-Based
RIS	Regulatory Issues Summary
RMA	Risk Mitigating Action
RWST	Refueling Water Storage Tank
SBO	Station Blackout
SDAFW	Steam Driven Auxiliary Feedwater

SE	Safety Evaluation
SER	Safety Evaluation Report
SFPE	Society of Fire Protection Engineers
SI	Safety Injection
SISBO	Self-Induced Station Blackout
SM	Safety Margin
SR	Supporting Requirement
SSA	Safe Shutdown Analysis
SSC	Structures, Systems, and Components
SSD	Safe Shutdown
SW	Service Water
UET	Unfavorable Exposure Time
UFSAR	Updated Final Safety Analysis Report
V&V	Verification and Validation
VCT	Volume Control Tank
VFDR	Variances from the deterministic requirements
ZOI	Zone of Influence

1.0 INTRODUCTION

The Nuclear Regulatory Commission (NRC) has promulgated an alternative rule for fire protection requirements at nuclear power plants, 10 CFR 50.48(c), National Fire Protection Association Standard 805 (NFPA 805). Duke Energy is implementing the Nuclear Energy Institute methodology NEI 04-02, “Guidance for Implementing a Risk-informed, Performance-based Fire Protection Program Under 10 CFR 50.48(c)” (NEI 04-02), to transition H. B. Robinson Steam Electric Plant Unit No. 2 (HBRSEP) from its current fire protection licensing basis to the new requirements as outlined in NFPA 805. This report describes the transition methodology utilized and documents how HBRSEP complies with the new requirements.

1.1 Background

1.1.1 NFPA 805 – Requirements and Guidance

On July 16, 2004 the NRC amended 10 CFR 50.48, Fire Protection, to add a new subsection, 10 CFR 50.48(c), which establishes new Risk-Informed, Performance-Based (RI-PB) fire protection requirements. 10 CFR 50.48(c) incorporates by reference, with exceptions, the National Fire Protection Association’s NFPA 805, Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants – 2001 Edition, as a voluntary alternative to 10 CFR 50.48 Section (b), Appendix R, and Section (f), Decommissioning.

As stated in 10 CFR 50.48(c)(3)(i), any licensee’s adoption of a RI-PB program that complies with the rule is voluntary. This rule may be adopted as an acceptable alternative method for complying with either 10 CFR 50.48(b), for plants licensed to operate before January 1, 1979, or the fire protection license conditions for plants licensed to operate after January 1, 1979, or 10 CFR 50.48(f), plants shutdown in accordance with 10 CFR 50.82(a)(1).

NEI developed NEI 04-02 to assist licensees in adopting NFPA 805 and making the transition from their current fire protection licensing basis to one based on NFPA 805. The NRC issued Regulatory Guide (RG) 1.205, Risk-Informed, Performance-Based Fire Protection for Existing Light Water Nuclear Power Plants, which endorses NEI 04-02, with exceptions, in December 2009.[1]

A depiction of the primary document relationships is shown in Figure 1-1:

[1] Where referred to in this document NEI 04-02 is Revision 2 and RG 1.205 is Revision 1.

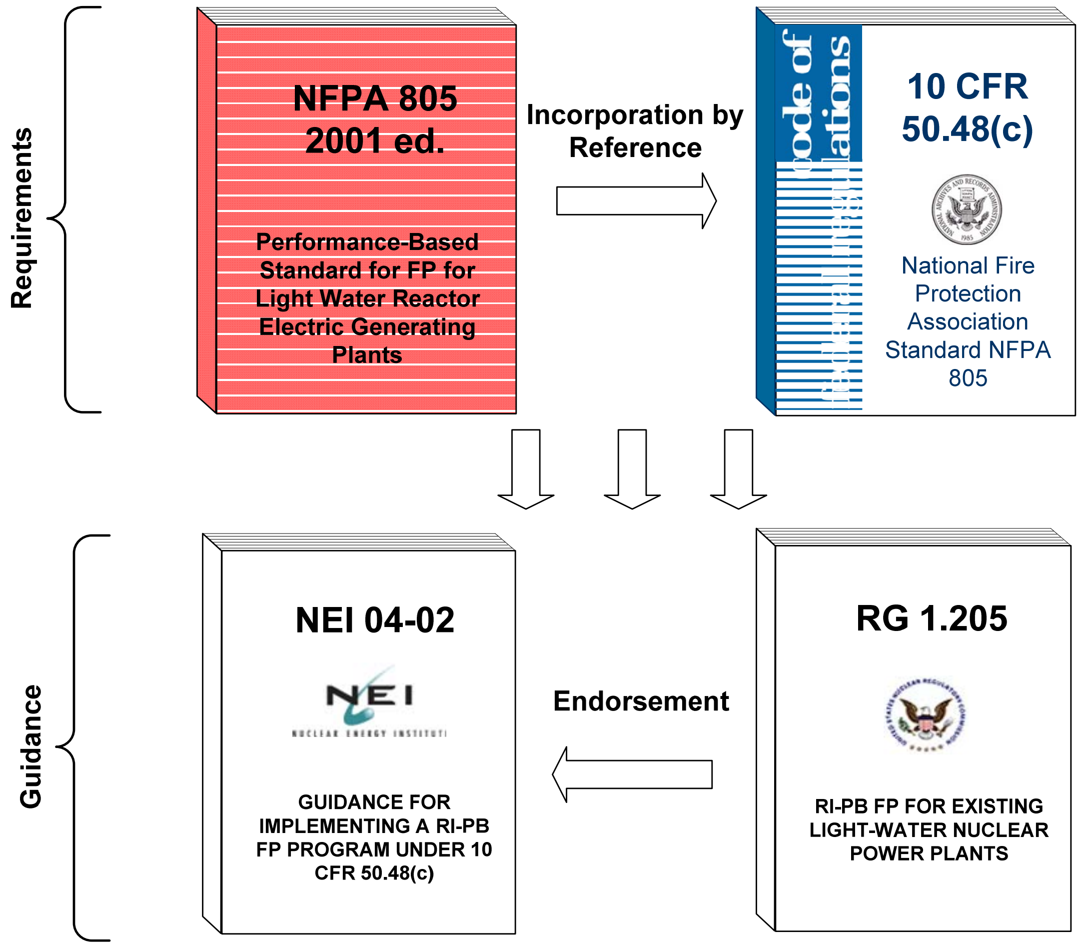

Figure 1-1 NFPA 805 Transition – Implementation Requirements/Guidance

1.1.2 Transition to 10 CFR 50.48(c)

1.1.2.1 Start of Transition

CP&L submitted a letter of intent to the NRC on June 10, 2005 (ML051720404), for the Shearon Harris Nuclear Power Plant (HNP) to adopt NFPA 805 in accordance with 10 CFR 50.48(c). This letter of intent also addressed other CP&L plants (Brunswick Steam Electric Plant Units No. 1 and 2, H.B. Robinson Steam Electric Plant Unit No. 2, and Crystal River Unit 3 Nuclear Generating Plant). The letter of intent requested three years of enforcement discretion and proposed that HNP be considered a Pilot Plant for the NFPA 805 transition process.

By letter dated April 29, 2007 (ML070590625), the NRC granted a three year enforcement discretion period. In accordance with NRC Enforcement Policy, the enforcement discretion period will continue until the NRC approval of the license amendment request (LAR) is completed.

The NRC expected approximately 23 LARs by the end of June 2011. As a result, the Commission worked with industry to develop and create a staggered LAR submittal schedule. On April 14, 2011, the NRC held a public meeting, during which the staff and stakeholders discussed the staggered approach method. In a letter (ML111101452)

dated April 20, 2011, the Commission approved the staff's recommendation to develop a staggered submittal and review process for these reviews, and submit a revision to the Enforcement Policy for Commission approval which would propose to extend enforcement discretion to correspond with the new LAR submittal dates. In a letter (ML11164A047) dated June 10, 2011, the Commission approved the staff's recommendation to publish the Federal Register Notice (FRN) announcing the revision to the Enforcement Policy to extend the enforcement discretion to correspond with a staggered LAR submittal schedule. On June 29, 2011, Progress Energy submitted a letter (ML11188A058) requesting extension of their enforcement discretion and committed to the submittal date of September 30, 2013.

1.1.2.2 Transition Process

The transition to NFPA 805 includes the following high level activities:

- Complete Safe Shutdown Analysis Reconstitution (activities started in 2003)
- A new Fire Probabilistic Risk Assessment (PRA) using NUREG/CR-6850, EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities, as guidance and a revision to the Internal Events PRAs to support the Fire PRAs
- Completion of activities required to transition the pre-transition licensing basis to 10 CFR 50.48(c) as specified in NEI 04-02 and RG 1.205

The project was implemented using a comprehensive project plan and individual procedures/instructions for individual scopes of work. These procedures/instructions (e.g., Project Instruction “FPIP” series procedures referenced in this report) were developed for the purposes of NFPA 805 transition. Appropriate technical content from these procedures were and will be incorporated into technical documents and configuration control procedures, as required.

1.2 Purpose

The purpose of the Transition Report is as follows:

1) Describe the process implemented to transition the current fire protection program to comply with the additional requirements of 10 CFR 50.48(c)
2) Summarize the results of the transition process
3) Explain the bases for conclusions that the fire protection program complies with 10 CFR 50.48(c) requirements
4) Describe the new fire protection licensing basis
5) Describe the configuration management processes used to manage post-transition changes to the station and the fire protection program, and resulting impact on the licensing basis

2.0 OVERVIEW OF EXISTING FIRE PROTECTION PROGRAM

2.1 Current Fire Protection Licensing Basis

H. B. Robinson Steam Electric Plant, Unit No. 2 was licensed to operate on July 31, 1970, with a Renewed Facility Operating License, dated June 27, 2007. As a result, the HBRSEP fire protection program is based on compliance with 10 CFR 50.48(a), 10 CFR 50.48(b), and the following License Condition:

Duke Energy HBRSEP License Condition 3.E states:

E. Fire Protection Program

> Carolina Power & Light Company shall implement and maintain in effect all provisions of the approved Fire Protection Program as described in the Updated Final Safety Analysis Report for the facility and as approved in the Fire Protection Safety Evaluation Report dated February 28, 1978, and supplements thereto. Carolina Power & Light Company may make changes to the approved Fire Protection Program without prior approval of the Commission only if those changes would not adversely affect the ability to achieve and maintain safe shutdown in the event of a fire.

2.2 NRC Acceptance of the Fire Protection Licensing Basis

In response to the NRC's May 11, 1976 request, CP&L performed a fire hazards analysis which analyzed the HBRSEP fire protection program against the guidance of Appendix A to Branch Technical Position (BTP) Auxiliary Power Conversion Systems Branch (APCSB) 9.5-1. CP&L submitted the HBRSEP Fire Hazards Analysis (FHA) and response to Appendix A on December 29, 1976. Subsequent to the submittal of the FHA, additional NRC review of the Fire Protection Program (FPP) took place in the form of written staff questions and CP&L responses, meetings and telephone conferences with the staff. The NRC accepted certain aspects of the program, while CP&L committed to make changes to other portions of the program. The final acceptance of the HBRSEP Fire Protection Program was documented in NRC SER dated February 28, 1978. Open issues from this SER were documented in supplements to the SER dated September 4, 1979, February 21, 1980, and December 8, 1980.

The NRC forwarded Section 10 CFR 50.48 and Appendix R to 10 CFR 50 to CP&L on November 24, 1980. This regulation became effective on February 17, 1981. Since HBRSEP was licensed prior to January 1, 1979, it was required to meet only certain provisions of Appendix R. CP&L sought and received such an exemption from the Appendix R requirements.

Supplemental SER for Sections III.G and III.L was issued on November 21, 1985 resolving the open items concerning spurious operations of high-low pressure interface valves due to a postulated fire (hot short). Exemptions from certain requirements of Section III.G.2 and III.G.3 were also granted by the NRC in letters dated November 13, 1981, November 25, 1983, October 25, 1984, September 17, 1986, June 30, 1988, and October 17, 1990.

In addition to the approval of HBRSEP alternative shutdown design, the NRC granted the following:

02/28/78	NLU-78-71	Amendment 31 to Operating License (OL) adds license conditions, revises Technical Specifications and issues Appendix A to BTP APCSB 9.5-1 Fire Protection SER.
09/04/79	NLU-79-398	Amendment 40 to OL, changing Fire Protection license conditions and Suppl. 1 to Appendix A Fire Protection SER extending completion dates for modifications.
02/21/80	NLU-80-106	NRC evaluations of issues relating to Appendix A Fire Protection SER, identifying completed, open and not acceptable issues.
12/08/80	NLU-80-623	SER closing several Fire Protection issues related to Appendix A Fire Protection SER.
05/15/81	NLU-81-245	Amendment 57 to OL, revising Technical Specifications.
11/13/81	NLU-81-564	NRC grants exemption to Appendix R Section III.G.3 for a fixed fire suppression system in the control room.
05/10/82	NLU-82-248	NRC grants exemption to 10 CFR 50.48c schedular requirements with criteria for evaluation.
12/10/82	NLU-82-709	NRC Letter Regarding DRAFT SER on Appendix R Exemption Request for Sections III.G.2, III.G.3, III.L, III.M and III.O
11/22/83	NLU-83-772	SER related to Appendix R Sections III.G.3 and III.L. Also denies CP&L request for exemption to achieve cold shutdown using onsite power within 72 hours. *Superceded* by 8/8/84 SER.
11/25/83	NLU-83-777	NRC grants exemption to Appendix R Section III.G.2 requirements for FZ 27 for 3-hour fire barrier separation between redundant trains and FZ 29 for automatic suppression and 20 foot separation. NRC also grants exemption to Appendix R Section III.M.2 for fire barrier penetration seal backface temperatures and approval of seals having a 2-hour fire rating.
05/21/84	NLS-84-155	Informal forwarding of DRAFT Supplemental SER on III.G.3 and III.L.

08/08/84	NLU-84-516	SER for Appendix R Sections III.G.3 and III.L. *Supersedes* 11/22/83 SER (sometimes referred to as SSER or Revised SER).
10/25/84	NLU-84-687	NRC grants exemption to Appendix R Section III.G.2 for FZ 5 from area wide automatic fire suppression.
03/07/85	NLS-85-146	NRC Letter Regarding Exemption To Appendix R Section III.O, Notice of Environmental Assessment and Finding of No Significant Impact
03/07/85	NLU-85-176	NRC grants exemption to Appendix R Section III.O from installation of reactor coolant pump oil collection system.
11/21/85	NLS-85-732	Supplemental SER for Appendix R Sections III.G. and III.L resolving open item concerning spurious operation of the high-low pressure interface valves due to a postulated fire (hot short).
09/09/86	NLS-86-552	NRC Letter Regarding Additional Information Regarding Exemption From Certain Requirements of 10 CFR Part 50, Appendix R, Sections III.G.2 and III.G.3
09/11/86	NLS-86-551	NRC Letter Regarding Environmental Assessment on Exemption Request from Certain Requirements of 10 CFR Part 50, Appendix R, Sections III.G.2.f and III.G.3
09/17/86	NLU-86-570	NRC Letter Granting Exemption from Certain Requirements of 10 CFR Part 50, Appendix R, Sections III.G.2.f for radiant heat shield in FZ 24 and III.G.3 for partial fire detection and suppression in Fire Areas A (FZs 3, 6, 7, 8, 11, 12, 13, 15, 16, 17, 18, 21, 23), B (FZ 4), and G (FZs 25, 28, 30, 31, 32, 33)
07/30/87	NLS-87-422	NRC Letter Regarding Exemptions from Certain Requirements of 10 CFR Part 50, Appendix R, Section III.J. *Superseded* by June 30, 1988.
06/30/88	NRC-88-390	NRC Letter Granting Exemptions From Certain Requirements of 10 CFR Part 50, Appendix R, Section III.J for cold shutdown equipment areas, along alternate egress routes outside buildings and use of dedicated portable hand held lighting. *Supersedes* July 30, 1987 Exemption due to inconsistencies between CP&L letters and NRC SER.

10/09/90	NRC-90-600	NRC Letter Regarding Environmental Assessment For Appendix R III.G.2 Exemption
10/17/90	NRC-90-622	NRC Letter Granting Exemption From Requirements of Section III.G.2.b of Appendix R for increased combustible loading up to a 1 hour in CCW Pump Room (FZ 5)
10/02/92	NRC-92-563	NRC Letter Regarding Environmental Assessment Related to Exemption From Section III.J of Appendix R
10/08/92	NRC-92-581	NRC Letter Granting Exemption From The Requirements of 10 CFR Part 50, Appendix R Section III.J for cold shutdown equipment areas and use of dedicated portable hand held lighting. SER also clarifies 6/30/88 Exemption allowing use of portable lights at the intake structure (FZ 29).
12/07/92	NRC-92-0702	NRC Issues Amendment No. 142 to Facility Operating License No. DPR-23 Regarding Fire Protection - Revising Fire Protection License Condition of Operating License and relocates the Fire Protection Tech Specs to plant procedures and UFSAR
02/09/96	NRC-96-0080	Environmental Assessment and Finding of No Significant Impact Regarding and Exemption from Requirements of 10CFR Part 50, Appendix R, Section III.J
06/03/96	NRC-96-0235	Exemption From Certain Requirements of 10CFR Part 50, Appendix R, Section III.J for access to and egress from, and operation of valves in outside areas which are illuminated by diesel backed security lighting.

3.0 TRANSITION PROCESS

3.1 Background

Section 4.0 of NEI 04-02 describes the process for transitioning from compliance with the current fire protection licensing basis to the new requirements of 10 CFR 50.48(c). NEI 04-02 contains the following steps:

1) Licensee determination to transition the licensing basis and devote the necessary resources to it;
2) Submit a Letter of Intent to the NRC stating the licensee's intention to transition the licensing basis in accordance with a tentative schedule;
3) Conduct the transition process to determine the extent to which the current fire protection licensing basis supports compliance with the new requirements and the extent to which additional analyses, plant and program changes, and alternative methods and analytical approaches are needed;
4) Submit a LAR;
5) Complete transition activities that can be completed prior to the receipt of the License Amendment;
6) Receive a Safety Evaluation; and
7) Complete implementation of the new licensing basis, including completion of modifications identified in Attachment S.

3.2 NFPA 805 Process

Section 2.2 of NFPA 805 establishes the general process for demonstrating compliance with NFPA 805. This process is illustrated in Figure 3-1. It shows that except for the fundamental fire protection requirements, compliance can be achieved on a fire area basis either by deterministic or RI-PB methods. Consistent with the guidance in NEI 04-02, Duke Energy has implemented the NFPA 805 Section 2.2 process by first determining the extent to which its current fire protection program supports findings of deterministic compliance with the requirements in NFPA 805. RI-PB methods are being applied to the requirements for which deterministic compliance could not be shown.

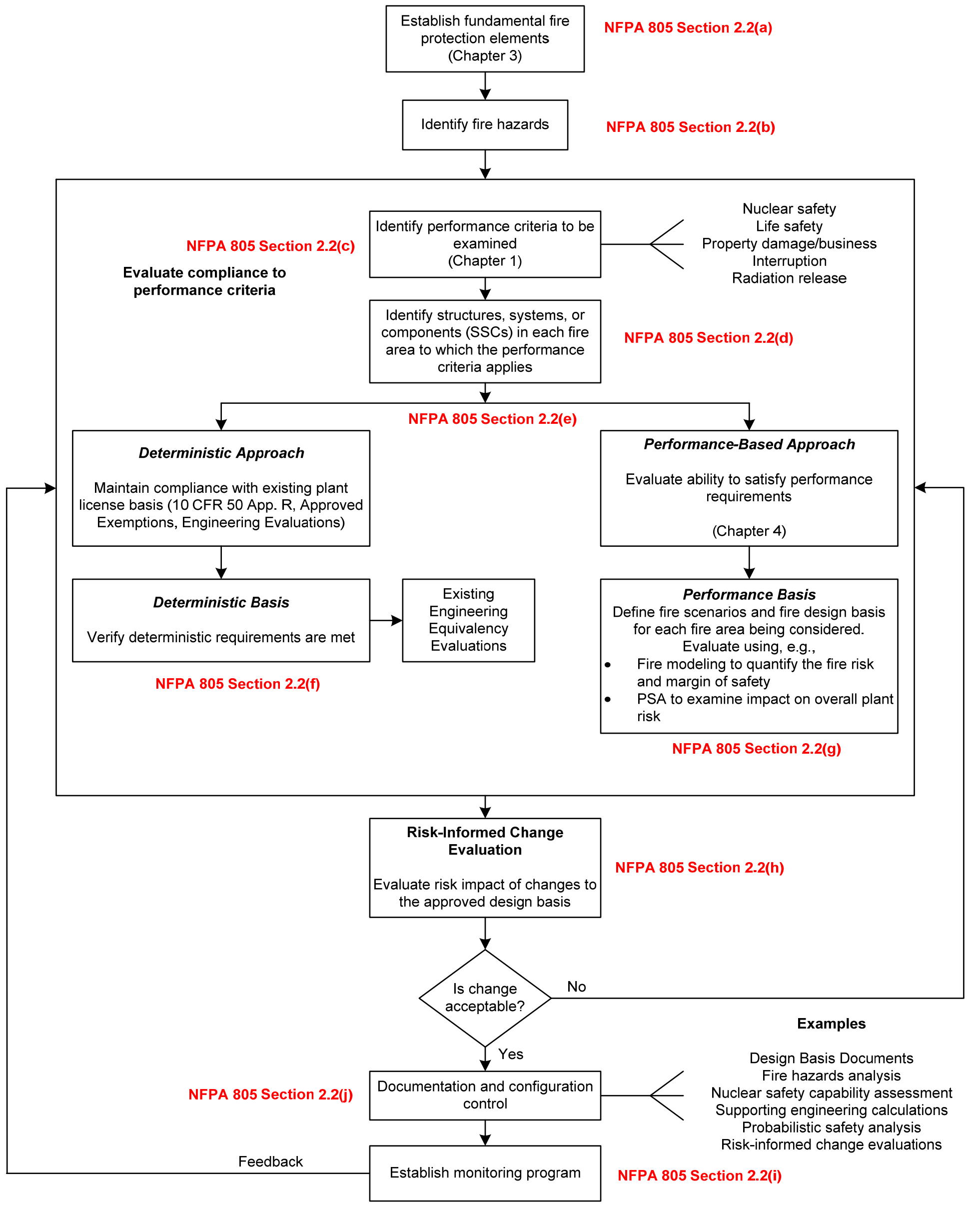

Figure 3-1 NFPA 805 Process [NEI 04-02 Figure 3-1 based on Figure 2-2 of NFPA 805][2]

3.3 NEI 04-02 – NFPA 805 Transition Process

NFPA 805 contains technical processes and requirements for a RI-PB fire protection program. NEI 04-02 was developed to provide guidance on the overall process (programmatic, technical, and licensing) for transitioning from a traditional fire protection licensing basis to a new RI-PB method based upon NFPA 805, as shown in Figure 3-2.

[2] Note: 10 CFR 50.48(c) does not incorporate by reference Life Safety and Plant Damage/Business Interruption goals, objectives and criteria. See 10 CFR 50.48(c) for specific exceptions to the incorporation by reference of NFPA 805.

Section 4.0 of NEI 04-02 describes the detailed process for assessing a fire protection program for compliance with NFPA 805, as shown in Figure 3-2.

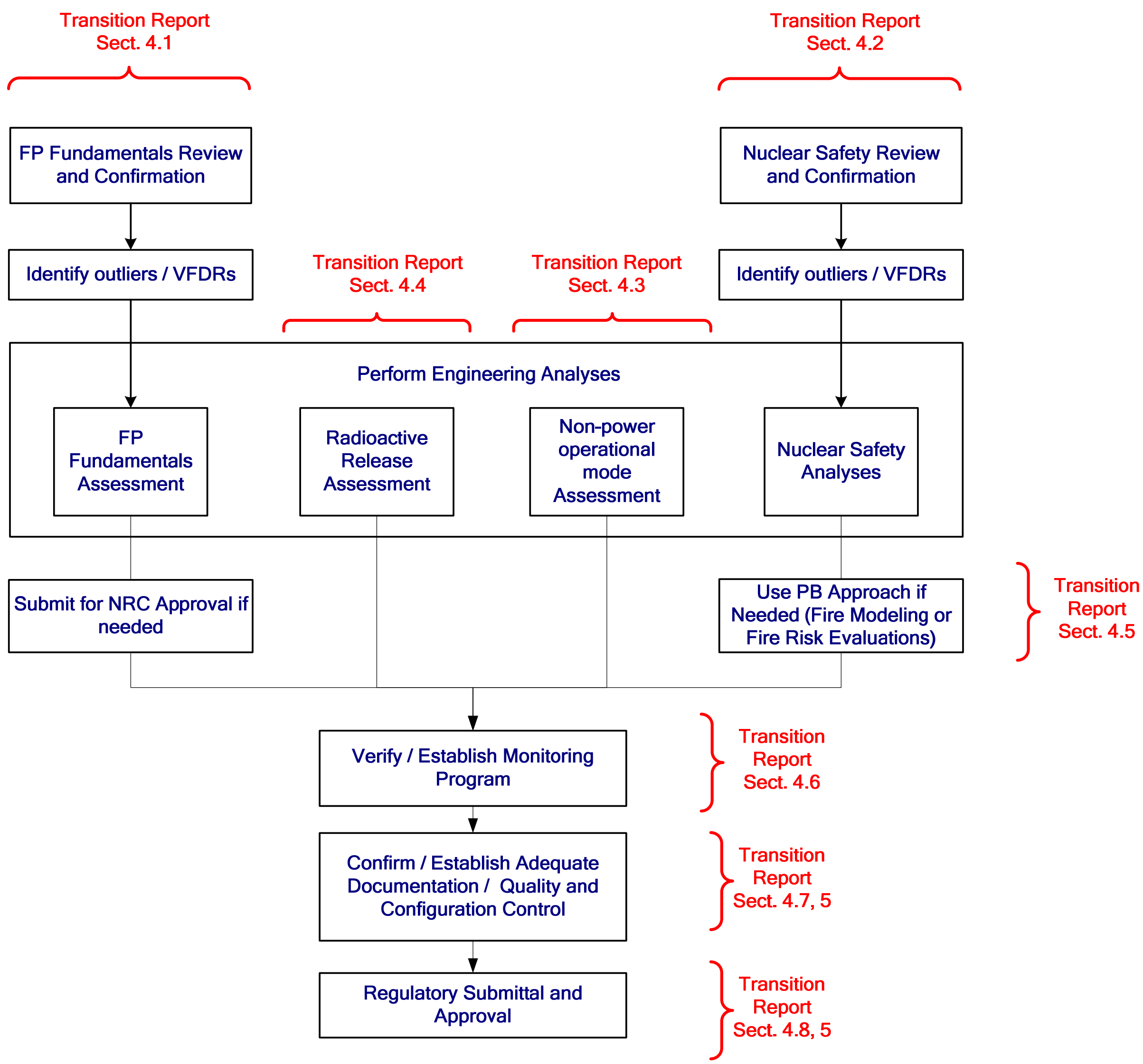

Figure 3-2 Transition Process (Simplified) [based on NEI 04-02 Figure 4-1]

3.4 NFPA 805 Frequently Asked Questions (FAQs)

The NRC has worked with NEI and two Pilot Plants (Oconee Nuclear Station and Harris Nuclear Plant) to define the licensing process for transitioning to a new licensing basis under 10 CFR 50.48(c) and NFPA 805. Both the NRC and the industry recognized the need for additional clarifications to the guidance provided in RG 1.205, NEI 04-02, and the requirements of NFPA 805. The NFPA 805 FAQ process was jointly developed by NEI and NRC to facilitate timely clarifications of NRC positions. This process is described in a letter from the NRC dated July 12, 2006, to NEI (ML061660105) and in Regulatory Issues Summary (RIS) 2007-19, Process for Communicating Clarifications

of Staff Positions Provided in RG 1.205 Concerning Issues Identified during the Pilot Application of NFPA Standard 805, dated August 20, 2007 (ML071590227).

Under the FAQ Process, transition issues are submitted to the NEI NFPA 805 Task Force for review, and subsequently presented to the NRC during public FAQ meetings. Once the NEI NFPA 805 Task Force and NRC reach agreement, the NRC issues a memorandum to indicate that the FAQ is acceptable. NEI 04-02 will be revised to incorporate the approved FAQs. This is an on-going revision process that will continue through the transition of NFPA 805 plants. Final closure of the FAQs will occur when future revisions of RG 1.205, endorsing the related revisions of NEI 04-02, are approved by the NRC. It is expected that additional FAQs will be written and existing FAQs will be revised as plants continue NFPA 805 transition after the Pilot Plant Safety Evaluations.

Attachment H contains the list of approved FAQs not yet incorporated into the endorsed revision of NEI 04-02. These FAQs have been used to clarify the guidance in RG 1.205, NEI 04-02, and the requirements of NFPA 805 and in the preparation of this LAR.

4.0 COMPLIANCE WITH NFPA 805 REQUIREMENTS

4.1 Fundamental Fire Protection Program and Design Elements

The Fundamental Fire Protection Program and Design Elements are established in Chapter 3 of NFPA 805. Section 4.3.1 of NEI 04-02 provides a systematic process for determining the extent to which the pre-transition licensing basis and plant configuration meets these criteria and for identifying the fire protection program changes that would be necessary for compliance with NFPA 805. NEI 04-02 Appendix B-1 provides guidance on documenting compliance with the program requirements of NFPA 805 Chapter 3.

4.1.1 Overview of Evaluation Process

The comparison of the HBRSEP Fire Protection Program to the requirements of NFPA 805 Chapter 3 was performed and documented in Attachment A, Table B-1, NFPA 805 Ch. 3 Transition Details. The analysis used the guidance contained in NEI 04-02, Section 4.3.1 and Appendix B-1 (See Figure 4-1).

Each section and subsection of NFPA 805 Chapter 3 was reviewed against the current fire protection program. Upon completion of the activities associated with the review, the following compliance statement(s) was used:

- Complies - For those sections/subsections determined to meet the specific requirements of NFPA 805
- Complies with Clarification - For those sections/subsections determined to meet the requirements of NFPA 805 with clarification
- Complies via previous NRC approval - For those sections/subsections where the specific NFPA 805 Chapter 3 requirements are not met but previous NRC approval of the configuration exists.
- Complies with use of Existing Engineering Equivalency Evaluations (EEEEs) - For those sections/subsections determined to be equivalent to the NFPA 805 Chapter 3 requirements as documented by engineering analysis
- License Amendment Required - For those sections/subsections for which approval is sought in this LAR submittal in accordance with 10 CFR 50.48(c)(2)(vii). A summary of the bases of acceptability is provided (See Attachment L for details).

In some cases multiple compliance statements have been assigned to a specific NFPA 805 Chapter 3 section/subsection. Where this is the case, each compliance/compliance basis statement clearly references the corresponding requirement of NFPA 805 Chapter 3.

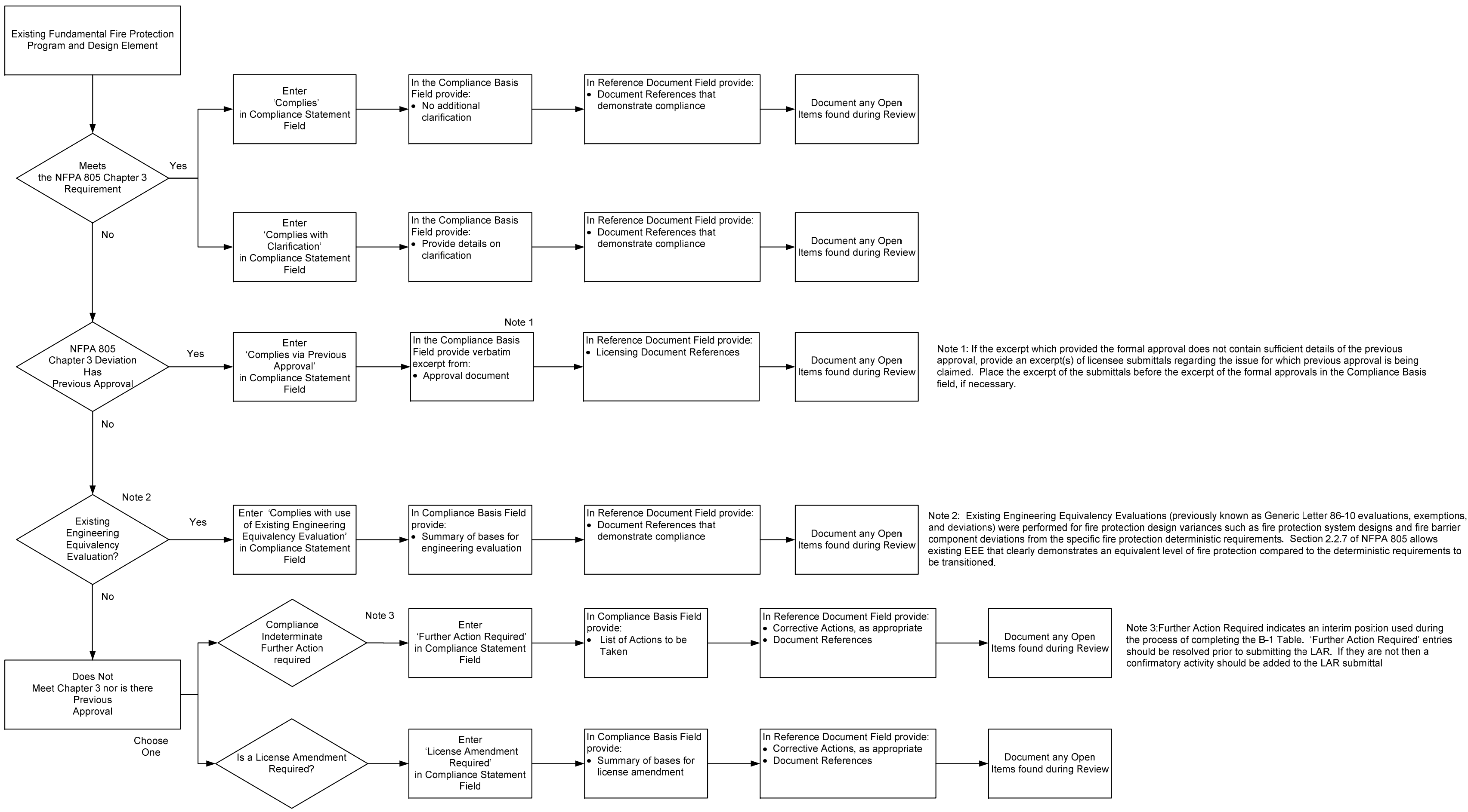

Figure 4-1 - Fundamental Fire Protection Program and Design Elements Transition Process [Based on NEI 04-02 Figure 4-2][3]

[3] Figure 4-1 depicts the process used during the transition and therefore contains elements (i.e., open items) that represent interim resolutions. Additional detail on the transition of EEEEs is included in Section 4.2.2.

4.1.2 Results of the Evaluation Process

4.1.2.1 NFPA 805 Chapter 3 Requirements Met or Previously Approved by the NRC

Attachment A contains the NEI 04-02 Table B-1, Transition of Fundamental Fire Protection Program and Design Elements. This table provides the compliance basis for the requirements in NFPA 805 Chapter 3. Except as identified in Section 4.1.2.3, Attachment A demonstrates that the fire protection program at HBRSEP either:

- Complies directly with the requirements of NFPA 805 Chapter 3,
- Complies with clarification with the requirements of NFPA 805 Chapter 3,
- Complies through the use of existing engineering equivalency evaluations which are valid and of appropriate quality, or
- Complies with a previously NRC approved alternative to NFPA 805 Chapter 3 and therefore the specific requirement of NFPA 805 Chapter 3 is supplanted.

4.1.2.2 NFPA 805 Chapter 3 Requirements Requiring Clarification of Prior NRC Approval

NFPA 805 Section 3.1 states in part, “Previously approved alternatives from the fundamental protection program attributes of this chapter by the AHJ take precedence over the requirements contained herein.” In some cases prior NRC approval of an NFPA 805 Chapter 3 program attribute may be unclear. Duke Energy does not have any requests for the NRC to concur with their finding of prior approval for any sections of NFPA 805 Chapter 3.

4.1.2.3 NFPA 805 Chapter 3 Requirements Not Met and Not Previously Approved by NRC

The following sections of NFPA 805 Chapter 3 are not specifically met nor do previous NRC approvals of alternatives exist:

3.3.5.1– Approval is requested for the use electrical wiring above suspended ceilings.

3.3.5.2– Approval is requested for the use of electrical raceway construction that may not comply.

3.5.16– Approval is requested for the use of fire protection water for specific plant evolutions.

3.2.3(1)- Approval is requested for the use of EPRI Technical Report TR-1006756 to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features credited by the fire protection program.

The specific deviation and a discussion of how the alternative satisfies 10 CFR 50.48(c)(2)(vii) requirements are provided in Attachment L. Duke Energy requests NRC approval of these performance-based methods.

4.1.3 Definition of Power Block and Plant

Where used in NFPA 805 Chapter 3 the terms “Power Block” and “Plant” refer to structures that have equipment required for nuclear plant operations, such as Containment, Auxiliary Building, Service Building, Control Building, Fuel Building, Radioactive Waste, Water Treatment, Turbine Building, and intake structures or structures that are identified in the facility’s pre-transition licensing basis.

The HBRSEP FHA assigned fire protection properties to defined Fire Areas and Fire Zones that are important for the safe shutdown of the plant. The Fire PRA analysis fire compartments are equivalent to defined Fire Zones in the plant. Therefore, detection systems, suppression systems and floor areas for defined Fire Zones are the same for Fire PRA fire compartments. The current Appendix R series drawings and the Fire Hazards analysis were utilized in the partitioning determination. For Fire Compartments FC400 through FC500 there are no current Fire Areas or Zones defined. These areas are currently considered to be part of the yard.

These structures are listed in Attachment I and define the “power block” and “plant”.

4.2 Nuclear Safety Performance Criteria

The Nuclear Safety Performance Criteria are established in Section 1.5 of NFPA 805. Chapter 4 of NFPA 805 provides the methodology to determine the fire protection systems and features required to achieve the performance criteria outlined in Section 1.5. Section 4.3.2 of NEI 04-02 provides a systematic process for determining the extent to which the pre-transition licensing basis meets these criteria and for identifying any necessary fire protection program changes. NEI 04-02, Appendix B-2 provides guidance on documenting the transition of Nuclear Safety Capability Assessment Methodology and the Fire Area compliance strategies.

4.2.1 Nuclear Safety Capability Assessment Methodology

The Nuclear Safety Capability Assessment (NSCA) Methodology review consists of four processes:

- Establishing compliance with NFPA 805 Section 2.4.2
- Establishing the Safe and Stable Conditions for the Plant
- Establishing Recovery Actions
- Evaluating Multiple Spurious Operations

The methodology for demonstrating reasonable assurance that a fire during non-power operational (NPO) modes will not prevent the plant from achieving and maintaining the fuel in a safe and stable condition is an additional requirement of 10 CFR 50.48(c) and is addressed in Section 4.3.

4.2.1.1 Compliance with NFPA 805 Section 2.4.2

Overview of Process

NFPA 805 Section 2.4.2 Nuclear Safety Capability Assessment states:

> *"The purpose of this section is to define the methodology for performing a nuclear safety capability assessment. The following steps shall be performed:*
> *(1) Selection of systems and equipment and their interrelationships necessary to achieve the nuclear safety performance criteria in Chapter 1*
> *(2) Selection of cables necessary to achieve the nuclear safety performance criteria in Chapter 1*
> *(3) Identification of the location of nuclear safety equipment and cables*
> *(4) Assessment of the ability to achieve the nuclear safety performance criteria given a fire in each fire area"*

The NSCA methodology review evaluated the existing post-fire safe shutdown analysis (SSA) methodology against the guidance provided in NEI 00-01, Revision 1 (ML050310295) Chapter 3, "Deterministic Methodology," as discussed in Appendix B-2 of NEI 04-02. The methodology is depicted in Figure 4-2 and consisted of the following activities:

Each specific section of NFPA 805 2.4.2 was correlated to the corresponding section of Chapter 3 of NEI 00-01 Revision 1. Based upon the content of the NEI 00-01 methodology statements, a determination was made of the applicability of the section to the station.

The plant-specific methodology was compared to applicable sections of NEI 00-01 and one of the following alignment statements and its associated basis were assigned to the section:

- Aligns
- Aligns with intent
- Not in Alignment
- Not in Alignment, but Prior NRC Approval
- Not in Alignment, but no adverse consequences
- For those sections that do not align, an assessment was made to determine if the failure to maintain strict alignment with the guidance in NEI 00-01 could have adverse consequences. Since NEI 00-01 is a guidance document, portions of its text could be interpreted as 'good practice' or intended as an example of an efficient means of performing the analyses. If the section has no adverse consequences, these sections of NEI 00-01 can be dispositioned without further review.

The comparison of the HBRSEP existing post-fire SSA methodology to NEI 00-01 Chapter 3 (NEI 04-02 Table B-2) was performed and documented in Attachment B.

In addition, a review of NEI 00-01, Revision 2, (ML091770265) Chapter 3, was conducted to identify the substantive changes from NEI 00-01, Revision 1 that are applicable to an NFPA 805 fire protection program. This review was performed and documented in Attachment B.

Results from Evaluation Process

The method used to perform the existing post-fire SSA with respect to selection of systems and equipment, selection of cables, and identification of the location of equipment and cables, either meets the NRC endorsed guidance from NEI 00-01, Revision 1, Chapter 3 (as supplemented by the gap analysis) directly or met the intent of the endorsed guidance with adequate justification as documented in Attachment B.

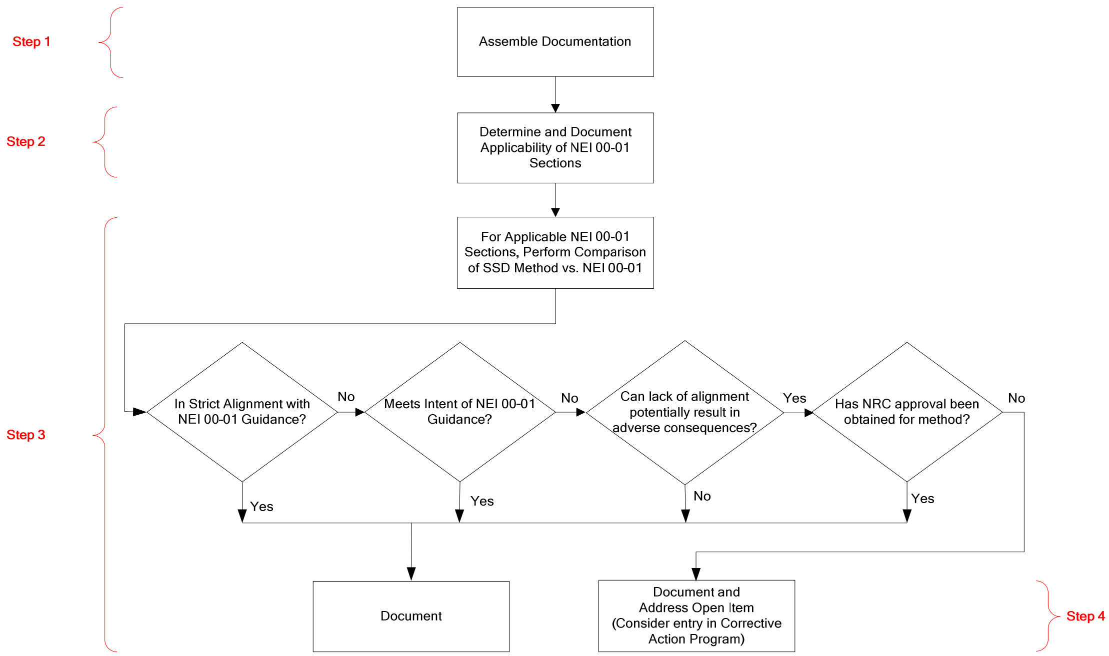

Figure 4-2 – Summary of Nuclear Safety Methodology Review Process (FAQ 07-0039)

Comparison to NEI 00-01 Revision 2

An additional review was performed of NEI 00-01, Revision 2, Chapter 3, for specific substantive changes in the guidance from NEI 00-01, Revision 1 that are applicable to an NFPA 805 transition. The results of this review are summarized below:

- Post fire manual operation of rising stem valves in the fire area of concern (NEI 00-01 Section 3.2.1.2)

  A review of the NSCA results indicated that there are defense-in-depth recovery actions that require manual operation of a rising stem valve in the fire area of concern. There are no ignition sources or in situ combustibles that would affect these valves, and operation of the valves would not be required for about two hours.
- Analysis of open circuits on a high voltage (e.g., 4.16 kV) ammeter current transformers (NEI 00-01 Section 3.5.2.1)

  The evaluation concludes that this failure mode is unlikely for CTs that could pose a threat to safe shutdown equipment.

4.2.1.2 Safe and Stable Conditions for the Plant

Overview of Process

The nuclear safety goals, objectives and performance criteria of NFPA 805 allow more flexibility than the previous deterministic programs based on 10 CFR 50 Appendix R and NUREG-0800, Section 9.5-1 (and NEI 00-01, Chapter 3) since NFPA 805 only requires the licensee to maintain the fuel in a safe and stable condition rather than achieve and maintain cold shutdown.

NFPA 805, Section 1.6.56, defines Safe and Stable Conditions as follows

> *"For fuel in the reactor vessel, head on and tensioned, safe and stable conditions are defined as the ability to maintain Keff <0.99, with a reactor coolant temperature at or below the requirements for hot shutdown for a boiling water reactor and hot standby for a pressurized water reactor. For all other configurations, safe and stable conditions are defined as maintaining Keff <0.99 and fuel coolant temperature below boiling."*

The nuclear safety goal of NFPA 805 requires "...*reasonable assurance that a fire during any operational mode and plant configuration will not prevent the plant from achieving and maintaining the fuel in a safe and stable condition*" without a specific reference to a mission time or event coping duration.

For the plant to be in a safe and stable condition, it may not be necessary to perform a transition to cold shutdown as currently required under 10 CFR 50, Appendix R. Therefore, the unit may remain at or below the temperature defined by a hot standby/hot shutdown plant operating state for the event.

Results

Based on the criteria discussed in NSCA calculation RNP-E/ELEC-1216, "The Fire Safe Shutdown Analysis for H.B. Robinson Nuclear Plant," the NFPA 805 licensing basis for HBRSEP is to achieve and maintain hot standby conditions following any fire occurring prior to establishing cold shutdown. Specifically, the conditions include:

- the reactor operating at power,
- a shutdown condition prior to aligning the RHR system for shutdown cooling, or
- the "transition" mode between these two operational phases.

Immediately following the reactor scram, RCS inventory and pressure control is maintained using the charging system, or the safety injection system if the charging pumps are not available (applies to one fire area). Pressurizer safety relief valves provide overpressure protection for the RCS. Main Steam line safety relief valves provide for initial decay heat removal. Cycling of the steam generator power-operated relief valves (PORVs) provide for continued decay heat removal, with steam generator inventory replenished by either the steam driven auxiliary feedwater (AFW) pump or the motor-driven AFW pumps. When the CST is depleted, the suction of the AFW pumps is manually aligned to the service water system. These actions are required in about two hours, and are considered defense in depth recovery actions. Since the valves requiring operation are all manual valves and are not electrically supervised, they are not considered to be VFDRs.

Following stabilization at hot standby, a long term strategy for decay heat removal and inventory/pressure control would be determined based on the extent of equipment damage. If an assessment of the post-fire conditions indicated that the residual heat removal (RHR) system should be in operation, then activities would commence in a safe and controlled manner to align plant equipment required for reactor cooldown.

The long-term actions required to maintain safe and stable conditions are largely routine and within the normal capabilities of site personnel, even in the face of fire damage. These include the previously mentioned actions to align the suction of the AFW pump(s) to the service water system, and opening CVC-358 to maintain the charging pump suction path to the RWST. LCV-115B will initially provide this suction path, but is conservatively assumed to fail closed after about four (4) hours. These are straightforward actions performed by operators and covered by plant procedures. Repairs to safe shutdown equipment would not be required and the management of the onsite inventories of makeup water, nitrogen and diesel fuel would not require resources beyond those available from normal operations staff, maintenance, and emergency response personnel.

Demonstration of the Nuclear Safety Performance Criteria for safe and stable conditions was performed in two analyses.

- At-Power analysis, Modes 1-4. This analysis is discussed in Section 4.2.4. The at-power analysis goes beyond safe and stable to include Mode 4.
- Non-Power Operations analysis that includes cold shutdown and below (Modes 5 and 6). This analysis is discussed in Section 4.3.

4.2.1.3 Establishing Recovery Actions

Overview of Process

NEI 04-02 and RG 1.205 suggest that a licensee submit a summary of its approach for addressing the transition of OMAs as recovery actions in the LAR (Regulatory Position 2.2.1 and NEI-04-02, Section 4.6). As a minimum, NEI 04-02 suggests that the assumptions, criteria, methodology, and overall results be included for the NRC to determine the acceptability of the licensee's methodology.

The discussion below provides the methodology used to transition pre-transition OMAs and to determine the population of post-transition recovery actions. This process is based on FAQ 07-0030 (ML110070485) and consists of the following steps:

- Step 1: Clearly define the primary control station(s) and determine which pre-transition OMAs are taken at primary control station(s) (Activities that occur in the Main Control Room are not considered pre-transition OMAs). Activities that take place at primary control station(s) or in the Main Control Room are not recovery actions, by definition.
- Step 2: Determine the population of recovery actions that are required to resolve variances from deterministic requirements (VFDRs) (to meet the risk acceptance criteria or maintain a sufficient level of defense-in-depth).

- Step 3: Evaluate the additional risk presented by the use of recovery actions required to demonstrate the availability of a success path
- Step 4: Evaluate the feasibility of the recovery actions
- Step 5: Evaluate the reliability of the recovery actions

Results

The review results are documented in RNP-0170 and RNP-0202. Refer to Attachment G for the detailed evaluation process and summary of the results from the process.

4.2.1.4 Evaluation of Multiple Spurious Operations

Overview of Process

NEI 04-02 suggests that a licensee submit a summary of its approach for addressing potential fire-induced MSOs for NRC review and approval. As a minimum, NEI 04-02 suggests that the summary contain sufficient information relevant to methods, tools, and acceptance criteria used to enable the NRC to determine the acceptability of the licensee's methodology. The methodology utilized to address MSOs for HBRSEP is summarized below.

As part of the NFPA 805 transition project, a review and evaluation of HBRSEP susceptibility to fire-induced MSOs was performed. The process was conducted in accordance with NEI 04-02 and RG 1.205, as supplemented by FAQ 07-0038 Revision 3 (ML110140242). The PWR Generic MSO list from NEI 00-01, Revision 3 was utilized.

The approach outlined in Figure 4-3 (based on Figure XX from FAQ 07-0038) is one acceptable method to address fire-induced MSOs. This method used insights from the Fire PRA developed in support of transition to NFPA 805 and consists of the following:

- Identifying potential MSOs of concern.
- Conducting an expert panel to assess plant specific vulnerabilities (e.g., per NEI 00-01, Rev. 1 Section F.4.2).
- Updating the Fire PRA model and existing post-fire NSCA to include the MSOs of concern.
- Evaluating for NFPA 805 Compliance.
- Documenting Results.

This process is intended to support the transition to a new licensing basis. Post-transition changes would use the RI-PB change process. The post-transition change process for the assessment of a specific MSO would be a simplified version of this process, and may not need the level of detail shown in the following section (e.g., An expert panel may not be necessary to identify and assess a new potential MSO. Identification of new potential MSOs may be part of the plant change review process and/or inspection process).

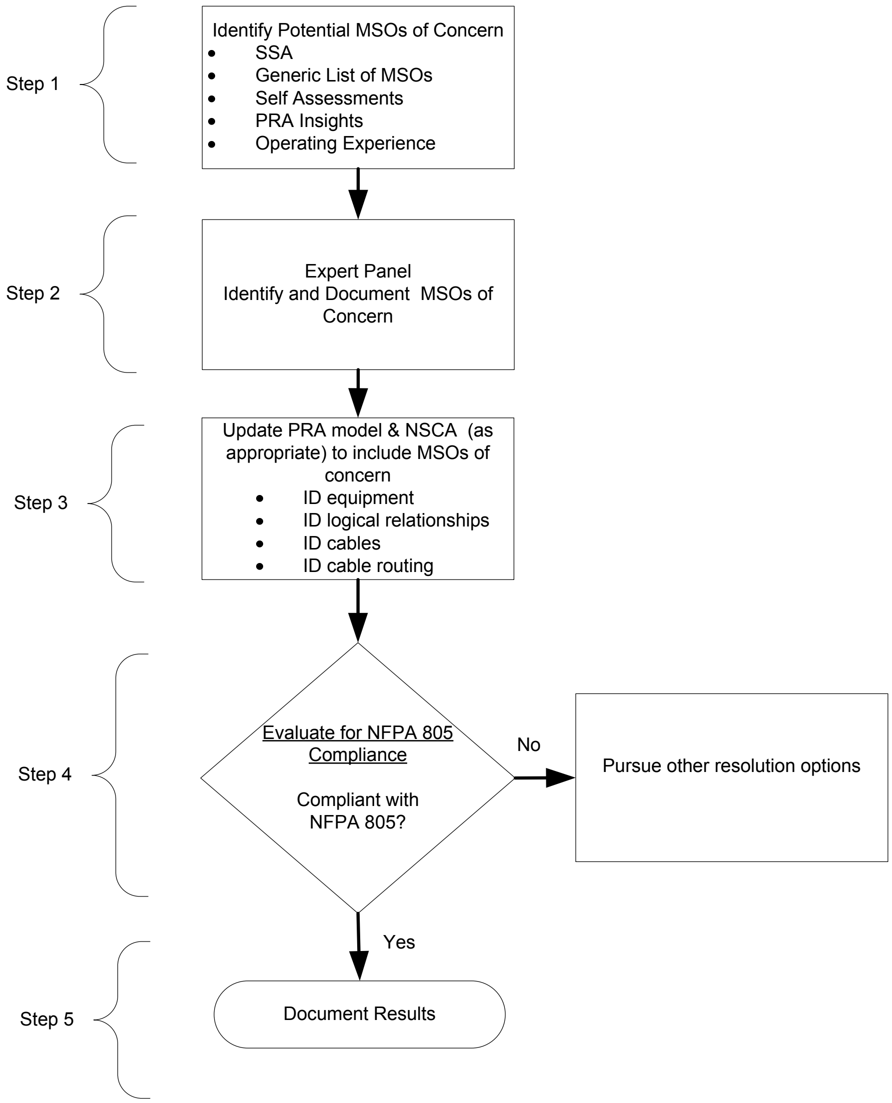

Figure 4-3 – Multiple Spurious Operations – Transition Resolution Process (Based on FAQ 07-0038)

Results

Refer to Attachment F for the process used and the results.

4.2.2 Existing Engineering Equivalency Evaluation Transition

Overview of Evaluation Process

The EEEEs that support compliance with NFPA 805 Chapter 3 or Chapter 4 (both those that existed prior to the transition and those that were created during the transition) were reviewed using the methodology contained in NEI 04-02. The methodology for performing the EEEE review included the following determinations:

- The EEEE is not based solely on quantitative risk evaluations,
- The EEEE is an appropriate use of an engineering equivalency evaluation,
- The EEEE is of appropriate quality,
- The standard license condition is met,
- The EEEE is technically adequate,
- The EEEE reflects the plant as-built condition, and
- The basis for acceptability of the EEEE remains valid

In accordance with the guidance in RG 1.205, Regulatory Position 2.3.2 and NEI 04-02, as clarified by FAQ 07-0054, Demonstrating Compliance with Chapter 4 of NFPA 805, EEEEs that demonstrate that a fire protection system or feature is “adequate for the hazard” are summarized in the LAR as follows:

If not requesting specific approval for “adequate for the hazard” EEEEs, then the EEEE was referenced where required and a brief description of the evaluated condition was provided.

If requesting specific NRC approval for “adequate for the hazard” EEEEs, then EEEE was referenced where required to demonstrate compliance and was included in Attachment L for NRC review and approval.

In all cases, the reliance on EEEEs to demonstrate compliance with NFPA 805 requirements was documented in the LAR.

Results

The review results for EEEEs are documented in Attachment A. In all cases the EEEEs reflect the plant as-built condition and the basis for acceptability of the evaluation remains the same.

In accordance with the guidance provided in RG 1.205, Regulatory Position 2.3.2, NEI 04-02, as clarified by FAQ 07-0054, Demonstrating Compliance with Chapter 4 of NFPA 805, EEEEs used to demonstrate compliance with Chapters 3 and 4 of NFPA 805 are referenced in the Attachments A and C as appropriate.

None of the transitioning EEEEs require NRC approval.

4.2.3 Licensing Action Transition

Overview of Evaluation Process

The existing licensing actions (i.e., Appendix R exemptions) review was performed in accordance with NEI 04-02. The methodology for the licensing action review included the following:

- Determination of the bases for acceptability of the licensing action.
- Determination that these bases for acceptability are still valid and required for NFPA 805.
- Additionally, variances from the deterministic requirements were identified in the NEI 04-02, Table B-3 (See Attachment C). Some of these variances were subsequently dispositioned via the use of the performance-based approach.

Results

Attachment K contains the detailed results of the Licensing Action Review.

This review concluded that the only Licensing Action that would be transitioned to the new licensing basis under NFPA 805 is the "Exemption from the Requirements of Section III.O of Appendix R to 10 CFR Part 50", which pertains to the requirement that a lube oil collection system be installed for the reactor coolant pumps. This Licensing Action is being transitioned based on prior approval and is considered compliant with 10CFR50.48(c).

The licensing action review resulted in the identification of licensing actions that would be transitioned to the new 10 CFR 50.48(c) licensing basis and those that would no longer be necessary. Attachment K of the Transition Report contains the results of the Licensing Action Review.

Since all exemptions are either compliant with 10 CFR 50.48(c) or no longer necessary, in accordance with the requirements of 10 CFR 50.48(c)(3)(i), CP&L requests that the exemptions listed in Attachment K be rescinded as part of the LAR process. It is CP&L's understanding that implicit in the superseding of the current license condition, all prior fire protection program Safety Evaluations and commitments will be superseded in their entirety.

4.2.4 Fire Area Transition

Overview of Evaluation Process

The Fire Area Transition (NEI 04-02 Table B-3) was performed using the methodology contained in NEI 04-02 and FAQ 07-0054. The methodology for performing the Fire Area Transition, depicted in Figure 4-4, is outlined as follows:

Step 1 - Assembled documentation. Gathered industry and plant-specific fire area analyses and licensing basis documents.

Step 2 – Documented fulfillment of nuclear safety performance criteria.

- Assessed accomplishment of nuclear safety performance goals. Documented the method of accomplishment, in summary level form, for the fire area.
- Documented evaluation of effects of fire suppression activities. Documented the evaluation of the effects of fire suppression activities on the ability to achieve the nuclear safety performance criteria.
- Performed licensing action reviews. Performed a review of the licensing aspects of the selected fire area and document the results of the review. See Section 4.2.3.
- Performed existing engineering equivalency evaluation reviews. Performed a review of existing engineering equivalency evaluations (or created new evaluations) documenting the basis for acceptability. See Section 4.2.2.
- Pre-transition OMA reviews. Performed a review of pre-transition OMAs to determine those actions taking place outside of the main control room or outside of the primary control station(s). See Section 4.2.1.3.

Step 3 – VFDR Identification and characterization and resolution considerations. Identified variances from the deterministic requirements of NFPA 805, Section 4.2.3. Documented variances as either a separation issue or a degraded fire protection system or feature. Developed VFDR problem statements to support resolution.

Step 4 – Performance-Based evaluations (Fire Modeling or Fire Risk Evaluations) See Section 4.5.2 for additional information.

Step 5 – Final Disposition.

Documented final disposition of the VFDRs in Attachment C (NEI 04-02 Table B-3).

- For recovery action compliance strategies, ensured the manual action feasibility analysis of the required recovery actions was completed. Note: if a recovery action cannot meet the feasibility requirements established per NEI 04-02, then alternate means of compliance was considered.
- Documented the post transition NFPA 805 Chapter 4 compliance basis.

Step 6 – Documented required fire protection systems and features. Reviewed the NFPA 805 Section 4.2.3 compliance strategies (including fire area licensing actions and engineering evaluations) and the NFPA 805 Section 4.2.4 compliance strategies (including simplifying deterministic assumptions) to determine the scope of fire protection systems and features ‘required’ by NFPA 805 Chapter 4. The ‘required’ fire

protection systems and features are subject to the applicable requirements of NFPA 805 Chapter 3.

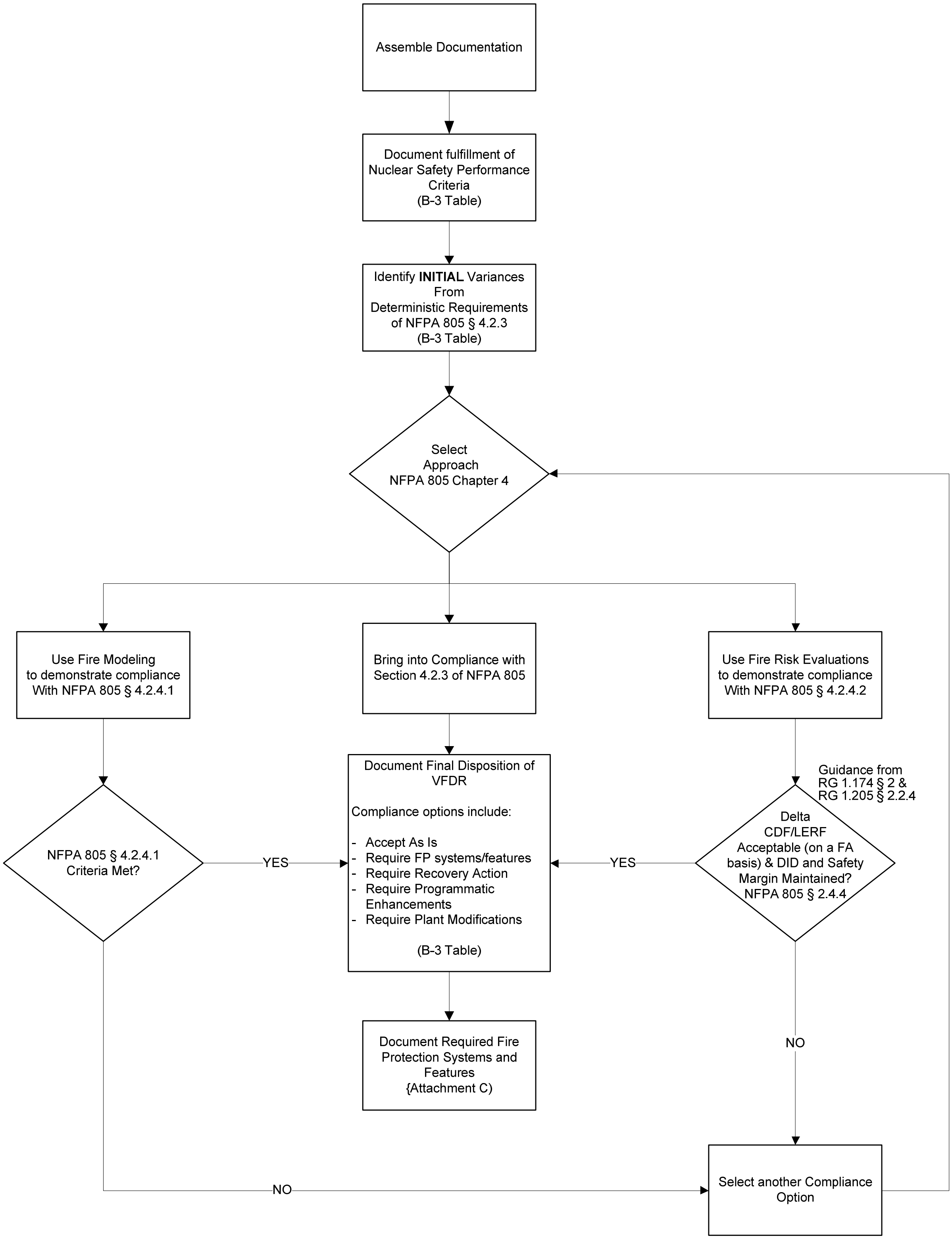

Figure 4-4 – Summary of Fire Area Review
[Based on FAQ 07-0054 Revision 1]

Results of the Evaluation Process

Attachment C contains the results of the Fire Area Transition review (NEI 04-02 Table B-3). On a fire area basis, Attachment C summarizes compliance with Chapter 4 of NFPA 805.

- NEI 04-02 Table B-3 includes the following summary level information for each fire area:
- Regulatory Basis – NFPA 805 post-transition regulatory bases are included.
- Performance Goal Summary – An overview of the method of accomplishment of each of the performance criteria in NFPA 805 Section 1.5 is provided.
- Reference Documents – Specific references to Nuclear Safety Capability Assessment Documents are provided.
- Fire Suppression Activities Effect on Nuclear Safety Performance Criteria – A summary of the method of accomplishment is provided.
- Licensing Actions – HBRSEP is transitioning one Licensing Action. This exemption will remain part of the post-transition licensing basis. The exemption from Section III.O of Appendix R was granted by the NRC to the extent that a reactor coolant pump lube oil collection system is not provided. In lieu of installing such a system, fixed fire suppression is maintained and additional detection and dikes were installed in the pump bays. Also, the Containment Spray system serves as a backup fire suppression system with Sodium Hydroxide isolated. This is further explained in Attachment K.
- EEEE – Specific references to EEEE that rely on determinations of "adequate for the hazard" that will remain part of the post-transition licensing basis. A brief description of the condition and the basis for acceptability should be provided.
- VFDRs – Specific variances from the deterministic requirements of NFPA 805 Section 4.2.3. Refer to Section 4.5.2 for a discussion of the performance-based approach.

4.3 Non-Power Operational Modes

4.3.1 Overview of Evaluation Process

HBRSEP implemented the process outlined in NEI 04-02 and FAQ 07-0040, Clarification on Non-Power Operations. The goal (as depicted in Figure 4-5) is to ensure that contingency plans are established when the plant is in a Non-Power Operational (NPO) mode where the risk is intrinsically high. During low risk periods, normal risk management controls and fire prevention/protection processes and procedures will be utilized.

The process to demonstrate that the nuclear safety performance criteria are met during NPO modes involved the following steps:

Reviewed the existing Outage Management Processes

Identified Equipment/Cables:

- o Reviewed plant systems to determine success paths that support each of the defense-in-depth Key Safety Functions (KSFs), and
- o Identified cables required for the selected components and determined their routing.

Performed Fire Area Assessments (identify pinch points – plant locations where a single fire may damage all success paths of a KSF).

Managed pinch-points associated with fire-induced vulnerabilities during the outage.

The process is depicted in Figures 4-5 and 4-6. The results are presented in Section 4.3.2.

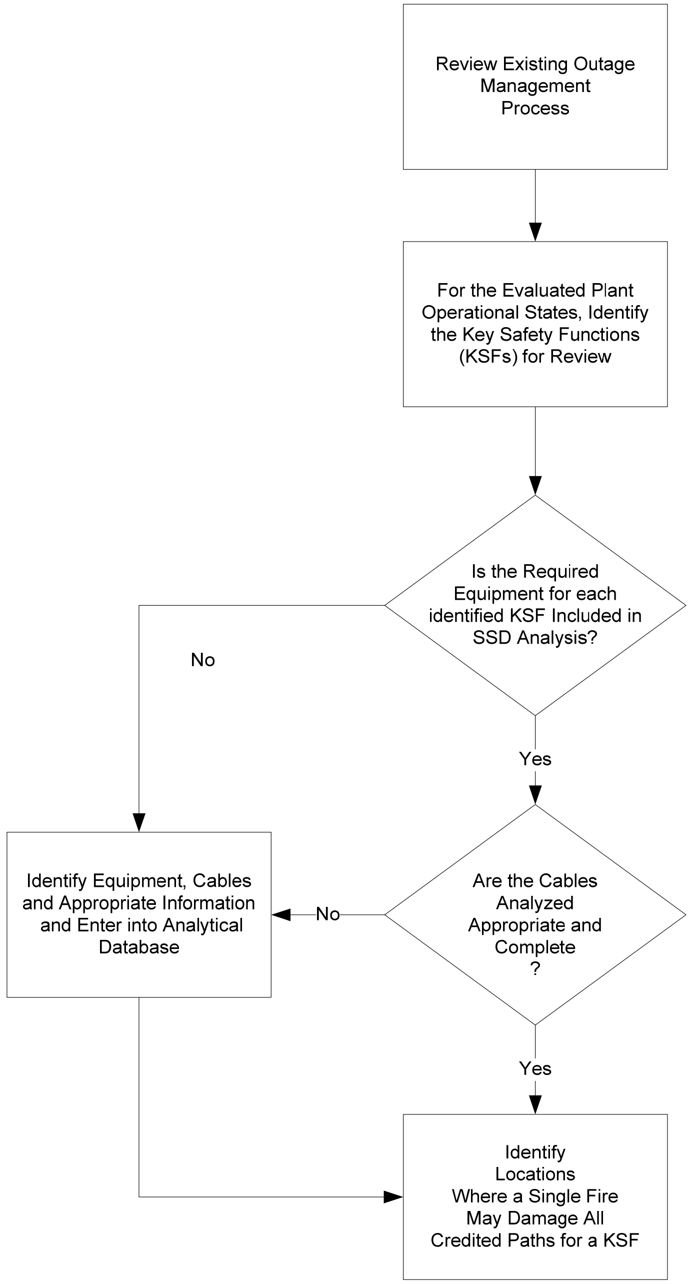

Figure 4-5 Review POSs, KSFs, Equipment, and Cables, and Identify Pinch Points

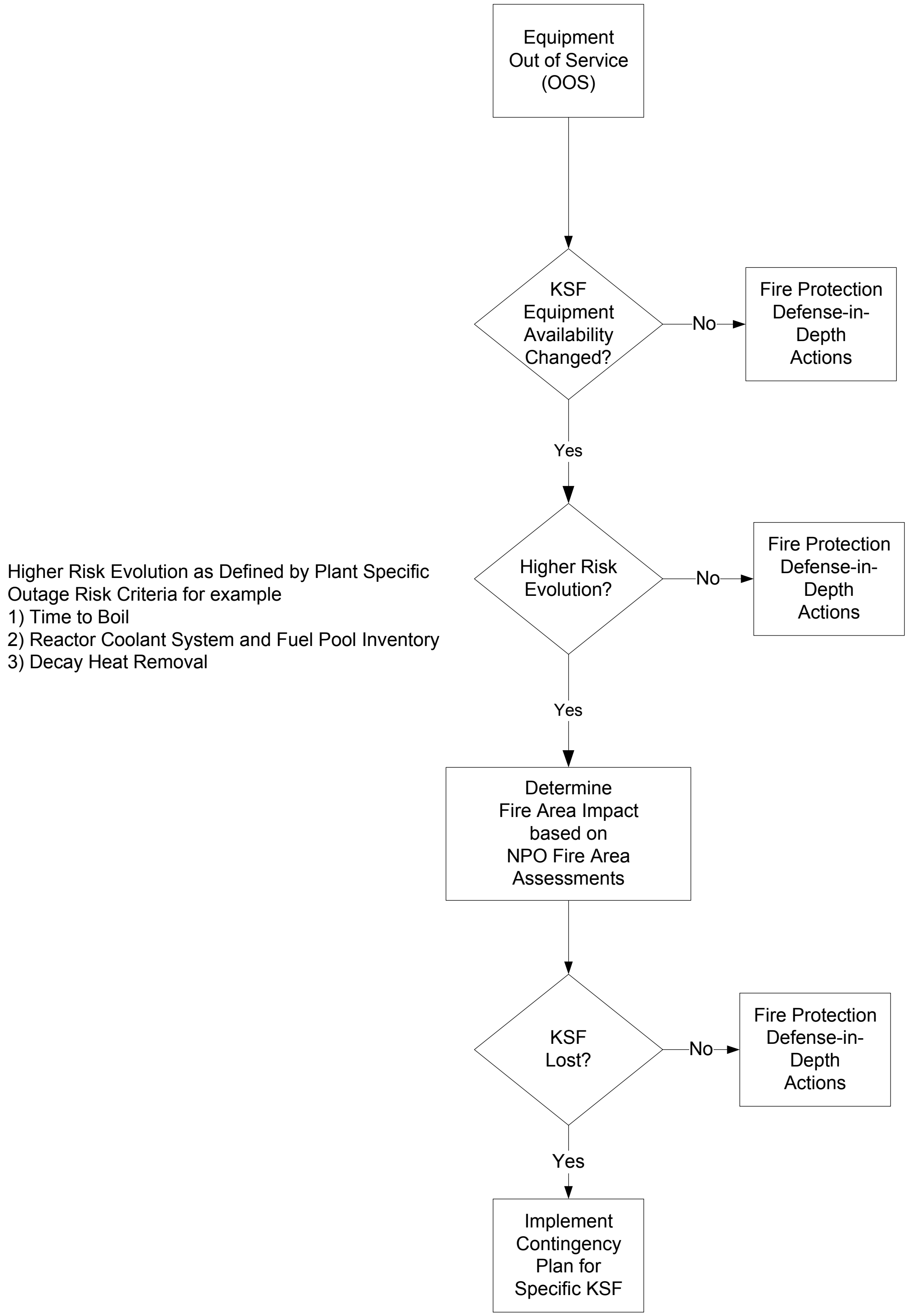

Figure 4-6 Manage Pinch Points

4.3.2 Results of the Evaluation Process

HBRSEP outage management processes were reviewed. Based on FAQ 07-0040, the Plant Operating States considered for equipment and cable selection are documented in calculation RNP-E/ELEC-1217, “Non-Power Operations Analysis”. Using a CAFTA fault tree that models NPO requirements, systems and components were identified to provide the following KSFs: Decay Heat Removal; Reactivity Control; Inventory Control; Pressure Control; Spent Fuel Pit Cooling; and Electrical Power Availability (to the extent that it supports the other KSFs).

For those components not already in the HBRSEP Access Database or those with a functional state for non-power operations differing from that in the At-Power Analysis, circuit analysis, cable selection and routing were performed as described in the plant’s NSCA methodology. Once all information had been entered into the HBRSEP Access Database, the ARC™ software package in conjunction with the NPO fault tree was used to determine KSF Pinch Points.

Calculation RNP-E/ELEC-1217 provides the results of the fire area assessments for the Pinch Point analysis and provides recommendations for changes to fire risk and outage management procedures and other administrative controls. These include:

- Prohibition or limitation of hot work in fire areas during periods of increased vulnerability.
- Prohibition or limitation of combustible materials in fire areas during periods of increased vulnerability.
- Provision of additional fire watches in affected fire areas during increased vulnerability.
- Identification and monitoring of in-situ ignition sources for fire precursors (e.g., equipment temperatures).
- Review of work activities for possible rescheduling.
- Equipment realignment (e.g., swing pumps or Backfeed)
- Identification of procedures to be briefed or walked down.
- Posting of protected equipment.
- Consideration of pre-emptive or recovery actions to mitigate potential losses of KSF success paths.

Attachment D provides a more detailed discussion. Based on incorporation of the recommendations from RNP-E/ELEC-1217 into appropriate plant procedures in conjunction with establishment of the NFPA 805 fire protection program, the performance goal for NPO modes (i.e., to maintain the fuel in a safe and stable condition) is fulfilled and the requirements of NFPA 805 are met.

4.4 Radioactive Release Performance Criteria

4.4.1 Overview of Evaluation Process

The review of the fire protection program against NFPA 805 requirements for fire suppression related radioactive release was performed using the methodology contained in NEI 04-02, Table E-1, and was performed using the methodology contained in Project Instruction FPIP-0121, Radiological Release Reviews During Fire Fighting Operations, Rev. 1. The methodology consisted of the following:

- A review of fire pre-plans and fire brigade training materials to identify fire protection program elements (e.g., systems / components / procedural control actions / flow paths) that are being credited to meet the radioactive release goals, objectives, and performance criteria during all plant operating modes, including full power and non-power conditions. Specifically for HBRSEP, a review was conducted by a review panel to ensure specific steps are included for containment and monitoring of potentially contaminated materials so as to limit the potential for release of radioactive materials due to firefighting operations. The review panel consisted of representatives from Operations, Engineering (i.e., Fire Protection, HVAC Systems), Operations Fire Brigade Training, and Radiation Protection. Site pre-fire plans were screened to identify those locations that have the potential for radiological contamination based on location within plant Radiological Controlled Areas, areas containing potentially contaminated systems, or locations where radioactive materials are routinely stored. In addition, the site fire brigade training materials were reviewed by the same review panel to ensure specific steps are included addressing containment and monitoring of potentially contaminated materials and monitoring of potentially contaminated fire suppression products following a fire event.

A review of engineering controls to ensure containment of gaseous and liquid effluents (i.e., smoke and fire fighting agents). This review included all plant operating modes (i.e., including full power and non-power conditions). Otherwise, provided a bounding analysis, quantitative analysis, or other analysis that demonstrates that the limitations for instantaneous release of radioactive effluents specified in the unit's Technical Specifications are met.

4.4.2 Results of the Evaluation Process

The review determined the Fire Protection Program (i.e., Pre-Fire Plans) meets the radioactive release performance criteria by ensuring that radioactive materials (i.e., radiation) generated as a direct result of fire suppression activities is contained and monitored prior to release to unrestricted areas, such that release would be as low as reasonably achievable and would not exceed applicable 10 CFR, Part 20 limits. Containment and monitoring is ensured through elements of the fire brigade training, guidance provided in pre-fire plans and certain plant features (i.e., engineering controls) such as curbs and ventilation systems or actions provided to control smoke management or fire suppression water run-off.

Site specific review of associated fire event and fire suppression related radioactive release is summarized in Attachment E, NEI 04-02, Table E-1. Containment and

monitoring actions associated with firefighting operations are included in the pre-fire plans for fire areas as appropriate based on the screening criteria previously stated (Attachment E) to meet the radiological performance criteria.

The standardized pre-fire plan outline identifies typical fixed radiological hazards for each area. All HBRSEP pre-fire plans were screened for applicability. Pre-fire plans that address areas where there is no possibility of radiological hazards were screened out from further review. This information was included as input to the individual fire area Fire Safety Analyses (FSAs) calculations. The FSA is the Design Basis Document for NFPA 805 compliance for each fire area and will serve as the location for maintenance and configuration control of the radioactive release review results. Change, modification, or revision to the FSAs is controlled under existing plant engineering configuration control processes.

4.5 Fire PRA and Performance-Based Approaches

RI-PB evaluations are an integral element of an NFPA 805 fire protection program. Key parts of RI-PB evaluations include:

- A Fire PRA (discussed in Section 4.5.1 and Attachments U, V, and W).
- NFPA 805 Performance-Based Approaches (discussed in Section 4.5.2).

4.5.1 Fire PRA Development and Assessment

In accordance with the guidance in RG 1.205, a Fire PRA model was developed for HBRSEP in compliance with the requirements of Part 4 "Requirements for Fires At Power PRA," of the ASME and ANS combined PRA Standard, ASME/ANS RA-Sa-2009, "Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Application," (hereafter referred to as Fire PRA Standard). Duke Energy conducted a peer review by independent industry analysts in accordance with RG 1.200 prior to a risk-informed submittal. The resulting fire risk assessment model is used as the analytical tool to perform Fire Risk Evaluations during the transition process.

Section 4.5.1.1 describes the Internal Events PRA model. Section 4.5.1.2 describes the Fire PRA model. Section 4.5.1.3 describes the results and resolution of the peer review of the Fire PRA, and Section 4.5.1.4 describes insights gained from the Fire PRA.

4.5.1.1 Internal Events PRA

The HBRSEP base internal events PRA, Calculation RNP-F/PSA-0006 was the starting point for the Fire PRA.

Attachment U provides a discussion of the internal events PRA and the results and disposition of the most recent peer review. Attachment U demonstrates that the internal events PRA is met at Capability Category II for all applicable supporting requirements according to peer review and/or disposition.

4.5.1.2 Fire PRA

The internal events PRA was modified to capture the effects of fire both as an initiator of an event and as a potential failure mode of affected circuits and individual targets. The

Fire PRA was developed using the guidance for Fire PRA development in NUREG/CR-6850/EPRI TR 1011989, approved FAQs, and EPRI TR 1016735.

The Fire PRA quality and results are discussed in the subsequent sections and in Attachments V and W, respectively.

Fire Model Utilization in the Application

As part of the NFPA 805 transition, fire modeling was performed as part of the Fire PRA development (i.e., NFPA 805 Section 4.2.4.2) and, therefore, maximum expected fire scenario (MEFS)/limiting fire scenario (LFS) were not analyzed separately. RG 1.205, Regulatory Position 4.2 and Section 5.1.2 of NEI 04-02, provide guidance to identify fire models that are acceptable to the NRC for plants implementing a risk-informed, performance-based licensing basis.

The following fire models were used:

- Fire Dynamics Tools (FDT's)
- Consolidated Model of Fire and Smoke Transport (CFAST)

The approach taken at HBRSEP to simplify the analysis process incorporates features of several fire model tools covered by NUREG-1824, as well as additional features. The approach is collectively referred to as the Fire Modeling Generic Treatments. The analysis basis and Verification and Validation (V&V) documentation was provided in a proprietary Hughes Associates, Inc. report to the NRC on January 24, 2008. The report entitled "Generic Fire Modeling Treatments" is effectively a technical reference guide, a user's guide, and the V&V basis.

The use of the Generic Treatments in specific applications at HBRSEP falls within their limitations as described in the "Generic Fire Modeling Treatments". In addition to the generic fire modeling treatments that were used in the hazard analysis, several calculations were produced that used CFAST and the FDT's as documented in NUREG-1824.

The acceptability of the use of these fire models is included in Attachment J.

4.5.1.3 Results of Fire PRA Peer Review

The HBRSEP Fire PRA Calculation RNP-F/PSA-0094 was peer reviewed against the requirements of ASME/ANS RA-Sa-2009, Part 4.

The results (i.e., Supporting Requirement capability assessments and Facts & Observations (F&Os)) documented in the Fire PRA peer review report (March 2013) and subsequent focused-scope peer-review report (July 2013) were used to support the Fire PRA for the NFPA 805 application.

The Fire PRA update addressed the Supporting Requirement assessed deficiencies (i.e., Not Met or Capability Category I (CC I)). Completion of recommendations related to Supporting Requirement assessments and 'Finding' F&Os results in a Capability Category II assessment for the associated Supporting Requirements. Any Supporting Requirements found not to meet Category II are considered "Open," but were justified to

have an insignificant impact on the NFPA 805 application through disposition. The results of the peer review and dispositions are summarized in Attachment V.

4.5.1.4 Risk Insights

Risk insights were documented as part of the development of the Fire PRA. The total plant fire CDF/LERF was derived using the NUREG/CR-6850 methodology for fire PRA development and is useful in identifying the areas of the plant where fire risk is greatest. A review of the fire scenarios contributing more than 1% to the overall risk is included as Attachment W.

4.5.2 Performance-Based Approaches

NFPA 805 outlines the approaches for performing performance-based analyses. As specified in Section 4.2.4, there are generally two types of analyses performed for the performance-based approach:

- Fire Modeling (NFPA 805 Section 4.2.4.1).
- Fire Risk Evaluation (NFPA 805 Section 4.2.4.2).

4.5.2.1 Fire Modeling Approach

The fire modeling approach was not utilized for demonstrating compliance with NFPA 805 for HBRSEP.

4.5.2.2 Fire Risk Approach

Overview of Evaluation Process

The Fire Risk Evaluations were completed as part of the HBRSEP NFPA 805 transition. These Fire Risk Evaluations were developed using the process described below. This methodology is based upon the requirements of NFPA 805, industry guidance in NEI 04-02, and RG 1.205. These are summarized in Table 4-1.

Table 4-1 Fire Risk Evaluation Guidance Summary Table

Document	Section(s)	Topic
NFPA 805	2.2(h), 4.2.4, A.2.2(h), A.2.4.4, D.5	Change Evaluation (2.2(h), 2.2.9, 2.4.4 A.2.2(h), A.2.4.4, D.5) Risk of Recovery Actions (4.2.4) Use of Fire Risk Evaluation (4.2.4.2)
NEI 04-02 Revision 2	4.4, 5.3, Appendix B, Appendix I, Appendix J	Change Evaluation, Change Evaluation Forms (App. I), No specific discussion of Fire Risk Evaluation
RG 1.205 Revision 1	C.2.2.4, C.2.4, C.3.2	Risk Evaluations (C.2.2.4) Recovery Actions (C.2.4)

During the transition to NFPA 805, variances from the deterministic approach in Section 4.2.3 of NFPA 805 were evaluated using a Fire Risk Evaluation per Section 4.2.4.2 of NFPA 805. A Fire Safety Analysis was performed for each fire area containing variances from the deterministic requirements of Section 4.2.3 of NFPA 805 (VFDRs), a Fire Risk Evaluation was performed for each fire area containing VFDRs

If the Fire Risk Evaluation meets the acceptance criteria, this is confirmation that a success path effectively remains free of fire damage and that the performance-based approach is acceptable per Section 4.2.4.2 of NFPA 805.

The Fire Risk Evaluation process consists of the following steps (Figure 4-7 depicts the Fire Risk Evaluation process used during transition. This is generally based on FAQ 07-0054 Revision 1:

Step 1 – Preparation for the Fire Risk Evaluation.

Definition of the Variances from the Deterministic Requirements. The definition of the VFDR includes a description of problem statement and the section of NFPA 805 that is not met, type of VFDR (e.g., separation issue or degraded fire protection system), and proposed evaluation per applicable NFPA 805 section.

Preparatory Evaluation – Fire Risk Evaluation Team Review. Using the information obtained during the development of the NEI 04-02 B-3 Table and the Fire PRA, a team review of the VFDR was performed. Depending on the scope and complexity of the VFDR, the team may include the Safe shutdown/NSCA Engineer, the Fire Protection Engineer, and the Fire PRA Engineer. The purpose and objective of this team review was to address the following;

- Review of the Fire PRA modeling treatment of VFDR
- Ensure discrepancies were captured and resolved

Step 2 – Performed the Fire Risk Evaluation

The Evaluator coordinated as necessary with the Safe shutdown/NSCA Engineer, Fire Protection Engineer and Fire PRA Engineer to assess the VFDR using the Fire Risk Evaluation process to perform the following:

- Change in Risk Calculation with consideration for additional risk of recovery actions and required fire protection systems and features due to fire risk.
- Fire area change in risk summary

Step 3 – Reviewed the Acceptance Criteria

The acceptance criteria for the Fire Risk Evaluation consist of two parts. One is quantitatively based and the other is qualitatively based. The quantitative figures of merit are ΔCDF and ΔLERF. The qualitative factors are defense-in-depth and safety margin.

- Risk Acceptance Criteria. The transition risk evaluation was measured quantitatively for acceptability using the ΔCDF and ΔLERF criteria from RG 1.174, as clarified in RG 1.205 Regulatory Position 2.2.4.
- Defense-in-Depth. A review of the impact of the change on defense-in-depth was performed, using the guidance NEI 04-02. NFPA 805 defines defense-in-depth as:
  - Preventing fires from starting
  - Rapidly detecting fires and controlling and extinguishing promptly those fires that do occur, thereby limiting damage

- Providing adequate level of fire protection for structures, systems and components important to safety; so that a fire that is not promptly extinguished will not prevent essential plant safety functions from being performed.

In general, the defense-in-depth requirement was considered to be satisfied if the proposed change does not result in a substantial imbalance among these elements (or echelons).

The review of defense-in-depth was qualitative and addressed each of the elements with respect to the proposed change. Defense-in-depth was performed on a fire area basis.

Fire protection features and systems relied upon to ensure defense-in-depth were identified as a result of the assessment of defense-in-depth.

- Safety Margin Assessment. A review of the impact of the change on safety margin was performed. An acceptable set of guidelines for making that assessment is summarized below. Other equivalent acceptance guidelines may also be used.
  - Codes and standards or their alternatives accepted for use by the NRC are met, and
  - Safety analysis acceptance criteria in the licensing basis (e.g., UFSAR, supporting analyses) are met, or provides sufficient margin to account for analysis and data uncertainty.

  The requirements related to safety margins for the change analysis are described for each of the specific analysis types used in support of the FRE.

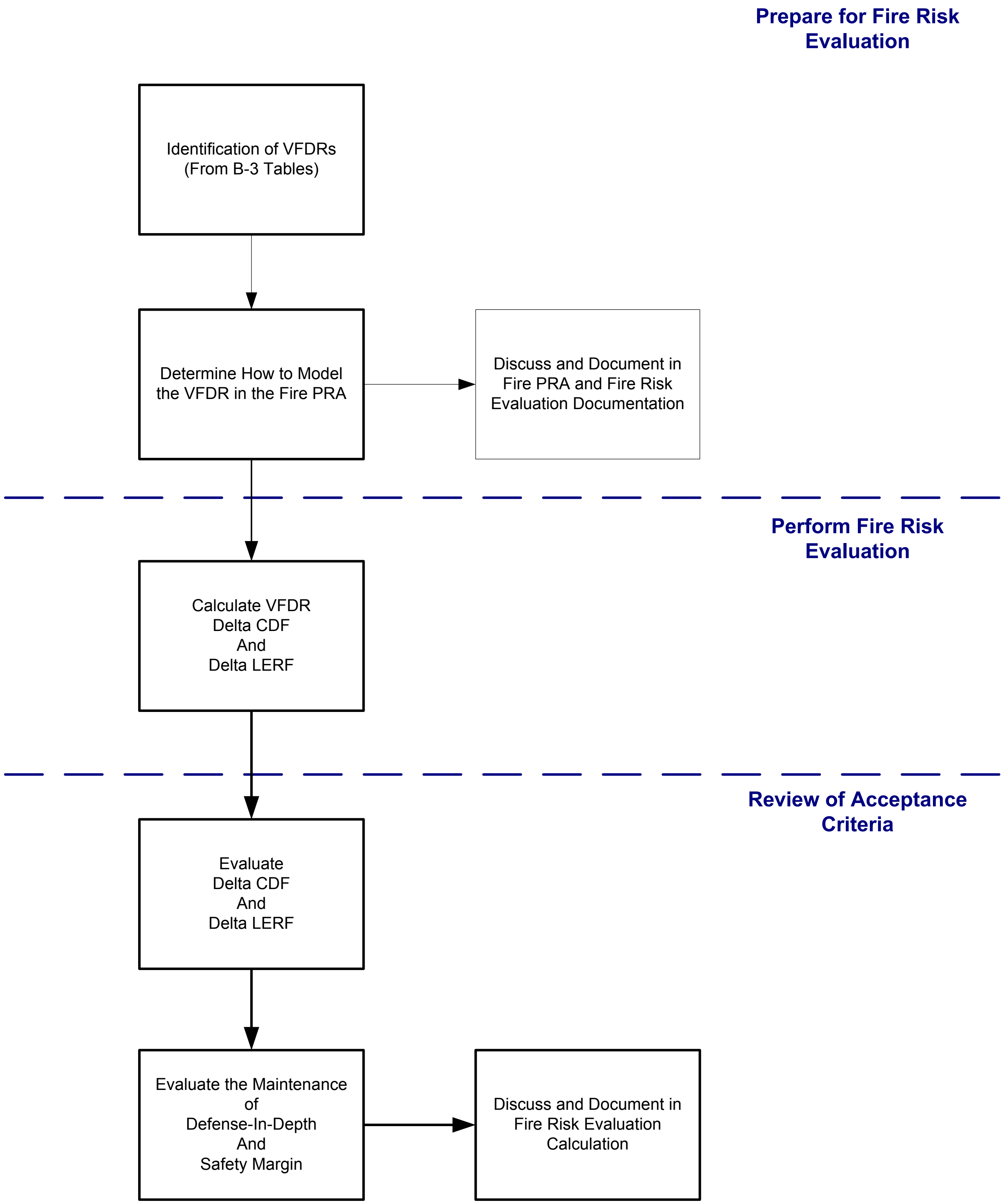

Figure 4-7 – Fire Risk Evaluation Process (NFPA 805 Transition) [Based on FAQ 07-0054 Revision 1]

Results of Evaluation Process

Disposition of VFDRs

The HBRSEP existing post-fire SSA and the NFPA 805 transition project activities have identified a number of variances from the deterministic requirements of NFPA 805 Section 4.2.3. These variances were dispositioned using the fire risk evaluation process.

Each variance dispositioned using a Fire Risk Evaluation was assessed against the Fire Risk Evaluation acceptance criteria of ΔCDF and ΔLERF; and maintenance of defense-in-depth and safety margin criteria from Section 5.3.5 of NEI 04-02 and RG 1.205. The results of these calculations are summarized in Attachment C.

Following completion of transition activities and planned modifications and program changes, the plant will be compliant with 10 CFR 50.48(c).

Risk Change Due to NFPA 805 Transition

In accordance with the guidance in RG 1.205, Section C.2.2.4, Risk Evaluations, risk increases or decreases for each fire area using Fire Risk Evaluations and the overall plant should be provided. Note that the risk increase due to the use of recovery actions was included in the risk change for transition for each fire area.

RG 1.205 Section C.2.2.4.2 states in part

> *"The total increase or decrease in risk associated with the implementation of NFPA 805 for the overall plant should be calculated by summing the risk increases and decreases for each fire area (including any risk increases resulting from previously approved recovery actions). The total risk increase should be consistent with the acceptance guidelines in Regulatory Guide 1.174. Note that the acceptance guidelines of Regulatory Guide 1.174 may require the total CDF, LERF, or both, to evaluate changes where the risk impact exceeds specific guidelines. If the additional risk associated with previously approved recovery actions is greater than the acceptance guidelines in Regulatory Guide 1.174, then the net change in total plant risk incurred by any proposed alternatives to the deterministic criteria in NFPA 805, Chapter 4 (other than the previously approved recovery actions), should be risk neutral or represent a risk decrease."*

The risk increases and decreases are provided in Attachment W.

4.6 Monitoring Program

4.6.1 Overview of NFPA 805 Requirements and NEI 04-02 Guidance on the NFPA 805 Fire Protection System and Feature Monitoring Program

Section 2.6 of NFPA 805 states:

> *"A monitoring program shall be established to ensure that the availability and reliability of the fire protection systems and features are maintained and to assess the performance of the fire protection program in meeting the performance criteria. Monitoring shall ensure that the assumptions in the engineering analysis remain valid."*

As part of the transition review, the adequacy of the inspection and testing program to address fire protection systems and equipment within plant inspection and the compensatory measures programs should be reviewed. In addition, the adequacy of the plant corrective action program in determining the causes of equipment and programmatic failures and minimizing their recurrence should also be reviewed as part of the transition to a risk-informed, performance-based licensing basis.

4.6.2 Overview of Post-Transition NFPA 805 Monitoring Program

This section describes the process that will be utilized to implement the post-transition NFPA 805 monitoring program. The monitoring program will be implemented after the safety evaluation issuance as part of the fire protection program transition to NFPA 805. See item for implementation in Attachment S. The monitoring process is comprised of four phases.

- Phase 1 – Scoping
- Phase 2 – Screening Using Risk Criteria
- Phase 3 – Risk Target Value Determination
- Phase 4 – Monitoring Implementation

Figure 4-8 provides detail on the Phase 1 and 2 processes.

The results of these phases will be documented in the NFPA 805 Monitoring Program scoping document developed during implementation.

Phase 1 – Scoping

In order to meet the NFPA 805 requirements for monitoring, the following categories of SSCs and programmatic elements will be reviewed during the implementation phase for inclusion in the NFPA 805 monitoring program:

- Structures, Systems, and Components required to comply with NFPA 805, specifically:
  - Fire protection systems and features
    - Required by the Nuclear Safety Capability Assessment
    - Modeled in the Fire PRA
    - Required by Chapter 3 of NFPA 805
  - Nuclear Safety Capability Assessment equipment[4]
    - Nuclear safety equipment
    - Fire PRA equipment
    - NPO equipment
  - Structures, systems and components relied upon to meet radioactive release criteria
- Fire Protection Programmatic Elements

Phase 2 – Screening Using Risk Criteria

The equipment from Phase 1 scoping will be screened to determine the appropriate level of NFPA 805 monitoring. As a minimum, the SSCs identified in Phase 1 will be part of an inspection and test program and system/program health reporting. If not in the current program, the SSCs will be added in order to assure that the criteria can be met reliably.

The following screening process will be used to determine those SSCs that may require additional monitoring beyond normal inspection and test program and system/program health reporting and will be documented in NFPA 805 Monitoring Program scoping document.

1. Fire Protection Systems and Features

Those fire protection systems and features identified in Phase 1 are candidates for additional monitoring in the NFPA 805 program commensurate with risk significance.

Risk significance is determined at the component, programmatic element, and/or functional level on an individual fire area basis. Compartments smaller than fire areas may be used provided the compartments are independent (i.e., share no fire protection SSCs). If compartments smaller than fire areas are used the basis will be documented in the calculation, RNP-F/PSA-0095, RNP Fire PSA NFPA 805 Transition.

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[4] For the purposes of the NFPA 805 Monitoring, "NSCA equipment" is intended to include Nuclear Safety Equipment, Fire PRA equipment, and NPO equipment.

The Fire PRA is used to establish the risk significance based on the following screening criteria:

Risk Achievement Worth (RAW) of the monitored parameter ≥ 2.0

(AND) either

Core Damage Frequency (CDF) x (RAW) ≥ 1.0E-7 per year

(OR)

Large Early Release Frequency (LERF) x (RAW) ≥ 1.0E-8 per year

CDF, LERF, and $RAW_{(monitored\ parameter)}$ are calculated for each fire area. The 'monitored parameter' will be established at a level commensurate with the amenability of the parameter to risk measurement (e.g., a fire barrier may be more conducive to risk measurement than an individual barrier penetration) and will be documented in the calculation, RNP-F/PSA-0095.

Fire protection systems and features that meet or exceed the criteria identified above are considered High Safety Significant (HSS) and will be included in the NFPA 805 Monitoring Program. The HSS fire protection systems and features not already monitored via an existing inspection and test program and/or in the existing system / program health reporting, as described in procedure EGR-NGGC-0010, will be added to the NFPA 805 Monitoring Program and documented in the NFPA 805 Monitoring Program scoping document.

2. Nuclear Safety Capability Assessment Equipment

Required NSCA equipment, except the NPO scope, identified in Phase 1 will be screened for safety significance using the Fire PRA and the Maintenance Rule guidelines differentiating HSS equipment from Low Safety Significant (LSS) equipment. The screening will also ensure that the Maintenance Rule functions are consistent with the required functions of the NSCA equipment.

HSS NSCA equipment not currently monitored in Maintenance Rule will be included in Maintenance Rule. All NSCA equipment that are not HSS are considered LSS and need not be included in the monitoring program.

For non-power operational modes, the qualitative use of fire prevention to manage fire risk during Higher Risk Evolutions does not lend itself to quantitative risk measurement. Therefore, fire risk management effectiveness is monitored programmatically similar to combustible material controls and other fire prevention programs. Additional monitoring beyond inspection and test programs and system/program health reporting is not considered necessary.

3. SSCs Relied upon for Radioactive Release Criteria

The evaluations performed to meet the radioactive release performance criteria are qualitative in nature. The SSCs relied upon to meet the radioactive release performance criteria are not amenable to quantitative risk measurement. Additionally, since 10 CFR Part 20 limits (which are lower than releases due to core damage and containment breach) for radiological effluents are not being exceeded, equipment relied upon to meet the radioactive release performance criteria is considered inherently low

risk. Therefore, additional monitoring beyond inspection and test programs and system/program health reporting is not considered necessary.

4. Fire Protection Programmatic Elements

Monitoring of programmatic elements is required in order to “assess the performance of the fire protection program in meeting the performance criteria”. These programs form the bases for many of the analytical assumptions used to evaluate compliance with NFPA 805 requirements Programmatic aspects include:

- Prompt Detection, including incipient detection fire watch and hot work fire watch
- Transient Combustible Controls Program Violations against FIR-NGGC-0009
- Fire Brigade Effectiveness including Fire Brigade Response Time, Fire Brigade Fire Drill, and Fire Brigade Fire Drill Objectives

Monitoring of programmatic elements is more qualitative in nature since the programs do not lend themselves to the numerical methods of reliability and availability. Therefore, monitoring is conducted using the existing system and program health programs. Fire protection health reports, self-assessments, regulator and insurance company reports provide inputs to the monitoring program.

Phase 3 – Risk Target Value Determination

Failure criteria is established by an expert panel based on the required fire protection and nuclear safety capability SSCs and programmatic elements assumed level of performance in the supporting analyses established in Phase 2. Action levels are established for the SSCs at the component level, program level, or functionally through the use of the pseudo system or ‘performance monitoring group’ concept. The actual action level is determined based on the number of component, program or functional failures within a sufficiently bounding time period (i.e., ~2-3 operating cycles).

Since the HSS NSCA equipment have been identified using the Maintenance Rule guidelines, the associated equipment specific performance criteria will be established as in the Maintenance Rule, provided the criteria are consistent with Fire PRA assumptions.

When establishing the action level threshold for reliability and availability, the action level will be no lower than the fire PRA assumptions. Adverse trends and unacceptable levels of availability, reliability, and performance will be reviewed against established action levels.

Documentation of the monitoring program failure criteria and action level targets will be contained in a documented evaluation. It is anticipated that the availability and reliability criterion for High Safety Significant Performance Monitoring Groups will use the guidance included in several industry documents tempered by site-specific operating experience, Fire PRA assumptions, and equipment types (and vendor data or valid design input when available). Industry documents such as the EPRI Fire Protection Equipment Surveillance Optimization and Maintenance Guide TR-1006756, Final Report July 2003, NFPA codes, and/or the NRC Fire Protection Significance Determination Process in addition to site specific operating experience data may be used. The monitoring program failure criteria and action level targets will be documented in the NFPA 805 Monitoring Program scoping document.

Note that fire protection systems and features, NSCA equipment, SSCs required to meet the radioactive release criteria, and fire protection program elements that do not meet the screening criteria in Phase 2 will be included in the existing inspection and test programs and the system and program health programs. Reliability and availability criteria will not be assigned.

Phase 4 – Monitoring Implementation

Phase 4 is the implementation of the monitoring program, once the monitoring scope and criteria are established. Monitoring consists of periodically gathering, trending, and evaluating information pertinent to the performance, and/or availability of the equipment and comparing the results with the established goals and performance criteria to verify that the goals are being met. Results of monitoring activities will be analyzed in timely manner to assure that appropriate action is taken. The corrective action process will be used to address performance of fire protection and nuclear safety SSCs that do not meet performance criteria.

For fire protection systems and features and NSCA HSS equipment that are monitored, unacceptable levels of availability, reliability, and performance will be reviewed against the established action levels. If an action level is triggered, corrective action in accordance with procedure, CAP-NGGC-0200 will be initiated to identify the negative trend. A corrective action plan will then be developed to ensure the performance returns to the established level.

When applicable, a sensitivity study can be performed to determine the margin below the action level that still provides acceptable fire PRA results to help prioritize corrective actions if the action level is reached.

A periodic assessment will be performed (i.e., at a frequency of approximately every two to three operating cycles), taking into account, where practical, industry wide operating experience. Issues that will be addressed include:

- Review systems with performance criteria. Do performance criteria still effectively monitor the functions of the system? Do the criteria still monitor the effectiveness of the fire protection and NSCA systems?
- Have the supporting analyses been revised such that the performance criteria are no longer applicable or new fire protection and NSCA SSCs, programmatic elements and/ or functions need to be in scope?
- Based on the performance during the assessment period, are there any trends in system performance that should be addressed that are not being addressed?

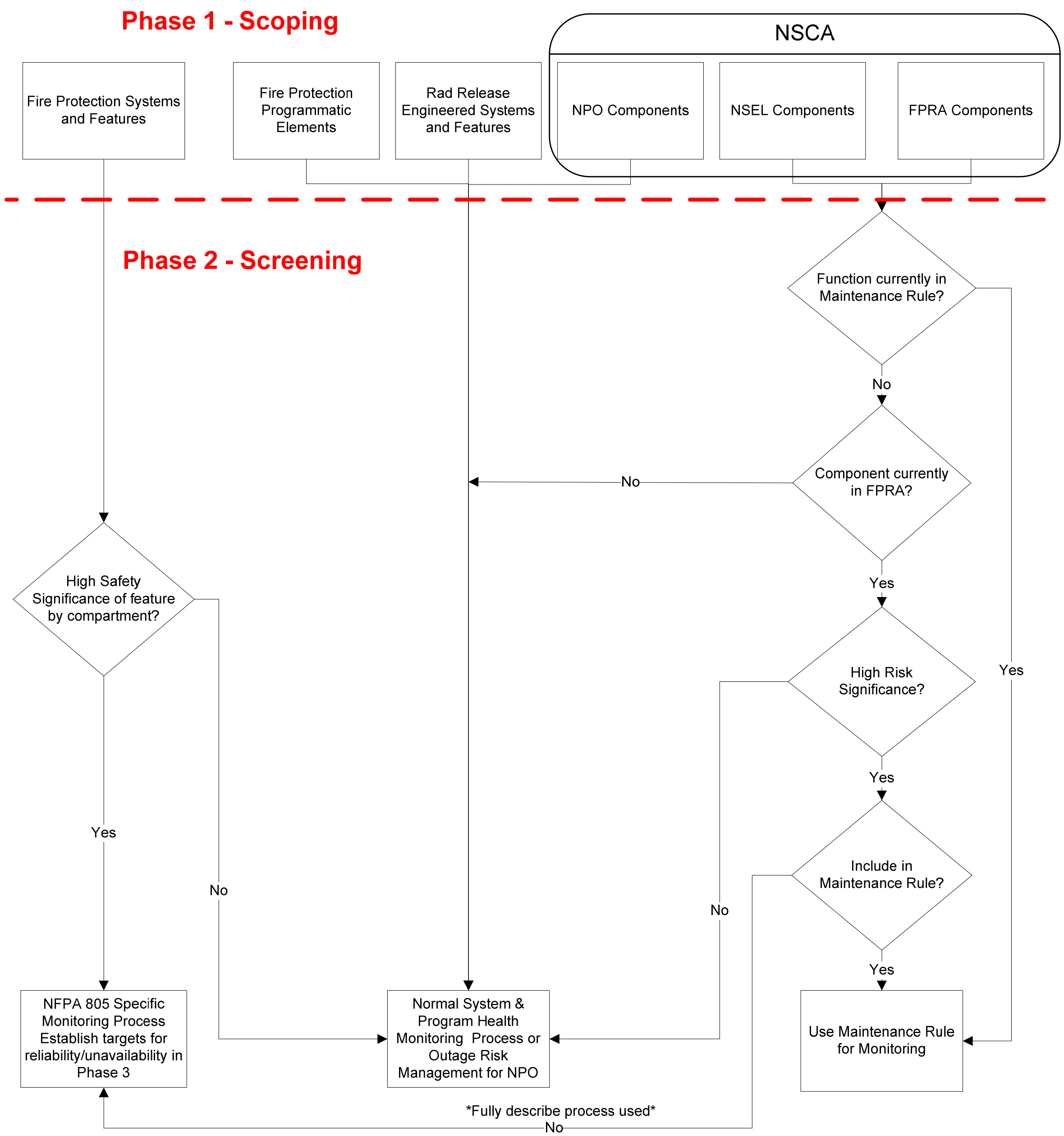

Figure 4-8 – NFPA 805 Monitoring – Scoping and Screening

Since the HSS SSCs have been identified using the Maintenance Rule guidelines, the associated SSC specific performance criteria will be established as in the Maintenance Rule, provided the criteria are consistent with Fire PRA assumptions. The actual action level is determined based on the number of component, program or functional failures within a sufficiently bounding time period (~2-3 operating cycles). Adverse trends and unacceptable levels of availability, reliability, and performance will be reviewed against established action levels. The Monitoring Program failure criteria and action level targets will be documented, as described in FAQ 10-0059.

4.7 Program Documentation, Configuration Control, and Quality Assurance

4.7.1 Compliance with Documentation Requirements in Section 2.7.1 of NFPA 805

In accordance with the requirements and guidance in NFPA 805 Section 2.7.1 and NEI 04-02, HBRSEP has documented analyses to support compliance with 10 CFR 50.48(c). The analyses are being performed in accordance with Duke Energy's processes for ensuring assumptions are clearly defined, that results are easily understood, that results are clearly and consistently described, and that sufficient detail is provided to allow future review of the entire analyses.

Analyses, as defined by NFPA 805 Section 2.4, performed to demonstrate compliance with 10 CFR 50.48(c) will be maintained for the life of the plant and organized to facilitate review for accuracy and adequacy. Note these analyses do not include items such as periodic tests, hot work permits, fire impairments, etc.

The Fire Protection Design Basis Document described in Section 2.7.1.2 of NFPA 805 and necessary supporting documentation described in Section 2.7.1.3 of NFPA 805 have been created as part of transition to 10 CFR 50.48(c) to ensure program implementation following receipt of the safety evaluation. Figure 4-9 shows the Planned Post-Transition Documents.

The Fire Protection licensing basis documents under NFPA 805 consist of the following:

- The Transition Report/LAR
- The NFPA 805 SE
- The Revised License Condition
- The revised (U)FSAR

The Fire Protection Program Design Basis Document (DBD) will contain or reference sub-tier documents that also form part of the fire protection program. The DBD's as described in NFPA 805 section 2.7.1.2, are the Fire Safety Analysis (FSA) calculations provided for each plant fire area. Also included, is the NFPA 805 Code Compliance Calculation which will maintain certain supporting elements of the LAR such as Tables B-1, B-2 and E-1. These and other supporting calculations are developed under fleet procedure EGR-NGGC-0017, Preparation and Control of Design Analyses and Calculations, and are maintained as design documents / controlled documents as described in the procedure.

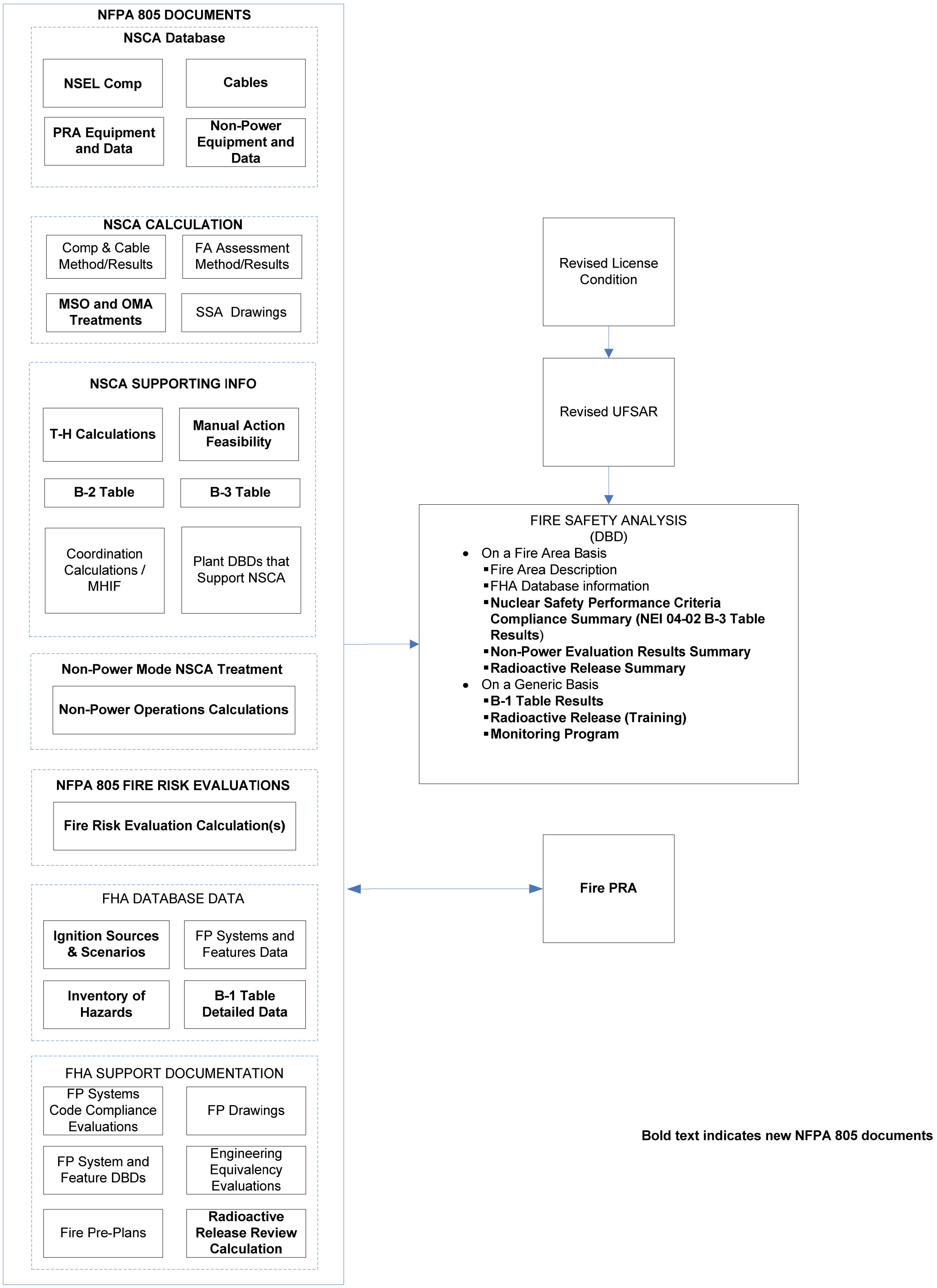

Figure 4-9 – NFPA 805 Planned Post-Transition Documents and Relationships

4.7.2 Compliance with Configuration Control Requirements in Section 2.7.2 and 2.2.9 of NFPA 805

Program documentation established, revised, or utilized in support of compliance with 10 CFR 50.48(c) is subject to Duke Energy configuration control processes that meet the requirements of Section 2.7.2 of NFPA 805. This includes the appropriate procedures and configuration control processes for ensuring that changes impacting the fire protection program are reviewed appropriately. The RI-PB post transition change process methodology is based upon the requirements of NFPA 805, and industry guidance in NEI 04-02, and RG 1.205. These requirements are summarized in Table 4-2.

Table 4-2 Change Evaluation Guidance Summary Table

Document	Section(s)	Topic
NFPA 805	2.2(h), 2.2.9, 2.4.4, A.2.2(h), A.2.4.4, D.5	Change Evaluation
NEI 04-02	5.3, Appendix B, Appendix I, Appendix J	Change Evaluation, Change Evaluation Forms (Appendix I)
RG 1.205	C.2.2.4, C.3.1, C.3.2, C.4.3	Risk Evaluation, Standard License Condition, Change Evaluation Process, Fire PRA

The Plant Change Evaluation Process consists of the following 4 steps and is depicted in Figure 4-10:

- Defining the Change
- Performing the Preliminary Risk Screening.
- Performing the Risk Evaluation
- Evaluating the Acceptance Criteria

Configuration control is and will be maintained going forward in accordance with existing procedures and processes which satisfy the NFPA 805 requirements. Procedure FIR-NGGC-0010, Fire Protection Program Impact Review, provides review of configuration, process, and procedure changes to ensure applicable requirements of NFPA 805 Fire Protection Program (Fundamental Elements, NSCA, NPO, Radioactive Release and FPRA) are maintained.

Change Definition

The Change Evaluation process begins by defining the change or altered condition to be examined and the baseline configuration as defined by the Design Basis and Licensing Basis (NFPA 805 Licensing Basis post-transition).

1. The baseline is defined as that plant condition or configuration that is consistent with the Design Basis and Licensing Basis (NFPA 805 Licensing Basis post-transition).
2. The changed or altered condition or configuration that is not consistent with the Design Basis and Licensing Basis is defined as the proposed alternative.

Preliminary Risk Review

Once the definition of the change is established, a screening is then performed to identify and resolve minor changes to the fire protection program. This screening is consistent with fire protection regulatory review processes in place at nuclear plants under traditional licensing bases. This screening process is modeled after the NEI 02-03 process. This process will address most administrative changes (e.g., changes to the combustible control program, organizational changes, etc.).

The characteristics of an acceptable screening process that meets the "assessment of the acceptability of risk" requirement of Section 2.4.4 of NFPA 805 are:

- The quality of the screen is sufficient to ensure that potentially greater than minimal risk increases receive detailed risk assessments appropriate to the level of risk.
- The screening process must be documented and be available for inspection by the NRC.
- The screening process does not pose undue evaluation or maintenance burden.

If any of the above is not met, proceed to the Risk Evaluation step.

Risk Evaluation

The screening is followed by engineering evaluations that may include fire modeling and risk assessment techniques. The results of these evaluations are then compared to the acceptance criteria. Changes that satisfy the acceptance criteria of NFPA 805 Section 2.4.4 and the license condition can be implemented within the framework provided by NFPA 805. Changes that do not satisfy the acceptance criteria cannot be implemented within this framework. The acceptance criteria require that the resultant change in CDF and LERF be consistent with the license condition. The acceptance criteria also include consideration of defense-in-depth and safety margin, which would typically be qualitative in nature.

The risk evaluation involves the application of fire modeling analyses and risk assessment techniques to obtain a measure of the changes in risk associated with the proposed change. In certain circumstances, an initial evaluation in the development of the risk assessment could be a simplified analysis using bounding assumptions provided the use of such assumptions does not unnecessarily challenge the acceptance criteria discussed below.

Acceptability Determination

The Change Evaluations are assessed for acceptability using the ΔCDF (change in core damage frequency) and ΔLERF (change in large early release frequency) criteria from the license condition. The proposed changes are also assessed to ensure they are consistent with the defense-in-depth philosophy and that sufficient safety margins were maintained.

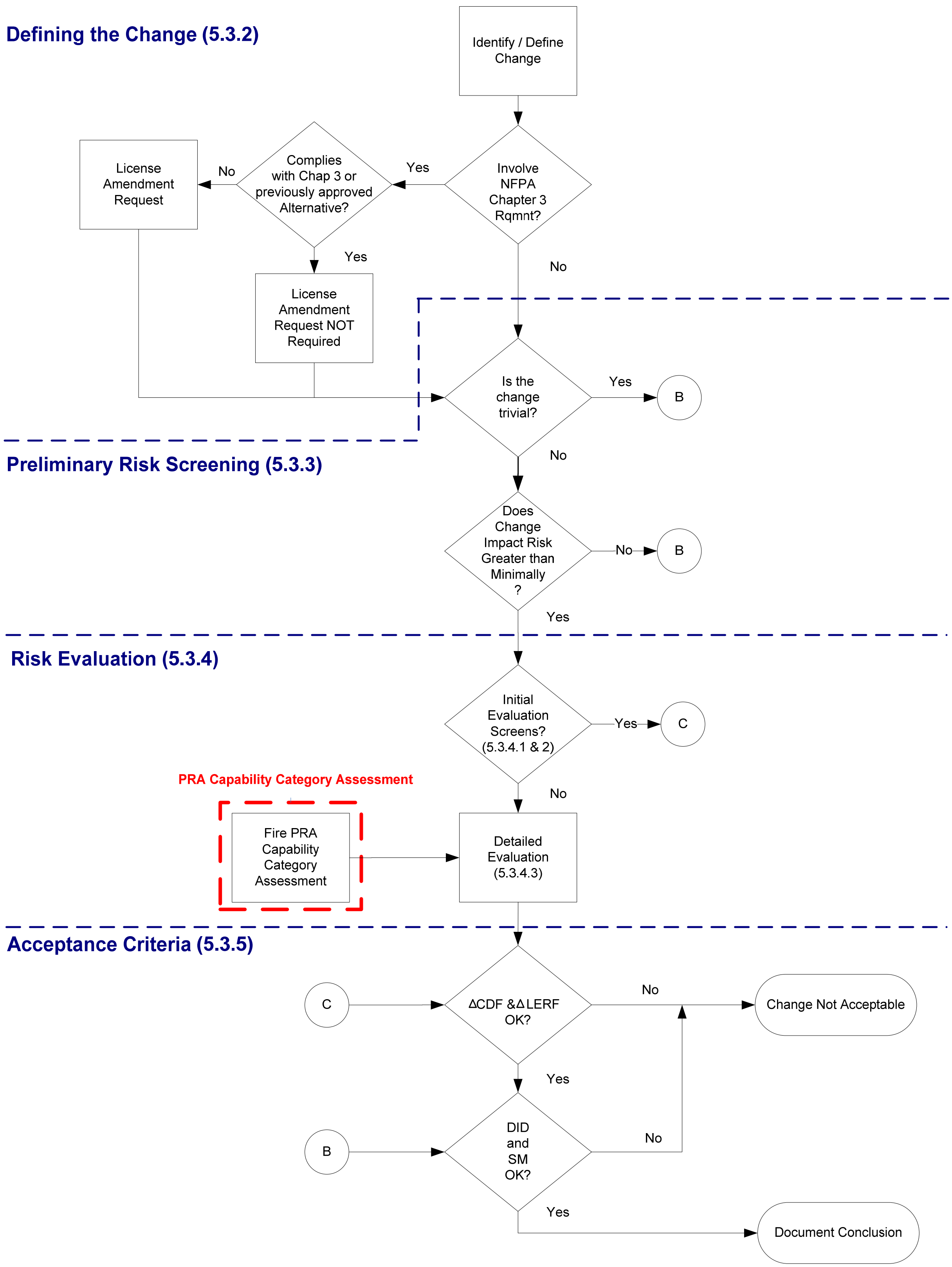

Figure 4-10 Plant Change Evaluation [NEI 04-02 Figure 5-1]
Note references in Figure refer to NEI 04-02 Sections

The HBRSEP Fire Protection Program configuration is defined by the program documentation. The existing configuration control processes for modifications, calculations and analyses, and Fire Protection Program License Basis Reviews will be utilized to maintain configuration control of the Fire Protection program documents. The configuration control procedures which govern the various HBRSEP documents and databases that currently exist will be revised to reflect the new NFPA 805 licensing bases requirements (Implementation Item in Attachment S).

Several NFPA 805 document types, such as NSCA Supporting Information, Non-Power Mode NSCA Treatment, generally require new control procedures and processes to be developed since they are new documents and databases created as a result of the transition to NFPA 805. The new procedures will be modeled after the existing processes for similar types of documents and databases. System level design basis documents will be revised to reflect the NFPA 805 role that the system components now play.

The process for capturing the impact of proposed changes to the plant on the Fire Protection Program will continue to be a multiple step review. The first step of the review is an initial screening for process users to determine if there is a potential to impact the Fire Protection program as defined under NFPA 805 through a series of screening questions/checklists contained in one or more procedures depending upon the configuration control process being used. Reviews that identify potential Fire Protection program impacts will be sent to qualified individuals (Fire Protection, Safe Shutdown/NSCA, Fire PRA) to ascertain the program impacts, if any. If Fire Protection program impacts are determined to exist as a result of the proposed change, the issue would be resolved by one of the following:

- Deterministic Approach: Comply with NFPA 805, Chapter 3 and 4.2.3 requirements
- Performance-Based Approach: Utilize the NFPA 805 change process developed in accordance with NEI 04-02, RG 1.205, and the NFPA 805 fire protection license condition to assess the acceptability of the proposed change. This process would be used to determine if the proposed change could be implemented "as-is" or whether prior NRC approval of the proposed change is required.

This process follows the requirements in NFPA 805 and the guidance outlined in RG 1.174, which requires the use of qualified individuals, procedures that require calculations be subject to independent review and verification, record retention, peer review, and a corrective action program that ensures appropriate actions are taken when errors are discovered. The plant documents that ensure these requirements are met are:

CAP-NGGC-0200 – Condition Identification and Screening Process
EGR-NGGC-0005 – Engineering Change
ESG0101N – Safe Shutdown Engineer (Post-NFPA 805 Transition)
ESG0102N – Fire Protection Plant Change Impact Review
ESG0103N – Circuit Analysis (Post-NFPA 805 Transition)

ESG0104N – Fire Protection Engineer (Post-NFPA 805 Transition)
ESG0105N – Basic Fire Modeling

4.7.3 Compliance with Quality Requirements in Section 2.7.3 of NFPA 805

Fire Protection Program Quality

Duke Energy will maintain the existing Fire Protection Quality Assurance program.

During the transition to 10 CFR 50.48(c), HBRSEP performed work in accordance with the quality requirements of Section 2.7.3 of NFPA 805.

Any future NFPA 805 analyses will be conducted in accordance with the Quality Requirements described in NFPA 805, section 2.7.3 under the design controls in place and required by the Fire Protection portions of the NGGM-PM-0007, Quality Assurance Program Manual.

Fire PRA Quality

Configuration control of the Fire PRA model will be maintained by integrating the Fire PRA model into the existing processes used to ensure configuration control of the internal events PRA model. This process complies with Section 1-5 of the ASME PRA Standard and ensures that Duke Energy maintains an as-built, as-operated PRA model of the plant. The process has been peer reviewed. Quality assurance of the Fire PRA is assured via the same processes applied to the internal events model.

This process follows the guidance outlined in RG 1.174, which requires the use of qualified individuals, procedures that require calculations be subject to independent review and verification, record retention, peer review, and a corrective action program that ensures appropriate actions are taken when errors are discovered. Although the entire scope of the formal 10 CFR 50, Appendix B program is not applied to the PRA models or processes in general, often parts of the program are applied as a convenient method of complying with the requirements of RG 1.174. For instance, the procedure which addresses independent review of calculations for 10 CFR 50, Appendix B, is applied to the PRA model calculations, as well.

With respect to Quality Assurance Program requirements for independent reviews of calculations and evaluations, those existing requirements for Fire Protection Program documents will remain unchanged. Duke Energy specifically requires that the calculations and evaluations in support of the NFPA 805 LAR, exclusive of the Fire PRA, be performed within the scope of the QA program which requires independent review as defined by plant procedures. As recommended by NUREG/CR-6850, the sources of uncertainty in the Fire PRA were identified and specific parameters were analyzed for sensitivity in support of the NFPA 805 Fire Risk Evaluation process.

Specifically with regard to uncertainty, an uncertainty and sensitivity matrix was developed and included with RNP-F/PSA-0094. In addition, sensitivity to uncertainty associated with specific Fire PRA parameters was quantitatively addressed in RNP-F/PSA-0095.

While the removal of conservatism inherent in the Fire PRA is a long-term goal, the Fire PRA results were deemed sufficient for evaluating the risk associated with this application. While Duke Energy continues to strive toward a more "realistic" estimate of

fire risk, use of mean values continues to be the best estimate of fire risk. During the Fire Risk Evaluation process, the uncertainty and sensitivity associated with specific Fire PRA parameters were considerations in the evaluation of the change in risk relative to the applicable acceptance thresholds.

Specific Requirements of NFPA 805 Section 2.7.3

The following discusses how the requirements of NFPA 805 Section 2.7.3 were met during the transition process. Post-transition, Duke Energy will perform work in accordance with NFPA 805 Section 2.7.3 requirements.

Reference plant procedures:

EGR-NGGC-0003 – Design Review Requirements

EGR-NGGC-0005 – Engineering Change

EGR-NGGC-0017 – Preparation and Control of Design Analyses and Calculations

Review and approval of corporate or fleet-wide procedures applied to HBRSEP and other Duke Energy Progress sites are controlled under PRO-NGGC-0204, Procedure Review and Approval. Site specific impact and technical reviews are completed under this process to ensure each individual plant's requirements and configurations are incorporated and maintained.

NFPA 805 Section 2.7.3.1 – Review

Analyses, calculations, and evaluations performed in support of compliance with 10 CFR 50.48(c) are performed in accordance with Duke Energy procedures that require independent review.

NFPA 805 Section 2.7.3.2 – Verification and Validation

Calculational models and numerical methods used in support of compliance with 10 CFR 50.48(c) were verified and validated as required by Section 2.7.3.2 of NFPA 805.

NFPA 805 Section 2.7.3.3 – Limitations of Use

Engineering methods and numerical models used in support of compliance with 10 CFR 50.48(c) were applied appropriately as required by Section 2.7.3.3 of NFPA 805.

NFPA 805 Section 2.7.3.4 – Qualification of Users

Cognizant personnel who use and apply engineering analysis and numerical methods in support of compliance with 10 CFR 50.48(c) are competent and experienced as required by Section 2.7.3.4 of NFPA 805.

During the transition to 10 CFR 50.48(c), work was performed in accordance with the quality requirements of Section 2.7.3 of NFPA 805. Personnel who used and applied engineering analysis and numerical methods (e.g. fire modeling) in support of compliance with 10 CFR 50.48(c) are competent and experienced as required by NFPA 805 Section 2.7.3.4.

Post-transition, for personnel performing fire modeling or Fire PRA development and evaluation, Duke Energy will develop and maintain qualification requirements for individuals assigned various tasks. Position Specific Guides will be developed to identify and document required training and mentoring to ensure individuals are appropriately qualified per the requirements of NFPA 805 Section 2.7.3.4 to perform assigned work. The following Training Guides have been developed and implemented.

ESG0089N - Fire Probabilistic Safety Assessment Engineer (Quantification),
ESG0093N - Fire Probabilistic Safety Assessment Engineer (Initial Development), and
ESG0094N - Fire Probabilistic Safety Assessment Engineer (Data Development), and
ESG0105N – Basic Fire Modeling

HBRSEP and NGG Fleet engineering personnel (design, programs and systems engineering) are provided training commensurate with the job responsibility through the INPO accredited Engineering Support Personnel (ESP) training program. This is provided in either ESP Continuing Training or Work Group Specific Continuing Training. Specific, qualification for performance of the FIR-NGGC-0010, *Fire Protection Program Change Process*, is documented using Training Guide (Qual. Card) ESG0102N, *Fire Protection Plant Change Impact Review*.

NFPA 805 Section 2.7.3.5 – Uncertainty Analysis

Uncertainty analyses were performed as required by 2.7.3.5 of NFPA 805 and the results were considered in the context of the application. This is of particular interest in fire modeling and Fire PRA development. Note: 10 CFR 50.48(c)(2)(iv) states that NFPA 805 Section 2.7.3.5 is not required for the deterministic approach because conservatism is included in the deterministic criteria.

4.8 Summary of Results

4.8.1 Results of the Fire Area Review

A summary of the NFPA 805 compliance basis and the required fire protection systems and features is provided in Attachment C. The table provides the following information from the NEI 04-02 Table B-3:

- Fire Area / Fire Zone: Fire Area/Zone Identifier.
- Description: Fire Area/Zone Description.
- NFPA 805 Regulatory Basis: Post-transition NFPA 805 Chapter 4 compliance basis
- Required Fire Protection System / Feature: Detection / suppression required in the Fire Area based on NFPA 805 Chapter 4 compliance. Other Required Features may include Electrical Raceway Fire Barrier Systems, fire barriers, etc. The documentation of required fire protection systems and features does not include the documentation of the fire area boundaries. Fire area boundaries are required and documentation of the fire area boundaries has been performed as part of reviews of engineering evaluations, licensing actions, or as part of the reviews of the NEI 04-02 Table B-1 process. The basis for the requirement of the fire protection system / feature is designated as follows:
  - S – Separation Criteria: Systems/Features required for Chapter 4 Separation Criteria in Section 4.2.3
  - E – EEEE/LA Criteria: Systems/Features required for acceptability of Existing Engineering Equivalency Evaluations / NRC approved Licensing Action (i.e., Exemptions/Deviations/Safety Evaluations) (Section 2.2.7)
  - R – Risk Criteria: Systems/Features required to meet the Risk Criteria for the Performance-Based Approach (Section 4.2.4)
  - D – Defense-in-depth Criteria: Systems/Features required to maintain adequate balance of Defense-in-Depth for a Performance-Based Approach (Section 4.2.4)

Attachment W contains the results of the Fire Risk Evaluations, additional risk of recovery actions, and the change in risk on a fire area basis.

4.8.2 Plant Modifications and Items to be Completed During the Implementation Phase

Planned modifications, studies, and evaluations to comply with NFPA 805 are described in Attachment S.

In Attachment S, three tables are listed. Table S-1 identifies completed Plant Modifications, Table S-2 identifies Plant Modifications required to be completed. Table S-3 identifies training, programs, personnel equipment, and document changes and upgrades required to be completed.

The Fire PRA model will represent the as-built, as-operated and maintained plant following completion of the risk related modifications identified in Attachment S. In the event the PRA model requires revision following completion of the modifications and

implementation items listed in Attachment S, the changes will be controlled through normal HBRSEP processes. These changes are not expected to be significant.

4.8.3 Supplemental Information –Other Licensee Specific Issues

4.8.3.1 Fire PRA Qualitative Review

The following methods and modeling aspects are qualitatively characterized as having a minimal impact or a conservative impact:

4.8.3.1.1 RCP Shutdown Seals

The HBRSEP FPRA applied credit for the installation of the Westinghouse Generation III SHIELD Shutdown Seal (SDS) in the Reactor Coolant Pumps as described in PWROG-14001, Rev. 1 An implementation item has been created in Attachment S to update the FPRA prior to self-approval to incorporate the NRC-accepted SDS failure model.

4.8.3.1.2 NSCA Power Supply Strategy

HBRSEP is changing the strategy used in a number of fire areas in the plant that were previously approved under the Appendix R licensing basis. The current strategy is to perform a fire incused load shed and recovery to limit operational uncertainties relative to circuit failure and spurious actuations. This strategy has been compared to what is often called self-induced station blackout (SISBO) in the industry. The strategy going forward is to use a symptom based operator response approach in response to fire events. The Attachment G recovery actions have been informed with the new strategy. The current fire PRA conservatively modeled the plant using the current load shed strategy. As part of program implementation, the operations procedures will be finalized and the Fire PRA updated. Therefore, there is a separate implementation item relative to this in Attachment S.

4.8.3.2 Fire PRA Sensitivity Analyses

The following methods and modeling aspects are quantitatively evaluated. Each sensitivity analysis modifies an applied fire PRA method and then recalculates total risk metrics from Attachment W in order to determine the impact of a given fire PRA method. The total plant risk and the total change in risk associated with the transition to NFPA 805 are reported for each sensitivity with the percentage change from the numbers reported in Attachment W.

4.8.3.2.1 FAQ 08-0048 Sensitivity Analysis

In order to use the updated fire bin ignition frequencies provided in Supplement 1 to NUREG/CR-6850, a sensitivity analysis must be performed comparing the impact of those bins characterized by an alpha from the EPRI TR-1016735 analysis that is less than or equal to 1. While the new point estimates for the bin ignition frequencies better represent the data, uncertainties are large and a sensitivity analysis using the old frequencies was required to assess the potential impact of using the new frequencies.

The sensitivity was simplified by replacing the select EPRI TR-1016735 ignition frequencies with values from NUREG/CR-6850. The results of the sensitivity for the EPRI ignition frequencies are provided below.

Table 4-3 - Ignition Frequency Sensitivity Delta CDF and Delta LERF Results

	∆CDF [/yr] (Change from baseline)[1]	∆LERF [/yr] (Change from baseline)[1]
Net Fire Risk Evaluation	6.9E-06 (+38%)	6.0E-07 (+30%)

Differences in percentages are due to rounding.
1. Baseline numbers are those presented in Attachment W, Table W-5.

Table 4-4 - Ignition Frequency Sensitivity Total CDF and LERF

	CDF [/yr] (Change from baseline)[1]	LERF [/yr] (Change from baseline)[1]
Internal Events plus External Flooding and High Winds	3.6E-06	8.8E-07
Fire	4.8E-05 (+66%)	6.0E-06 (+71%)
Total	5.2E-05 (+58%)	6.9E-06 (+57%)

Differences in percentages are due to rounding.
1. Baseline numbers are those presented in Attachment W, Table W-5.

4.8.3.2.2 Cable Spread Room Area Wide Incipient Detection Sensitivity Analysis

As permitted by Appendix P of NUREG/CR-6850 Volume 2 and draft NUREG-2180 guidance, the FPRA credits the use of air-aspirated incipient detection, also known as Very Early Warning Fire Detection Systems (VEWFDS) for area wide detection in the Unit 2 cable spread room. The fire PRA applies the credit outlines in the draft NUREG-2180 with a modification to the event tree allowing for credit of conventional detection and suppression systems, as they are independent of the success or failure of area-wide incipient detection. Plant procedures will be developed and implemented to ensure that VEWFDS alarms are promptly addressed with qualified plant personnel who will be present in the immediate area prior to fire growth, allowing for fire prevention or prompt fire response.

The area-wide incipient detector credit will be removed, leaving in place the existing conventional detection and suppression systems for this sensitivity analysis. The results of removing the area-wide VEWFDS and maintaining existing system credits are below.

Table 4-5 – Area Wide Incipient Detection Sensitivity Delta CDF and Delta LERF Results

	∆CDF [/yr] (Change from baseline)[1]	∆LERF [/yr] (Change from baseline)[1]
Net Fire Risk Evaluation	5.9E-06 (+18%)	5.7E-07 (+24%)

Differences in percentages are due to rounding.
1. Baseline numbers are those presented in Attachment W, Table W-5.

Table 4-6 – Area Wide Incipient Detection Sensitivity Total CDF and LERF Results

	CDF [/yr] (Change from baseline)[1]	LERF [/yr] (Change from baseline)[1]
Internal Events plus External Flooding and High Winds	3.6E-06	8.8E-07
Fire	3.1E-05 (+7%)	3.7E-06 (+6%)
Total	3.5E-05 (+6%)	4.6E-06 (+5%)

Differences in percentages are due to rounding.
1. Baseline numbers are those presented in Attachment W, Table W-5.

5.0 REGULATORY EVALUATION

5.1 Introduction – 10 CFR 50.48

On July 16, 2004 the NRC amended 10 CFR 50.48, Fire Protection, to add a new subsection, 10 CFR 50.48(c), which establishes alternative fire protection requirements. 10 CFR 50.48 endorses, with exceptions, NFPA 805, Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants – 2001 Edition (NFPA 805), as a voluntary alternative for demonstrating compliance with 10 CFR 50.48 Section (b), Appendix R, and Section (f), Decommissioning.

The voluntary adoption of 10 CFR 50.48(c) by HBRSEP does not eliminate the need to comply with 10 CFR 50.48(a) including the provision for nuclear plants licensed prior to 10 CFR 50, Appendix A, GDC 3, Fire Protection, becoming effective as is the case for HBRSEP[5]. The NRC addressed the overall adequacy of the regulations during the promulgation of 10 CFR 50.48(c) (Reference FR Notice 69 FR 33536 dated June 16, 2004, ML041340086).

> *"NFPA 805 does not supersede the requirements of GDC 3, 10 CFR 50.48(a), or 10 CFR 50.48(f). Those regulatory requirements continue to apply to licensees that adopt NFPA 805. However, under NFPA 805, the means by which GDC 3 or 10 CFR 50.48(a) requirements may be met is different than under 10 CFR 50.48(b). Specifically, whereas GDC 3 refers to SSCs important to safety, NFPA 805 identifies fire protection systems and features required to meet the Chapter 1 performance criteria through the methodology in Chapter 4 of NFPA 805. Also, under NFPA 805, the 10 CFR 50.48(a)(2)(iii) requirement to limit fire damage to SSCs important to safety so that the capability to safely shut down the plant is ensured is satisfied by meeting the performance criteria in Section 1.5.1 of NFPA 805. The Section 1.5.1 criteria include provisions for ensuring that reactivity control, inventory and pressure control, decay heat removal, vital auxiliaries, and process monitoring are achieved and maintained.*
>
> *This methodology specifies a process to identify the fire protection systems and features required to achieve the nuclear safety performance criteria in Section 1.5 of NFPA 805. Once a determination has been made that a fire protection system or feature is required to achieve the performance criteria of Section 1.5, its design and qualification must meet any applicable requirements of NFPA 805, Chapter 3. Having identified the required fire protection systems and features, the licensee selects either a deterministic or performance-based approach to*

[5] The General Design Criteria (GDC) in existence at the time HBRSEP was licensed (July, 1970) for operation were contained in Proposed Appendix A to 10CFR50, General Design Criteria for Nuclear Power Plants, published in the Federal Register on July 11, 1967. (Appendix A to 10CFR50, effective in 1971 and subsequently amended, is somewhat different from the proposed 1967 criteria.) HBRSEP was evaluated with respect to the proposed 1967 GDC and the original FSAR contained a discussion of the criteria as well as a summary of the criteria by groups.

demonstrate that the performance criteria are satisfied. This process satisfies the GDC 3 requirement to design and locate SSCs important to safety to minimize the probability and effects of fires and explosions." (Reference FR Notice 69 FR 33536 dated June 16, 2004, ML041340086)

The new rule provides actions that may be taken to establish compliance with 10 CFR 50.48(a), which requires each operating nuclear power plant to have a fire protection program plan that satisfies GDC 3, as well as specific requirements in that section. The transition process described in 10 CFR 50.48(c)(3)(ii) provides, in pertinent parts, that a licensee intending to adopt the new rule must, among other things, "modify the fire protection plan required by paragraph (a) of that section to reflect the licensee's decision to comply with NFPA 805." Therefore, to the extent that the contents of the existing fire protection program plan required by 10 CFR 50.48(a) are inconsistent with NFPA 805, the fire protection program plan must be modified to achieve compliance with the requirements in NFPA 805. All other requirements of 10 CFR 50.48 (a) and GDC 3 have corresponding requirements in NFPA 805.

A comparison of the current requirements in Appendix R with the comparable requirements in Section 3 of NFPA 805 shows that the two sets of requirements are consistent in many respects. This was further clarified in FAQ 07-0032, 10 CFR 50.48(a) and GDC 3 clarification (ML081400292). The following tables provide a cross reference of fire protection regulations associated with the post-transition HBRSEP fire protection program and applicable industry and HBRSEP documents that address the topic.

10 CFR 50.48(a)

Table 5-1 10 CFR 50.48(a) – Applicability/Compliance Reference

10 CFR 50.48(a) Section(s)		Applicability/Compliance Reference
(1)	Each holder of an operating license issued under this part or a combined license issued under part 52 of this chapter must have a fire protection plan that satisfies Criterion 3 of appendix A to this part. This fire protection plan must:	See below
	(i) Describe the overall fire protection program for the facility;	NFPA 805 Section 3.2 NEI 04-02 Table B-1
	(ii) Identify the various positions within the licensee's organization that are responsible for the program;	NFPA 805 Section 3.2.2 NEI 04-02 Table B-1
	(iii) State the authorities that are delegated to each of these positions to implement those responsibilities; and	NFPA 805 Section 3.2.2 NEI 04-02 Table B-1
	(iv) Outline the plans for fire protection, fire detection and suppression capability, and limitation of fire damage.	NFPA 805 Section 2.7 and Chapters 3 and 4 NEI 04-02 B-1 and B-3 Tables
(2)	The plan must also describe specific features necessary to implement the program described in paragraph (a)(1) of this section such as:	See below
	(i) Administrative controls and personnel requirements for fire prevention and manual fire suppression activities;	NFPA 805 Sections 3.3.1 and 3.4 NEI 04-02 Table B-1

Table 5-1 10 CFR 50.48(a) – Applicability/Compliance Reference

10 CFR 50.48(a) Section(s)	Applicability/Compliance Reference
(ii) Automatic and manually operated fire detection and suppression systems; and	NFPA 805 Sections 3.5 through 3.10 and Chapter 4 NEI 04-02 B-1 and B-3 Tables
(iii) The means to limit fire damage to structures, systems, or components important to safety so that the capability to shut down the plant safely is ensured.	NFPA 805 Section 3.3 and Chapter 4 NEI 04-02 B-3 Table
(3) The licensee shall retain the fire protection plan and each change to the plan as a record until the Commission terminates the reactor license. The licensee shall retain each superseded revision of the procedures for 3 years from the date it was superseded.	NFPA 805 Section 2.7.1.1 requires that documentation (Analyses, as defined by NFPA 805 Section 2.4, performed to demonstrate compliance with this standard) be maintained for the life of the plant. RDC-NGGC-0001
(4) Each applicant for a design approval, design certification, or manufacturing license under part 52 of this chapter must have a description and analysis of the fire protection design features for the standard plant necessary to demonstrate compliance with Criterion 3 of appendix A to this part.	Not applicable. HBRSEP is licensed under 10 CFR 50.

General Design Criterion 3

Table 5-2 GDC 3 – Applicability/Compliance Reference

GDC 3, Fire Protection, Statement	Applicability/Compliance Reference
Structures, systems, and components important to safety shall be designed and located to minimize, consistent with other safety requirements, the probability and effect of fires and explosions.	NFPA 805 Chapters 3 and 4 NEI 04-02 B-1 and B-3 Tables
Noncombustible and heat resistant materials shall be used wherever practical throughout the unit, particularly in locations such as the containment and control room.	NFPA 805 Sections 3.3.2, 3.3.3, 3.3.4, 3.11.4 NEI 04-02 B-1 Table
Fire detection and fighting systems of appropriate capacity and capability shall be provided and designed to minimize the adverse effects of fires on structures, systems, and components important to safety.	NFPA 805 Chapters 3 and 4 NEI 04-02 B-1 and B-3 Tables
Firefighting systems shall be designed to assure that their rupture or inadvertent operation does not significantly impair the safety capability of these structures, systems, and components	NFPA 805 Sections 3.4 through 3.10 and 4.2.1 NEI 04-02 Table B-3

10 CFR 50.48(c)

Table 5-3 10 CFR 50.48(c) – Applicability/Compliance Reference

	10 CFR 50.48(c) Section(s)	Applicability/Compliance Reference
(1)	*Approval of incorporation by reference.* National Fire Protection Association (NFPA) Standard 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants, 2001 Edition" (NFPA 805), which is referenced in this section, was approved for incorporation by reference by the Director of the Federal Register pursuant to 5 U.S.C. 552(a) and 1 CFR part 51.	General Information. NFPA 805 (2001 edition) is the edition used.
(2)	Exceptions, modifications, and supplementation of NFPA 805. As used in this section, references to NFPA 805 are to the 2001 Edition, with the following exceptions, modifications, and supplementation:	General Information. NFPA 805 (2001 edition) is the edition used.
	(i) *Life Safety Goal, Objectives, and Criteria.* The Life Safety Goal, Objectives, and Criteria of Chapter 1 are not endorsed.	The Life Safety Goal, Objectives, and Criteria of Chapter 1 of NFPA 805 are not part of the LAR.
	(ii) *Plant Damage/Business Interruption Goal, Objectives, and Criteria.* The Plant Damage/Business Interruption Goal, Objectives, and Criteria of Chapter 1 are not endorsed.	The Plant Damage/Business Interruption Goal, Objectives, and Criteria of Chapter 1 of NFPA 805 are not part of the LAR.
	(iii) *Use of feed-and-bleed.* In demonstrating compliance with the performance criteria of Sections 1.5.1(b) and (c), a high-pressure charging/injection pump coupled with the pressurizer power-operated relief valves (PORVs) as the sole fire-protected safe shutdown path for maintaining reactor coolant inventory, pressure control, and decay heat removal capability (i.e., feed-and-bleed) for pressurized-water reactors (PWRs) is not permitted.	Feed and bleed is not utilized as the sole fire-protected safe shutdown methodology.
	(iv) Uncertainty analysis. An uncertainty analysis performed in accordance with Section 2.7.3.5 is not required to support deterministic approach calculations.	Uncertainty analysis was not performed for deterministic methodology.
	(v) Existing cables. In lieu of installing cables meeting flame propagation tests as required by Section 3.3.5.3, a flame-retardant coating may be applied to the electric cables, or an automatic fixed fire suppression system may be installed to provide an equivalent level of protection. In addition, the italicized exception to Section 3.3.5.3 is not endorsed.	Electrical cable construction complies with a flame propagation test that was found acceptable to the NRC as documented in NEI 04-02 Table B-1.
	(vi) Water supply and distribution. The italicized exception to Section 3.6.4 is not endorsed. Licensees who wish to use the exception to Section 3.6.4 must submit a request for a license amendment in accordance with paragraph (c)(2)(vii) of this section.	HBRSEP complies as documented in Attachment A. See NEI 04-02 Table B-1.

Table 5-3 10 CFR 50.48(c) – Applicability/Compliance Reference

	10 CFR 50.48(c) Section(s)	Applicability/Compliance Reference
	(vii) Performance-based methods. Notwithstanding the prohibition in Section 3.1 against the use of performance-based methods, the fire protection program elements and minimum design requirements of Chapter 3 may be subject to the performance-based methods permitted elsewhere in the standard. Licensees who wish to use performance-based methods for these fire protection program elements and minimum design requirements shall submit a request in the form of an application for license amendment under § 50.90. The Director of the Office of Nuclear Reactor Regulation, or a designee of the Director, may approve the application if the Director or designee determines that the performance-based approach; (A) Satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release; (B) Maintains safety margins; and (C) Maintains fire protection defense-in-depth (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown capability).	The use of performance-based methods for NFPA 805 Chapter 3 is requested. See Attachment L.
(3)	*Compliance with NFPA 805.*	See below
	(i) A licensee may maintain a fire protection program that complies with NFPA 805 as an alternative to complying with paragraph (b) of this section for plants licensed to operate before January 1, 1979, or the fire protection license conditions for plants licensed to operate after January 1, 1979. The licensee shall submit a request to comply with NFPA 805 in the form of an application for license amendment under § 50.90. The application must identify any orders and license conditions that must be revised or superseded, and contain any necessary revisions to the plant's technical specifications and the bases thereof. The Director of the Office of Nuclear Reactor Regulation, or a designee of the Director, may approve the application if the Director or designee determines that the licensee has identified orders, license conditions, and the technical specifications that must be revised or superseded, and that any necessary revisions are adequate. Any approval by the Director or the designee must be in the form of a license amendment approving the use of NFPA 805 together with any necessary revisions to the technical specifications.	The LAR was submitted in accordance with 10 CFR 50.90. The LAR included applicable license conditions, orders, technical specifications/bases that needed to be revised and/or superseded.
	(ii) The licensee shall complete its implementation of the methodology in Chapter 2 of NFPA 805 (including all required evaluations and analyses) and, upon completion, modify the fire protection plan required by paragraph (a) of this section to reflect the licensee's decision to comply with NFPA 805, before changing its fire protection program or nuclear power plant as permitted by NFPA 805.	The LAR and transition report summarize the evaluations and analyses performed in accordance with Chapter 2 of NFPA 805.
(4)	Risk-informed or performance-based alternatives to compliance with NFPA 805. A licensee may submit a request to use risk-informed or performance-based alternatives to compliance with NFPA 805. The request must be in the form of an application for license amendment under § 50.90 of this chapter. The Director of the Office of Nuclear Reactor Regulation, or designee of the Director, may approve the application if the Director or designee determines that the proposed alternatives: (i) Satisfy the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release; (ii) Maintain safety margins; and (iii) Maintain fire protection defense-in-depth (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown capability).	No risk-informed or performance-based alternatives to compliance with NFPA 805 (per 10 CFR 50.48(c)(4)) were utilized. See Attachment P.

5.2 Regulatory Topics

5.2.1 License Condition Changes

The current HBRSEP fire protection license condition 3.E is being replaced with the standard license condition based upon Regulatory Position 3.1 of RG 1.205, as shown in Attachment M.

5.2.2 Technical Specifications

HBRSEP conducted a review of the Technical Specifications to determine which Technical Specifications are required to be revised, deleted, or superseded. HBRSEP determined that the changes to the Technical Specifications and applicable justification listed in Attachment N are adequate for the HBRSEP adoption of the new fire protection licensing basis.

5.2.3 Orders and Exemptions

A review was conducted of the HBRSEP docketed correspondence to determine if there were any orders or exemptions that needed to be superseded or revised. A review was also performed to ensure that compliance with the physical protection requirements, security orders, and adherence to those commitments applicable to the plant are maintained. A discussion of affected orders and exemptions is included in Attachment O.

5.3 Regulatory Evaluations

5.3.1 No Significant Hazards Consideration

A written evaluation of the significant hazards consideration of a proposed license amendment is required by 10 CFR 50.92. According to 10 CFR 50.92, a proposed amendment to an operating license involves no significant hazards consideration if operation of the facility in accordance with the proposed amendment would not:

- Involve a significant increase in the probability or consequences of an accident previously evaluated; or
- Create the possibility of a new or different kind of accident from any accident previously evaluated; or
- Involve a significant reduction in a margin of safety.

This evaluation is contained in Attachment Q.

Based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public. HBRSEP has evaluated the proposed amendment and determined that it involves no significant hazards consideration.

5.3.2 Environmental Consideration

Pursuant to 10 CFR 51.22(b), an evaluation of the LAR has been performed to determine whether it meets the criteria for categorical exclusion set forth in 10 CFR 51.22(c). That evaluation is discussed in Attachment R. The evaluation confirms that this LAR meets the criteria set forth in 10 CFR 51.22(c)(9) for categorical exclusion from the need for an environmental impact assessment or statement.

5.4 Revision to the UFSAR

After the approval of the LAR, in accordance with 10 CFR 50.71(e), the HBRSEP UFSAR will be revised. The format and content will be consistent with NEI 04-02 FAQ 12-0062. This will occur during the implementation phase. Changes to the UFSAR are controlled under procedure REG-NGGC-0101, Final Safety Analysis Report Revisions.

5.5 Transition Implementation Schedule

The following schedule for transitioning HBRSEP to the new fire protection licensing basis requires NRC approval of the LAR in accordance with the following schedule:

Implementation of new NFPA 805 fire protection program includes procedure changes, process updates, and training to affected plant personnel. This will occur 12 months after NRC approval. This implementation window is being driven by a planned refueling outage and the availability to schedule operator training to support transition.

Modifications will be completed by the startup of the third refueling outage after issuance of the Safety Evaluation (SE), this is Refueling outage 32, currently scheduled for September/October 2020. Appropriate compensatory measures will be maintained until modifications are complete.

6.0 REFERENCES

The following references were used in the development of the TR. Additional references are in the NEI 04-02 Tables in the various Attachments.

Industry References

1. NUREG/CR-6850, “EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities Volume 2 Detailed Methodology,” EPRI 1008239 Final Report, NUREG/CR-6850 / EPRI 1023259, Nuclear Regulatory Commission, Rockville, MD, September, 2005.
2. NUREG/CR-6850 Supplement 1, “Fire Probabilistic Risk Assessment Methods Enhancements,” EPRI 1019259, Technical Report, NUREG/CR-6850 Supplement 1, Nuclear Regulatory Commission, Rockville, MD, September, 2010.
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10. NEI 04-06, Guidance for Self-Assessment of Circuit Failures
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26. EPRI Technical Report TR-1006756, EPRI Fire Protection Equipment Surveillance Optimization and Maintenance Guide

Plant Specific References

1. AOP-014, Loss of CCW
2. AOP-022, Loss of Service Water
3. AOP-041, Response to Fire Event
4. CAP-NGGC-0200, Condition Identification and Screening Process
5. DSP-001, Alternate Shutdown Diagnostic
6. DSP-002, Hot Shutdown Using the Dedicated/Alternate Shutdown System
7. EDMG-001, Extreme Damage Event Early Actions
8. EDMG-002, Refueling Water Storage Tank (RWST)
9. EDMG-003, Condensate Storage Tank (CST)
10. EDMG-005, Containment Vessel (CV)
11. EDMG-011, Spent Fuel Pit Casualty
12. EDMG-012, Core Cooling Using Alternate Water Source
13. EDMG-013, Airborne Release Scrubbing
14. EGR-NGGC-0003, Design Review Requirements
15. EGR-NGGC-0005, Engineering Change
16. EGR-NGGC-0010, System & Component Trending Program and System Notebooks
17. EGR-NGGC-0017, Preparation and Control of Design Analyses and Calculations
18. EPP-001, Loss of All AC Power
19. FIR-NGGC-0009, NFPA 805 Transient Combustibles and Ignition Source Controls Program
20. FIR-NGGC-0010, Fire Protection Program Change Process
21. FIR-NGGC-0101, Fire Protection Nuclear Safety Capability Assessment (NSCA)

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23. HBR2-0B060, Electrical Installation Practices, Notes and Details
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25. NED-M/MECH-1006, Generic Fire Modeling Treatments
26. NED-M/MECH-1007, Radiant Energy Target Damage Profile
27. NED-M/MECH-1008, Fire Zone of Influence Calculation
28. NED-M/MECH-1009, Thermal Damage Time of Cables Above a Burning Ignition Source
29. OMA-NGGC-0203, Shutdown Risk Management
30. OMM-002, Fire Protection Manual
31. OMM-003, Fire Protection Pre-Plan
32. OMM-033, Implementation of CV Closure
33. OMP-003, Shutdown Safety Function Guidelines
34. PRO-NGGC-0204, Procedure Review and Approval
35. RDC-NGGC-0001, NGG Standard Records Management Program
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37. Report Number 0004-0042-412-002, Evaluation of Main Control Room Abandonment Times at the H.B. Robinson Nuclear Plant
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39. Report Number P2217-1021-01-01, Robinson Fire PRA Quantification Calculation
40. Report Number P2217-1021-01-03
41. RNP-E/ELEC-1216, The Fire Safe Shutdown Analysis for H.B. Robinson Nuclear Plant
42. RNP-E/ELEC-1217, Non-Power Operations
43. RNP-F/PSA-0006, RNP Initiating Events Assessment
44. RNP-F/PSA-0014, Post Initiator Human Reliability Analysis
45. RNP-F/PSA-0018, PSA Model Appendix A – System Notebooks
46. RNP-F/PSA-0043, RNP PRA – Accident Sequence Notebook
47. RNP-F/PSA-0066, RNP Fire PRA Component Selection
48. RNP-F/PSA-0067, RPN Fire PRA Plant Partitioning and Ignition Frequency
49. RNP-F/PSA-0074, RNP Uncertainty Analysis
50. RNP-F/PSA-0077, RNP Quantification Calculation

51. RNP-F/PSA-0094, RNP Fire PSA Quantification
52. RNP-F/PSA-0095, RNP Fire PRA – NFPA 805 Transition Support
53. RNP-M/MECH-1826, Hot Gas Layer Calculation
54. RNP-M/MECH-1884, Verfication and Validation of Fire Models Supporting the Robinson Nuclear Plant (RNP) Fire PRA
55. SAM-1, Inject into the Steam Generator
56. SAM-3, Inject into the RCS
57. SAM-4, Inject into Containment
58. SAM-6, Control Containment Conditions
59. SAM-8, Flood Containment

Table B-1 NFPA 805 Ch.3 Transition Details

Chapter 3 Reference: 3.3.4 Insulation Materials

Chapter 3 Requirement: 3.3.4 Insulation Materials.
Thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials shall be noncombustible or limited combustible.

Compliance Statement	Compliance Basis
License Amendment Required	NRC approval is being requested in Attachment L.

Reference Document	Doc Details
UFSAR,HBR 2 Updated Final Safety Analysis Report (FSAR)	Appendix 9.5.1.B-6
CPL-HBR2-M-025,Heating, Ventilation, and Air Conditioning (HVAC) Main Plant Fabrication and Installation	Section II-2.01
CPL-HBR2-M-028,Specification for RHR Pump Pit to HVE-5 Exhaust Tie-In Fabrication and Installation	Section II-2.01
L2-M-039,Piping and Equpment Thermal Insulation	Section 4.4.1.4
GID/87038-0014,Fire Barrier System	ALL

Table B-1 NFPA 805 Ch.3 Transition Details

Chapter 3 Reference: 3.3.5 Electrical.

Chapter 3 Requirement: N/A

Compliance Statement	Compliance Basis
N/A	N/A - General statement; No technical requirements.

Table B-1 NFPA 805 Ch.3 Transition Details

Chapter 3 Reference: 3.3.5.1 [Electrical Wiring Above Suspended Ceiling Limitations]

Chapter 3 Requirement: 3.3.5.1
Wiring above suspended ceiling shall be kept to a minimum. Where installed, electrical wiring shall be listed for plenum use, routed in armored cable, routed in metallic conduit, or routed in cable trays with solid metal top and bottom covers.

I. Definition of Power Block

1 Pages Attached

The structures in the Owner Controlled Area were evaluated to determine those structures that contain equipment that is required to meet the nuclear safety performance criteria and radioactive release performance criteria described in Section 1.5 of NFPA 805.

For the purposes of establishing the structures included in the Fire Protection program in accordance with 10 CFR 50.48(c) and NFPA 805, plant structures listed in the following table are considered to be part of the power block.

Table I-1 – Power Block Definition

Power Block Structures	Fire Areas	Notes
Auxiliary Building	A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A13, A14, A15, A16, A17, A19, B, C, D, E, G4	Includes Waste evaporator area
Control Room	A18	Includes Hagan Room
Containment Building	F	
Turbine Building	G1	Includes the Dedicated Shutdown Transformer, Main and Auxiliary Start-Up Transformer Yard, Refueling Water Storage Tank, Primary Water Storage Tank, Condensate Storage Tank
Diesel Fuel Oil Storage Tank	G2	
Intake Structure	G3	
Fuel Handling Building	G4	Includes the Cask Preparation Area, Hot Machine Shop and Fuel Building, Radwaste Building, Purge inlet valve room,
115kV and 230kV Switchyards	G5	Includes Unit 1 and 2 Switchyard
Dedicated Shutdown Diesel Generator Enclosure	G7	
Residual Heat Removal Pump Room	H	
YARD	YARD	Secondary Sampling Building, Nitrogen Storage and "C" Auxiliary Boiler, Condensate Polishing Building, Deepwell Pump "A" Area South of Unit 1 Service Building, Deepwell Pump "C" area North side of O&M Building, and the Deepwell Pump "D" Enclosure, Diesel Fuel Oil Unloading/Transfer Area

The Independent Spent Fuel Storage Installation Area was considered for Radioactive Release fire fighting activities. This area is not included in the NFPA 805 definition of power block or any analysis because it is licensed under 10 CFR Part 72.

J. Fire Modeling V&V

23 Pages Attached

INTRODUCTION

This attachment documents the verification and validation (V&V) of the fire models as applied to the Robinson Fire PRA following the guidance documented in NUREG-1824, and NUREG-1934. These documents are relatively recent joint publications by the US NRC and the Electric Power Research Institute intended to provide guidance on how to conduct and document fire modeling studies, as well as develop the necessary V&V material for supporting these studies.

The analysis summarized in this appendix is based on the technical material documented in RNP-M/MECH-1884, Verification and Validation of Fire Models Supporting the Robinson Nuclear Plant (HBRSEP) Fire PRA. The summary covers all the fire models and the fire modeling applications within the Robinson Nuclear Plant Fire PRA as documented in the different calculations prepared for those purposes during the development of the Fire PRA. Each of the models used in the different calculations is identified and a V&V discussion is provided. The report also includes a summary table listing the fire models with the corresponding V&V results.

SCOPE

The scope of this study includes the V&V of fire models based on the guidance available in NUREG-1824 and NUREG-1934 as applied in the HBRSEP Fire PRA. The following subsections list and describe the HBRSEP fire modeling calculations within the scope of the V&V study.

Zone Models (CFAST)

The computer model CFAST, is used in the main control room abandonment study documented in Report 0004-0042-412-002, Rev. 1, “Evaluation of Control Room Abandonment Times at the H. B. Robinson Nuclear Plant” and to document hot gas layer conditions in Fire Zone 20 in Report 0004-0042-000-001, Rev. 1, “Evaluation of the Development and Timing of Hot Gas Layer Conditions in HBRSEP Fire Zone 20”, respectively. The V&V for CFAST in the HBRSEP main control room abandonment study and in the Fire Zone 20 hot gas layer calculation is included in the respective report and is summarized in this document for completeness purposes.

Engineering Calculations (Hand Calculations)

The HBRSEP Fire PRA is characterized by a number of engineering (i.e., hand calculations) used throughout the analysis for various purposes. The following subsections provide a brief description of these calculations.

Hot Gas Layer Calculations

The report RNP-M/MECH-1826, Rev. 1, "Hot Gas Layer Calculation", documents the approach for determining the damage time for cables immersed in a hot gas layer. The hand calculations used for this analysis are the MHQ room temperature correlation for rooms assuming an open door (NUREG-1805, Chapter 2.1) and the Beyler room temperature correlation for closed doors room (NUREG-1805, Chapter 2.3). The document also includes an analysis for screening multi compartment combinations. In general, hot gas layer temperatures are calculated for selected fire zones. If the hot gas

layer temperature is calculated to be lower than the damage thresholds for cables, the multi compartment scenario is screened.

Cable Tray Fire Propagation

NED-M/MECH-1009, Rev. 0, "Thermal Damage Time of Cables Above a Burning Ignition Source". This calculation describes the approach for determining the time to damage or ignition of the closest cable tray or conduit to an ignition source and subjected to fire plume conditions. The calculation produces a “look up” table for damage or ignition times that are used in the quantification process for calculating non suppression probabilities. The fire model within the scope of this validation and verification study is the Heskestad Plume Temperature Correlation documented in Chapter 9 of NUREG-1805.

ZOI Calculations

The ZOI calculations in the HBRSEP Fire PRA are based on hand calculations. These calculations are documented in the following reports:

- NED-M/MECH-1008, "Fire Zone of Influence Calculation". The goal of this calculation is to calculate ZOI values for various fire sizes that are conservative, encompass a broad set of fuel packages, and integrate more effectively with the scoping fire modeling process. The fire models within the scope of this V&V study are the Heskestad Plume Temperature Correlation documented in Chapter 9 of NUREG-1805 and the solid flame radiation model documented in Section 5.2 of NUREG-1805.
- NED-M/MECH-1007, "Radiant Energy Target Damage Profile": The purpose of this document is to provide a refinement of the radiant energy ZOI calculation used for identification of transients from electrical cabinet fires. The fire models within the scope of this V&V and the solid flame radiation model documented in Section 5.2 of NUREG-1805.
- NED-M/MECH-1006, "Generic Fire Modeling Treatments": The generic treatments document offers a set of pre-defined ZOI calculations. A number of fire models are subjected to V&V. These models are listed in Table J-1.
- RNP-0206, “Analysis of Oil Fires for Compressors in the Lower Hallway (Fire Zone 7)”. This report calculates damage that may occur in the vicinity of equipment (i.e., compressors) due to radiant affects and due to plume affects after an oil spill fire scenario. The report evaluates the fire size and determines whether resulting damage to cables and components takes place. The fire ZOI is determined using methods and tools provided by NUREG-1805, Fire Dynamics Tools.
- P2217-2300-01-03, Rev 3, “Robinson Fire PRA Exposed Structural Steel-Fire Interaction Analysis”. This report analyzes the potential risk for structural damage due to a high hazard fire affecting the integrity of exposed structural steel. If a high hazard fire source was identified, it was determined if the fire source was located within the ZOI, where exposed steel could be damaged by the plume or by flame radiation. The Heskestad Plume Temperature Correlation

documented in Chapter 9 of NUREG 1805 and the point source radiation model documented in Chapter 5 of NUREG 1805.

REFERENCES

This section lists the references utilized in this report to perform the fire model V&V. References are classified as "Industry" and "plant specific".

Industry References

1. NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities Volume 2 Detailed Methodology," EPRI 1008239 Final Report, NUREG/CR-6850 / EPRI 1023259, Nuclear Regulatory Commission, Rockville, MD, September, 2005.
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11. Hughes Associates, “Generic Fire Modeling Treatments,” Project Number 1SPH02902.030, Revision 0, January 15, 2008.

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17. SFPE Handbook of Fire Protection Engineering, Section 3–1, “Heat Release Rates,” Babrauskas, V., The SFPE Handbook of Fire Protection Engineering, 4th Edition, P. J. DiNenno, Editor-in-Chief, National Fire Protection Association, Quincy, MA, 2008.

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19. ASME/ANS Ra-Sa-2009, Addenda to ASME/ANS Ra-Sa-2008, Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications, American Society of Mechanical Engineers/American Nuclear Society, New York,

20. NUREG-1824, Volume 5, “Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications Volume 5: Consolidated Fire Growth and Transport Model”, NUREG-1824 / EPRI 1011999, Salley, M. H. and Kassawara, R. P., NUREG-1824, Final Report, U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D. C., May, 2007.

Plant Specific References

1. RNP-M/MECH-1826, "Hot Gas Layer Calculation".
2. NED-M/MECH-1008, "Fire Zone of Influence Calculation".
3. NED-M/MECH-1009, "Thermal Damage Time of Cables Above a Burning Ignition Source".
4. NED-M/MECH-1006, "Generic Fire Modeling Treatments".
5. NED-M/MECH-1007, "Radiant Energy Target Damage Profile".
6. Report Number 0004-0042-412-002, "Evaluation of Main Control Room Abandonment Times at the H.B. Robinson Nuclear Plant".
7. Report Number 0004-0042-000-001, "Evaluation of the Development and Timing of Hot Gas Layer Conditions in RNP Fire Zone 20".
8. RNP-0206, Analysis of Oil Fires for Compressors in the Lower Hallway (Fire Zone 7).
9. Report Number P2217-2300-01-03, Rev 3, "Robinson Fire PRA Exposed Structural Steel-Fire Interaction Analysis".
10. RNP-M/MECH-1884, Rev. 1, "Verification and Validation of Fire Models Supporting the Robinson Nuclear Plant (RNP) Fire PRA"

VERIFICATION AND VALIDATION

This section includes Table J-1 and Table J-2, which present a summary of the fire models with the corresponding V&V results. Specifically, Table J-1 summarizes the verification and validation results for the different fire modeling calculations listed earlier under the scope section. Table J-2 is specifically devoted to discussing the validation for the fire models used in the generic fire modeling treatment document. The technical material supporting the summary presented in these tables is documented in RNP-M/MECH-1884, Verification and Validation of Fire Models Supporting the Robinson Nuclear Plant (HBRSEP) Fire PRA.

Table J-1: Summary of V & V Results for Fire Models in Specific HBRSEP Fire PRA Applications

Calculation	Report Section	Application	Fire Models	Verification	Validation
NED-M/MECH-1008, Fire ZOI Calculations	5.1	Use of U.S. Nuclear Regulatory Commission (NRC) Fire Dynamics Tools (FDT[s]) [NUREG-1805.0] to determine the ZOI of a fire scenario in support of scenario development for the HBRSEP Fire PRA	Heskestad Plume Temperature Correlation documented in Chapter 9 of NUREG-1805. Solid flame radiation model documented in Section 5.2 of NUREG-1805.	The verification of the models used in support of calculation NED-M/MECH-1008, is provided in NUREG-1805, which contains pre-programmed Microsoft Excel Spreadsheets. The spreadsheets from NUREG 1805 are used directly in NED-M/MECH-1008, (Attachment 1) and therefore additional verification is not needed.	The ZOI calculations for the Fire Froude number present a few “out of range” results. All of the “out of range” cases are due to calculations exceeding the upper limit of the range, suggesting high intensity fires for the selected fire diameter. One reason for exceeding the upper limit is the use of the 98th percentile heat release rates for the corresponding fire diameters. Based on the guidance in Chapter 8 of NUREG, 98th percentile heat release rate values are used for screening and can be considered on the high end of the values assigned to ignition sources. In addition, setting the Froude number calculation to the upper range limit of 2.4 for the 98th percentile heat release rate values would result in a larger diameter. With a larger diameter, the flame height calculation would result in shorter flame lengths, and plume temperature calculations would suggest lower temperatures. The “out of range” results are based on conservative ZOI calculations for the Fire PRA. Parameters are ”in range” for the fire plume application. Parameters are “out of range” for the use of the solid flame radiation model. The reason for number of ZOI results are “out of range” is because the ZOI distances are close to the flames and the experiments selected for validation purposes measured radiation at longer distances from the flames. This is a limitation on the available data for validation and not necessarily a

Table J-1: Summary of V & V Results for Fire Models in Specific HBRSEP Fire PRA Applications

Calculation	Report Section	Application	Fire Models	Verification	Validation
					limitation on the use of the solid flame radiation model for calculating horizontal components of the ZOI for Fire PRA applications. To account for this limitation, it is noted that validation results from Figure 6-8 in Volume 3 of NUREG-1824 suggest significant heat flux over predictions over the intensity levels used for ZOI calculations (i.e., between 6 and 11 kW/m^2) that would result in longer, and therefore conservative, horizontal distances.
RNP-0206, Analysis of Oil Fires for Compressors in the Lower Hallway (Fire Zone 7)	5.2	Use of U.S. Nuclear Regulatory Commission (NRC) Fire Dynamics Tools (FDT^s) [NUREG-1805.0] to determine a fire ZOI for two pieces of equipment, the Station Air Compressor Motor, and the Instrument Air Compressor “B” for unconfined and confined fire scenarios.	Heskestad Plume Temperature Correlation documented in Chapter 9 of NUREG-1805. Solid flame radiation model documented in Section 5.2 of NUREG-1805.	The verification of the models used in support of calculation NED-M/MECH-1008, is provided in NUREG-1805, which contains pre-programmed Microsoft Excel Spreadsheets. The spreadsheets from NUREG-1805 are used directly in NED-M/MECH-1008, (Attachment 1) and therefore additional verification is not needed.	The Fire Froude Number for all the cases in the vertical ZOI calculations are within the validation range, indicating the heat release rates relative to the fire diameters for the scenarios described by calculation RNP-0206, are within the scope of NUREG-1824. With regards to the flame length ratio dimensionless parameter, the majority of the unconfined cases are above the valid range, an indication that the flame height exceeds the distance of the target above the fire for both compressors. These are conservative calculations for the Fire PRA given that the thermoplastic cables would be in direct contact with the flame and could ignite. That is if even with the “out of range results” the cables are set to fail in the fire PRA quantification The confined fire scenario calculation for both compressors results in Fire Froude number and a flame length ratio within the validation ranges included in NUREG-1824. The Fire Froude numbers calculated for

Table J-1: Summary of V & V Results for Fire Models in Specific HBRSEP Fire PRA Applications

Calculation	Report Section	Application	Fire Models	Verification	Validation
					both the unconfined and confined cases for the horizontal ZOI are within the validation range reported by NUREG-1824. Most of the radial distance ratio parameters for unconfined fire scenarios are below the valid range for this parameter, indicating that the ZOI for these fire scenarios is characterized by distances close to the flames. These calculations were conducted with the solid flame radiation model described in Chapter 5.2 of NUREG-1805. A review of Figure 6-8 in Volume 3 of NUREG-1824 suggests that the majority of the validation results (with a few exceptions for Cable G in radiation ranges larger than the 6 and 11 kW/m^2 for ZOI calculations) over predict flame radiation, which result in longer horizontal distances for the ZOI. This is a limitation on the available data for validation and not necessarily a limitation on the use of the solid flame radiation model for calculating horizontal components of the ZOI for Fire PRA applications. The confined fire scenario calculation for both compressors for fire scenarios 2 and 3 results in a Fire Froude number and a radial distance ratio parameter within the validation ranges included in the NUREG-1824
NED-M/MECH-1009, Thermal Damage Time of Cables Above a Burning	5.3	Calculation NED-M/MECH-1009, determines the time at which damage occurs to cables suspended	Heskestad Plume Temperature Correlation documented in	The Calculation NED-M/MECH-1009, was developed under a QA program. During the design verification review, an	Several Fire Froude Numbers fall "out of range" either under or over the valid range. All of the "out of range" cases exceeding the upper limit of the range, suggest high intensity fires for the

Table J-1: Summary of V & V Results for Fire Models in Specific HBRSEP Fire PRA Applications

Calculation	Report Section	Application	Fire Models	Verification	Validation
Ignition Source		over a burning electrical cabinet.	Chapter 9 of NUREG-1805	independent check of the quantitative results was performed, therefore, results were found to be consistent and the calculations included in the report have been verified.	selected fire diameter. One reason for exceeding the upper limit is the use of the 98th percentile heat release rates for the corresponding fire diameters. Based on the guidance in Chapter 8 of NUREG, 98th percentile heat release rate values are used for screening and can be considered on the high end of the values assigned to ignition sources. In addition, setting the Froude number calculation to the upper range limit of 2.4 for the 98th percentile heat release rate values would result in a larger diameter. With a larger diameter, the flame height calculation would result in shorter flame lengths, and plume temperature calculations would suggest lower temperatures. The "out of range" results are based on conservative ZOI calculations for the Fire PRA. Cases where the Fire Froude Number results below the validation range indicate low intensity fires where the fire HRR is low compared to the pool fire area. This occurs for the lowest three HRR cases included in the calculation (i.e., 69, 143 and 211 kW) at different fire diameters. These are cases where the thermal plume that is expected from the ignition source fire could be wider than the range evaluated in NUREG-1824. A wider thermal plume will have a greater entrainment rate than one associated with a similar heat release rate fire that has a smaller diameter. This means that the conditions relative to a source fire that falls within the validation range will be less severe in terms of temperature.

Table J-1: Summary of V & V Results for Fire Models in Specific HBRSEP Fire PRA Applications

Calculation	Report Section	Application	Fire Models	Verification	Validation
					These are cases where damage to the target occurs most likely due to direct flame impingement before damage time to the target occurs. Several flame length ratio calculations resulted "out of range". All of these results are above the high end of the validation range, meaning that the length of the flame was always greater than the height of the target above the fire source causing direct flame impingement on the target. For these cases, given the diameter and HRR of the fire, direct flame impingement occurred to the target cable. Thus, a larger fire diameter would result in flame length ratios within the validation range but lower Fire Froude Numbers. Thus, the values of flame length ratio that are not within the validation range are based on conservative calculations for the Fire PRA.
NED-M/MECH-1007, Radiant Energy Target Damage Profile	5.4	Calculation NED-M/MECH-1007, utilizes the U.S. Nuclear Regulatory Commission (NRC) Fire Dynamics Tools (FDT[s]) [NUREG-1805.0] to determine a radiative ZOI from electrical cabinet fires to qualified and unqualified cables.	Solid flame radiation model documented in Section 5.2 of NUREG-1805.	To ensure the equations were coded correctly in the spreadsheets used in the calculation, the spreadsheet results were checked against the results of the NUREG-1805 FDTs Solid Flame Model 2 spreadsheet for identical inputs. Both spreadsheet models were found to produce the same results (NED-M/MECH-1007), therefore the spreadsheets used in the calculations are considered verified.	The comparison of dimensionless parameters with the validation range suggest a number of "out of range" results, which are expected for both the Fire Froude Number and the radial distance ratio dimensionless parameter. For the radial distance ratio dimensionless parameter, all the calculations that are "out of range" are on the low side of the range. This happens because the target is close to the flames and the experiments selected for validation purposes measured radiation at longer distances of the target from the flames. This is a limitation on the available data for

Table J-1: Summary of V & V Results for Fire Models in Specific HBRSEP Fire PRA Applications

Calculation	Report Section	Application	Fire Models	Verification	Validation
					validation and not necessarily a limitation on the use of the solid flame radiation model for calculating horizontal components of the ZOI for Fire PRA applications. To account for this limitation, it is noted that validation results, from Figure 6-8 in Volume 3 of NUREG-1824, suggest significant heat flux over predictions over the intensity levels used for ZOI calculations (i.e., between 6 and 11 kW/m^2) that would result in longer, and therefore conservative, horizontal distances.
RNP-M/MECH-1826, Hot Gas Layer Calculation	5.5	Calculation RNP-M/MECH-1826, determines the fire heat release rate necessary to generate a damaging hot gas layer within a compartment or multicompartment for a given floor area. Furthermore, this calculation describes the process for crediting the "heat soak" time. The "heat soak" time refers to the lag time between the temperature surrounding the cable targets and the temperatures inside the cable targets generating the electrical damage and/or ignition.	The hand calculations used for this analysis are the MHQ room temperature correlation for rooms assuming an open door (NUREG-1805, Chapter 2.1) and the Beyler room temperature correlation for closed doors room (NUREG-1805, Chapter 2.3).	The fire modeling documented in this calculation is a Microsoft Excel Spreadsheet supplemented with VBA Macros. The spreadsheet is a custom built fire modeling tool that uses the same closed-form room temperature correlations (Sections 5.1 and 5.3 of NUREG-1805) that are provided in NUREG-1824	The Beyler room temperature correlation was developed using data with a maximum temperature rise of 150°C. Extrapolation of this correlation to higher temperatures (330°C) is justified by using the Beyler correlation only when it is the most conservative result (i.e., lower estimate of HRR for room-wide damage to cables), compared to the MQH correlation, which is validated at higher temperatures The results show that the majority of the compartment ratio parameters are within the valid range, suggesting that the room size of these fire scenarios was included in the V&V study described in NUREG-1824. Those compartment aspect ratios that fall outside the application range do so on both ends of the range. This can be explained by the limited experiments selected for the validation study. As indicated in NUREG-1934, the selected experiments are representative of

Table J-1: Summary of V & V Results for Fire Models in Specific HBRSEP Fire PRA Applications

Calculation	Report Section	Application	Fire Models	Verification	Validation
					various types of spaces in commercial NPPs, but do not encompass all possible geometries or applications. This is a limitation on the available data for validation and not necessarily a limitation on the use of the model for calculating HGL scenarios applicable to the Fire PRA. To address this limitation, it is noted that both the MQH and Beyler room temperature models are reported to overpredict room temperatures for most configurations in Table 3-1 of NUREG-1824, Volume 1 (which lists a yellow-plus) and Table 4-1 in NUREG-1934 (which suggests an average bias of 1.44). This over prediction throughout the evaluated scenarios suggest that the configurations that are outside the validation range in this application will also result in temperature over predictions.
NED-M/MECH-1006, Generic Fire Modeling Treatments	5.6	The “Generic Fire Modeling Treatments,” Revision 0 document is used to establish ZOI for specific classes of ignition sources and primarily serves as a screening calculation in the Fire PRA under NUREG/CR-6850 Sections 8 and 11.	Listed in Table 2 later in this section	The calculation development and review process in place at the time the “Generic Fire Modeling Treatments” document was prepared included contributions from a calculation preparer, a calculation reviewer, and a calculation approver.	Listed in Table 2 later in this section.
Report No. 0004-0042-412-002, Evaluation of Control Room Abandonment Times at the H. B.	5.7	Calculation of main control room abandonment times. The abandonment times are then used as	CFAST, Version 6.1.1	Attachment 4 of Report 0004-0042-412-002, includes a software description and benchmark V&V. The attachment provides a	A full validation study for the analysis is described in Section A4.5.1 of Report 0004-0042-412-002. The non-dimensional parameters that affect the model results as documented in

Table J-1: Summary of V & V Results for Fire Models in Specific HBRSEP Fire PRA Applications

Calculation	Report Section	Application	Fire Models	Verification	Validation
Robinson Nuclear Plant		inputs to the risk quantification of main control room fire scenarios. The report provides operator abandonment times in the HBRSEP MCR due to visibility reduction and/or temperature increase for fire scenarios in the HBRSEP MCR. Fire sizes are postulated using the discretized distributions for specific types of electronic equipment fires and transient combustible fires as described in NUREG/CR-6850.		description of the verification documentation for CFAST. The primary documents applicable to this effort are NIST SP 1086 (Ref. 9), NUREG-1824, Volume 1 (Ref. 3), and NUREG-1824, Volume 5 (Ref. 20). A benchmark installation and verification procedure is provided by NIST (Ref. 8) to ensure correct installation and proper function of the CFAST model components. This procedure was performed as part of the verification process.	NUREG-1824, Volumes 1 and 5 and NUREG-1934, include the model geometry, the equivalence ratio, the fire Froude Number, and the flame length ratio. All non-dimensional geometry parameters fall within the NUREG-1824, Vol. 1 validation range of 0.6 – 5.7. Table A4-5 of Report 0004-0042-412-002, shows the approximate Fire Froude Number for NUREG/CR-6850, Appendix E Case 8 (Transient Fires). The table indicates that the Fire Froude Number falls below the NUREG-1824 validation range of 0.4 – 2.4 in nearly all cases, which means that the thermal plume that is expected from the ignition source fire could be wider than the range evaluated in NUREG-1824. A wider thermal plume will have a greater entrainment rate than one associated with a similar heat release rate fire that has a smaller diameter. This means that the conditions relative to a source fire that falls within the validation range will be less severe both in terms of the concentration of combustion products and the temperature. In the case of the Main Control Room the results are conservative when applied to low Fire Froude Number fire scenarios. Regarding the equivalence ratio calculation, Report 0004-0042-412-002, demonstrates that all cases fall within the NUREG-1824 validation range (i.e., 0.04-0.6). The global equivalence ratio for normal air supply to the MCR is

Table J-1: Summary of V & V Results for Fire Models in Specific HBRSEP Fire PRA Applications

Calculation	Report Section	Application	Fire Models	Verification	Validation
					assessed using the ratio of the maximum supported fire size to the fire size postulated. The report indicates that the fresh air supply and the initial oxygen concentration within the HBRSEP MCR is capable of supporting a fire on the order of 1,990 kW (1890 Btu/s) for twenty-five minutes when the HVAC system is providing outside air and 1,440 kW (1,360 kW) when the HVAC system is not providing outside air. At an equivalence ratio of 0.6, the maximum fire size would be about 1,194 kW (1,132 Btu/s). This is larger than the transient, single bundle electrical panel, and multiple bundle electrical panel fire scenarios. However, the workstation and the propagating MCB panel fire scenarios (Bin 7 and above) have fire sizes that are greater than 1,194 kW (1,132 Btu/s) at least for a portion of the scenario. When the time at which the abandonment is predicted is factored into the equivalence ratio calculation, it is shown that all cases have equivalence ratios less than 0.6 up to the time that abandonment is predicted.
Report No. 0004-0042-000-001, Evaluation of the Development and Timing of the Hot Gas Layer Conditions in HBRSEP Fire Zone 20	5.8	Analysis of the hot gas layer temperature and soot concentration conditions in the Robinson Nuclear Plant (HBRSEP) fire compartments for transient ignition sources and electronic panel ignition sources	CFAST Version 6.1.1.54	Attachment B of Report 0004-0042-000-001, describes the Verification for the CFAST model Version 6.1.1.54. The attachment provides a description of the verification documentation for CFAST. The primary documents applicable to this effort are NIST SP 1086 (Ref. 9),	Tables A2-7 through A2-10 of Report 0004-0042-000-001, summarize the non-dimensional parameters for a transient fuel package fire and the electrical panel fires as located in the E1/E2 Switchgear Room and the Safeguards Room for the initial ignition source. The tables indicate that the transient fire scenario parameters and most of the panel fire scenario

Table J-1: Summary of V & V Results for Fire Models in Specific HBRSEP Fire PRA Applications

Calculation	Report Section	Application	Fire Models	Verification	Validation
		that involve secondary combustibles (cable trays). Fire scenarios are evaluated in the E1/E2 Switchgear Room and the Safeguards Room, in the Reactor Auxiliary Building (RAB).		NUREG-1824, Volume 1 (Ref. 3), and NUREG-1824, Volume 5 (Ref. 20).	parameters fall within the NUREG-1824, Volume 1 parameter space range. Several of the panel fires have fire Froude Numbers that are somewhat below or above the NUREG-1824, Volume 1 (Ref. 3) range. In addition, the flame height to enclosure ratio is greater than the NUREG, Vol. 1 (Ref. 3) range for the smallest diameter panel (MCCs) in the Safeguards Room. The large flame length predicted for the Safeguards Room panel fire scenario is not expected to adversely affect the calculation results. In the case of the Halon actuation, the fire size at the time the smoke detectors actuate is much smaller than the peak fire size upon which the values in Table A2-8 are derived. In this case, the flame length will be shorter than the ceiling and the application will be within the NUREG-1824, Volume 1 (Ref. 3) range. Although this line of reasoning does not apply to the hot gas layer temperature calculation, it may be inferred that the overall treatment of the electronic panel fire, especially in the MCCs, is not representative of the way in which they will actually behave if ignited. The MCCs are relatively well sealed and external combustion may occur at gaps or seams in the MCC enclosure. The CFAST model conservatively removes the metal enclosure and places the fire 0.3 m (1 ft) below the panel top. The actual flame length will be shorter and within the NUREG-1824, Vol. 1

Table J-1: Summary of V & V Results for Fire Models in Specific HBRSEP Fire PRA Applications

Calculation	Report Section	Application	Fire Models	Verification	Validation
					(Ref. 3) test basis. The fire Froude Numbers for several panels are shown in Tables A2-7 and A2-8 of Report 0004-0042-000-001 to be either lower or higher than the range evaluated in NUREG-1824, Volume 1 (Ref. 3). A similar argument that was developed for the flame length applies to the fire Froude Number. The characteristic length is somewhat arbitrarily established using the panel plan dimensions. The actual characteristic length is difficult to assess since the panel is not a simple two-dimensional fuel package. Burning will occur at the vents, if present, and gaps and seams, all of which are smaller than the characteristic dimension. From a macroscopic perspective, the 464 kW (440 Btu/s) electronic panel fire is a common plant ignition source and is not significantly different from the types of source fires considered in the NUREG-1824, Volume 1 (Ref. 3) test series.
P2217-2300-01-03, Rev 3, Structural Steel-Fire Interaction Analysis Fire ZOI Calculations	5.9	Use of U.S. Nuclear Regulatory Commission (NRC) Fire Dynamics Tools (FDTs) [NUREG-1805.0] to determine the ZOI of a fire scenario in support of scenario development for the RNP Fire PRA	Heskestad Plume Temperature Correlation documented in Chapter 9 of NUREG 1805. Point source radiation model documented in Section 5.3.1 of NUREG 1805.	The verification of the models used in support of calculation P2217-2300-01-03, Rev 3, is provided in NUREG-1805, which contains pre-programmed Microsoft Excel Spreadsheets. The spreadsheets from NUREG 1805 are used directly in P2217-2300-01-03, Rev 3, (Attachment B) and therefore additional verification is not needed.	The vertical ZOI calculations for the Fire Froude number present several “out of range” results. Most of the “out of range” cases are due to calculations exceeding the upper limit of the range, suggesting high intensity fires for the selected fire diameter. One reason for exceeding the upper limit is the use of the 98th percentile heat release rates for the corresponding fire diameters. Based on the guidance in Chapter 8 of NUREG, 98th percentile heat release rate values are used for screening and

Table J-1: Summary of V & V Results for Fire Models in Specific HBRSEP Fire PRA Applications

Calculation	Report Section	Application	Fire Models	Verification	Validation
					can be considered on the high end of the values assigned to ignition sources. In addition, setting the Froude number calculation to the upper range limit of 2.4 for the 98th percentile heat release rate values would result in a larger diameter. With a larger diameter, the flame height calculation would result in shorter flame lengths, and plume temperature calculations would suggest lower temperatures. The “out of range” results are based on conservative ZOI calculations for the Fire PRA. In the transient case, with the fire in the center of the room, the Fire Froude number is out of range on the lower limit. The other two transient cases, with a fire on the wall and in the corner, have higher HRR values and are within the validation range of the Fire Froude number. Both of these scenarios (wall and corner) are more conservative than the transient fire in the center of the room. Since all three of the transient scenarios were screened out in the structural steel-impact analysis (P2217-2300-01-03, Rev 3), including the more conservative wall and corner scenarios, the use of the model for the transient scenarios is justified. Flame length ratio is within the validation range for all scenarios. Parameters are “out of range” for the use of the point source radiation model. The reason for number of ZOI results are “out of range” is because the ZOI distances are close to the flames and the experiments selected for validation purposes measured radiation at longer

Table J-1: Summary of V & V Results for Fire Models in Specific HBRSEP Fire PRA Applications

Calculation	Report Section	Application	Fire Models	Verification	Validation
					distances from the flames. This is a limitation on the available data for validation and not necessarily a limitation on the use of the point source radiation model for calculating horizontal components of the ZOI for Fire PRA applications. The model limitations presented in Chapter 5.5 of NUREG 1805, indicate that the point source radiation model overestimates the intensity of thermal radiation at target locations close to the fire. Therefore, the results are conservative and no further justification for the use of the point source radiation model is required.

Table J-2: V & V Basis for Fire Models / Model Correlations Used: Generic Fire Modeling Treatments Correlations.

Correlation	Location in Generic Fire Modeling Treatments (Ref. 11)	Reference in "Generic Fire Modeling Treatments" Document*	Application	Original Correlation Range	Subsequent Validation and Verification*	Limits in Generic Fire Modeling Treatments (Ref. 11)
Flame Height	Page 18	Heskestad (Ref. 19); Heskestad (Ref. 20)	Provides a limit on the use of the ZOI	$-5 \lesssim \log_{10}\left[\left(\frac{c_p T_\infty}{g\rho_\infty \left(\Delta H_c/r\right)^3}\right)\frac{\dot{Q}^2}{D^5}\right] \lesssim 5$ In practice, wood and hydrocarbon fuels, momentum or buoyancy dominated, with diameters between 0.05 – 10 m (0.16 – 33 ft).	Directly NUREG-1824, Volume 3 (Ref. 23) Indirectly NUREG-1824, Volume 5 (Ref. 42) (Correlation used in CFAST)	$\frac{4\dot{m}\Delta H_c}{\pi D^2}$ < 3000
Point Source Model	Page 19	Modak (Ref. 45)	Lateral extent of ZOI – comparison to other methods	Isotropic flame radiation. Compared with data for 0.37 m (1.2 ft) diameter PMMA pool fire and a target located at a $\frac{R_o}{R}$ ratio of 10.	NUREG-1824, Volume 3 (Ref. 23); SFPE (Ref. 24)	Predicted heat flux at target is less than 5 kW/m² (0.4 4 Btu/s-ft²) per SFPE.
Method of Shokri and Beyler	Page 19	Shokri et al. (Ref. 46)	Lateral extent of ZOI – comparison to other methods	Pool aspect ratio less than 2.5. Hydrocarbon fuel in pools with a diameter between 1 – 30 m (3.3 – 98 ft). Vertical target, ground level.	SFPE (Ref. 24) NUREG-1824, Volume 3 (Ref. 23)	Ground based vertical target.
Method of Mudan (and Croce)	Page 20	Mudan (Ref. 47)	Lateral extent of ZOI – comparison to other methods	Round pools; Hydrocarbon fuel in pools with a diameter between 0.5 – 80 m (1.64 – 262 ft).	SFPE (Ref. 24)	Total energy emitted by thermal radiation less than total heat released.

Table J-2: V & V Basis for Fire Models / Model Correlations Used: Generic Fire Modeling Treatments Correlations.

Correlation	Location in Generic Fire Modeling Treatments (Ref. 11)	Reference in "Generic Fire Modeling Treatments" Document*	Application	Original Correlation Range	Subsequent Validation and Verification*	Limits in Generic Fire Modeling Treatments (Ref. 11)
Method of Shokri and Beyler	Page 20	Shokri et al. (Ref. 46)	Lateral extent of ZOI	Round pools; Hydrocarbon fuel in pools with a diameter between 1 – 50 m (3.3 – 164 ft).	SFPE (Ref. 24) NUREG-1824, Volume 3 (Ref. 23)	Predicted heat flux at target is greater than 5 kW/m² (0.44 Btu/s-ft²) per SFPE (Ref. 24). Shown to produce most conservative heat flux over range of scenarios considered among all methods considered.
Plume heat fluxes	Page 22	Wakamatsu et al. (Ref. 48)	Vertical extent of ZOI	Fires with an aspect ratio of about 1 and having a plan area less than 1 m² (0.09 ft²).	Wakamatsu et al. (Ref. 48) (larger fires) SFPE Handbook of Fire Protection Engineering, Section 2–14 (Ref. 49)	Area source fires with aspect ratio ~ 1. Used with plume centerline temperature correlation; most severe of the two is used as basis for the ZOI dimension. This is not a constraint in the fire model analysis for the cases evaluated.
Plume centerline temperature	Page 23	Yokoi (Ref. 21); Beyler (Ref. 50)	Vertical extent of ZOI	Alcohol lamp assumed to effectively be a fire with a diameter ~0.1 m (0.33 ft).	NUREG-1824, Volume 3 (Ref. 23); SFPE Handbook of Fire Protection Engineering, Section 2–1 (Ref. 51)	Area source fires with aspect ratio ~ 1. Used with plume flux correlation; most severe of the two is used as basis for the ZOI dimension.

Table J-2: V & V Basis for Fire Models / Model Correlations Used: Generic Fire Modeling Treatments Correlations.

Correlation	Location in Generic Fire Modeling Treatments (Ref. 11)	Reference in "Generic Fire Modeling Treatments" Document*	Application	Original Correlation Range	Subsequent Validation and Verification*	Limits in Generic Fire Modeling Treatments (Ref. 11)
Hydrocarbon spill fire size	Page 51	SFPE Handbook of Fire Protection Engineering, Section 2–15 (Ref. 52)	Determine heat release rate for unconfined hydrocarbon spill fires.	Hydrocarbon spill fires on concrete surfaces ranging from ~1 to ~10 m (3.3 – 33 ft) in diameter.	None. Based on limited number of observations.	None. Transition from unconfined spill fire to deep pool burning assumed to be abrupt.
Flame extension	Page 100	SFPE Handbook of Fire Protection Engineering, Section 2–14 (Ref. 53)	Determine the fire offset for open panel fires.	Corner fires ranging from ~10 to ~1,000 kW (9.5 – 948 Btu/s). Fires included gas burners and hydrocarbon pans.	None. Based on limited number of observations.	None. Offset is assumed equal to the depth of the ceiling jet from the experiments.
Line source flame height	Page 101	Delichatsios (Ref. 54)	Determine the vertical extent of the ZOI	Theoretical development.	SFPE Handbook of Fire Protection Engineering, Section 2–14 (Ref. 49)	None. Transition to area source assumed for aspect plan ratios less than four. Maximum of area and line source predictions used in this region.
Corner flame height	Page 108	SFPE Handbook of Fire Protection Engineering, Section 2–14 (Ref. 53)	Determine the vertical extent of the ZOI	Corner fires ranging from ~10 to ~1,000 kW (9.5 – 948 Btu/s). Fires included gas burners and hydrocarbon pans.	None. Correlation form is consistent with other methods; comparison to dataset from SFPE Handbook, Section 2–14 (Ref. 53) provides basis.	None.

Table J-2: V & V Basis for Fire Models / Model Correlations Used: Generic Fire Modeling Treatments Correlations.

Correlation	Location in Generic Fire Modeling Treatments (Ref. 11)	Reference in "Generic Fire Modeling Treatments" Document*	Application	Original Correlation Range	Subsequent Validation and Verification*	Limits in Generic Fire Modeling Treatments (Ref. 11)
Air mass flow through opening	Page 140	Kawagoe (Ref. 55)	Compare mechanical ventilation and natural ventilation	Small scale, ⅓ scale, and full scale single rooms with concrete and steel boundaries. Vent sizes and thus opening factor varied. Wood crib fuels.	Drysdale (Ref. 56); SFPE (Ref. 57)	None. SFPE (Ref. 57) spaces with a wide range of opening factors.
Line fire flame height	Page 210	Yuan et al. (Ref. 22)	Provides a limit on the use of the ZOI (ZOI); Extent of ZOI for cable tray fires.	$0.002 < \frac{Z}{\dot{Q}'} < 0.6$ In practice, from the base to several times the flame height based on 0.015 – 0.05 m (0.05 – 0.16 ft) wide gas burners.	None. Correlation form is consistent with other methods; comparison to dataset from Yuan et al. (Ref. 22) provides basis.	None.
Cable heat release rate per unit area	Page 210	NBSIR 85-3196 (Ref. 58)	Provides assurance that the method used is bounding	Cables with heat release rates per unit area ranging from about 100 – 1,000 kW/m² (8.8 – 88 Btu/s-ft²).	None.	Correlation predicts a lower heat release rate than assumed in the Treatments and is based on test data.
Line fire plume centerline temperature	Page 212	Yuan et al. (Ref. 22)	Provides a limit on the use of the ZOI (ZOI); Extent of ZOI for cable tray fires.	$0.002 < \frac{Z}{\dot{Q}'} < 0.6$ In practice, from the base to several times the flame height based on 0.015 – 0.05 m (0.05 – 0.16 ft) wide gas burners.	None. Correlation form is consistent with other methods; comparison to dataset from Yuan et al. (Ref. 22) provides basis.	None.

Table J-2: V & V Basis for Fire Models / Model Correlations Used: Generic Fire Modeling Treatments Correlations.

Correlation	Location in Generic Fire Modeling Treatments (Ref. 11)	Reference in "Generic Fire Modeling Treatments" Document*	Application	Original Correlation Range	Subsequent Validation and Verification*	Limits in Generic Fire Modeling Treatments (Ref. 11)
Ventilation limited fire size	Page 283	Babrauskas (Ref. 59)	Assessing the significance of vent position on the hot gas layer temperature	Ventilation factors between 0.06 – 7.51. Fire sizes between 11 – 2,800 kW (10 – 2,654 Btu/s) Wood, plastic, and natural gas fuels.	SFPE (Ref. 57)	None. Provides depth in the analysis of the selected vent positions. The global equivalence ratio provides an alternate measure of the applicability of the analysis and for reported output is within the validation range of CFAST.

L. NFPA 805 Chapter 3 Requirements for Approval
10 CFR 50.48(c)(2)(vii)

15 Pages Attached

Approval Request 1

NFPA 805 Section 3.3.5.1

NFPA 805 Section 3.3.5.1 states:

> *"Wiring above suspended ceiling shall be kept to a minimum. Where installed, electrical wiring shall be listed for plenum use, routed in armored cable, routed in metallic conduit, or routed in cable trays with solid metal top and bottom covers."*

HBRSEP has wiring above suspended ceilings that may not comply with the requirements of this code section.

Suspended ceilings are noncombustible and exist only in the Control Room (FZ 23), Inside AO Office and old Turbine Building RCA Entrance (FZ 25A). Combustibles in concealed spaces are minimal.

The three areas currently with suspended ceilings inside the NFPA 805 defined power block are in the Control Room (FZ 23), Inside AO Office and old Turbine Building RCA Entrance (FZ 25A). The Inside AO Office and old Turbine Building RCA Entrance (FZ 25A) are not risk significant. Neither of the rooms nor the cables are safety-related.

Most electrical wiring above the Control Room partial suspended ceiling is in conduit except for short flexible connectors to lighting fixtures. There is one eight-foot length of eight-inch diameter UL approved flexible air duct with flame spread rating of 25 or less. The quantity of cabling above the suspended ceilings in the Control Rooms is very low and results in limited combustible loading. The existing fire detection capability and/or the Control Room Operators who are continuously present in the area would identify the presence of smoke. In addition, no equipment important to nuclear safety is located in the vicinity of these cables.

Video/communication/data cables that have been field routed above suspended ceilings are low voltage. Existing cables for video, communication, and networking may not be plenum rated, but are not generally susceptible to shorts that would result in a fire.

Basis for Request:

The basis for the approval request of this deviation is:

- All electrical wiring above the control room partial suspended ceiling is in conduit except for short flexible connectors to lighting fixtures. According to FAQ 06-0021, cable air drops of limited length (~3 feet) are considered acceptable.
- No equipment important to nuclear safety is located in the vicinity of these cables.
- Minimum amount of cables exist above the Control Room ceiling, which results in limited combustible loading.
- Smoke Detectors are installed both above and below the partial suspended ceiling in the Control Room.
- The Inside AO Office and old Turbine Building RCA Entrance (FZ 25A) are not risk significant. Neither of the rooms nor the cables are safety related.

- Existing fleet procedures will be used to ensure that changes moving forward are considered for NFPA 805 impacts. (FIR-NGGC-0010)

Acceptance Criteria Evaluation:

Nuclear Safety and Radiological Release Performance Criteria:

The location of wiring above suspended ceilings does not affect nuclear safety. No equipment important to nuclear safety is located in the vicinity of these cables. Therefore, there is no impact on the nuclear safety performance criteria.

The location of cables above suspended ceilings has no impact on the radiological release performance criteria. The radiological release review was performed based on the manual fire suppression activities in areas containing or potentially containing radioactive materials and is not dependent on the type of cables or locations of suspended ceilings. The location of cables does not change the radiological release evaluation performed that potentially contaminated water is contained and smoke monitored. The cables do not add additional radiological materials to the area or challenge system boundaries that contain such.

Safety Margin and Defense-in-Depth:

The use of these materials has been defined by the limitations of the analytical methods used in the development of the FPRA. Therefore, the inherent safety margin and conservatisms in these methods remain unchanged.

The three echelons of defense-in-depth are 1) to prevent fires from starting (combustible/hot work controls), 2) rapidly detect, control and extinguish fires that do occur thereby limiting damage (fire detection systems, automatic fire suppression, manual fire suppression, pre-fire plans), and 3) provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed (fire barriers, fire rated cable, success path remains free of fire damage, recovery actions). The prior introduction of non-listed video/communication/data cables routed above suspended ceilings does not impact fire protection defense-in-depth. Echelon 1 is maintained by the current cable installation procedures documenting the requirements of NFPA 805 Section 3.3.5.1. The control room is a continuously manned area of the plant. The introduction of cables above suspended ceilings does not affect echelons 2 and 3. The video/communication/data cables routed above suspended ceilings does not result in compromising automatic fire suppression functions, manual fire suppression functions, fire protection for systems and structures, or post-fire safe shutdown capability.

Conclusion:

HBRSEP determined that the performance based approach satisfies the following criteria:

- Satisfies the performance goals performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release
- Defense in Depth
- Safety Margin

Approval Request 2

NFPA 805 Section 3.3.5.2

NFPA 805 Section 3.3.5.2 states:
"Only metal tray and metal conduits shall be used for electrical raceways. Thin wall metallic tubing shall not be used for power, instrumentation, or control cables. Flexible metallic conduits shall only be used in short lengths to connect components."

The use of PVC piping for underground embedded conduit is permitted by HBRSEP per HBR2-0B060 Sht D6 for electrical raceway installations. Polyvinyl Chloride (PVC) or High Density Polyethylene (HDPE) type ducts (conduits) are permitted when embedded in compacted sand or reinforced concrete. In addition, some PVC conduit was found in reinforced concrete wall. The PVC/HDPE conduit is embedded within a noncombustible enclosure which provides protection from mechanical damage and from damage resulting from either an exposure fire or from a fire within the conduit impacting other targets.

Basis for Request:

- The PVC/HDPE conduit, while a combustible material, is not subject to flame/heat impingement from an external source which would result in structural failure, contribution to fire load, and damage to the circuits contained within where the conduit is embedded in concrete or compacted sand.
- Failure of circuits within the conduit resulting in a fire would not result in damage to external targets.

Acceptance Criteria Evaluation:

Nuclear Safety and Radiological Release Performance Criteria:

The use of PVC/HDPE conduit in embedded locations does not affect nuclear safety as the material in which conduits are run within an embedded location is not subject to the failure mechanisms potentially resultant in circuit damage or resultant damage to external targets. Therefore there is no impact on the nuclear safety performance criteria.

The use of PVC/HDPE conduits in embedded installations has no impact on the radiological release performance criteria. The radiological release review was performed based on the manual fire suppression activities in areas containing or potentially containing radioactive materials and is not dependent on the type of conduit material. The conduit material does not change the radiological release evaluation performed that concluded that potentially contaminated water is contained and smoke is monitored. The conduits do not add additional radiological materials to the area or challenge systems boundaries that contain such as the PVC/HDPE conduits are embedded.

Safety Margin and Defense-in-Depth:

The PVC/HDPE conduit material is embedded in a non-combustible configuration. The material is protected when embedded from mechanical damage and from damage resulting from either an exposure fire or from a fire within the conduit impacting other targets. The areas with PVC/HDPE conduit have been analyzed in their current configuration. The precautions and limitations on the use of these materials do not impact the analysis of the fire event. Therefore, the inherent safety margin and conservatisms in these analysis methods remain unchanged.

The three echelons of defense-in-depth are 1) to prevent fires from starting (combustible/hot work controls), 2) rapidly detect, control and extinguish fires that do occur thereby limiting damage (fire detection systems, automatic fire suppression, manual fire suppression, pre-fire plans), and 3) provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed (fire barriers, fire rated cable, success path remains free of fire damage, recovery actions). The use of PVC/HDPE conduits in embedded installations does not impact fire protection defense-in-depth. The PVC/HDPE conduit in embedded installations does not affect echelons 1, 2, and 3. The PVC/HDPE conduits do not directly result in compromising automatic fire suppression functions, manual fire suppression functions, or post-fire safe shutdown capability.

Conclusion:

HBRSEP determined that the performance based approach satisfies the following criteria"

- Satisfies the performance goals performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release
- Defense in Depth
- Safety Margin

Approval Request 3

NFPA 805 Section 3.5.16

NFPA 805 Section 3.5.16 states:
"The fire protection water supply system shall be dedicated for fire protection use only.
Exception No. 1: Fire protection water supply systems shall be permitted to be used to provide backup to nuclear safety systems, provided the fire protection water supply systems are designed and maintained to deliver the combined fire and nuclear safety flow demands for the duration specified by the applicable analysis.
Exception No. 2: Fire protection water storage can be provided by plant systems serving other functions, provided the storage has a dedicated capacity capable of providing the maximum fire protection demand for the specified duration as determined in this section.

The review of plant flow diagrams show no hard connections to other plant systems, besides those for fire protection use. It should be noted that although there are no hard pipe connections to other plant systems, there are procedures that utilize the fire protection water supply. They are as follows:

- AOP-014 - Loss of CCW
- AOP-022 - Loss of Service Water
- EDMG-001 - Extreme Damage Event Early Actions
- EDMG-002 - Refueling Water Storage Tank (RWST)
- EDMG-003 - Condensate Storage Tank (CST)
- EDMG-005 - Containment Vessel (CV)
- EDMG-011 - Spent Fuel Pit Casualty
- EDMG-012 - Core Cooling Using Alternate Water Source
- EDMG-013 - Airborne Release Scrubbing
- SAM-1 – Inject into the Steam Generator
- SAM-3 – Inject into the RCS
- SAM-4 – Inject into Containment
- SAM-6 – Control Containment Conditions
- SAM-8 – Flood Containment

The use of the fire protection water for these non-fire protection system water demands would have no adverse impact on the ability of the fire protection system to provide required flow and pressure. OMM-002, Section 8.15, details restrictions and allowances for use of the fire protection water supply system at HBRSEP.

Basis for Request:

The use of the fire protection water for these non-fire protection system water demands would have no adverse impact on the ability of the fire protection system to provide required flow and pressure. This is based on how fire water usage is restricted (CR 99-01247), in the following ways:

1. Fire service related activities (emergency, testing and training).
2. When the use of fire water is specifically called out in approved plant procedures (i.e., AOPs).
3. During plant emergencies when fire water is needed to protect safety related equipment.
4. When usage is deemed necessary AND sufficient justification is provided to show that the use of the fire water system for the proposed activity does not cause the fire water system to be in a condition outside of its design basis (i.e., the quantity of water needed for the proposed activity does not drop supply and pressure below that required/defined in UFSAR Section 9.5.1). Permission shall have the approval of the Shift Manager (CR 96-00729 and CR 96-00730).

The water supply system is capable of maintaining the pressure in the main plant loop at 70 psi or higher with the largest deluge system in operation and with the system supplying an additional 1000 gpm to hoses.

Acceptance Criteria Evaluation:

Nuclear Safety and Radiological Release Performance Criteria:

The use of fire protection water for non-fire protection plant evolutions is an occurrence that requires Shift Manager review and concurrence. The flow limitations to those non-fire protection functions ensure that there is no impact in the ability of the automatic suppression systems to perform Therefore, there is no impact on the nuclear safety performance criteria.

The use of fire protection water for plant evolutions other than fire protection has no impact on the radiological release performance criteria. The radiological release performance criteria is satisfied based on the determination of limiting radioactive release (Attachment E), which is not affected by impacts on the fire protection system due it's use for non-fire protection purposes.

Safety Margin and Defense-in-Depth:

The use of the fire water system, including the use of hydrants and hose, for non-fire protection uses does not impact fire protection defense-in-depth. The fire pumps have the excess capacity to supply the demands of the fire protection system as well as the non-fire protection uses identified above. This does not compromise automatic or manual fire suppression functions, fire suppression for systems and structures, or the nuclear safety capability assessment. Since both the automatic and manual fire suppression functions are maintained, defense-in-depth is maintained.

The methods, input parameters, and acceptance criteria used in this analysis were reviewed and found to be in accordance with NFPA 805 Chapter 3. The methods, input parameters, and acceptance criteria used to calculate flow requirements for the automatic and manual suppression systems were not altered. Therefore, the safety margin inherent in the analysis for the fire event has been preserved.

Conclusion:

HBRSEP determined that the performance based approach satisfies the following criteria:

- Satisfies the performance goals performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release
- Defense in Depth
- Safety Margin

Approval Request 4

NFPA 805 Section 3.2.3(1)

In accordance with 10 CFR 50.48(c)(2)(vii), “Performance-based methods,” the fire protection program elements and minimum design requirements of Chapter 3 may be subject to the performance-based methods permitted elsewhere in the standard.

In accordance with NFPA 805 Section 2.2.8, the performance-based approach to satisfy the nuclear safety, radiation release, life safety, and property damage/business interruption performance criteria requires engineering analyses to evaluate whether the performance criteria are satisfied.

In accordance with 10 CFR 50.48(c)(2)(vii), the engineering analysis performed shall determine that the performance-based approach utilized to evaluate a variance from the requirements of NFPA 805 Chapter 3:

A. Satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release;
B. Maintains safety margins; and
C. Maintains fire protection defense-in-depth (fire prevention, fire detection, fire suppression, mitigation, and post-fire nuclear safety capability).

Duke Energy, HBRSEP requests formal approval of performance-based exception to the requirements in Chapter 3 of NFPA 805 as follows:

NFPA 805, Section 3.2.3(1)

> *"Procedures shall be established for implementation of the fire protection program. In addition to procedures that could be required by other sections of the standard, the procedures to accomplish the following shall be established:*
> *Inspection, testing, and maintenance for fire protection systems and features credited by the fire protection program."*

Duke Energy, HBRSEP requests the ability to utilize performance-based methods to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features required by NFPA 805. Performance-based inspection, testing, and maintenance frequencies will be established as described in Electric Power Research Institute (EPRI) Technical Report TR-1006756, "Fire Protection Surveillance Optimization and Maintenance Guide for Fire Protection", Final Report, July 2003.

Basis for Request:

NFPA 805 Section 2.6, "Monitoring," requires that

> *"A monitoring program shall be established to ensure that the availability and reliability of the fire protection systems and features are maintained and to assess the performance of the fire protection program in meeting the performance criteria. Monitoring shall ensure that the assumptions in the engineering analysis remain valid."*

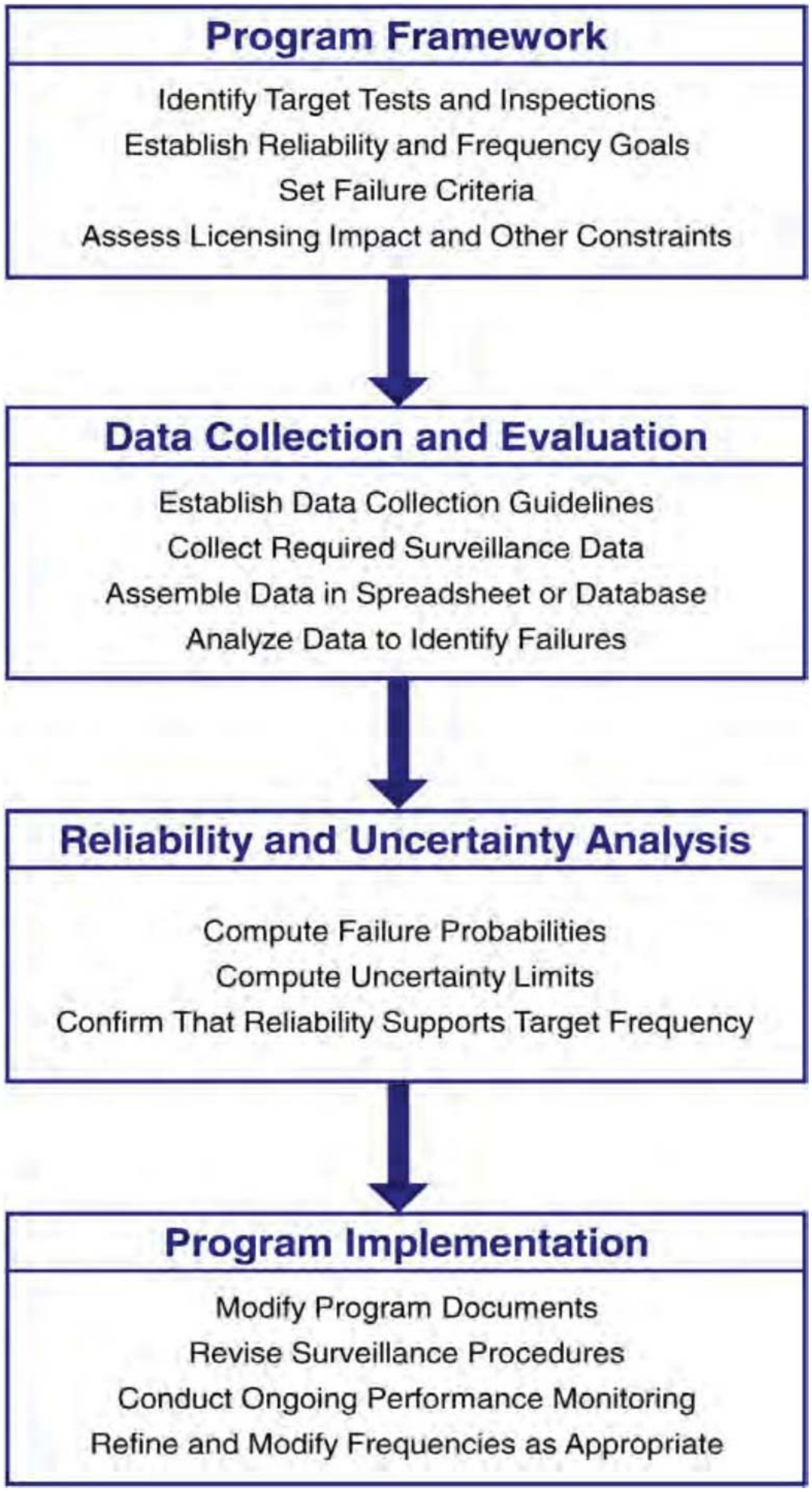
NFPA 805 Section 2.6.1, *"Availability, Reliability, and Performance Levels," requires that "Acceptable levels of availability, reliability, and performance shall be established."*

NFPA 805 Section 2.6.2, *"Monitoring Availability, Reliability, and Performance," requires that "Methods to monitor availability, reliability, and performance shall be established. The methods shall consider the plant operating experience and industry operating experience."*

The scope and frequency of the inspection, testing, and maintenance activities for fire protection systems and features required in the fire protection program have been established based on the previously approved Technical Specifications / License Controlled Documents and appropriate NFPA codes and standard. This request does not involve the use of the EPRI Technical Report TR-1006756 to establish the scope of those activities as that is determined by the required systems review identified in Attachment C

This request is specific to the use of EPRI Technical Report TR-1006756 to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features credited by the fire protection program. As stated in EPRI Technical Report TR-1006756 Section 10.1, "The goal of a performance-based surveillance program is to adjust test and inspection frequencies commensurate with equipment performance and desired reliability." This goal is consistent with the stated requirements of NFPA 805 Section 2.6. The EPRI Technical Report TR-1006756 provides an accepted method to establish appropriate inspection, testing, and maintenance frequencies which ensure the required NFPA 805 availability, reliability, and performance goals are maintained.

The target tests, inspections, and maintenance will be those activities for the NFPA 805 required fire protection systems and features. The reliability and frequency goals will be established to ensure the assumptions in the NFPA 805 engineering analysis remain valid. The failure criterion will be established based on the required fire protection systems and features credited functions and will ensure those functions are maintained. Data collection and analysis will follow the EPRI Technical Report TR-1006756 document guidance. The failure probability will be determined based on EPRI Technical Report TR-1006756 guidance and a 95% confidence level will be utilized. The performance monitoring will be performed in conjunction with the Monitoring Program required by NFPA 805 Section 2.6 and it will ensure site specific operating experience is considered in the monitoring process. The following is a flow chart that identifies the basic process that will be utilized.



EPRI TR-1006756 - Figure 10-1
Flowchart for Performance-Based Surveillance Program

Duke Energy, HBRSEP does not intend to revise any fire protection surveillance, test or inspection frequencies until after transitioning to NFPA 805. Existing fire protection surveillance, test and inspection will remain consistent with applicable station, Insurer, and NFPA Code requirements. HBRSEP's intent is to obtain approval via the NFPA 805 Safety Evaluation to use EPRI Technical Report TR1006756 guideline in the future as opportunities arise. Duke Energy, HBRSEP reserves the ability to evaluate fire protection features with the intent of using the EPRI performance-based methods to provide evidence of equipment performance beyond that achievable under traditional prescriptive maintenance practices to ensure optimal use of resources while maintaining reliability.

Nuclear Safety and Radiological Release Performance Criteria:

Use of performance-based test frequencies established per EPRI Technical Report TR-1006756 methods combined with NFPA 805 Section 2.6, Monitoring Program, will ensure that the availability and reliability of the fire protection systems and features are maintained to the levels assumed in the NFPA 805 engineering analysis. Therefore, there is no adverse impact to Nuclear Safety Performance Criteria by the use of the performance-based methods in EPRI Technical Report TR-1006756.

The radiological release performance criteria are satisfied based on the determination of limiting radioactive release. Fire Protection Systems and Features may be credited as part of that evaluation. Use of performance-based test frequencies established per the EPRI Technical Report TR-1006756 methods combined with NFPA 805 Section 2.6, Monitoring Program, will ensure that the availability and reliability of the fire protection systems and features are maintained to the levels assumed in the NFPA 805 engineering analysis which includes those assumptions credited to meet the Radioactive Release performance criteria. Therefore, there is no adverse impact to Radioactive Release performance criteria.

Safety Margin and Defense-in-Depth:

Use of performance-based test frequencies established per EPRI Technical Report TR-1006756 methods combined with NFPA 805, Section 2.6, Monitoring Program, will ensure that the availability and reliability of the fire protection systems and features are maintained to the levels assumed in the NFPA 805 engineering analysis which includes those assumptions credited in the Fire Risk Evaluation safety margin discussions. In addition, the use of these methods in no way invalidates the inherent safety margins contained in the codes and standards used for design and maintenance of fire protection systems and features. Therefore, the safety margin inherent and credited in the analysis has been preserved.

The three echelons of defense-in-depth described in NFPA 805 Section 1.2 are

1) to prevent fires from starting (combustible/hot work controls),
2) rapidly detect, control and extinguish fires that do occur thereby limiting damage (fire detection systems, automatic fire suppression, manual fire suppression, pre-fire plans), and
3) provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed (fire barriers, fire rated cable, success path remains free of fire damage, recovery actions).

Echelon 1 is not affected by the use of the EPRI Technical Report TR-1006756 methods. Use of performance-based test frequencies established per EPRI Technical Report TR-1006756 methods combined with NFPA 805 Section 2.6, Monitoring Program, will ensure that the availability and reliability of the fire protection systems and features credited for defense-in-depth are maintained to the levels assumed in the NFPA 805 engineering analysis. Therefore, there is no adverse impact to echelons 2 and 3 for defense-in-depth.

Conclusion:

NRC approval is requested for use of the performance-based methods contained in the Electric Power Research Institute (EPRI) Technical Report TR-1006756, "Fire Protection Equipment Surveillance Optimization and Maintenance Guide", Final Report, July 2003 to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features required by NFPA 805. As described above, this approach is considered acceptable because it:

A. Satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release;
B. Maintains safety margins; and
C. Maintains fire protection defense-in-depth (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown capability).

Approval Request 5

NFPA 805 Section 3.3.4

NFPA 805 Section 3.3.4 states:
“Thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials shall be noncombustible or limited combustible.”

Insulation materials such as Armaflex , Neoprene, Styrofoam and other foam based insulating materials are used at HBRSEP. These insulation materials meet flame spread and smoke developed criteria, but do not meet the NFPA 805 definition of non or limited combustible regarding heat value content.

Duke Energy, HBRSEP requests the ability to use thermal insulation materials that meet the flame spread and smoke developed criteria, but do not meet the heat value content criteria of NFPA 805.

Basis for Request:

Armaflex insulation meets the Branch Technical Position BTP APCSB 9.5.1/ Appendix R requirements for limited combustibles by meeting the flame spread rating of 25 or less as measured using the test method of ASTM E-84, but does not meet the current heat value content requirement based on an initial review of the definition of a limited combustible due to the heat value exceeding 3500 Btu/Lb.

NFPA 805 Section 3.3.4 requires: “Thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials shall be noncombustible or limited combustible.” The definition of a limited combustible for NFPA 805 uses the definition from NFPA 220 which states:

> *1.6.36 Limited Combustible. Material that, in the form in which it is used, has a potential heat value not exceeding 3500 Btu/lb (8141 kJ/kg) and either has a structural base of noncombustible material with a surfacing not exceeding a thickness of 1/8 in. (3.2 mm) that has a flame spread rating not greater than 50, or has another material having neither a flame spread rating greater than 25 nor evidence of continued progressive combustion, even on surfaces exposed by cutting through the material on any plane. (See NFPA 220, Standard on Types of Building Construction).*

The insulation materials used in the plant have flame spread and smoke developed ratings of 50 or less. Interior walls and structural components, radiation shielding, soundproofing, and interior finishes are non- combustible or are listed by a nationally recognized testing laboratory, such as Factor Mutual (FM) or UL, or have flame-spread, smoke and fuel contribution of 25 or less and are considered acceptable per the original BTP/Appendix R requirements. The materials do not contribute appreciably to the spread of fire.

Acceptance Criteria Evaluation:

Nuclear Safety and Radiological Release Performance Criteria:

The use of insulation material other than non-combustible and more than limited combustible in the plant does not affect nuclear safety. The Fire PRA development requires the inclusion of the effect of intervening combustibles to be documented and included in the analysis where determined to have fire effects as part of the performance-based approach. General area walkdowns and personnel interviews found that there were no large concentration installations of this insulation in the plant.

The use of insulation material other than non-combustible and more than limited combustible has no impact on the radiological release performance criteria. The radiological release review was performed based on the manual fire suppression activities in areas containing or potentially containing radioactive materials and is not dependent on the type of insulation material. The insulation material does not change the radiological release evaluation performed that concluded that potentially contaminated water is contained and smoke is monitored. The insulation materials do not add additional radiological materials to the area or challenge systems boundaries.

Safety Margin and Defense-in-Depth:

The insulation materials in their current configuration are considered as non-cable intervening combustibles. The precautions and limitations on the use of these materials do not impact the fire safety analysis of the fire event. Therefore, the inherent safety margin and conservatisms in these analysis methods remain unchanged.

The three echelons of defense-in-depth are 1) to prevent fires from starting (combustible/hot work controls), 2) rapidly detect, control and extinguish fires that do occur thereby limiting damage (fire detection systems, automatic fire suppression, manual fire suppression, pre-fire plans), and 3) provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed (fire barriers, fire rated cable, success path remains free of fire damage, recovery actions). The use of insulation material which is non-combustible or more than limited combustible does not impact fire protection defense-in-depth. The insulation material does not affect echelons 1, 2, and 3. The insulation material does not directly result in compromising automatic fire suppression functions, manual fire suppression functions, or post-fire safe shutdown capability.

Conclusion:

NRC approval is requested for use of thermal insulation materials that meet the flame spread criteria, but do not meet the heat value content criteria of NFPA 805 based on these materials meeting BTP APCSB 9.5.1/Appendix R requirements. HBRSEP has determined that the approach satisfies the following criteria:

- Satisfies the performance goals performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release
- Defense in Depth
- Safety Margin

M. License Condition Changes

3 Pages Attached

Replace the current HBRSEP fire protection license condition 3.E with the standard license condition from Regulatory Guide 1.205, modified as shown below. No other license conditions need to be superseded or revised.

HBRSEP implemented the following process for determining that these are the only license conditions required to be either revised or superseded to implement the new fire protection program which meets the requirements in 10 CFR 50.48(a) and 50.48(c):

A review was conducted of the HBRSEP Operating License DPR-23, by HBRSEP licensing staff and Duke Energy fire protection staff. The review was performed by reading the Operating License and performing electronic searches. Outstanding License Amendment Requests that have been submitted to the NRC were also reviewed for potential impact on the license conditions.

Supersede the existing license condition 3.E, in its entirety, as shown below:

E. Fire Protection Program

> Carolina Power & Company shall implement and maintain in effect all provisions of the approved Fire Protection Program as described in the Updated Final Safety Analysis Report for the facility and as approved in the Fire Protection Safety Evaluation Report dated February 28, 1978, and supplements thereto. Carolina Power & Light Company may make changes to the approved Fire Protection Program without prior approval of the Commission only if those changes would not adversely affect the ability to achieve and maintain safe shutdown in the event of a fire.

It is HBRSEP's understanding that implicit in the superseding of this license condition, all prior fire protection program SEs and commitments have been superseded in their entirety by the revised license condition.

The proposed license condition follows:
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Duke Energy shall implement and maintain in effect all provisions of the approved fire protection program that comply with 10 CFR 50.48(a) and 10 CFR 50.48(c), as specified in the license amendment request dated September 16, 2012, and as approved in the safety evaluation report dated __________. Except where NRC approval for changes or deviations is required by 10 CFR 50.48(c), and provided no other regulation, Technical Specification, license condition or requirement would require prior NRC approval, the licensee may make changes to the fire protection program without prior approval of the Commission if those changes satisfy the provisions set forth in 10 CFR 50.48(a) and 10 CFR 50.48(c), the change does not require a change to a Technical Specification or a license condition, and the criteria below are satisfied.

Risk-Informed Changes that May Be Made Without Prior NRC Approval

A risk assessment of the change must demonstrate that the acceptance criteria below are met. The risk assessment approach, methods, and data shall be acceptable to the NRC and shall be appropriate for the nature and scope of the change being evaluated, be based on the as-built, as-operated, and maintained plant, and reflect the operating experience at the plant. Acceptable methods to assess the risk of the change may include methods that have been used in the peer-reviewed fire PRA model, methods that have been approved by NRC through a plant-specific license amendment or NRC approval of generic methods specifically for use in NFPA 805 risk assessments, or methods that have been demonstrated to bound the risk impact.

(a) Prior NRC review and approval is not required for changes that clearly result in a decrease in risk. The proposed change must also be consistent with the defense-in-depth philosophy and must maintain sufficient safety margins. The change may be implemented following completion of the change evaluation.

(b) Prior NRC review and approval is not required for individual changes that result in a risk increase less than 1E-7/yr for CDF and less than 1E-8/yr for LERF. The proposed change must also be consistent with the defense-in-depth philosophy and must maintain sufficient safety margins. The change may be implemented following completion of the change evaluation.

Other Changes that May Be Made Without Prior NRC Approval

(1) Changes to NFPA 805, Chapter 3, Fundamental Fire Protection Program.

Prior NRC review and approval are not required for changes to the NFPA 805, Chapter 3, fundamental fire protection program elements and design requirements for which an engineering evaluation demonstrates that the alternative to the Chapter 3 element is functionally equivalent or adequate for the hazard. The licensee may use an engineering evaluation to demonstrate that a change to NFPA 805, Chapter 3 element is functionally equivalent to the corresponding technical requirement. A qualified fire protection engineer shall perform the engineering evaluation and conclude that the change has not affected the functionality of the component, system, procedure, or physical arrangement, using a relevant technical requirement or standard.

The licensee may use an engineering evaluation to demonstrate that changes to certain NFPA 805, Chapter 3 elements are acceptable because the alternative is “adequate for the hazard.” Prior NRC review and approval would not be required for alternatives to four specific sections of NFPA 805, Chapter 3, for which an engineering evaluation demonstrates that the alternative to the Chapter 3 element is adequate for the hazard. A qualified fire protection engineer shall perform the engineering evaluation and

conclude that the change has not affected the functionality of the component, system, procedure, or physical arrangement, using a relevant technical requirement or standard. The four specific sections of NFPA 805, Chapter 3, are as follows:

- 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).

This License Condition does not apply to any demonstration of equivalency under Section 1.7 of NFPA 805.

(2) Fire Protection Program Changes that Have No More than Minimal Risk Impact

Prior NRC review and approval are not required for changes to the licensee's fire protection program that have been demonstrated to have no more than a minimal risk impact. The licensee may use its screening process as approved in the NRC safety evaluation dated ___________ to determine that certain fire protection program changes meet the minimal criterion. The licensee shall ensure that fire protection defense-in-depth and safety margins are maintained when changes are made to the fire protection program.

Transition License Conditions

(1) Before achieving full compliance with 10 CFR 50.48(c), as specified by (2) below, risk-informed changes to the licensee's fire protection program may not be made without prior NRC review and approval unless the change has been demonstrated to have no more than a minimal risk impact, as described in (2) above.

(2) The licensee shall implement the modifications described in Attachment S, Table S-2, "Plant Modifications Committed," by the end of the unit refueling outage currently scheduled for September/October 2020 (R232). The licensee shall maintain appropriate compensatory measures in place until completion of the modifications delineated above.

(3) The licensee shall implement the items as listed in Attachment S, Table S-3, "Implementation Items," within 365 days after receipt of the safety evaluation/license amendment with the exception of implementation items S-3.11, 12, and 14, which are associated with modifications and will be completed after all procedure updates, modifications and training are complete.

V. Fire PRA Quality

26 Pages Attached

In accordance with RG 1.205 position 4.3:

> *"The licensee should submit the documentation described in Section 4.2 of Regulatory Guide 1.200 to address the baseline PRA and application-specific analyses. For PRA Standard "supporting requirements" important to the NFPA 805 risk assessments, the NRC position is that Capability Category II is generally acceptable. Licensees should justify use of Capability Category I for specific supporting requirements in their NFPA 805 risk assessments, if they contend that it is adequate for the application. Licensees should also evaluate whether portions of the PRA need to meet Capability Category III, as described in the PRA Standard."*

The HBRSEP Combined Internal Events and Fire PRA was peer reviewed March 2013. The peer review was conducted by a team of industry personnel (utility and vendor). The Westinghouse Owner's Group performed the review and have documented the outcome via LTR-RAM-13-06 "Fire PRA Peer Review of the H. B. Robinson Nuclear Plant Fire Probabilistic Risk Assessment Against the Fire PRA Standard Supporting Requirements from Section 4 of the ASME/ANS Standard". As noted in LTR-RAM-13-06, the HBRSEP Fire PRA was found to be consistent with the ASME/ANS Standard and is suitable for supporting risk-informed applications.

The peer review team noted a number of Facts and Observations (F&Os). As documented in LTR-RAM-13-06, 85% of the Supporting Requirements (SRs) were assessed at Capability Category II or higher. Approximately eighteen Finding level and nine Suggestion level F&Os were identified during the peer review conducted in March 2013. Duke Energy recognized that the Core Damage and Large Early Release Frequencies were relatively high, as noted in LTR-RAM-13-06. Based on the CDF and LERF values at the time of the initial peer review, coupled with the number of findings associated with the Fire Scenario Selection (FSS) Technical Element (18), Duke Energy decided to have a focused peer review.

The focused peer review was conducted July 2013 and evaluated the FSS Technical Element based on refinements to approved methodologies and updated documentation. The focused peer review was conducted by Frederick Mowrer (C P Fire, LLC) and Bijan Najafi (Hughes Associates) and is documented via Hughes Calculation No. 0004-0042-415-RPT-001, Robinson Nuclear Plant Fire PRA Focused Peer Review, Revision 2. As noted in LTR-RAM-13-06 and Hughes Calculation No. 0004-0042-415-RPT-001, the Fire PRA does apply the methodologies outlined in NUREG/CR-6850 correctly, is consistent with the ASME/ANS Standard and is applicable for supporting risk-informed applications. Although several of the initial F&Os were resolved, six new findings and four new suggestions were identified during the focused-scope peer review.

Both of these peer reviews were performed to RG 1.200 Revision 2 and account for the clarifications defined there.

Table V-1 documents the Finding level F&Os associated with both the initial and focused peer reviews.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
CF-A1 (CAT III) CF-B1 (CAT I/II/III)	REVIEW the conditional failure probabilities for fire-induced circuit failures *and* ASSIGN the appropriate industry-wide generic values for risk-significant contributors based on the specific circuit configuration under consideration	Dispositioned	RNP-0153 is Attachment 9 of RNP-F/PRA-0094 and describes cable failure analyzed for the HBRSEP Fire PRA, RNP-0153. The third bullet of RNP-0153, Section 3.0 states, "All cables are assumed to be Thermoset. This is consistent with the cable specifications for safety related cable at BNP and there are no substantive differences in failure probabilities for the two cable types for the purposes of this analysis." Reference 5.1 of RNP-0153 is "BNP Fire Safe Shutdown Program Database, Rev. 26." In response to a Peer Review question, it was advised that BNP should be RNP, that cable should be Thermo-plastic rather than Thermo-set and the HBRSEP FSSPMD should be referenced instead. The determination of meeting the requirements of CF-A1 depends on the information in RNP-0153. As presently written, RNP-0153 leads to questions of whether it is really applicable to HBRSEP. Revise and update RNP-0153. Perform a confirmation that the balance of information in RNP-0153 is valid for H.B. Robinson.	RNP-0153 (Attachment 7 of P2217-1021-01-03) has been updated to reflect all HBRSEP information. Additionally, Reference 5.1 has been updated to “RNP Fire Safe Shutdown Program Database, Rev 19”.
CF-A2 (NOT MET)	CHARACTERIZE the uncertainty associated with the applied conditional failure probability assigned per CF-A1.	Dispositioned	No characterization of the uncertainty associated with the applied conditional circuit failure probabilities was documented in EPM Report P2217-1021-01-01, Robinson Fire PRA Quantification Calculation, as captured in EC 90905.	The basic events associated with hot short probabilities have been assigned an error factor when the combined cutset is created using the UNCERT code. Although important for determining the statistical uncertainty of the PRA cutsets, the criteria needed for the LAR are based on the mean values which are not significantly impacted by the uncertainty analysis. RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION: Based on the above disposition, SR CF-A2 is considered to be MET at CAT I/II/III.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
CS-A1 (CAT I/II/III) CS-A2 (CAT III) CS-A10 (CAT III)	IDENTIFY cables whose fire-induced failure could adversely affect selected equipment and/or credited functions in the Fire PRA plant response model.	Dispositioned	Attachment 7 of RNP-F/PSA-0066 (Equipment Selection) contains a list of equipment which is to be credited in the Fire PRA, but which does not have cables identified and routed. A spot check review of the cable database (RNP FSSPMD R21_Read Only QA Record.mdb) reveals that several of the components listed in Attachment 7 are not included in the cable database. For example, Attachment 7 includes "Fire Tag" CHG-C-INDICATING-LIGHT corresponding to PRA BE JILCHGPCTF; however, CHG-C-INDICATINGLIGHT is not in the cable database, hence BE JILCHGPCTF will never be affected by fires. Others identified by spot check include 480V-52/11A, 480V-52/13B, EDGA-AMMETER, etc. Thus, there are some PRA components which are being credited in the PRA which do not have cable routing incorporated into the cable database; hence, they will never fail. Review Attachment 7 of RNP-F/PSA-0066, identify components which are not in the cable database, and update the cable database to include all credited PRA components.	All cables identified in Attachment 7 of RNP-F/PSA-0066 have been routed and added to FSSPMD with the exception of components that were not installed prior to RNP-F/PSA-0066 being completed.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
CS-A11 (CAT I/II/III) CS-C3 (NOT MET)	If assumed cable routing used in the Fire PRA, IDENTIFY the scope and extent, and PROVIDE a basis for the assumed cable routing.	Open	The scope and extent of assumed cable routing for non-credited components (i.e., components assumed to fail for all fires) is documented in Table 4 of RNP-F/PSA-0066. Although a basis is not provided for the assumed routing, it is a generally accepted practice to omit certain systems which do not perform a safety function (but may back up a safety system) and would require immense amount of work to manually trace the cables. The credited components with assumed routing are contained in the FSSPMD, however, there is no documented basis for the routing, and it is unclear if the scope and extent is understood. The basis for assumed routing is not documented. Furthermore, to understand, and to be able to evaluate the uncertainty associated with assumed routing some form of documentation should be assembled describing the scope and extent of the assumed routing. For example, are there fire compartments with a significant amount of assumed routing, are there high significance fire compartments, systems, trains or components dominated by cable failure of cables which have an assumed routing, etc. As part of an overall Task 3 documentation package, describe the scope and extent of assumed routing used in the HBRSEP Fire PRA.	As noted in HBRSEP Change Package RNP-0152 (Attachment 19 of P2217-1021-01-03), cable toning was used to confirm cable routes. There were some instances where cable toning was not possible within a specific compartment (embedded cable, etc.). In these instances, the cable was assumed to be failed throughout the entire compartment that it was known to traverse through. As noted in HBRSEP change package RNP-0205, (Attachment 19 of P2217-1021-01-03), the assumed cable route data determines the cable-to-fire zone correlation (which is sufficient for NSCA), but does not determine the cable-to-raceway-to-fire zone correlation (which is needed for PRA). Based on this assumption, any ignition source within a given fire zone will impact all cables with assumed cable routes in the ignition source's fire zone. RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION: As the Fire PRA documentation has not been updated to further describe the scope and extent of the assumed routing, no improvement has been made to the capability category assessment for SR CS-C3. However, RNP considers the risk results from the Fire PRA to be creditable for the NFPA 805 application because documentation of the scope and extent of the assumed routing will not change the quantified risk metrics.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
CS-C1 (NOT MET)	DOCUMENT the cable selection and location methodology applied in the Fire PRA in a manner that facilitates Fire PRA applications, upgrades, and peer review.	Dispositioned	There is no notebook encompassing Task 3 (Cable Selection) making review and update difficult. There are numerous change packages, and a database (FSSPMD) which is a repository for the cable routing information; however, there is no document explaining what tasks were performed, which procedures or guidelines were employed, and in which document the analysis is contained.	In the process at HBRSEP, Fire Protection/NSCA develops and maintains the cable selection and circuit analysis data. This data is then referenced as inputs to the Component Selection and Quantification FPRA calculations. This process and associated results are easily reviewable, has been peer reviewed multiple times for our other sites and found to be acceptable. There is no requirement to have a separate PRA notebook. RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION: With no change being made, HBRSEP considers the risk results from the Fire PRA to be creditable for the NFPA 805 application and this finding to be sufficiently resolved for SR CS-C1 to be assessed as CAT I/II/III.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
ES-A2 (NOT MET) ES-B4 (NOT MET) CS-A3 (CATI/II/III)	REVIEW power supply, interlock circuits, instrumentation, and support system dependencies and IDENTIFY additional equipment whose fire-induced failure, including spurious actuation, could adversely affect any of the equipment identified per SR ES-A1.	Dispositioned	Power supplies, support systems, interlock circuits and instrumentation are included in the internal events PRA model. For fire PRA specific logic, examples indicate that not all support system dependencies were completely considered. The area of concern is the lack of modeling of instrumentation power dependency (self-identified by the utility). For example, see gate HRAPORV-455C "PORV FAILS TO CLOSE DUE TO HRA", one of its inputs is an AND gate for "INDICATIONS THAT PORV IS OPEN FAIL." For the indicators modeled here, if there is a loss of power, the indicators will scale low, potentially preventing the operators from taking necessary actions. For the indication discussed in the example above, a loss of power will cause the indicators to scale low, potentially preventing the operators from taking necessary actions, and thus could adversely impact fire risk.	A detailed review of the modeling of associated circuits for all components functional states in the fire PRA CAFTA model was performed. The details of the review are provided in Attachment 2 of Hughes Associates Inc. (HAI) 1RCS04042.414.031-002, and revisions to the fire PRA CAFTA model, the RR file table BE, and Component Selection Database (CSDB) table PRA_SSEL as a result of this detailed review are listed in 1RCS04042.414.031-001, Attachments 3, 4, and 5, respectively. Revision 4 of the HBRSEP fire PRA calculation for component selection (RNP-F/PSA-0066) incorporates all of the changes required to the fire PRA CAFTA model as a result of the detailed review of the associated circuits. Review credited components to ensure that power supplies, support systems, interlock circuits, and instrumentation dependencies are adequately captured. RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION: With the above described changes incorporated, these SRs are considered to be MET at CAT I/II/III.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
ES-A3 (NOT MET)	INCLUDE equipment whose fire-induced failure, not including spurious operation, contributes to or causes (a) fire-induced initiating events treated in the Fire Safe Shutdown / Appendix R analysis (b) Internal Events PRA initiators as identified using the IE requirements in Part 2 (including any gradations across capability categories in that standard) as modified per 4-2.5, or (c) unique fire-induced initiating events not addressed or otherwise screened from the above two analyses if SR IE-C4 in Part 2 cannot be met.	Dispositioned	The "RCP Seal No. 1 Leak-Off" and "SI test line" are both ISLOCA paths that were screened from the Internal Events analysis; however these screened paths are not explicitly dispositioned in the fire PRA component selection calculation. These items were discussed with the host utility that provided the following input on the two ISLOCA paths mentioned above: "The seal leak-off is normally open and seal leak-off is part of the normal cooling path. Failure in either direction is non-consequential" and "The test line has 3+ locked closed manual valves." Based on this feedback, it is judged that this is a documentation issue with no impact on the analysis. This finding is related to the consideration of previously screened ISLOCA pathways from the Internal Events PRA for inclusion in the Fire PRA. Include, in the component selection calculation, a discussion of screened paths and why or why not they contain components that warrant inclusion in the fire PRA.	RNP-0148, Multiple Spurious Operation Expert Panel Report, did consider spurious isolation of the RCP Seal No. 1 leakoff valves. As noted in the report, 125V DC power will be removed within ten minutes as noted in HBRSEP Dedicated Shutdown Procedure (DSP-002). As noted in Attachment 3 of the HBRSEP Component Selection Calculation, RCP Seal No. 1 Leak-Off is not consequential. Leakoff is not required to maintain adequate seal cooling in the PRA model. Furthermore, seal leakoff is not modeled in the Fire PRA. RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION: Based on the above disposition, this SR is considered to be MET at CAT I/II/III.
FQ-B1 (CAT I/II/III)	PERFORM the quantification in accordance with HLR-QU-B and its SRs in Part 2 and DEVELOP a defined basis to support the claim of non-applicability of any of the requirements under HLR-QU-B in Part 2.	Dispositioned	In review of the fire PRA documentation there no convergence study was performed in support of the selection of truncation level for quantification.	RNP-F/PSA-0077 documented proof of convergence for CDF and LERF for the internal events PRA. As the fire PRA model is largely dependent on the internal events PRA, it can be concluded that there is convergence for CDF and LERF in the fire PRA The model was quantified based on a CDF quantification of 1E-12. This is about seven orders of magnitude below the final CDF. This is generally accepted as a good bounding truncation level

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
FQ-F1 (CAT I/II/III)	DOCUMENT the CDF and LERF analyses in accordance with HLR-QU-F and HLR-LE-G and their SRs in Part 2 with the following clarifications: (a) SRs QU-F2 and QU-F3 of Part 2 are to be met including identification of which fire scenarios and which physical analysis units (consistent with the level of resolution of the Fire PRA such as fire area or fire compartment) are significant contributors (as defined in Part 1); (b) SR QU-F4 of Part 2 is to be met consistent with 4-2.13 (c) SRs LE-G2 (uncertainty discussion) and LE-G4 of Part 2 are to be met consistent with 4-2.13, and DEVELOP a defined basis to support the claim of non-applicability of any of the requirements under these sections in Part 2.	Dispositioned	The contents of the elements of applicable SRs of Part 2 were addressed in the FQ and associated documents; however, no explicit connections were established in the documents to associate with the "back-references" requirements LE-G2, LE-G4 and LE-G5.	The HBRSEP Fire PRA was developed using the Internal Events PRA. The Internal Events PRA is aligned with RG 1.200 and was peer reviewed. Therefore, the “back-references” associated with requirements LE-G2, LE-G4 and LE-G5 are considered to be met.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
FSS-B1 (CAT I/II/III) FSS-A6 (CAT III) FSS-B2 (CAT III)	DEFINE and JUSTIFY the conditions that are assumed to cause MCR abandonment and/or reliance on ex-control room operator actions including remote and/or alternate shutdown actions.	Dispositioned	The conditions and timing that lead to Main Control Room (MCR) abandonment due to environmental conditions and reliance on ex-control room actions are described in main control room analysis report (Report 0004-0042-412-002). Abandonment due to equipment damage and to loss of habitability is based on the guidelines provided in Section 11.5.2.11 of NUREG/CR-6850. The analysis method described in NUREG/CR-6850 Appendix L is used to assess scenarios in the MCB. This SR is considered met. A new Finding (FSS-B1-01) has been assigned to this SR because all conditions requiring reliance on remote/alternate shutdown are not identified. Fires in the MCR or other location in the plant that may lead to loss of control room functions such that use of remote/alternate shutdown capability is required are not characterized and evaluated. Such scenarios for MCR habitability are identified and analyzed.	Section 5.9.2 of P2217-1021-01-03 provides a discussion of Main Control Room abandonment due to environment conditions. The probability associated with main control room abandonment due to a loss of habitability has been incorporated into the quantification of the Fire PRA.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
FSS-C2 (CAT II/III)	CHARACTERIZE ignition source intensity using a realistic time-dependent fire growth profile (i.e., a time-dependent heat release rate) for significant contributors as appropriate to the ignition source.	Dispositioned	Section 5.6.2 of the Quantification Calculation (EPM Report No. P2217-1021-01-01, Rev. 1, dated February 2013 included in EC 90905) and in particular the third bullet under Figure 7 on Page 51 of 113 indicates that "The HGL threshold assumes a constant HRR up to HGL formation." The basis for using the time versus HGL based on a constant HRR and then compare it to a curve based on a variable HRR has not been provided. At the top of Page 52 of 113 in the Quantification Calculation it states that, "The net effect of these uncertainties is generally a conservative time to HGL. For ignition sources that are high risk, more detailed fire modeling may be pursued on a case by case basis." The intent of the Standard is that conservative = Category I, and that realistic = Category II/III, therefore this SR is evaluated at Category I. An example of a more realistic analysis is Hughes Report Number: 0004-0042-000-001 for Fire Compartment 20. **Finding FSS-C2-01 has not been resolved.** For each scenario, the ignition source intensity is characterized using a time-dependent heat release rate, consistent with the Category II/III requirement for this SR; however, the total heat release required to cause hot gas layer formation is based on a fire that is initiated at full peak intensity, consistent with the Category I requirement for this SR. Suggestion FSS-C2-02 has been prepared to suggest further justification and validation of the methodology used to determine the total heat release required to cause hot gas layer formation.	Section 5.6.2 of the Fire PRA Quantification Calculation discusses the growth profile used. This can also be seen in the RNP_EVAL_Rev2 spreadsheet used during the quantification process. This spreadsheet includes a cable tray propagation model (HGL_Time worksheet). Furthermore, Calculation NED-M/MECH-1009 also provides a time to damage based on fire growth.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
FSS-C4 (CAT II)	If a severity factor is credited in the analysis, ENSURE that a. the severity factor remains independent of other quantification factors b. the severity factor reflects the fire event set used to estimate fire frequency c. the severity factor reflects the conditions and assumptions of the specific fire scenarios under analysis, and d. a technical basis supporting the severity factor's determination is provided.	Dispositioned	The severity factors, as described in Section 5.5.4.5 of the Quantification Calculation (EPM Report No. P2217-1021-01-01, dated February 2013 included in EC 90905) are apparently evaluated using the calculation logic in Attachment 20 of the Quantification Calculation. This is not explained in a clear and concise way in Section 5.5.4.5, nor is any reference to Attachment 20 found in that section. The general reference to module "MakeSScen" and the fact that its contents are listed in Attachment 20 in the introductory paragraph of Section 5.5.4 is not considered to be sufficient. Further, the descriptions in Section 5.5.4.5 (pages 41-42 of 113) of how the Severity Factor determination is done do not appear to exactly match with the programming logic found on pages 7-12 of Attachment 20. This needs to be clarified and clearly documented to support future use, update, and peer review of the Severity Factor calculations. In addition, the use of generic fire modeling data and severity factors for different ignition source "Bins" from NUREG/CR-6850 without considering mode of exposure and position (i.e., not just distance) of the targets relative to the fire source may not fully constitute "explicit consideration" in quantifying the severity factor such that it reflects the conditions and assumptions of the specific fire scenario under analysis.	Section 5.5.4.5 of the Quantification Calculation (EPM Report No. P2217-1021-01-03) has been updated to provide more detail as to why specific severity factors are applied in the MakeSScen module.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
FSS-C7 (NOT MET)	If multiple suppression paths are credited, EVALUATE and PROPERLY MODEL dependencies among the credited paths including dependencies associated with recovery of a failed fire suppression system, if such recovery is credited.	Dispositioned	Credit is given for both automatic sprinkler suppression and manual firefighting, but mutual dependency on the common water supply system has not been evaluated or properly modeled.	No credit has been applied for manual actuation or recovery of fixed suppression systems. The common water supply at HBRSEP is sufficient to provide water to both the automatic suppression system as well as the manual firefighting. The reliability/unavailability of the fire pump and associated sprinkler has already been accounted for in the non-suppression probability. RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION: Based on the above disposition, SR FSS-C7 is considered to be MET at CAT I/II/III.
FSS-D2 (CAT I/II/III) FSS-D6 (CAT I/II/III)	USE fire models that have sufficient capability to model the conditions of interest and only within known limits of applicability.	Dispositioned	This finding recommends that the HGL calculation (RNP-M/MECH-1826) be subjected to validation and verification in order to establish its technical basis and known limits of applicability.	Attachment J of the LAR provides a discussion on the software used during the development of the HBRSEP HGL Calculation (RNP-M/MECH-1826).

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
FSS-D7 (NOT MET) FSS-F1 (CAT III)	In crediting fire detection and suppression systems, USE generic estimates of total system unavailability provided that (a) the credited system is installed and maintained in accordance with applicable codes and standards (b) the credited system is in a fully operable state during plant operation, and (c) the system has not experienced outlier behavior relative to system unavailability.	Dispositioned	There is a failure to meet the Category I requirement of having systems installed and maintained in accordance with applicable codes and standards. The Main Turbine Lube Oil Deluge system must be replaced to account for system deficiencies identified in NCR-425437 where a simultaneous actuation of the Turbine Lube Oil suppression system, along with the mezzanine and ground level sprinkler systems, could place a higher system demand on the water supply than can be provided by a single fire pump. This was not identified, nor is a comparison provided in the Fire PRA of all installed detection and suppression systems vs. the corresponding Code Compliance calculation. **Finding FSS-D7-01 has not been resolved.** Because evidence is not provided to support that credited detection/suppressions systems are installed and maintained in accordance with applicable codes and standards. System health report for period Q2-2013 for systems 6185/6181/6175/6195/6205/6180 notes that age, obsolescence and replacement part procurement is an issue. This system health report also notes that "There are LTAMs budgeted for 2014 and 2015 which study and replace the detection, CO2, and Halon Systems." This report suggests that some of the fire protection systems at HBRSEP may be experiencing outlier behavior relative to system unavailability and may not be in a fully operable state during plant operation. Consequently, this SR is still considered to be not met.	Currently, system performance is monitored and maintained at a high level as part of the System Health Reporting and System Notebook processes. Outlier behavior with respect to system availability would be evident to the system engineer and plant management through the health data (available for the previous 12 months), which indicates overall Excellent (Green) performance. Furthermore, during the periods when key fire protection systems are unavailable due to testing and maintenance, compensatory actions are taken such that the risk associated with the system being unavailable does not increase. RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION: Using plant-specific information to quantify total unavailability factors is a CAT III requirement and was not done. With no change being made, HBRSEP considers the risk results from the Fire PRA to be creditable for the NFPA 805 application and this finding to be sufficiently resolved for SR FSS-D7 to be assessed as CAT II is MET.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
FSS-D7 (NOT MET)	In crediting fire detection and suppression systems, USE generic estimates of total system unavailability provided that (a) the credited system is installed and maintained in accordance with applicable codes and standards, and (b) the credited system is in a fully operable state during plant operation.	Dispositioned	Evidence needs to be provided to support that credited detection/suppressions systems are installed and maintained in accordance with applicable codes and standards. System health report for period Q2-2013 for systems 6185/6181/6175/6195/6205/6180 notes that age, obsolescence and replacement part procurement is an issue for multiple fire protection systems. This system health report also notes that "There are LTAMs budgeted for 2014 and 2015 which study and replace the detection, CO_2, and Halon Systems." This report suggests that some of the fire protection systems at HBRSEP may be experiencing outlier behavior relative to system unavailability and may not be in a fully operable state during plant operation.	Currently, system performance is monitored and maintained at a high level as part of the System Health Reporting and System Notebook processes. Outlier behavior with respect to system availability would be evident to the system engineer and plant management through the health data (available for the previous 12 months), which indicates overall Excellent (Green) performance. Furthermore, during the periods when key fire protection systems are unavailable due to testing and maintenance, compensatory actions are taken such that the risk associated with the system being unavailable does not increase. RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION: Using plant-specific information to quantify total unavailability factors is a CAT III requirement and was not done. With no change being made, HBRSEP considers the risk results from the Fire PRA to be creditable for the NFPA 805 application and this finding to be sufficiently resolved for SR FSS-D7 to be assessed as CAT II is MET.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
FSS-E1 (CAT I/II/II) FSS-H4 (CAT II)	For any fire modeling parameters not covered by the requirements of HLR-FSS-C or HLR-FSS-D, USE plant-specific parameter estimates for fire modeling if available, or use generic information modified as discussed in SR FSS-E2; USE generic information for the remaining parameter estimates.	Open	Section 4.3 of Calculation No. P2217-2100-00, Fire Scenario Data, RNP-F/PSA-0079, dated January 2013 contains information about fire modeling parameters that were used. However, Section 4.4 through 4.7 should be completed because they are missing information about other relevant fire modeling parameters. Add relevant information to the report. **Finding FSS-E1-01 has not been resolved.** Sections 4.3 through 4.7 still make reference to databases for the parameters used in the fire modeling. These parameters should be added to the report.	Section 4.3 of Calculation P2217-2100-01-01 will be updated appropriately at a later date. This is a documentation issue that will not impact fire scenario development or quantification. As stated in the response to FPRA RAI 1A, parametric uncertainty for fire ignition frequency, non-suppression probability, and hot short probability have been assessed for their impact to CDF and LERF in the integrated analysis performed in response to FPRA RAI 3.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
FSS-E3 (CAT I)	PROVIDE a mean value of, and statistical representation of, the uncertainty intervals for the parameters used for modeling the significant fire scenarios.	Open	No statistical representation of uncertainty intervals (e.g., NUREG/CR-6850 Table E-1 or G-1 for HRR, Tables E-2 through E-9 for severity factor) is documented for the mean values of parameter estimates used for fire modeling the significant fire scenarios.	HBRSEP used the HRRs and applied them using the guidance found in NUREG/CR-6850. As NUREG/CR-6850 is the consensus methodology, a detailed uncertainty analysis on these parameters is not needed and does not add to the credibility of the results. The majority of applied values are based on the 98th and 75th percentile fires from NUREG/CR-6850, and the ZOIs are applied conservatively. It is not believed that reducing these values would allow the use of reduced impacts for the applications being pursued. RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION: Although no change has yet been made that would improve the Capability Category assessments, HBRSEP considers the risk results from the Fire PRA to be creditable for the NFPA 805 application because documenting the statistical representation of uncertainty intervals will not change the quantified risk metrics.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
FSS-E4 (NOT MET) FSS-A1 (CAT I/II/III)	PROVIDE a characterization of the uncertainties associated with cases where cable routing has been assumed based on SRs CS-A10 and/or CS-A11.	Dispositioned	There is some assumed cable routing applied directly in FSSPMD. These routings are identified in RNP-0152. Components with unknown routing are otherwise assumed to fail in the PRA model. However, there is no discussion that characterizes the uncertainties associated with cases where cable routing has been assumed. A more detailed characterization of the uncertainties associated with cases where cable routing has been assumed is needed for SR FSS-E4 to be met. Provide a detailed uncertainty characterization discussion in appropriate reports related to circuits with assumed routing.	As noted in HBRSEP Change Package RNP-0152 (Attachment 19 of P2217-1021-01-03), cable toning was used to confirm cable routes. There were some instances where cable toning was not possible within a specific compartment (embedded cable, etc.). In these instances, the cable was assumed to be failed throughout the entire compartment that it was known to traverse through. As noted in HBRSEP change package RNP-0205 (Attachment 19 of P2217-1021-01-03), the assumed cable route data determines the cable-to-fire zone correlation (which is sufficient for NSCA), but does not determine the cable-to_raceway-to-fire zone correlation (which is needed for PRA). Based on this assumption, any ignition source within a given fire zone will impact all cables with assumed cable routes in the ignition source's fire zone. RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION: Based on the above disposition, SR FSS-E is considered to be MET at CAT I/II/III.
FSS-F3 (CAT I/II/III) FSS-D7 (NOT MET)	In crediting fire detection and suppression systems, USE generic estimates of total system unavailability provided that (a) the credited system is installed and maintained in accordance with applicable codes and standards, and (b) the credited system is in a fully operable state during plant operation.	Dispositioned	Section 2.4 of the Structural Steel report (P2217-2300-01-03) states that "It is assumed that an unavailability value of 0.01 will be bounding and conservative for the deluge sprinkler system." What is the basis for this? Has this value been confirmed against the plant-specific experience for availability of the detection/suppression systems?	The unavailability of the Turbine Lube Oil Deluge system has been updated to 0.05 in Rev. 3 of P2217-1021-01-03 (Fire PRA Quantification Calculation). This change was made based on engineering judgment. RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION: Based on the above disposition, SR FSS-D7 is considered to be MET at CAT I/II/III.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
FSS-G2 (CAT I/II/III) FSS-G3 (CAT II)	APPLY all the supporting requirements listed in SRs FSS-C1 through FSS-C8 for fire modeling of single physical analysis units to the modeling of multi-compartment fire scenarios.	Dispositioned	Fire modeling performed in support of the Multi-Compartment Analysis (MCA) failed to consider the acute effect of hot gas flow through openings and ducts on local potential targets. In addition, the consideration and evaluation of additional aspects of multi-compartment fire scenarios was not documented and/or done, i.e., the fact that the Turbine Building has no exterior walls was not identified and the impact of this evaluated. Treatment of MCA in only 7 pages of the Quantification Calculation does not appear to be adequate. Furthermore, in their evaluation of compartments subject to a hot gas layer, HBRSEP used a criterion of 1E-07 for total ignition frequency. Based on this, HBRSEP excluded all but two compartments. A review of the table that was subject to the review showed there were two additional compartments that met the criterion for inclusion. This is an error rate of 100%.	A detailed multi-compartment analysis was performed and is documented in RNP-F/PSA-0089. The Fire PRA Quantification Calculation only updated results based on new CCDPs and a new HGL Calculation. The open Turbine Building was discussed in the HGL Calculation (RNP-M/MECH-1826). The detailed review of hot gas flow through openings has not been performed. The impact of hot gas flow through openings and ducts on local targets is expected to be minimal. RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION: Based on the above disposition, SR FSS-G2 is considered to be MET at CAT I/II/III.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
FSS-G6 (CAT I)	**QUANTIFY the risk contribution** of any selected multi-compartment fire scenarios in a manner consistent with the FQ requirements.	Dispositioned	Table B-5 of this report defines lists fourteen (14) unscreened multi-compartment fire scenarios. Attachment E of the same report offers risk associated with these scenario. The Quantification Report (P2217-1021-01-02) Section 5.10 states that "Based on updated Hot Gas Layer frequencies, all of the fire compartments previously analyzed in the Multi-Compartment Analysis (Reference 3.14), have now screen." Reference 3.14 is RNP-F/PSA-0089 Rev 0 and it does not support the statement that all MC fire is screened. Finding FSS-G6-01 has been resolved. Hughes Calculation No. 1RCS04042.414.031, Revision 0 (Multi-Compartment Analysis for the Fire Probabilistic Risk Assessment at Robinson Nuclear Plant), provides a detailed multi-compartment analysis. This analysis has been included in Section 5.10 of the HBRSEP Fire PRA Quantification Calculation. Based on updated Hot Gas Layer data, the scenarios identified in the Hughes calculation screen from further analysis.	Section 5.10 of P2217-1021-01-03 provides a discussion of the multi-compartment scenarios quantified in the Fire PRA. There are five scenarios that do not screen currently based on an updated HGL Calculation (RNP-M/MECH-1826, Rev. 0). These scenarios have been quantified in a manner consistent with the FQ requirements. RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION: Based on the above disposition, SR FSS-G6 is considered to be Met at CAT II/III.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
FSS-H2 (CAT I)	DOCUMENT a basis for target damage mechanisms and thresholds used in the analysis, including references for any plant-specific or target-specific performance criteria applied in the analysis.	Dispositioned	The fire modeling in Hughes Report No. 0004-0042-000-001 for Fire Compartment 20 credits fire coating. Category II of this SR requires documentation of the references for any plant-specific or target-specific performance criteria applied in the analysis, and a basis for target damage mechanisms and thresholds used in the analysis, which has not been provided. **Finding FSS-H2-01 has not been resolved.** Plant-specific documentation should be provided for the performance criteria used to evaluate damage to coated cables and cable trays with solid bottoms.	Plant modifications in addition to intumastic cable coating are incorporated into the Fire PRA Calculation (EPM Report No. P2217-1021-01-03). These plant modifications are discussed in Attachment S of the LAR. The ten minute time until cable damage (per NUREG/CR-6850) is achieved via plant modifications discussed in Attachment S. RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION: Based on the above disposition, SR FSS-H2 is considered to be Met at CAT II/III.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
HRA-C1 (CAT II) FQ-C1 (CAT I/II/III)	For each selected fire scenario, QUANTIFY the HEPs for all HFEs and ACOUNT FOR relevant fire-related effects using detailed analyses for significant HFEs and conservative estimates (e.g., screening values) for non-significant HFEs, in accordance with the SRs for HLR-HR-G in Part 2 set forth under at least Capability Category II, with the following clarification: a. Attention is to be given to how the fire situation alters any previous assessments in non-fire analyses as to the influencing factors and the timing considerations covered in SRs HR-G3, HR-G4, and HR-G5 in Part 2 *and* b. Develop a defined basis to support the claim of non-applicability of any of the requirements under HLR-HR-G in Part 2.	Dispositioned	The fire-specific operator actions are evaluated using only the Cause-Based Decision Tree method (CBDTM). The HRAs from the Internal Events methods used both CBDTM and HCR/ORE to address the cognitive risk of the operator actions. The HCR/ORE method is generally the dominant risk value for actions with short system time windows or very long median response times. Events 0FIREOMA01 and 0FIREOMA02 are events with short time windows where the HCR/ORE method would be the dominant cognitive risk. The cognitive risk is underestimated by an order of magnitude. The HRA needs to be revised to better address the cognitive risk portion for each HEP.	All fire response actions have been updated such that they are quantified using the CBDTM and HCR/ORE combination method similar to Internal Events operator actions. P2217-1022-01-03 documents the Fire HRA.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
IGN-A7 (CAT I/II/III)	USE a plant-wide consistent methodology based on parameters that are expected to influence the likelihood of ignition to apportion high-level ignition frequencies (e.g., plant-wide values) to estimate physical analysis unit or ignition source level frequencies.	Dispositioned	In general the SR was met. There are areas such as the transient ignition sources related identification are still required, some of these is already self-identified as part of the "lead review" activities as indicated in the -0067 notebook. For instance, fire zone 22 and others are identified in the "lead reviews" as additional effort is needed. Address the transient ignition sources for application fire zones. Providing a complete and through ignition sources identification is important.	Transient fire scenarios have been postulated in each fire compartment as noted in Hughes Calculation No. 1RCS04042.414.031-002.
IGN-A9 (CAT I/II/III)	POSTULATE the possibility of transient combustible fires for all physical analysis units regardless of the administrative restrictions.	Dispositioned	HBRSEP did postulate transient combustibles for all physical analysis units except for one, FC490. This physical analysis unit is the deepwell pump D enclosure. HBRSEP needs to provide justification for why transient combustibles are not postulated for FC490.	Transient fire ignition frequency has been assigned to FC490. Transient Influence Factors of Low(1), Low(1), and Low(1) replaced factors No(0), No(0), and No(0) for maintenance, occupancy, and storage, since entry to FC490, which requires using a crane to remove the concrete enclosure, is not precluded.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
PP-B6 (CAT I/II/III)	ENSURE a. that collectively, the defined physical analysis units encompass all locations within the global analysis boundary *and* b. that defined physical analysis units do not overlap	Dispositioned	Underground cabling was not addressed in RNP-F/PSA-0067. The HBRSEP project team noted a comment was included in this calculation that a "Yard" fire zone should be included in the next revision of the report.	The cable routing database system FSSPMD was reviewed determining which manholes had cables within the scope of the Fire PRA associated with them. The manholes where cables were identified have been included as plant partitioning elements (i.e., Physical Analysis Units) in the Fire PRAs. The following manholes have been included as plant partitioning elements: MH M-34, MH M-35, MH-1, and MH-34. The cables that were identified as routed through MH-35, MH-36 and MH have been included in the Intake Structure Fire Compartment, FC290. The cable loading for the manholes have been assessed following the same approach documented in the HBRSEP combustible loading calc. The approach consists of multiplying the factor of 5,515 BTU/ln-ft to each linear ft of cable. Under this approach, a total of 496350 BTUs have been estimated for each manhole. This assumes nine 10' long exposed cables per manhole. Nine cables is the average number of cables identified in the manholes.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
PRM-B11 (NOT MET) PRM-B2 (CAT I/II/III) HRA-B2 (NOT MET)	MODEL all operator actions and operator influences in accordance with the HRA element of this Standard.	Dispositioned	Main control room abandonment is discussed in Section 7.1.4 of Calculation P2217-1022-01-01, "Fire Human Reliability Analysis" and Table 7.1 lists the human failure events (HFEs) associated with main control room abandonment. However, these HFEs have not yet been incorporated into the HBRSEP fire PRA model. Without the HFEs for main control room abandonment, the HBRSEP fire PRA is incomplete. Incorporate the main control room abandonment HFEs into the fire PRA model.	Fire response and Main Control Room Abandonment HFEs have not been incorporated in the combined Internal Events/Fire PRA. The Main Control Room Abandonment HFEs from Hughes Calculation No. RSC-CALKNX-2013-0301 has been incorporated into the recovery rule files used during the quantification process as appropriate based on the fire compartment being quantified. RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION: Based on the abovementioned details, these SRs are considered to be MET at CAT I/II/III.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
PRM-B15 (CAT I/II/III)	MODEL any new accident progressions beyond the onset of core damage identified per PRM-B13 to determine the fire-induced LERF in accordance with HLR-LE-A, HLR-LE-B, HLR-LE-C, and HLR-LE-D and their SRs in Part 2 with the following clarifications: (a) All the SRs under HLR-LE-A, HLR-LE-B, HLR-LE-C, and HLR-LE-D in Part 2 are to be addressed in the context of fire scenarios including effects on system operability / functionality, operator actions, accident progression, and possible containment failures accounting for fire damage to equipment and associated cabling. (b) LE-C2 and LE-C6 in Part 2 are to be met in a manner consistent with 4-2.10. (c) LE-C6 in Part 2 is to be met in a manner consistent with PRM-B9 above. (d) LE-C8 in Part 2 is to be met in a manner consistent with PRM-B6 above. and DEVELOP a defined basis to support the claim of nonapplicability of any of these requirements in Part 2.	Dispositioned	Quantification of the HBRSEP fire PRA model indicates that the fire-related LERF is about 90 percent of the fire-related CDF. This result is exceptionally high and has been self-identified by the utility. The result is produced by MSO events in the switchgear and cable spreading rooms that cause a core damaging accident sequence and also result in the spurious opening of several containment isolation valves. Fire-related LERF for HBRSEP is an unusually high proportion of the fire-related CDF. Typically, fire-related LERF is 10 - 25 percent of the fire-related CDF. At HBRSEP, fire-related LERF is about 90 percent of the fire-related CDF. Investigate ways to remove conservatisms from the HBRSEP fire PRA model, particularly for the MSOs in the switchgear and cable spreading rooms.	Following additional refinements to the model, LERF is more in line with typical results.

Table V-1 Fire PRA Peer Review – Facts and Observations (with RESOLUTION OF CAPABILITY CATEGORY CLASSIFICATION For Non-CAT II)

SR	Topic	Status	Finding	Disposition
PRM-C1 (CAT I/II/III)	DOCUMENT the Fire PRA plant response model in a manner consistent with HLR-IE-D, HLRAS-C, HLR-SC-C, HLR-SY-C, and HLR-DA-E and their SRs in Part 2 as well as 4-2.10 with the following clarifications: (a) HLR-IE-D in Part 2 is to be met in a manner consistent with that required under HLR-IGN-B of this Standard. (b) Document any defined bases to support the claim of nonapplicability of any of the referenced requirements in Part 2 beyond that already covered by the clarifications in this section.	Dispositioned	Documentation of development of the plant response model is spread over several calculations and documents. The primary documents are RNP-F/PSA-0066 (component selection) and P2217-1021-01-01 (quantification). Thus, key elements of the PRM development (e.g., assumptions that are made while developing the model) being dispersed and difficult to assimilate and comprehend. The dispersion of pertinent information about development of the PRM makes understanding of the development difficult for reviewers and for utility staff who will make future modifications to the HBRSEP fire PRA model and documentation. Develop a PRM-specific calculation or notebook which combines the pertinent portions of PRM documentation from existing documents or calculations.	The development of the plant response model is documented in Attachment 9 of RNP-/PSA-0066 via a model change log. RNP-F/PSA-0066 also discusses assumptions made during the development of the model.
UNC-A2 (CAT I/II/III) IGN-B5 (CAT I/II/III)	INCLUDE the treatment of uncertainties, including their documentation, as called out in SRs PRM-A4, FQ-F1, IGN-A10, IGN-B5, FSS-E3, FSS-E4, FSS-H5, FSS-H9, and CF-A2 and that required by performing Part 2 referenced requirements throughout this Standard.	Dispositioned	To comply with Section 2 applicable SRs intent for UNC, a final documentation of importance rankings considering various sensitivity studies along with applicable sequences is suggested to be included in the UNC discussion in an independent document.	Section 7.0 of the HBRSEP Fire PRA Quantification Calculation, provides an analysis of uncertainty regarding the quantification of the HBRSEP Fire PRA. Importance rankings are also discussed in this section. Additionally, Section 9.0 provides a discussion of sensitivities that were evaluated.