UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

April 29, 2014

Mr. Oscar A. Limpias
Vice President-Nuclear and CNO
Nebraska Public Power District
72676 648A Avenue
Brownville, NE 68321

SUBJECT: COOPER NUCLEAR STATION – ISSUANCE OF AMENDMENT REGARDING TRANSITION TO A RISK-INFORMED, PERFORMANCE-BASED FIRE PROTECTION PROGRAM IN ACCORDANCE WITH 10 CFR 50.48(c) (TAC NO. ME8551)

Dear Mr. Limpias:

The U.S. Nuclear Regulatory Commission (NRC) has issued the enclosed Amendment No. 248 to Renewed Facility Operating License No. DPR-46 for the Cooper Nuclear Station (CNS). The amendment consists of changes to the license and Technical Specifications (TSs) in response to your application dated April 24, 2012, as supplemented by letters dated July 12, 2012; January 14, February 12, March 13, June 13, and December 12, 2013; and January 17, February 18, and April 11, 2014. Nebraska Public Power District (NPPD, the licensee), submitted a license amendment request (LAR) to revise the fire protection program in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.48(c), for Cooper and change the license and TSs accordingly.

The proposed amendment would transition the CNS fire protection program to a risk-informed, performance-based program based on National Fire Protection Association (NFPA) 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants, 2001 Edition" (NFPA 805), in accordance with 10 CFR 50.48(c). NFPA 805 allows the use of performance-based methods such as fire modeling and risk-informed methods such as fire probabilistic risk assessment to demonstrate compliance with the nuclear safety performance criteria.

The fire protection license condition in CNS's license is revised to reflect the use of NFPA 805. To assure proper pagination of the license, the NRC is issuing license pages 3 through 8, but the only changes are the changes to the fire protection license condition.

A copy of the related Safety Evaluation is also enclosed. A Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

Joseph M. Sebrosky, Senior Project Manager
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-298

Enclosures:
1. Amendment No. 248 to DPR-46
2. Safety Evaluation

cc w/encls: Distribution via Listserv

ENCLOSURE 1

AMENDMENT NO. 248

TO RENEWED FACILITY OPERATING LICENSE NO. DPR-46

NEBRASKA PUBLIC POWER DISTRICT

COOPER NUCLEAR STATION

DOCKET NO. 50-298

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

NEBRASKA PUBLIC POWER DISTRICT

COOPER NUCLEAR STATION

DOCKET NO. 50-298

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 248
License No. DPR-46

1. The U.S. Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Nebraska Public Power District (the licensee), dated April 24, 2012, as supplemented by letters dated July 12, 2012; January 14, February 12, March 13, June 13, and December 12, 2013; and January 17, February 18, and April 11, 2014, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and Paragraph 2.C.(2) of Renewed Facility Operating License No. DPR-46 is hereby amended to read as follows:

(2) Technical Specifications and Environmental Protection Plan*

The Technical Specifications contained in Appendix A, as revised through Amendment No. 248, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

In addition, the license is amended as indicated in the attachment to this license amendment, and Paragraph 2.C.(4) of Facility Operating License No. DPR-46 is hereby amended to read as follows:

(4) Fire Protection

NPPD 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 April 24, 2012 (and supplements dated July 12, 2012, January 14, 2013, February 12, 2013, March 13, 2013, June 13, 2013, December 12, 2013, January 17, 2014, February 18, 2014, and April 11, 2014), and as approved in the safety evaluation dated April 29, 2014. 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 listed below are satisfied.

(a) 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 CNS. 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.

1. 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 plant change evaluation.

2. Prior NRC review and approval is not required for individual changes that result in a risk increase less than $1x10^{-7}$/year (yr) for CDF and less than $1x10^{-8}$/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 plant change evaluation.

(b) <u>Other Changes that May Be Made Without Prior NRC Approval</u>

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 an 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 April 29, 2014, 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.

(c) <u>Transition License Conditions</u>

1. Before achieving full compliance with 10 CFR 50.48(c), as specified by (c)2. below, risk-informed changes to NPPD'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 (b)2. above.

2. The licensee shall implement the modifications to its facility, as described in Table S-2, "Plant Modifications Committed," of NPPD letter NLS2014015, dated February 18, 2014, to complete the transition to full compliance with 10 CFR 50.48(c) prior to startup from the first refueling outage greater than 12 months following the issuance of the License Amendment. The licensee shall maintain appropriate compensatory measures in place until completion of these modifications.

3. The licensee shall implement the items S-3.1 through S-3.29 as listed in Table S-3, "Implementation Items," of NPPD letter NLS2014015, dated February 18, 2014, within 12 months after issuance of the License Amendment.

4. The licensee shall implement item S-3.30 as listed in Table S-3, "Implementation Items," of NPPD letter NLS2014015, dated February 18, 2014, no later than May 31, 2017.

3. This license amendment is effective as of its date of issuance and shall be implemented by 12 months from the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Michael T. Markley

Michael T. Markley, Chief
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Renewed Facility Operating License No. DPR-46 and Technical Specifications

Date of Issuance: April 29, 2014

ATTACHMENT TO LICENSE AMENDMENT NO. 248

TO RENEWED FACILITY OPERATING LICENSE NO. DPR-46

DOCKET NO. 50-298

Replace the following pages of Renewed Facility Operating License No. DPR-46 with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

REMOVE	INSERT
3 through 6	3 through 8

Replace the following page of Appendix A, Technical Specifications, with the attached revised page. The revised page is identified by amendment number and contains marginal lines indicating the areas of change.

REMOVE	INSERT
5.0-5	5.0-5

(5) Pursuant to the Act and 10 CFR Parts 30, 40, and 70, to possess, but not separate, such byproduct and special nuclear materials as may be produced by operation of the facility.

C. This license shall be deemed to contain and is subject to the conditions specified in the following Commission regulations in 10 CFR Chapter I: Part 20, Section 30.34 of Part 30, Section 40.41 of Part 40, Sections 50.54 and 50.59 of Part 50, and Section 70.32 of Part 70; is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

The licensee is authorized to operate the facility at steady state reactor core power levels not in excess of 2419 megawatts (thermal).

(2) Technical Specifications

The Technical Specifications contained in Appendix A as revised through Amendment No. 248, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

(3) Physical Protection

The licensee shall fully implement and maintain in effect all provisions of the Commission-approved physical security, training and qualification and safeguards contingency plans including amendments made pursuant to provisions of the Miscellaneous Amendments and Search Requirements revisions to 10 CFR 73.55 (51 FR 27817 and 27822) and to the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The combined set of plans, which contain Safeguards Information protected under 10 CFR 73.21, are entitled: "Cooper Nuclear Station Safeguards Plan," submitted by letter dated May 17, 2006.

NPPD shall fully implement and maintain in effect all provisions of the Commission-approved cyber security plan (CSP), including changes made pursuant to the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The NPPD CSP was approved by License Amendment No. 238 as supplemented by a change approved by License Amendment No. 244.

(4) Fire Protection

NPPD 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 April 24, 2012 (and supplements dated July 12, 2012, January 14, 2013, February 12, 2013, March 13, 2013, June 13, 2013, December 12, 2013, January 17, 2014, February 18, 2014, and April 11, 2014), and as approved in the safety evaluation dated April 29, 2014. 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 listed below are satisfied.

(a) 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 CNS. 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.

1. 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 plant change evaluation.

2. Prior NRC review and approval is not required for individual changes that result in a risk increase less than 1×10^{-7}/year (yr) for CDF and less than 1×10^{-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 plant change evaluation.

(b) 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 an 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 April 29, 2014, 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.

(c) Transition License Conditions

1. Before achieving full compliance with 10 CFR 50.48(c), as specified by (c)2. below, risk-informed changes to NPPD'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 (b)2. above.

2. The licensee shall implement the modifications to its facility, as described in Table S-2, "Plant Modifications Committed," of NPPD letter NLS2014015, dated February 18, 2014, to complete the transition to full compliance with 10 CFR 50.48(c) prior to startup from the first refueling outage greater than 12 months following the issuance of the License Amendment. The licensee shall maintain appropriate compensatory measures in place until completion of these modifications.

3. The licensee shall implement the items S-3.1 through S-3.29 as listed in Table S-3, "Implementation Items," of NPPD letter NLS2014015, dated February 18, 2014, within 12 months after issuance of the License Amendment.

4. The licensee shall implement item S-3.30 as listed in Table S-3, "Implementation Items," of NPPD letter NLS2014015, dated February 18, 2014, no later than May 31, 2017.

(5) Additional Conditions

The Additional Conditions contained in Appendix C, as revised through Amendment No. 178, are hereby incorporated into this license. Nebraska Public Power District shall operate the facility in accordance with the Additional Conditions.

(6) Deleted

(7) Mitigation Strategy License Condition

Develop and maintain strategies for addressing large fires and explosions and that include the following key areas:

(a) Fire fighting response strategy with the following elements:
1. Pre-defined coordinated fire response strategy and guidance
2. Assessment of mutual aid fire fighting assets
3. Designated staging areas for equipment and materials
4. Command and control
5. Training of response personnel

(b) Operations to mitigate fuel damage considering the following:
1. Protection and use of personnel assets
2. Communications
3. Minimizing fire spread
4. Procedures for implementing integrated fire response strategy
5. Identification of readily-available pre-staged equipment
6. Training on integrated fire response strategy
7. Spent fuel pool mitigation measures

(c) Actions to minimize release to include consideration of:
1. Water spray scrubbing
2. Dose to onsite responders

(8) The licensee shall implement and maintain all Actions required by Attachment 2 to NRC Order EA-06-137, issued June 20, 2006, except the last action that requires incorporation of the strategies into the site security plan, contingency plan, emergency plan and/or guard training and qualification plan, as appropriate.

(9) Upon implementation of Amendment No. 230 adopting TSTF-448-A, Revision 3, the determination of control room envelope (CRE) unfiltered air inleakage as required by SR 3.7.4.4, in accordance with Specification 5.5.13.c.(i), the assessment of CRE habitability as required by Specification 5.5.13.c.(ii), and the measurement of CRE pressure as required by Specification 5.5.13.d, shall be considered met. Following implementation:

(a) The first performance of SR 3.7.4.4, in accordance with Specification 5.5.13.c.(i), shall be within the specified Frequency of 6 years, plus the 18-month allowance of SR 3.0.2, as measured from July 12, 2004, the date of the most recent successful tracer gas test. (The tracer gas test was stated to have been performed in July, 2004, in the September 30, 2004 letter response to Generic Letter 2003-01).

(b) The first performance of the periodic assessment of CRE habitability, Specification 5.5.13.c.(ii), shall be within the next 9 months.

(c) The first performance of the periodic measurement of CRE pressure, Specification 5.5.13.d, shall be within 18 months, plus the 138 days allowed by SR 3.0.2, as measured from May 4, 2007, the date of the most recent successful pressure measurement test.

D. (Not Used)

E. The Updated Safety Analysis Report (USAR) supplement, as revised, submitted pursuant to 10 CFR 54.21(d), shall be included in the next scheduled update to the USAR required by 10 CFR 50.71(e)(4), as appropriate, following the issuance of this renewed operating license. Commitment Numbers NLS2008071-01 (Revision 1), NLS2008071-02 through 04, NLS2008071-05 (Revision 1), NLS2008071-06 (Revision 1), NLS2008071-07, NLS2008071-08 (Revision 3), NLS2008071-09, NLS2008071-10, NLS2008071-11 (Revision 1), NLS2008071-12 through 15, NLS2008071-16 (Revision 2), NLS2008071-17 through 22, NLS2008071-23 (Revision 1), NLS2008071-24, NLS2008071-25 (and Supplement 1), NLS2008071-26, NLS2009100-1 (Revision 1), NLS2009100-2, NLS2009100-3, NLS2010019-01, NLS2010019-02, NLS2010044-01, NLS2010050-01 through NLS2010050-03, NLS2010050-04 (Revision 1), NLS2010050-05 (Revision 1), NLS2010050-06, NLS2010062-01, and NLS2010062-02 shall be incorporated in the first update to the USAR required by 10 CFR 50.71(e)(4) following incorporation of the original USAR supplement. Until these respective updates are complete, the licensee may not make changes to the information in the supplement, or the above commitments. Following incorporation of the supplement and commitments into the USAR, the need for Commission approval of any changes will be governed by 10 CFR 50.59.

F. The USAR supplement, as revised, describes certain future activities to be completed prior to and/or during the period of extended operation. The licensee shall complete these activities in accordance with Appendix A of NUREG-1944, "Safety Evaluation Report Related to the License Renewal of Cooper Nuclear Station," dated October 2010, as supplemented by letters from the licensee to the U.S. Nuclear Regulatory

Commission (NRC) dated November 15 and 18, 2010. The licensee shall notify the NRC in writing when implementation of these activities is complete and can be verified by NRC inspection.

G. This license is effective as of the date of issuance and shall expire at midnight, January 18, 2034.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Eric J. Leeds, Director
Office of Nuclear Reactor Regulation

Attachments:
Appendices A&B - Technical Specifications
Appendix C - Additional Conditions

Date of Issuance: November 29, 2010

5.0 ADMINISTRATIVE CONTROLS

5.4 Procedures

5.4.1 Written procedures shall be established, implemented, and maintained covering the following activities:

a. The applicable procedures recommended in Regulatory Guide 1.33, Revision 2, Appendix A, February 1978;

b. The emergency operating procedures required to implement the requirements of NUREG-0737 and NUREG-0737, Supplement 1, as stated in Generic Letter 82-33;

c. Quality assurance program for radioactive effluent and radiological environmental monitoring; and

d. Not Used

e. All programs specified in Specification 5.5.

ENCLOSURE 2

SAFETY EVALUATION BY THE

OFFICE OF NUCLEAR REACTOR REGULATION

TRANSITION TO A RISK-INFORMED, PERFORMANCE-BASED

FIRE PROTECTION PROGRAM IN ACCORDANCE WITH 10 CFR 50.48(c)

AMENDMENT NO. 248 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-46

NEBRASKA PUBLIC POWER DISTRICT

COOPER NUCLEAR STATION

DOCKET NO. 50-298

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SAFETY EVALUATION

ATTACHMENTS

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 248 TO

RENEWED FACILITY OPERATING LICENSE NO. DPR-46

TRANSITION TO A PERFORMANCE-BASED FIRE PROTECTION

PROGRAM IN ACCORDANCE WITH 10 CFR 50.48(c)

NEBRASKA PUBLIC POWER DISTRICT

COOPER NUCLEAR STATION

DOCKET NO. 50-298

1.0 INTRODUCTION

1.1 Background

The U.S. Nuclear Regulatory Commission (NRC) started developing fire protection requirements in the 1970s, and in 1976, the NRC published comprehensive fire protection guidelines in the form of Branch Technical Position (BTP) APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants" (Agencywide Documents Access and Management System (ADAMS) Accession No. ML070660461), and Appendix A to BTP APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants Docketed Prior to July 1, 1976" (ADAMS Accession No. ML070660458). Subsequently, the NRC performed fire protection reviews for the operating reactors, and documented the results in safety evaluation reports (SERs) or supplements to SERs. In 1980, to resolve issues identified in those reports, the NRC amended its regulations for fire protection in operating nuclear power plants and published its Final Rule, Fire Protection Program for Operating Nuclear Power Plants, in the *Federal Register* (FR) on November 19, 1980 (45 FR 76602), adding Section 50.48, "Fire Protection," and Appendix R to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979." Section 50.48(a)(1) of 10 CFR Part 50 requires each holder of an operating license, and holders of a combined operating license issued under Part 52 to have a fire protection plan that satisfies General Design Criterion (GDC) 3 of Appendix A to 10 CFR Part 50 and states that the fire protection plan must describe the overall fire protection program; identify the positions responsible for the program and the authority delegated to those positions; outline the plans for fire protection, fire detection and suppression capability, and limitation of fire damage. Section 50.48(a)(2) states that the fire protection plan must describe the specific features necessary to implement the program described in paragraph (a)(1) including administrative controls and personnel requirements; automatic and manual fire detection and suppression systems; and the means to limit fire damage to structures, systems, and components (SSCs) to ensure the capability to safely shut down the plant. Section 50.48(a)(3) requires that the licensee retain the fire protection plan and each change to the plan as a record until the Commission terminates the license and that the licensee retain each superseded revision of the procedures for 3 years.

In the 1990s, the NRC worked with the National Fire Protection Association (NFPA) and industry to develop a risk-informed (RI), performance-based (PB) consensus standard for fire protection. In 2001, the NFPA Standards Council issued NFPA 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants" (Reference 1), which describes a methodology for establishing fundamental fire protection program (FPP) design requirements and elements, determining required fire protection systems and features, applying PB requirements, and administering fire protection for existing light-water reactors during operation, decommissioning, and permanent shutdown. It provides for the establishment of a minimum set of fire protection requirements, but allows PB or deterministic approaches to be used to meet performance criteria.

Regulatory Guide (RG) 1.205, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants," Revision 1 (RG 1.205) (Reference 2), states, in part, that:

> On March 26, 1998, the staff sent to the Commission SECY-98-058, "Development of a Risk-Informed, Performance-Based Regulation for Fire Protection at Nuclear Power Plants" [Reference 3], in which it proposed to work with NFPA and the industry to develop a risk-informed, performance-based consensus standard for nuclear power plant fire protection. This consensus standard could be endorsed in a future rulemaking as an alternative set of fire protection requirements to the existing regulations in 10 CFR 50.48. In SECY-00-0009, "Rulemaking Plan, Reactor Fire Protection Risk-Informed, Performance-Based Rulemaking," dated January 13, 2000 [Reference 4], the NRC staff requested and received Commission approval to proceed with a rulemaking to permit reactor licensees to adopt NFPA 805 as an alternative to existing fire protection requirements. On February 9, 2001, the NFPA Standards Council approved the 2001 edition of NFPA 805 as an American National Standard for performance-based fire protection for light-water nuclear power plants.

An adoptee of NFPA 805 must meet the performance goals, objectives, and criteria that are itemized in Chapter 1 of NFPA 805 through the implementation of PB or deterministic approaches. The goals include ensuring that reactivity control, inventory and pressure control, decay heat removal, vital auxiliaries, and process monitoring are achieved and maintained. The adoptee then must establish plant fire protection requirements using the methodology in Chapter 2 of NFPA 805, such that the minimum FPP elements and design criteria contained in Chapter 3 of NFPA 805 are satisfied. Next, an adoptee identifies fire areas and fire hazards through a plant-wide analysis, and then applies either a PB or a deterministic approach to meet the performance criteria. As part of a PB approach, an adoptee will use engineering evaluations, probabilistic safety assessments, and fire modeling calculations to show that the criteria are met. Chapter 4 of NFPA 805 establishes the methodology to determine the fire protection systems and features required to achieve the performance criteria. It also specifies that at least one success path to achieve the nuclear safety performance criteria shall be maintained free of fire damage by a single fire.

RG 1.205 also states, in part, that:

> Effective July 16, 2004, the Commission amended its fire protection requirements in 10 CFR 50.48 to add 10 CFR 50.48(c), which incorporates by reference the 2001 edition of NFPA 805, with certain exceptions, and allows licensees to apply for a license amendment to comply with the 2001 edition of NFPA 805 (69 FR 33536). NFPA has issued subsequent editions of NFPA 805, but the regulation does not endorse them.

Throughout this safety evaluation (SE), where the NRC staff states that the licensee's FPP element is in compliance with (or meets the requirements of) NFPA 805, the NRC staff is referring to NFPA 805 with the exceptions, modifications, and supplements described in 10 CFR 50.48(c)(2).

RG 1.205 also states, in part, that:

> In parallel with the Commission's efforts to issue a rule incorporating the risk-informed, performance-based fire protection provisions of NFPA 805, NEI [the Nuclear Energy Institute] published implementing guidance for the specific provisions of NFPA 805 and 10 CFR 50.48(c) in NEI 04-02, ["Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c)."]

RG 1.205 provides the NRC staff's position on NEI 04-02, Revision 2 (Reference 5), and offers additional information and guidance to supplement the NEI document and assist licensees in meeting the NRC's regulations in 10 CFR 50.48(c) related to adopting a risk-informed, performance-based (RI/PB) FPP. RG 1.205 endorses the guidance of NEI 04-02, Revision 2, subject to certain exceptions, as providing methods acceptable to the staff for adopting an FPP consistent with the 2001 edition of NFPA 805 and complying with the regulations in 10 CFR 50.48(c).

Accordingly, Nebraska Public Power District (NPPD, the licensee), requested a license amendment to allow the licensee to revise the Cooper Nuclear Station (CNS) FPP in accordance with 10 CFR 50.48(c) and change the license and technical specifications (TSs) accordingly.

1.2 Requested Licensing Action

By letter to the NRC dated April 24, 2012 (Reference 6), as supplemented by letters dated July 12, 2012 (Reference 7), January 14, 2013 (Reference 9), February 12, 2013 (Reference 10), March 13, 2013 (Reference 11), June 13, 2013 (Reference 12), December 12, 2013 (Reference 13), January 17, 2014 (Reference 14), February 18, 2014 (Reference 15), and April 11, 2014 (Reference 8), the licensee submitted an application for a license amendment to transition the CNS FPP from 10 CFR 50.48(b) to 10 CFR 50.48(c), NFPA 805, "Performance-Based Standard for Fire Protection For Light Water Reactor Electric Generating Plants," 2001 Edition. The supplemental letters were in response to the NRC staff's requests for additional information (RAIs) dated November 14, 2012 (Reference 16), and November 14, 2013 (Reference 17). The licensee's supplemental letters dated December 12, 2013, and January 17, February 18, and April 11, 2014, provided additional information that clarified the application, did not expand the scope of the application as originally noticed, and did not change the NRC staff's original proposed no significant hazards consideration determination as published in the *Federal Register* (FR) on November 26, 2013 (78 FR 70593). Additionally, the *Federal Register* notice listed a letter to the NRC dated August 23, 2012 (ADAMS Accession No. ML12248A069) which agreed to terms for NRC staff have limited online access to licensee documents related to the amendment request. Since the letter is administrative and provides no technical information related to the application, it is not referenced in this SE, in the license amendment, or in the *Federal Register* notice of issuance.

The licensee requested an amendment to the CNS renewed facility operating license and TSs in order to establish and maintain an RI/PB FPP in accordance with the requirements of 10 CFR 50.48(c).

Specifically, the licensee requested to transition from the existing deterministic fire protection licensing basis - established in accordance with all provisions of the approved FPP as described in the CNS Updated Safety Analysis Report (USAR) and as approved in the SEs dated November 29, 1977 (Reference 57); May 23, 1979 (Reference 54); November 21, 1980 Reference 55); April 29, 1983 (Reference 93); April 16, 1984 (Reference 94); June 1, 1984 (Reference 95); January 3, 1985 (Reference 96); August 21, 1985 (Reference 97); April 10, 1986 (Reference 98); September 9, 1986 (Reference 99); November 7,1988 (Reference 100); February 3, 1989 (Reference 101); August 15,1995 (Reference 102); and July 31, 1998 (Reference 103) - to an RI/PB FPP in accordance with 10 CFR 50.48(c), that uses risk information, in part, to demonstrate compliance with the fire protection and nuclear safety goals, objectives, and performance criteria of NFPA 805. As such, the proposed FPP at CNS is referred to as RI/PB throughout this SE.

In its license amendment request (LAR), the licensee provided a description of the revised FPP for which it is requesting NRC approval to implement, a description of the FPP that it will implement under 10 CFR 50.48(a) and (c), and the results of the evaluations and analyses required by NFPA 805.

This SE documents the NRC staff's evaluation of the licensee's LAR and the NRC staff's conclusion that:

1) The licensee has identified any orders and license conditions that must be revised or superseded, and has provided the necessary revisions to the plant's TSs and TS Bases, as required by 10 CFR 50.48(c)(3)(i);

2) The licensee has completed its implementation of the methodology in Chapter 2, "Methodology," of NFPA 805 (including all required evaluations and analyses), and the NRC staff has approved the licensee's modified FPP, which reflects the decision to comply with NFPA 805, as required by 10 CFR 50.48(a); and

3) The licensee will modify its FPP, as described in the LAR, in accordance with the implementation schedule set forth in this SE and the accompanying license condition, as required by 10 CFR 50.48(c)(3)(ii).

The licensee proposed a new fire protection license condition reflecting the new RI/PB FPP licensing basis, as well as revisions to the TSs that address this change to the current FPP licensing basis. Section 2.4.2 and Section 4.0 of this SE discuss in detail the license condition, and Section 2.4.3 discusses the TS changes.

2.0 REGULATORY EVALUATION

Section 50.48, "Fire Protection," of 10 CFR provides the NRC requirements for nuclear power plant fire protection. The NRC regulations include specific requirements for requesting approval for an RI/PB FPP based on the provisions of NFPA 805 (Reference 1). Paragraph 50.48(c)(3)(i) of 10 CFR states, in part, that:

> A licensee may maintain a fire protection program that complies with NFPA 805 as an alternative to complying with [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. The licensee shall submit a request to comply with NFPA 805 in the form of an application for license amendment under [10 CFR] 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.

In addition, 10 CFR 50.48(c)(3)(ii) states that:

> 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 intent of 10 CFR 50.48(c)(3)(ii) is given in the statement of considerations for the Final Rule, Voluntary Fire Protection Requirements for Light Water Reactors; Adoption of NFPA 805 as a Risk-Informed, Performance-Based Alternative (69 FR 33536, 33548; June 16, 2004), which states:

> This paragraph requires licensees to complete all of the Chapter 2 methodology (including evaluations and analyses) and to modify their fire protection plan before making changes to the fire protection program or to the plant configuration. This process ensures that the transition to an NFPA 805 configuration is conducted in a complete, controlled, integrated, and organized manner. This requirement also precludes licensees from implementing NFPA 805 on a partial or selective basis (*e.g.*, in some fire areas and not others, or truncating the methodology within a given fire area).

As stated in 10 CFR 50.48(c)(3)(i), the Director of the Office of Nuclear Reactor Regulation (NRR), 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 TSs that must be revised or superseded, and that any necessary revisions are adequate.

The regulations also allow for flexibility that was not included in the NFPA 805 standard. Licensees who choose to adopt 10 CFR 50.48(c), but wish to use the PB methods permitted elsewhere in the standard to meet the fire protection requirements of NFPA 805 Chapter 3, "Fundamental Fire Protection Program and Design Elements," must submit a LAR to obtain approval in accordance with 10 CFR 50.48(c)(2)(vii). This regulation further provides that:

> 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).

Alternatively, licensees who want to use RI or PB alternatives to comply with NFPA 805 must obtain approval by submitting a LAR as required in 10 CFR 50.48(c)(4). This regulation further provides that:

> 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).

In addition to the conditions outlined by the rule that require licensees to submit an LAR for NRC review and approval in order to adopt an RI/PB FPP, a licensee may submit additional elements of its FPP for which it wishes to receive specific NRC review and approval, as set forth in Regulatory Position C.2.2.1 of RG 1.205 (Reference 2). Inclusion of these elements in the NFPA 805 LAR is meant to alleviate uncertainty in portions of the current FPP licensing bases as a result of the lack of specific NRC approval of these elements. Regulatory guides are not substitutes for regulations, and compliance with them is not required. Methods and solutions that differ from those set forth in regulatory guides will be deemed acceptable if they provide a basis for the findings required for the issuance or continuance of a permit or license by the Commission. Accordingly, any submittal addressing these additional FPP elements needs to include sufficient detail to allow the NRC staff to assess whether the licensee's treatment of these elements meets 10 CFR 50.48(c) requirements.

The purpose of the FPP established by NFPA 805 is to provide assurance, through a defense-in-depth (DID) philosophy, that the NRC's fire protection objectives are satisfied. NFPA 805 Section 1.2, "Defense-in-Depth," states the following:

> Protecting the safety of the public, the environment, and plant personnel from a plant fire and its potential effect on safe reactor operations is paramount to this standard. The fire protection standard shall be based on the concept of defense-in-depth. Defense-in-depth shall be achieved when an adequate balance of each of the following elements is provided:
>
> (1) Preventing fires from starting
>
> (2) Rapidly detecting fires and controlling and extinguishing promptly those fires that do occur, thereby limiting fire damage
>
> (3) Providing an 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 addition, in accordance with GDC 3, "Fire protection," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, fire detection and fighting systems must be designed such that their rupture or inadvertent operation does not significantly impair the ability of the SSCs important to safety to perform their intended safety functions.

2.1 Applicable Regulations

The following regulations address fire protection:

- GDC 3, "Fire protection," to 10 CFR Part 50, Appendix A:

  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. Noncombustible and heat resistant materials shall be used wherever practical throughout the unit, particularly in locations such as the containment and control room. 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. 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.

- 10 CFR 50.48(a)(1) requires that each holder of an operating license have a fire protection plan that satisfies GDC 3 of Appendix A to 10 CFR Part 50.

- 10 CFR 50.48(c) incorporates NFPA 805 (2001 Edition) by reference, with certain exceptions, modifications and supplementation. This regulation establishes the requirements for using an RI/PB FPP in conformance with NFPA 805 as an alternative to the requirements associated with 10 CFR 50.48(b) and Appendix R, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979," to 10 CFR Part 50, or the specific plant fire protection license condition.

- 10 CFR Part 20, "Standards for Protection Against Radiation," establishes the radiation protection limits used as NFPA 805 radioactive release performance criteria, as specified in NFPA 805, Section 1.5.2, "Radioactive Release Performance Criteria."

2.2 Applicable Staff Guidance

The NRC staff review also relied on the following additional codes, regulatory guides, and standards:

- RG 1.205, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants," Revision 1, issued December 2009 (Reference 2), provides guidance for use in complying with the requirements that the NRC has promulgated for RI/PB FPPs that comply with 10 CFR 50.48 and the referenced 2001 Edition of the NFPA standard. It endorses portions of NEI 04-02, Revision 2 (Reference 5), where it has been found to provide methods acceptable to the NRC for implementing NFPA 805 and complying with 10 CFR 50.48(c). The regulatory positions in Section C of RG 1.205 include clarification of the guidance provided in NEI 04-02, as well as NRC exceptions to the guidance. RG 1.205 sets forth regulatory positions, emphasizes certain issues, clarifies the requirements of 10 CFR 50.48(c) and NFPA 805, clarifies the guidance in NEI 04-02, and provides exceptions to the NEI 04-02 guidance where required. Should a conflict occur between NEI 04-02 and this RG, the regulatory positions in RG 1.205 govern.

- The 2001 Edition of NFPA 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants" (Reference 1), specifies the minimum fire protection requirements for existing light-water nuclear power plants during all phases of plant operations, including shutdown, degraded conditions, and decommissioning, which had not been explicitly addressed by previous requirements and guidelines. NFPA 805 was developed to provide a comprehensive RI/PB standard for fire protection. The NFPA 805 Technical Committee on Nuclear Facilities is composed of nuclear plant licensees, the

NRC, insurers, equipment manufacturers, and subject matter experts. The standard was developed in accordance with NFPA processes, and consisted of a number of technical meetings and reviews of draft documents by committee and industry representatives. The scope of NFPA 805 includes goals related to nuclear safety, radioactive release, life safety, and plant damage/business interruption. The standard addresses fire protection requirements for nuclear plants during all plant operating modes and conditions, including shutdown and decommissioning, which had not been explicitly addressed by previous requirements and guidelines. NFPA 805 became effective on February 9, 2001.

- NEI 04-02, "Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c)," Revision 2 (Reference 5), provides guidance for implementing the requirements of 10 CFR 50.48(c), and represents methods for implementing in whole or in part an RI/PB FPP. This implementing guidance for NFPA 805 has two primary purposes: (1) to provide direction and clarification for adopting NFPA 805 as an acceptable approach to fire protection, consistent with 10 CFR 50.48(c); and (2) to provide additional supplemental technical guidance and methods for using NFPA 805 and its appendices to demonstrate compliance with fire protection requirements. Although there is a significant amount of detail in NFPA 805 and its appendices, clarification and additional guidance for select issues help ensure consistency and effective utilization of the standard. The NEI 04-02 guidance focuses attention on the RI/PB fire protection goals, objectives, and performance criteria contained in NFPA 805 and the RI/PB tools considered acceptable for demonstrating compliance. Revision 2 of NEI 04-02 incorporates guidance from RG 1.205 and approved Frequently Asked Questions (FAQs).

- NEI 00-01, "Guidance for Post Fire Safe Shutdown Circuit Analysis," Revision 2, (Reference 18), provides a deterministic methodology for performing post-fire safe shutdown analysis (SSA). In addition, NEI 00-01 includes information on risk-informed methods (when allowed within a plant's licensing basis) that may be used in conjunction with the deterministic methods for resolving circuit failure issues related to Multiple Spurious Operations (MSOs). The risk-informed method is intended for application by licensees to determine the risk significance of identified circuit failure issues related to MSOs.

- RG 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," Revision 2, issued May 2011 (Reference 19), provides the NRC staff's recommendations for using risk information in support of licensee-initiated licensing basis changes to a nuclear power plant that require such review and approval. The guidance provided does not preclude other approaches for requesting licensing basis changes. Rather, RG 1.174 is intended to improve consistency in regulatory decisions in areas in which the results of risk analyses are used to help justify regulatory action. As such, the RG provides general guidance concerning one approach that the NRC has determined to be acceptable for analyzing issues associated with proposed changes to a plant's licensing basis and for assessing the impact of such proposed changes on the risk associated with plant design and operation.

- RG 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," Revision 2, issued March 2009 (Reference 20), provides guidance to licensees for use in determining the technical adequacy of the base probabilistic risk assessment (PRA) used in a risk-informed regulatory activity, and endorses standards and industry peer review guidance. The RG provides guidance in four areas:

  (1) a definition of a technically acceptable PRA;

  (2) the NRC's position on PRA consensus standards and industry PRA peer review program documents;

  (3) demonstration that the baseline PRA (in total or specific pieces) used in regulatory applications is of sufficient technical adequacy; and

  (4) documentation needed to support a regulatory submittal.

  It does not provide guidance on how the base PRA is revised for a specific application or how the PRA results are used in application-specific decision-making processes.

- American Society of Mechanical Engineers/American Nuclear Society (ASME/ANS) RA-Sa-2009, "Addenda to ASME/ANS RA-S-2008, Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications" (Reference 21), provides guidance for PRAs used to support RI decisions for commercial light-water reactor nuclear power plants and prescribes a method for applying these requirements for specific applications. The Standard gives guidance for a Level 1 PRA of internal and external hazards for all plant operating modes. In addition, the Standard provides guidance for a limited Level 2 PRA sufficient to evaluate large early release frequency (LERF). The only hazards explicitly excluded from the scope are accidents resulting from purposeful human-induced security threats (e.g., sabotage). The Standard applies to PRAs used to support applications of RI decision-making related to design, licensing, procurement, construction, operation, and maintenance.

- RG 1.189, "Fire Protection for Nuclear Power Plants," Revision 2, issued October 2009 (Reference 22), provides guidance to licensees on the proper content and quality of engineering equivalency evaluations used to support the FPP. The NRC staff developed the RG to provide a comprehensive fire protection guidance document and to identify the scope and depth of fire protection that the staff would consider acceptable for nuclear power plants.

- NUREG-0800, Section 9.5.1.1, "Fire Protection Program," Revision 0, issued February 2009 (Reference 68), provides the NRC staff with guidance for evaluating LARs related to deterministic FPPs. Previous revisions of this section of NUREG-0800 were issued as Section 9.5.1.

- NUREG-0800, Section 9.5.1.2, "Risk-Informed, Performance-Based Fire Protection Program," Revision 0, issued December 2009 (Reference 23), provides the NRC staff with guidance for evaluating LARs that seek to implement an RI/PB FPP in accordance with 10 CFR 50.48(c).

- NUREG-0800, Section 19.1, "Determining the Technical Adequacy of Probabilistic Risk Assessment for Risk-Informed License Amendment Requests After Initial Fuel Load," Revision 3, issued September 2012 (Reference 24), provides the NRC staff with guidance for evaluating the technical adequacy of a licensee's PRA results when used to request RI changes to the licensing basis.

- NUREG-0800, Section 19.2, "Review of Risk Information Used to Support Permanent Plant-Specific Changes to the Licensing Basis: General Guidance," Revision 0, issued June 2007 (Reference 25), provides the NRC staff with guidance for evaluating the risk information used by a licensee to support permanent RI changes to the licensing basis.

- NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities," Volumes 1 and 2 and Supplement 1 (References 26, 27, and 28), presents a compendium of methods, data, and tools to perform a fire probabilistic risk assessment (FPRA) and develop associated insights. In order to address the need for improved methods, the NRC Office of Nuclear Regulatory Research (RES) and Electric Power Research Institute (EPRI) embarked upon a program to develop a state-of-art FPRA methodology. Both RES and EPRI provided specialists in fire risk analysis, fire modeling (FM), electrical engineering, human reliability analysis, and systems engineering for methods development. A formal technical issue resolution process was developed to direct the deliberative process between RES and EPRI. The process ensures that divergent technical views are fully considered, yet encourages consensus at many points during the deliberation. Significantly, the process provides that each party maintain its own point of view if consensus is not reached. Consensus was reached on all technical issues documented in NUREG/CR-6850. The methodology documented in this report reflects the current state-of-the-art in FPRA. These methods are expected to form a basis for risk-informed analyses related to the plant FPP. Volume 1, the Executive Summary, provides general background and overview information, project insights and conclusions. Volume 2 provides the detailed discussion of the recommended approach, methods, data, and tools for conduct of an FPRA. Supplement 1 provides certain FPRA methods enhancements.

- Interim Technical Guidance provided in a Memorandum from Richard P. Correia, RES, to Joseph G. Giitter, NRR, titled "Interim Technical Guidance on Fire-Induced Circuit Failure Mode Likelihood Analysis," dated June 14, 2013 (Reference 29), discusses that, based on new experimental information documented in NUREG/CR-6931, "Cable Response to Live Fire (CAROLFIRE)" issued April 2008 (Reference 30), and NUREG/CR-7100 "Direct Current Electrical Shorting in Response to Exposure Fire (DESIREE-Fire): Test Results," issued April 2012 (Reference 31), the effect of any control power transformer (CPT) reduction to the hot short-induced spurious operation likelihood could not be substantiated.

- NUREG-1805, "Fire Dynamics Tools (FDT^s): Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program" (Reference 32), provides quantitative methods, known as FDT^s, to assist regional fire protection inspectors in performing fire hazard analysis. The FDT^s are intended to assist fire protection inspectors in performing RI evaluations of credible fires that may cause critical damage to essential safe shutdown equipment.

- NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," Volumes 1 through 7 (Reference 33), provide technical documentation regarding the predictive capabilities of a specific set of fire models for the analysis of fire hazards in nuclear power plant scenarios. This report is the result of a collaborative program with the EPRI and the National Institute of Standards and Technology (NIST). The selected models are:

  (1) FDT^s developed by NRC (Volume 3);
  (2) The Fire-Induced Vulnerability Evaluation, Revision 1 (FIVE) developed by EPRI (Volume 4);
  (3) The zone model, Consolidated Model of Fire and Smoke Transport (CFAST), developed by NIST (Volume 5);
  (4) The zone model MAGIC developed by Electricite de France (EdF) (Volume 6); and
  (5) The computational fluid dynamics model, Fire Dynamics Simulator (FDS) developed, by NIST (Volume 7).

  In addition to the fire model volumes, Volume 1 is the comprehensive main report and Volume 2 is a description of the experiments and associated experimental uncertainty used in developing this report.

- NUREG/CR-7010, "Cable Heat Release, Ignition, and Spread in Tray Installations during Fire (CHRISTIFIRE), Phase 1: Horizontal Trays," Volume 1 (Reference 34), describes Phase 1 of the CHRISTIFIRE testing program conducted by NIST. The overall goal of this multiyear program is to quantify the burning characteristics of grouped electrical cables installed in cable trays. This first phase of the program focuses on horizontal tray configurations. CHRISTIFIRE addresses the burning behavior of a cable in a fire beyond the point of electrical failure. The data obtained from this project can be used for the development of fire models to calculate the heat release rate (HRR) and flame spread of a cable fire.

- NUREG-1855, Volume 1, "Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decision Making" (Reference 35), provides guidance on how to treat uncertainties associated with PRA in RI decision-making. The objectives of this guidance include fostering an understanding of the uncertainties associated with PRA and their impact on the results of PRA and providing a pragmatic approach to addressing these uncertainties in the context of the decision-making. To meet the objective of the NUREG, it is necessary to understand the role that PRA results play in the context of the decision process. To define this context, NUREG-1855 provides an overview of the RI decision-making process itself.

- NUREG-1921, "EPRI/NRC-RES Fire Human Reliability Analysis Guidelines – Final Report" (Reference 36), presents the state-of-the-art in fire human reliability analysis (HRA) practice. This report was developed jointly between RES and EPRI to develop the methodology and supporting guidelines for estimating human error probabilities (HEPs) for human failure events (HFEs) following the fire-induced initiating events of an FPRA. The report builds on existing HRA methods, and is intended primarily for practitioners conducting a fire HRA to support an FPRA.

- NUREG-1934, "Nuclear Power Plant Fire Modeling Analysis Guidelines (NPP FIRE MAG)" (Reference 80), describes the implications of the verification and validation results from NUREG-1824 for fire model users. The features and limitations of the fire models documented in NUREG-1824 are discussed relative to their use to support nuclear power plant fire hazard analyses. The report also provides information to assist fire model users in applying this technology in the nuclear power plant environment.

- Generic Letter (GL) 2006-03, "Potentially Nonconforming Hemyc and MT Fire Barrier Configurations" (Reference 63), requested that licensees evaluate their facilities to confirm compliance with the existing applicable regulatory requirements in light of the information provided in this GL and, if appropriate, take additional actions. Specifically, NRC testing revealed that, for the configurations tested, Hemyc and MT fire barriers failed to provide the protective function intended for compliance with existing regulations.

- NFPA 101, "Life Safety Code" (Reference 59), provides the minimum requirements for egress, features of fire protection, sprinkler systems, alarms, emergency lighting, smoke barriers, and special hazard protection.

- NFPA 20, "Standard for the Installation of Stationary Pumps for Fire Protection" (Reference 60), provides requirements for the selection and installation of pumps to ensure that systems will work as intended to deliver adequate and reliable water supplies in a fire emergency.
- NFPA 14, "Standard for the Installation of Standpipe and Hose Systems" (Reference 61), provides the minimum requirements for the installation of standpipes and hose systems to ensure that systems will work as intended to deliver adequate and reliable water supplies in a fire emergency. NFPA 14 covers all system components and hardware, including piping, fittings, valves, and pressure-regulation devices, as well as system requirements; installation requirements; design; plans and calculations; water supply; and system acceptance.
- NFPA 10, "Standard for Portable Fire Extinguishers" (Reference 62), provides requirements to ensure that portable fire extinguishers will work as intended to provide a first line of defense against fires of limited size.

2.3 NFPA 805 Frequently Asked Questions

In the LAR, the licensee proposed to use a number of documents commonly known as NFPA 805 FAQs. The following table provides the set of FAQs the licensee used that the NRC staff referenced in the preparation of this SE, as well as the SE section(s) in which each FAQ is referenced.

Table 2.3-1: NFPA 805 Frequently Asked Questions

FAQ #	FAQ Title and Summary	Reference No.	SE Section
07-0030	"Establishing Recovery Actions" • This FAQ provides an acceptable process for determining the recovery actions for NFPA 805 Chapter 4 compliance. The process includes: ▪ Differentiation between recovery actions and activities in the main control room or at primary control station(s). ▪ Determination of which recovery actions are required by the NFPA 805 fire protection program. ▪ Evaluate the additional risk presented by the use of recovery actions. ▪ Evaluate the feasibility of the identified recovery actions. ▪ Evaluate the reliability of the identified recovery actions.	37	3.2.5 3.4.4

FAQ #	FAQ Title and Summary	Reference No.	SE Section
07-0038	"Lessons Learned on Multiple Spurious Operations (MSOs)" • This FAQ reflects an acceptable process for the treatment of MSOs during transition to NFPA 805: ▪ Step 1 – Identify potential MSO combinations of concern. ▪ Step 2 – Expert panel assesses plant-specific vulnerabilities and reviews MSOs of concern. ▪ Step 3 – Update the fire PRA and Nuclear Safety Capability Assessment to include MSOs of concern. ▪ Step 4 – Evaluate for NFPA 805 compliance. ▪ Step 5 – Document the results.	38	3.2.4 3.2.7
07-0039	"Incorporation of Pilot Plant Lessons Learned – Table B-2" • This FAQ provides additional detail for the comparison of the licensee's safe shutdown strategy to the endorsed industry guidance, NEI 00-01, "Guidance for Post-Fire Safe Shutdown Circuit Analysis," Revision 1 (Reference 67). In short, the process has the licensee: ▪ Assemble industry and plant-specific documentation; ▪ Determine which sections of the guidance are applicable; ▪ Compare the existing safe shutdown methodology to the applicable guidance; and ▪ Document any discrepancies.	39	3.2.1
07-0040	"Non-Power Operations (NPO) Clarifications" • This FAQ clarifies an acceptable NFPA 805 NPO program. The process includes: ▪ Selecting NPO equipment and cabling. ▪ Evaluation of NPO Higher Risk Evolutions (HRE). ▪ Analyzing NPO key safety functions (KSF). ▪ Identifying plant areas to protect or "pinch points" during NPO HREs and actions to be taken if KSFs are lost.	40	3.5.3
08-0042	"Fire Propagation From Electrical Cabinets" • This FAQ provides clarification of NUREG/CR-6850 (EPRI 1011989) guidance for screening of electrical cabinets from overall set of ignition sources. ▪ Correct Guidance: Wording provided in Chapter 11 relative to fire propagation from electrical cabinets. ▪ Guidance to be Disregarded: Wording provided in Appendix G relative to the potential for fire spread beyond the boundaries of an un-vented cabinet.	41	3.4.2.2

<table>
<tr><th>FAQ #</th><th>FAQ Title and Summary</th><th>Reference No.</th><th>SE Section</th></tr>
<tr><td>08-0046</td><td>"Incipient Fire Detection Systems"

• This FAQ provides guidance for modeling non-suppression probability when an incipient fire detection system is installed to monitor electrical cabinets.
• Applies to Aspirating Smoke Detectors installed as Very Early Warning Fire Detectors (VEWFDS) to monitor incipient degradation in electrical cabinets.</td><td>42</td><td>3.2.6</td></tr>
<tr><td>08-0048</td><td>"Revised Fire Ignition Frequencies"

• This FAQ provides an acceptable method for using updated fire ignition frequencies in the licensee's fire PRA. The method involves the use of sensitivity studies when the updated fire ignition frequencies are used.</td><td>43</td><td>3.4.7</td></tr>
<tr><td>08-0053</td><td>"Kerite-FR Cable Failure Thresholds"

• This FAQ provides guidance regarding the damage threshold for Kerite-FR cable.</td><td>45</td><td>3.4.2.2</td></tr>
<tr><td>08-0054</td><td>"Demonstrating Compliance with Chapter 4 of NFPA 805"

• This FAQ provides an acceptable process to demonstrate Chapter 4 compliance for transition:
▪ Step 1 – Assemble documentation
▪ Step 2 – Document Fulfillment of Nuclear Safety Performance Criteria
▪ Step 3 – Variance From Deterministic Requirements (VFDR) Identification, Characterization, and Resolution Considerations
▪ Step 4 – Performance-Based Evaluations
▪ Step 5 – Final VFDR Evaluation
▪ Step 6 – Document Required Fire Protection Systems and Features</td><td>46</td><td>3.5.1.4
3.4.3</td></tr>
<tr><td>09-0056</td><td>"Radioactive Release Transition"

• This FAQ provides an acceptable level of detail and content for the radioactive release section of the LAR. It includes:
▪ Justification of the compartmentation, if the radioactive release review is not performed on a fire area basis.
▪ Pre-fire plan and fire brigade training review results.
▪ Results from the review of engineering controls for gaseous and liquid effluents.</td><td>47</td><td>3.6.1</td></tr>
</table>

FAQ #	FAQ Title and Summary	Reference No.	SE Section
10-0059	"NFPA 805 Monitoring Program" • This FAQ provides clarification regarding the implementation of an NFPA 805 monitoring program for transition. It includes: ▪ Monitoring program analysis units; ▪ Screening of low safety significant structures, systems, and components; ▪ Action level thresholds; and ▪ The use of existing monitoring programs.	48	3.7
12-0062	"Updated Final Safety Analysis Report (UFSAR) Content" • This FAQ provides guidance on the content and necessary level of detail for the transition of the fire protection sections within the UFSAR.	51	2.4.4

2.4 Orders, License Conditions, and Technical Specifications

Paragraph 50.48(c)(3)(i) of 10 CFR states that the LAR "... 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."

2.4.1 Orders

The NRC staff reviewed Section 5.2.3, "Orders and Exemptions," and Attachment O, "Orders and Exemptions," of CNS's LAR dated April 24, 2012 (Reference 6), with regard to NRC-issued Orders pertinent to CNS that are being revised or superseded by the NFPA 805 transition process. The LAR stated that the licensee conducted a review of its docketed correspondence to determine if there were any orders or exemptions that needed to be superseded or revised. The LAR also stated that the licensee conducted a review to ensure that compliance with the physical protection requirements, security orders, and adherence to those commitments applicable to CNS are maintained. The licensee discussed the affected orders and exemptions in Attachment O of the LAR.

The licensee requested that 10 exemptions be rescinded, and determined that no Orders need to be superseded or revised to implement an FPP at CNS that complies with 10 CFR 50.48(c).

The licensee's review included an assessment of docketed correspondence files and electronic searches, including the NRC's Agencywide Documents Access and Management System (ADAMS). The review was performed to ensure that compliance with the physical protection requirements, security orders, and adherence to commitments applicable to CNS are maintained. The NRC staff concludes that the licensee's determination that 10 exemptions should be rescinded (i.e. no exemptions are transitioned to NFPA 805 as listed in Attachment K of the LAR) and that no Orders need to be superseded or revised to implement NFPA 805 at

CNS is appropriate. See Section 2.5 of this SE for the NRC staff's detailed evaluation of the exemptions being rescinded.

In addition, the licensee performed a specific review of the license amendment that incorporated the mitigation strategies required by 10 CFR 50.54(hh)(2) to ensure that any changes being made in order to comply with 10 CFR 50.48(c) do not invalidate existing commitments applicable to CNS. The licensee's review of this regulation and the related license amendment demonstrated that changes to the FPP during transition to NFPA 805 will not affect the mitigation measures required by 10 CFR 50.54(hh)(2) because the licensee will continue to have strategies that address large fires and explosions including a firefighting response strategy, operations to mitigate fuel damage, and actions to minimize release upon transition to NFPA 805. The NRC staff concludes that the licensee's determination in regard to 10 CFR 50.54(hh)(2) is acceptable.

2.4.2 License Conditions

The NRC staff reviewed LAR Section 5.2.1, "License Condition Changes," and Attachment M, "License Condition Changes," regarding changes the licensee seeks to make to the CNS fire protection license condition in order to adopt NFPA 805, as required by 10 CFR 50.48(c)(3).

The NRC staff reviewed the revised license condition, which supersedes the current CNS fire protection license condition, for consistency with the format and content guidance in Regulatory Position C.3.1 of RG 1.205, Revision 1, and with the proposed plant modifications identified in the LAR.

The revised license condition provides a structure and detailed criteria to allow self-approval for RI/PB as well as other types of changes to the FPP. The structure and detailed criteria result in a process that meets the requirements in Sections 2.4, Engineering Analyses, 2.4.3, Fire Risk Evaluations, and 2.4.4, Plant Change Evaluation of NFPA 805. These sections establish the requirements for the content and quality of the engineering evaluations to be used for approval of changes.

The revised license condition also defines the limitations imposed on the licensee during the transition phase of plant operations when the physical plant configuration does not fully match the configuration represented in the fire risk analysis. The limitations on self-approval are required because NFPA 805 requires that the risk analyses be based on the as-built, as-operated, and maintained plant, and reflect the operating experience at the plant. Until the proposed implementation items and plant modifications are completed, the risk analysis is not based on the as-built, as-operated and maintained plant.

Overall, the licensee's proposed revised license condition allows self-approval for FPP changes that meet the requirements of NFPA 805 with regard to engineering analyses, fire risk evaluations (FREs), and plant change evaluations (PCEs). The NRC staff's evaluation of the self-approval process for FPP changes (post-transition) is contained in Section 2.6 of this SE. The license condition also references the plant-specific modifications, and associated implementation schedules that must be accomplished at CNS to complete transition to NFPA 805 and comply with 10 CFR 50.48(c). In addition, the license condition includes a requirement that appropriate compensatory measures will remain in place until implementation of the specified plant modifications is completed. These modifications and implementation schedules are identical to those identified elsewhere in the LAR, as discussed by the NRC staff in Sections 2.7.1 and 2.7.2, and reviewed in Section 3.0, of this SE.

Section 4.0 of this SE provides the NRC staff's review of the proposed CNS FPP license condition.

2.4.3 Technical Specifications

The NRC staff reviewed LAR Section 5.2.2, "Technical Specifications," and Attachment N, "Technical Specification Changes," with regard to proposed changes to the CNS TSs that are being revised or superseded during the NFPA 805 transition process. According to the LAR, the licensee conducted a review of the CNS TSs to determine which, if any, TS sections will be impacted by the transition to an RI/PB FPP based on 10 CFR 50.48(c).

The licensee identified changes to the TSs needed for CNS adoption of the new fire protection licensing basis and provided applicable justification listed in Attachment N of its submittal dated April 24, 2012. The NRC staff found that the licensee had previously requested and obtained NRC approval for removal of fire protection requirements from the CNS TSs in Amendment No. 178 (Reference 50). Although the licensee previously removed fire protection requirements from the CNS TSs, the licensee did identify one change to the TS that involved deleting TS 5.4.1.d, which requires that procedures be established, implemented, and maintained for FPP implementation. The licensee stated that deleting TS 5.4.1.d is acceptable for adoption of the new fire protection licensing basis since the requirement for establishing, implementing, and maintaining fire protection procedures is embodied in 10 CFR 50.48(c)(1), which approves the incorporation of NFPA 805 by reference and that NFPA 805 Section 3.2.2, "Procedures," states that "Procedures shall be established for implementation of the fire protection program." The licensee further stated that removal of administrative controls TSs that are redundant to other regulatory requirements is consistent with established NRC guidance.

Based on the information provided by the licensee, the NRC staff concludes that the proposed change to the TS is acceptable because TS 5.4.1.d is an administrative control, NFPA 805 requires the licensee to establish FPP procedures, and 10 CFR 50.48(a) would become the fire protection licensing basis of CNS.

2.4.4 Updated Safety Analysis Report

The NRC staff reviewed LAR Attachment S, Table S-3, "Implementation Items," with regard to changes the licensee is proposing to make to the Updated Safety Analysis Report (USAR). Attachment S, Table S-3, Item S-3.26 states that the USAR will be updated following the guidance provided in FAQ 12-0062 (Reference 51).

Since the licensee has provided an implementation item that will update the USAR after approval of the LAR in accordance with 10 CFR 50.71(e), and the content will be consistent with the guidance contained in NEI 04-02, the NRC staff concludes that the licensee's method to update the USAR following the guidance in FAQ 12-0062 is acceptable.

2.5 Rescission of Exemptions

The NRC staff reviewed LAR Section 5.2.3, "Orders and Exemptions," Attachment O, "Orders and Exemptions," and Attachment K, "Existing Licensing Action Transition," with regard to previously-approved exemptions to Appendix R to 10 CFR Part 50, which the transition to an FPP licensing basis in conformance with NFPA 805 will supersede. These exemptions will no longer be required since upon approval of the RI/PB FPP in accordance with NFPA 805, Appendix R will not be part of the licensing basis for CNS.

The licensee requested and received NRC approval for 10 exemptions from 10 CFR Part 50 Appendix R. These exemptions were discussed in detail in Attachment K of the LAR. The licensee stated that an RI/PB analysis was performed on all the exemptions and that the conditions described in Attachment K of the LAR (and described below) were found to be acceptable. The licensee requested in accordance with the requirements of 10 CFR 50.48(c)(3)(i), that all the exemptions be rescinded.

Disposition of Appendix R exemptions may follow two different paths during transition to NFPA 805:

- The exemption was found to be unnecessary since the underlying condition has been evaluated using RI/PB methods (FM and/or FRE) and found to be acceptable and no further actions are necessary by the licensee.
- The exemption was found to be appropriate as a qualitative engineering evaluation that meets the deterministic requirements of NFPA 805 and is carried forward as part of the engineering analyses supporting NFPA 805 transition.

The following exemptions, originally approved by NRC SE dated September 21, 1983 (Reference 104), are rescinded as requested by the LAR and the underlying condition has been evaluated using RI/PB methods and found to be acceptable with no further actions because the philosophy of defense-in-depth and sufficient safety margin is maintained:

- Exemption for lack of 20-foot separation between redundant Service Water Pumps in the Intake Structure.
- Exemption for lack of 20-foot separation free of intervening combustibles or 1-hour barriers between redundant trains in the Cable Spreading Room.
- Exemption for lack of 20-foot separation or 1-hour barriers between redundant trains in the Cable Expansion Room.
- Exemption from the requirement for 1-hour-rated fire barriers for redundant conduits and area wide automatic suppression system in the Reactor Building northeast corner, 903'-6" Elevation.

- Exemption from the requirement for an automatic suppression system in the Control Building Basement.

- Exemption from a fixed fire suppression system in the Auxiliary Relay Room.

- Exemption from a fixed fire suppression system in the Control Room.

- Exemption from the requirement of a 3-hour fire barrier, or 20 feet of separation free of intervening combustibles combined with automatic suppression and detection in the 931' Elevation of the Reactor Building.

- Exemption from the requirement of a 3-hour fire barrier, or 20 feet of separation free of intervening combustibles combined with automatic suppression and detection, and lack of alternate shutdown capability independent of the area in the 903'-6" Elevation of the Reactor Building (excluding the northeast corner).

- Exemption from the requirement of a 3-hour fire barrier, or 20 feet of separation free of intervening combustibles combined with automatic suppression and detection, and lack of alternate shutdown capability independent of the area in the 859' and 881' Elevations of the Reactor Building.

2.6 <u>Self-Approval Process for FPP Changes (Post-Transition)</u>

Upon completion of the implementation of the RI/PB FPP and issuance of the license condition discussed in Section 2.4.2 of this SE, changes to the approved FPP must be evaluated by the licensee to ensure that they are acceptable. NFPA 805 Section 2.2.9, "Plant Change Evaluation," states the following:

> In the event of a change to a previously approved fire protection program element, a risk-informed plant change evaluation shall be performed and the results used as described in 2.4.4 to ensure that the public risk associated with fire-induced nuclear fuel damage accidents is low and that adequate defense-in-depth and safety margins are maintained.

NFPA 805, Section 2.4.4, "Plant Change Evaluation," states, in part, that:

> A plant change evaluation shall be performed to ensure that a change to a previously approved fire protection program element is acceptable. The evaluation process shall consist of an integrated assessment of the acceptability of risk, defense-in-depth, and safety margins.

2.6.1 Post-Implementation Plant Change Evaluation Process

The NRC staff reviewed LAR Section 4.7.2, "Compliance with Configuration Control Requirements in Section 2.7.2 and 2.2.9 of NFPA 805," for compliance with the NFPA 805 Plant Change Evaluation (PCE) process requirements to address potential changes to the NFPA 805 RI/PB FPP after implementation is completed. The licensee will develop a change process that is based on the guidance provided in NEI 04-02, Section 5.3, "Plant Change Process," as well as Appendices B, I, and J, as modified by RG 1.205, Regulatory Positions 2.2.4, 3.1, 3.2, and 4.3.

In its letter dated April 24, 2012, the licensee states in LAR Section 4.7.2 that the PCE process will consist of four steps:

1. defining the change
2. performing the preliminary risk screening
3. performing the risk evaluation
4. evaluating the acceptance criteria

In the LAR, the licensee stated that the PCE process begins by defining the change or altered condition to be examined and the baseline configuration. The licensee stated that 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) and that the changed or altered condition or configuration that is not consistent with the design basis and licensing basis is defined as the proposed alternative.

The licensee stated that once the definition of the change is established, a screening will be performed to identify and resolve minor changes to the FPP and that the screening will be consistent with fire protection regulatory review processes currently in place at CNS. The licensee stated that the screening process is modeled after the NEI 02-03, "Guidance for Performing a Regulatory Review of Proposed Changes to the Approved Fire Protection Program," (Reference 52), a process that will address most administrative changes (e.g., changes to the combustible control program, organizational changes, etc.). The licensee further stated in LAR Section 4.7.2 that if 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 not met, then the licensee will proceed to the risk evaluation step of the PCE process.

The licensee stated that the risk evaluation screening will be followed by engineering evaluations that may include fire modeling (FM) and risk assessment techniques and that the results of the evaluations are compared to the acceptance criteria. The licensee stated that changes that satisfy the acceptance criteria of NFPA 805 Section 2.4.4 and the fire protection license condition (see Attachment M to the LAR) can be implemented within the framework provided by NFPA 805, and that changes that do not satisfy the acceptance criteria cannot be implemented within this framework. The licensee further stated that the acceptance criteria will require that the resultant change in CDF and LERF be consistent with the fire protection license condition, and that the acceptance criteria will also include consideration of DID and safety margin, which would typically be qualitative in nature.

The licensee stated that the risk evaluation involves the application of FM analyses and risk assessment techniques to obtain a measure of the changes in risk associated with the proposed change. The licensee also stated that, 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.

The licensee stated that PCEs are assessed for acceptability using the change in CDF (delta-CDF or ΔCDF) and change in LERF (delta-LERF or ΔLERF) criteria from the license condition and that the proposed changes are assessed to ensure they are consistent with the DID philosophy and that sufficient safety margin is maintained.

The licensee stated that the CNS FPP configuration is defined by the program documentation and that, to the greatest extent possible, the existing configuration control processes for modifications, calculations and analyses, and FPP license basis reviews will be used to maintain configuration control of the FPP documents. The licensee further stated that the configuration control procedures which govern the various CNS documents and databases that currently exist will be revised to reflect the new NFPA 805 licensing bases requirements.

The licensee stated that several NFPA 805 document types, such as Nuclear Safety Capability Assessment (NSCA) Supporting Information, Non-Power Mode Review, Fire Modeling Calculations, Fire Safety Assessments, Risk Evaluations, etc., 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. In addition, the new procedures will be modeled after the existing processes for similar types of documents and databases. The licensee further stated that system level design basis documents will be revised to reflect the NFPA 805 role that the systems and components now play and that new procedures will be developed and existing documentation revised as part of LAR implementation. See LAR Attachment S, as supplemented, for implementation items.

The licensee stated that the process for capturing the impact of proposed changes to the plant on the FPP will continue to be a multiple step review and that the first step of the review will be an initial screening for process users to determine if there is a potential to impact the FPP 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. The licensee further stated that reviews that identify potential FPP impacts will be sent to qualified individuals (e.g., Fire Protection Engineer, Fire PRA Engineer, etc.) to ascertain the program impacts, if any, and that if FPP impacts are determined to exist as a result of the proposed change, the issue would be resolved by one of the following:

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

The licensee stated that this process follows the requirements in NFPA 805 and the guidance outlined in RG 1.174 (Reference 19), which requires the use of qualified individuals, procedures that require calculations and evaluations 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.

Since NFPA 805 always requires the use of a PCE, regardless of what element requires the change, the NRC staff concludes that, in accordance with the requirements of NFPA 805, if FPP impacts are determined to exist as a result of the proposed change, the issue would be resolved by utilizing the NFPA 805 change process developed in accordance with NEI 04-02, RG 1.205, and the CNS NFPA 805 fire protection license condition to assess the acceptability of the proposed change. This process will be used to determine if prior NRC approval of the proposed change is required.

While reviewing the licensee's approach to self-approved changes under the new RI/PB FPP, the staff requested the licensee to provide additional information. In Programmatic RAI 05 (Reference 16), the NRC staff requested the licensee to describe how the NFPA 805 plant change evaluation process will be implemented post-transition. The licensee responded (Reference 9) by stating that NPPD anticipates incorporating the process described in FAQ 12-0061, which is currently being vetted by the FAQ process, into existing CNS procedures.

Based on the information provided by the licensee, the NRC staff concludes that the licensee's PCE process is considered acceptable because it meets the guidance in NEI 04-02, Revision 2 (Reference 5), as well as RG 1.205, Revision 1 (Reference 2), and addresses attributes for using FREs in accordance with NFPA 805. Section 2.4.4 of NFPA 805 requires that PCEs consist of an integrated assessment of risk, DID and safety margin. Section 2.4.3.1 of NFPA 805 requires that the probabilistic safety assessment (PSA) use CDF and LERF as measures for risk. Section 2.4.3.3 of NFPA 805 requires that the risk assessment approach, methods, and data shall be acceptable to the Authority Having Jurisdiction (AHJ), which is the NRC. Section 2.4.3.3 of NFPA 805 also requires that the PSA be appropriate for the nature and scope of the change being evaluated, be based on the as-built and as-operated and maintained plant, and reflect the operating experience at the plant.

The licensee's PCE process includes the required delta risk calculations, uses risk assessment methods acceptable to the NRC, uses appropriate risk acceptance criteria in determining acceptability, involves the use of an FPRA of acceptable quality, and includes an integrated assessment of risk, DID, and safety margin as discussed above.

2.6.2 Requirements for the Self-Approval Process Regarding Plant Changes

Risk assessments performed to evaluate PCEs must use methods that are acceptable to the NRC staff. Acceptable methods to assess the risk of the proposed plant change may include methods that have been used in developing the peer-reviewed FPRA model, methods that have been approved by the NRC via a plant-specific license amendment or through NRC approval of generic methods specifically for use in NFPA 805 risk assessments, or methods that have been demonstrated to bound the risk impact.

Based on the information provided by the licensee in the LAR, the process established to evaluate post-transition plant changes meets the guidance in NEI 04-02, as well as RG 1.205. The NRC staff concludes that the proposed PCE process at CNS, which includes defining the change, a preliminary risk screening, a risk evaluation, and an acceptability determination, as described in Section 2.6.1, is acceptable because it addresses the required delta-risk calculations, uses risk assessment methods acceptable to the NRC, uses appropriate risk acceptance criteria in determining acceptability, involves the use of an FPRA of acceptable quality, and includes an integrated assessment of risk, DID, and safety margin.

However, before achieving full compliance with 10 CFR 50.48(c) by implementing the plant modifications listed in Section 2.7.1 of this SE (i.e., during full implementation of the transition to NFPA 805), RI changes to the licensee's FPP may not be made without prior NRC review and approval unless the changes have been demonstrated to have no more than a minimal risk impact using the screening process discussed above because the risk analysis is not consistent with the as-built, as-operated, and maintained plant since the modifications have not been completed. In addition, the licensee is required to ensure that fire protection DID and safety margin are maintained during the transition process. The "Transition License Conditions" in the proposed NFPA 805 license condition include the appropriate acceptance criteria and other attributes to form an acceptable method for meeting Regulatory Position C.3.1 of RG 1.205, Revision 1, (Reference 2), with respect to the requirements for FPP changes during transition, and therefore demonstrate compliance with 10 CFR 50.48(c).

The proposed NFPA 805 license condition also includes a provision for self-approval of changes to the FPP that may be made on a qualitative, rather than an RI, basis. Specifically, the license condition states that prior NRC review and approval are not required for changes to the NFPA 805 Chapter 3 fundamental FPP elements and design requirements for which an engineering evaluation demonstrates that the alternative to the NFPA 805 Chapter 3 element is functionally equivalent or adequate for the hazard. The licensee may use an engineering evaluation to demonstrate that a change to an 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 (i.e., has not impacted its contribution toward meeting the nuclear safety and radioactive release performance criteria), using a relevant technical requirement or standard.

Use of this approach does not fall under NFPA 805, Section 1.7, "Equivalency," because the condition can be shown to meet the NFPA 805 Chapter 3 requirement. Section 1.7 of NFPA 805 is a standard format used throughout NFPA standards. It is intended to allow owner/operators to use the latest state of the art fire protection features, systems, and equipment, provided the alternatives are of equal or superior quality, strength, fire resistance, durability, and safety. However, the intent is to require approval from the authority having jurisdiction because not all of these state-of-the-art features are in current use or have relevant operating experience. This is a different situation than the use of functional equivalency since functional equivalency demonstrates that the condition meets the NFPA 805 code requirement.

Alternatively, the licensee may use an engineering evaluation to demonstrate that changes to certain NFPA 805 Chapter 3 elements are acceptable because the changes are "adequate for the hazard." Prior NRC review and approval would not be required for alternatives to four specific sections of NFPA 805 Chapter 3 listed below, 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 (with respect to the ability to meet the nuclear safety and radioactive release performance criteria), using a relevant technical requirement or standard. NFPA 805 Section 2.4 states that engineering analysis is an acceptable means of evaluating an FPP against performance criteria. Engineering analyses shall be permitted to be qualitative or quantitative. Use of qualitative engineering analyses by a qualified fire protection engineer to determine that a change has not affected the functionality of the component, system, procedure or physical arrangement is allowed by NFPA 805 Section 2.4.

The four specific sections of NFPA 805 Chapter 3 for which prior NRC review and approval are not required to implement alternatives that an engineering evaluation has demonstrated are adequate for the hazard are as follows:

1. "Fire Alarm and Detection Systems" (Section 3.8);
2. "Automatic and Manual Water-Based Fire Suppression Systems" (Section 3.9);
3. "Gaseous Fire Suppression Systems" (Section 3.10); and
4. "Passive Fire Protection Features" (Section 3.11).

The engineering evaluations described above (i.e., functionally equivalent and adequate for the hazard) are engineering analyses governed by the NFPA 805 guidelines. In particular, this means that the evaluations must meet the requirements of NFPA 805, Section 2.4, "Engineering Analyses," and NFPA 805, Section 2.7, "Program Documentation, Configuration Control, and Quality." Specifically, the effectiveness of the fire protection features under review must be evaluated and found acceptable in relation to their ability to detect, control, suppress, and extinguish a fire and provide passive protection to achieve the performance criteria and not exceed the damage threshold for the plant being analyzed. The associated evaluations must also meet the documentation content (as outlined by NFPA 805, Section 2.7.1, "Content") and quality requirements (as outlined by NFPA 805, Section 2.7.3, "Quality") of the standard in order to be considered adequate. Note that the NRC staff's review of the licensee's compliance with NFPA 805, Sections 2.7.1 and 2.7.3 is provided in Section 3.8 of this SE.

According to the LAR, the licensee intends to use an FPRA to evaluate the risk of proposed future plant changes. Section 3.4.2, "Quality of the Fire Probabilistic Risk Assessment," of this SE discusses the technical adequacy of the FPRA, including the licensee's process to ensure that the FPRA remains current. The NRC staff determined that the quality of the licensee's FPRA and associated administrative controls and processes for maintaining the quality of the PRA model is sufficient to support self-approval of future RI changes to the FPP under the proposed license conditions. Therefore, the NRC staff concludes that the licensee's process for self-approving future FPP changes is acceptable.

The NRC staff also concludes that the FRE methods used at CNS to model the cause and effect relationship of associated changes as a means of assessing the risk of plant changes during transition to NFPA 805 may continue to be used after implementation of the RI/PB FPP, based on the licensee's administrative controls to ensure that the models remain current and to provide assurance of continued quality (see SE Section 3.4.1, "Quality of the Fire Probabilistic Risk Assessment"). Accordingly, these cause-and-effect relationship models may be used after transition to NFPA 805 as a part of the PCEs conducted to determine the change in risk associated with proposed plant changes.

2.7 Implementation

Regulatory Position C.3.1 of RG 1.205, Revision 1, says that a license condition included in a NFPA 805 LAR should include: (1) a list of modifications being made to bring the plant into compliance with 10 CFR 50.48(c); (2) a schedule detailing when these modifications will be completed; and (3) a statement that the licensee shall maintain appropriate compensatory measures in place until implementation of the modifications are completed.

The NRC staff noted that the list of modifications and implementation items originally submitted in the LAR have been updated by the licensee with the final version of LAR Attachment S, "Plant Modifications and Items to be Completed during Implementation." The updated LAR Attachment S is provided in the licensee's letter dated February 18, 2014 (Reference 15).

2.7.1 Modifications and Implementation Items

The NRC staff reviewed LAR Attachment S, "Plant Modifications and Items to be Completed during Implementation," which describes the CNS plant modifications necessary to implement the NFPA 805 licensing basis, as proposed. These modifications are identified in the LAR as necessary to bring CNS into compliance with either the deterministic or PB requirements of NFPA 805. As described below, LAR Attachment S provides a description of each of the proposed plant modifications, presents the problem statement explaining why the modification is needed, and identifies the compensatory actions required to be in place pending completion/implementation of the modification.

The NRC staff's review confirmed that the modifications identified in LAR Tables S-1 and S-2 are the same as those identified in LAR Table B-3, "Fire Area Transition," on a fire area basis, as the modifications being credited in the proposed NFPA 805 licensing basis. The NRC staff also confirmed that the LAR Table S-2 modifications and Table S-3 associated implementation schedule are the same as those provided in the proposed NFPA 805 license conditions.

LAR Attachment S, Table S-1 provides a list of the modifications the licensee indicated it has already completed at CNS as part of the NFPA 805 transition. LAR Attachment S, Table S-2 provides a detailed listing of the plant modifications that must be completed in order for CNS to be fully in accordance with NFPA 805, implement many of the attributes upon which this SE is based, and thereby meet the requirements of 10 CFR 50.48(c). LAR Attachment S, Table S-3 provides a list of items (procedure changes, process updates, and training to affected plant personnel) that will be completed prior to the implementation of new NFPA 805 FPP. These items will be implemented in accordance with the schedule provided in the NFPA 805 license condition, which states that items S-3.1 through S-3.29 identified in LAR Attachment S, Table S-3, will be in place 12 months after issuance of the NFPA 805 license amendment and that item S-3.30 will be in place by May 31, 2017. In addition, the licensee has agreed to keep the appropriate compensatory measures in place until the modifications described in LAR Attachment S, Table S-2, have been fully implemented.

2.7.2 Schedule

LAR Section 5.5, as supplemented by letter dated December 12, 2013 (Reference 13), provides the overall schedule for completing the NFPA 805 transition at CNS. The licensee stated that it will complete the implementation of the new program, including any procedure changes, process updates, and training for affected plant personnel to implement the NFPA 805 FPP within 12 months after NRC approval of the NFPA 805 license amendment with the exception of implementation item S-3.30 which will be completed by May 31, 2017.

LAR Section 5.5 also states that modifications identified in LAR Attachment S, Table S-2, will be completed prior to startup from the first refueling outage greater than 12 months following the issuance of the NFPA 805 license amendment and that appropriate compensatory measures will be maintained until modifications are complete.

2.8 Summary of Implementation Items

Implementation items are items that the licensee has not fully completed or implemented as of the issuance date of the license amendment, but which will be completed during implementation of the license amendment to transition to NFPA 805 (e.g., procedure changes that are still in process, or NFPA 805 programs that have not been fully implemented). These items do not impact the bases for the safety conclusions made by the NRC staff in the associated SE. The licensee identified the implementation items in LAR Attachment S, Table S-3 of the LAR. For each implementation item, the licensee and the NRC staff have reached a satisfactory resolution involving the level of detail and main attributes that each remaining change will incorporate upon completion.

Each implementation item will be completed prior to the deadline for implementation of the RI/PB FPP based on NFPA 805, as specified in the license condition and the letter transmitting the amended license (i.e., implementation period).

The NRC staff, through an onsite audit or during a future fire protection inspection, may choose to examine the closure of the implementation items, with the expectation that any variations discovered during this review, or concerns with regard to adequate completion of the implementation item, would be tracked and dispositioned appropriately under the licensee's corrective action program. Any discrepancies noted during onsite audits or fire protection inspections examining dispositioning of the implementation items could be subject to appropriate NRC enforcement action as completion of the implementation items is required by the proposed license conditions.

3.0 TECHNICAL EVALUATION

The following sections evaluate the technical aspects of the requested license amendment to transition the FPP at CNS to one based on NFPA 805 (Reference 1) in accordance with 10 CFR 50.48(c). While performing the technical evaluation of the licensee's submittal, the NRC staff utilized the guidance provided in NUREG-0800, Section 9.5.1.2, "Risk-Informed, Performance-Based Fire Protection" (Reference 23), to determine whether the licensee had provided sufficient information in both scope and level of detail to adequately demonstrate compliance with the requirements of NFPA 805, as well as the other associated regulations and guidance documents discussed in Section 2.0 of this SE. Specifically:

- Section 3.1 provides the results of the NRC staff review of the licensee's transition of the FPP from the existing deterministic guidance to that of NFPA 805 Chapter 3, "Fundamental FPP and Design Elements."

- Section 3.2 provides the results of the NRC staff review of the methods used by the licensee to demonstrate the ability to meet the nuclear safety performance criteria (NSPC).

- Section 3.3 provides the results of the NRC staff review of the FM methods used by the licensee to demonstrate the ability to meet the NSPC using an FM PB approach.

- Section 3.4 provides the results of the NRC staff review of the fire risk assessments used to demonstrate the ability to meet the NSPC using an FRE PB approach.

- Section 3.5 provides the results of the NRC staff review of the licensee's NSCA results by fire area.

- Section 3.6 provides the results of the NRC staff review of the methods used by the licensee to demonstrate an ability to meet the radioactive release performance criteria.

- Section 3.7 provides the results of the NRC staff review of the NFPA 805 monitoring program developed as a part of the transition to an RI/PB FPP based on NFPA 805.

- Section 3.8 provides the results of the NRC staff review of the licensee's program documentation, configuration control, and quality assurance.

In addition, Attachments A and B to this SE provide additional detailed information that was evaluated and/or disposed by the NRC staff to support the licensee's request to transition to an RI/PB FPP in accordance with NFPA 805 (i.e., 10 CFR 50.48(c)). These attachments are discussed as appropriate in the associated section of this SE.

3.1 NFPA 805 Fundamental FPP and Design Elements

NFPA 805 Chapter 3 contains the fundamental elements of the FPP and specifies the minimum design requirements for fire protection systems and features that are necessary to meet the standard. The fundamental FPP elements and minimum design requirements include necessary attributes pertaining to the fire protection plan and procedures, the fire prevention program and design controls, internal and external industrial fire brigades, and fire protection SSCs. However, 10 CFR 50.48(c) provides exceptions, modifications, and supplementations to certain aspects of NFPA 805 Chapter 3 as follows:

- 10 CFR 50.48(c)(2)(v) – Existing cables. In lieu of installing cables meeting flame propagation tests as required by Section 3.3.5.3 of NFPA 805, 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 of NFPA 805 is not endorsed.

- 10 CFR 50.48(c)(2)(vi) – Water supply and distribution. The italicized exception to Section 3.6.4 of NFPA 805 is not endorsed. Licensees who wish to use the exception to Section 3.6.4 of NFPA 805 must submit a request for a license amendment in accordance with 10 CFR 50.48(c)(2)(vii).

- 10 CFR 50.48(c)(2)(vii) – Performance-based methods. While Section 3.1 of NFPA 805 prohibits the use of PB methods to demonstrate compliance with the NFPA 805 Chapter 3 requirements, 10 CFR 50.48(c)(2)(vii) states that the FPP elements and minimum design requirements of NFPA 805 Chapter 3 may be subject to the PB methods permitted elsewhere in the standard.

Furthermore, Section 3.1 of NFPA 805 specifically allows the use of alternatives to the NFPA 805 Chapter 3 fundamental FPP requirements that have been previously approved by the NRC (the AHJ as denoted in NFPA 805 and RG 1.205), and are contained in the currently approved FPP for the facility.

3.1.1 Compliance with NFPA 805 Chapter 3 Requirements

The licensee used the systematic approach described in NEI 04-02, Revision 2 (Reference 5), as endorsed by the NRC in RG 1.205, Revision 1, to assess the proposed CNS FPP against the NFPA 805 Chapter 3 requirements.

As part of this assessment, the licensee reviewed each section and subsection of NFPA 805 Chapter 3 against the existing CNS FPP and provided specific compliance statements for each Chapter 3 attribute that contained applicable requirements. As discussed below, some subsections of NFPA 805 Chapter 3 do not contain requirements, or are otherwise not applicable to CNS, and others are provided with multiple compliance statements to fully document compliance with the element.

The methods used by CNS for achieving compliance with the NFPA 805 Chapter 3 fundamental FPP elements and minimum design requirements are as follows:

1. The existing FPP element directly complies with the requirement: noted in LAR Attachment A, "NEI 04-02 Table B-1, Transition of Fundamental Fire Protection Program and Design Elements" (LAR Table B-1), as "Complies";

2. The existing FPP element complies through the use of an explanation or clarification: noted in LAR Table B-1 as "Complies with Clarification";

3. The existing FPP element complies through the use of existing engineering equivalency evaluations (EEEEs) whose bases remain valid and are of sufficient quality: noted in LAR Table B-1 as "Complies with Use of EEEEs";

4. The existing FPP element complies with the requirement based on prior NRC approval of an alternative to the fundamental FPP attribute and the bases for the NRC approval remain valid: noted in LAR Table B-1 as "Complies by Previous NRC Approval";

5. The existing FPP element does not comply with the requirement, but the licensee is requesting specific approval for a PB method in accordance with 10 CFR 50.48(c)(2)(vii): noted in LAR Table B-1 as "Submit for NRC Approval"; and

6. The existing FPP element does not comply with the requirement, but will be in direct compliance with the completion of a required action; noted in LAR Table B-1 as "Complies with Required Action." These outstanding actions are identified as implementation items in Attachment S of the LAR as discussed in Section 2.7 and 2.8 of this SE.

Compliance approach No. 6, "Complies with Required Action," is a modification from the guidance provided in NEI 04-02, Section 4.3.1. The intent of this choice is to identify FPP elements that will comply with the associated element of NFPA 805 Chapter 3, after completion of an action by the licensee. The required actions are identified in LAR Attachment S as implementation items.

The NRC staff has determined that, taken together, these methods compose an acceptable approach for documenting compliance with the NFPA 805 Chapter 3 requirements, because the licensee has followed the compliance strategies identified in the endorsed NEI 04-02 guidance document. The process defined in the endorsed guidance provides an organized structure to document each attribute in NFPA 805 Chapter 3, allowing the licensee to provide significant detail in how the program meets the requirements. In addition to the basic strategy of "Complies," which itself makes the attribute both auditable and inspectable, additional strategies have been provided allowing for amplification of information, when necessary, regarding how or why the attribute is acceptable.

The licensee stated in LAR Section 4.2.2, "Existing Engineering Equivalency Evaluation Transition," that the EEEEs that support compliance with NFPA 805 Chapter 3 or Chapter 4 were reviewed using the methodology contained in NEI 04-02 and that the review determined that the EEEEs are not based solely on quantitative risk evaluations; are appropriate use of an engineering equivalency evaluation; are of appropriate quality; meet the standard license condition; are technically adequate; reflect the plant as-built condition; and, basis for acceptability remains valid. In addition, the licensee determined that none of the transitioning EEEEs require NRC approval.

EEEEs refer to "existing engineering equivalency evaluations" (previously known as Generic Letter 86-10 evaluations) performed for fire protection design variances such as fire protection system designs and fire barrier component deviations from the specific fire protection deterministic requirements. Once a licensee transitions to NFPA 805, future equivalency evaluations are to be conducted using a PB approach. The evaluation should demonstrate that the specific plant configuration meets the performance criteria in the standard.

Additionally, the licensee stated in LAR Section 4.2.3, "Licensing Action Transition," that the existing licensing actions used to demonstrate compliance have been evaluated to ensure that their bases remain valid. The results of these licensing action evaluations are provided in Attachment K of the LAR.

LAR Attachment A (the NEI 04-02 B-1 Table) provides further details regarding the licensee's compliance strategy for specific NFPA 805 Chapter 3 requirements, including references to where compliance is documented.

3.1.1.1 Compliance Strategy – Complies

For the majority of the NFPA 805 Chapter 3 requirements, as modified by 10 CFR 50.48(c)(2), the licensee determined that the RI/PB FPP complies directly with the fundamental FPP element using the existing FPP element. In these instances, based on the information provided by the licensee in the LAR, as supplemented, and the information gained from the NFPA 805 site audit conducted October 1 – 5, 2012 (Reference 53) (that is, the documents reviewed, discussions held with the licensee and the plant tours performed), the NRC staff concludes that the licensee's statements of compliance are acceptable.

NFPA 805 Section 3.2.3, identified in the LAR B-1 Table, as complying via this method, required additional review by the staff. NFPA 805 Section 3.2.3 requires procedures be established for implementation of the FPP. The compliance basis for this element cited the Technical Specifications governing fire protection procedures. However, these specifications will be deleted post-transition. In fire protection engineering (FPE) RAI 15 dated November 14, 2012 (Reference 16), the NRC staff requested that the licensee identify the post-transition NFPA 805 compliance basis for NFPA 805 Section 3.2.3. In its response dated January 14, 2013 (Reference 9), the licensee stated that NFPA 805 is the post-transition basis for compliance with this element and provided an amendment to LAR Table B-1 for Element 3.2.3. Based on this RAI response, the staff concludes that the licensee's statement of compliance is acceptable because CNS will use NFPA 805 as the post-transition basis for the procedures governing the FPP.

3.1.1.2 Compliance Strategy – Complies with Clarification

For certain NFPA 805 Chapter 3 requirements, the licensee provided additional clarification when describing its means of compliance with the fundamental FPP element. In these instances, the NRC staff reviewed the additional clarifications and concludes that the licensee meets the underlying requirement for the FPP element.

3.1.1.3 Compliance Strategy – Complies with Use of EEEEs

For certain NFPA 805 Chapter 3 requirements, the licensee demonstrated compliance with the fundamental FPP element through the use of EEEEs. In its review, the NRC staff identified that none of the summaries of the EEEEs cited in LAR Attachment A, Table B-1 or described in LAR Attachment C, Table B-3 state that the basis of acceptability remains valid. In FPE RAI 11 dated November 14, 2012 (Reference 16), the staff requested that the licensee provide an explicit statement that the EEEEs were determined to meet the NEI 04-02 criteria and that the basis for acceptability of previous EEEEs remains valid. In its response dated January 14, 2013 (Reference 9), the licensee provided a supplement to LAR Section 4.2.2. The NRC staff reviewed the licensee's statement of continued validity for the EEEEs, as supplemented by the response to FPE RAI 11, as well as a statement on the quality and appropriateness of the evaluations, and concludes that the licensee's statements of compliance are acceptable.

3.1.1.4 Compliance Strategy – Complies with Previous NRC Approval

Certain NFPA 805 Chapter 3 requirements were supplanted by an alternative that was previously approved by the NRC. The approvals were documented in the original 1979 FPP SE (Reference 54), the 1980 Supplement 1 to the FPP SE (Reference 55), the 1973 CNS SE (Reference 56), and a 1977 SE for FPP Technical Specifications (Reference 57).

In FPE RAI 17 dated November 14, 2012 (Reference 16), the NRC staff requested that the licensee provide the NRC citations that establish the previous approval for Elements 3.4.1(a) and 3.6.4. In its response dated January 14, 2013 (Reference 9), the licensee stated that the approval for Element 3.4.1(a) regarding fire brigade staffing was established through the SE that approved the CNS TSs that contained the fire brigade staffing requirements. For Element 3.6.4, the licensee stated that NPPD indicated in Final Safety Analysis Report (FSAR) Amendment 15 that whenever fire protection piping passes over or near the Class IS piping or equipment in the Reactor Building, Control Building, or Intake Structure, it will be supported and restrained to withstand a Class IS seismic occurrence and maintain structural and pressure integrity. As described in the RAI response, this inclusion in the FSAR was addressed in Section 9.3.4 of the 1973 SE for CNS, which acknowledged the following:

> The NRC staff also required the applicant to analyze the effect on plant safety of failure of the Class II (seismic) Fire Protection System. The intake structure area was of particular concern where Fire Protection System piping and equipment, including a diesel-driven fire pump is in close proximity to service water pump and piping. The applicant agreed to modify Fire Protection System piping to Class I (seismic) standards in all areas where it passed over or near the Class I (seismic) systems.

In each instance where previous approval was utilized, the licensee evaluated the basis for the original NRC approval and determined that in all cases the bases were still valid. The NRC staff reviewed the information provided by the licensee and concludes that previous NRC approval has been demonstrated using suitable documentation that meets the approved guidance contained in RG 1.205, Revision 1. Based on the licensee's justification for the continued validity of the previously approved alternatives to the NFPA 805 Chapter 3 requirements, the NRC staff concludes that the licensee's statements of compliance in these instances are acceptable.

3.1.1.5 Compliance Strategy – Submit for NRC Approval

The licensee also requested approval for the use of PB methods to demonstrate compliance with fundamental FPP elements. In accordance with 10 CFR 50.48(c)(2)(vii), the licensee requested specific approvals be included in the license amendment approving transition to NFPA 805 at CNS. The NFPA 805 sections identified in LAR Table B-1 as complying via this method are as follows:

- 3.2.3(1), which concerns the establishing of procedures for inspection, testing, and maintenance for fire protection systems and features credited by the fire protection program. The licensee requested to use EPRI Technical Report (TR) 1006756, "Fire Protection Equipment Surveillance Optimization and Maintenance Guide," Final Report, July 2003 (Reference 58), in order to modify fire protection system surveillance frequencies. This approval request was added by the licensee in its response to FPE RAI 04 dated January 14, 2013 (Reference 9). See Section 3.1.4.1 of this SE for the NRC staff's evaluation of this request.

- 3.3.1.2(1), which concerns the use of fire-retardant wood within the power block. The licensee requested approval to use commercially available products which utilize small quantities of wood as an integral part of a finished product (e.g., tools, janitorial supplies, special fixtures, and office type furniture). See Section 3.1.4.2 of this SE for the NRC staff's evaluation of this request.

- 3.3.3, which concerns the classification of interior wall or ceiling finish in accordance with the NFPA 101, "Life Safety Code" (Reference 59), requirements for Class A materials and floor finish in accordance with NFPA 101, Class I criteria. NFPA 101 addresses construction, protection, and occupancy features in buildings necessary to minimize danger to life from the effects of fire. The licensee requested approval to use paints and floor coatings that do not have the necessary test documentation and therefore do not meet the exact interior finish requirements of NFPA 805. See Section 3.1.4.3 of this SE for the NRC staff's evaluation of this request. In FPE RAI 01 dated November 14, 2012 (Reference 16), the NRC staff noted that LAR Section 4.1.2.3 did not include NFPA 805, Section 3.3.3, on the list of elements for which NRC staff review and approval was requested, but did include Section 3.3.3 in LAR Attachments A and L as requiring NRC approval. The NRC staff requested the licensee confirm that Section 3.3.3 should be included in LAR Section 4.1.2.3. In its response dated

January 14, 2013 (Reference 9), the licensee provided amended text to LAR Section 4.1.2.3 to include NFPA 805 Section 3.3.3 in the list of elements for which NRC review and approval was requested.

- 3.3.5.1, which concerns minimizing wiring above suspended ceilings, and where installed, requires electrical wiring to be listed for plenum use, or routed in armored cable, metal conduit, or cable trays with solid metal top and bottom covers. The licensee requested approval for limited amounts of wiring above suspended ceilings in the power block that does not meet the requirements of NFPA 805. See Section 3.1.4.4 of this SE for the NRC staff's evaluation of this request.

- 3.3.5.2, which concerns the use of metal tray and metal conduit for electrical raceways. The licensee requested approval for the use of plastic embedded conduit installations. See Section 3.1.4.5 of this SE for the NRC staff's evaluation of this request.

- 3.3.7.2, which concerns the location of outdoor high-pressure flammable gas storage so the long axis is not pointed at buildings. The licensee requested approval of the hydrogen storage located in a separate building that has the tank axis pointed at the Intake Structure. In LAR Attachment L, the licensee described the hydrogen storage containers as being installed in mounting frames to provide support and restraint and located in a separate structure with walls constructed of 1-foot-thick reinforced concrete. The long axis of the storage containers aligns with the 1-foot-thick walls. The storage structure is open on the east side, which prevents development of an explosive atmosphere. In FPE RAI 13 dated November 14, 2012 (Reference 16), the NRC staff requested the licensee provide additional discussion of how the hydrogen storage configuration inside a separate building is a deviation from the requirement of NFPA 805, which addresses outdoor storage and not the storage of high-pressure containers in a separate structure. In its response dated January 14, 2013 (Reference 9), the licensee revised the LAR to state the hydrogen storage complies with NFPA 805 Section 3.3.7.2. On the basis that the high-pressure hydrogen gas cylinders are restrained by mounting frames in a separate, well-ventilated (open), structure with 1-foot-thick reinforced walls, and separated from other buildings, the configuration is not outdoor storage as described in NFPA 805 Section 3.3.7.2 and the NRC staff concludes that the revised licensee statement of "Complies" is acceptable.

- 3.5.3, which concerns design and installation of fire pumps in accordance with NFPA 20, "Fire Pumps" (Reference 60). NFPA 20 addresses the selection and installation of pumps supplying liquid for private fire protection. The licensee requested approval of the electric fire pump control design that provides the ability to manually stop the fire pump from the Control Room following an automatic start. As stated by the licensee, this design for remote manual stop deviates from the NFPA 805 requirement to meet NFPA 20. In FPE RAI 14 dated November 14, 2012 (Reference 16), the NRC staff requested additional information regarding the indications to Control Room staff in the event of electric fire pump failure to start with the diesel fire pump locked out. In its response dated January 14, 2013 (Reference 9), the licensee described the annunciators that provide alarms of fire pump and system status to the Control Room. See Section 3.1.4.7 of this SE for the NRC staff's evaluation of this request and the licensee's response to FPE RAI 14.

- 3.6.1, which concerns the design of standpipe and hose systems to NFPA 14, "Standard for the Installation of Standpipe and Hose Systems," 1974 (Reference 61). NFPA 14 addresses the minimum requirements for the installation of standpipe and hose systems. The licensee requested approval of deviations from NFPA 14, 1974 regarding hose length that exceeds the 100 feet allowed by the code, standpipe outlet pressures exceeding 100 psi, standpipe system pressures above hose valve rating, and lack of flow alarms on individual standpipes. In FPE RAI 06 dated November 14, 2012 (Reference 16), the NRC staff requested that the licensee confirm that hydraulic calculations for the standpipe system demonstrate acceptable pressure and flow conditions at the nozzle considering the additional 50 feet of hose length specified by the licensee as necessary to reach all portions of the plant. See Section 3.1.4.8 of this SE for the NRC staff's evaluation of this request and the licensee's response to FPE RAI 06.

- 3.7, which concerns installation of fire extinguishers of appropriate number, size, and type in accordance with NFPA 10, "Portable Fire Extinguishers," 1975 (Reference 62). NFPA 10 applies to the selection, installation, inspection, maintenance, recharging, and testing of portable fire extinguishers. The licensee requested approval of the placement of fire extinguishers for Class B hazards (flammable liquids) that exceed travel distances specified in NFPA 10, 1975. See Section 3.1.4.9 of this SE for the NRC staff's evaluation of this request.

- 3.10.5, which concerns securing and strictly controlling the provisions for locally disarming automatic gaseous suppression systems. The licensee requested continued use of installed local abort switches for the diesel generator carbon dioxide (CO_2) system that are not key-controlled and thus not secured as required by this element of NFPA 805. See Section 3.1.4.10 of this SE for the NRC staff's evaluation of this request.

- 3.10.7, which concerns the installation of pre-discharge alarm, discharge delay, and odorizer on total flooding CO_2 systems. The CNS diesel generator CO_2 system is not provided with an odorizer and the licensee requested approval of this deviation for NFPA 805. See Section 3.1.4.11 of this SE for the NRC staff's evaluation of this request.

In addition to the above, in FPE RAI 07 dated November 14, 2012 (Reference 16), the NRC staff noted that LAR Attachment A, Table B-1, Element 3.5.6, included "Submit for NRC approval" in the compliance statement, but Element 3.5.6 was not included in LAR Section 4.1.2.3 or LAR Attachment L regarding those NFPA 805 Chapter 3 elements for which NRC review and approval was requested. The LAR Table B-1 Compliance Basis stated this review and approval was necessary for the remote stop capability of the electric motor-driven fire pump for the Control Room. In its response dated January 14, 2013 (Reference 9), the licensee determined that Element 3.5.6 did not indicate a requirement for remote or local stop capability, the remote stop capability was a deviation from NFPA 20 (see discussion of Chapter 3 Element 3.5.3 above), which is addressed in LAR Attachment L, Approval Request 6, and therefore, Element 3.5.6 is in compliance with NFPA 805 Chapter 3. In its response, the licensee also provided an amendment to LAR Table B-1 to indicate Element 3.5.6 complies. On the basis that the issue of electric fire pump remote control is addressed under LAR Table B-1, Element 3.5.3 and Element 3.5.6 does not contain specific requirements relative to remote manual control and complies with NFPA 805, the NRC staff concludes that the licensee's response is acceptable.

As discussed in SE Section 3.1.4 below, the NRC staff concluded that the use of PB methods to demonstrate compliance with these fundamental FPP elements is acceptable.

3.1.1.6 Compliance Strategy – Complies with Required Action

For certain NFPA 805 Chapter 3 requirements, as modified by 10 CFR 50.48(c)(2), the licensee determined that the RI/PB FPP complies with the fundamental FPP element pending completion of an implementation item listed in LAR Attachment S. The "required actions" as described by the licensee, involve the update of the FPP or plant procedures to specifically incorporate the provisions of the NFPA 805 Chapter 3 elements associated with this compliance strategy.

In its compliance strategy for NFPA 805 Chapter 3 Element 3.2.3(1), the licensee identified an action (i.e., LAR Attachment S, Item S-3.1) to establish PB surveillance frequencies for fire protection systems and features as described in EPRI TR 1006756. The use of EPRI TR 1006756 is a PB method for meeting the provisions of NFPA 805 Chapter 3 and as such must comply with the requirements of 10 CFR 50.48(c)(2)(vii), which requires NRC approval. In FPE RAI 04 dated November 14, 2012 (Reference 16), the NRC staff requested that the licensee discuss its plans for complying with 10 CFR 50.48(c)(2)(vii) and to describe how the EPRI TR guidance will be integrated into the NFPA 805 monitoring program. In its response dated January 14, 2013 (Reference 9), the licensee revised LAR Section 4.1.2.3 and Attachments A, L, and S to revise the compliance strategy for Element 3.2.3(1) to "Submit for NRC Approval." See SE Section 3.1.1.5 and the NRC staff evaluation in SE Section 3.1.4.1. In addition, the licensee stated that the EPRI TR provides guidance for establishing reliability for fire protection systems and features that is consistent with the FPRA and maintenance rule program and the inspection, testing, and maintenance frequencies established using the EPRI TR will be addressed in the NFPA 805 monitoring program. This commitment is described in LAR Attachment S, implementation item S-3.1, which is included in the proposed NFPA 805 license condition.

On the basis that the "required actions" as described by the licensee will incorporate the provisions of NFPA 805 Chapter 3 in the licensee's FPP and plant procedures, the actions are included as implementation items in LAR Attachment S, and the revised compliance strategy for Element 3.2.3(1) to require NRC staff approval for use of EPRI TR 1006756, the NRC staff concludes that the licensee's statements of compliance are acceptable.

3.1.1.7 Compliance Strategy – Multiple Strategies

In certain compliance statements of the NFPA 805 Chapter 3 requirements, the licensee used more than one of the above strategies to demonstrate compliance with aspects of the fundamental FPP element.

In each of these cases, the NRC staff concludes that the individual compliance statements are acceptable, for the reasons outlined above, that the combination of compliance strategies is acceptable, and that holistic compliance with the fundamental FPP element is assured.

3.1.1.8 Chapter 3 Sections Not Reviewed

Some NFPA 805 Chapter 3 sections either do not apply to the transition to an RI/PB FPP or have no technical requirements. Accordingly, the NRC staff did not review these sections for acceptability. The sections that were not reviewed fall into one of the following categories:

- Sections that do not contain any technical requirements (e.g., NFPA 805 Chapter 3, Section 3.4.5 and Section 3.11).
- Sections that are not applicable to CNS because of the following:
    - The licensee stated that CNS does not have systems of this type installed (e.g., Section 3.6.5, which applies to seismic hose station cross-connected to non-fire protection systems and Section 3.10.4, which has single failure limitations for gaseous fire suppression systems in areas that are required by both primary and backup systems); and
    - The requirements are structured with an applicability statement (e.g., Section 3.3.12, which applies to reactor coolant pumps in non-inerted containments, or Sections 3.4.1(a)(2) and 3.4.1(a)(3), which code(s) apply to the fire brigade depends on the type of brigade specified in the FPP at the site).

3.1.1.9 Compliance with Chapter 3 Requirements Conclusion

As discussed above, the NRC staff evaluated the results of the licensee's assessment of the proposed CNS RI/PB FPP against the NFPA 805 Chapter 3 fundamental FPP elements and minimum design requirements, as modified by the exceptions, modifications, and supplementations in 10 CFR 50.48(c)(2). Based on this review of the licensee's submittal, as supplemented, the NRC staff concludes that the RI/PB FPP is acceptable with respect to the fundamental FPP elements and minimum design requirements of NFPA 805 Chapter 3, as modified by 10 CFR 50.48(c)(2), because the licensee:

- Used an overall process consistent with NRC staff approved guidance to determine the state of compliance with each of the applicable NFPA 805 Chapter 3 requirements.

- Provided appropriate documentation of CNS's state of compliance with the NFPA 805 requirements, which adequately demonstrated compliance in that the licensee was able to substantiate that it complied:
  - With the requirement directly or with the requirement directly after the completion of an implementation item;
  - With the intent of the requirement (or element) and provided adequate justification;
  - Via previous NRC staff approval of an alternative to the requirement;
  - Through the use of EEEEs;
  - Through the use of a combination of the above methods; and
  - Through the use of a PB method that the NRC staff has specifically reviewed and approved in accordance with 10 CFR 50.48(c)(2)(vii).

3.1.2 Identification of the Power Block

The NRC staff reviewed the CNS structures identified in LAR Table I-1, "CNS Power Block Definition," as comprising the "power block." The plant structures listed are established as part of the power block for the purpose of denoting the structures and equipment included in the CNS RI/PB FPP that have additional requirements in accordance with 10 CFR 50.48(c) and NFPA 805. As stated in LAR Section 4.1.3, the power block includes structures that contain equipment required for nuclear plant operations.

In LAR Attachment I, Table I-1, the licensee identified the "Yard" as a building/structure in the power block. In FPE RAI 02 November 14, 2012 (Reference 16), the NRC staff requested that the licensee further identify the structures and equipment included in the Yard. In its response dated January 14, 2013 (Reference 9), the licensee provided a supplement to LAR Attachment I with additional description and explanation of structures in the power block, including those excluded from consideration under NFPA 805 requirements, and deleted the reference to the Yard as a building/structure.

On the basis of the supplement to LAR Attachment I that deleted the Yard as a building/structure and identified the structures and components previously included within the Yard, the NRC staff concludes that the licensee has appropriately evaluated the structures and equipment at CNS, and adequately documented a list of those structures that fall under the definition of "power block" in NFPA 805.

3.1.3 Closure of Generic Letter 2006-03, "Potentially Nonconforming Hemyc™ and MT™ Fire Barrier Configurations," Issues

GL 2006-03 requested that licensees evaluate their facilities to confirm compliance with existing applicable regulatory requirements in light of the results of NRC testing that determined that both Hemyc™ and MT™ fire barriers failed to provide the protective function intended for compliance with existing regulations, for the configurations tested using the NRC's thermal acceptance criteria. CNS does not use either the Hemyc™ or MT™ electrical raceway fire barrier systems (ERFBS). Therefore, the generic issue discussed in Generic Letter (GL) 2006-03 (Reference 63) related to the use of these ERFBS is not applicable to CNS.

3.1.4 Performance-Based Methods for NFPA 805 Chapter 3 Elements

In accordance with 10 CFR 50.48(c)(2)(vii), a licensee may request NRC approval for use of the PB methods permitted elsewhere in the standard as a means of demonstrating compliance with the prescriptive NFPA 805 Chapter 3 fundamental FPP elements and minimum design requirements. Paragraph 50.48(c)(2)(vii) of 10 CFR requires that an acceptable PB approach accomplish the following:

(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).

In Attachment L, "NFPA 805 Chapter 3 Requirements for Approval (10 CFR 50.48(c)(2)(vii))," of the LAR, the licensee requested NRC staff review and approval of PB methods to demonstrate an equivalent level of fire protection for the requirement of the elements identified in Section 3.1.1.5 of this SE. In addition, in its response to FPE RAI 04 dated January 14, 2013 (Reference 9), the licensee supplemented Attachment L to include an additional request related to NFPA 805 Section 3.2.3(1) as described in SE Section 3.1.1.5 and in response to FPE RAI 13 (Reference 9), the licensee supplemented the LAR to retract the request for approval related to NFPA 805 Chapter 3, Element 3.3.7.2 regarding outdoor high-pressure flammable gas storage. The NRC staff evaluation of these proposed methods is provided below.

3.1.4.1 NFPA 805, Section 3.2.3(1) – Inspection, Testing, and Maintenance Procedures

As discussed in SE Sections 3.1.1.5 and 3.1.1.6, the NRC staff requested information regarding the compliance strategy for NFPA 805 Section 3.2.3(1). In its response to FPE RAI 04 dated January 14, 2013 (Reference 9), the licensee supplemented LAR Attachment L with Approval Request 11. The licensee requested NRC staff review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirements regarding inspection, testing, and maintenance of credited fire protection systems and features. Specifically, the licensee requested approval to utilize PB methods to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features.

As described by the licensee, the PB inspection, testing, and maintenance frequencies would be established using the methods described in EPRI TR 1006756. The licensee stated that there will be no impact on the NFPA 805 NSPC because the use of PB test frequencies established per TR 1006756 methods, combined with NFPA 805 Section 2.6, "Monitoring Program," will provide assurance that the availability and reliability of the fire protection systems and features are maintained to the levels assumed in the NFPA 805 engineering analyses. The licensee also stated the radiological release performance criteria are satisfied based on the determination of limiting radioactive release (LAR Attachment E). Some fire protection systems and features are credited as part of that evaluation and the use of PB test frequencies established per TR 1006756 methods, with the new monitoring program, should ensure that the availability and reliability of the systems and features are maintained to the levels assumed in the analyses credited for meeting the radioactive release performance criteria. Therefore, there should be no adverse impact on meeting these criteria.

The licensee further stated that the proposed alternative maintains the safety margin of the analyses because it provides assurance that the availability and reliability of the systems and features are maintained to the levels assumed in the original NFPA 805 engineering analyses which includes those assumptions credited in the risk evaluation safety margin discussions. In addition, the licensee stated the use of these methods should in no way invalidate the inherent safety margin contained in the codes used for design and maintenance of fire protection systems and features. Therefore, the safety margin inherent and credited in the analyses should be preserved.

The three echelons of DID described in NFPA 805 Section 1.2 are: 1) to prevent fires from starting (combustible/hot work controls); 2) to 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) to 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 (RAs)).

The TR 1006756 PB methods will be used to establish PB inspection, testing, and maintenance frequencies for fire protection systems and features credited by the FPP. Therefore, the TR 1006756 PB methods do not affect echelon 1. For echelons 2 and 3, the use of PB test frequencies methods in TR-1006756, combined with the new monitoring program, should provide assurance that the availability and reliability of the fire protection systems and features credited for DID are maintained to the levels assumed in the NFPA 805 engineering analyses. Therefore, there should be no adverse impact to DID echelons 2 and 3.

Based on its review of the information submitted by the licensee, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the proposed PB method is an acceptable alternative to the corresponding NFPA 805, Section 3.2.3(1) requirement because it satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID.

3.1.4.2 NFPA 805, Section 3.3.1.2(1) – Use of Untreated Wood in the Power Block

The licensee requested review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement of NFPA 805, Section 3.3.1.2(1) regarding the use of only listed, pressure-impregnated or coated, fire-retardant wood in the power block. Specifically, the licensee requested approval for the use of commercially available products which utilize small quantities of (untreated) wood as an integral part of a finished product and, therefore, do not meet the provision of Section 3.3.1.2(1). As described by the licensee, it is not possible to procure commercially available products that only have treated wood as an integral part of the finished product (e.g., tools, janitorial supplies, special fixtures, and office type furniture) and it would be impractical to ban such products altogether from the power block.

The licensee stated that the presence of small quantities of non-treated wood used in commercially finished products such as hand tools, which contain wooden components such as handles, does not affect nuclear safety. The small quantities of wood do not contribute significantly to the combustible loading of a given area, and, therefore, only a small fire size is anticipated. There is no impact on the NSPC. The use of small quantities of non-treated wood used in commercially finished products does not impact the radiological release performance criteria. The licensee also stated the radiological release review was performed based on the fire suppression activities in areas containing or potentially containing radioactive materials, and is not impacted by a small quantity of non-treated wood. These non-treated wood tools do not change the radiological release evaluation, which concluded that potentially contaminated water is contained and smoke is monitored. This minimal non-treated wood does not add additional radiological materials to the area or challenge system boundaries.

The licensee further stated that the presence of small quantities of non-treated wood used in commercially finished products does not produce a fire hazard and will not adversely impact the ability of the station to achieve and maintain fire safe shutdown. Therefore, the safety margin inherent in the analysis for a fire event has been preserved.

The licensee further stated that the presence of small quantities of non-treated wood used in commercially finished products does not impact fire protection DID and that its presence does not compromise administrative fire prevention controls, automatic fire detection and suppression functions, manual fire suppression functions, or post-fire safe shutdown capabilities.

Based on its review of the information submitted by the licensee, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the proposed PB method is an acceptable alternative to the corresponding NFPA 805, Section 3.3.1.2(1) requirement because it satisfies the performance goals, objectives, and criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID.

3.1.4.3 NFPA 805, Section 3.3.3 – Interior Finish

The licensee requested review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement of NFPA 805, Section 3.3.3 regarding interior finishes. Specifically, the use of paints and coatings, which do not have the necessary documentation to demonstrate testing under American Society for Testing and Materials (ASTM) standard E136 (Reference 64) or an equivalent test method and therefore do not meet the specific combustibility standards for interior finish cited in Section 3.3.3.

As described by the licensee, this PB method consists of an engineering evaluation that determined the contribution of the paints and coatings to combustible loading would not challenge the plant fire barriers and was negligible overall. If the applied coatings were to be considered combustible, and assuming the most coats on any floor are four, the resulting fire load would be less than 8 minutes based on manufacturer's recommended application rates. In addition, as described by the licensee, these paints and coatings are located on concrete walls, ceilings, or floors. These thin interior finishes are considered to present an insignificant fire hazard due to the ability of the concrete to absorb heat during the early stages of fire and mitigate fire growth of the coating.

In the request, the licensee stated that the use of these paints and coatings does not affect nuclear safety, as in general, they meet the NFPA 805 definition of a limited combustible material with only isolated instances of thickness excesses. The paints and coating materials were evaluated to have a negligible effect on combustibility. Application of the paints and coatings is controlled via a CNS procedure, and these unqualified coatings are no longer allowed to be used at CNS. Therefore, there is no impact on the NSPC. The licensee also stated the use of these paints and coatings 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 paints and coating materials. The coatings do not change the radiological release evaluation, which concluded that potentially contaminated water is contained and smoke monitored. Coatings do not add additional radiological materials to the area or challenge system boundaries.

The licensee further stated in the LAR that the use of unqualified paints and coatings do not affect safety margin, as in general, they meet the NFPA 805 definition of a limited combustible material with only isolated instances of thickness excesses. The paints and coating materials were evaluated to have a negligible effect on combustibility. Application of paints and coatings is controlled via a CNS procedure, and these unqualified coatings are no longer allowed to be used at CNS.

Finally, the licensee stated in the LAR that fire protection DID will be maintained, because the use of these paints and coatings does not impact fire protection DID. It does not compromise administrative fire prevention controls, automatic fire detection and suppression functions, manual fire suppression functions, or post-fire safe shutdown capabilities.

Based on its review of the information submitted by the licensee, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the proposed PB method is an acceptable alternative to the corresponding NFPA 805, Section 3.3.3 requirement because it satisfies the performance goals, objectives, and criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate DID.

3.1.4.4 NFPA 805, Section 3.3.5.1 – Wiring above Suspended Ceilings

The licensee requested review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement in NFPA 805 Section 3.3.5.1 regarding wiring installed above suspended ceilings being listed for plenum use, routed in armored cable, routed in metallic conduit, or routed in cable trays with solid metal top and bottom covers. Specifically, the licensee requested approval of a PB method to justify the installation of limited amounts of wiring above suspended ceilings in the power block that does not meet the requirements of Section 3.3.5.1.

As described in the request, there are no significant amounts of wiring above suspended or dropped ceilings, and most of the wiring and cabling that is installed above the suspended or dropped ceiling is in conduit or is Institute of Electrical and Electronics Engineers (IEEE)-383 (Reference 65) qualified. However, some of the wiring installed above the suspended ceilings in the power block does not comply with the requirements of Section 3.3.5.1. The wiring in these locations that is not approved for plenum use and not installed in conduit includes lighting/power receptacle circuits, Gai-tronics cables, fire detection circuits, and/or communications cables associated with computers, telephones, televisions, or projectors. The licensee further stated that visual inspection of the areas above the suspended or dropped ceilings in the power block did not identify any ignition sources and cabling is routed in conduit or is IEEE-383 qualified and for newly installed wiring, engineering design procedures include requirements for electrical wiring above suspended ceilings and specifically reference NFPA 805, Section 3.3.5.1.

In FPE RAI 05 dated November 14, 2012 (Reference 16), the NRC staff requested that the licensee provide additional details regarding the installation of wiring above suspended ceilings at CNS including the following:

- A description of the specific circuits associated with the unqualified wires or cables (e.g., type, voltage, communication, data, signal, etc.);
- A description of fire detection or suppression provided above the suspended ceilings;
- A description of the visual inspection for ignition sources above the ceilings and the comprehensiveness of the inspection;
- Additional discussion of the wording "minimal amount" as used in the approval request to describe the wiring installed above suspended ceilings;
- A description of the pathway for smoke above the ceilings, including whether the space is considered a plenum or part of a smoke purge system;

- A discussion of the wiring installations relative to fire areas containing NSCA systems and equipment, including any NSCA wiring routed in areas above suspended ceilings where unqualified cables are located.

In its response dated January 14, 2013 (Reference 9), the licensee stated that the only wiring or cables installed above the suspended ceilings in the power block are low voltage (48 Volts (V)) data cables used for phone, computer, security (Gai-tronics), lighting and power receptacle circuits, and fire detection circuits. The licensee further stated that as of 2006, CNS procedures require that communication cabling installed in the power block meets NFPA 262 (Reference 66) requirements and although no non-plenum rated wiring was identified during walkdowns, there is potential that non-rated wiring could have been installed prior to 2006. The licensee further stated that no ignition sources are located above the suspended ceiling that would be binned as fire ignition sources (i.e., transformers greater than 45 kilovolt ampere or motors greater than 5 horsepower) and in the majority of the areas there are no combustibles or less than one pound of Class A combustibles. The licensee stated there is no detection or suppression provided in the areas above the suspended ceilings and the areas above the ceiling are not plenum areas (i.e., are not a part of the plant air distribution system). Lastly, the licensee identified the following fire zones where suspended ceilings are installed and stated that any NSCA, non-power operations (NPO), or FPRA cables located above the ceilings in these areas are routed in conduit:

Control Building - Computer Room (Fire Zone 10A)

Turbine Building - Crafts (Electrical and I&C) Shop Areas (Fire Zones 13C and 13D)

Multi-Purpose Facility - Office Area (Fire Zone 24)

Machine Shop - Office Area (Fire Zone 18A)

Water Treatment Building - Control Room and Storage Room (Fire Zone 17)

Radwaste Building - Chemistry Lab Areas (Elevation 932'-6", Fire Zone 21D, and Elevation 918'-0", Fire Zone 21C)

Augmented Radwaste Building - Drum Handling Control Room, Offgas Control Room, and Auxiliary Radwaste Control Room (Fire Zone 22B)

Based on the additional description of the inspection performed by the licensee above the suspended ceilings, the licensee's identification of limited combustibles and ignition sources in these areas, the licensee procedures for installation of communication wiring, and the confirmation that only low voltage data cables and wiring for lighting and power receptacles are routed outside conduit, the NRC staff concludes that the licensee's response to the NRC staff request for additional detail of the wiring installation and inspection is acceptable.

In FPE RAI 16 dated November 14, 2012 (Reference 16), the NRC staff identified that the licensee stated, in LAR Attachment L, that the request is similar to the request made by

Arkansas Nuclear One (ANO), Unit 2. The NRC staff described in the RAI that the ANO request contained an error in assuming that IEEE-383-1974 tested cables were equivalent to those tested to NFPA 262. The NRC staff requested the licensee to describe if the equivalence assumption between IEEE 383-1974 and NFPA 262 had been relied upon in the CNS evaluation of wiring and cables. In its response dated January 14, 2013 (Reference 9), the licensee stated the approval request does not rely on the assumption of equivalence between IEEE 383 and NFPA 262 and provided amended text for LAR Attachment L, Approval Request 2, in the RAI response that deleted the reference to the ANO request. Based on the licensee's statement that the assumption of equivalence between IEEE 383-1974 and NFPA 262 was not relied on at CNS and the LAR amendment to delete reference to ANO in the approval request, the NRC staff concludes that the licensee's response is acceptable.

In the request, the licensee stated the presence of non-rated and non-enclosed wiring above the suspended ceilings in the power block does not affect nuclear safety. The amount of wiring that is not rated for plenum use and is not located in conduit is limited and the presence of ignition sources located above the ceiling is minimal. Therefore, there is no impact on the NSPC. The licensee also stated the location of non-rated and non-enclosed wiring above suspended ceilings has no impact on the radiological release performance criteria. The radiological review was performed based on the potential location of radiological concerns and is not dependent on the type of wiring or locations of suspended ceilings.

The licensee further stated in the LAR that the amount of non-rated and non-enclosed wiring above the ceilings in the power block is minor and does not present a significant fire hazard. Therefore, the safety margin inherent in the analysis for the fire event has been preserved.

Finally, the licensee stated in the LAR that the introduction of the non-listed wiring routed above the suspended ceilings does not impact fire protection DID. The wiring located above the ceilings in the power block does not compromise administrative fire prevention controls, and does not directly result in challenging automatic fire detection and suppression functions, manual fire suppression functions, or post-fire safe shutdown capability.

Based on its review of the information submitted by the licensee, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the proposed PB method is an acceptable alternative to the corresponding NFPA 805, Section 3.3.5.1 requirement because it satisfies the performance goals, objectives, and criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID.

3.1.4.5 NFPA 805, Section 3.3.5.2 – Metal Tray and Metal Conduit for Electrical Raceways

The licensee requested NRC staff review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement of NFPA 805 Section 3.3.5.2 regarding use of metal tray or conduit for electrical raceways. Specifically, the licensee requested approval of a PB method to justify the use of plastic conduit embedded in concrete or below grade.

As described in the request, plastic conduit is used in embedded installations, either in concrete or below grade. As stated by the licensee, the intent of the NFPA 805 requirement is mainly to provide protection of conductors from an exposure fire and to ensure the raceway (i.e., plastic conduit) does not contribute to the fire source/overall combustible loading of the fire area. For the locations where NRC approval is requested, fire ignition or self-sustaining combustion of the plastic conduit is not plausible. In addition, plastic conduit embedded in concrete or located below grade is not expected to be exposed to a fire in an adjacent area given the fire-resistive characteristics of concrete.

The licensee stated in the LAR that the presence of plastic conduit currently embedded in concrete or installed below grade, and potential future similar configurations does not affect nuclear safety as the embedded or below grade conduit are not subject to failure from an external source and circuit damage would not occur. Therefore, there is no impact on the NSPC. The presence of plastic conduit in the mentioned locations has no impact on the radiological release performance criteria. The radiological release review was performed based on the 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, which concluded that potentially contaminated water is contained and smoke is monitored. The plastic conduit does not add additional radiological materials to the area or challenge system boundaries.

The licensee further stated in the LAR that the presence of plastic conduit embedded in concrete or installed below grade are not subject to fire damage via an external source and circuit damage will not occur. The type of conduit material will not adversely impact the ability of the station to achieve and maintain fire safe shutdown. Therefore, the safety margin inherent in the analysis for a fire event has been preserved.

Finally, the licensee stated the presence of plastic conduit in the above-mentioned locations does not impact fire protection DID. The presence and location of the plastic conduit does not compromise administrative fire prevention controls, automatic fire detection and suppression functions, manual fire suppression functions, or post-fire safe shutdown capabilities.

Based on its review of the LAR, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the proposed PB method is an acceptable alternative to the corresponding NFPA 805, Section 3.3.5.2 requirement because it satisfies the performance goals, objectives, and criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID.

3.1.4.6 NFPA 805, Section 3.3.7.2 – Outdoor High-Pressure Flammable Gas Storage

In the original LAR submittal, the licensee requested in Attachment L, Approval Request 4, the NRC staff's review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement of NFPA 805 Section 3.3.7.2 regarding the installation of high-pressure flammable gas containers with the long axis pointed at buildings. On the basis of the licensee's response to FPE RAI 13, the licensee revised the compliance strategy for NFPA 805

Section 3.3.7.2 to "Complies," and retracted this request for approval. See SE Section 3.1.1.5 for the NRC staff evaluation of the licensee's RAI response.

3.1.4.7 NFPA 805, Section 3.5.3 – Electric Motor-Driven Fire Pump Remote Manual Stop

The licensee requested NRC staff review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement of NFPA 805 Section 3.5.3 regarding fire pumps designed and installed in accordance with NFPA 20. Specifically, the licensee requested approval of a PB method to justify the use of manual remote shutdown capability for the electric motor-driven fire pump.

As described in the request, NFPA 20 prohibits manual remote control stations from being operable to stop the motor. The electric motor-driven fire pump (FP-P-E) is normally configured for automatic start on low system pressure. This pump requires manual operation to stop once started. Fire pump FP-P-E can be stopped locally at the pump controller, and remotely in the Control Room. The ability to stop FP-P-E after auto-start from the Control Room is considered to be a deviation from this NFPA 805 requirement to meet NFPA 20, for which NRC approval is requested. As described in the LAR, the ability to stop FP-P-E from the Control Room after auto-start resolved Atomic Energy Commission (AEC) Concern 102 during the licensing of CNS in 1973. This AEC Concern regarded the ability to quickly shut off the fire water supply in the event of line break or other catastrophe which might cause flooding of critical equipment needed for safe shutdown. Although this design change was not specifically agreed to by NPPD, or credited in the AEC SE Report for CNS, NPPD does not believe it would be appropriate to eliminate this AEC-requested feature.

The licensee further described in the request that, in the case where the electric motor-driven fire pump is stopped, either remotely or locally, the redundant diesel engine drive fire pump FP-P-D will operate upon loss of fire water supply header pressure as designed, and is sized to provide water for the largest fire suppression system demand plus the simultaneous flow of 1,000 gallons per minute (gpm) from manual hose stations for 2 hours. An alarm will annunciate in the Control Room if the automatic start of FP-P-E is overridden, precluding the inadvertent performance of this action. In FPE RAI 14 dated November 14, 2012 (Reference 16), the NRC staff requested that the licensee describe the indications available to the Control Room operators in the event of electric fire pump failure to start while the diesel fire pump is locked out from starting. In its response dated January 14, 2013 (Reference 9), the licensee described the fire system annunciators available in the Control Room, which include Fire System Low Pressure, which alarms on low system pressure, Electric Fire Pump E Power Failure, which alarms when 480V alternating current (AC) power is not available to the pump controller, and Electric Fire Pump E Locked Out, which alarms when the control switch is not in Auto. The licensee also stated that Control Room operators have a pressure indicator available in the Control Room to monitor system pressure. On the basis of the various annunciators and system pressure indication available in the Control Room to provide system status, the NRC staff concludes that the licensee's response is acceptable because the electric fire pump failure to start with the diesel fire pump locked out will be indicated by Control Room annunciators and indication.

The licensee stated that the ability to remotely stop the electric motor-driven fire pump does not affect nuclear safety, as there are strict administrative controls placed over the monitoring and control of the fire pump. Redundant diesel-driven fire pump, FP-P-D, would be present to ensure site-wide fire protection systems remain in service in the event the electric motor-driven fire pump is taken off line. Therefore, there is no impact on the NSPC. The licensee also stated that the radiological release review was performed based on the fire suppression activities in areas containing or potentially containing radioactive materials and is not impacted by the remote stopping capability of the electric fire pump. This does not change the radiological release evaluation, which concluded that potentially contaminated water is contained and smoke is monitored. This pump remote stop capability does not add additional radiological materials to the area or challenge system boundaries and therefore, has no impact on the radiological release performance criteria.

The licensee further stated in the LAR that as adequate site-wide fire protection capability is provided via the redundant diesel-driven fire pump, the remote stopping capability of the electric motor-driven fire pump will not adversely impact the ability of the plant to achieve and maintain fire safe shutdown. Therefore, the safety margin inherent in the analysis for a fire event has been preserved.

Finally, the licensee stated the means of remotely stopping the electric motor-driven fire pump does not impact fire protection DID. This feature does not compromise administrative fire prevention controls, automatic fire detection and suppression functions, manual fire suppression functions, or post-fire safe shutdown capability. Means are available to ensure that the fire pump, or the redundant fire pump, is operable during a fire event.

Based on its review of the LAR, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the proposed PB method is an acceptable alternative to the corresponding NFPA 805, Section 3.5.3 requirement because it satisfies the performance goals, objectives, and criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID.

3.1.4.8 NFPA 805, Section 3.6.1 – Standpipe and Hose System Design

The licensee requested NRC staff review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement of NFPA 805 Section 3.6.1 regarding the design of standpipe and hose stations in accordance with NFPA 14, 1974 edition (Reference 61). Specifically, the licensee requested approval of a PB method to justify the following deviations from the NFPA standard:

- Contrary to the provision in NFPA 14 (1974) Section 322, that hose stations be provided such that all portions of each story of the building are within 30 feet of a nozzle when attached to not more than 100 feet of hose, the maximum of 100 feet of hose is exceeded for Fire Zones 14A-D, 15, 16, 18B-E, 20A-B, 23A-C, and 25, which are not protected by standpipe and hose stations. In addition, all portions of Fire Zones 1F, 10B, 11L, 12B, and 12F cannot be reached with 100 feet of hose plus 30 feet of hose stream.

- Contrary to the provision in NFPA 14 (1974), Section 442, that standpipe outlet pressure exceeding 100 pounds per square inch (psi) have a device installed to reduce the pressure to 100 psi at the outlet, no pressure reducing devices have been installed in CNS standpipe systems that exceed 100 psi at the outlet.

- Contrary to the provision in NFPA 14 (1974), Section 625, that valves shall be extra-heavy flanged pattern where system pressure exceeds 175 psi, standpipe hose valves in below grade elevations where pressures are slightly above 175 psi are rated at 175 psi and are not extra-heavy flanged pattern.

- Contrary to the provision in NFPA 14 (1974), Section 671, that water flow alarms be provided on all standpipe risers, Fire Zones 19B, 19C, and 24 are the only zones equipped with water flow alarms.

In its request, the licensee provided the following additional discussion of each of the NFPA 14 deviations described above:

With regard to the provision in NFPA 14 that all portions of the building be within 30 feet of a nozzle when attached to not more than 100 feet of hose, the fire protection for Fire Zones 14A-D, 15, 16, 18B-E, 20A-B, 23A-C, and 25 is provided from outside hydrants and hoses and none of the fire zones requires more than 350 feet of hose, which is within the NFPA 500 feet limitation for hoses when attached to hydrants. The licensee further stated that Fire Zones 10B, 12B, and 12F can be reached with a maximum additional 50 feet of hose. CNS procedures ensure that the Fire Brigade has additional lengths of hose available for these locations, which ensures that all portions of these fire zones can be reached with a hose stream. Hose stations protecting these zones are supplied by a minimum 4-inch standpipe, which minimizes friction loss even with heavy hose stream. Fire Zone 1F is the Torus and 11L is the pipe chase between the Reactor Building and the Turbine Building. Both of these fire zones have a negligible combustible loading and transient combustibles are controlled in accordance with CNS procedures. In addition, in the event of a fire in these areas, CNS procedures ensure that the Fire Brigade has additional lengths of hose available to ensure that all portions of these two fire zones can be reached with a hose stream. The site fire pumps are capable of providing sufficient outlet pressure for the additional required hose. Therefore, the location and spacing of the existing hose stations is considered to be adequate.

In FPE RAI 06 dated November 14, 2012 (Reference 16), the NRC staff requested that for those fire zones that require an additional 50 feet of hose that the licensee confirm that hydraulic calculations for the standpipe system demonstrate that acceptable pressure and flow conditions at the nozzle with the head-loss associated with total length of 150 feet of hose. In its response dated February 12, 2013 (Reference 10), the licensee stated that the impact of the additional 50 feet of hose to the standard 100 feet of hose required by NFPA 14 was evaluated and the calculation documented that the use of an additional 50 feet of 1-1/2-inch fire hose at hose stations adjacent to Fire Zones 1F, 10B, 11L, 12B, and 12F is acceptable, and within the capability of the fire protection water supply system. Pressure conditions at the nozzle of each fire hose will only be reduced by approximately 12 psi and an acceptable flow rate of 100 gpm is available at the nozzle which meets the flow rate requirements of NFPA 14. On the basis that the licensee's calculations demonstrate that acceptable flow conditions are achieved with the additional 50 feet of hose, the NRC staff concludes that the licensee's response is acceptable.

With regard to the provision in NFPA 14 that outlet pressures exceeding 100 psi be reduced to 100 psi, the intent of this section is to limit hose pressures seen by fire hose handlers. However, in accordance with CNS procedures, only Fire Brigade qualified personnel are allowed to utilize fire hose stations at CNS. All Fire Brigade personnel are trained in the use of heavy hose streams, such as CNS fire hose stations at full system pressure. Furthermore, NFPA 14 (current edition) permits static pressures of 175 psi at Class I (2 ½ inch) and Class II (1 ½ inch) hose stations, well above the 1974 requirement of 100 psi. Although NFPA 14 (current) edition requires the installation of a pressure reducer when the residual pressure exceeds 100 psi for a Class II hose station (175 psi residual pressure for a Class I hose station), the intent of the requirement is to limit the pressure so that "trained occupants" can use the hose outlet. As discussed, only trained Fire Brigade personnel are permitted to use the hose stations. Therefore, hose station residual pressures between 100 psi and 175 psi are deemed acceptable for use by the Fire Brigade.

With regard to the provision in NFPA 14 regarding use of extra-heavy flange pattern valves where standpipe system pressures exceed 175 psi, these standpipe hose valves are rated at 175 psi, but are hydrostatically pressure tested to 350 psi. This hydrostatic test pressure is well above the system pressure. Therefore, the existing valves are deemed acceptable, as installed, and are capable of performing the intended function.

With regard to the provision in NFPA 14 to provide water flow alarms on all standpipes, the intent of this section is to alert station personnel of a fire, based on fire hose station water flow. However, only Fire Brigade members are allowed to use the fire hose stations at CNS. Therefore, if the Fire Brigade is using the hose station, then the fire has already been reported to the Control Room, and the fire alarm system has been activated. A water flow alarm is not necessary to notify the Control Room that a hose station is in use.

The licensee stated in the LAR that the standpipe system features that deviate from NFPA 14 do not affect nuclear safety, as adequate manual firefighting capability is provided for these areas. Therefore, there is no impact on the NSPC. The licensee also stated the radiological release review was performed based on the fire suppression activities in areas containing or potentially containing radioactive materials and is not impacted by these standpipes system features and does not change the radiological release evaluation, which concluded that potentially contaminated water is contained and smoke is monitored. The standpipe system features addressed in this approval request do not add additional radiological materials to the area or challenge system boundaries, and therefore, have no impact on the radiological release performance criteria.

The licensee further stated in the LAR that the standpipe system features addressed in this approval request will not adversely impact the ability of the station to achieve and maintain fire safe shutdown, as adequate manual fire suppression capability is provided for these areas. Therefore, the safety margin inherent in the analysis for a fire event has been preserved.

Finally, the licensee stated the standpipe system features addressed in this approval request do not impact fire protection DID. Its presence does not compromise administrative fire prevention controls, automatic fire detection and suppression functions, manual fire suppression functions, or post-fire safe shutdown capabilities.

Based on its review of the LAR, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the proposed PB method is an acceptable alternative to the corresponding NFPA 805, Section 3.6.1 requirement because it satisfies the performance goals, objectives, and criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID.

3.1.4.9 NFPA 805, Section 3.7 – Class B Fire Extinguisher Placement

The licensee requested NRC staff review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement of NFPA 805 Section 3.7 regarding the installation of fire extinguishers in accordance with NFPA 10, 1975 edition (Reference 62). Specifically, the licensee requested approval of a PB method to justify the size and placement of fire extinguishers for Class B (flammable liquid) hazards in certain CNS fire zones.

As described in the request, NFPA 10 (1975) Section 3-3 provides requirements for fire extinguisher size and placement for Class B fires (flammable liquids) other than for fires in flammable liquids of appreciable depth. CNS Fire Zones 5B, 11C, 11D, 11H, 11J, 11K, 12C, 13A (behind bio-shield wall only), and 18D contain Class B hazards that are not of appreciable depth; however, the placement of the Class B fire extinguishers provided in, and adjacent to, the stated fire zones is deficient as the travel distance requirements of NFPA 10 (1975) are exceeded.

As also described in the request, Fire Zones 11D, 12C, and 13A (behind bio-shield wall only) are provided with automatic suppression systems protecting the lube oil hazards. In addition, large-wheeled fire extinguishers are provided in adjacent fire zones and can be used within Fire Zones 11D, 12C, and 13A. The presence of fire extinguishers adjacent to the as low as reasonably achievable (ALARA)-concerned areas satisfies the intent of NFPA 805, Section 3.7. Fire Zones 5B, 11C, 11H, 11J, 11K, and 18D are provided with automatic suppression systems and additional Class B fire extinguishers are also provided in adjacent fire zones. All of these fire zones are provided with fire detection (smoke, heat, or flame) which alarms in the Control Room to initiate prompt fire investigation and Fire Brigade response. Additionally, standpipes are provided within, or adjacent to, these fire zones.

The licensee stated in the LAR that the number and locations of existing Class B fire extinguishers does not affect nuclear safety as adequate manual and fixed suppression capability are provided for these areas. Therefore, there is no impact on the NSPC. The radiological release review was performed based on the fire suppression activities in areas containing or potentially containing radioactive materials and is not impacted by the location and number of portable fire extinguishers. This does not change the radiological release evaluation, which concluded that potentially contaminated water is contained and smoke is monitored. The number and locations of existing Class B fire extinguishers do not add additional radiological materials to the area or challenge system boundaries and therefore have no impact on the radiological release performance criteria.

The licensee further stated in the LAR that the number and locations of existing Class B fire extinguishers will not adversely impact the ability of the station to achieve and maintain fire safe shutdown, as adequate manual and fixed suppression capability is provided in these areas. Therefore, the safety margin inherent in the analysis for a fire event has been preserved.

Finally, the licensee stated the number and locations of existing Class B fire extinguishers does not impact fire protection DID. It does not compromise administrative fire prevention controls, automatic fire detection and suppression functions, manual fire suppression functions, or post-fire safe shutdown capabilities.

Based on its review of the LAR, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the proposed PB method is an acceptable alternative to the corresponding NFPA 805, Section 3.7 requirement because it satisfies the performance goals, objectives, and criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID.

3.1.4.10 NFPA 805, Section 3.10.5, Local Disarming of Automatic Gaseous Suppression Systems

The licensee requested NRC staff review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement of NFPA 805 Section 3.10.5 regarding the security and control of provisions for locally disarming automatic gaseous suppression systems. Specifically, the licensee requested approval of a PB method to justify the use of local abort switches for the diesel generator CO_2 system that are not key-controlled and thus are not secured as required by NFPA 805.

As described in the request, only authorized personnel are allowed to abort the system. This would include Fire Brigade members and Operations personnel, who are trained in the methods of manually actuating the system while in the "Abort" position. Although the diesel generator CO_2 system is not provided with keyed abort switches, they are provided with abort switches that will annunciate at the local panel and in the Control Room upon operation. Fire Brigade members and Control Room Operators are trained in the locations of station CO_2 systems, automatic and manual methods of actuation, system interlocks and time delays, abort switch operation, and actions required upon abort switch annunciation on the Control Room suppression panel. In addition, CNS procedures provide instructions/safeguards required to safely reset the system to normal operation following system discharge or system abort. The procedures also provide instructions required to safely abort the system or take the system out of service. A fire watch is required when the system is aborted or taken out of service. Therefore, these procedures ensure that the systems are not left in the disarmed mode following the manual aborting action; or that if the systems are intended to be left out of service, procedural controls ensure that a fire watch is in place to ensure adequate fire protection is maintained for the diesel generator areas.

The licensee stated in the LAR that administrative controls provide assurance that the presence of a "non-keyed" system abort switch does not affect nuclear safety, as a fire watch is required when the system is aborted or taken out of service. Therefore, there is no impact on the NSPC. The functional attributes of the abort switch remain the same. The radiological release review was performed based on the fire suppression activities in areas containing or potentially containing radioactive materials and is not impacted by the presence of a "non-keyed" abort switch. The diesel generator areas do not contain any radioactive materials, and therefore, the presence of a "non-keyed" system abort switch has no impact on the radiological release performance criteria.

The licensee further stated in the LAR that the presence of a "non-keyed" system abort switch will not adversely impact the ability of the station to achieve and maintain fire safe shutdown, as adequate manual suppression capability is provided in the event that the CO_2 system is aborted or out-of-service. Therefore, the safety margin inherent in the analysis for a fire event has been preserved.

Finally, the licensee stated the presence of a "non-keyed" system abort switch does not impact fire protection DID. Its presence does not compromise administrative fire prevention controls, automatic fire detection and suppression functions, manual fire suppression functions, or post-fire safe shutdown capabilities.

Based on its review of the LAR, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the proposed PB method is an acceptable alternative to the corresponding NFPA 805, Section 3.10.5 requirement because it satisfies the performance goals, objectives, and criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID.

3.1.4.11 NFPA 805, Section 3.10.7, Odorizer for Automatic Total Flooding Carbon Dioxide Systems

The licensee requested NRC staff review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement of NFPA 805 Section 3.10.7 regarding use of an odorizer in automatic total flooding CO_2 systems. Specifically, the licensee requested approval of a PB method to justify the current system design at CNS that does not include an odorizer.

As described in the request, the intent of the NFPA 805 odorizer requirement is to provide notification to personnel to exit an enclosed space prior to an impending and toxic CO_2 system discharge. The following safeguards are present to ensure personnel safety:

- Strobe lights are located inside the protected space and outside the protected space serve as an alert in the event of CO_2 system actuation;
- Audible and visual pre-discharge signals have been provided inside and outside of the protected space;

- A 50-second pneumatic time delay is provided following actuation of the CO_2 system to allow for personnel evacuation prior to system discharge; and
- Appropriate warning signs are affixed outside the area covered by the CO_2 system. Another placard is located inside the hazard area, advising immediate evacuation in the event of the system alarm sounding.

The request further noted that NFPA 12 (either the 1972 Code of record edition or the current 2011 edition) does not require the presence of an odorizer; however, it is suggested in the Appendix as a potential safeguard (i.e., "above and beyond" required features) for alerting personnel to imminent system discharge. The licensee stated that per its NFPA 12 code compliance review, all "required" safeguards for "Hazards to Personnel" are satisfied for the as-installed CO_2 system configuration.

The licensee stated in the LAR that the lack of an odorizer is a personnel safety issue that does not affect nuclear safety. Adequate fixed suppression capability is provided by the CO_2 system, and, therefore, there is no impact on the NSPC. The functional attributes of the CO_2 system remain the same. The radiological release review was performed based on the fire suppression activities in areas containing or potentially containing radioactive materials and is not impacted by the lack of an odorizer. The diesel generator areas do not contain any radioactive materials and, therefore, the lack of an odorizer has no impact on the radiological release performance criteria.

The licensee further stated in the LAR that the lack of an odorizer will not adversely impact the ability of the station to achieve and maintain fire safe shutdown as adequate fixed suppression capability is provided by the CO_2 system. Therefore, the safety margin inherent in the analysis for a fire event has been preserved.

Finally, the licensee stated the lack of an odorizer does not impact fire protection DID. It does not compromise administrative fire prevention controls, automatic fire detection and suppression functions, manual fire suppression functions, or post-fire safe shutdown capabilities.

The requirement to install an odorizer is intended to assist licensees in meeting the Life Safety Criteria of NFPA 805. In accordance with 10 CFR 50.48(c)(2)(i), the NRC does not endorse the Life Safety Goal, Objectives and Criteria. Based on its review of the LAR, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the proposed PB method is an acceptable alternative to the corresponding NFPA 805, Section 3.10.7 requirement because it satisfies the performance goals, objectives, and criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID.

3.2 Nuclear Safety Capability Assessment (NSCA) Methods

NFPA 805 is an RI/PB standard that allows engineering analyses to be used to show that FPP features and systems provide sufficient capability to meet the requirements of 10 CFR 50.48(c).

NFPA 805, Section 2.4, "Engineering Analyses," states, in part, that:

> Engineering analysis is an acceptable means of evaluating a fire protection program against performance criteria. Engineering analyses shall be permitted to be qualitative or quantitative... The effectiveness of the fire protection features shall be evaluated in relation to their ability to detect, control, suppress, and extinguish a fire and provide passive protection to achieve the performance criteria and not exceed the damage threshold defined in Section [2.5] for the plant area being analyzed.

Chapter 1 of the standard defines the goals, objectives, and performance criteria that the FPP must meet in order to be in accordance with NFPA 805.

NFPA 805, Section 1.3.1, "Nuclear Safety Goal," states that:

> The nuclear safety goal is to provide 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.

NFPA 805, Section 1.4.1, "Nuclear Safety Objectives," states that:

> In the event of a fire during any operational mode and plant configuration, the plant shall be as follows:
>
> (1) *Reactivity Control.* Capable of rapidly achieving and maintaining subcritical conditions.
>
> (2) *Fuel Cooling.* Capable of achieving and maintaining decay heat removal and inventory control functions.
>
> (3) *Fission Product Boundary.* Capable of preventing fuel clad damage so that the primary containment boundary is not challenged.

NFPA 805, Section 1.5.1, "Nuclear Safety Performance Criteria," states that:

> Fire protection features shall be capable of providing reasonable assurance that, in the event of a fire, the plant is not placed in an unrecoverable condition. To demonstrate this, the following performance criteria shall be met:
>
> (a) *Reactivity Control.* Reactivity control shall be capable of inserting negative reactivity to achieve and maintain subcritical conditions. Negative reactivity inserting shall occur rapidly enough such that fuel design limits are not exceeded.
>
> (b) *Inventory and Pressure Control.* With fuel in the reactor vessel, head on and tensioned, inventory and pressure control shall be capable of controlling coolant level such that subcooling is maintained for a

[pressurized-water reactor (PWR)] and shall be capable of maintaining or rapidly restoring reactor water level above top of active fuel for a [boiling-water reactor (BWR)] such that fuel clad damage as a result of a fire is prevented.

(c) *Decay Heat Removal.* Decay heat removal shall be capable of removing sufficient heat from the reactor core or spent fuel such that fuel is maintained in a safe and stable condition.

(d) *Vital Auxiliaries.* Vital auxiliaries shall be capable of providing the necessary auxiliary support equipment and systems to assure that the systems required under (a), (b), (c), and (e) are capable of performing their required nuclear safety function.

(e) *Process Monitoring.* Process monitoring shall be capable of providing the necessary indication to assure the criteria addressed in (a) through (d) have been achieved and are being maintained.

3.2.1 Compliance with NFPA 805 NSCA Methods

NFPA 805, Section 2.4.2, "Nuclear Safety Capability Assessment," states the following:

> 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

This section of the SE evaluates the first three steps listed above. SE Section 3.5 addresses the assessment of the fourth step.

RG 1.205, Revision 1, endorses NEI 04-02, Revision 2, and Chapter 3 of NEI 00-01, Revision 2, "Guidance for Post-Fire Safe Shutdown Circuit Analysis" (Reference 34). This NRC-endorsed guidance (i.e., NEI 04-02 Table B-2, "NFPA 805 Chapter 2 – Nuclear Safety Transition – Methodology Review," and NEI 00-01, Chapter 3) has been determined to address the related requirements of NFPA 805, Section 2.4.2. The NRC staff reviewed LAR Section 4.2.1, "Nuclear Safety Capability Assessment Methodology," and LAR Attachment B, "NEI 04-02 Table B-2 – Nuclear Safety Capability Assessment – Methodology Review" (LAR Table B-2), against these guidelines.

The endorsed guidance provided in NEI 00-01, Revision 2 provides a framework to evaluate the impact of fires on the ability to maintain post-fire safe shutdown. It provides detailed guidance for:

(1) Selecting systems and components required to meet the nuclear safety performance criteria;

(2) Selecting the cables necessary to achieve the nuclear safety performance criteria;

(3) Identifying the location of nuclear safety equipment and cables; and

(4) Appropriately conservative assumptions to be used in the performance of the NSCA.

The licensee developed the LAR based on the three guidance documents cited above. Although RG 1.205, Revision 1, endorses NEI 00-01, Revision 2, the licensee's review was originally performed to the guidance in NEI 00-01, Revision 1 (Reference 67). To ensure that changes to the text in Chapter 3 did not alter the conclusions reached during the original review, the licensee performed a gap analysis against NEI 00-01, Revision 2. The licensee stated there were no additional justifications to address the impact of changes due to the gap analysis that required inclusion in Attachment B. As discussed in safe shutdown (SSD) RAI 01 dated November 14, 2012 (Reference 16), the NRC staff requested a summary of the technical issues resulting from the gap analysis from NEI 00-01, Revision 1 to Revision 2. Based on the information provided in the licensee's submittal, as supplemented, the licensee developed and implemented a systematic process to evaluate the post-fire SSA against the requirements of NFPA 805, Section 2.4.2, Subsections (1), (2), and (3), which meets the methodology outlined in the latest NRC-endorsed industry guidance.

FAQ 07-0039 (Reference 39) provides one acceptable method for documenting the comparison of the SSA against the NFPA 805 requirements. This method first maps the existing SSA to the NEI 00-01, Chapter 3 methodology, which in turn, is mapped to the NFPA 805 Section 2.4.2 requirements.

The licensee performed this evaluation by comparing its SSA against the NFPA 805 NSCA requirements using the NRC-endorsed process in Chapter 3 of NEI 00-01, Revision 1, and documenting the results of the review in the LAR Attachment B, "NEI 04-02 Table B-2 Nuclear Safety Capability Assessment Methodology Review," in accordance with the guidance of NEI 04-02, Revision 2.

The categories used by CNS to describe alignment with the NEI 00-01, Chapter 3, attributes are as follows:

(1) The SSA directly aligns with the attribute: noted in the LAR Table B-2 as "Aligns."

(2) The SSA aligns with the intent of the attribute: noted in the LAR Table B-2 as "Aligns with intent."

(3) The SSA does not align with the attribute: noted in LAR Table B-2 as "Not in Alignment."

(4) The SSA does not align with the attribute, but there is a prior NRC approval of an alternative to the attribute, and the bases for the NRC approval remain valid: noted in LAR Table B-2 as "Not in Alignment, but Prior NRC Approval."

(5) The SSA does not align with the attribute, but there are no adverse consequences because of the non-alignment: noted in LAR Table B-2 as "Not in Alignment, but no adverse consequences."

As stated above, the licensee performed a gap analysis based on the review of the NSCA to the guidance of NEI 00-01, Revision 1 with respect to Revision 2 as endorsed by RG 1.205, Revision 1, and determined there were no impacts requiring inclusion in LAR Table B-2. In SSD RAI 01 dated November 14, 2012 (Reference 16), the NRC staff requested that the licensee summarize the technical issues resulting from the gap analysis and specifically requested the licensee address NEI 00-01, Revision 2, Section 3.2.1.2 for post-fire operation of manual rising-stem valves that have been exposed to fire conditions, and Section 3.5.1, for the consideration of proper-polarity hot shorts in certain direct current (DC) control circuits for non-high-low pressure interface components. In its response dated January 14, 2013 (Reference 9), the licensee stated that there are no instances where it is necessary to manually operate valves that are located in the fire area of concern. In addition, the license also stated that DC hot shorts, including consideration of proper polarity shorts in non-high-low interface components where source and target conductors are in the same cable were considered. On the basis of the licensee's response to SSD RAI 01 and the statements in the LAR that no impacts were identified in the gap analysis to NEI 00-01, Revision 2, the NRC staff concludes that the licensee has reviewed CNS SSD analysis against the methods endorsed in RG 1.205.

3.2.1.1 Attribute Alignment – Aligns

For all of the applicable NEI 00-01, Chapter 3, attributes, the licensee determined that the SSA aligns directly with the attribute. In these instances, based on the information provided by the licensee in the LAR, as supplemented, and the information gained from the NFPA 805 site audit conducted October 1 – 5, 2012 (Reference 53) (that is, the documents reviewed, discussions held with the licensee and the plant tours performed), the NRC staff concludes that the licensee's statements of alignment are acceptable.

3.2.1.2 Attribute Alignment – Aligns with Intent

The licensee did not identify any attributes in this category.

3.2.1.3 Attribute Alignment – Not in Alignment, but Prior NRC Approval

The licensee did not identify any attributes in this category.

3.2.1.4 Attribute Alignment – Not in Alignment, but No Adverse Consequences

The licensee did not identify any attributes in this category.

3.2.1.5 Attribute Alignment – Not in Alignment

The licensee did not identify any attributes in this category.

3.2.1.6 NFPA 805 Nuclear Safety Capability Assessment Methods Conclusion

The NRC staff reviewed the documentation provided by the licensee describing the process used to perform the NSCA required by NFPA 805, Section 2.4.2. The licensee performed this evaluation by comparing the SSA against the NFPA 805 NSCA requirements using NEI 00-01, Revision 1 with a gap analysis to the NRC-endorsed process in Chapter 3 of NEI 00-01, Revision 2. The results of the review are documented in LAR Attachment B, Table B-2 in accordance with NEI 04-02, Revision 2, and the gap analysis of NEI 00-01, Revision 2 as described in LAR Section 4.2.1.1 and discussed in SSD RAI 01 dated November 14, 2012 (Reference 16). The licensee indicated that there are no significant differences between alignment with NEI 00-01, Revision 1 and NEI 00-01, Revision 2.

Based on the information provided in the licensee's submittal, as supplemented, the NRC staff accepts the method the licensee used to perform the NSCA with respect to the selection of systems and equipment, selection of cables, and identification of the location of nuclear safety equipment and cables, as required by NFPA 805, Section 2.4.2. The NRC staff concludes that the licensee's method is acceptable because it met the NRC-endorsed guidance directly.

3.2.2 Maintaining Fuel in a Safe and Stable Condition

The nuclear safety goals, objectives, and performance criteria of NFPA 805 allow more flexibility than the previous deterministic FPPs based on Appendix R to 10 CFR 50 and NUREG-0800, Section 9.5.1.1 (Reference 68), since NFPA 805 only requires the licensee to maintain the fuel in a safe and stable condition rather than achieve and maintain cold shutdown in 72 hours. In LAR Section 4.2.1.2, the licensee stated that the NFPA 805 licensing basis is to achieve and maintain the fuel in a "safe and stable" condition assuming a fire occurs during Mode 1 (Power Operation), Mode 2 (Startup), or Mode 3 (Hot Shutdown). The Mode 3 applicability for the analysis is defined as being up to the point at which the DC breaker for the shutdown cooling suction valve is un-locked and closed, at which point spurious operation of these high/low pressure interface valves can occur due to fire damage to the valve control circuitry.

The licensee stated that safe and stable conditions can be maintained for an initial 24-hour coping period. For the most limiting fire scenarios, the NSCA documents the availability of long-term decay heat removal provided by water from the torus, with temperature maintained by the Residual Heat Removal (RHR) system operating in the suppression pool cooling mode. The licensee stated that initiation of RHR in the suppression pool cooling mode does not imply that the plant would proceed all the way to cold shutdown and that following stabilization at hot shutdown, a long-term strategy for reactivity control, decay heat removal, and inventory/pressure control would be determined based on the extent of equipment damage. The licensee further stated that if an assessment of the post-fire conditions indicated that placing RHR in the shutdown cooling mode would be advisable, then repair activities would commence in a safe and controlled manner to restore plant equipment necessary for reactor cool down.

In SSD RAI 02 dated November 14, 2012 (Reference 16), the NRC staff requested that the licensee provide additional information of the specific capabilities and actions as well as any limitations on systems or time limited actions necessary beyond 24 hours to meet the specific NSPC and to maintain safe and stable conditions. The NRC staff also requested the licensee provide a qualitative or quantitative evaluation of the risk associated with the failure of actions and equipment necessary to extend safe and stable beyond 24 hours given the post-fire scenarios during which they may be required. In its response dated January 14, 2013 (Reference 9), the licensee described the scope of actions, repairs, and restoration activities prior to and beyond 24 hours, which are summarized as follows:

- The 24-hour coping period allows for the CNS Emergency Response Organization (ERO) to respond, with adequate time to muster additional resources, assess the extent of fire damage, and assist plant staff with actions to sustain hot shutdown (Mode 3) or alternatively to assist the plant operating staff with any necessary repairs and actions to transition and proceed to cold shutdown (Mode 4) if necessary.

- DC Battery Power - 250V and 125V DC power for the High Pressure Coolant Injection (HPCI), Reactor Core Isolation Cooling (RCIC), and Emergency Diesel Generator (EDG) System operation. Station batteries have sufficient capacity to operate for 4.5 hours before battery chargers need to be repowered. Replacement cables are pre-staged at the worksite and replacement instructions are provided in post-fire operating procedure.

- Sufficient diesel fuel oil on-site for an EDG (as necessary, for those fire areas where offsite power is not free of fire damage) to operate for 7 days at maximum load demand, which is longer than the time to replenish the supply from outside sources. In the event the fuel oil transfer pump cables are damaged by fire, replacement cables are staged and procedures are established to restore the transfer pump function.

- Diesel Driven Fire Pump with sufficient fuel available for 8 hours of pump run based on full fire pump rated flow of 3000 gpm. Operators would have sufficient time to replenish the fuel supply if necessary. An additional five diesel fuel tanks with a capacity of approximately 300 gallons each that are used to fuel vehicles can provide addition sources of diesel fuel for the fire pump, are available on site, and replenished routinely by the vendor that also provides the diesel fuel for the fire pump. A portable tank that can be carried by truck can be used to transfer fuel from the on-site tanks to the fire pump fuel tank. If the fire pump is used as a backup source of inventory, the additional fuel available on site would allow injection for more than 24 hours.

- Accumulators provided on the ADS valves ensure air is available for initial valve operation. The accumulators provide adequate pressure to operate the ADS valves for a minimum of 8 hours after isolation from back-up air or nitrogen systems. Long-term pneumatic supply for the safety relief valves in the Alternate Shutdown Cooling mode is provided via a repair procedure that directs restoration of nitrogen supply to the ADS accumulators.

- Emergency Condensate Storage Tanks (ECST) - The primary source of water to the HPCI and RCIC systems is the ECST. The two tanks, each with a 50,000 gallon capacity, are the preferred source of injection water to the reactor vessel. The suppression pool provides the secondary source of water to these two systems with both pumps provided with the capability to automatically shift suction to the suppression pool.

The licensee further stated that recovery of NSCA equipment that may be required beyond 24 hours has been qualitatively evaluated and determined to have no significant measurable contribution to risk based on the following factors:

- The requisite inventory and manpower for maintaining systems operable is not time critical based on the long periods of time before depletion of commodities such as fuel oil and nitrogen.

- Activation of Emergency Response Facilities and existing Emergency Operating Procedures (EOP) and other emergency response procedures to assist the plant operating staff with an option to proceed and implement such actions and/or repairs for the plant to transition to, and enter, Mode 4 (Cold Shutdown).

- Availability of offsite resources (e.g., equipment, power, vehicles) as backups to primary methods of prevention and mitigation.

LAR Attachment S, implementation item S-3.3, addresses the update of post-fire operating procedures and associated training to include NSCA strategies. LAR Attachment S, implementation item S-3.6, addresses validation of RAs.

The licensee has modeled the CNS capability to achieve and maintain safe and stable conditions for the initial 24 hours of the event. Beyond 24 hours, the licensee has described the means to maintain safe and stable conditions and determined that these post-24-hour actions have no significant contribution to risk. On the basis of the licensee's analysis as described in the LAR, as supplemented, the NRC staff concludes that the licensee has provided an acceptable means to demonstrate that the fuel can be maintained in a safe and stable condition, post-fire, for an extended period of time.

3.2.3 Applicability of Feed-and-Bleed

The limitations of 10 CFR 50.48(c)(2)(iii), "Use of feed-and-bleed," are not applicable to boiling water reactors.

3.2.4 Assessment of Multiple Spurious Operations

NFPA 805, Section 2.4.2.2.1, "Circuits Required in Nuclear Safety Functions," states, in part, that:

> Circuits required for the nuclear safety functions shall be identified. This includes circuits that are required for operation, that could prevent the operation, or that result in the maloperation of the equipment identified in 2.4.2.1. This evaluation shall consider fire-induced failure modes such as hot shorts (external and internal), open circuits, and shorts to ground, to identify circuits that are required to support the proper operation of components required to achieve the nuclear safety performance criteria, including spurious operation and signals.

In addition, NFPA 805, Section 2.4.3.2, states that the probabilistic safety assessment (PSA) evaluation shall address the risk contribution associated with all potentially risk-significant fire scenarios. Because the PB approach taken at CNS utilized FREs in accordance with NFPA 805 Section 4.2.4.2, "Use of Fire Risk Evaluation," adequately identifying and including potential multiple spurious operation (MSO) combinations is required to ensure that all potentially risk-significant fire scenarios have been evaluated.

The NRC staff reviewed LAR Section 4.2.1.4, "Evaluation of Multiple Spurious Operations," and Attachment F, "Fire-Induced Multiple Spurious Operations Resolution," to determine whether the licensee has adequately addressed MSO concerns. As described in the LAR, the licensee's process for identification and evaluation of MSOs used an expert panel and followed the guidance of NEI 04-02, RG 1.205, and FAQ 07-0038 (Reference 38). The expert panel consisted of subject matter experts with experience in electrical engineering, PRA, SSA, fire protection, and plant operations.

LAR Attachment F states that the licensee conducted an initial expert panel review in July 2008 and a follow-up meeting in November 2008. Prior to the initial review, the panel was provided with training and with a specific project instruction for conducting the review. The expert panel sources for identifying MSOs included the SSA, the Boiling Water Reactor Owner's Group (BWROG) generic list of MSOs, PRA insights, and operating experience. The LAR further states that the MSO analysis was updated in 2011 without reconvening the expert panel. In SSD RAI 07 dated November 14, 2012 (Reference 16), the NRC staff requested that the licensee provide additional discussion of the 2011 update of the MSO analysis and the process used for the update. In its response dated January 14, 2013 (Reference 9), the licensee stated that the MSO analysis was updated to address FPRA peer review comments and revision to NEI 00-01, which included an update to the BWROG Generic MSO list. In addition, the licensee's response summarizes the noteworthy changes to the report and states that based on the nature of the changes, it was determined that reconvening the panel was not necessary. In lieu of reconvening, the update was provided to applicable MSO panel members for review and concurrence. The results of the review were integrated into the NSCA and the FPRA.

LAR Attachment F describes the process the licensee utilized to address MSOs, which follows the guidance of FAQ 07-0038. That process includes five steps: 1. identify potential MSOs of concern; 2. conduct an expert panel to assess plant specific vulnerabilities; 3. update the FPRA model and NSCA to include the MSOs of concern; 4. evaluate for NFPA 805 compliance; and, 5. document results. As described in LAR Attachment F, under the results for Steps 3, 4, and 5, the MSOs identified in Steps 1 and 2 were incorporated in the FPRA model and evaluated for inclusion in the NSCA. Variances from deterministic requirements (VFDRs) were created where MSO combinations did not meet the deterministic requirements of NFPA 805, Section 4.2.3 and these VFDRs were addressed using the PB approach of NFPA 805, Section 4.2.4 or a plant modification was recommended. The CNS FPRA quantified the fire-induced risk model containing the MSO pathways. MSO combinations that required RAs were evaluated for feasibility and reliability as well as for any additional risk presented by the action. The MSO contribution is included in the FPRA results, including those associated with VFDRs in the FREs.

The NRC staff reviewed the expert panel process for identifying circuits susceptible to multiple spurious operations as described above and concludes that the licensee adopted a systematic and comprehensive process for identifying MSOs to be analyzed utilizing available industry guidance. Furthermore, the process used provides reasonable assurance that the FRE appropriately identifies and includes risk significant MSO combinations. Based on the above, the NRC staff concludes that the licensee's approach for assessing the potential for MSO combinations is acceptable.

3.2.5 Establishing Recovery Actions

NFPA 805, Section 1.6.52, "Recovery Action," defines a recovery action (RA) as follows:

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

NFPA 805, Section 4.2.3.1 states that:

> One success path of required cables and equipment to achieve and maintain the nuclear safety performance criteria without the use of recovery actions shall be protected by the requirements specified in either 4.2.3.2, 4.2.3.3, or 4.2.3.4, as applicable. Use of recovery actions to demonstrate availability of a success path for the nuclear safety performance criteria automatically shall imply use of the PB approach as outlined in 4.2.4.

NFPA 805, Section 4.2.4, "Performance-Based Approach," states, in part, that:

> When the use of recovery actions has resulted in the use of this approach, the additional risk presented by their use shall be evaluated.

The NRC staff reviewed LAR Section 4.2.1.3, "Establishing Recovery Actions," and Attachment G, "Recovery Actions Transition," to evaluate whether the licensee meets the associated requirements for the use of RAs per NFPA 805.

The licensee used the endorsed guidance provided in NEI 04-02, Section 4.6 and the guidance of FAQ 07-0030 (Reference 37) to establish the population of RAs being carried forward in the RI/PB FPP. The population of RAs addressed during the NFPA 805 transition process at CNS included the existing operator manual actions (OMAs) in the deterministic FPP, as well as those actions being added based on the VFDRs identified in the individual fire area assessments. OMAs are actions performed by plant operators to manipulate components and equipment from outside the main control room to achieve and maintain post fire hot shutdown, not including "repairs." OMAs include an integrated set of actions needed to ensure that hot shutdown can be accomplished for a fire in a specific plant area. OMAs are transitioned to recovery actions (RAs) under NFPA 805. RAs are activities to achieve the NSPC that take place outside of the main control room or outside of the primary control station (PCS) for the equipment being operated, including the replacement or modification of components.

CNS utilized the guidance in RG 1.205, Revision 1 (Reference 2) for addressing RAs. This included consideration of the definition of PCS and RA, as clarified in the RG 1.205, Revision 1. Accordingly, any actions required to transfer control to, or operate equipment from, the PCS, while required as part of the RI/PB FPP, were not considered RAs per the RG 1.205 guidance and in accordance with NFPA 805. Alternatively, any OMAs required to be performed outside the control room and not at the PCS were considered RAs.

LAR Section G "Recovery Actions Transition," identifies that there is one location designated as an alternate shutdown room as defined in RG 1.205. The alternate shutdown capability is made up of three control panels that provide an alternate location from which to operate selected components of the Automatic Depressurization (ADS), High Pressure Coolant Injection (HPCI), RHR, and Reactor Equipment Cooling (REC) systems. The NRC staff documented its evaluation of the alternate shutdown capability design and concluded it to be in accordance with Appendix R to 10 CFR 50, Items III.G.3 and III.L in previous SEs.

OMAs meeting the definition of an RA are required to comply with the NFPA 805 requirements outlined above. Some OMAs may not be required to demonstrate the availability of a success path in accordance with NFPA 805, Section 4.2.3.1, but may still be required to be retained in the RI/PB FPP because of the DID considerations described in Section 1.2 of NFPA 805. Accordingly, the licensee defined a defense-in-depth recovery action (DID-RA) as an action that is not needed to meet the NSPC, but has been retained to provide DID. In each instance, the licensee determined whether a transitioning OMA was an RA, a DID-RA, or not necessary for the post-transition RI/PB FPP.

The licensee stated that all credited RAs, as listed in LAR Attachment G (including DID-RAs), were subjected to a feasibility review. In accordance with the NRC-endorsed guidance in NEI 04-02, the feasibility criteria used in the licensee's assessment process were based on the criteria described in FAQ 07-0030, and each of the 11 individual feasibility attributes were addressed. Attachment G, Table G-1, "Recovery Actions Transition," describes each RA associated with the disposition of a VFDR from the fire area assessments as documented in LAR Attachment C, "NEI 04-02 Table B-3 - Fire Area Transition." The feasibility review was based on documentation only, including previously validated actions assessed under the existing FPP. The licensee has included implementation items S-3.6 and S-3.7 in

LAR Attachment S to perform confirmatory field walkdowns to demonstrate the feasibility of identified RAs and update the fire HRA documentation.

In SSD RAI 05 dated November 14, 2012 (Reference 16), the NRC requested additional discussion and details from the licensee regarding RAs that involved repairs associated with the removal or replacement of conductors. The specific actions include repair of the 125 Volts direct current (VDC) and 250 VDC train B battery charger cables for fire scenarios in fire area CB-D, the lifting of leads to secure power to valves RW-AOV-A082 and RW-AOV-A094 for fire scenarios in fire areas CB-D and RB-CF, and the repair to the fuel oil transfer pump for a fire in CB-A that is credited in the FPRA for a fire in CB-A, but is not included as an RA in LAR Attachment G.

In its response dated January 14, 2013 (Reference 9), the licensee provided the following:

- The post-fire battery charger repair ensures long-term battery operation (greater than 4.5 hours) should a fire impact both sets of battery charger cables that run through the Auxiliary Relay Room (Fire Zone 8A). Replacement cables are pre-staged at the worksite and replacement instructions are provided in post-fire operating procedures and the repairs have been evaluated for implementation time adequacy. This repair supports long-term operations and lineup shifts after achieving safe and stable condition as discussed in the response to SSD RAI 02.

- Securing power to valves RW-AOV-A082 and RW-AOV-A094 is necessary to address the potential for loss of containment overpressure (COP) due to spurious hot shorts that could result in the potential inability to maintain adequate Net Positive Suction Head (NPSH) for the emergency core cooling system (i.e., RHR) pumps. For Fire Area RB-CF, the ADS and Core Spray systems are credited and therefore COP is required at 1.5 hours. For Fire Area CB-D, the HPCI system is credited and therefore COP is required at 3.5 hours. RW-AOV-AO82 and RW-AOV-AO94 are part of the system logic associated with ensuring COP is maintained. Lifting the leads will ensure these valves fail closed and isolate the drywell sumps. The leads for these valves have been clearly identified with tools pre-staged at the worksite and appropriate instructions provided in post-fire operating procedures.

- The repair to the fuel oil transfer pump is credited under the current licensing basis to ensure availability of EDG2, but is not necessary under the NFPA 805 licensing basis because offsite power has been evaluated and determined to be available for a fire in Fire Area CB-A. Therefore, EDG2 is not considered in the NSCA success path and loss of the fuel transfer pump was not considered a VFDR for this fire area. However, risk insights from the Fire PRA indicate benefits can be gained through the availability of a second AC power source, and credit was taken for post-fire repair using existing procedures for long-term usage of the EDG as a redundant source of power.

In SSD RAI 06 dated November 14, 2012 (Reference 16), the NRC requested additional information from the licensee regarding confirmatory walk downs of the feasibility of RAs per implementation item S-3.6, including validation of execution times. Specifically, the NRC staff requested the licensee describe the extent to which the actions would be validated (e.g., the opening of cabinets to access the components and verify the components could be operated as described) and whether procedures are used in the confirmatory walkdowns that describe the performance and acceptance criteria for the procedure validations. In its response dated January 14, 2013 (Reference 9), the licensee stated that RA validation will be performed to the extent practical using field validation forms, feasibility timelines, and the revised CNS procedures. Implementation item S-3.6 will confirm that the NFPA 805 RAs determined to be required, align with CNS procedure re-writes from implementation item S-3.3 and can meet the requisite feasibility acceptance criteria as described in the response to SSD RAI 02(d). For new or revised CNS procedures that will contain RA, the verification and validation (V&V) process includes guidance for opening cabinets and verifying a component can be operated as described in the procedure.

In SSD RAI 09 dated November 14, 2012 (Reference 16), the NRC staff requested additional information from the licensee regarding RAs associated with the removal of fuses and operation of motor-operated valves (MOVs) using the motor starters at the motor control center (MCC). Specifically, the NRC staff requested that the licensee describe how proper positioning of the valve is assured and how the process prevents valve/actuator damage due to overtorque/overthrust. In its response dated January 14, 2013 (Reference 9), the licensee stated that the actions to remove the fuses and use the motor starters have been demonstrated and included in post-fire operating procedures. The licensee further stated that the plant will be modified to install new local auxiliary safe shutdown control panels near the MCC or DC starter for each of the MOVs that were previously required to be controlled by removing fuses and using the motor starter to control the valve. The new panels and cables have been analyzed for NFPA 805 impact and the applicable documentation, including the NSCA fire area analysis, will be updated to include a revised description for performing the RAs when the modification is completed. The new actions will not require the operator to locally operate contactors (that is, the changes will eliminate the need for the removal of fuses and operation of MOVs using the motor starter), but rather utilize a local/remote isolation switch to take control of the valve at a local control panel with indicating lights for position, along with a control switch which will utilize the limit switches to preclude over driving the valve. The licensee's response included an amendment to LAR Attachment S to include new S-2 Table modification S-2.8 to track completion of this modification. The licensee also amended LAR Attachment G (Reference 6) to include the revised recovery actions based on the modification to install the local MOV controls.

Based on the above, the NRC staff concludes that the licensee has followed RG 1.205 and the endorsed guidance of NEI 04-02 to identify and evaluate RAs in accordance with NFPA 805, and has provided information to assure that the requirements of 10 CFR 50.48(c) are met. The NRC staff concludes that the feasibility criteria applied to RAs are acceptable based on conformance with the endorsed guidance contained in NEI 04-02 and successful completion of modification S-2.8 and implementation items S-3.3, S-3.6, and S-3.7.

3.2.6 Plant-Specific Treatments or Technologies

The licensee proposed to install Very Early Warning Fire Detection Systems (VEWFDS) (also referred to as "incipient detection") to monitor conditions, as well as provide indication and alarms for Panels 9-32 and 9-33 in the Auxiliary Relay Room, which is located in fire area CB-D. As described in LAR Attachment V, this modification is credited with reducing risk associated with main control room (MCR) abandonment scenarios. As described in LAR Attachment S, Table S-2, modification S-2.4, control room abandonment and use of alternate shutdown procedures is required for a fire in Panels 9-32 and 9-33 without the modification. The installation of incipient detection in these panels will allow shutdown from the MCR with minimal field actions. This incipient detection system is to provide indication in the MCR so that an operator/auxiliary operator can respond to the Auxiliary Relay Room confirm that the incipient detector for one of these panels has activated, and inform the MCR.

In SSD RAI 04 dated November 14, 2012 (Reference 16), the NRC staff requested that the licensee describe the MCR actions in response to an incipient alarm and how these actions mitigate the circuit failures of concern (that previously required alternate shutdown). In its response dated January 14, 2013 (Reference 9), the licensee stated there are no immediate actions required from the MCR or outside of the MCR, and that detailed circuit analysis demonstrates that operators can operate at least one train of equipment from the MCR, with some limited, long-term local manual actions (which would only be necessary if the panels actually experienced a fire). The purpose of the system is to provide early indication of the potential for a fire inside one of these panels. The system will provide indication in the MCR so that an operator/auxiliary operator can respond to the auxiliary relay room, confirm that the incipient detector for one of these panels has activated, and inform the MCR. The MCR operators can then respond in the MCR using procedures for these panels to reach safe and stable conditions. The expected scenario, given correct response to the annunciator, is fundamentally a normal shutdown, as all equipment would remain available. Even if operators are delayed in commencing a normal plant shutdown, but are aware of the source of the fire, the actions would be taken since the MCR has not been abandoned, even assuming maximum damage has occurred to components within the specific panel. Absent the incipient detection, there is an increased potential for the MCR operators to implement alternate shutdown as a fire in either of these panels would impact automatic operation of core cooling equipment and MCR instrumentation. In addition to installation of an incipient detection system, fire response procedures will be changed such that the MCR will be the command and control center for reaching safe and stable conditions. LAR Attachment S implementation item S-3.3 will update post-fire operating procedures to reflect new NSCA strategies and provide training as necessary.

In FPE RAI 10 dated November 14, 2012 (Reference 16), the NRC staff requested that the licensee provide additional description of the VEWFDS to be installed at CNS and the compensatory measures necessary in the period between post-transition (issuance of this SE) and completion of the modification. In its response dated January 14, 2013 (Reference 9) and as revised in its submittal dated April 11, 2014 (Reference 8), the licensee stated that the design will be based on FAQ 08-0046 and will meet the FAQ guidance, such as sensitivity, equipment voltage restrictions, and fast-versus-slow acting devices in regard to fire growth. The system will be tested in accordance with the manufacturer's and code requirements, including sensitivity. A review of the panels indicates that these are 125 VDC and 120 VAC panels containing terminal boards, relays, lights, switches and associated cabling/wiring, which will exhibit incipient degradation (i.e., slow acting components), and there is no equipment that will exceed the 250 VDC and 480 VAC restriction in the FAQ. The detection system configuration will consist of an alarm unit that is individually assigned to each relay panel. The system will be designed and installed in accordance with NFPA 72 and 76.

The licensee also stated that as part of modification S-2.4, alarm procedures will be developed to guide the operator response to incipient detection alarm events. The procedures will provide guidance as to what actions are recommended in regard to diagnosing the cause of an incipient detection alarm, providing recommended compensatory measures, and identification of support resources. The licensee will have thermal imaging cameras and hand-held incipient detectors which will be available for use in responding to alarms associated with the incipient detection in these relay panels. The cameras and hand-held incipient detectors will be appropriately staged to be rapidly accessible by the first responders when needed. The alarm procedures will be designed to work in conjunction with existing operating procedures, abnormal operating, and emergency response procedures.

From the time the amendment is issued until the procedures and training related to the modification S-2.4 are complete, the licensee stated that compensatory measures will be established in accordance with their site-specific fire protection program procedures. The licensee further stated that post-implementation, for compensatory measures during times when the incipient detection is out of service, plant procedures will provide for a continuous fire watch in the Auxiliary Relay Room.

Based on the licensee's description of the VEWFDS, including the response to FPE RAI 10, the NRC staff concludes that the fire protection aspects related to the proposed installation of the VEWFDS at CNS are acceptable for the following reasons:

- The installation of the VEWFDS at CNS will be performed in accordance with the appropriate NFPA codes and the equipment manufacturer's requirements.
- The VEWFDS will be properly tested during commissioning such that the alert and alarm triggers will be set to provide an appropriate level of sensitivity without unnecessary nuisance or spurious alarms.
- The CNS configuration and design control process will control and maintain the setpoints for both alert and alarm functions from the VEWFDS.
- The VEWFDS equipment will be periodically tested and maintained in accordance with the appropriate NFPA codes and the equipment manufacturers' requirements.
- First responders to VEWFDS indications will be properly trained to respond to the incipient condition, identify the faulted cabinet, and suppress potential fires.

- The licensee will develop procedures to guide the operator response to detection alarms.

In addition, the CNS FPRA modeled the installation of the VEWFDS and took credit for its use in assessing the risk of fires in the Auxiliary Relay Room in Fire Area CB-D. Section 3.4 of this SE addresses the technical review of the treatment of the VEWFDS in the CNS FPRA, as part of the acceptability of the risk credit taken for the associated fire area.

3.2.7 Conclusion for Section 3.2

The NRC staff reviewed the licensee's LAR, as supplemented, for conformity with the requirements contained in NFPA 805, Section 2.4.2, regarding the process used to perform the NSCA. The NRC staff concluded that the declared safe and stable condition proposed was acceptable, and that the licensee's process is adequate to appropriately identify and locate the systems, equipment, and cables, required to provide reasonable assurance of achieving and maintaining the fuel in a safe and stable condition, as well as to meet the NFPA 805 NSPC.

The NRC staff reviewed the licensee's process to identify and analyze MSOs. Based on the information provided in the LAR, as supplemented, the process used to identify and analyze MSOs is considered comprehensive and thorough. Through the use of an expert panel process in accordance with the guidance of RG 1.205, NEI 04-02 and FAQ 07-0038, potential MSO combinations were identified and included as necessary into the NSCA as well as the applicable FREs. The NRC staff also considers the licensee's approach for assessing the potential for MSO combinations to be acceptable because it was performed in accordance with NRC-endorsed guidance.

Pending completion of modification S-2.8, and implementation items S-3.3, S-3.6, and S-3.7, the NRC staff concludes that, based on the information provided in the LAR, as supplemented, the process used by the licensee to review, categorize and address RAs during the transition is consistent with RG 1.205 and the NRC-endorsed guidance contained in NEI 04-02. Therefore, the information provided by the licensee is acceptable to assure that the requirements of 10 CFR 50.48(c) and NFPA 805 for NSCA methods are met.

The NRC staff reviewed the proposed installation of a VEWFDS to monitor conditions in certain key electrical cabinets at CNS. Based on the information provided in the LAR, as supplemented, the NRC staff concluded that the fire protection aspects of the proposed VEWFDS installation are acceptable as described in Section 3.2.6 of this SE.

3.3 Fire Modeling

NFPA 805 (Reference 1) allows both FM and FREs as PB alternatives to the deterministic approach outlined in the standard. These two PB approaches are described in NFPA 805, Sections 4.2.4.1 and 4.2.4.2, respectively. Although FM and FREs are presented as two different approaches for PB compliance, the FRE approach generally involves some degree of FM to support engineering analyses and fire scenario development. NFPA 805, Section 1.6.18, defines a fire model as a "mathematical prediction of fire growth, environmental conditions, and potential effects on structures, systems, or components based on the conservation equations or empirical data."

The NRC staff reviewed LAR (Reference 6) Section 4.5.2, "Performance-Based Approaches," which describes how the licensee used FM as part of the transition to NFPA 805 at CNS, and LAR Section 4.7.3, "Compliance with Quality Requirements in Section 2.7.3 of NFPA 805," which describes how the licensee performed FM calculations in compliance with the NFPA 805 PB evaluation quality requirements for fire protection systems and features at CNS, to determine whether the FM used to support transition to NFPA 805 is acceptable.

In LAR Section 4.5.2, the licensee indicated that the FM approach (NFPA 805 Section 4.2.4.1) was not used for the CNS NFPA 805 transition. The licensee used the FRE PB method (i.e., FPRA) with input from FM analyses. Therefore, the NRC staff reviewed the technical adequacy of the CNS FREs, including the supporting FM analyses, as documented in Section 3.4.2 of this SE, to evaluate compliance with the NSPC.

The licensee did not propose any FM methods to support PB evaluations in accordance with NFPA 805, Section 4.2.4.1, as the sole means for demonstrating compliance with the NSPC. There are no plant-specific FM methods acceptable for use to support compliance with NFPA 805, Section 4.2.4.1, as part of this licensing action supporting the transition to NFPA 805 at CNS.

3.4 Fire Risk Assessments

This section addresses the licensee's FRE PB method, which is based on NFPA 805, Section 4.2.4.2. The licensee chose to use only the FRE PB method in accordance with NFPA 805, Section 4.2.4.2. The FM PB method of NFPA 805, Section 4.2.4.1 was not used for this application.

NFPA 805, Section 4.2.4.2, "Use of Fire Risk Evaluation," states the following:

> Use of fire risk evaluation for the performance-based approach shall consist of an integrated assessment of the acceptability of risk, defense-in-depth, and safety margins.
>
> The evaluation process shall compare the risk associated with implementation of the deterministic requirements with the proposed alternative. The difference in risk between the two approaches shall meet the risk acceptance criteria described in 2.4.4.1. The fire risk shall be calculated using the approach described in 2.4.3.

3.4.1 Maintaining Defense-in-Depth and Safety Margins

NFPA 805, Section 4.2.4.2, requires that the "use of fire risk evaluation for the PB approach shall consist of an integrated assessment of the acceptability of risk, defense-in-depth, and safety margins."

3.4.1.1 Defense-in-Depth (DID)

NFPA 805, Section 1.2, "Defense-in-Depth," states the following:

> Protecting the safety of the public, the environment, and plant personnel from a plant fire and its potential effect on safe reactor operations is paramount to this standard. The fire protection standard shall be based on the concept of defense-in-depth. Defense-in-depth shall be achieved when an adequate balance of each of the following elements is provided:
>
> - Preventing fires from starting.
> - Rapidly detecting fires and controlling and extinguishing promptly those fires that do occur, thereby limiting fire damage.
> - Providing an 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.

The NRC staff reviewed LAR Section 4.5.2.2, "Fire Risk Approach," LAR Table 4-3, "Summary of NFPA 805 Compliance Basis and Required Fire Protection Systems and Features," and Attachment C Table B-3, "Attachment C – NEI 04-02 Table B-3 – Fire Area Transition," as well as the associated supplemental information, in order to determine whether the principles of DID were maintained in regard to the planned transition to NFPA 805 at CNS.

The licensee developed a methodology for evaluating DID which defines each of the three DID elements identified in NFPA 805 Section 1.2, and in more detail in the response to PRA RAI 12 dated January 14, 2013 (Reference 9), referred to as echelons 1, 2, and 3, respectively. In the response, the licensee provided a table where, for each of the three echelons, several examples of fire protection features that addressed that echelon are identified, along with a discussion of the considerations used in assessing those features. The assessment determined whether changes would be needed to assure that each echelon has been satisfactory achieved or whether reliance on features in other echelons were needed and should be developed. Many of the identified fire protection features are required to be in place in order to demonstrate compliance with the fundamental fire protection program and design elements of NFPA 805 Chapter 3 (e.g., combustible control program, hot work control program, etc.). However, the capabilities for some of the fire protection features for DID were evaluated and improved as needed based on the results of the PB analyses conducted during the NFPA 805 transition (e.g., detection and suppression systems, and use of RAs).

As described in the response to PRA RAI 12 (Reference 9), this method for addressing DID was implemented in the FREs performed on each PB fire area. The licensee's FREs evaluate VFDRs using an integrated assessment of risk, DID, and safety margin. CNS evaluated the VFDRs and fire area risk and scenario consequences to identify general DID echelon imbalances. The licensee further stated that methods to balance the DID features were identified to ensure that an adequate balance of DID features is maintained for the Fire Area.

Finally, the licensee stated that the results of the FRE reviews associated with DID identified the need to implement and credit RAs, as well as a detection system.

In PRA RAI 12, the licensee stated that it may become necessary to consider the potential for risk significant fire scenarios to impact VFDRs and quantitatively defines "potentially risk significant fire scenarios." "Potentially risk significant" fire scenarios for the purpose of evaluating the need for DID are defined as:

- A scenario in which the calculated risk is equal to or greater than 1E-6/year for CDF and/or 1E-7/year for LERF;

- A scenario in which the calculated risk falls between 1E-6/year and 1E-8/year for CDF, or between 1E-7/year and 1E-9/year for LERF, and where DID echelon 1 and 2 attributes are causing a significant reduction in risk;

- A scenario with a high consequence (i.e., conditional core damage probability (CCDP) > 1E-1).

Based on its review of the response to PRA RAI 12, the FREs during its audit of the CNS NFPA 805 transition to RI/PB FPP, and the DID discussion at the beginning of Attachment C, the NRC staff concludes that the licensee has systematically and comprehensively evaluated fire hazards, area configuration, detection and suppression features, and administrative controls in each fire area and concludes that the methodology as proposed in its LAR adequately evaluates DID against fires as required by NFPA 805 and therefore the proposed RI/PB FPP adequately maintains DID.

3.4.1.2 Safety Margins

NFPA 805 Section 2.4.4.3, "Safety Margins," states the following:

> The plant change evaluation shall ensure that sufficient safety margins are maintained.

NEI 04-02 Section 5.3.5.3, "Safety Margins," lists two specific criteria that should be addressed when considering the impact of plant changes on safety margin:

- 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., FSAR, supporting analyses, etc.) are met, or provides sufficient margin to account for analysis and data uncertainty.

LAR Section 4.5.2.2, "Fire Risk Approach," discusses how safety margin is addressed as part of the FRE process and that this process is based on the requirements of NFPA 805, industry guidance in NEI 04-02, and RG 1.205. An FRE was performed for each fire area containing

VFDRs. The FREs contain the details of the licensee's review of safety margin for each PB fire area.

In response to PRA RAI 12 dated January 14, 2013 (Reference 9), the licensee further described the methodology used to evaluate safety margin in the FREs to include the following evaluations and determinations:

- Fire Protection systems and features determined to be required by NFPA 805 Chapter 4 have been confirmed to meet the requirements of NFPA 805 Chapter 3, and their associated referenced codes and listings, or provided with acceptable alternatives using processes accepted for use by the NRC (i.e., FAQs).

- Development of the PRA logic model and the FPRA application was performed in accordance with industry accepted codes and standards including 10 CFR 50.48(c), NFPA 805 (2001 edition), ASME/ANS RA-Sa-2009, "Addenda to ASME/ANS RA-S2008, Standard for Level 1/Large Early Release Frequency Probabilistic Risk. Assessment for Nuclear Power Plant Applications" (Reference 21), and RG 1.200, Revision 2 (Reference 20).

The safety margin criteria described in NEI 04-02, Section 5.3.5.3 and the LAR, as supplemented, are consistent with the criteria as described in RG 1.174 (Reference 19) and, therefore, acceptable. CNS used appropriate codes and standards (or NRC approved guidance) and met the safety analyses acceptance criteria in the licensing basis. Based on its review of the LAR and the response to PRA RAI 12, the NRC staff concludes that the licensee's approach has adequately addressed the safety margin in the implementation of the FRE process.

3.4.1.3 Defense-in-Depth and Safety Margin Conclusion

Based on the information provided by the licensee in the LAR, as supplemented, the transition process included a detailed review of fire protection DID and safety margin. The individual FREs, LAR Table 4-3, and LAR Attachment C Table B-3 document the results of the DID and safety margin review. The NRC staff concludes that the licensee's evaluation in regard to DID and safety margin is acceptable, because the licensee's process and results followed the endorsed guidance in NEI 04-02, Revision 2, and are consistent with the NRC staff guidance in RG 1.205, Revision 1, and RG 1.174, Revision 1. Section 3.5 of this SE discusses the results of the individual fire area reviews, including the documentation of the required suppression and detection systems.

3.4.2 Quality of the Fire Probabilistic Risk Assessment

The objective of the PRA quality review is to determine whether the plant-specific PRA used in evaluating the proposed LAR is of sufficient scope, level of detail, and technical adequacy for the application. The NRC staff evaluated the PRA quality information provided by the licensee in its LAR (Reference 6) NFPA 805 submittal, as supplemented (Reference 7), including industry peer review results and self-assessments performed by the licensee. The NRC staff reviewed LAR Section 4.5.1, "Fire PRA Development and Assessment," Section 4.7, "Program Documentation, Configuration Control, and Quality Assurance," Attachment C, "NEI 04-02 Table B-3 – Fire Area Transition," Attachment U, "Internal Events PRA Quality," Attachment V, "Fire PRA Quality," and Attachment W, "Fire PRA Insights."

The licensee developed its internal events PRA during the Individual Plant Examination process and continued to maintain and improve the PRA as RG 1.200, "An Approach For Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," and supporting industry standards have evolved. The licensee developed its FPRA model using the guidance of NUREG/CR-6850, "EPRI/NRC-RES, Fire PRA Methodology for Nuclear Power Facilities" (References 26 - 28). The model addresses both Level 1 (core damage frequency) and partial Level 2 (i.e., large early release frequency only) PRA during at-power conditions. The licensee modified its internal events PRA model to capture the effects of fire.

In LAR Section 4.8.2, the licensee reported that it did not identify any significant outstanding plant changes that would require a change to the FPRA model other than the modifications identified in Appendix S of the LAR. Based on this information, the NRC staff concludes that the FPRA model for CNS meets the criteria that it represents the current as-built, as-operated configuration and, therefore, is capable of being adapted to model both the post transition and compliant plant as needed.

The licensee identified implementation item S-3.24 in Table S-3 of the LAR which ensures that the FPRA database will be controlled as an electronic document in the same way as the Internal Events PRA model is controlled. In addition, implementation item S-3.27 ensures that configuration control procedures which govern the various CNS Section 4.7.2 (of the LAR) documents and databases that currently exist will be revised to reflect the new NFPA 805 licensing bases requirements. Section 4.7.2 of the LAR includes a discussion of the RI/PB post-transition change process methodology. Further, as described in Section 3.7.3 of this SE, the licensee has a program for ensuring that developers and users of these models are appropriately trained and qualified. Therefore, the NRC staff concludes that the PRA should be capable of supporting post-transition PCEs to support the self-approval process after any changes required during implementation are completed.

3.4.2.1 Internal Events PRA Model

The licensee's evaluation of the technical adequacy of its internal events PRA model used to support development of the FPRA model consisted of a full-scope peer review performed in May 2008 using the NEI 05-04 process (Reference 69) and the ASME PRA Standard, ASME-RA-Sc-2007 (Reference 70) as clarified by RG 1.200 Revision 1 (Reference 71). The 2007 ASME/ANS PRA Standard is an earlier version of the combined ASME/ANS-RA-Sa-2009 Standard which is the version referenced in RG 1.200 Revision 2. The internal events PRA model that was reviewed for the focused-scope peer review serves as the basis of the FPRA used in performing PRA evaluations for the LAR.

For each supporting requirement (SR), there are three degrees of "satisfaction" referred to as Capability Categories (i.e., I, II, and III), with I being the minimum, II considered widely acceptable, and III indicating "beyond the state of the art." For many SRs, the Capability

Categories are combined (e.g., the requirement for meeting Capability Category I may be combined with II) or the requirement is the same across all Capability Categories so that the SR is simply met or not met. For each SR, the PRA reviewer from the peer review team designates the highest Capability Category met or indicates that the SR is met or not met.

Because the peer review was performed against an earlier version of the PRA standard than recognized by RG 1.200 Revision 2, the NRC staff asked the licensee to explain how the change in SRs between the 2007 and 2009 version of the PRA Standard and the clarifications to SRs defined in RG 1.200, Revision 2 were addressed. In response to PRA RAI-17 dated January 14, 2013 (Reference 9), the licensee explained that changes to the SRs and clarifications from the ASME-RA-Sc-2007 referenced in RG 1.200, Revision 1, and the ASME/ANS RA-Sa-2009 Standard referenced in Revision 2 were minor. The NRC staff concludes that there are only minor differences between the internal events SRs in ASME-RA-Sa-2009 and ASME-RA-Sc-2007 as clarified in RG 1.200. Also, the NRC staff notes that Internal Event PRA SRs that are applicable to the FPRA (internal event SRs that are specifically referenced by fire event SRs) were evaluated at the time of the FPRA peer review. For these reasons, the NRC staff concludes that a peer review against ASME/ANS PRA Standard, ASME-RA-Sc-2007 (Reference 70) as clarified by RG 1.200 Revision 1 is an acceptable evaluation of Internal Events PRA quality.

Table U-1 of the LAR provides the licensee's dispositions to all 22 Facts and Observations (F&Os) developed during the May 2008 peer review, 20 of which are Findings and 2 of which are Suggestions as defined in peer review guidelines (Reference 69). These F&Os include three F&Os strictly on internal flooding. In general, an F&O is written for any SR that is judged not to be met or does not fully satisfy Capability Category II of the ASME standard, consistent with RG 1.200, Revision 2.

As described in Attachment U, the licensee dispositioned each F&O by assessing the impact of the F&O on the FPRA and the results for the NFPA 805 application. The NRC staff requested additional information to assess the adequacy of some of the dispositioned F&Os. The NRC staff evaluated each F&O and the licensee's disposition in Attachment U and supplemental information when requested to determine whether the F&O had any significant impact for the application. The results of the NRC staff's review of these F&Os and their resolutions are summarized in the NRC's record of review (Reference 73). The NRC staff did not identify any issues related to the internal events F&O resolution that are included in this SE.

In PRA RAI 20 dated November 14, 2012 (Reference 16), the NRC staff requested the licensee to identify any changes made to the Internal Events PRA that are consistent with the definition of a "PRA upgrade" since the last full-scope peer review of PRA models as defined by the ASME/ANS PRA Standard (Reference 21). In its response dated January 14, 2013 (Reference 9), the licensee discussed revisions made and stated that no changes meeting the definition of a PRA upgrade was made to the Internal Events for FPRA since their respective peer reviews.

As a result of its review of the LAR, as supplemented, the NRC staff concludes that the CNS internal events PRA is technically adequate such that its quantitative results can be used to demonstrate that the change in risk due to the transition to NFPA 805 meets the acceptance guidelines in RG 1.174. To reach this conclusion, the NRC staff has reviewed all F&Os provided by the peer reviewers and determined that the resolution of every F&O supports the conclusion that the quantitative results are adequate. Accordingly, the NRC staff concludes that the licensee has demonstrated that the internal events PRA meets the guidance in RG 1.200, Revision 2, which is reviewed against the applicable SRs in ASME/ANS RA-Sa 2009, and that it is technically adequate to support the FREs and other risk calculations required for the NFPA 805 application.

3.4.2.2 Fire PRA Model

The licensee evaluated the technical adequacy of the CNS FPRA model for this application by conducting a peer review using the NEI 07-12 process (Reference 72) and the combined PRA standard, ASME/ANS RA-Sa-2009 FPRA standard (Reference 21) as clarified by RG 1.200, Revision 2 (Reference 20), and a follow-on focused-scope peer review to address two specific analysis elements. The full-scope peer review of the FPRA was performed in April 2010, and the follow-on focused-scope peer review was performed in February 2011 to address multi-compartment analyses and final quantification.

Table V-1 of the LAR provides the licensee's dispositions of all 54 F&Os, 37 of which are Findings and 17 of which are Suggestions as defined in peer review guidelines (Reference 72), and the licensee's assessment of all F&Os, which included F&Os against SRs that were met, not met, achieved Capability Category I, II, or III, or were not applicable. Table V-2 of the LAR identifies all SRs that were determined by the peer review not to be met or met only at CC-I, and provided an evaluation of those SRs. In all cases, the SR evaluations refer to a Finding or Suggestion already presented in Table V-1, with the exception of two Suggestions not presented in Table V-1.

In PRA RAI-20 dated November 14, 2012 (Reference 16) NRC staff requested the licensee to identify any changes made to the FPRA that are consistent with the definition of a "PRA upgrade" since the last full-scope peer review of PRA models as defined by the ASME/ANS PRA Standard (Reference 21). In its response dated January 14, 2013 (Reference 9), the licensee discussed revisions made and stated that no changes meeting the definition of a PRA upgrade was made to the Internal Events for FPRA since their respective peer reviews.

The NRC staff reviewed the licensee's dispositions of all of the F&Os provided in Table V-1 as well as SR evaluations provided in Table V-2 to determine the technical adequacy of the FPRA for the NFPA 805 application. The NRC staff requested additional information for the review of some F&Os. The NRC staff's review and conclusion of the licensee resolution of each of the F&Os is summarized in the NRC's record of review (Reference 73). A summary of some of these issues and the resolution of the issues is provided below. The resolution of some of these issues resulted in changes in the FPRA methods, assumptions, or models.

The FPRA includes operator actions for which the probability of failure to accomplish the action is evaluated by human reliability analysis (HRA). The licensee used EPRI HRA calculator. This calculator provides an acceptable HRA method as described in NUREG-1921, "EPRI/NRC-RES Fire Human Reliability Analysis Guidelines Final Report," U.S. Nuclear Regulatory Commission (NRC)," July 2012 (Reference 36).

In response to PRA RAI-02c dated February 12, 2013 (Reference 10), the license clarified how indications needed for diagnosis, and associated instrumentation, are identified and included in the Fire HRA, and explained how random failures of those instruments are addressed for F&O 4-10. Instrumentation modeling is associated with three bins in performing the HRA as a result of a fire: all instrumentation available; a minimal set of instrumentation is available due to fire-induced failure of some instruments; or no instrumentation is available which includes the situation where cables have not been traced. If no instrumentation is available, the HEP is generally set to 1.0. In the response to PRA RAI 02.c.1 dated December 12, 2013 (Reference 13), the licensee clarified an exception where it assigned an HEP not equal to the 1.0 normally associated with minimal instrumentation when the cable routing is not known for the instruments. The licensee identified the EOP actions that directed the operators to depressurize the reactor pressure vessel (RPV) and initiate low pressure injection if the RPV water level cannot be determined, such as when RPV level instruments are failed by the fire. The NRC staff concludes that this exception to the methodology is acceptable because the specific circumstances indicate that the operators will take actions if all instrumentation is failed and the use of the intermediate bin instead of the two extreme bins appropriately reflects the possibility of success of the necessary actions.

The response to PRA RAI 29.h dated January 14, 2013 (Reference 9), states that the licensee established floor values for individual and combinations of HEPs of 1E-6 for actions required within 24 hours, and 5E-7 for actions if greater than 24 hours was available. In PRA RAI 2.o dated November 14, 2012 (Reference 16), for F&O 2-15, and in a follow-up PRA RAI 2.o.1 dated November 14, 2013 (Reference 17), the NRC staff requested additional information on how HEP dependencies had been addressed. In response to PRA RAI 2.o.1 dated December 12, 2013 (Reference 13), the licensee stated that cutsets contributing 99.9 percent of the total CCDP from all fire scenarios were reviewed for HEP dependency analysis, and a HEP of 1E-3 was used as a lower bound for dependent events. In a few instances, the licensee evaluated joint HEPs in further detail to justify a lower joint HEP than 1E-3. For individual and combined HEPs in a cutset, the response to PRA RAI 29.h dated January 14, 2013, states that none of the human failure events created for the FPRA was less than the 1E-6 floor (i.e., lower bound). The licensee notes in Supplement 3 to PRA RAI 40 that the method of assigning a floor to an HEP is a method which meets NUREG-1921 guidance and will continue to be used for self-approval. The NRC staff concludes that using the guidance in NUREG-1921 is an acceptable method of assigning an HEP.

LAR Section V.2 dated April 24, 2012, identified a deviation from the guidance in NUREG/CR-6850 where a few fire zones were assigned fractional influence factors instead of the integer values provided in NUREG/CR-6850. In the July 12, 2012 (Reference 7), response to the NRC staff acceptance review comments, the licensee provided sensitivity results using the NUREG/CR-6850 values that indicated that all risk metrics increased by some few percentage points. In a later response in Supplement 3 to PRA RAI 40 dated February 18, 2014 (Reference 15), the licensee indicated that an additional multiplier (0.1) to the influence factors in three locations had also been used to credit enhanced transient controls. The final composite risk estimates provided in the later response to PRA RAI 40 used the NUREG/CR-6850 values and did not include the additional multiplier. Supplement 3 to PRA RAI 40 indicated that the FPRA currently includes the values used in the composite analysis.

The licensee indicated in implementation item S-3.19 that the fire analysis will be updated to incorporate all changes identified in Supplement 3 prior to approving self-approval evaluations. The NRC staff concludes that the transient factors are appropriate because they are developed in accordance with accepted guidance and they, or other acceptable values, will be used in the self-approval process.

In response to PRA RAI 18 dated November 14, 2012 (Reference 16), the licensee stated that none of the VFDRs involved PB evaluations of wrapped or embedded cables although these types of cables are found in the plant and modeled in the FPRA. Any such cables were credited in the FPRA as being protected from fire damage, commensurate with the fire barrier rating of the wrap or embedment.

The disposition to the FPRA peer review Finding 6-15 against SR FSS-H5 states that a revision to the main control room (MCR) abandonment analysis was performed to address the fire spread between Main Control Board (MCB) panels and electrical panels in the MCR. The NRC staff requested additional information in PRA RAI-02f.i dated November 14, 2012 (Reference 16), about propagation of fires in the MCR between open back cabinets. In response to the RAI dated December 12, 2013 (Reference 13), the licensee explained that for open back panels with no cables communicating between them, including through the base of the panels, fire is not assumed to propagate because the open backs provide a vent that precludes hot gases from collecting. In follow-up PRA RAI-02f.i-01 dated November 14, 2013 (Reference 17), NRC noted that there is a vented cable run atop the MCBs and requested that possible spread between panels from this cable run be evaluated. The licensee acknowledged the cable run in the response to the RAI dated December 12, 2013 (Reference 13), and stated that it would be evaluated in the response to the composite analysis requested in PRA RAI 40. Table 1 in the response to PRA RAI 40 stated that the propagation along the cable run was determined to be insignificant contributor to CDF and LERF and any contribution to delta CDF and LERF is bounded by the approach to assessing delta CDF and LERF in Supplement 2. Supplement 3 to PRA RAI 40 indicated that the risk from fire propagating in the vented cable run atop the MCBs will be included in the final FPRA. The licensee indicated in implementation item S-3.19 that the fire analysis will be updated to incorporate all changes identified in Supplement 3 prior to approving self-approval evaluations. The NRC staff concludes that the vented cable run has been included in the transition risk, and that it will be included in the self-approval evaluations and therefore the issue is resolved.

The licensee plans to install a VEWFDS in panels, 9-32, 9-33, as described in LAR Attachment S, Table S-2. Without the modification to panels 9-32 and 9-33 in the Auxiliary Relay Room, the licensee may need to use the ASD capability following fires in these panels. After the modification and associated procedural changes, the licensee states in the response to PRA RAI 03 dated February 12, 2013 (Reference 10), that fires in these panels will be detected early enough that the MCR can be used for reaching safe and stable conditions. The response to PRA RAI 03 provides detailed descriptions of the expected failures and associated operator actions associated with the sequence of events following early detection of fires in these two panels. Failure of the early detection would result in MCR abandonment scenarios that are addressed in the MCR abandonment evaluation. The NRC staff concludes that crediting the VEWFDS early detection to avoid MCR abandonment and, therefore, allow a more orderly (and reliable) shutdown from the MCR is acceptable because the licensee has identified and prepared responses to the specific equipment that would be affected by fire in these panels.

The VEWFDS method used by the licensee did not include damage outside the 9-32 and 9-33 panels which is one of the end states achieved by failure of the VEWFDS that is included in FAQ 08-0046 (Reference 42). In response to PRA RAI 03, the licensee stated that, in order to ensure that Panels 9-32 and 9-33 of the Auxiliary Relay Room meet the guidance in FAQ 08-0042 (Reference 41), modifications to these panels include mechanical latching to prevent fire spread outside the panels. In addition, the licensee is similarly modifying five additional relay panels 9-30, 9-39, 9-41, 9-42, and 9-45 located in the Auxiliary Relay Room that are of similar construction. Therefore, all seven relay panels in the Auxiliary Relay Room are separate panels creating a double wall with air gap between the adjacent panels and, in accordance with Appendix S of NUREG/CR-6850, there is no damage to an adjacent panel. The NRC staff concludes that the VEWFDS end states of equipment damage outside the ignition source panel are appropriately excluded because the modified construction of the panels satisfy the guidelines in FAQ 08-0042 (Reference 41) that allows damage to be contained within the cabinet.

In response to PRA RAI 14 dated January 14, 2013 (Reference 9), the licensee described a screening approach that used a value of 0.1 as the single estimate for CCDP and conditional large early release probability (CLERP) following any fire which forced abandonment of the main control room. The estimate was justified largely with a qualitative argument that the feasibility assessment and the seven considerations identified in NUREG-1921 are addressed. In response to PRA RAI 14.01 dated January 17, 2014 (Reference 14), the licensee stated that it reanalyzed the MCR abandonment to address human and equipment performance. The new MCR analysis was performed by identifying each fire scenario which could lead to MCR abandonment, and evaluating their sequences for CDF and LERF. The MCR analysis considered the fire response procedures, fire-impacted equipment including spurious operations, and HEPs for PCS actions as well as actions not at the PCS. In the supplemental response to PRA RAI 14.01c, the licensee further clarified that, "[t]he loss of command and control MCR abandonment fire scenarios were developed through a detailed analysis of potential fires and propagation paths (including both panel and transient fires). The level of damage was assessed using detailed circuit analysis and NEI guidance on spurious and multiple spurious operations (NEI 00-01)." The licensee reported that a CCDP/CLERP of 0.108 was an adequate estimate for effectively all scenarios based on its plant design, procedures, and PCS design, and that "the contribution of multiple spurious operations is very low and for specific, insignificant scenarios a higher CCDP/CLERP could have been used." The licensee reported that a cutset review that identified complex MSO damage states and set their CCDP/CLERP to 1.0 resulted in less than a 1 percent increase in CDF and LERF. The NRC staff concludes that the licensee's latest method is acceptable because it includes a detailed evaluation and modeling of all fire-caused MCR abandonment scenarios, including the impacts of spurious and multiple spurious operations, and provides an estimate of the impact on risk of assuming that complex fire scenarios have a high likelihood of failure (i.e., 1.0). The value of 0.108 was used in the final transition risk estimates provided in the response to PRA RAI 40. The licensee indicated in implementation item S-3.19 that the fire analysis will be updated to incorporate all changes identified in Supplement 3 of PRA RAI 40 prior to approving self-approval evaluations. Supplement 3 states that the refined MCR abandonment model will be included in the FPRA and therefore the NRC staff concludes that this approach is acceptable.

The NRC staff's review also noted that in some MCR fire scenarios, operators remain in the MCR but use the ASD panel for some actions. In response to PRA RAI 29.e dated January 14, 2013 (Reference 9), the licensee noted these operator actions, and found them not to be risk significant for this application. In addition, PRA RAI 14 (Reference 9) notes that currently fire area RB-FN is an area where, given a fire, the operators may abandon the MCR. In the FPRA, however, no MCR abandonment was postulated for this area because no loss of command and control occurred for any of the Fire Area RB-FN fire scenarios. Fire area RB-FN will become a non-abandonment area in the post-NFPA 805 configuration, and was modeled in the FPRA accordingly.

In PRA RAI 36 dated November 14, 2013 (Reference 17), the NRC staff noted that the response to PRA RAI 13 and PRA RAI 15 dated February 12, 2013 (Reference 10) stated that corrections were made to the FPRA model after the LAR submittal for several scenarios in Fire Area TB-A and RB-FN (PRA RAI 16e, Reference 10) and requested description and explanation of the changes. In addition, PRA RAI 11b (Reference 17) requested information about how transient fires were modeled in the MCR. The licensee clarified that the fire-affected equipment list for several transients related to PRA RAI 13 and PRA RAI 15 were inappropriate and were revised; that an RA listed in LAR Attachment G was not included in the FPRA and was added; and that transient fires had not been postulated in the MCR and seven scenarios were developed. These corrections were included in the final composite transition risk results reported in PRA RAI 40. The NRC staff concludes that these few changes do not appear to be caused by a systemic problem. The licensee indicated in implementation item S-3.19 that the fire analysis will be updated to incorporate all changes identified in Supplement 3 of PRA RAI 40 prior to approving self-approval evaluations. Supplement 3 states that the FPRA includes the model corrections from RAI-36, RAI-11, and RAI-16e and, therefore, the issue is resolved.

In response to PRA RAI 04 dated January 14, 2013 (Reference 9), regarding the use of a reduced Heat Release Rate (HRR) for modeling transient fires within the Auxiliary Relay Room and the Cable Spreading Room (CSR), the licensee explained that use of a 69 kW transient HRR is justified based on enhanced combustible controlled areas in those areas, absence of the potential for large liquid fires, absence of a history of transient fire events for these fire areas, and absence of combustibles that would contribute to larger HRR fires. In a follow-up RAI 04.01 dated November 14, 2013 (Reference 17), the NRC staff requested that the licensee discuss the results of review of violations of transient combustible controls, and justify the use of 142 kW HRR transient fires in the FPRA. In response to PRA RAI 04.01 (Reference 13), the licensee explained that review of plant Condition Reports over the last 5 years identified violations involving only minor quantities of combustible materials in the CSR, and described those combustibles. Also, in response to PRA RAI 04.01, the licensee stated that the 75th percentile transient HRR of 142 kW was used for Fire Zones 8B, 8C, 8E, 8F, 8G, and 8H, and described the potential limited ignition sources and combustible materials in those fire zones. The licensee justified use of this reduced HRR based on the following: 1) absence of pumps and maintenance of oil containing equipment, 2) administrative control of combustibles that includes limitations on combustibles permitted, storage of combustibles in solid metal containers, control of excess combustibles using Fire Protection staff evaluation or a fire watch, and removal of combustibles upon job completion, and 3) review of violations in these fire zones that found no violations of combustible control procedures over the last 5 years. The NRC staff concludes that the licensee's approach in identifying the HRRs is consistent with the guidance of NEI's letter to the NRC dated September 27, 2011 (Reference 74), and, therefore, acceptable. The licensee indicated in implementation item S-3.19 that the fire analysis will be updated to incorporate all changes identified in Supplement 3 of PRA RAI 40 prior to approving self-approval evaluations. Supplement 3 states that transient fire HRRs are included in the FPRA as identified in PRA RAI 04 and PRA RAI 04.01 and, therefore, this issue is resolved.

F&O 5-2 against SR CS-A7 identifies that Kerite-FR cables were treated as thermoset material for modeling flame spread and HRR. According to the licensee's supplemental information response to PRA RAI 40 dated February 18, 2014 (Reference 15), the fire scenario frequencies, including severity factors and non-suppression probabilities, and target impacts were revised based on the failure threshold of Kerite-FR cables of 247 degrees Celsius (°C) as recommended in NUREG/CR-7102, "Kerite Analysis in Thermal Environment of FIRE (KATE-Fire)" (Reference 75). Also, the response stated that the thermoplastic damaging heat flux threshold has conservatively been used in the FM. This FM approach was used in the final transition risk estimates provided in the response to PRA RAI 40 dated January 17, 2014 (Reference 14). The licensee indicated in implementation item S-3.19 that the fire analysis will be updated to incorporate all changes identified in Supplement 3 of PRA RAI 40 prior to approving self-approval evaluations. Supplement 3 states that the FM in Note 2 will be included in the FPRA and, therefore, the issue is resolved.

In PRA RAI 06 dated November 14, 2012 (Reference 16), the NRC staff requested information about use of non-suppression probability (P_{ns}) values less than 0.001, contrary to guidance in NUREG/CR-6850 Attachment P. In response to PRA RAI 06 dated February 12, 2013 (Reference 10), the licensee provided the results of a sensitivity analysis (CDF, LERF, delta CDF, delta LERF) using a P_{ns} no lower than 1E-03 and incorporating revised abandonment times as addressed in the response to Fire Modeling RAI 2d (Reference 10). The results of the sensitivity show that the impact to the risk estimates is negligible. In Supplement 3 to PRA RAI 40 dated February 18, 2014 (Reference 15), the licensee confirmed there are no P_{ns} values less than 1E-3 in the FPRA model. The licensee indicated in implementation item S-3.19 that the fire analysis will be updated to incorporate all changes identified in Supplement 3 of PRA RAI 40 prior to approving self-approval evaluations. Supplement 3 states that suppression probabilities less than 1E-3 will not be used consistent with accepted guidance and, therefore, the issue is resolved.

In PRA RAI 05 dated November 14, 2012 (Reference 16), the NRC staff requested clarification of what was being credited in the FPRA model for "flame impingement shields" and "radiant energy shields" noted in Table 4-3 of the LAR. In response to PRA RAI 05 dated January 14, 2013 (Reference 9), the licensee explained that the installed Promat-H boards and the shields to-be-installed are credited in relevant fire scenarios to prevent damage or delay damage to FPRA credited conduit and cable trays. The licensee stated that although a fire rating cannot be assigned to the Promat-H board fire barriers in the CSR and Cable Expansion Room, the construction is similar to that of a 1-hour fire rated barrier. The licensee explained that the 1-hour fire rated resistance is adequate for transient fires of less than 1 hour in duration where there are no additional secondary cable trays or other combustibles also involved in the fire scenarios. The shields to be installed are described in LAR Attachment S, Table S-2, Items S-2.5, S-2.6, and S-2.7. Justification of the design and construction and acceptability of these barriers is further discussed In Section 3.5.1.8 of this SE.

In PRA RAI 15 dated November 14, 2012 (Reference 16), the NRC staff noted that new information indicated that the reduction in hot short probabilities for circuits protected by control transformers (CPT) identified in NUREG/CR-6850 was too high and should be reduced. The reduction in hot short probabilities was removed from the final transition risk estimates provided in the response to PRA RAI 40. The licensee indicated in implementation item S-3.19 that the fire analysis will be updated to incorporate all changes identified in Supplement 3 of PRA RAI 40 prior to approving self-approval evaluations. Supplement 3 states that no credit will be given for the CPTs in the FPRA and, therefore, the issue is resolved.

In its response to PRA RAI 21 dated January 14, 2013 (Reference 9), the licensee explained how non-rated fire barrier elements were credited in the FREs. Non-rated elements were only credited as compartment boundaries provided that they have been included in the fire protection program and justified as acceptable in engineering equivalency evaluations. In PRA RAI 21, the NRC staff's review of the LAR Attachment C noted that the reactor protection system (RPS) and the critical switchgear rooms had non-rated fire barrier connections. The licensee concluded in the response to the RAI that for the RPS rooms, based on the ignition sources modeled in the RPS rooms and lack of significant secondary combustibles (i.e., no cable trays), the resistance provided by the ductwork is adequate to prevent failure of FPRA credited targets in the adjacent fire compartment. For the critical switchgear rooms, the response notes that fire barriers exist with a rating of 1.5 hours. The response states that the 1.5-hour rated doors are adequate to prevent failure of FPRA targets in the adjacent compartment. The licensee noted that the Multi-Compartment Analysis (MCA) assessed the potential failure of fire dampers and also the spread of fire/smoke between fire zones via interconnected ductwork, and that failure of fire doors and penetrations were also included in the MCA. The NRC staff concludes that the licensee has evaluated the fire barriers for these rooms for their potential effect on FPRA targets, and has included them in the MCA appropriately.

In its response to PRA RAI-02f.01 dated January 14, 2013 (Reference 9), the licensee explained that several fire zones besides the MCR containing sensitive electronics associated with FPRA credited components were identified, and assessed to determine if sensitive electronics could be subject to the damage threshold recommended by NUREG/CR-6850 (65 °C/150 degrees Fahrenheit (°F)). The licensee determined via walkdowns that sensitive equipment is located at "floor level" and therefore not subject to hot gas layer (HGL) temperatures exceeding 65 °C. The licensee also reasoned that damage to sensitive equipment was protected by steel housing so could be bounded by radiant heat damage to the thermoset cabling termination points to equipment. The licensee explained that assessment of sensitive electronics in the MCR was not explicitly performed because: 1) the NUREG/CR Appendix L approach to fire propagation was used for the MCB, 2) the damage threshold for sensitive electronics is not reached prior to MCR abandonment conditions being reached, and 3) the MCB cabinet walls protect sensitive equipment for a sufficient period such that the likelihood of not suppressing fire prior to damage is low.

In a follow-up RAI dated November 14, 2013 (Reference 17), the NRC staff asked the licensee to describe the process by which sensitive components or devices were identified, selected, and located. In response to PRA RAI-02f.01 dated December 12, 2013 (Reference 13), the licensee provided the definition of "sensitive electronics" it used, describes its process of identifying sensitive electronics, and presents a listing of the components treated as temperature-sensitive equipment. Solid state devices and printed circuit board components were identified and modeled as temperature-sensitive components. These components were identified using the plant equipment database, the FPRA (for ignition sources and components), and plant walkdowns. The NRC staff concludes that the licensee has systematically identified sensitive electronics and has provided adequate justification for its evaluation in the FPRA model.

The NRC staff requested additional information in PRA RAI 37 dated November 14, 2013 (Reference 17), to confirm the adequacy of the FPRA modeling of containment overpressure (COP). In response to PRA RAI 37 dated December 12, 2013 (Reference 13), the licensee explained that the FPRA models the need for COP if suppression pool cooling is not initiated within 4 hours and provides a list of the isolation failures that can result in the loss of COP. The licensee also discussed the COP timing analysis as it related to HRA of containment isolation and all components associated with containment isolation pathways were selected and subsequently cable traced. The NRC staff concludes that the COP modeling in the FPRA is acceptable since it is consistent with supporting COP analysis noted in the response.

The NRC staff also reviewed the HRA modeling of the hardened pipe vent system since containment venting is generally an important function for BWR containments, and is relied upon in the dominant CDF sequences of the LAR Attachment W. The response to PRA RAI 27 dated January 14, 2013 (Reference 9), states that the hardened pipe vent components modeled in the FPRA are three valves, one MOV and two air-operated valves, needed to align and use the system. Some fire scenarios will require local operation of the air-operated valves since the FPRA assumes instrument air is failed according to PRA RAI 27. The HRA for operating the hardened pipe vent is described in RAI responses PRA RAI 29.b and 29.c dated January 14, 2013, and involves a screening HEP for opening locally air-operated valves and a detailed HRA for other operator actions from the MCR to use the hardened pipe vent. Additional technical basis for the screening value and the ability to operate air-operated valves from the MCR was provided in the licensee's response to follow-up PRA RAI 27.01 dated December 12, 2013 (Reference 13). The licensee also has identified the fire areas where fire impact would preclude crediting the hardened pipe vent valves in PRA RAI 27, and fire areas where these can be credited in response to PRA RAI 29.01 (Reference 13). Therefore, the NRC staff concludes that the licensee's HRA approach for modeling hardened pipe vent for the FPRA is acceptable.

F&O against QU-E3 noted that statistical propagation of uncertainty had not been performed. The principal reason to propagate uncertainty is to ensure that the point estimate is reasonably close to the mean value used in RG 1.174 which may differ from the point estimate because of state of knowledge correlations. In the response to PRA RAI 02.h dated January 14, 2013 (Reference 9), the licensee noted that the application indicates a net decrease in risk implying that any slight changes between the point estimate and the mean value would not cause the resulting risk estimates to exceed the RG 1.174 acceptance guidelines. In the response to RAI 02.h.01 dated January 17, 2014 (Reference 14), the licensee reported that correlation between probabilities is not significant based on a review of the cuts-sets contributing to CDF and LERF. The licensee indicated in implementation item S-3.19 that the fire analysis will be updated to incorporate all changes identified in Supplement 3 of PRA RAI 40 prior to approving self-approval evaluations. Supplement 3 states that the FPRA will explicitly include state-of-knowledge correlations and, therefore, the issue is resolved.

As a result of the review of the LAR, as supplemented, the NRC staff concludes that the CNS FPRA is technically adequate and that its quantitative results, considered together with the sensitivity studies, can be used to demonstrate that the change in risk due to the transition to NFPA 805 meets the acceptance guidelines of RG 1.174.

3.4.2.3 Fire Modeling in Support of the Development of the Fire Risk Evaluations (FREs)

The NRC staff performed detailed reviews of the FM used to support the FREs to gain further assurance that the methods and approaches used for the application to transition to NFPA 805 (Reference 1) were technically adequate. NFPA 805 has the following requirements that pertain to FM used in support of the development of the FREs:

NFPA 805, Section 2.4.3.3: On Acceptability

> The [probabilistic safety assessment (PSA)] approach, methods, and data shall be acceptable to the AHJ.

NFPA 805, Section 2.7.3.2, "Verification and Validation":

> Each calculational model or numerical method used shall be verified and validated through comparison to test results or comparison to other acceptable models.

NFPA 805, Section 2.7.3.3, "Limitations of Use":

> Acceptable engineering methods and numerical models shall only be used for applications to the extent these methods have been subject to verification and validation. These engineering methods shall only be applied within the scope, limitations, and assumptions prescribed for that method.

NFPA 805, Section 2.7.3.4, "Qualification of Users":

> Cognizant personnel who use and apply engineering analysis and numerical models (e.g., fire modeling techniques) shall be competent in that field and experienced in the application of these methods as they relate to nuclear power plants, nuclear power plant fire protection, and power plant operations.

NFPA 805, Section 2.7.3.5, "Uncertainty Analysis":

> An uncertainty analysis shall be performed to provide reasonable assurance that the performance criteria have been met.

The following Sections discuss the results of the NRC staff's reviews of the acceptability of the FM (first requirement). The results of the NRC staff's reviews of compliance with the remaining requirements are discussed in Sections 3.8.3.2 through 3.8.3.5 of this SE.

3.4.2.3.1 Overview of Fire Models Used to Support the FREs

FM was used to develop the zone of influence (ZOI) around ignition sources in order to determine the thresholds at which a target would exceed the critical temperature or radiant heat flux. This approach provides a basis for the scoping or screening evaluation as part of the CNS FPRA. The following algebraic fire models and correlations were used for this purpose:

- Flame Height, Method of Heskestad (Reference 32, Chapter 3)
- Plume Centerline Temperature, Method of Heskestad (Reference 32, Chapter 9)
- Radiant Heat Flux, Point Source Method (Reference 32, Chapter 5)
- Ceiling Jet Temperature, Method of Alpert (Reference 86)

The first three algebraic models are described in NUREG-1805, "Fire Dynamics Tools (FDT^S): Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program" (Reference 32). Alpert's ceiling jet temperature correlation is described in "EPRI Fire Induced Vulnerability Evaluation Methodology," Revision 1 (FIVE) (Reference 76), and serves as the basis for FDT^S that are used to estimate sprinkler, smoke detector and heat detector response times as documented in NUREG-1805 Chapters 10, 11, and 12, respectively. Verification and Validation (V&V) of these algebraic models is documented in NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," Volumes 1-7 (Reference 33).

The algebraic fire models and empirical correlations were implemented in a database and workbook referred to as the Fire Modeling Workbook (FMWB). The FMWB also calculate the plume radius according to Heskestad's correlation described in FIVE. The plume radius was used as the horizontal ZOI where it exceeded the ZOI based on heat flux.

In addition, the licensee developed screening approaches for the evaluation of ignition sources to determine the potential for the generation of an HGL in the compartment or fire area being analyzed. The CNS FPRA used these HGL screening approaches to further screen ignition sources, scenarios, and compartments that would not be expected to generate an HGL, and to identify the ignition sources that have the potential to generate an HGL for further analysis. The following correlations were used to determine the potential for the development of an HGL:

- Method of McCaffrey, Quintiere and Harkleroad (for naturally ventilated compartments)
- Method of Beyler (for closed compartments)
- Method of Foote, Pagni, and Alvares (for mechanically ventilated compartments)
- Method of Deal and Beyler (for mechanically ventilated compartments)

These HGL correlations are described in NUREG-1805, Chapter 2, and implemented in the FMWB.

In LAR Section 4.5.1.2, the licensee also identified the use of the following empirical correlations that are not addressed in NUREG-1824 Volumes 3 and 4 (Reference 33).

- Sprinkler Activation Correlation (Reference 32, Chapter 10)
- Smoke Detection Actuation Correlation, Method of Heskestad and Delichatsios (Reference 32, Chapter 11)
- Corner and Wall Heat Release Rate (Reference 79)
- Correlation for Heat Release Rates of Cables (Reference 32, Chapter 7)
- Correlation for Flame Spread over Horizontal Cable Trays, FLASH-CAT, described in NUREG/CR-7010, "Cable Heat Release, Ignition, and Spread in Tray Installations During Fire (CHRISTIFIRE), Volume 1: Horizontal Trays" (Reference 34)

The licensee's ZOI approach was used as a screening tool to distinguish between fire scenarios that required further evaluation and those that did not require further evaluation. Qualified personnel performed a plant walk-down to identify ignition sources and surrounding targets or SSCs in compartments and applied the empirical correlation screening tool to assess whether the SSCs were within the ZOI of the ignition source. Based on the fire hazard present, these generalized ZOIs were used to screen from further consideration those CNS-specific ignition sources that did not adversely affect the operation of credited SSCs, or targets, following a fire. The licensee's screening was based on the 98th percentile fire HRR from the NUREG/CR-6850 methodology (References 26, 27, and 28).

The Consolidated Model of Fire and Smoke Transport (CFAST), Version 6, was used for:

- HGL temperature calculations in specific fire areas
- Temperature sensitive equipment HGL study

Finally, Fire Dynamics Simulator (FDS), Version 5, was used for:

- Control room abandonment calculations
- Temperature sensitive equipment ZOI study
- Plume/HGL interaction study
- Smoke detector activation calculations in specific fire areas, based on the method by Cleary to estimate detector response time (Reference 77)

V&V of CFAST and FDS is documented in NUREG-1824, Volumes 5 and 7, respectively.

Finally, a plume temperature correlation developed by Zalosh (Reference 78) was used in the analysis of selected structural steel members. In response to a request for additional information (RAI) (Reference 16), the licensee revised the plume temperature calculations in the structural steel analysis and used Heskestad's correlation described in NUREG-1805 instead.

The V&V of all correlations and fire models that were used to support the CNS FPRA is discussed in detail in Section 3.8.3.2 of this SE.

3.4.2.3.2 RAIs Pertaining to Fire Modeling in Support of the Cooper Fire PRA

By letter dated November 14, 2012 (Reference 16), the NRC staff sought additional information concerning the FM conducted to support the FPRA. By letters dated January 14, 2013 (Reference 9), February 12, 2013 (Reference 10), and March 13, 2013 (Reference 11), the licensee responded to these RAIs. In addition, by letter dated June 13, 2013 (Reference 12), the licensee provided supplemental information to clarify its response to an FM RAI. The following paragraphs describe selected RAI responses related to the acceptability of the fire models used.

- During the onsite audit the NRC staff noted that in some fire areas the potential contribution of non-cable intervening combustibles to fire growth was not considered in the FM analysis. As a result, the NRC staff issued FM RAI 01.a (Reference 16), to ask the licensee to identify areas with secondary combustibles that were not considered in the FM analyses, and to assess the impact on the risk of fire scenarios that involve intervening combustibles in these areas.

  In its response dated February 12, 2013 (Reference 10), the licensee identified the nature and quantity of secondary combustibles in every compartment and fire zone included in the FPRA. A detailed analysis was conducted in fire zone 3C, because the secondary combustible (pipe insulation) in this zone is relatively close to targets. The analysis shows that additional targets are damaged due to the HRR contribution of the pipe insulation. This resulted in an increase of the risk and delta risk by less than 1 percent, and the FPRA was revised accordingly.

For the remaining zones, an explanation was provided to justify why fires involving non-cable secondary combustibles need not be considered. The justification is generally one of the following: (1) the secondary combustible (thermal insulation) is covered with a foil-faced fire retardant Kraft vapor barrier and therefore does not support flame spread, or (2) the analysis without secondary combustibles already fails all targets in the zone.

In reviewing the licensee's response, the NRC staff identified two fire zones with large amounts of secondary combustibles (i.e. fire zone 7A in fire compartment CB-A (polyurethane foam insulation) and fire zone 10B in fire compartment CB-D (unspecified insulation)). The NRC staff requested that the licensee provide more information regarding the secondary combustibles in these two fire zones. In its response to this request dated June 13, 2013 (Reference 12), the licensee provided more detail concerning the nature of the insulation and covering material and the distribution of the insulation in the fire zone.

Based on (1) the detailed information provided concerning the non-cable intervening combustibles present in fire zones where a FRE was conducted; (2) the adjustment that was made to the FPRA based on a detailed analysis of fires involving intervening combustibles in fire zone RB-3C; and (3) the licensee's justification for not considering fire scenarios involving intervening combustibles in the remaining fire zones, the NRC staff concludes that all risk-significant fire scenarios involving non-cable intervening combustibles have been addressed in the FPRA and are acceptable.

- The NRC staff issued FM RAI 01.b (Reference 16), to request that the licensee explain why the effect of the size of the ventilation opening was not evaluated in the CFAST temperature sensitive equipment HGL study, and to revise the analysis to include the ventilation opening size, if needed.

  In its response (Reference 10), the licensee indicated that the study was revised and now considers the actual geometry of zones in the plant where sensitive equipment is present, instead of the generic compartment geometries that were used in the original study. The response includes a table, which shows that the compartment aspect ratio is within the NUREG-1824 validated range for all zones containing sensitive equipment.

  Based on the revised analysis, the NRC staff concludes that actual plant conditions in terms of natural ventilation have been accounted for in the temperature sensitive equipment HGL study and, therefore, the revised HGL study is acceptable.

- During the on-site audit, the NRC staff reviewed the structural steel analysis for fire zones 13A and 20B, and noted that the flame height exceeds the elevation of the beams that were evaluated in the analysis. The NRC staff issued FM RAI 01.c (Reference 16), to ask the licensee to explain why the gas temperature at the beams is lower than the flame temperature, and to determine the effect of using the correct temperature on the results of the evaluation. In addition, the NRC staff issued FM RAI 01.d (Reference 16), to ask the licensee to provide technical justification for determining the fire resistance of columns in fire zone 13A using an empirical method that is based on ASTM E119, "Standard Test Method for Fire Tests of Building Construction and Materials, American Society for Testing and Materials," test data, since a standard ASTM E119 fire is less severe than the engulfing hydrocarbon pool fire that was postulated in the analysis.

In its response (Reference 9), the licensee revised the analysis and assumed that the exposed structural steel members are engulfed by flame.

Based on the results of the revised analysis, the NRC staff concludes there is reasonable assurance that the structural steel members in fire areas 13A and 20B will continue to support the imposed load after exposure to the postulated pool fires and therefore the revised analysis is acceptable.

- The NRC staff issued FM RAI 01.e (Reference 16), to ask the licensee to explain how it will ensure that the model assumptions in terms of transient combustibles in a fire area or zone will not be violated during and post-transition.

  In its response (Reference 9), the licensee summarized the administrative procedure that is used to control combustibles in each fire zone, provided the basis for assuming a 69 kilowatt (kW) transient HRR in fire zones 8A and 9A, and explained that enhanced controls are used to prevent combustibles from accumulating in specific fire areas.

  The NRC staff concludes that the administrative combustible control procedure is acceptable because it provides for control of transient combustibles within the fire model assumptions during and post-transition. The NRC staff further concludes that the licensee's approach to enhanced controls used to prevent combustibles from accumulating in specific fire areas is acceptable.

- Regarding the use of the algebraic models, the NRC staff issued FM RAI 01.f (Reference 16), to request that the licensee to do the following:

  1) Explain how fire location corner and wall proximity effects are accounted for in the MQH (McCaffrey, Quintiere, and Harkleroad) method for calculating HGL temperature; and in Alpert's method for calculating ceiling jet temperature.

  2) Describe how the time to sprinkler actuation and the time to heat and smoke detector actuation was calculated, and provide technical justification for applying steady-state models to time-varying conditions.

3) Explain how the damage threshold for targets in a mixed convective/radiative environment was established and address F&O 3-9 under FSS-D1.

4) Explain how the elevation and dimensions of ignition source fires were determined, and provide technical justification for not adjusting the height and dimensions following ignition of secondary combustibles.

The licensee's responses to the four parts of FM RAI 01.f (Reference 10), and the NRC staff's conclusions are summarized below.

1) In its response to the first part, the licensee explained that fires located within 2 feet of a wall or corner were addressed on a scenario-by-scenario basis in the HGL calculations. For Alpert's correlation, the licensee used the same adjustment to account for fire location effects as in Heskestad's plume temperature correlation (i.e., double the HRR for fires within 2 feet of a wall and quadruple the HRR for fires within 2 feet of a corner).

   Based on the explanation provided, the NRC staff concludes that the licensee's approach to account for wall and corner effects in the MQH method for calculating HGL temperature and Alpert's method to calculate ceiling jet temperature is acceptable because the approach is conservative.

2) In its response to the second part, the licensee explained that detection timing was determined using NUREG-1805, FDT 11 "Estimating Smoke Detector Response Time." Assuming a standard t^2 fire growth profile, the FM analyst used this method to determine when the minimum HRR for detector activation is reached. The licensee explained that a steady state detection model is conservative because the pre-heating effect during the t^2 fire growth period prior to reaching the activating HRR is ignored.

   In addition, the licensee explained that the time to suppression for systems activated by an automatic detection system was determined as the sum of the time to detector activation and the delay in the delivery of the suppression agent. For systems with a bulb or fusible link, the sprinkler response time was determined using NUREG-1805, FDT10 "Estimating Sprinkler Response Time," and an approach similar to that used to estimate detector activation time. Fire suppression was credited in cases when the suppression time is less than the time to target damage.

   Based on the explanation provided, the NRC staff concludes that the licensee's approach to determine sprinkler and smoke detector activation time is acceptable.

3) In its response to the third part, the licensee explained that target failures due to combined convective and radiative heating are bound by the conservative methods and model input parameters, which are based on the guidance in NUREG/CR-6850. To illustrate this, the licensee then discussed selected conservative FM input parameters, methods and assumptions which provide safety margin related to the ZOI. Finally, the licensee indicated that F&O 3-9 is addressed in the FDS analysis of the effect of the HGL on plume temperatures.

   Based on the explanation provided, the NRC staff concludes that the licensee's approach to determine target damage in a mixed convective/radiative environment is used in FM at CNS is acceptable.

4) In its response to the fourth part, the licensee explained that the height of fixed ignition sources was the highest location of an opening, vent or door as determined through plant walkdowns. An area of 20" x 20" was used, unless inspection of cabinet contents indicated that a different area is more representative of field conditions.

   Furthermore, the licensee stated that the height of transient fire sources was selected as 2 feet based on the guidelines in the Fire Protection Significance Determination Process (Reference 79). The area of transient fires was selected as 2 feet by 2 feet in order to bound a typical trash can.

   Finally, the licensee explained that for fires involving multiple combustibles, the combined total HRR was used as the input to the algebraic models. The licensee justified maintaining the diameter and elevation of the original source fire after involvement of an intervening combustible based on guidelines in NUREG-1934, "Nuclear Power Plant Fire Modeling Application Guide (NPP FIRE MAG)," (Reference 80).

   Based on the additional information and justification provided, the NRC staff concludes that the licensee's assumptions concerning the physical fire size and elevation are acceptable.

- Regarding the use of FDS in the MCR abandonment study, the NRC staff issued FM RAI 01(h) (Reference 16), to ask the licensee to do the following:

  1) Provide justification for assuming an alarm set point of 8.2 percent per meter (%/m) of smoke detector SD-1001 in the CSR.

  2) Provide justification for using a Response Time Index (RTI) of 132 $m^{1/2} \cdot s^{1/2}$ for the fusible link of the dampers between the MCR and the CSR.

The licensee's responses to the two parts (Reference 10), and the NRC staff's conclusions are summarized below.

1) To justify the assumed obscuration value of 8.2%/m, the licensee reviewed a number of vendor manuals and determined that 9.8%/m is a typical value for duct smoke detectors of the same type as installed in the CSR at CNS. The licensee also noted that the default smoke detector alarm setting in FDS is 3.3%/m.

   Based on the licensee's justification, the NRC staff concludes that a smoke detector alarm setting of 8.2%/m is acceptable.

2) In its response to the second part, the licensee stated that the activation temperature used for the fire damper fusible links was obtained from the vendor manual for the fire dampers. The RTI was estimated based on engineering judgment and guidance provided in NUREG-1805, Chapter 12.

   Based on the information provided and the fact that the FDS simulations show that heating, ventilation and air conditioning (HVAC) shutdown in all scenarios is initiated by smoke detector activation in the CSR well before the fire damper activation temperature is reached, the NRC staff concludes that the input parameter for fire damper fusible link RTI of 132 $m^{1/2} \cdot sec^{1/2}$ used in the FM at CNS is acceptable.

3.4.2.3.3 Conclusion for Section 3.4.2.3

Based on the licensee's description in the LAR, as supplemented, of the CNS process for performing FM in support of the FREs, the NRC staff concludes that the licensee's approach for meeting the requirements of NFPA 805, Section 2.4.3.3, is acceptable.

3.4.2.4 Conclusions Regarding Fire PRA Quality

The NRC staff concludes that the PRA approach, methods, and data are acceptable and that Section 2.4.3.3 of NFPA 805 is satisfied for transition to NFPA 805. The NRC staff based this conclusion on the findings that: (1) the PRA model for CNS adequately represents the current, as built, as operated configuration, and is therefore capable of being adapted to model both the post-transition and compliant plant as needed; (2) the PRA models conform to the applicable industry PRA standards for internal events and fires at an appropriate Capability Category, considering the acceptable disposition of the peer review and NRC staff review findings; and (3) the FM used to support the development of the CNS FPRA has been confirmed as appropriate and acceptable.

The self-approval change in risk acceptance guidelines are much smaller than the transition change in risk acceptance guidelines and issues that are not important for transition may be important for self-approval. Therefore, the NRC staff concludes that the changes identified in the supplemental response to PRA RAI 40 dated February 18, 2014 (Reference 15), shall be made to the FPRA before the FPRA is used for self-approval. The licensee indicated in implementation item S-3.19 that the fire analysis will be updated to incorporate all changes identified in Supplement 3 of PRA RAI 40 prior to performing self-approval evaluations.

Finally, based on the licensee's administrative controls to maintain the PRA models current and to assure continued quality, and using only qualified staff and contractors (as described in Section 3.8.3 of this safety evaluation), the NRC staff concludes that the quality of the CNS PRA is sufficient to support the self-approval of future risk-informed changes to the FPP under the NFPA 805 transition license conditions as given in the supplemental response dated February 18, 2014 (Reference 15), which includes modifications and procedures credited in the FPRA model.

3.4.3 Fire Risk Evaluations

For those fire areas for which the licensee used a PB approach to meet the NSPC, the licensee used FREs in accordance with NFPA 805 Section 4.2.4.2 to demonstrate the acceptability of the plant configuration. In accordance with the guidance in RG 1.205, Section C.2.2.4, "Risk Evaluations," the licensee used a risk-informed approach to justify acceptable alternatives to comply with NFPA 805 deterministic criteria. The NRC staff reviewed the following information during its evaluation of CNS's FREs: LAR Section 4.5.2, "Performance Based Approaches," LAR Attachment C, "NEI 04-02 Table B-3 – Fire Area Transition," LAR Attachment W, "Fire PRA Insights," as well as associated supplemental information.

Plant configurations that did not meet the deterministic requirements of NFPA 805, Section 4.2.3.1 were considered VFDRs. As clarified in response to PRA RAI 16.1 dated November 14, 2013 (Reference 17), one VFDR was resolved using a modification, and the other modifications were credited for risk reduction. The licensee identified a number of VFDRs that it does not intend to bring under deterministic compliance under NFPA 805 in LAR Attachment C Table B-3, "Fire Area Transition." For these VFDRs, the licensee performed risk evaluations in accordance with NFPA 805, Section 4.2.4.2, to address FPP non-compliances and demonstrate that the VFDRs are acceptable.

All of the VFDRs identified by the licensee were categorized as separation issues. The VFDRs can generally be categorized into the following three types of plant configurations: (1) inadequate separation resulting in fire-induced damage of process equipment or associated cables required for the identified success path; (2) inadequate separation resulting in fire-induced spurious operation of equipment that may defeat the identified success path; (3) inadequate separation resulting in fire-induced failure of process monitoring instrumentation or associated cables required for the identified success path; (4) combinations of the above configurations.

The licensee explained the FRE process in response to PRA RAI 16 dated January 14, 2013 (Reference 9). The change in risk for transition (ΔCDF and ΔLERF) was evaluated by subtracting the risk of a compliant plant configuration from the risk of the NFPA 805 post-transition case for each fire area. In the response, the licensee also clarified that the compliant case was based on the current plant design and operation with VFDRs eliminated. The post-NFPA case was based on the anticipated plant design and operation including all planned modifications and all retained VFDRs. The licensee also clarified that credited modifications include procedural (e.g., fire response procedures) modifications as well as hardware changes. In the response to the supplemental RAI dated February 18, 2014 (Reference 15), the licensee clarified that VFDRs are eliminated by setting the recovery action to success if a recovery action is modeled, or by removing the failure due to fire damage if no recovery action is modeled. In addition, each fire area and risk evaluation is performed (which considers all the VFDRs) to address any potential synergies among the affected components. The results by fire area and the total for all fire areas are provided in Section 3.4.6 of this SE.

The NRC staff concludes that the licensee's methods for calculating the change in risk associated with VFDRs are acceptable because they are consistent with the guidance in RG 1.205, Section 2.2.4.1, and FAQ 08-0054 (Reference 46). The staff further concludes that the results of these calculations for each fire area, which are summarized in Table 3.4.6-2 of this SE, demonstrate that the difference between the risk associated with implementation of the deterministic requirements and that of the VFDRs meets the risk acceptance criteria described in NFPA 805, Section 2.4.4.1.

3.4.4 Additional Risk Presented by Recovery Actions

The NRC staff reviewed LAR Attachment C, "NEI 04-02 Table B-3 – Fire Area Transition," Attachment G, "Recovery Actions Transition," and Attachment W, "Fire PRA Insights," during its evaluation of the additional risk presented by the NFPA 805 RAs at CNS. Section 3.2.4 of this SE describes the identification and evaluation of RAs.

The licensee used the guidance in RG 1.205 Revision 1 (Reference 2) for addressing RAs. This included consideration of the definition of PCS and RA, as clarified in the RG 1.205, Revision 1. Accordingly, any actions required to transfer control to, or operate equipment from, the PCS, while required as part of the RI/PB FPP, were not considered RAs per the RG 1.205 guidance and in accordance with NFPA 805. Conversely, any manual actions required to be performed outside the control room and not at the PCS were considered RAs.

The LAR Attachment G, Table G-1 provides RAs that were credited in the FPRA for risk reduction as well as for DID. The licensee also explains that none of the RAs listed in Attachment G of the LAR are considered previously approved, and all RAs listed in Attachment G were identified as a result of a VFDR separation issue and were evaluated for acceptability through the FRE process. Operator actions performed at the PCS following MCR abandonment are identified in Table G-1, but as explained above are not considered RAs.

Per LAR Attachment G, the licensee reviewed all of the RAs for adverse impact and dispositioned each action. None of the RAs listed in LAR Table G-1 were found to have an adverse impact on the FPRA. All RAs listed in Attachment G were evaluated against feasibility criteria provided in the NEI 04-02, FAQ 07-0030, Revision 5, and RG 1.205. During the NRC staff's review, the licensee noted in response to SSD RAI 09 dated January 14, 2013 (Reference 9), that RAs related to removing fuses and operation of an MOV using a motor starter will be revised to account for a modification to involve a control panel to operate the MOVs, and provided the revised RAs in the RAI response dated February 12, 2013, as an enclosure. A confirmatory demonstration of the feasibility of the RAs, including a field verification walk-through will be performed per implementation item S-3.6 of Attachment S Table S-3. The licensee's risk calculations will be reviewed and updated to incorporate any quantitative HEP changes based on the as-built configurations as part of implementation item S-3.30 of Attachment S Table S-3.

Per LAR Section W.3 and the updated LAR Table W-2 dated July 12, 2012 (Reference 7), for all PB fire areas including those fire areas that utilize an Alternate Shutdown (ASD) strategy, the additional risk associated with RAs was determined. The NRC staff noted that, consistent with FAQ 07-0030 (Reference 37) and the NFPA 805 definition of additional risk of RAs, the additional risk of RAs should be re-calculated by crediting plant modifications in both cases with and without RA risk estimates such that the difference between the two cases is due solely to the RAs. The licensee provided the additional risk of RAs in a revised Table W-2 provided in the LAR supplement response dated July 12, 2012 (Reference 7), in conformance with FAQ 07-0030. In response to PRA RAI 14.01.d dated November 14, 2013 (Reference 17), regarding the compliant case modeling for the MCR analysis, the licensee explains that the operator actions at the PCS are credited in the compliant case, however, the RAs (i.e., those taken away from the PCS) are modeled as successful, which the NRC staff concludes is also consistent with FAQ 07-0030 and FAQ 08-0054 (Reference 46) guidance.

The NRC staff noted that the total additional risk from RAs is 1.12E-5/year and 3.97E-6/year for CDF and LERF, respectively. These values are above the acceptance guidelines in RG 1.174. RG 1.205 Position 2.2.4.2 states that, "If the additional risk associated with previously approved RAs is greater than the acceptance guidelines in RG 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 RAs), should be risk-neutral or represent a risk decrease." Application of this guidance to RAs in general (i.e., not solely to previously approved RAs) indicate that the proposed additional risk of RAs is acceptable since the licensee has reported a total change in risk being a risk decrease. This was documented in response to PRA RAI 40 supplemental information dated February 18, 2014 (Reference 15).

The NRC staff concludes that the licensee's approach for calculating the additional risk of RAs is acceptable because it is consistent with the guidance in RG 1.205, Section 2.2.4.1, and FAQ 07-0030 (Reference 37) and FAQ 08-0054 (Reference 46) guidance. The results of the delta risk calculations for each fire area, and the total for all fire areas, are summarized in Table 3.4.6-2 of this SE. As discussed in Sections 3.4.6 and 3.4.7 of this SE, the NRC staff concludes that these results demonstrate that the total risk of transition, of which part is attributable to the risk of RAs, is less than the risk acceptance guidelines in RG 1.174 and, therefore, the additional risk associated with RAs is acceptable.

3.4.5 Risk-Informed or Performance-Based Alternatives to Compliance with NFPA 805

The licensee did not use any RI or PB alternatives to compliance with NFPA 805, which falls under the requirements of 10 CFR 50.48(c)(4), at CNS.

3.4.6 Cumulative Risk and Combined Changes

According to RG 1.205, Section 3.2.5, "Combined Changes and Relative Cumulative Risk of Changes," risk increases may be combined with risk decreases when estimating the total change in risk. For VFDRs for which the NFPA 805 PB approach is used, the risk associated with retaining some VFDRs and their associated recovery actions, can be offset by the decrease in risk associated with plant modifications and procedural changes unrelated to VFDRs (i.e., beyond compliance changes). The CNS NFPA 805 transition risk was shown to have an overall total decrease in delta CDF and delta LERF. In addition, licensees should address combined changes in accordance with the guidance in Regulatory Positions 2.1.1 and 2.1.2 of RG 1.174. The NRC staff's evaluation of Regulatory Positions 2.1.1 and 2.1.2 of RG 1.174 (DID and safety margin) is given in Section 3.4.1.

The licensee identified planned NFPA 805 transition modifications that decrease risk and for which the licensee takes credit during the assessment of the cumulative risk impact of the transition to NFPA 805 at CNS in Attachment S of the LAR, Table S-2. The licensee included modifications which did not result in bringing the facility into compliance with the deterministic requirements of NFPA 805. In response to PRA RAI 16.01 dated December 12, 2013 (Reference 13), the licensee clarified that all modifications except one were considered "beyond compliance" modifications. According to the response, "beyond compliance" modifications for the CNS reduce the fire risk associated with VFDRs but do not remove the VFDR. The licensee credited the risk reduction from these modifications by including them in the post-transition plant risk but not in the compliant plant risk.

In the response to PRA RAI 40 dated January 17, 2014 (Reference 14), the licensee provide final risk estimates obtained by changing some of the original methods and assumption to ones that are acceptable to the NRC staff as required by NFPA 805 Section 2.4.3.3. The individual changes are discussed in Section 3.4.2 of this SE and are summarized in PRA RAI 40 and in the tables provided in the response to PRA RAI 40. The final composite estimates by the licensee are a fire CDF of 6.07E-5/year, a total fire LERF of 1.26E-5/year, a change in CDF of -6.94E-6/year and a change in LERF of -1.25E-5/year. The changes in CDF and LERF associated with the request to transition to NFPA 805 are both negative and therefore well below the risk acceptance guidelines in RG 1.174. In addition, the licensee has included the following implementation item S-3.30 in Table S-3:

> Upon completion of all fire PRA credited implementation items in Transition report Tables S-2 and S-3, verify the validity of the change-in risk (total modifications) provided in Attachment W. If this verification determines that the risk metrics have changed such that the risk metrics from LAR Attachment W are exceeded, additional analytical efforts, and/or procedure changes, and/or plant modifications will be implemented to assure the Regulatory Guide 1.205 acceptance criteria are met.

Since the net total transition risk is negative, the total CDF and LERF for the baseline are not required to be provided for the application in accordance with RG 1.174 guidance.
Table 3.4.6-1 below shows the internal events and fire events PRA CDF and LERF for CNS

after transition to NFPA 805. Accordingly, the net change in risk for transition for NFPA 805 meets the RG 1.174 acceptance criteria.

Table 3.4.6-1: CDF and LERF for CNS after Transition to NFPA 805

Hazard Group	CDF (/year)	LERF (/year)
Internal Events	7.0×10^{-6}	2.3×10^{-6}
Fire Events	6.1×10^{-5} (1)	1.3×10^{-5} (1)
TOTAL	6.8×10^{-5}	1.5×10^{-5}

(1) Supplement response dated February 18, 2014 (Reference 15)

Uncertainties in the FPRA CDF and LERF are discussed in Section 3.4.7 below, and F&Os involving uncertainty have been adequately dispositioned as noted in the "record of review."

The licensee also provided in the LAR (Reference 6), as supplemented by letter dated July 12, 2012 (Reference 7), the risk increases and decreases, ΔCDF and ΔLERF, estimated for each fire area at CNS that is not deterministically compliant, in accordance with NFPA 805, Section 4.2.3, "Deterministic Approach." The risk estimates for the individual fire areas result from the completed and planned modifications and administrative controls that will be implemented as part of the transition to NFPA 805 at CNS, as well as recovery actions associated with VFDRs. The ΔCDF and ΔLERF results by fire area, as reported in the LAR as supplemented (Reference 7) are summarized in Table 3.4.6-2. The licensee re-evaluated fire area RB-FN and provided its results in Attachment 2 of the RAI response letter dated February 18, 2014 (Reference 15). In addition, based on the supplemental response to PRA RAI 40 dated February 18, 2014, the total ΔCDF and ΔLERF were re-evaluated using the changes and acceptable methods described above.

Table 3.4.6-2: ΔCDF and ΔLERF for CNS after Transition to NFPA 805

Fire Area	Description	Fire Risk Evaluation	
		ΔCDF (/year)	ΔLERF (/year)
CB-A	RHR SW Booster Pump and Service Air Compressor Areas Emergency Condensate Storage Tank Area RPS Room 1A Seal Water Pump Area and Corridor	1.48×10^{-7}	4.62×10^{-8}
CB-A-1	Control Building 903, DC Switchgear Room 1A and Battery Room 1A	9.49×10^{-8}	4.68×10^{-8}
CB-B	Control Building 903, DC Switchgear Room 1B and Battery Room 1B	1.54×10^{-7}	6.94×10^{-8}
CB-C	RPS Room 1B	ε (3)	ε (3)
CB-D	Control Room and SAS Corridor, Computer Room, Cable Spreading Room, Cable Expansion Room, Auxiliary Relay Room	-1.53×10^{-5}	-1.44×10^{-8}
IS-A	SW Pump Area Circ Water Pump and Traveling Screen Area	2.36×10^{-8}	4.43×10^{-10}
RB-A	RCIC and Core Spray Pump Room	7.90×10^{-8}	2.29×10^{-9}

Fire Area	Description	Fire Risk Evaluation	
		ΔCDF (/year)	ΔLERF (/year)
RB-B	Reactor Building South East Quad	1.25×10^{-7}	1.15×10^{-8}
RB-CF	Reactor Building Northwest Quad, Reactor Building 903 North Area and South Corridor, RHR Heat Exchanger Room A	7.90×10^{-7}	5.12×10^{-8}
RB-DI	Reactor Building Southwest Quad, HPCI Room, Reactor Building 903 South, RHR Heat Exchanger Room B	9.50×10^{-7}	2.00×10^{-8}
RB-E	Suppression Pool Area	2.18×10^{-9}	2.44×10^{-9}
RB-FN	Reactor Building 903' Northeast Corner	1.59×10^{-7}	5.08E-09
RB-J	Critical Switchgear Room 1F	1.43×10^{-7}	5.65×10^{-8}
RB-K	Critical Switchgear Room 1G	-2.08×10^{-6}	-2.15×10^{-6}
RB-M	Reactor Building North / East Side, RHR Heat Exchanger Room A	-6.32×10^{-7}	-2.76×10^{-9}
RB-N	Reactor Building South West Corner, RHR Heat Exchanger Room B and RWCU Heat Exchanger Room	6.43×10^{-8}	5.70×10^{-10}
RB-P	RB Elevator and Accessway Area RB HVAC Areas Fuel Pool, HX, CRD Repair Room, and Raw Water Cleanup Areas Reactor MG Set Oil Pump Area	4.63×10^{-8}	1.72×10^{-8}
RB-V	Reactor Recirculation Motor Generator Set Area	1.88×10^{-8}	6.31×10^{-9}
TB-A	Turbine Generator Building, Water Treatment Building, Radwaste Building, Augmented Radwaste Building, and Multi-Purpose Facility	6.77×10^{-6}	3.33×10^{-6}
TB-C	Steam Tunnel	ε (3)	ε (3)
TOTAL		-8.44×10^{-6} (1) -6.94×10^{-6} (2)	-1.29×10^{-5} (1) -1.25×10^{-5} (2)

(1) LAR dated April 24, 2012, as supplemented by letter dated July 12, 2012 (References 6 and 7, respectively), and RAI response letter dated February 12, 2013 (Reference 10)

(2) The total was updated in the licensee's supplement response dated February 18, 2014.

(3) ε = Epsilon, Non-zero but below truncation limit

The NRC staff did not request, and the licensee did not provide, a new table of changes in risk for each fire area as part of the response to PRA RAI 40. The LAR indicates that the change in CDF and LERF for each individual fire area is negative or very small, with the exception of the ΔLERF (3.33E-6/year) for Fire Area TB-A exceeds the acceptance criteria. However, since the change in total CDF and total LERF for this application is a net negative change from contributions of all VFDR risk and plant changes as described previously, the NRC staff concludes that the RG 1.205 guidance is satisfied and the total delta CDF and total delta LERF meet the acceptance guidelines in RG 1.174.

Based on the licensee's FREs, including implementation item S-3.30 that the as-built and as operated post-transition plant risk will be verified to be acceptable, the NRC staff concludes that the risk associated with the proposed alternatives to compliance with the deterministic criteria of NFPA 805 is acceptable for this application. Additionally, the NRC staff concludes that the licensee has satisfied RG 1.174, Sections 2.2.4 and 2.2.5, and NUREG-0800, Section 19.2 regarding acceptable risk.

3.4.7 Uncertainty and Sensitivity Analyses

The licensee used updated fire bin frequencies provided in NUREG/CR-6850, Supplement 1 (i.e., FAQ-08-0048). The guidance in FAQ-08-0048 (Reference 43) states that a sensitivity study must be performed using the mean of the fire frequency bins contained in Section 6 of NUREG/CR-6850 for those bins with an alpha value less than or equal to one. In response to PRA RAI 13 dated February 12, 2013, the licensee provided this sensitivity (Reference 10). These results indicate a greater decrease in the total ΔCDF and ΔLERF than the decrease obtained using the updated frequencies, but an increase in total CDF and LERF. Given the significant decrease in the total ΔCDF and ΔLERF, the NRC staff concludes that the use of the updated bin frequencies is acceptable.

Supporting Requirement FSS-E3 of the ASME/ANS PRA standard requires that a mean value and statistical representation of the uncertainties intervals for parameters used in FM of significant scenarios be provided. The NRC staff requested in PRA RAI 2.m dated January 14, 2013 (Reference 9), detailed justification for why only meeting Capability Category I was acceptable for this application regarding uncertainty evaluation. In the response, the licensee explained that FM in support of the FREs was, in general, performed using conservative methods and input values based on NUREG/CR-6850. The licensee confirmed that qualitative characterization of uncertainty was performed and documented as part of information supplementing the LAR, and then lists sources of those uncertainties. Sources of those uncertainties include detector and suppression system reliability and availability and numerous FM input parameters uncertainties. The licensee also listed many examples in which FM parameters or probabilistic treatment of FM is conservatively performed. Based on the information provided, the NRC staff concludes that meeting SR FSS-E3 at Capability Category I is acceptable since it provides an adequate level of conservatism.

3.4.8 Conclusion for Section 3.4

Based on the information provided by the licensee in the LAR, as supplemented, regarding the fire risk assessment methods, tools, and assumptions used to support transition to NFPA 805 at CNS, the NRC staff concludes that the following:

- The licensee's PRA used to perform the risk assessments in accordance with NFPA 805, Section 2.4.4 (PCEs) and Section 4.2.4.2 (FRE), is of sufficient quality to support the application to transition CNS FPP to NFPA 805. The NRC staff concludes that the PRA approach, methods, tools, and data are acceptable and in accordance with NFPA 805 Section 2.4.3.3.

- The licensee's PRA maintenance process is adequate to support self-approval of future risk-informed changes to the FPP following completion of the PRA related implementation items. These implementation items are: 1) Item S-3.19 to incorporate model changes identified in Supplement 3 of the response to PRA RAI 40, and 2) Item S-3.30 to verify the acceptability of the transition change in risk after completion of all plant modifications and implementation items credited in the PRA.

- The transition process included a detailed review of fire protection DID and safety margin as required by NFPA 805. The NRC staff concludes that the licensee's evaluation of DID and safety margin is acceptable. The licensee's process followed the NRC-endorsed guidance in NEI 04-02, Revision 2, and is consistent with the approved NRC staff guidance in RG 1.205, Revision 1, which provides an acceptable approach for meeting the requirements of 10 CFR 50.48(c).

- The changes in risk (i.e., ΔCDF and ΔLERF) associated with the proposed alternatives to compliance with the deterministic criteria of NFPA 805 (FREs) are acceptable for the purposes of this application, and that the licensee has satisfied the guidance contained in RG 1.205, Revision 1, RG 1.174, Sections 2.2.4 and 2.2.5, and NUREG-0800, Section 19.2, regarding acceptable risk. By meeting the guidance contained in these approved regulatory documents, the changes in risk have been concluded to be acceptable to the NRC staff, and therefore meet the requirements of NFPA 805.

- The total additional risk from RAs is 1.12E-5/year and 3.97E-6/year for CDF and LERF, respectively. These values are above the acceptance guidelines in RG 1.174. RG 1.205 Position 2.2.4.2 states, in part, that:

  > 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.

  In general, the application of this guidance to RAs (not solely to previously approved RAs) is found to be acceptable because the licensee has stated that the total change in risk represents a risk decrease. The licensee reported this risk decrease in its response to PRA RAI 40 supplemental information (Reference 15)

- The licensee did not utilize any risk informed or PB alternatives to compliance to NFPA 805 under the requirements of 10 CFR 50.48(c)(4).

3.5 Nuclear Safety Capability Assessment Results

NFPA 805, Section 2.2.3, "Evaluating Performance Criteria," states the following:

> To determine whether plant design will satisfy the appropriate performance criteria, an analysis shall be performed on a fire area basis, given the potential fire exposures and damage thresholds, using either a deterministic or performance-based approach.

NFPA 805, Section 2.2.4, "Performance Criteria," states the following:

> The performance criteria for nuclear safety, radioactive release, life safety, and property damage/business interruption covered by this standard are listed in Section 1.5 and shall be examined on a fire area basis.

NFPA 805, Section 2.2.7, "Existing Engineering Equivalency Evaluations," states:

> When applying a deterministic approach, the user shall be permitted to demonstrate compliance with specific deterministic fire protection design requirements in Chapter 4 for existing configurations with an engineering equivalency evaluation. These existing engineering evaluations shall clearly demonstrate an equivalent level of fire protection compared to the deterministic requirements.

3.5.1 Nuclear Safety Capability Assessment Results by Fire Area

NFPA 805, Section 2.4.2, "Nuclear Safety Capability Assessment (NSCA)," states the following:

> 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

This section of the SE addresses the last topic regarding the ability of each fire area to meet the NSPC of NFPA 805. Section 3.2.1 of this SE addresses the first three topics.

NFPA 805, Section 2.4.2.4, "Fire Area Assessment," also states the following:

> An engineering analysis shall be performed in accordance with the requirements of Section 2.3 for each fire area to determine the effects of fire or fire suppression activities on the ability to achieve the nuclear safety performance criteria of Section 1.5....

In accordance with the above, the process defined in NFPA 805, Chapter 4, provides a framework to select either a deterministic or a PB approach to meet the NSPC. Within each of these approaches, additional requirements and guidance provide the information necessary for the licensee to perform the engineering analyses necessary to determine which fire protection systems and features are required to meet the NSPC of NFPA 805.

NFPA 805, Section 4.2.2, "Selection of Approach," states the following:

> For each fire area either a deterministic or performance-based approach shall be selected in accordance with Figure 4.2.2. Either approach shall be deemed to satisfy the nuclear safety performance criteria. The performance-based approach shall be permitted to use deterministic methods for simplifying assumptions within the fire area.

This section of the SE evaluates the approach used to meet the NSPC on a fire area basis, as well as what fire protection features and systems are required to meet the NSPC.

The NRC staff reviewed LAR Section 4.2.4, "Fire Area-Transition," Section 4.8.1, "Results of the Fire Area Review," Attachment C, "NEI 04-02 Table B-3 – Fire Area Transition," Attachment G, "Recovery Actions Transition," Attachment S, "Plant Modifications and Items to be Completed During Implementation" and Attachment W, "Fire PRA Insights," in its evaluation of the ability of each fire area to meet the NSPC of NFPA 805.

CNS is a single unit BWR, and was divided into individual 25 fire areas with each area consisting of one or more individual fire zones. Based on the information provided in the LAR, as supplemented, the licensee performed the NSCA on a fire area basis. LAR Attachment C provides the results of these analyses on a fire area basis and also identifies the individual fire zones within the fire areas.

Table 3.5-1 of this SE identifies those fire areas that were analyzed using either the deterministic or PB approach in accordance with NFPA 805 Chapter 4 based on the information provided in LAR Attachment C Table B-3, "Fire Area Transition."

Table 3.5-1 Fire Area and Compliance Strategy Summary

Fire Area	Area Description	NFPA 805 Compliance Basis
CB-A	Control Building Basement, Control Building 903 Corridor and RPS Room 1A	Performance Based
CB-A-1	Control Building 903, DC Switchgear Room 1A and Battery Room 1A	Performance Based
CB-B	Control Building 903, DC Switchgear Room 1B and Battery Room 1B	Performance Based
CB-C	RPS Room 1B	Performance Based
CB-D	Control Room, Computer Room, Cable Spreading Room, Cable Expansion Room, Auxiliary Relay Room	Performance Based
DG-A	Diesel Generator Room 1A	Deterministic
DG-B	Diesel Generator Room 1B	Deterministic
DW	Drywell	Deterministic
IS-A	Intake Structure	Performance Based
RB-A	RCIC and Core Spray Pump Room	Performance Based
RB-B	Reactor Building South East Quad	Performance Based
RB-CF	Reactor Building Northwest Quad, Reactor Building 903 North Area and South Corridor, RHR Heat Exchanger Room A	Performance Based
RB-DI	Reactor Building Southwest Quad, HPCI Room, Reactor Building 903 South, RHR Heat Exchanger Room B	Performance Based
RB-E	Suppression Pool Area	Performance Based
RB-FN	Reactor Building 903' Northeast Corner	Performance Based
RB-J	Critical Switchgear Room 1F	Performance Based
RB-K	Critical Switchgear Room 1G	Performance Based
RB-M	Reactor Building North / East Side, RHR Heat Exchanger Room A	Performance Based
RB-N	Reactor Building South West Corner, RHR Heat Exchanger Room B and RWCU Heat Exchanger Room	Performance Based
RB-P	Reactor Building 958 Accessible Areas	Performance Based
RB-T	Reactor Building East Side and Refueling Floor	Deterministic
RB-V	Reactor Recirculation Motor Generator Set Area	Performance Based
TB-A	Turbine Generator Building, Water Treatment Building, Radwaste Building, Augmented Radwaste Building, and Multi-Purpose Facility	Performance Based
TB-C	Steam Tunnel	Performance Based

Fire Area	Area Description	NFPA 805 Compliance Basis
YD	Transformer Yard, Fire Pumphouse, Off Gas Building, Optimum Water Chemistry Building, offsite power distribution equipment, portions of non-safety power distribution system, and diesel generator oil storage transfer pumps	Deterministic

LAR Attachment C provides the results of these analyses on a fire area basis. For each fire area, the licensee documented the following:

- The approach used in accordance with NFPA 805 (i.e., the deterministic approach in accordance with NFPA 805, Section 4.2.3, or the PB approach in accordance with NFPA 805, Section 4.2.4)
- The SSCs required in order to meet the NSPC
- Fire detection and suppression systems required to meet the NSPC
- An evaluation of the effects of fire suppression activities on the ability to achieve the NSPC
- The disposition of each VFDR using either modifications (completed or captured as part of a license condition obligation) or the performance of an FRE in accordance with NFPA 805, Section 4.2.4.2.

3.5.1.1 Fire Detection and Suppression Systems Required to meet the NSPC

A primary purpose of NFPA 805, Chapter 4 is to determine, by analysis, what fire protection features and systems need to be credited to meet the NSPC. Four sections of NFPA 805 Chapter 3 have requirements dependent upon the results of the engineering analyses performed in accordance with NFPA 805, Chapter 4: (1) fire detection systems, in accordance with Section 3.8.2; (2) automatic water-based fire suppression systems, in accordance with Section 3.9.1; (3) gaseous fire suppression systems, in accordance with Section 3.10.1; and (4) passive fire protection features, in accordance with Section 3.11. The features/systems addressed in these sections are only required when the analyses performed in accordance with NFPA 805, Chapter 4 indicate the features and systems are required to meet the NSPC.

The licensee performed a detailed analysis of fire protection features and identified the fire suppression and detection systems required to meet the NSPC for each fire area. LAR Table 4-3, "Summary of NFPA 805 Compliance Basis and Required Fire Protection Systems and Features," and Attachment C, "NEI 04-02 Table B-3 – Fire Area Transition," lists the fire areas and fire zones at CNS, and identifies if the fire suppression and detection systems installed in these areas are required to meet criteria for separation, DID, risk, licensing actions, or EEEEs.

The NRC staff reviewed LAR Attachment C for each fire area to ensure fire detection and suppression met the principles of DID in regard to the planned transition to NFPA 805 at CNS.

Based on the statements provided in LAR Attachment C, as supplemented, the NRC staff concludes that the CNS treatment of this issue is acceptable because the licensee has adequately identified the fire detection and suppression systems required to meet the NFPA 805 NSPC on a fire area basis.

3.5.1.2 Evaluation of Fire Suppression Effects on NSPC

Each fire area of LAR Attachment C includes a discussion of how the licensee met the requirement to evaluate the fire suppression effects on the ability to meet the NSPC.

The licensee stated that the plant fire brigade is trained to minimize damage to plant areas and equipment not immediately involved in the fire by limiting overspray and drainage features and equipment pedestals mitigate the potential for flooding damage due to fire suppression, such that the standing water would not affect safety-related equipment. Therefore, fire suppression activities will not adversely affect achievement of the NSPC.

Based on the information provided by the licensee in the LAR, as supplemented, the licensee has evaluated fire suppression effects on meeting the NSPC and determined that fire suppression activities will not adversely affect achievement of the NSPC. The NRC staff has reviewed this information and concludes that the licensee's evaluation of the suppression effects on the NSPC is acceptable.

3.5.1.3 Licensing Actions

Based on the information provided in the LAR Section 4.2.3 and Attachment K, "Existing Licensing Action Transition," the licensee did not identify any exemptions from deterministic requirements that were previously approved by the NRC to be transitioned with the NFPA 805 FPP. As previously stated in Section 2.5 of this SE the licensee requested in accordance with the requirements of 10 CFR 50.48(c)(3)(i), that all exemptions be rescinded.

3.5.1.4 Existing Engineering Equivalency Evaluations (EEEEs)

The EEEEs that support compliance with NFPA 805 Chapter 4 were reviewed by the licensee 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 LAR Section 4.2.2 "Existing Engineering Equivalency Evaluation Transition," the licensee stated that the guidance in RG 1.205, Regulatory Position 2.3.2 (Reference 2), and FAQ 08-0054 (Reference 46) was followed. EEEEs that demonstrate that a fire protection system or feature is "adequate for the hazard" are to be addressed in the LAR as follows:

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

- If requesting specific NRC approval for "adequate for the hazard" EEEEs, then the EEEE is referenced where required to demonstrate compliance and is included in LAR Attachment L for NRC review and approval.

The licensee identified and summarized the EEEEs for each fire area in LAR Attachment C, as applicable. The licensee did not request the NRC staff to review and approve any of these EEEEs.

Based on the NRC staff's review of the licensee's methodology for review of EEEEs and identification of the applicable EEEEs in LAR Attachment C, the NRC staff concludes that the use of EEEEs meets the requirements of NFPA 805, the guidance of RG 1.205, and FAQ 08-0054, and is acceptable.

3.5.1.5 Variances from Deterministic Requirements

For those fire areas where deterministic criteria were not met, VFDRs were identified and evaluated using PB methods. VFDR identification, characterization, and resolutions were identified and summarized in LAR Attachment C for each fire area. Documented variances were all represented as separation issues. The following strategies were used by the licensee in resolving the VFDRs:

- An FRE determined that applicable risk, DID, and safety margin criteria were satisfied without further action.

- An FRE determined that applicable risk, DID, and safety margin criteria were satisfied with a credited RA.

- An FRE determined that applicable risk, DID, and safety margin criteria were satisfied with a DID action

- An FRE determined that applicable risk, DID, and safety margin criteria were satisfied with a plant modification(s), as identified in LAR Attachment C, as well as Attachment S, Table S-1 "Completed Modifications," and Table S-2 "Committed Modifications."

For fire areas where the licensee utilized the PB approach to meet the NSPC, each VFDR and the associated disposition has been described in LAR Attachment C. The details of the NRC staff review for DID and safety margin is described in SE Section 3.4.1, "Maintaining Defense-in-Depth and Safety Margins." Based on the review of the VFDRs and associated resolutions as described in LAR Attachment C, as supplemented, the NRC staff concludes that the licensee's identification and resolution of the VFDRs is acceptable.

3.5.1.6 Recovery Actions

LAR Attachment G lists the RAs identified in the resolution of VFDRs in LAR Attachment C for each fire area. The RAs identified include both actions considered necessary to meet risk acceptance criteria, as well as actions relied upon as defense-in-depth (see SE Section 3.5.1.7 below).

The NRC staff reviewed LAR Section 4.2.1.3, "Establishing Recovery Actions," and Attachment G, "Recovery Actions Transition," to evaluate whether the licensee meets the associated requirements for the use of RAs per NFPA 805. The details of the NRC staff review for RAs are described in Section 3.2.5, "Establishing Recovery Actions" of this SE. The NRC staff's evaluation of the additional risk of RAs credited to meet the risk acceptance guidelines is provided in Section 3.4.4, "Additional Risk Presented by Recovery Actions," of this SE.

3.5.1.7 Recovery Actions Credited for Defense-in-Depth

The licensee indicates in the LAR that RAs required for DID are not credited in the fire safety analysis as a part of the risk determination for any fire area. The licensee stated in the LAR that DID RAs provide plant operations with written guidance where such actions will enhance Echelon (or Element) 3 of DID to provide some assurance that one success path of safe shutdown capability can be restored in the event that Element 1 and Element 2 of DID are somehow degraded or rendered ineffective.

The licensee indicates that the nuclear safety and radioactive release performance goals, objectives, and criteria of NFPA 805, including the risk acceptance guidelines, are met without these actions. However, RAs required for DID are retained to meet the requirements to maintain a sufficient level of DID and are therefore considered part of the RI/PB FPP, which necessitates that these actions would be subject to a PCE if subsequently modified or removed.

The NRC staff reviewed LAR Section 4.2.1.3, "Establishing Recovery Actions," and Attachment G, "Recovery Actions Transition," to evaluate whether the licensee meets the associated requirements for the use of RAs per NFPA 805. The NRC staff's evaluation of the licensee's process for identifying RAs and assessing their feasibility is provided in SE Section 3.2.5, "Establishing Recovery Actions." In SE Section 3.2.5, the NRC staff concluded that the feasibility criteria applied to RAs are acceptable based on conformance with the endorsed guidance contained in NEI 04-02 and successful completion of modification S-2.8 and implementation items S-3.3, S-3.6, and S-3.7.

3.5.1.8 Plant Fire Barriers and Separations

With the exception of ERFBS, passive fire protection features include the fire barriers used to form fire area boundaries (and barriers separating safe shutdown trains) that were established in accordance with CNS's pre-NFPA 805 deterministic FPP. For the transition to NFPA 805, the licensee retains previously established fire area boundaries as part of the RI/PB FPP.

Fire area boundaries are established for those areas described in LAR Attachment C, as modified by applicable EEEEs that determine the barriers are adequate for the hazard or otherwise disposition differences in barrier design and performance from applicable criteria. The acceptability of fire barriers and separations is also evaluated as part of the NRC staff's review of LAR Attachment A Table B-1 process and as such are addressed in SE Section 3.1 "NFPA 805 Fundamental fire protection program and Design Elements."

LAR Table 4-3 and Attachment C identify flame impingement and radiant energy shields as fire protection features that are installed, or will be installed, in Fire Areas CB-D and RB-M and are required for risk based on credit for the shields in FM that was performed in support of the FPRA. LAR Attachment S, Table S-2, modifications S-2.5, S-2.6, and S-2.7 address the installation of these fire protection features. In FPE RAI 03 and PRA RAI 05 dated November 14, 2012 (Reference 16), the NRC staff requested the licensee provide additional information regarding the design, installation, credit taken, and justification for use of the shields, including any addition fire protection systems in these fire areas. In its response dated January 14, 2013 (Reference 9), the licensee stated that the installed, and to be installed, shields are credited in the FM performed for the FPRA to prevent damage or delay damage to FPRA credited conduit and cable trays. The licensee further stated that installations of the flame impingement and radiant energy shields are not rated because the installations are not completely enclosed; however, the construction (e.g., materials, seams, and thickness) is the same as specified for a 1-hour rated barrier and is adequate for the fire duration of the transient and fixed source fires assumed in these fire areas. Automatic fire detection and suppression is provided in fire area CB-D. There is no automatic fire detection and suppression in fire area RB-M in the locations where the radiant energy shields are to be installed. Further discussion of the NRC staff's review of the fire risk in fire areas CB-D and RB-M and FM used in support of the FREs is addressed in SE section 3.4. In SE Section 3.4, the NRC staff concluded that all risk-significant fire scenarios involving non-cable intervening combustibles have been addressed in the FPRA and are considered acceptable.

3.5.1.9 Electrical Raceway Fire Barrier Systems

In LAR Attachment A, "NEI 04-02 Table B-1 - Transition of Fundamental Fire Protection Program and Design Elements (NFPA 805 Chapter 3)," the licensee stated that there are no electrical raceway fire barrier systems (ERFBS) installed at CNS.

3.5.1.10 Issue Resolution

In SSD RAI 08 dated November 14, 2012 (Reference 16), the NRC staff noted that descriptions for VFDRs CBD-05, CBA1-01, and CBB-01 indicated effective cooling for components was provided by open compartments and requested that the licensee describe whether these compartments required actions to open doors or other features, and if so, if these actions should be included in LAR Attachment G as RAs and demonstrated to be feasible. In its response dated January 14, 2013 (Reference 9), the licensee stated that HVAC was modeled in the NSCA to protect credited equipment from overheating or to ensure habitability. Upon loss of credited HVAC due to fire-induced circuit damage, VFDRs were created and subsequently evaluated through the FRE process. Through this process, it was determined that none of the noted VFDRs resulted in the need to carry forward previously credited actions to open doors or other features as NFPA 805 RAs. Based on the licensee's response that HVAC has been evaluated and the disposition of the VFDRs does not require actions to open doors or other features to meet equipment cooling requirements for the NSCA, the NRC staff concludes that the licensee's response is acceptable.

3.5.1.11 Conclusion for Section 3.5.1

Based on its review of information in LAR Attachment C for those fire areas that utilized a deterministic approach in accordance with NFPA 805, Section 4.2.3, the NRC staff concludes that each of the fire areas analyzed using the deterministic approach meet the associated criteria of NFPA 805, Section 4.2.3. This conclusion is based on (1) the licensee's documented compliance with NFPA 805, Section 4.2.3; (2) the licensee's assertion that a success path will be free of fire damage without reliance on RAs; (3) an assessment that the suppression systems in the fire area will have no impact on the ability to meet the NSPC; and (4) the licensee's appropriate determination of the automatic fire suppression and detection systems required to meet the NSPC.

For those fire areas that used the PB approach in accordance with NFPA 805, Section 4.2.4, the NRC staff concludes that, based on the licensee's LAR, as supplemented, each fire area has been properly analyzed, and compliance with the NFPA 805 requirements demonstrated as follows:

- There were no exemptions from the pre-NFPA 805 fire protection licensing basis that were transitioned to the NFPA 805 licensing basis.
- VFDRs were evaluated and either found to be acceptable based on an integrated assessment of risk, DID, and safety margin, or modifications or RAs were identified and actions planned or implemented to address the issue.
- RAs used to demonstrate the availability of a success path to achieve the nuclear safety performance criteria were evaluated and the additional risk of their use determined, reported, and found to be acceptable. The licensee's analysis appropriately identified the fire protection SSCs required to meet the nuclear safety performance criteria, including fire suppression and detection systems.
- The licensee's analysis appropriately identified fire area boundaries (ceilings, walls, and floors), such as fire barriers, fire barrier penetrations, and through penetration fire stops.

Each fire area utilizing the PB approach was able to achieve and maintain the NSPC, and the associated FREs meet the applicable NFPA 805 requirements for risk, DID, and safety margin.

3.5.2 Clarification of Prior NRC Approvals

As stated in LAR Attachment T, there are no elements of the current FPP licensing basis for which NRC clarification is needed.

3.5.3 Fire Protection during Non-Power Operational Modes (NPO) Modes

NFPA 805, Section 1.1, "Scope," states the following:

> This standard specifies the minimum fire protection requirements for existing light water nuclear power plants during all phases of plant operation, including shutdown, degraded conditions, and decommissioning.

NFPA 805, Section 1.3.1, "Nuclear Safety Goal," states the following:

> The nuclear safety goal is to provide 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.

The NRC staff reviewed LAR Section 4.3, "Non-Power Operational Modes" and Attachment D, "NEI 04-02 Table F-1 Non-Power Operational Modes Transition," to evaluate the licensee's treatment of potential fire impacts during non-power operational modes (NPOs). The licensee followed the guidance used in the process described in NEI 04-02 (Reference 5) as modified by FAQ 07-0040 (Reference 40), for demonstrating that the NSPC are met for higher risk evolutions (HREs) during NPO modes.

3.5.3.1 NPO Strategy and Plant Operational States (POSs)

In LAR Section 4.3 and Attachment D, the licensee stated that the process used to demonstrate that the NSPC are met during NPO modes is consistent with the guidance contained in NEI 04-02 and FAQ 07-0040. As described in the LAR Attachment D, the licensee's procedure for outage safety directs that risk management actions should be developed and implemented to include the fire risk of outage activities. The procedure defines HREs as outage activities, plant configurations, or conditions during shutdown where the plant is more susceptible to an event causing the loss of a key safety function (KSF) and uses time to boil and decay heat removal availability in defining actions associated with HREs.

As described in the LAR, the licensee identified equipment and cables necessary to support the KSF success paths. The operational modes and functional requirements for the systems and components were reviewed. The KSF success path equipment and cables were incorporated in the SSA software used by CNS. Following identification of KSF equipment and cables, the licensee performed analysis on a fire area basis to identify areas where redundant equipment and cables credited for a given KSF might fail due to fire damage (i.e., pinch-points). The licensee used a deterministic approach to identify these pinch-points and mitigated these pinch-points through the use of RAs and/or fire prevention/protection controls. As stated in Section 4.3.2 of the LAR, FM was not used to eliminate any pinch-points.

LAR Attachment D describes the CNS outage safety procedure as requiring the effect of outage work scope on the KSFs to be qualitatively assessed and when entering an HRE, a "Shutdown Safety Contingency Plan" is required. Risk management actions are recommended for performance of maintenance activities with potential to cause fire; removal or impairment of fire protection systems and features; or removal of KSF equipment from service. These risk management actions include compensatory measures for temporary barrier removal; increased fire watches; and rescheduling activities that involve increase fire likelihood in areas where the in-service KSF equipment would be relied upon in the event of a fire.

3.5.3.2 NPO Analysis Process

The licensee stated in LAR Section 4.3.1 that its goal is to ensure that contingency plans are established when the plant is in an NPO mode where the risk is intrinsically high. As described in LAR Attachment D, in addition to normal FPP defense-in-depth actions, additional measures will be taken during HREs by managing risk in fire areas containing pinch points and managing risk in fire areas where pinch points may arise because of equipment taken out of service. LAR Section 4.3 and Attachment D discuss these additional controls and measures. However, during low risk periods normal risk management controls, as well as fire prevention and protection processes and procedures will be used.

As described in the LAR Attachment D, the licensee's procedure defines KSFs as decay heat removal, fuel pool cooling, inventory control, containment, power supplies, and reactivity control. Based on the guidance of FAQ 07-0040, the licensee evaluated the KSFs against NPO plant operating states to identify the necessary components and associated cables to be included in the analysis. The evaluation resulted in the exclusion of fuel pool cooling, containment, and reactivity control. Fuel pool cooling was excluded because actions to restore cooling are not time critical and a number of options are available to replenish water to the pool prior to uncovering the fuel. The containment KSF was excluded on the basis that administrative and procedural controls are credited with re-establishing containment when containment may be relaxed. When containment must be intact, the equipment used is covered by the CNS TSs, plant design, and procedural or administrative controls. The exclusion of reactivity control KSF equipment is based on the control rods providing sufficient reactivity control.

As stated in LAR Attachment D, the components relied on for the remaining KSFs, including those at-power components whose functions are different for NPO and those components that support KSF components (e.g., power supplies), were identified. For those components not already in the licensee's safe shutdown model, cable selection and routing were performed in accordance with the NSCA methodology. The NSCA methodology identified all required cables associated with a component and this information was added to the safe shutdown model. The safe shutdown model was run and the resulting analysis by fire area identified "pinch points," that is, fire areas where a KSF success path was not available.

3.5.3.3 NPO Key Safety Functions and SSCs Used to Achieve Performance

LAR Attachment D defines the KSFs, and describes the process to identify the success paths to achieve the KSFs and the components required for the success paths. As described in Section 3.5.3.2 above, the KSFs evaluated for NPO include decay heat removal, inventory control, and associated supporting systems and components. KSF equipment, including power supplies and other supporting components such as interlocks associated with the KSF success paths were added to the CNS SSA software model to identify pinch points.

Pinch points refer to a particular location in an area where the damage from a single fire scenario could result in failure of multiple components or trains of a system such that the maximum detriment on that systems' performance would be realized from the single fire scenario. Typically, this involves close vertical proximity of cables which support redundant components or trains of a system such that all such cables can be damaged by just one fire scenario.

As described in LAR Section 4.3.2 and Attachment D, the licensee stated that the NPO fire area reviews conservatively assumed that the entire contents of a fire area would be lost. Fire modeling was not used to eliminate any area from being a pinch point. These reviews identified that there are fire areas where a single fire could result in a loss of all credited paths for a given KSF and also identified that there are certain fire areas that are vulnerable to a loss of a KSF if certain system trains or components are taken out of service during a NPO and a fire were to occur (i.e., fire area where only a single path is recovered).

Based on its review of the information provided in the LAR, the NRC staff review concludes that the licensee used methods consistent with the guidance provided in FAQ 07-0040 and RG 1.205 to identify the equipment required to achieve and maintain the fuel in a safe and stable condition during NPO modes and that the methods are acceptable. Furthermore, based on the NRC staff's review, the NRC staff concludes that the licensee has an acceptable process in place to ensure that fire protection DID measures will be implemented to achieve the KSFs during plant outages.

3.5.3.4 NPO Pinch Point Resolutions and Program Implementation

As described in the sections above, the licensee identified power-operated components needed to support an NPO KSF that were not included in the post-fire safe shutdown equipment list or whose functional requirements are different for NPO, and thus required additional circuit analysis. For those components not already in SSA software model, cable selection and routing were performed in accordance with the NSCA methodology. The safe shutdown model was run and the resulting analysis by fire area identified "pinch points," that is, fire areas where a KSF success path was not available.

In SSD RAI 03 (Part a) dated November 14, 2012 (Reference 16), the NRC staff requested that the licensee provide a description of any actions being credited to minimize the impact of fire-induced spurious actuations on power-operated valves (e.g., air-operated valves and MOVs) during NPO either as pre-fire configuring or as required during the fire response recovery (e.g., pre-fire rack out and isolation of air supplies). In its response dated January 14, 2013

(Reference 9), the licensee stated fire areas with identified pinch points were evaluated and plant strategies consistent with FAQ 07-0040 were considered for minimizing fire risk. It is intended that operations and outage planning personnel will use the results provided in the NPO analysis as guidance to determine the protective measures consistent with FAQ 07-0040. These strategies include, but are not limited to, the following:

- Prohibiting or limiting hot work in fire areas during periods of increased vulnerability.
- Verifying operable detection and /or suppression in the vulnerable areas.
- Prohibiting or limiting of combustible materials in fire areas during periods of increased vulnerability.
- Modifying system status (e.g., removing power from equipment once it is placed in its desired position).
- Providing additional fire patrols at periodic intervals or other appropriate compensatory measures (such as surveillance cameras) during increased vulnerability.
- Using RAs, where feasible, to mitigate potential losses of KSFs.

The licensee further describes that, as a result of the NPO analysis, pre-emptive actions were recommended for two components to preclude short-cycling of the fuel during the shutdown cooling mode of operation. In addition, the licensee identified power-operated valves associated with recommended strategies to operate the valves either to align a system or minimize the potential impact of fire-induced spurious operations during fire response recovery. The licensee stated that these recommendations will be evaluated for implementation into applicable operating or outage procedures as part of implementation item S-3.4 in LAR Attachment S, Table S-3.

In SSD RAI 03 (Part b) dated November 14, 2012 (Reference 16), the NRC staff requested that the licensee identify the locations where KSFs are achieved solely by RAs or for which instrumentation not already included in the at-power analysis is needed to support RAs required to maintain safe and stable conditions. In addition, the NRC staff requested that the licensee identify those RAs and instrumentation relied upon in NPO and describe how RA feasibility is evaluated, including a description of whether these variables have been or will be factored into operator procedures supporting these actions. In its response (Reference 9), the licensee stated that the goal of the NPO analysis was to demonstrate that for any given deterministic (complete burn-out) fire in any given fire area, at least one success path for each required KSF remains free of fire damage or is capable of performing required functions despite fire damage (i.e., no "Pinch-Points"). Identified pinch points were evaluated and resolved as necessary to create KSF success. Equipment failures were resolved, as needed, by considering resolutions having the least impact first (e.g., circuit analysis shows that the failed cable cannot cause spurious operation) to those with the most impact (e.g., an RA is required to position the equipment). Where compatible, existing deterministic and NSCA at-power resolutions, including RAs, were applied in the NPO analysis to resolve equipment failures. RAs were used whenever possible to show that the KSF could be recovered. Once identified, the specific nature of each RA was further evaluated to determine its feasibility. For example, where a repair or local operation of a component specifically to restore shutdown cooling (i.e., local operation of RHR loop suction valves) was initially identified, the RA was reconsidered and replaced with an alternate protective strategy (i.e., Administrative Controls) since the ability to perform the action within the available time period before the reactor coolant could commence boiling could not be guaranteed. Similarly, RAs which required entry into the affected fire area were also replaced with alternate protective strategies, since extinguishing the fire, restoring area habitability, and entering the area to perform an RA was also determined to not be feasible within the scope of time available before reactor coolant could commence boiling. From this evaluation process, a final set of RAs was proposed for consideration and documented. RAs are only one option that could be credited as part of a fire contingency plan. If RA use is not desirable or feasible for a specific outage scenario, alternative protective strategies (LAR Section 4.3.2) would be considered, as appropriate. The licensee further stated that, as part of implementation item S-3.4, CNS procedures will be reviewed and revised to incorporate guidance from the NPO review.

NFPA 805 requires that the NSPC be met during any operational mode or condition, including NPO. As described above, the licensee has performed the following engineering analyses to demonstrate that it meets this requirement:

- Identified the KSFs required to support the NSPC during NPOs.
- Identified the plant operating states where further analysis is necessary during NPOs.
- Identified the SSCs required to meet the KSFs during the plant operating states analyzed.
- Identified the location of these SSCs and their associated cables.
- Performed analyses on a fire area basis to identify pinch points where one or more KSF could be lost as a direct result of fire-induced damage.
- Planned/implemented modifications to appropriate station procedures in order to employ one or more fire protection strategy for reducing risk at these pinch points during HREs.

The analyses performed by the licensee have identified vulnerabilities associated with loss of KSFs during the plant operating states and associated HREs. In LAR Table S-3, the licensee has identified an action to incorporate the NPO analysis in plant procedures and documentation (implementation item S-3.4). LAR Attachment D identifies the strategies that will be included in procedures to preclude or mitigate loss of KSFs.

Based on the information provided in the LAR as supplemented, the NRC staff concludes that the NSPC are acceptable for NPO modes and HREs at CNS.

3.5.4 Conclusion for Section 3.5

The NRC staff reviewed the licensee's RI/PB FPP, as described in the LAR and its supplements, to evaluate the NSCA results. The licensee used a combination of the deterministic approach and the PB approach in accordance with NFPA 805, Sections 4.2.3 and 4.2.4.

For those fire areas that utilized a deterministic approach, the NRC staff verified the following:

- Fire suppression effects were evaluated and found to have no adverse impact on the ability to achieve and maintain the NSPC for each fire area.
- The required automatic fire suppression and automatic fire detection systems were appropriately documented for each fire area.

The NRC staff concludes that each fire area utilizing the deterministic approach does so in accordance with NFPA 805, Section 4.2.3.

For those fire areas that utilized a PB approach, the NRC staff verified the following:

- Fire suppression effects were evaluated and found to have no adverse impact on the ability to achieve and maintain the NSPC for each fire area.
- VFDRs were evaluated using the FRE PB approach (in accordance with NFPA 805, Section 4.2.4.2) to address risk impact, DID, and safety margin, and were found to be acceptable.
- RAs necessary to demonstrate the availability of a success path were evaluated with respect to the additional risk presented by their use and found to be acceptable in accordance with NFPA 805, Section 4.2.4.
- The required automatic fire suppression and automatic fire detection systems were appropriately documented for each fire area.

Accordingly, the NRC staff concludes that each fire area utilizing the PB approach, in accordance with NFPA 805, Section 4.2.4, is able to achieve and maintain the NSPC. Furthermore, there is reasonable assurance that the associated FREs meet the requirements for risk, DID, and safety margin.

The NRC staff's review of the licensee's analysis and outage management process during NPO modes concluded that the NSPC will be met during NPO modes and HREs, and that the licensee used methods consistent with the guidance provided in FAQ 07-0040 and RG 1.205. The NRC staff's review also concluded no RAs are required during NPO modes. If RAs are selected as an NPO risk management strategy, feasibility is evaluated. The NRC staff concludes that this overall approach for fire protection during NPO modes is acceptable because the requirements for risk, DID, and safety margin are met.

3.6 Radioactive Release Performance Criteria

3.6.1 Method of Review

NFPA 805, Chapter 1 defines the radioactive release goals, objectives, and performance criteria that must be met by the fire protection program in the event of a fire at a nuclear power plant in any plant operational mode.

NFPA 805, Section 1.3.2, "Radioactive Release Goal," states that:

> The radioactive release goal is to provide reasonable assurance that a fire will not result in a radiological release that adversely affects the public, plant personnel, or the environment.

NFPA 805, Section 1.4.2, "Radioactive Release Objective," states that:

> Either of the following objectives shall be met during all operational modes and plant configurations.
>
> (1) Containment integrity is capable of being maintained [such that fire-fighting products are monitored and released within the plant's normal effluents program].
>
> (2) The source term is capable of being limited [such that any unmonitored releases would not exceed the performance criteria].

NFPA 805, Section 1.5.2, "Radioactive Release Performance Criteria," states that:

> Radiation release to any unrestricted area due to the direct effects of fire suppression activities (but not involving fuel damage) shall be as low as reasonably achievable and shall not exceed applicable 10 CFR Part 20 limits.

The NRC staff has endorsed (with certain exceptions) the methodology given in NEI 04-02 as providing methods acceptable to the staff for establishing an FPP consistent with NFPA 805 and 10 CFR 50.48(c) in RG 1.205. Using these methods, the licensee has assessed the capability of the current FPP to meet the NFPA 805 performance criteria as contained in NEI 04-02 and FAQ 09-0056 (Reference 47). The results of the licensee's assessment are documented in the LAR.

The NRC reviewed the assessment provided in the LAR in order to determine if the existing FPP with its planned modifications would meet the radioactive release performance criteria requirements of an RI/PB FPP, in accordance with 10 CFR 50.48(a) and (c) using the guidance in RG 1.205 and NUREG-0800, Section 9.5.1.2. The NRC staff also performed an audit of the licensee's evaluation to determine whether the CNS FPP and its planned modifications would be capable of meeting the NFPA radioactive release goals, objectives, and performance criteria. The results of the NRC staff evaluation and audit are provided below.

3.6.2 Scope of Review

The licensee's evaluation of the capability of the CNS FPP to meet the goals, objectives, and performance criteria of NFPA 805 was performed for all plant operating modes (including power and non-power operations) and for all plant areas. The licensee's review as documented in the LAR found that the fire suppression activities, as defined in the pre-fire plans and fire brigade firefighting instruction operating guidelines, were written and valid for any plant operating mode. The NRC staff's review concludes that the scope of the licensee's assessment was adequate because the review included all modes of plant operation and all plant areas.

3.6.3 Identification of Plant Areas Containing Radioactive Materials and Providing Containment during Fire Fighting Operations

The licensee performed a screening of plant fire areas to determine where there was a potential for generating radioactive effluents during firefighting operations. The results of the screening review are documented in the LAR Attachment E, Table E-1, "Radioactive Release Compartment Review." The fire areas where there was no possibility of radioactive materials being present were identified and eliminated from further review. Each fire area that had the potential for generation of radioactive effluents created by firefighting activities was identified (screened in) for further evaluation.

The screened in areas included those areas where most of the radioactive materials was present such as in the reactor building, drywell, control building, and the turbine building. The review found that these areas had adequate engineered controls for containment of liquid and gaseous effluent. The licensee's review identified the existing engineering controls that were present and sufficient to contain gaseous and liquid effluent. These engineering controls credited for containment of gaseous and liquid effluent are identified and documented in the LAR Attachment E. The NRC staff's review determined that the identified engineering controls were adequate because they provided sufficient capacity to contain the gaseous and liquid firefighting effluents.

The licensee's review also identified other plant areas where radioactive materials were present where there were minimal or no engineered controls for containment of effluents. These areas include the Multi-Purpose Facility, East Warehouse, Low Level Radioactive Waste pad, the Radwaste Materials Storage Building, the Off-gas Building, and the outside Yard area where Sealand containers with radioactive materials are stored. For these areas, the potential for radioactive release and radiation exposure to members of the public was evaluated in a quantitative assessment (see Section 3.6.5, "Gaseous Effluent Controls" and Section 3.6.6, Liquid Effluent Controls").

The NRC staff's review concludes that the licensee's screening of plants areas and identification of the potentially affected areas is acceptable because the review incorporated all plant areas, and identified potentially affected areas with and without engineering controls, in accordance with the guidance in NEI 04-02 as endorsed by RG 1.205.

3.6.4 Fire Pre-plans

The licensee reviewed the existing fire pre-plans to determine whether the CNS FPP is adequate to ensure that gaseous and liquid radioactive effluents generated as a direct result of fire suppression activities would be contained and monitored before release to unrestricted areas. The results of the licensee's review are documented in the LAR Table E-1. This review included the following steps:

- Identification of applicable documentation, including fire pre-plan, procedures, and support drawings.
- Review of current documentation to identify whether the current documents discuss the containment and monitoring of potential contamination involving fire suppression activities.
- Review of engineering controls for gaseous effluents to determine in which areas the gaseous effluents are contained (for example contaminated smoke and related particulates).
- Review of engineering controls for liquid effluents to determine in which areas the liquid effluents are contained (for example automatic or manual fire-fighting water).
- An identification of those documents needing revision such as to provide for monitoring and containment of fire suppression agents and radioactive release.

The NRC staff's review concludes that the licensee's evaluation of the Fire Pre-plans is acceptable because the review was comprehensive and was performed in accordance with the guidance in NEI 04-02, Appendix G, as endorsed by RG 1.205.

3.6.5 Gaseous Effluent Controls

In areas where engineering controls exist for containment, filtering, and monitoring of gaseous effluent, the engineering controls were determined to provide adequate containment because the effluent was either contained, or filtered to remove radioactive materials and subsequently monitored prior to discharge.

For plant areas where the effectiveness of the installed engineering controls was not adequate to contain the gaseous effluent, the licensee will modify the FPP to establish compensatory actions such that the Fire Brigade and Radiation Protection personnel will manually establish containment and perform monitoring of radioactive effluent. Where possible, the firefighting activities will route the radioactive gaseous effluent back into the plant ventilation system for filtering and monitoring of the effluent prior to discharge. For these plant areas, the NRC staff concludes that NFPA 805 radioactive release goals, objectives, and performance criteria will be met because the radioactive release will be manually contained to within acceptable limits by a combination of the installed engineered controls and compensatory actions taken by the Fire Brigade and Radiation Protection personnel.

In other plant areas where adequate engineered controls were not sufficient for containment of radioactive effluents, the licensee evaluated potential releases using a bounding quantitative analysis of the potential impacts of radioactive gaseous effluents during a fire. The bounding case was the yard area where the largest single radioactive source was in a Sealand storage container fully loaded with radioactive waste. The licensee performed a dose assessment based on the type of radionuclides that are stored, and the maximum amount of radioactive material that was allowed to be stored, and then assumed to be released during a fire.

During the NRC's audit of the licensee's LAR, the NRC reviewed the licensee's calculational methods used to perform the bounding analysis. The assessment models used were based on models and assumptions provided in the following documents: Offsite Dose Assessment Manual, NUREG-0016, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors, NRC's computer code RADTRAD (RADionuclide Transport and Removal And Dose," and the Environmental Protection Agency (EPA) Manual 400-R-92-001, "External Exposure to Radionuclides in Air, Water and Soil (1992). The results of the analysis concluded that the maximum offsite dose at the Exclusion Area Boundary was less than the 10 CFR 20 dose limits for members of the public.

The NRC staff reviewed the licensee's assessment and determined the assessment to be acceptable because models and assumptions used are consistent with NRC-approved analytical methods (i.e., the offsite dose calculation manual is a document required by the plant's TSs and is prepared in accordance with NRC regulatory guidance, and the other analytical models are acceptable models used by Federal agencies such as the Environmental Protection Agency and NRC.

The NRC staff's review concludes that the licensee has adequately quantified and limited the maximum amount of radioactive material that can be safely stored during a fire event. The staff also concludes that the public dose from radioactive material released as a gaseous effluent during a fire would not exceed the radiological release performance criteria of NFPA 805 and the public dose limits of 10 CFR 20.

3.6.6 Liquid Effluent Controls

The licensee identified those areas where sufficient engineering controls exist for containment of liquid effluent (e.g., floor drains routed to sumps and tanks). The NRC staff reviewed those engineering controls and determined that those controls provided adequate containment because the effluent is collected, stored, processed and monitored in the Radwaste building prior to discharge.

The licensee's review also identified those areas where there were not sufficient engineered controls to adequately contain potential liquid effluents released during firefighting activities, such as in the outside yard area. In these areas, the licensee identified the potential for discharge of radioactive liquid effluent into storm drains, French drains, or to seep into the ground unless mitigating actions were taken. To mitigate this release, the licensee will revise the FPP procedures and training programs to have the fire brigade and Radiation Protection staff trained and instructed to monitor, and if necessary, to install pre-staged temporary containment materials (e.g., soak pads, sandbags, and construction material).

For liquid effluent that may be discharged into storm drains, French drains, or into the soil, the licensee performed a bounding assessment to determine the potential radiological impact. The assessment concluded that the potential radiological impact of uncontained liquid effluent would not exceed the radiological release performance criteria of NFPA 805 and the public dose limits of 10 CFR 20.

The NRC staff reviewed the calculation methods and concludes that the licensee adequately assessed the potential dose impact of uncontained liquid effluent because the bounding assessment was based on conservative assumptions and analytical methods. Based on the NRC staff's review of this bounding assessment, the NRC concludes that a potential radiological liquid effluent release would not exceed the radiological release performance criteria of NFPA 805 and the public dose limits of 10 CFR 20.

3.6.7 Fire Brigade Training Materials

The licensee reviewed the fire brigade training materials to ensure they were consistent with the pre-fire plans in terms of containment and monitoring of potentially contaminated smoke and fire suppression water. The review is documented in LAR Attachment E, Table E-1.

Each training module and lesson plan was evaluated, and those training materials needing improvements were identified and documented. The training materials that will be revised to address radioactive release requirements of NFPA 805 are listed in the LAR Attachment E and listed as an action to be completed in Attachment S, implementation item S-3.20.

The training material revisions will describe the actions the Fire Brigade will take to ensure that the engineering controls are intact and capable of supporting containment of gaseous and liquid effluents, including the use of manual mitigation methods when necessary.

The NRC staff reviewed the licensee's evaluation of training materials and concludes that upon completion of implementation item S-3.20 as referenced in the proposed license condition, the training materials will be adequate to instruct the CNS staff to implement the FPP because plant staff will be informed and capable of taking actions to limit the public dose to within the radiological release performance criteria of NFPA 805.

3.6.8 Actions to Be Taken

In LAR Attachment S, Table S-1 provides a list of completed plant modifications in support of the LAR. Table S-2 provides a list of planned plant modifications (yet to be completed). Table S-3 provides a list of planned procedure changes, process updates, and training (yet to be completed). The completion schedule for modifications and implementation items is described in Sections 2.7 and 2.8 of this SE.

3.6.9 Conclusion for Section 3.6

Based on (1) information and analyses provided in the LAR; (2) use of installed and manual engineered controls to contain potential releases; (3) use of fire pre-plans; (4) use of revised fire brigade response procedures and training procedures; and (5) dose assessments when containment of radioactive release is not fully effective, the NRC staff concludes that the licensee's RI/PB FPP provides reasonable assurance that radiation releases to any unrestricted area resulting from the direct effects of fire suppression activities are as low as reasonably achievable and are not likely to exceed the radiological release performance criteria of NFPA 805 and the radiological dose limits in 10 CFR Part 20. The NRC staff therefore concludes that the licensee's FPP complies with the requirements specified in NFPA 805, Sections 1.3.2, 1.4.2, and 1.5.2 and that this approach is acceptable.

3.7 NFPA 805 Monitoring Program

For this section of the SE, the following requirements from NFPA 805, Section 2.6, are applicable to the NRC staff's review of the licensee's LAR:

NFPA 805, Section 2.6, "Monitoring":

> 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":

> Acceptable levels of availability, reliability, and performance shall be established.

NFPA 805, Section 2.6.2, "Monitoring Availability, Reliability, and Performance":

> Methods to monitor availability, reliability, and performance shall be established. The methods shall consider the plant operating experience and industry operating experience.

NFPA 805, Section 2.6.3, "Corrective Action":

> If the established levels of availability, reliability, or performance are not met, appropriate corrective actions to return to the established levels shall be implemented. Monitoring shall be continued to ensure that the corrective actions are effective.

The NRC staff reviewed LAR Section 4.6, "Monitoring Program," that the licensee developed to monitor availability, reliability, and performance of CNS FPP systems and features after transition to NFPA 805. The focus of the NRC staff review was on critical elements related to the monitoring program, including the selection of FPP systems and features to be included in the program, the attributes of those systems and features that will be monitored, and the methods for monitoring those attributes. Implementation of the monitoring program will occur on the same schedule as the NFPA 805 RI/PB FPP implementation.

The licensee stated that CNS will develop an NFPA 805 monitoring program consistent with FAQ 10-0059 (Reference 48). Development of the monitoring program will include a review of existing surveillance, inspection, testing, compensatory measures, and oversight processes for adequacy. The review will examine adequacy of the scope of SSCs within the existing plant programs, performance criteria for availability and reliability of SSCs, and the adequacy of the plant corrective action program. The monitoring program will incorporate phases for scoping, screening using risk criteria, risk target value determination, and monitoring implementation. The scope of the program will include fire protection systems and features, NSCA equipment, SSCs relied upon to meet radioactive release criteria, FPRA equipment, and fire protection programmatic elements.

As described above, NFPA 805, Section 2.6, requires that a monitoring program be established in order to ensure that the availability and reliability of fire protection systems and features are maintained, as well as to assess the overall effectiveness of the FPP in meeting the performance criteria. Monitoring should ensure that the assumptions in the associated engineering analysis remain valid.

Based on the information provided in the LAR, as supplemented, the NRC staff concludes that the licensee's NFPA 805 monitoring program development and implementation process is acceptable because it is consistent with FAQ 10-0059, provides assurance that NPPD will implement an effective program for monitoring risk significant fire SSCs, and ensures that the NFPA 805 monitoring program does the following:

- Establishes the appropriate performance monitoring groups to be monitored;
- Uses an acceptable screening process for determining the SSCs to be included in the performance monitoring groups;
- Establishes availability, reliability and performance criteria for the SSCs being monitored; and
- Requires corrective actions when SSC availability, reliability, and performance criteria targets are exceeded in order to bring performance back within the required range.

However, since the final values for availability and reliability, as well as the performance criteria for the SSCs being monitored, have not been established for the monitoring program as of the date of this SE, completion of the CNS NFPA 805 Monitoring Program is an implementation item, as noted previously (LAR Attachment S, Table S-3 implementation items, items S-3.1 and S-3.23).

Completion of the monitoring program will occur on the same schedule as the implementation of NFPA 805, which the NRC staff concludes is acceptable.

3.7.1 Conclusion for Section 3.7

The NRC staff reviewed the licensee's RI/PB FPP and RAI responses for Section 3.7 of this SE and the NRC staff concludes that the licensee's monitoring program meets the requirements specified in Section 2.6.1, 2.6.2, and 2.6.3 of NFPA 805 and is acceptable.

3.8 Program Documentation, Configuration Control, and Quality Assurance

For this section of the SE, the requirements from NFPA 805 (Reference 1), Section 2.7, "Program Documentation, Configuration Control and Quality," are applicable to the NRC staff's review of the LAR (Reference 6) in regard to the appropriate content, configuration control, and quality of the documentation used to support the CNS FPP transition to NFPA 805.

3.8.1 Documentation

The NRC staff reviewed LAR Section 4.7.1, "Compliance with Documentation Requirements in Section 2.7.1 of NFPA 805," to evaluate the CNS FPP design basis document and supporting documentation.

The CNS FPP design basis is a compilation of multiple documents (i.e., fire safety analyses, calculations, engineering evaluations, NSCA, etc.), databases, and drawings which are identified in LAR Figure 4-10, "NFPA 805 Planned Post-Transition Documentation and Relationships." The licensee stated that the analyses conducted to support the NFPA 805 transition were performed in accordance with CNS processes which meet or exceed the requirements for documentation outlined in NFPA 805, Section 2.7.1.

Specifically, the design analysis and calculation procedures provide the methods and requirements to ensure that design inputs and assumptions are clearly defined, results are easily understood by being clearly and consistently described, and that sufficient detail is provided to allow future review of the entire analysis. The process includes provisions for appropriate design and engineering review and approval. In addition, the approved analyses are considered controlled documents, and are accessible via CNS's document control system. Being analyses, they are also subject to review and revision consistent with the other plant calculations and analyses, as required by the plant design change process.

The LAR also stated that the documentation associated with the FPP will be maintained for the life of the plant and organized in such a way to facilitate review for accuracy and adequacy by independent reviewers, including the NRC staff.

Based on the LAR description, as supplemented, of the content of the FPP design basis and supporting documentation, and taking into account the licensee's plans to maintain this documentation throughout the life of the plant, the NRC staff concludes that the licensee's approach for meeting the requirements of NFPA 805, Sections 2.7.1.1, 2.7.1.2, and 2.7.1.3, regarding adequate development and maintenance of the FPP design basis documentation, is acceptable.

3.8.2 Configuration Control

The NRC staff reviewed LAR Section 4.7.2, "Compliance with Configuration Control Requirements in Section 2.7.2 and 2.2.9 of NFPA 805," in order to evaluate the CNS configuration control process for the new NFPA 805 FPP.

To support the many other technical, engineering and licensing programs at CNS, the licensee has existing configuration control processes and procedures for establishing, revising, or utilizing program documentation. Accordingly, the licensee is integrating the new FPP design basis and supporting documentation into these existing configuration control processes and procedures. These processes and procedures require that all plant changes be reviewed for potential impact on the various CNS licensing programs, including the FPP.

The LAR stated that the configuration control process includes provisions for appropriate design, engineering reviews and approvals, and that approved analyses are considered controlled documents available through the CNS document control system. The LAR also stated that analyses based on the PRA program, which includes the FREs, are issued as formal analyses subject to these same configuration control processes, and are additionally subjected to the PRA peer review process specified in the ASME/ANS PRA standard (Reference 21).

Configuration control of the existing FPP during the transition period is maintained by the CNS change evaluation process, as defined in existing CNS configuration management and configuration control procedures. CNS will revise these procedures as necessary for application to the NFPA 805 FPP.

The NRC staff reviewed the licensee's process for updating and maintaining the CNS FPRA in order to reflect plant changes made after completion of the transition to NFPA 805 and the results of that review is included Section 3.4 of this SE.

Based on the description of the CNS configuration control process, which indicates that the new FPP design basis and supporting documentation will be controlled documents and that plant changes will be reviewed for impact on the FPP, the NRC staff concludes that the requirements of NFPA 805 Sections 2.7.2.1 and 2.7.2.2 will be met and that the licensee's configuration control process is acceptable.

3.8.3 Quality

The NRC staff reviewed LAR Section 4.7.3, "Compliance with Quality Requirements in Section 2.7.3 of NFPA 805," to evaluate the quality of the engineering analyses used to support transition of the CNS FPP to NFPA 805 based on the requirements outlined above. The individual sections of this SE provide the NRC staff's evaluation of the application of the NFPA 805 quality requirements to the licensee's FPP, as appropriate.

3.8.3.1 Review

NFPA 805 requires that each analysis, calculation, or evaluation performed be independently reviewed. The licensee stated that its procedures require independent review of analyses, calculations, and evaluations, including those performed in support of compliance with 10 CFR 50.48(c). The LAR also stated that the transition to NFPA 805 was independently reviewed, and that analyses, calculations, and evaluations to be performed post-transition will be independently reviewed, as required by the existing CNS procedures.

Based on the licensee's description of the process for performing independent reviews of analyses, calculations, and evaluations, the NRC staff concludes that the licensee's approach for meeting the Quality requirements of NFPA 805, Section 2.7.3.1, is acceptable

3.8.3.2 Verification and Validation

NFPA 805 requires that each calculational model or numerical method used be verified and validated through comparison to test results or other acceptable models. The licensee stated that the calculational models and numerical methods used in support of the transition to NFPA 805 were verified and validated, and that the calculational models and numerical methods used post-transition will be similarly verified and validated. As an example, the licensee provided extensive information related to the V&V of fire models used to support the development of the CNS FREs. The NRC staff's evaluation of this information is discussed below.

3.8.3.2.1 General

NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," Volumes 1-7 (Reference 33), documents the V&V of five selected fire models commonly used to support applications of RI/PB fire protection at nuclear power plants. The seven volumes of this NUREG-series report provide technical documentation concerning the predictive capabilities of a specific set of fire dynamics calculation tools and fire phenomenological models that may be used for the analysis of fire hazards in postulated nuclear power plant scenarios. When used within the limitations of the fire models and considering the identified uncertainties, these models may be employed to demonstrate compliance with the requirements of 10 CFR 50.48(c).

Accordingly, for those FM elements performed by the licensee using the V&V applications contained in NUREG-1824 to support the transition to NFPA 805 at CNS, the NRC staff concludes that the use of these models is acceptable, provided that the intended application is within the appropriate limitations of the model, as identified in NUREG-1824.

In LAR Section 4.5.2, the licensee also identified the use of several empirical correlations that are not addressed in NUREG-1824. The NRC staff reviewed these correlations, as well as the related material provided in the LAR, in order to determine whether the licensee adequately demonstrated alignment with specific portions of the applicable NUREG-1824 guidance.

The NRC staff concludes that the theoretical bases of the models and empirical correlations used in the FM calculations that were not addressed in NUREG-1824 were identified and described in authoritative publications (References 34, 77, 78, and 79).

Table 3.8-1, "V&V Basis for Fire Modeling Correlations Used at CNS," in Attachment A and Table 3.8-2, "V&V Basis for Other Fire Models and Related Calculations Used at CNS," in Attachment B to this SE identify these empirical correlations and algebraic models, respectively, as well as a staff disposition for each.

As reflected in Tables 3.8-1 and 3.8-2, of Attachments A and B to this SE, the FM employed by the licensee in the development of the CNS FPRA used either: (1) empirical correlations that provide bounding solutions for the ZOI, or (2) conservative input parameters in the application of the other models, which produced conservative results for the FM analysis.

Based on the above, the NRC staff concludes that the FM used in the development of the fire scenarios for the CNS FPRA is acceptable for use in this application (i.e., transition to NFPA 805).

3.8.3.2.2 Discussion of Selected RAI Responses

By letter dated November 14, 2012 (Reference 16), the NRC staff requested additional information concerning the FM conducted to support the FPRA. By letters dated January 14, 2013 (Reference 9), February 12, 2013 (Reference 10), and March 13, 2013 (Reference 11), the licensee responded to these RAIs. In addition, by letter dated June 13, 2013 (Reference 12), the licensee provided supplemental information to clarify its responses to an RAI. The following paragraphs describe selected RAI responses related to the V&V of the fire models used.

- During the on-site audit, the NRC staff noted that the algebraic models that were used to characterize flame radiation, flame height, plume temperature, ceiling jet temperature, and HGL temperature were implemented in a database and workbook referred to as the Fire Modeling Workbook (FMWB). The NRC staff issued FM RAI 02(a) (Reference 16), to ask the licensee to describe how the algebraic fire model calculations in the FMWB were verified.

  In its response (Reference 9), the licensee described the process that was used to verify the FMWB. The process involved comparing the results from the FMWB for a number of cases to those produced by the NUREG-1805 FDT^s and FIVE with identical inputs.

  Based on the additional information provided, the NRC staff concludes that the approach used by the licensee to verify the FMWB is acceptable.

- The NRC staff issued FM RAI 02(b) (Reference 16), to ask the licensee to demonstrate that the algebraic models were applied within the validated range of input parameters, or to justify the application of the models outside the validated range.

  In its response (Reference 12), the licensee summarized the results of an extensive review of the use of algebraic fire models in each fire compartment and fire zone. The purpose of the review was to determine whether the following dimensionless parameters were within the validated range specified in NUREG-1824:

- o Fire Froude Number
- o Flame Length Relative to Ceiling Height
- o Ceiling Jet Radial Distance Relative to Ceiling Height (Detector and Sprinkler Activation)
- o Compartment Aspect Ratio
- o Radial Distance Relative to Fire Diameter
- o Sprinkler Activation Temperature vs. Surrounding Gas Temperature

The licensee demonstrated that algebraic models were generally applied within the validated range, and provided detailed documentation to justify the application in the cases where a model was used outside the validated range.

Based on the additional information provided, the NRC staff concludes that the licensee has demonstrated that algebraic models were generally applied within the validated input parameter range, and that in those cases where an algebraic model was applied outside the validated range, its use is acceptable.

- The NRC staff issued RAI 02(c) (Reference 16), to ask the licensee to demonstrate that that the application of CFAST in the MCA and the sensitive equipment HGL study was within the validated range of input parameters, or to justify the application of the model outside the validation range.

  In its response (Reference 10), the licensee provided tables, which show that the compartment aspect ratio is generally within the NUREG-1824 validated range for the generic compartment geometries that were considered in the MCA and the original sensitive equipment HGL study. For those cases where CFAST was used outside the validated range, a detailed technical justification was provided. The licensee updated the analysis for the revised sensitive equipment HGL study. The results of this update are described in the response to RAI 01(b) (see Section 3.4.2.3.2 of the SE).

  Based on the additional information provided, the NRC staff concludes that the licensee has demonstrated that CFAST was generally applied within the validated input parameter range, and that in those cases where the model was applied outside the validated range, its use is acceptable.

- The NRC staff issued FM RAI 02(d) (Reference 16), to ask the licensee to demonstrate that FDS was applied in the MCR abandonment study and plume/HGL study within the validated range of input parameters, or to justify the application of the model outside the validation range.

In its response (Reference 10), the licensee provided tables, which show that FDS was generally applied within the NUREG-1824 validated input parameter range. For those cases where FDS was used outside the validated range, a detailed technical justification was provided.

Based on the additional information provided, the NRC staff concludes that the licensee has demonstrated that FDS was generally applied within the validated input parameter range, and that in those cases where the model was applied outside the validated range, its use is acceptable.

- The NRC staff issued FM RAI 02(e) (Reference 16), to ask the licensee to provide the V&V basis for the method that models a smoke detector as a heat detector and uses a temperature increase of 10 °C as the criterion for detector actuation (this addresses PRA F&O 3-1 under FSS-D1).

  In its response (Reference 10), the licensee referred to NUREG-1805, Chapter 11 and Chapter 4-1, of the SFPE Handbook (Reference 74) as the V&V basis for the smoke detector model.

  Based on the additional information provided, the NRC staff concludes that the V&V basis for the method to calculate smoke detector response is acceptable.

3.8.3.2.3 Post-Transition

The licensee also stated that it will revise the appropriate processes and procedures to include NFPA 805 quality requirements for use during the performance of post-transition FPP changes, including those for V&V. Revision of the applicable post-transition processes and procedures to include NFPA 805 requirements for V&V is identified in LAR Table S-3 as implementation item S-3.8.

3.8.3.2.4 Conclusion for Section 3.8.3.2

Based on the licensee's description of the CNS process for V&V of calculational models and numerical methods and their obligation for continued use post-transition, the NRC staff concludes that the licensee's approach to meeting the requirements of NFPA 805 Section 2.7.3.2 is acceptable.

3.8.3.3 Limitations of Use

NFPA 805 requires that only acceptable engineering methods and numerical models be used for transition to the extent that these methods have been subject to V&V; and that they are applied within the scope, limitations, and assumptions prescribed for that method. The LAR stated that the engineering methods and numerical models used in support of the transition to NFPA 805 were subject to the limitations of use outlined in NFPA 805, Section 2.7.3.3, and that the engineering methods and numerical models used post-transition will be subject to these same limitations of use.

3.8.3.3.1 General

The NRC staff assessed the acceptability of empirical correlation and fire models in terms of the limits of its use. SE Table 3.8-1 in Attachment A and Table 3.8-2 in Attachment B, summarize the fire models used, how each was applied in the CNS FREs, the V&V basis for each, and the NRC staff evaluation for each.

3.8.3.3.2 Discussion of RAIs

By letter dated November 14, 2012 (Reference 16), the NRC staff requested additional information concerning the FPRA. By letters dated January 14, 2013 (Reference 9), February 12, 2013 (Reference 10), and March 13, 2013 (Reference 11), the licensee responded to these RAIs. In addition, by letter dated June 13, 2013 (Reference 12), the licensee provided supplemental information to clarify its responses to an FM RAI. The following paragraphs describe selected RAI responses related to the limitations of the fire models used.

- In light of F&O 3-12 under FSS-D1, the NRC staff issued FM RAI 03 (Reference 16), to ask the licensee to identify uses of the FM tools outside the limits of applicability of the method and to explain for those cases how the use of the fire model was justified.

  In its response (Reference 9), the licensee identified the scenarios where the following models were used outside the limits of their applicability:

  - o Heskestad's Flame Height Correlation
  - o Heskestad Plume Temperature Correlation
  - o McCaffrey-Quintiere-Harkleroad (MQH) HGL Calculation
  - o Foote-Pagni-Alvares (FPA) HGL Calculation
  - o CFAST in fire zones 8B, 8C, 8D, 8E, 8F, 8G, and 8H

  For each of these scenarios, the licensee discussed the impact of the model limitations on the ZOI and HGL calculations, and provided detailed technical justification for the use of the model outside the limits of applicability.

Based on the additional information provided, the NRC staff concludes that the licensee has demonstrated that fire models were generally used within the limits of applicability, and that in those cases where a model was applied outside the limits of applicability, their use is acceptable.

3.8.3.3.3 Post-Transition

The licensee also stated that it will revise the appropriate processes and procedures to include the NFPA 805 quality requirements for use during the performance of post-transition FPP changes, including those for limitations of use. Revision of the applicable post-transition processes and procedures to include NFPA 805 requirements for limitations of use is identified in LAR Table S-3 as implementation items S-3.8 and S-3.27.

3.8.3.3.4 Conclusion for Section 3.8.3.3

Based on the licensee's statements that the fire models used to support development of the FREs were used within their limitations, and the description of the CNS process for placing limitations on the use of engineering methods and numerical models, the NRC staff concludes that the licensee's approach to meeting the requirements of NFPA 805 Section 2.7.3.3 is acceptable.

3.8.3.4 Qualification of Users

NFPA 805 requires that personnel performing engineering analyses and applying numerical methods (e.g., FM) shall be competent in that field and experienced in the application of these methods as they relate to nuclear power plants, nuclear power plant fire protection, and power plant operations. Section 4.7.3 of the LAR, "Compliance with Quality Requirements in Section 2.7.3 of NFPA 805 Fire Protection Quality," states, in part, that:

> For personnel performing fire modeling or FPRA development and evaluation, NPPD 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.

3.8.3.4.1 General

The licensee has developed procedures that require that cognizant personnel who use and apply engineering analyses and numerical models be competent in the field of application and experienced in the application of the methods, including those personnel performing analyses in support of compliance with 10 CFR 50.48(c). These requirements are being addressed through the implementation of an engineering qualification process. CNS has developed qualification or training requirements for personnel performing engineering analyses and numerical methods.

3.8.3.4.2 Discussion of RAI Responses

By letter dated November 14, 2012 (Reference 16), the NRC staff requested additional information concerning the FM conducted to support the FPRA. By letters dated January 14, 2013 (Reference 9), February 12, 2013 (Reference 10), and March 13, 2013 (Reference 11), the licensee responded to these RAIs. In addition, by letter dated June 13, 2013 (Reference 12), the licensee provided supplemental information to clarify its responses to an FM

RAI. The following paragraphs describe selected RAI responses related to the qualifications of the fire model users involved in the FPRA.

- The NRC staff issued FM RAI 04(a) (Reference 16), to ask the licensee to describe the process and procedures for qualifying engineers and personnel performing the fire analyses and modeling activities.

  In its response (Reference 9), the licensee explained that the personnel responsible for preparing and reviewing the FM analyses and related activities had Masters Degrees in Fire Protection Engineering. Furthermore, the licensee explained that the personnel was qualified to the FM contractor's established procedures for detailed FM, field walk-downs, and data entry into the contractor's System Assurance and Fire Protection Engineering software (SAFE).

  Based on the additional information provided, the NRC staff concludes that the process and procedures for qualifying engineers and personnel performing the FM analyses and related activities are acceptable.

- The NRC staff issued FM RAI 04(b) (Reference 16), to ask the licensee to explain how the necessary communication and exchange of information between FM analysts and FPRA personnel was accomplished, and to describe how direction and guidance provided by one group to the other was confirmed to be implemented correctly.

  In its response (Reference 9), the licensee described the results of the FM and related calculations that were obtained, and explained how these results were transmitted to the PRA personnel for use in risk quantification. Furthermore, the licensee explained that the FM and PRA personnel operated as a single team throughout the NFPA 805 project, ensuring close communication and coordination between the FM analysts and the FPRA analysts.

  Based on the additional information provided, the NRC staff concludes that the licensee has demonstrated that the information, direction and guidance provided by one group (FM analysts and FPRA personnel) to the other was used and implemented promptly and correctly.

Based on its review and above explanation, the NRC staff concludes that appropriately competent and experienced personnel developed the CNS FPRA, including the supporting FM calculations and including the additional documentation for models and empirical correlations not identified in previous NRC approved V&V documents.

3.8.3.4.3 Post-Transition

The post-transition qualification training program will be implemented to include NFPA 805 requirements for Qualification of Users as identified LAR Table S-3 implementation item 15.

3.8.3.4.4 Conclusion for Section 3.8.3.4

Based on the licensee's description of the procedures for ensuring personnel who use and apply engineering analyses and numerical methods are competent and experienced, the NRC staff concludes that the licensee's approach for meeting the requirements of NFPA 805, Section 2.7.3.4, is acceptable.

3.8.3.5 Uncertainty Analysis

NFPA 805 requires that an uncertainty analysis be performed to provide reasonable assurance that the performance criteria have been met. (Note: 10 CFR 50.48(c)(2)(iv) states that an uncertainty analysis performed in accordance with NFPA 805, Section 2.7.3.5, is not required to support calculations used in conjunction with a deterministic approach.) The licensee stated that an uncertainty analysis was performed for the analyses used in support of the transition to NFPA 805, and that an uncertainty analysis will be performed for post-transition analyses.

3.8.3.5.1 General

The industry consensus standard for PRA development (i.e., the ASME/ANS PRA standard, (Reference 21) includes requirements to address uncertainty. Accordingly, the licensee addressed uncertainty as a part of the development of the CNS FPRA. The NRC staff's evaluation of the licensee's treatment of these uncertainties is discussed in SE Section 3.4.7.

According to NUREG-1855, Volume 1, "Guidance on the Treatment of Uncertainties Associated with PRAs in RI Decision Making" (Reference 35), there are three types of uncertainty associated with FM calculations:

(1) Parameter Uncertainty: Input parameters are often chosen from statistical distributions or estimated from generic reference data. In either case, the uncertainty of these input parameters affects the uncertainty of the results of the FM analysis.

(2) Model Uncertainty: Idealizations of physical phenomena lead to simplifying assumptions in the formulation of the model equations. In addition, the numerical solution of equations that have no analytical solution can lead to inexact results. Model uncertainty is estimated via the processes of V&V. An extensive discussion of quantifying model uncertainty can be found in NUREG-1934 (Reference 80).

(3) Completeness Uncertainty: This refers to the fact that a model is not a complete description of the phenomena it is designed to simulate. Some consider this a form of model uncertainty because most fire models neglect certain physical phenomena that are not considered important for a given application. Completeness uncertainty is addressed by the description of the algorithms found in the model documentation. It is addressed, indirectly, by the same process used to address the Model Uncertainty.

3.8.3.5.2 Discussion of Fire Modeling RAIs

By letter dated November 14, 2012 (Reference 16), the NRC staff requested additional information concerning the FM conducted to support the FPRA. By letters dated January 14, 2013 (Reference 9), February 12, 2013 (Reference 10), and March 13, 2013 (Reference 11), the licensee responded to these RAIs. In addition, by letter dated June 13, 2013 (Reference 12), the licensee provided supplemental information to clarify its responses to an FM RAI. The following paragraphs describe selected RAI responses related to the acceptability of the fire models used.

- The NRC staff issued FM RAI 05(a) (Reference 16), to ask the licensee to describe how the uncertainty associated with the fire model input parameters was accounted for in the analyses.

  In its response (Reference 9), the licensee explained that the uncertainty analysis performed with respect to FM was qualitative in nature and focused on the fact that substantial safety margin was obtained by using conservative model input parameters in the FM calculations. The licensee provided the following examples of conservative modeling assumptions that provide safety margin:

  - Fire scenarios involving electrical cabinets utilize the 98th percentile HRR to determine the severity factor.
  - The fire elevation in most cases is at the top of the cabinet or pump body.
  - The radiant fraction utilized is 0.4, while the convective fraction utilized is maintained at 0.7.
  - For transient fire impacts, a large bounding transient zone assumes all targets within its ZOI are affected by a fire and time to damage is calculated based on the closest target.
  - For HGL calculations, no equipment or structural steel is credited as a heat sink.
  - Cable trays are assumed to be filled to capacity.
  - As the fire propagates to secondary combustibles, the fire is modeled as one single fire.
  - Target damage is assumed to occur when the exposure environment meets or exceeds the damage threshold.
  - The fire elevation for transient fires is 2 feet.
  - Oil fires are analyzed as both unconfined and confined spills with 20-minute duration.

- o High energy arcing fault scenarios are assumed to be at peak fire intensity for 20 minutes from time zero.

- o Fire brigade intervention is not credited prior to 85 minutes.

Based on the additional information provided, the NRC staff concludes that the licensee has demonstrated that the uncertainty associated with the model input parameters was adequately accounted for in the FM analyses performed in support of the FPRA.

- The NRC staff issued FM RAI 05(b) (Reference 16), to ask the licensee to describe how the "model" and "completeness" uncertainties were accounted for in the analyses.

  In its response (Reference 9), the license summarized the sections in NUREG-1824 concerning the degree to which the following fire model calculations used at CNS fall within or outside of experimental uncertainty:

  - o HGL Temperature using FDT^s
  - o HGL Height and Temperature using FDS
  - o HGL Temperature and Height using CFAST
  - o Ceiling Jet Temperature using Alpert Correlation
  - o Plume Temperature using FDT^s
  - o Plume Temperature using FDS
  - o Flame Height using FDT^s
  - o Smoke Concentration using FDS
  - o Radiant Heat Flux using FDT^s
  - o Radiant Heat Flux using FDS

  The licensee concluded that the results of the fire model calculations are within or very near the experimental uncertainty.

  Based on the additional information provided and the conservatism in the input parameters, the NRC staff concludes that the licensee has demonstrated that the model and completeness uncertainty were adequately accounted for in the FM analyses performed in support of the FPRA.

3.8.3.5.3 Post-Transition

The licensee also stated that it will revise the appropriate processes and procedures to include the NFPA 805 quality requirements for use during the performance of post-transition fire protection program changes, including those regarding uncertainty analysis. Revision of the applicable post-transition processes and procedures to include NFPA 805 requirements regarding uncertainty analysis is identified in LAR Table S-3 as implementation item S-3.8.

3.8.3.5.4 Conclusion for Section 3.8.3.5

Based on the licensee's description of the CNS process for performing an uncertainty analysis, the NRC staff concludes that the licensee's approach for meeting the requirements of NFPA 805 Section 2.7.3.5 is acceptable.

3.8.3.6 Conclusion for Section 3.8.3

Based on the above discussions, the NRC staff concludes that the CNS RI/PB fire protection quality assurance (QA) process adequately addresses each of the requirements of NFPA 805, Section 2.7.3, which include conducting independent reviews, performing V&V, limiting the application of acceptable methods and models to within prescribed boundaries, ensuring that personnel applying acceptable methods and models are qualified, and performing uncertainty analyses.

3.8.4 Fire Protection Quality Assurance Program

GDC 1 of Appendix A to 10 CFR Part 50 requires the following:

> Structures, systems, and components important to safety shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed.

The licensee established its fire protection QA Program in accordance with the guidelines of NUREG-0800, Section 9.5.1 Position C.4, "Quality Assurance Program" (Reference 75). In addition, the guidance in Appendix C to NEI 04-02 (Reference 5) suggests that the LAR include a description of how the existing fire protection QA program will be transitioned to the new NFPA 805 RI/PB FPP, as discussed below.

The LAR stated that the fire protection QA program is included within and implemented by the CNS nuclear QA program, although certain aspects of that program are not applicable to the FPP. Further, the LAR stated that no changes to the fire protection QA program were needed to meet the applicable requirements of Section 2.7.3 of NFPA 805. The QA program will be updated in accordance with the requirements of Section 2.7.3 as identified in LAR Table S-3 as implementation item 8.

Based on its review and the above explanation, the NRC staff concludes that the licensee's changes to the fire protection QA program are acceptable because they expand the existing program to include new fire protection systems that are required by NFPA 805 for transition and post-transition.

3.8.5 Conclusion for Section 3.8

The NRC staff reviewed the licensee's RI/PB FPP and RAI responses for Section 3.8 of this SE. The NRC staff concludes that, based on completion of the required implementation items related to the QA program, the licensee's approach for meeting the requirements specified in Section 2.7 of NFPA 805 is acceptable.

4.0 FIRE PROTECTION LICENSE CONDITION

The licensee proposed an FPP license condition regarding transition to an RI/PB FPP under NFPA 805, in accordance with 10 CFR 50.48(c)(3)(i). The new license condition adopts the guidelines of the standard fire protection license condition promulgated in RG 1.205, Revision 1, Regulatory Position C.3.1, as issued on December 18, 2009 (74 FR 67253). Plant-specific changes were made to the sample license condition; however, the proposed plant-specific FPP license condition is consistent with the standard fire protection license condition, incorporates all of the relevant features of the transition to NFPA 805 at Cooper Nuclear Station and is, therefore, acceptable.

The following license condition is included in the revised license for the Cooper Nuclear Station, and will replace Operating License No. DPR-46 Condition 2.C.(4):

Fire Protection

NPPD 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 April 24, 2012 (and supplements dated July 12, 2012, January 14, 2013, February 12, 2013, March 13, 2013, June 13, 2013, December 12, 2013, January 17, 2014, February 18, 2014, and April 11, 2014), and as approved in the safety evaluation dated April 29, 2014. 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 listed below are satisfied.

(a) 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 CNS. 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.

1. 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 plant change evaluation.

2. Prior NRC review and approval is not required for individual changes that result in a risk increase less than $1x10^{-7}$/year (yr) for CDF and less than $1x10^{-8}$/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 plant change evaluation.

(b) 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 an 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 April 29, 2014, 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.

(c) <u>Transition License Conditions</u>

1. Before achieving full compliance with 10 CFR 50.48(c), as specified by (c)2. below, risk-informed changes to NPPD'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 (b)2. above.

2. The licensee shall implement the modifications to its facility, as described in Table S-2, "Plant Modifications Committed," of NPPD letter NLS2014015, dated February 18, 2014, to complete the transition to full compliance with 10 CFR 50.48(c) prior to startup from the first refueling outage greater than 12 months following the issuance of the License Amendment. The licensee shall maintain appropriate compensatory measures in place until completion of these modifications.

3. The licensee shall implement the items S-3.1 through S-3.29 as listed in Table S-3, "Implementation Items," of NPPD letter NLS2014015, dated February 18, 2014, within 12 months after issuance of the License Amendment.

4. The licensee shall implement item S-3.30 as listed in Table S-3, "Implementation Items," of NPPD letter NLS2014015, dated February 18, 2014, no later than May 31, 2017.

5.0 SUMMARY

The NRC staff reviewed the licensee's application, as supplemented by various letters, to transition to an RI/PB FPP in accordance with the requirements established by NFPA 805. The NRC staff concludes that the applicant's approach, methods, and data are acceptable to establish, implement and maintain an RI/PB FPP in accordance with 10 CFR 50.48(c).

Implementation of the RI/PB FPP in accordance with 10 CFR 50.48(c) will include the application of a new fire protection license condition. The new license condition includes a list of implementation items (in tables S-2 and S-3 of Reference 15) that must be completed in order to support the conclusions made in this SE, as well as an established date by which full compliance with 10 CFR 50.48(c) will be achieved. Before the licensee is able to fully implement the transition to an FPP based on NFPA 805 and apply the new fire protection license condition, to its full extent, the implementation items must be completed within the timeframe specified.

6.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Nebraska State official was notified on February 21, 2014, of the proposed issuance of the amendment. The state official had no comments.

7.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to the installation or use of facility components located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts and no significant change in the types of any effluents that may be released offsite and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding published in the *Federal Register* on November 26, 2013 (78 FR 70593). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

8.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner; (2) there is reasonable assurance that 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.

9.0 REFERENCES

1. National Fire Protection Association, NFPA 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," 2001 Edition, Quincy, Massachusetts.

2. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.205, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants," Revision 1, December 2009 (ADAMS Accession No. ML092730314).

3. U.S. Nuclear Regulatory Commission, SECY-98-058, "Development of a Risk-Informed, Performance-Based Regulation for Fire Protection at Nuclear Power Plants," March 1998 (ADAMS Accession No. ML992910106).

4. U.S. Nuclear Regulatory Commission, SECY-00-0009, "Rulemaking Plan, Reactor Fire Protection Risk-Informed, Performance-Based Rulemaking," January 2000 (ADAMS Accession No. ML003671923).

5. Nuclear Energy Institute, NEI 04-02, Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c), Revision 2, Washington, DC, April 2008 (ADAMS Accession No. ML081130188).

6. O'Grady, Brian J., Nebraska Public Power District, letter to U.S. Nuclear Regulatory Commission, "Cooper Nuclear Station, Docket No. 50-298, License No. DPR-46, License Amendment Request to Revise the Fire Protection Licensing Basis to NFPA 805 Per 10 CFR 50.48(c)," dated April 24, 2012 (ADAMS Accession No. ML121220216).

7. Willis, Demetrius L., Nebraska Public Power District, letter to U.S. Nuclear Regulatory Commission, "Response to Acceptance Review of Cooper Nuclear Station License Amendment Request to Adopt NFPA 805, Cooper Nuclear Station, Docket No. 50-298, DPR-46," dated July 12, 2012 (ADAMS Accession No. ML12202A042).

8. Limpias, Oscar A., Nebraska Public Power District, letter to U.S. Nuclear Regulatory Commission, "Revisions to NFPA 805 License Amendment Request and Response to a Request for Additional Information, Cooper Nuclear Station, Docket No. 50-298, DPR-46," dated April 11, 2014 (ADAMS Accession No. ML14108A069).

9. Higginbotham, Kenneth, Nebraska Public Power District, letter to U.S. Nuclear Regulatory Commission," Response to Request For Additional Information Regarding License Amendment Request To Adopt National Fire Protection Association Standard 805, Cooper Nuclear Station, Docket No. 50-298, DPR-46," dated January 14, 2013 (ADAMS Accession No. ML13018A006).

10. Higginbotham, Kenneth, Nebraska Public Power District, letter to U.S. Nuclear Regulatory Commission, "90-Day Response to Request for Additional Information Regarding License Amendment Request to Adopt National Fire Protection Association Standard 805, Cooper Nuclear Station, Docket No. 50-298, DPR-46," dated February 12, 2013 (ADAMS Accession No. ML13051A539).

11. Limpias, Oscar A., Nebraska Public Power District, letter to U.S. Nuclear Regulatory Commission," 120-Day Response to Request For Additional Information Regarding License Amendment Request To Adopt National Fire Protection Association Standard 805, Cooper Nuclear Station, Docket No. 50-298, DPR-46," dated March 13, 2013 (ADAMS Accession No. ML13080A266).

12. Higginbotham, Kenneth, Nebraska Public Power District, letter to U.S. Nuclear Regulatory Commission, "Response to Supplemental Information Request Regarding License Amendment Request to Adopt National Fire Protection Association Standard 805, Cooper Nuclear Station, Docket No. 50-298, DPR-46," dated June 13, 2013 (ADAMS Accession No. ML13169A059).

13. Higginbotham, Kenneth, Nebraska Public Power District, letter to U.S. Nuclear Regulatory Commission, "Response to Request for Additional Information Regarding License Amendment Request to Adopt National Fire Protection Association Standard 805, Cooper Nuclear Station, Docket No. 50-298, DPR-46," dated December 12, 2013 (ADAMS Accession No. ML13353A073).

14. Limpias, Oscar A., Nebraska Public Power District, letter to U.S. Nuclear Regulatory Commission, "60-Day Response to Request for Additional Information Regarding License Amendment Request to Adopt National Fire Protection Association Standard 805, Cooper Nuclear Station, Docket No. 50-298, DPR-46," dated January 17, 2014 (ADAMS Accession No. ML14027A425).

15. Limpias, Oscar A., Nebraska Public Power District, letter to U.S. Nuclear Regulatory Commission, Cooper Nuclear Station, Docket No. 50-298, License No. DPR-46, Supplement to 60-Day Response to Request for Additional Information Regarding License Amendment Request to Adopt National Fire Protection Association Standard 805, dated February 18, 2014 (ADAMS Accession No. ML14056A240).

16. Wilkins, Lynnea, U.S. Nuclear Regulatory Commission, letter to Brian O'Grady, Nebraska Public Power District," Cooper Nuclear Station, Request For Additional Information, License Amendment Request To Adopt National Fire Protection Association Standard NFPA 805 (TAC No. ME8551)," dated November 14, 2012 (ADAMS Accession No. ML12312A281).

17. Wilkins, Lynnea, U.S. Nuclear Regulatory Commission, e-mail to David Van Der Kamp, Nebraska Public Power District, "Cooper Nuclear Station, Round 2 Requests For Additional Information, License Amendment Request To Adopt National Fire Protection Association Standard NFPA 805 (TAC No. ME8551)," dated November 14, 2013 (ADAMS Accession No. ML13319B220).

18. Nuclear Energy Institute, NEI 00-01, "Guidance for Post Fire Safe Shutdown Circuit Analysis, Revision 2, Nuclear Energy Institute (NEI), Washington, DC, May 2009 (ADAMS Accession No. ML091770265).

19. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," Revision 2, May 2011 (ADAMS Accession No. ML100910006).

20. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," Revision 2, March 2009 (ADAMS Accession No. ML090410014).

21. American Society of Mechanical Engineers (ASME) and American Nuclear Society (ANS) standard ASME/ANS RA-Sa-2009, "Addenda to ASME/ANS RA-S-2008, Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," dated February 2, 2009.

22. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.189, "Fire Protection for Nuclear Power Plants," Revision 2, October 2009 (ADAMS Accession No. ML092580550).

23. U.S. Nuclear Regulatory Commission, NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Section 9.5.1.2, "Risk-Informed, Performance-Based Fire Protection Program," Revision 0, December 2009 (ADAMS Accession No. ML092590527).

24. U.S. Nuclear Regulatory Commission, NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Section 19.1, "Determining the Technical Adequacy of Probabilistic Risk Assessment for Risk-Informed License Amendment Requests After Initial Fuel Load," Revision 3, September 2012 (ADAMS Accession No. ML12193A107):

25. U.S. Nuclear Regulatory Commission, NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Section 19.2, "Review of Risk Information Used to Support Permanent Plant-Specific Changes to the Licensing Basis: General Guidance," Revision 0, June 2007 (ADAMS Accession No. ML071700658).

26. U.S. Nuclear Regulatory Commission, NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities, Volume 1: Summary and Overview," September 2005 (ADAMS Accession No. ML052580075).

27. U.S. Nuclear Regulatory Commission, NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities, Volume 2: Detailed Methodology," September 2005 (ADAMS Accession No. ML052580118).

28. U.S. Nuclear Regulatory Commission, NUREG/CR-6850, Supplement 1, "Fire Probabilistic Risk Assessment Methods Enhancements," September 2010 (ADAMS Accession No. ML103090242).

29. Correia, R. P., memorandum to Joseph G. Giitter, U.S. Nuclear Regulatory Commission, "Interim Technical Guidance on Fire-Induced Circuit Failure Mode Likelihood Analysis," dated June 14, 2013 (ADAMS Accession No. ML13165A194).

30. U.S. Nuclear Regulatory Commission, NUREG/CR-6931, "Cable Response to Live Fire (CAROL-FIRE)," Volumes 1, 2, and 3, April 2008 (ADAMS Accession Nos. ML081190230, ML081190248, and ML081190261, respectively).

31. U.S. Nuclear Regulatory Commission, NUREG/CR-7100, "Direct Current Electrical Shorting in Response to Exposure Fire (DESIREE-Fire): Test Results," April 2012 (ADAMS Accession No. ML121600316).

32. U.S. Nuclear Regulatory Commission, NUREG-1805, "Fire Dynamics Tools (FDT^s): Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program," December 2004 (ADAMS Accession No. ML043290075).

33. U.S. Nuclear Regulatory Commission, NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," May 2007. Volume 1: Main Report, Volume 2: Experimental Uncertainty, Volume 3: Fire Dynamics Tools (FDT^s), Volume 4: Fire-Induced Vulnerability Evaluation (FIVE-Rev1), Volume 5: Consolidated Fire Growth and Smoke Transport Model (CFAST), Volume 6: MAGIC, and Volume 7: Fire Dynamics Simulator (ADAMS Accession Nos. ML071650546, ML071730305, ML071730493, ML071730499, ML071730527, ML071730504, ML071730543, respectively).

34. U.S. Nuclear Regulatory Commission, NUREG/CR-7010, Volume 1, "Cable Heat Release, Ignition, and Spread in Tray Installations during Fire (CHRISTIFIRE), Phase 1: Horizontal Trays," July 2012 (ADAMS Accession No. ML12213A056).

35. U.S. Nuclear Regulatory Commission, NUREG-1855, Volume 1, "Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decision Making," March 2009 (ADAMS Accession No. ML090970525).

36. U.S. Nuclear Regulatory Commission, NUREG-1921, "EPRI/NRC-RES Fire Human Reliability Analysis Guidelines," July 2012 (ADAMS Accession No. ML12216A104).

37. Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of National Fire Protection Association Frequently Asked Question 07-0030 on Establishing Recovery Actions," dated February 4, 2011 (ADAMS Accession No. ML110070485).

38. Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of National Fire Protection Association Frequently Asked Question 07-0038 on Lessons Learned on Multiple Spurious Operations," dated February 3, 2011 (ADAMS Accession No. ML110140242).

39. Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of National Fire Protection Association Standard 805 Frequently Asked Question 07-0039 Incorporation of Pilot Plant Lessons Learned- Table B-2," dated January 15, 2010 (ADAMS Accession No. ML091320068).

40. Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of National Fire Protection Association 805 Frequently Asked Question 07-0040 on Non-Power Operations Clarifications," dated August 11, 2008 (ADAMS Accession No. ML082200528).

41. Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of National Fire Protection Association Standard 805 Frequently Asked Question 08-0042: Fire Propagation from Electrical Cabinets," dated August 4, 2009, 2012 (ADAMS Accession No. ML092110537).

42. Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of National Fire Protection Association Standard 805 Frequently Asked Question 08-0046: Incipient Fire Detection Systems," dated December 1, 2009 (ADAMS Accession No. ML093220426).

43. Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Closure of National Fire Protection Association 805 Frequently Asked Question 08-0048 Revised Fire Ignition Frequencies," dated September 1, 2009 (ADAMS Accession No. ML092190457).

44. Not used.

45. Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of National Fire Protection Association Standard 805 Frequently Asked Question 08-0053: Kerite-FR Cable Failure Thresholds," dated June 6, 2012 (ADAMS Accession No. ML121440155).

46. Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of National Fire Protection Association Frequently Asked 08-0054 on Demonstrating Compliance with Chapter 4 of National Fire Protection Association 805," dated February 17, 2011 (ADAMS Accession No. ML110140183).

47. Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of National Fire Protection Association 805 Frequently Asked Question 09-0056 on Radioactive Release Transition," dated January 14, 2011 (ADAMS Accession No. ML102920405).

48. Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of National Fire Protection Association Standard 805 Frequently Asked Question 10-0059: National Fire Protection 805 Monitoring Program," dated March 19, 2012 (ADAMS Accession No. ML120750108).

49. Not used.

50. Donohew, Jack, U.S. Nuclear Regulatory Commission, letter to G. Horn, Nebraska Public Power District, "Conversion to Improved Technical Specifications for the Cooper Nuclear Station, Amendment No. 178 to Facility Operating License No. DPR 46 (TAC No. M98317)," dated July 31, 1998 (ADAMS Accession No. ML021410047).

51. Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of National Fire Protection Association Standard 805 Frequently Asked Question 12-0062: Updated Final Safety Analysis Report Content," dated September 5, 2012 (ADAMS Accession No. ML121980557).

52. Marion, Alexander, Nuclear Energy Institute, letter dated June 17, 2003, to John Hannon, U.S. Nuclear Regulatory Commission, transmitting Revision 0 of NEI 02-03, "Guidance for Performing a Regulatory Review of Proposed Changes to the Approved Fire Protection Program," June 2003 (ADAMS Accession No. ML031780500).

53. Klein, Alexander, and Harrison, Donnie, U.S. Nuclear Regulatory Commission, Memorandum to Michael Markley, U.S. Nuclear Regulatory Commission, "Cooper Nuclear Station, Regulatory Audit In Support of the License Amendment Request to Implement Risk Informed, Performance-Based, Fire Protection Program as Allowed by Title 10 of the Code of Federal Regulations Paragraph 50.48(C), (TAC No. ME8551)," dated September 5, 2012 (not publicly available).

54. Ippolito, Thomas, U.S. Nuclear Regulatory Commission, letter to J. Pilant, Nebraska Public Power District, "Issuance of Amendment No. 56 to Facility Operating License No. DPR-46 for the Cooper Nuclear Station," dated May 23, 1979, (ADAMS Accession No. ML021340455).

55. Ippolito, Thomas, U.S. Nuclear Regulatory Commission, letter to J. Pilant, Nebraska Public Power District, "Issuance of Amendment No. 66 to Facility Operating License No. DPR-46 for the Cooper Nuclear Station," dated November 21, 1980, (ADAMS Accession No. ML021350047).

56. U.S. Atomic Energy Commission, "Safety Evaluation of the Cooper Nuclear Station," dated February 14, 1973.

57. Goller, Karl, U.S. Nuclear Regulatory Commission, letter to J. Pilant, Nebraska Public Power District, "Cooper Nuclear Station," dated November 29, 1977 (ADAMS Accession No. ML14086A196).

58. Electric Power Research Institute (EPRI) Technical Report TR-1006756, "Fire Protection Equipment Surveillance Optimization and Maintenance Guide for Fire Protection Systems and Features," Final Report, Palo Alto, CA, Final Report July 2003.

59. National Fire Protection Association Standard 101, (NFPA 101), "Life Safety Code," Quincy, Massachusetts.

60. National Fire Protection Association Standard 20, (NFPA 20), "Standard for the Installation of Stationary Pumps for Fire Protection," 1999 Edition, Quincy, Massachusetts.

61. National Fire Protection Association Standard 14, (NFPA 14), "Standard for the Installation of Standpipe and Hose Systems," 1974 Edition, Quincy, Massachusetts.

62. National Fire Protection Association Standard 10, (NFPA 10), "Standard for Portable Fire Extinguishers," 1975 Edition, Quincy, Massachusetts.

63. U.S. Nuclear Regulatory Commission, Generic Letter 2006-03, "Potentially Nonconforming HEMYC and MT Fire Barrier Configurations," dated April 10, 2006 (ADAMS Accession No. ML053620142).

64. American Society of Testing Materials Standard E136 (ASTM E136), "Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 °C", West Conshohocken, Pennsylvania.

65. Institute of Electrical and Electronics Engineers, IEEE-383: "Standard for Qualifying Class 1E Electric Cables and Field Splices for Nuclear Power Generating Stations," 2003.

66. National Fire Protection Association Standard 262, (NFPA 262), "Standard Method of Test for Flame Travel and Some of Wires and Cables For Use in Air-Handling Spaces", Quincy, Massachusetts.

67. Nuclear Energy Institute, NEI 00-01, "Guidance for Post Fire Safe Shutdown Circuit Analysis," Revision 1, Nuclear Energy Institute (NEI), Washington, DC, January 2005 (ADAMS Accession No. ML050310295).

68. U.S. Nuclear Regulatory Commission, NUREG-0800 "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Section 9.5.1.1, "Fire Protection Program," Revision 0, February 2009 (ADAMS Accession No. ML090510170).

69. Nuclear Energy Institute, NEI 05-04, "Process for Performing Internal Events PRA Peer Reviews Using the ASME/ANS PRA Standard," Revision 2, Washington, DC, November 2008.

70. American Society of Mechanical Engineers (ASME) and American Nuclear Society (ANS) ASME/ANS RA-Sc-2007, "Addenda to ASME/ANS RA-S-2002, Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications," ASME, New York, NY, August 31, 2007.

71. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," Revision 1, January 2007 (ADAMS Accession No. ML070240001).

72. Nuclear Energy Institute, NEI 07-12, "Fire Probabilistic Risk Assessment (FPRA) Peer Review Process Guidelines," Revision 1, Washington, DC, June 2010.

73. U.S. Nuclear Regulatory Commission, "Record of Review, Cooper Nuclear Station, LAR Attachment U - Table U-1 Internal Events PRA Peer Review – Facts and Observations (F&Os)," and "Record of Review, Cooper Nuclear Station, LAR Attachment V – Tables V-1 and V-2 Fire PRA Peer Review – Facts and Observations (F&Os)," March 17, 2014 (ADAMS Accession Nos. ML14077A019 and ML14077A020, respectively).

74. Giitter, J., U.S. Nuclear Regulatory Commission, letter to B. Bradley, Nuclear Energy Institute, "Recent Fire PRA Methods Review Panel Decisions and EPRI 1022993, "Evaluation of Peak Heat Release Rates in Electrical Cabinet Fires,"" dated June 21, 2012 (ADAMS Accession No. ML12171A583).

75. U.S. Nuclear Regulatory Commission, NUREG/CR-7102, "Kerite Analysis in Thermal Environment of FIRE (KATE-Fire): Test Results - Final Report," December 2011 (ADAMS Accession No. ML11333A033).

76. Electric Power Research Institute Technical Report TR-100370, "Fire Induced Vulnerability Evaluation (FIVE)," Revision 1, Palo Alto, California, May 1992.

77. Cleary, T., M. Donnelly, G. Mulholland, and B. Farouk, "Fire Detector Performance Predictions in a Simulated Multi-Room Configuration," in Proceedings of the 12th International Conference on Automatic Fire Detection (AUBE '01), NIST SP 965, National institute of Standards and Technology, Gaithersburg, Maryland, February 2001.

78. Zalosh, R. G., "Industrial Fire Protection Engineering," John Wiley & Sons, Chichester, West Sussex, England, 2003.

79. U.S. Nuclear Regulatory Commission, NRC Reactor Oversight Process Inspection Manual, (IMC) Chapter 0609, Appendix F, "Fire Protection Significance Determination Program," Washington, DC, February 2005.

80. U.S. Nuclear Regulatory Commission, NUREG-1934, "Nuclear Power Plant Fire Modeling Analysis Guidelines (NPP FIRE MAG)," November 2012 (ADAMS Accession No. ML12314A165).

81. Custer R.L.P., Meacham B. J., and Schifiliti, R. P, "Design of Detection Systems," Chapter 4–1 of The SFPE Handbook of Fire Protection Engineering, 4th Edition, P. J. DiNenno, Editor-in-Chief, National Fire Protection Association, Quincy, MA, 2008.

82. U.S. Nuclear Regulatory Commission, NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Section 9.5.1, "Fire Protection Program," Revision 3, July 1981 (ADAMS Accession No. ML052350030).

83. Heskestad, G., "Fire Plumes, Flame Height, and Air Entrainment," Chapter 2–1, SFPE Handbook of Fire Protection Engineering, 4th Edition, National Fire Protection Association, Quincy, Massachusetts, 2008.

84. Beyler, C. L., "Fire Hazard Calculations for Large, Open Hydrocarbon Fires," Chapter 3–10, SFPE Handbook of Fire Protection Engineering, 4th Edition, P. J. DiNenno, Editor-in-Chief, National Fire Protection Association, Quincy, Massachusetts, 2008.

85. Walton W. and Thomas, P., "Estimating Temperatures in Compartment Fires," Chapter 3–6, SFPE Handbook of Fire Protection Engineering, 4th Edition, P. J. DiNenno, Editor-in-Chief, National Fire Protection Association, Quincy, Massachusetts, 2008.

86. Alpert, R. L., "Ceiling Jet Flows," Chapter 2–2, SFPE Handbook of Fire Protection Engineering, 4th Edition, P. J. DiNenno, Editor-in-Chief, National Fire Protection Association, Quincy, Massachusetts, 2008.

87. Budnick, E.K., D.D. Evans, and H.E. Nelson, "Simplified Fire Growth Calculations," Section 3, Chapter 9, NFPA Fire Protection Handbook, 19th Edition, A.E. Cote, Editor-in-Chief, National Fire Protection Association, Quincy, Massachusetts, 2003.

88. McDermott, R., McGrattan, K., Hostikka, S., Floyd, J. "Fire Dynamics Simulator (Version 5) Technical Reference Guide Volume 2: Verification FDS Version 5.4", NIST Special Publication 1018-5, National Institute of Standards and Technology, Gaithersburg (NIST), Maryland, September 2009.

89. McGrattan, K., McDermott, R, Prased, K., Hostikka, S., and Floyd, J., "Fire Dynamics Simulator (Version 5) Technical Reference Guide Volume 3: Validation FDS Version 5.4," NIST Special Publication 1018-5, National Institute of Standards and Technology, Gaithersburg, Maryland, September 2009.

90. Peacock, R.D., McGrattan, K., Klein, B., Jones, W.W., and Reneke, P.A., "CFAST–Consolidated Model of Fire Growth and Smoke Transport (Version 6) Software Development and Model Evaluation Guide", NIST Special Publication 1086, National Institute of Standards and Technology (NIST), Gaithersburg, Maryland, December 2008.

91. Babrauskas, V., "Heat Release Rates," Chapter 3–1, SFPE Handbook of Fire Protection Engineering, 4th Edition, P. J. DiNenno, Editor-in-Chief, National Fire Protection Association, Quincy, Massachusetts, 2008.

92. Lee, B.T., "Heat Release Rate Characteristics of Some Combustibles Fuel Sources in Nuclear Power Plants," NBSIR 85-3195, U.S. Department of Commerce, National Bureau of Standards (NBS), Washington, DC, July 1985.

93. Vassallo, D. B., U.S. Nuclear Regulatory Commission, letter to J. M. Pilant, Nebraska Public Power District, License Amendment 82, Amendment Revises TS Regarding Fire Protection System Clean Water Supply, & Scram Discharge Volume, dated April 29, 1983 (ADAMS Accession No. ML021350188).

94. Vassallo, D. B., U.S. Nuclear Regulatory Commission, letter to J. M. Pilant, Nebraska Public Power District, "Safety Evaluation for Appendix R to 10 CFR Part 50, Items II.G.3 and III.L, Alternate of Dedicated Shutdown Capability," dated April 16, 1984 (ADAMS Legacy Accession Nos. 8405150239 and 8405150246).

95. Siegel, B. L., U.S. Nuclear Regulatory Commission, letter to J. M. Pilant, Nebraska Public Power District, License Amendment 86, Amendment Revises TS to Incorporate Administrative Changes to Ensure Compliance with new Regulations Related to Licensee Event Reporting Requirements Contained in Section 50.73, dated June 1, 1984 (ADAMS Accession No. ML021350326).

96. Sylvester, E. D., U.S. Nuclear Regulatory Commission, letter to J. M. Pilant, Nebraska Public Power District, License Amendment 90, Amendment Revises TS to Incorporate Changes Proposed in Response to TMI [Three Mile Island] Action Plan Items Set Forth in NUREG-0737, dated January 3, 1985 (ADAMS Accession No. ML021350480).

97. Thompson, H. L., U.S. Nuclear Regulatory Commission, letter to J. M. Pilant, Nebraska Public Power District, "Outstanding Fire Protection Modifications," dated August 21, 1985 (ADAMS Legacy Accession Nos. 8508290424 and 8508290429).

98. Long, W. O., U.S. Nuclear Regulatory Commission, letter to J. M. Pilant, Nebraska Public Power District, License Amendment 98, Changes to Technical Specifications, dated April 10, 1986 (ADAMS Accession No. ML021350652).

99. Long, W. O., U.S. Nuclear Regulatory Commission, letter to J. M. Pilant, Nebraska Public Power District, License Amendment 101, Amendment Changes Administrative Controls Section of TS to Clarify Requirements Relating to Procedures, dated September 9, 1986 (ADAMS Accession No. ML021350557).

100. O'Connor, P. W., U.S. Nuclear Regulatory Commission, letter to G. A. Trevors, Nebraska Public Power District, License Amendment 126, Amendment Changes TS to add Limiting Conditions for Operation and Surveillance Requirements for Recently Installed Alternative Shutdown System, dated November 7, 1988 (ADAMS Accession No. ML021360586).

101. O'Connor, P. W., U.S. Nuclear Regulatory Commission, letter to G. A. Trevors, Nebraska Public Power District, License Amendment 127, Amendment Changes TS Relating to Fire Protection Program, dated February 3, 1989 (ADAMS Accession No. ML021360573).

102. Hall, J. R., .S. Nuclear Regulatory Commission, letter and safety evaluation to G. R. Horn, Nebraska Public Power District, regarding justification for withdrawal of exemption from fire protection and safe shutdown requirements of Appendix R to 10 CFR Part 50, dated August 15, 1995 (ADAMS Legacy Accession No. 9508230019).

103. Donohew, J. N., U.S. Nuclear Regulatory Commission, letter to G. A. Trevors, Nebraska Public Power District, "License Amendment 178, Amendment Converts Current TS for CNS to Improved TS, dated July 31, 1998 (ADAMS Accession No. ML021410047).

104. Vassallo, D. B., U.S. Nuclear Regulatory Commission, letter and safety evaluation to Kuncl, L. G., Nebraska Public Power District, Exemption from certain 10 CFR Part 50 Appendix R and 10 CFR 50.48 Requirements; Level of Protection Currently Provided in Conjunction with Proposed Modifications Provides Level of Fire Protection Equivalent to Requirements of Section III.G., dated September 21, 1983 (ADAMS Legacy Accession Nos. 8310070391 and 8310070393).

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Date: April 29, 2014

Attachments:

A. Table 3.8-1 – V&V Basis for Fire Modeling Correlations Used at CNS
B. Table 3.8-2 – V&V Basis for Fire Model Calculations of Other Models Used at CNS
C. Abbreviations and Acronyms

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at CNS

Correlation	Application at CNS	V&V Basis	NRC Staff Evaluation of Acceptability
Flame Height (Method of Heskestad)	The Flame Height Correlation was implemented in the Fire Modeling Workbook (FMWB). The correlation was used to determine the vertical extension of the flame region as part of the Zone of Influence (ZOI) calculations.	NUREG-1805, Chapter 3, 2004 (Reference 32) NUREG-1824, Volume 3, 2007 (Reference 33) SFPE Handbook, 4th Edition, Chapter 2-1, Heskestad, 2008 (Reference 83)	• The licensee provided verification of the FMWB on basis of comparison with NUREG-1805 (Response to RAI 02(a), Reference 9). • The correlation is validated in NUREG-1824 and an authoritative publication of the SFPE Handbook. • The licensee stated that in most cases, the correlation has been applied within the validated range reported in NUREG-1824. The licensee provided justification for cases where the correlation was used outside the validated range reported in NUREG-1824 (Responses to RAIs 02(b) and 03; Reference 11 and 9, respectively). Based its review and the licensee's explanation, the NRC staff concludes that the use of this correlation in the CNS application is acceptable.
Plume Centerline Temperature (Method of Heskestad)	The Plume Centerline Temperature correlation was implemented in the FMWB. The correlation was used to determine vertical separation distance, based on temperature, to a target in order to determine the vertical extent of the ZOI.	NUREG-1805, Chapter 9, 2004 (Reference 32) NUREG-1824, Volume 3, 2007 (Reference 33) SFPE Handbook, 4th Edition, Chapter 2-1, Heskestad, 2008 (Reference 83)	• The licensee provided verification of the FMWB on basis of comparison with NUREG-1805 (Response to RAI 02(a), Reference 9). • The correlation is validated in NUREG-1824 and an authoritative publication of the SFPE Handbook. • The licensee stated that in most cases, the correlation has been applied within the validated range reported in NUREG-1824. The licensee provided justification for cases where the correlation was used outside the validated range reported in NUREG-1824 (Responses to RAIs 02(b) and 03; References 11 and 9, respectively). Based its review and the licensee's explanation, the NRC staff concludes that the use of this correlation in the CNS application is acceptable.

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at CNS

Correlation	Application at CNS	V&V Basis	NRC Staff Evaluation of Acceptability
Radiant Heat Flux (Point Source Method)	The Radiant Heat Flux (Point Source Method) correlation was implemented in the FMWB. The correlation was used to determine the horizontal separation distance, based on heat flux, to a target in order to determine the horizontal extent of the ZOI.	NUREG-1805, Chapter 5, 2004 (Reference 32) NUREG-1824, Volume 3, 2007 (Reference 33) SFPE Handbook, 4th Edition, Chapter 3-10, Beyler, C., 2008 (Reference 84)	• The licensee provided verification of the FMWB on basis of comparison with NUREG-1805 (Response to RAI 02(a), Reference 9). • The correlation is validated in NUREG-1824 and an authoritative publication of the SFPE Handbook. • The licensee stated that in most cases, the correlation has been applied within the validated range reported in NUREG-1824. The licensee provided justification for cases where the correlation was used outside the validated range reported in NUREG-1824 (Response to RAI 02(b), Reference 11). Based its review and the licensee's explanation, the NRC staff concludes that the use of this correlation in the CNS application is acceptable.
Hot Gas Layer (Method of McCaffrey, Quintiere, and Harkleroad)	The Hot Gas Layer (Method of McCaffrey, Quintiere, and Harkleroad) correlation was implemented in the FMWB. The correlation was used to calculate the hot gas layer temperature for a room with natural ventilation.	NUREG-1805, Chapter 2, 2004 (Reference 32) NUREG-1824, Volume 3, 2007 (Reference 33) SFPE Handbook, 4th Edition, Chapter 3-6, Walton W. and Thomas, P., 2008 (Reference 85)	• The licensee provided verification of the FMWB on basis of comparison with NUREG-1805 (Response to RAI 02(a), Reference 9). • The correlation is validated in NUREG-1824 and an authoritative publication of the SFPE Handbook. • The licensee stated that in most cases, the correlation has been applied within the validated range reported in NUREG-1824. The licensee provided justification for cases where the correlation was used outside the validated range reported in NUREG-1824 (Responses to RAIs 02(b) and 03; References 11 and 9, respectively). Based its review and the licensee's explanation, the NRC staff concludes that the use of this correlation in the CNS application is acceptable.

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at CNS

Correlation	Application at CNS	V&V Basis	NRC Staff Evaluation of Acceptability
Hot Gas Layer (Method of Beyler)	The Hot Gas Layer (Method of Beyler) correlation was implemented in the FMWB. The correlation was used to calculate the hot gas layer temperature for a room with no ventilation.	NUREG-1805, Chapter 2, 2004 (Reference 32) NUREG-1824, Volume 3, 2007 (Reference 33) SFPE Handbook, 4th Edition, Chapter 3-6, Walton W. and Thomas, P., 2008 (Reference 85)	• The licensee provided verification of the FMWB on basis of comparison with NUREG-1805 (Response to RAI 02(a), Reference 9). • The correlation is validated in NUREG-1824 and an authoritative publication of the SFPE Handbook. • The licensee stated that in most cases, the correlation has been applied within the validated range reported in NUREG-1824. The licensee provided justification for cases where the correlation was used outside the validated range reported in NUREG-1824 (Response to RAI 02(b), Reference 11). Based its review and the licensee's explanation, the NRC staff concludes that the use of this correlation in the CNS application is acceptable.
Hot Gas Layer (Method of Foote, Pagni, and Alvares [FPA])	The Hot Gas Layer (Method of Foote, Pagni, and Alvares) correlation was implemented in the FMWB. The correlation was used to calculate the hot gas layer temperature for a room with forced ventilation.	NUREG-1805, Chapter 2, 2004 (Reference 32) NUREG-1824, Volume 3, 2007 (Reference 33) SFPE Handbook, 4th Edition, Chapter 3-6, Walton W. and Thomas, P., 2008 (Reference 85)	• The licensee provided verification of the FMWB on basis of comparison with NUREG-1805 (Response to RAI 02(a), Reference 9). • The correlation is validated in NUREG-1824 and an authoritative publication of the SFPE Handbook. • The licensee stated that in most cases, the correlation has been applied within the validated range reported in NUREG-1824. The licensee provided justification for cases where the correlation was used outside the validated range reported in NUREG-1824 (Responses to RAIs 02(b) and 03; References 11 and 9, respectively). Based its review and the licensee's explanation, the NRC staff concludes that the use of this correlation in the CNS application is acceptable.

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at CNS

Correlation	Application at CNS	V&V Basis	NRC Staff Evaluation of Acceptability
Ceiling Jet Temperature (Method of Alpert)	The Ceiling Jet Temperature (Method of Alpert) correlation was implemented in the FMWB. The correlation was used to calculate horizontal separation distance, based on temperature at the ceiling of a room, to a target in order to determine the horizontal extent of the ZOI.	NUREG-1824, Volume 4, 2007 (Reference 33) SFPE Handbook, 4th Edition, Chapter 2-2, Alpert, R., 2008, (Reference 86)	• The licensee provided verification of the FMWB on basis of comparison with NUREG-1805 (Response to RAI 02(a), Reference 9). • The correlation is validated in NUREG-1824 and an authoritative publication of the SFPE Handbook. • The licensee stated that in most cases, the correlation has been applied within the validated range reported in NUREG-1824. The licensee provided justification for cases where the correlation was used outside the validated range reported in NUREG-1824 (Response to RAI 02(b), Reference 11). Based its review and the licensee's explanation, the NRC staff concludes that the use of this correlation in the CNS application is acceptable.
Sprinkler Activation Correlation	Sprinkler Activation Correlation was implemented in the FMWB. The correlation was used to estimate sprinkler actuation time based on ceiling jet temperature, velocity, and thermal response of sprinkler.	NUREG-1805, Chapter 10, 2004 (Reference 32) NFPA Handbook, 19th Edition, Chapter 3-9, Budnick, E., Evans, D., and Nelson, H., 2003. (Reference 87)	• The licensee provided verification of the FMWB on basis of comparison with NUREG-1805 (Response to RAI 02(a), Reference 9). • The correlation is validated in an authoritative publication of the NFPA Handbook. • The licensee stated that in most cases, the correlation has been applied within the validated range. The licensee provided justification for cases where the correlation was used outside the validated range (Response to RAI 02(b), Reference 11). Based its review and the licensee's explanation, the NRC staff concludes that the use of this correlation in the CNS application is acceptable.

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at CNS

Correlation	Application at CNS	V&V Basis	NRC Staff Evaluation of Acceptability
Heat Detection Actuation Correlation	The Heat Detector Actuation correlation was implemented in the FMWB. The correlation was used to estimate heat detector actuation time based on ceiling jet temperature, velocity, and thermal response of detector.	NUREG-1805, Chapter 11, 2004 (Reference 32) NUREG-1824, Volume 4, 2007 (Reference 33) NFPA Handbook, 19th Edition, Chapter 3-9, Budnick, E., Evans, D., and Nelson, H., 2003. (Reference 87)	• The licensee provided verification of the FMWB on basis of comparison with NUREG-1805 (Response to RAI 02(a), Reference 9). • The correlation is validated in authoritative publications of the NFPA. • The licensee stated that in most cases, the correlation has been applied within the validated range. The licensee provided justification for cases where the correlation was used outside the validated range (Response to RAIs 02(b), Reference 11). Based its review and the licensee's explanation, the NRC staff concludes that the use of this correlation in the CNS application is acceptable.

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at CNS

Correlation	Application at CNS	V&V Basis	NRC Staff Evaluation of Acceptability
Smoke Detection Actuation Correlation (Method of Heskestad and Delichatsios)	The Smoke Detector Actuation correlation (Method of Alpert and Method of Heskestad and Delichatsios) was implemented in the FMWB. The correlation was used to estimate smoke detector time based on ceiling jet temperature, velocity, and thermal response of detector. The method of Heskestad and Delichatsios was used to calculate the activation time.	NUREG-1805, Chapter 11, 2004 (Reference 32) NUREG-1824, Volume 4, 2007 (Reference 33) NFPA Handbook, 19th Edition, Chapter 3-9, Budnick, E., Evans, D., and Nelson, H., 2003. (Reference 87) SFPE Handbook, 4th Edition, Chapter 4-1, Custer R., Meacham B., and Schifiliti, R., 2008. (Reference 81)	• The licensee provided verification of the FMWB on basis of comparison with NUREG-1805 (Response to RAI 02(a), Reference 9). • The correlation is validated in an authoritative publication of the NFPA and SFPE Handbooks. • The licensee stated that in most cases, the correlation has been applied within the validated range. The licensee provided justification for cases where the correlation was used outside the validated range (Response to RAI 02(e), Reference 10). Based its review and the licensee's explanation, the NRC staff concludes that the use of this correlation in the CNS application is acceptable.

Attachment B: Table 3.8-2, V&V Basis for Other Fire Models and Related Calculations Used at CNS

Calculation	Application at CNS	V&V Basis	NRC Staff Evaluation of Acceptability
Fire Dynamics Simulator (Version 5) Control Room Abandonment Calculation	Fire Dynamics Simulator (Version 5) was used to calculate abandonment time for the CNS main control room.	NUREG-1824, Volume 7, 2007 (Reference 33) NIST Special Publication 1018-5, Volume 2: Verification (Reference 88) NIST Special Publication 1018-5, Volume 3: Validation (Reference 89)	• The modeling technique is validated in NUREG-1824 (Reference 33) and authoritative publications of NIST (Reference 81 and 82). • The licensee stated that in most cases, the correlation has been applied within the validated range reported in NUREG-1824. The licensee provided justification for cases where the correlation was used outside the validated range reported in NUREG-1824 (Response to RAI 02(d), Reference 10). Based its review and the licensee's explanation, the NRC staff concludes that the use of FDS in the CNS application for the MCR abandonment time calculations is acceptable.

Attachment B: Table 3.8-2, V&V Basis for Other Fire Models and Related Calculations Used at CNS

Calculation	Application at CNS	V&V Basis	NRC Staff Evaluation of Acceptability
Temperature Sensitive Equipment Zone of Influence Study	FDS (Version 5) was used to calculate the radiant heat flux ZOI at which temperature sensitive equipment will reach damage thresholds.	NUREG-1824, Volume 7, 2007 (Reference 33) NIST Special Publication 1018-5, Volume 2: Verification (Reference 88) NIST Special Publication 1018-5, Volume 3: Validation (Reference 89)	• The modeling technique is validated in NUREG-1824 (Reference 33) and authoritative publications of NIST (Reference 81 and 82). • The licensee stated that in most cases, the correlation has been applied within the validated range reported in NUREG-1824. The licensee provided justification for cases where the correlation was used outside the validated range reported in NUREG-1824 (Response to RAI 02(d), Reference 10). Based its review and the licensee's explanation, the NRC staff concludes that the use of FDS in the CNS application is acceptable.

Attachment B: Table 3.8-2, V&V Basis for Other Fire Models and Related Calculations Used at CNS

Calculation	Application at CNS	V&V Basis	NRC Staff Evaluation of Acceptability
Plume/Hot Gas Layer Interaction Study	FDS (Version 5) was used to locate the point where hot gas layer and plume interact and establish limits for plume temperature application.	NUREG-1824, Volume 7, 2007 (Reference 33) NIST Special Publication 1018-5, Volume 2: Verification (Reference 88) NIST Special Publication 1018-5, Volume 3: Validation (Reference 89)	• The modeling technique is validated in NUREG-1824 (Reference 33) and authoritative publications of NIST (Reference 81 and 82). • The licensee stated that in most cases, the correlation has been applied within the validated range reported in NUREG-1824. The licensee provided justification for cases where the correlation was used outside the validated range reported in NUREG-1824 (Response to RAI 02(d), Reference 10). Based its review and the licensee's explanation, the NRC staff concludes that the use of FDS in the CNS application is acceptable
Hot Gas Layer Calculations using Consolidated Model of Fire and Smoke Transport (Version 6)	CFAST (Version 6) was used in the multi-compartment analysis to calculate the upper and lower gas layer temperatures and the layer height in connected compartments.	NUREG-1824, Volume 5, 2007 (Reference 33) NIST Special Publication 1086, 2008 (Reference 89)	• The modeling technique is validated in NUREG-1824 (Reference 33) and an authoritative publication of NIST (Reference 83). • The licensee stated that in most cases, the correlation has been applied within the validated range reported in NUREG-1824. The licensee provided justification for cases where the correlation was used outside the validated range reported in NUREG-1824 (Response to RAI 02(c), Reference 10). Based its review and the licensee's explanation, the NRC staff concludes that the use of CFAST in the CNS application is acceptable.

Attachment B: Table 3.8-2, V&V Basis for Other Fire Models and Related Calculations Used at CNS

Calculation	Application at CNS	V&V Basis	NRC Staff Evaluation of Acceptability
Temperature Sensitive Equipment Hot Gas Layer Study	CFAST (Version 6) was used to calculate the upper and lower gas layer temperatures for various compartments, and the layer height, for use in assessment of damage to temperature sensitive equipment.	NUREG-1824, Volume 5, 2007 (Reference 33) NIST Special Publication 1086, 2008 (Reference 90)	• The modeling technique is validated in NUREG-1824 (Reference 33) and an authoritative publication of NIST (Reference 83). • The licensee stated that in most cases, the correlation has been applied within the validated range reported in NUREG-1824. The licensee provided justification for cases where the correlation was used outside the validated range reported in NUREG-1824 (Response to RAI 02(c), Reference 10). Based its review and the licensee's explanation, the NRC staff concludes that the use of CFAST in the CNS application is acceptable.
Correlation for Heat Release Rates of Cables (Method of Lee)	Method of Lee was used to correlate bench scale data to heat release rates from cable tray fires.	SFPE Handbook, 4th Edition, Chapter 3-1, Babrauskas, 2008 (Reference 91) NBSIR 85-3195, Lee, 1985 (Reference 92)	• The modeling technique is documented in authoritative publications of SFPE (Reference 84) and NIST, formerly NBS (Reference 85). • The licensee stated that the correlation has been applied within the range of its applicability (Reference 6). Based its review and the licensee's explanation, the NRC staff concludes that the use of this correlation in the CNS application is acceptable.

Attachment B: Table 3.8-2, V&V Basis for Other Fire Models and Related Calculations Used at CNS

Calculation	Application at CNS	V&V Basis	NRC Staff Evaluation of Acceptability
Correlation for Flame Spread over Horizontal Cable Trays (FLASH-CAT)	The FLASH-CAT method was used to calculate the growth and spread of a fire within a vertical stack of horizontal cable trays.	NUREG/CR-7010, Section 9, 2010 (Reference 34)	• The modeling technique is validated in an authoritative publication of NIST (Reference 34). • The licensee stated that the correlation has been applied within the range of its applicability (Reference 6). Based its review and the licensee's explanation, the NRC staff concludes that the use of this correlation in the CNS application is acceptable.

Attachment C: Abbreviations and Acronyms

AC	alternating current
ADAMS	Agencywide Documents Access and Management System
ADS	automatic depressurization
AEC	Atomic Energy Commission
AHJ	authority having jurisdiction
ALARA	as low as reasonably achievable
ANO	Arkansas Nuclear One
ANS	American Nuclear Society
ASD	Alternate shutdown
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BWR	boiling-water reactor
BWROG	Boiling Water Reactor Owner's Group
CAROLFIRE	Cable Response to Live Fire
CCDP	conditional core damage probability
CDF	core damage frequency
CFAST	consolidated model of fire and smoke transport
CFR	Code of Federal Regulations
CHRISTIFIRE	Cable Heat Release, Ignition, and Spread in Tray Installations During Fire
CLERP	conditional large early release probability
CNS	Cooper Nuclear Station
CO_2	carbon dioxide
COP	containment overpressure
CPT	control power transformer
CSR	Cable spreading room
DC	direct current
DESIREE-Fire	Direct Current Electrical Shorting in Response to Exposure Fire
DID RA	defense-in-depth recovery action
DID	defense-in-depth
ECST	emergency condensate storage tank
EdF	Electricite de France
EDG	emergency diesel generators
EEEE	existing engineering equivalency evaluation
EOP	emergency operating procedure
EPRI	Electric Power Research Institute
Epsilon (ε)	Non-zero but below truncation limit
ERFBS	electrical raceway fire barrier system
ERO	emergency response organization
F&O	facts and observations
FAQ	frequently asked question
FDS	fire dynamics simulator
FDT	fire dynamics tool
FIVE	Fire Induced Vulnerability Evaluation Methodology
FLASH-CAT	Flame Spread over Horizontal Cable Trays
FM	fire modeling
FMWB	fire modeling workbook

FPE	fire protection engineering
FPP	fire protection program
FPRA	fire probabilistic risk assessment
FR	Federal Register
FRE	fire risk evaluation
FSAR	final safety analysis report
GDC	general design criteria
GL	generic letter
gpm	gallons per minute
HEP	human error probability
HFE	human failure event
HGL	hot gas layer
HPCI	high pressure coolant injection
HRA	human reliability analysis
HRE	high(er) risk evolution
HRR	heat release rate
HVAC	heating, ventilation, and air conditioning
IEEE	Institute of Electrical and Electronics Engineers
KATE-Fire	Kerite Analysis in Thermal Environment of FIRE
KSF	key safety function
kV	kilovolt
kW	kilowatt
LAR	license amendment request
LERF	large early release frequency
MCA	Multi-compartment analysis
MCB	main control board
MCR	main control room
min	minute(s)
MOV	motor-operated valve
MQH	McCaffrey, Quintiere, and Harkleroad
MSO	multiple spurious operation
NEI	Nuclear Energy Institute
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
No.	number
NPO	non-power operation
NPP	nuclear power plant
NPPD	Nebraska Public Power District
NPSH	net positive suction head
NRC	U.S. Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
NSCA	nuclear safety capability assessment
NSPC	nuclear safety performance criteria
OMA	operator manual action
PB	performance-based
PCE	plant change evaluation
PCS	primary control station
PRA	probabilistic risk assessment
PSA	probabilistic safety assessment

psi	pounds per square inch
PWR	pressurized-water reactor
QA	quality assurance
RA	recovery action
RAI	request for additional information
RCIC	reactor core isolation cooling
RCP	reactor coolant pump
REC	reactor equipment cooling
RES	Office of Nuclear Regulatory Research
RG	Regulatory Guide
RHR	residual heat removal
RI	risk-informed
RI/PB	risk-informed, performance-based
RPV	reactor pressure vessel
RTI	response time index
SE	safety evaluation
SER	safety evaluation report
SFPE	Society of Fire Protection Engineers
SR	supporting requirement
SRV	safety relief valve
SSA	safe shutdown analysis
SSC	structures, systems, and components
SSD	safe shutdown
TR	technical/topical report
TS	technical specifications
USAR	Updated Safety Analysis Report
V	Volt
V&V	verification and validation
VDC	Volts direct current
VEWFDS	very early warning fire detectors
VFDR	variance from deterministic requirements
YD	yard
yr	year
ZOI	zone of influence

A copy of the related Safety Evaluation is also enclosed. A Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

/RA/

Joseph M. Sebrosky, Senior Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-298

Enclosures:
1. Amendment No. 248 to DPR-46
2. Safety Evaluation

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