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

February 3, 2017

Mr. Ernest J. Kapopoulos Jr.
Site Vice President
H. B. Robinson Steam Electric Plant
Duke Energy Progress, LLC
3581 West Entrance Road, RNPA01
Hartsville, SC 29550

SUBJECT: H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2 – ISSUANCE OF AMENDMENT REGARDING NATIONAL FIRE PROTECTION ASSOCIATION STANDARD 805 (CAC NO. MF2746)

Dear Mr. Kapopoulos:

By letter dated September 16, 2013, as supplemented by letters dated November 24, and December 22, 2014; January 22, March 16, April 1, May 19, and July 31, 2015; March 16, May 25, July 25, and October 5, 2016 (References 8 through 19 in the enclosure), Duke Energy Progress, LLC (previously Duke Energy Progress, Inc.) (the licensee) submitted a license amendment request to transition the H. B. Robinson Steam Electric Plant, Unit No. 2 (HBRSEP) to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.48(c), "National Fire Protection Association Standard NFPA 805."

The U.S. Nuclear Regulatory Commission has issued the enclosed Amendment No. 249 to Renewed Facility Operating License No. DPR-23 for HBRSEP. The amendment authorizes the transition of the 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, 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 the HBRSEP license is revised to reflect the use of NFPA 805.

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

Sincerely,

Dennis J Galvin

Dennis J. Galvin, Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-261

Enclosures:
1. Amendment No. 249 to DPR-23
2. Safety Evaluation

cc w/enclosures: Distribution via Listserv

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

DUKE ENERGY PROGRESS, LLC.

DOCKET NO. 50-261

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 249
Renewed License No. DPR-23

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

   A. The application for amendment by Duke Energy Progress, LLC (the licensee) (previously Duke Energy Progress, Inc.), dated September 16, 2013, as supplemented by letters dated November 24, 2014, December 22, 2014, January 22, 2015, March 16, 2015, April 1, 2015, May 19, 2015, July 31, 2015, March 16, 2016, May 25, 2016, July 25, 2016, and October 5, 2016, 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. Paragraph 3.B. of Renewed Facility Operating License No. DPR-23 is hereby amended to read as follows:

B. Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No 249, 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. Paragraph 3.E. of Renewed Facility Operating License No. DPR-23 is hereby amended to read as follows:

E. Fire Protection Program

Duke Energy Progress, LLC 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 licensee amendment request dated September 16, 2013, as supplemented by letters dated November 24, 2014, December 22, 2014, January 22, 2015, March 16, 2015, April 1, 2015, May 19, 2015, July 31, 2015, March 16, 2016, May 25, 2016, July 25, 2016, and October 5, 2016, and as approved in the SE dated February 3, 2017. 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.

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

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

a) Prior NRC review and approval is not required for changes that clearly result in a decrease in risk. The proposed change must also be consistent with the defense-in-depth philosophy and must maintain

sufficient safety margins. The change may be implemented following completion of the plant change evaluation.

b) 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.

2. Other Changes that May Be Made Without Prior NRC Approval

a) Changes to NFPA 805, Chapter 3, Fundamental Fire Protection Program

Prior NRC review and approval is 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.

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

Prior NRC review and approval is 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 SE dated February 3, 2017 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.

3. Transition License Conditions

   a) Before achieving full compliance with 10 CFR 50.48(c), as specified by 3.b) and 3.c) below, risk-informed changes to the licensee's fire protection program may not be made without prior NRC review and approval unless the change has been demonstrated to have no more than a minimal risk impact, as described in 2.b) above.

   b) The licensee shall implement the modifications described in Attachment S, Table S-2, "Plant Modifications Committed," of Duke Energy letter dated May 25, 2016, by the end of the unit refueling outage currently scheduled for September/October 2020 (R232). The licensee shall maintain appropriate compensatory measures in place until completion of the modifications delineated above.

   c) The licensee shall implement the items as listed in Attachment S, Table S-3, "Implementation Items," of Duke Energy letters dated May 25, 2016, and October 5, 2016, within 365 days after receipt of the safety evaluation/license amendment with the exception of implementation items S-3.11, 12, and 14, which are associated with modifications and will be completed after all procedure updates, modifications and training are complete.

3. This license amendment is effective as of the date of its issuance and shall be implemented as stated in paragraph 3.E of the license.

FOR THE NUCLEAR REGULATORY COMMISSION

Benjamin G. Beasley, Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to Renewed Facility
Operating License No. DPR-23
and the Technical Specifications

Date of Issuance: February 3, 2017

ATTACHMENT TO LICENSE AMENDMENT NO. 249

H. B. ROBINSON STEAM ELECTRIC PLANT UNIT NO. 2

RENEWED FACILITY OPERATING LICENSE NO. DPR-23

DOCKET NO. 50-261

Replace the following pages of the Renewed Facility Operating License and Appendix A Technical Specifications with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

Operating License

Remove Pages	Insert Pages
3	3
4	4
	4A
	4B

Technical Specifications

Remove Page	Insert Page
5.0-6	5.0-6

D. Pursuant to the Act and 10 CFR Parts 30, 40 and 70, to receive, possess, and use in amounts as required any byproduct, source, or special nuclear material without restriction to chemical or physical form for sample analysis or instrument and equipment calibration or associated with radioactive apparatus or components;

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

3. This renewed license shall be deemed to contain and is subject to the conditions specified in the following Commission regulations: 10 CFR Part 20, Section 30.34 of 10 CFR Part 30, Section 40.41 of 10 CFR Part 40, Section 50.54 and 50.59 of 10 CFR Part 50, and Section 70.32 of 10 CFR Part 70; and 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:

A. Maximum Power Level

The licensee is authorized to operate the facility at a steady state reactor core power level not in excess of 2339 megawatts thermal.

B. Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 249 are hereby incorporated in the license.

The licensee shall operate the facility in accordance with the Technical Specifications.

(1) For Surveillance Requirements (SRs) that are new in Amendment 176 to Final Operating License DPR-23, the first performance is due at the end of the first surveillance interval that begins at implementation of Amendment 176. For SRs that existed prior to Amendment 176, including SRs with modified acceptance criteria and SRs whose frequency of performance is being extended, the first performance is due at the end of the first surveillance interval that begins on the date the Surveillance was last performed prior to implementation of Amendment 176.

C. Reports

Duke Energy Progress, LLC shall make certain reports in accordance with the requirements of the Technical Specifications.

D. Records

Duke Energy Progress, LLC shall keep facility operating records in accordance with the requirements of the Technical Specifications.

E. Fire Protection Program

Duke Energy Progress, LLC 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 licensee amendment request dated September 16, 2013, as supplemented by letters dated November 24, 2014, December 22, 2014, January 22, 2015, March 16, 2015, April 1, 2015, May 19, 2015, July 31, 2015, March 16, 2016, May 25, 2016, July 25, 2016, and October 5, 2016, and as approved in the SE dated February 3, 2017. 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.

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

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

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

   b) 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.

2. Other Changes that May Be Made Without Prior NRC Approval

   a) Changes to NFPA 805, Chapter 3, Fundamental Fire Protection Program

   Prior NRC review and approval is 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.

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

   Prior NRC review and approval is 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 SE dated February 3, 2017 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.

3. Transition License Conditions

a) Before achieving full compliance with 10 CFR 50.48(c), as specified by 3.b) and 3.c) below, risk-informed changes to the licensee's fire protection program may not be made without prior NRC review and approval unless the change has been demonstrated to have no more than a minimal risk impact, as described in 2.b) above.

b) The licensee shall implement the modifications described in Attachment S, Table S-2, "Plant Modifications Committed," of Duke Energy letter dated May 25, 2016, by the end of the unit refueling outage currently scheduled for September/October 2020 (R232). The licensee shall maintain appropriate compensatory measures in place until completion of the modifications delineated above.

c) The licensee shall implement the items as listed in Attachment S, Table S-3, "Implementation Items," of Duke Energy letters dated May 25, 2016, and October 5, 2016, within 365 days after receipt of the safety evaluation/license amendment with the exception of implementation items S-3.11, 12, and 14, which are associated with modifications and will be completed after all procedure updates, modifications and training are complete.

F. Physical Protection and Cyber Security

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 the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The combined set of plans, which contains Safeguards Information protected under 10 CFR 73.21, is entitled: "H. B. Robinson Steam Electric Plant Security, Training and Qualification, and Safeguards Contingency Plan, Revision 0" submitted by letter dated October 1, 2004, as supplemented by letter dated October 20, 2004.

The licensee 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 licensee's CSP was approved by License Amendment No. 226, as supplemented by changes approved by License Amendment Nos. 230 and 239.

G. The following programs shall be implemented and maintained by the licensee:

(1) DELETED

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 commitments to NUREG-0737 and of NUREG-0737, Supplement 1, as stated in Generic Letter 82-33;

c. Quality assurance for effluent and environmental monitoring; and

d. All programs specified in Specification 5.5.

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATED TO TRANSITION TO A RISK-INFORMED, PERFORMANCE-BASED FIRE PROTECTION PROGRAM IN ACCORDANCE WITH 10 CFR 50.48(c)

AMENDMENT NO. 249 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-23

DUKE ENERGY PROGRESS, LLC.

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

DOCKET NO. 50-261

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ATTACHMENTS

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATED TO TRANSITION TO A RISK-INFORMED, PERFORMANCE-BASED FIRE PROTECTION PROGRAM IN ACCORDANCE WITH 10 CFR 50.48(c) AMENDMENT NO. 249 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-23 DUKE ENERGY PROGRESS, LLC. H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2 DOCKET NO. 50-261

1.0 INTRODUCTION

1.1 Background

The U.S. Nuclear Regulatory Commission (NRC or the Commission) started developing fire protection requirements in the 1970s. In 1976, the NRC published comprehensive fire protection guidelines in the form of Branch Technical Position (BTP) Auxiliary and Power Conversion Systems Branch (APCSB) 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants" (Reference 1), and Appendix A to BTP APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants Docketed Prior to July 1, 1976" (Reference 2). Subsequently, the NRC performed fire protection reviews for the operating reactors and documented the results in safety evaluations (SEs) or supplements to SEs.

In 1980, to resolve issues identified in those reports, the NRC amended its regulations for fire protection in operating nuclear power plants (NPPs) 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 Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.48, "Fire Protection," and Appendix R, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979."

Section 50.48(a)(1) of 10 CFR 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 (FPP); identify the positions responsible for the program and the authority delegated to those positions; and 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 for fire prevention and manual suppression activities; 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 3), which describes a methodology for establishing fundamental 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 4), states, in part, that:

> On March 26, 1998, the NRC staff sent to the Commission SECY-98-058, "Development of a Risk-Informed, Performance-Based Regulation for Fire Protection at Nuclear Power Plants" (Reference 5), in which it proposed to work with the 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 6), the NRC staff requested and received Commission approval to proceed with rulemaking to permit reactor licensees to adopt an NFPA standard as an alternative to existing fire protection requirements. On February 9, 2001, the NFPA Standards Council approved the 2001 edition of NFPA 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," as an American National Standard for performance-based fire protection for light-water nuclear power plants.

A licensee that elects to adopt 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 licensee 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, a licensee identifies fire areas and fire hazards though 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, a licensee will use engineering evaluations, probabilistic safety assessments, and fire modeling (FM) calculations to show that the criteria are met. Chapter 4 of NFPA 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 (NSPC) 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 SE, where the NRC staff states that the licensee's FPP element is in compliance with (or meeting the requirements of) NFPA 805, the NRC staff is referring to NFPA 805 with the exceptions, modifications, and supplementation 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)," Revision 2 (Reference 7)].

RG 1.205 provides the NRC staff's position on NEI 04-02, Revision 2, 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 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 10 CFR 50.48(c).

Accordingly, Duke Energy Progress, LLC (Duke Energy, the licensee) (previously, Duke Energy Progress, Inc.) requested a license amendment to allow the licensee to maintain H.B. Robinson Steam Electric Plant, Unit 2, (HBRSEP) FPP in accordance with 10 CFR 50.48(c), and change the Renewed Facility Operating License and Technical Specifications (TSs) accordingly.

1.2 Requested Licensing Action

By letter dated September 16, 2013 (Reference 8), as supplemented by letters dated November 24, 2014[1] (Reference 9), December 22, 2014 (Reference 10), January 22, 2015 (Reference 11), March 16, 2015 (Reference 12), April 1, 2015 (Reference 13), May 19, 2015 (Reference 14), July 31, 2015 (Reference 15), March 16, 2016 (Reference 16), May 25, 2016 (Reference 17), July 25, 2016 (Reference 18), and October 5, 2016 (Reference 19), the licensee submitted an application for a license amendment to transition the HBRSEP 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 October 23, 2014 (Reference 20), March 26, 2015 (Reference 21), April 23, 2015 (Reference 22), July 7, 2015 (Reference 23), March 2, 2016 (Reference 24), and June 28, 2016 (Reference 25). The licensee's supplemental letters dated November 24 and December 22, 2014; January 22, March 16, April 1, May 19, and July 31, 2015; March 16, May 25, July 25, and October 5, 2016, 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 December 26, 2013 (78 FR 78405).

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[1] The November 24, 2014, submittal did not include appropriate security-related information markings and thus is not publicly available. The same document was submitted on March 16, 2015, with appropriate markings, supersedes the November 24, 2014, submittal, and applicable portions are publicly available.

The licensee requested an amendment to the HBRSEP renewed facility operating license and TSs to establish and maintain a 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 the Updated Final Safety Analysis Report (UFSAR) for HBRSEP and as approved in the safety evaluation (SE) dated November 25, 1983 (Reference 26), which implements the fire protection requirements of 10 CFR 50.48 and 10 CFR 50, Appendix R, to a 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 HBRSEP 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, license conditions, and TSs that must be revised or superseded, and has provided the necessary revisions to the plant's TSs and 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 fire protection plan, which reflects the decision to comply with NFPA 805, as required by 10 CFR 50.48(a); and

3. The licensee is required to 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 a revision to the TSs that address this change to the current FPP licensing basis. SE Sections 2.4.2 and 4.0 discuss in detail the license condition, and SE Section 2.4.3 discusses the TS change.

2.0 REGULATORY EVALUATION

The following explains the use of general design criteria for HBRSEP. HBRSEP received its construction permit in 1967 and was licensed for operation in July 1970. On July 11, 1967, the Atomic Energy Commission published for public comment in the *Federal Register* (32 FR 10213), a revised and expanded set of 70 draft GDC (hereinafter referred to as the "draft GDC"). On February 20, 1971, the Atomic Energy Commission published in the *Federal Register* (36 FR 3255) a final rule that added Appendix A to 10 CFR Part 50, "General Design Criteria for Nuclear Power Plants" (hereinafter referred to as the "final GDC"). Differences between the draft GDC and final GDC included a consolidation from 70 to 64 criteria. As discussed in the NRC Staff Requirements Memorandum for SECY-92-223, "Resolution of

Deviations Identified during the Systematic Evaluation Program," dated September 18, 1992 (Reference 27), the Commission decided not to apply the final GDC to plants with construction permits issued prior to May 21, 1971. At the time of promulgation of Appendix A to 10 CFR Part 50, the Commission stressed that the final GDC were not new requirements and were promulgated to more clearly articulate the licensing requirements and practice in effect at that time. Each plant licensed before the final GDC were formally adopted, was evaluated on a plant-specific basis, determined to be safe, and licensed by the Commission.

Based on a review of the HBRSEP UFSAR Section 3.1, "Conformance with General Design Criteria," and the LAR, the NRC staff identified the following draft GDC as being applicable to the proposed amendment:

In the HBRSEP UFSAR Section 3.1.2.3, "Fire Protection" (GDC 3), HBRSEP states that:

> The facility is designed so that the probability of fires and explosions and the potential consequences of such events do not result in undue risk to the health and safety of the public. Noncombustible and fire-resistant materials shall be used throughout the facility wherever necessary to preclude such risk, particularly in areas containing critical portions of the facility such as containment, Control Room, and components of ESF [engineered safety features]. (GDC 3)

The current Fire Protection Program for HBRSEP is described in UFSAR Appendix 9.5.1B, "Fire Protection Program Description and Review per Appendix A to BTP APCSB 9.5-1." The Safe Shutdown Analysis, described in UFSAR Appendix 9.5.1C, "Post-Fire Safe-Shutdown Analysis Report," provides an evaluation to assure that the facility can be shutdown given worst case fire damage in any single fire area. The analysis also provides a summary of the information for the review of design modifications to determine that compliance with 10 CFR Part 50, Appendix R is maintained. The Fire Protection Rule (10 CFR 50.48 and 10 CFR Part 50, Appendix R), effective February 17, 1982, set forth fire protection features required to satisfy 10 CFR Part 50, Appendix A, GDC 3. Therefore, for the review of this LAR, the NRC staff applied the GDC requirements.

Section 50.48, "Fire Protection," of 10 CFR provides the NRC requirements for NPP fire protection. Section 50.48 includes specific requirements for requesting approval for a RI/PB FPP based on the provisions of NFPA 805 (Reference 3). Section 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 paragraph (b) of this section [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, as published in the FR on June 16, 2004 (69 FR 33536 through 33548), which states, in part, that:

> 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, or a designee of the Director, may approve the application if the Director or designee determines that the licensee has identified orders, license conditions, and the technical specifications that must be revised or superseded, and that any necessary revisions are adequate.

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 an LAR 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 may choose to use RI or PB alternatives to comply with NFPA 805 by submitting an LAR in accordance with 10 CFR 50.48(c)(4), which states:

> 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 a RI/PB FPP, a licensee may also 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 4). 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. RGs are not substitutes for regulations, and compliance with them is not required. Methods and solutions that differ from those set forth in RGs 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:

> 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 and controlling and extinguishing promptly those fires that do occur, thereby limiting fire damage; and
>
> (3) Providing an adequate level of fire protection for SSCs 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 protection systems must be designed such that their failure 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, states:

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) (Reference 3) by reference, with certain exceptions, modifications and supplementation. This regulation establishes the requirements for using a 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 Guidance

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

- RG 1.205, "Revision 1, issued December 2009 (Reference 4), provides guidance for use in complying with the requirements that the NRC has promulgated for RI/PB FPPs in accordance with 10 CFR 50.48 and the referenced 2001 Edition of the NFPA standard. It endorses portions of NEI 04-02, Revision 2 (Reference 7), 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 modifies 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. This RG also indicates that Chapter 3 of NEI 00-01, "Guidance for Post-Fire Safe Shutdown Circuit Analysis," Revision 2, issued May 2009 (Reference 28), when used in conjunction with NFPA 805 and the RG, provides an acceptable

approach to circuit analysis for a plant implementing an FPP under 10 CFR 50.48(c).

- The 2001 edition of NFPA 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," (Reference 3), which specifies the minimum fire protection requirements for existing light water NPPs during all phases of plant operations, including shutdown, degraded conditions, and decommissioning. 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 (Reference 7), provides guidance for implementing the requirements of 10 CFR 50.48(c), and represents methods for implementing in whole or in part a RI/PB FPP. This implementing guidance for NFPA 805 has two primary purposes: (1) provide direction and clarification for adopting NFPA 805 as an acceptable approach to fire protection, consistent with 10 CFR 50.48(c); and (2) 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 FPP 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 28), provides a deterministic methodology for performing post-fire safe shutdown analysis (SSA). In addition, NEI 00-01 includes information on RI 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 RI method is intended for application by licensees to determine the risk significance of identified circuit failure issues related to MSOs. RG 1.205 indicates that Chapter 3 of NEI 00-01, when used in conjunction with NFPA 805 and RG 1.205, provides an acceptable approach to circuit analysis for a plant implementing an FPP under 10 CFR 50.48(c).

- NEI 05-04, "Process for Performing Internal Events PRA [Probabilistic Risk Assessment] Peer Reviews Using the ASME/ANS [American Society of Mechanical Engineers/American Nuclear Society] PRA Standard," Revision 2

(Reference 29), which provides guidance material for conducting and documenting a peer review for PRAs using the ASME/ANS PRA Standard RA-S-2008a (Revision 1, Addendum A). The original intent of NEI 05-04 was to provide a methodology for PRA peer reviews as a follow-on to the NEI 00-02 methodology. With the release of ASME and ANS standards (to form the basis of a peer review), the emphasis of NEI 05-04 changed from follow-on peer reviews to simply peer reviews performed against an industry consensus standard.

- NEI 07-12, "Fire Probabilistic Risk Assessment (FPRA) Peer Review Process Guidelines," Revision 1 (Reference 30), which provides guidance material for use in conducting and documenting an FPRA peer review. NEI 07-12 provides the method for reviewing a FPRA against part 4 of the ASME/ANS PRA standard, ASME/ANS RA-Sa-2009.

- 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 31), provides the NRC staff's recommendations for using risk information in support of licensee-initiated licensing basis changes to a NPP 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 32), which provides guidance to licensees for use in determining the technical adequacy of the base PRA used in a RI 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 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.

- 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 33), which provides guidance related to PRAs used to support RI decisions for commercial light water reactor NPPs 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 34), 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 NPPs.

- NUREG-0800, Section 9.5.1.2, "Risk-Informed, Performance-Based Fire Protection Program," Revision 0, issued December 2009 (Reference 35), provides the NRC staff with guidance for evaluating LARs that seek to implement a 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 36), 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 37), 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 (Reference 38) and 2 (Reference 39), and Supplement 1 (Reference 40), which presents a compendium of methods, data and tools to perform a fire PRA (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 state-of-art FPRA methodology. Both RES and EPRI have provided specialists in fire risk analysis, 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 RI analyses related to the plant FPP. Volume 1, the Executive Summary, provides general background and overview information including both programmatic and technical, and project insights and conclusions. Volume 2 provides the detailed discussion of the recommended approach, methods, data and tools for conduct of a FPRA. Supplement 1 provides certain FPRA method enhancements.

- 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 41) notes that, based on new experimental information documented in NUREG/CR-6931, "Cable Response to Live Fire (CAROLFIRE)" issued April 2008 (Reference 42), and NUREG/CR- 7100, "Direct Current Electrical Shorting in Response to Exposure Fire (DESIREE-Fire): Test Results," issued April 2012 (Reference 43), the reduction in hot short probabilities for circuits provided with control power transformers identified in NUREG/CR-6850 cannot be repeated in experiments and, therefore, may be too high and should be reduced.

- NUREG-1792, "Good Practices for Implementing Human Reliability Analysis (HRA)" (Reference 44), which establishes good practices for performing HRAs and reviewing HRAs to assess the quality of those analyses. The HRAs in NUREG-1792 are of a generic nature and support implementation of RG 1.200 for level 1 and limited level 2 internal events PRAs with the reactor at full power.

- NUREG-1805, "Fire Dynamics Tools (FDTs): Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program," (Reference 45) provides quantitative methods, known as FDTs, to assist regional fire protection inspectors in performing fire hazard analysis. The FDTs are intended to assist fire protection inspectors in performing RI evaluations of credible fires that may cause critical damage to essential safe-shutdown equipment, as provided in the new reactor oversight process defined in the NRC's inspection manual.

- NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," Volumes 1 through 7 (Reference 46), provides technical documentation regarding the predictive capabilities of a specific set of fire models for the analysis of fire hazards in NPP scenarios. This report is the result of a collaborative program with EPRI and the National Institute of Standards and Technology (NIST). The selected models are:

  1. FDTs developed by NRC (Volume 3);

  2. Fire Induced Vulnerability Evaluation (FIVE) Methodology, Rev. 1 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 (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 47), 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/CR-7150, "Joint Assessment of Cable Damage and Quantification of Effects from Fire (JACQUE-FIRE)," Volume 1 (Reference 48), and Volume 2 (Reference 49), which documents the results of a Phenomena Identification and Ranking Table (PIRT) exercise that was undertaken on fire-induced electrical circuit failures that may occur in nuclear power plants when cables are damaged by fires (Volume 1), and also documents the PRA expert elicitation results and includes the best estimate conditional probabilities of hot short-induced spurious operations of control circuits, given fire damage to associated cables (Volume 2).

- NUREG-1855, Volume 1, "Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decision Making," (Reference 50), 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-making process. To define this context, NUREG-1855, Volume 1, provides an overview of the RI decision-making process itself.

- NUREG-1921, "EPRI/NRC-RES Fire Human Reliability Analysis Guidelines – Final Report" (Reference 51), 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 a FPRA. The report builds on existing human reliability analysis methods, and is intended primarily for practitioners conducting a fire HRA to support a FPRA.

- NUREG-1934, "Nuclear Power Plant Fire Modeling Analysis Guidelines (NPP FIRE MAG)" (Reference 52), describes the implications of the verification and validation (V&V) 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 NPP fire hazard analyses. The report also provides information to assist fire model users in applying this technology in the NPP environment.

- Generic Letter (GL) 2006-03. "Potentially Nonconforming Hemyc and MT Fire Barrier Configurations" (Reference 53), which 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.

- NFPA 13, "Standard for the Installation of Sprinkler Systems" (Reference 54) provides the minimum requirements for the design and installation of sprinkler systems to ensure that systems will work as intended to deliver adequate water in a fire emergency.

- NFPA 101, "Life Safety Code" (Reference 55), provides the minimum requirements for egress; features of fire protection, sprinkler systems, alarms, emergency lighting, smoke barriers; and special hazard protection.

- NFPA 51B, "Standard for Fire Prevention During Welding, Cutting, and Other Hot Work" (Reference 56), provides requirements for preventing injury, loss of life, and loss of property from fire or explosion as a result of hot work projects such as welding, heat treating, grinding, and similar applications producing or using sparks, flames, or heat.

- NFPA 72, "National Fire Alarm and Signaling Code" (Reference 57), provides requirements for the application, installation, location, performance, inspection, testing, and maintenance of fire alarm systems, supervising station alarm systems, public emergency alarm reporting systems, fire warning equipment and emergency communications systems, and their components.

- NFPA 76, "Standard for the Fire Protection of Telecommunications Facilities" (Reference 58), provides requirements for fire protection of telecommunications facilities providing telephone, data, internet transmission, wireless, and video services as well as life safety for the occupants plus protection of equipment and service continuity.

- NFPA 241, "Standard for Safeguarding Construction, Alteration, and Demolition Operations" (Reference 59), provides requirements for preventing or minimizing fire damage to structures, including those in underground locations, during construction, alteration, or demolition.

- NFPA 262, "Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces" (Reference 60), to evaluate the potential for smoke and fire spread along cables and wires housed in a plenum or other air transport spaces.

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) to which each FAQ was referenced.

Table 2.3-1: NFPA 805 Frequently Asked Questions

FAQ #	FAQ Title and Summary	Reference	SE Section
06-0021	"Cable Air Drops" • This FAQ clarifies the use of exposed cable air drops of limited length (approximately 3 feet).	(Reference 61)	3.1.4.1
06-0022	"Electrical Cable Flame Propagation Tests" • This FAQ provides a list of acceptable electrical cable flame propagation tests.	(Reference 62)	3.1.1.2 3.1.4.1
07-0030	"Establishing Recovery Actions" • This FAQ provides an acceptable process for determining the recovery actions (RAs) for NFPA 805 Chapter 4 compliance. The process includes: ▪ Differentiation between RAs and activities in the main control room (MCR) or at primary control station(s) (PCSs). ▪ Determination of which RAs are required by the NFPA 805 FPP. ▪ Evaluate the additional risk presented by the use of RAs. ▪ Evaluate the feasibility of the identified RAs. ▪ Evaluate the reliability of the identified RAs.	(Reference 63)	3.2.5 3.4.4
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 FPRA and nuclear safety capability assessment (NSCA) to include MSOs of concern. ▪ Step 4 – Evaluate for NFPA 805 compliance. ▪ Step 5 – Document the results.	(Reference 64)	3.2.4 3.2.7

FAQ #	FAQ Title and Summary	Reference	SE Section
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 (SSD) strategy to the endorsed industry guidance, NEI 00-01 "Guidance for Post-Fire SSD Circuit Analysis," Revision 1 (Reference 65). In short, the process has the licensees: ▪ Assemble industry and plant-specific documentation; ▪ Determine which sections of the guidance are applicable; ▪ Compare the existing SSD methodology to the applicable guidance; and ▪ Document any discrepancies.	(Reference 66)	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 (KSFs). ▪ Identifying plant areas to protect or "pinch points" during NPO HREs and actions to be taken if KSFs are lost.	(Reference 67)	3.5.3 3.5.3.1 3.5.3.3 3.5.4
08-0046	"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 (ASD) installed as a Very Early Warning Fire Detection System (VEWFDS) to monitor incipient degradation in electrical cabinets.	(Reference 68)	3.1.3.2 3.2.6.1 3.2.7 3.4.2.2 3.4.6
08-0050	"Manual Non-Suppression Probability" • This FAQ updates the treatment of manual suppression and fire brigade response. The update includes a process to adjust the non-suppression analysis for scenario-specific fire brigade responses.	(Reference 69)	3.4.2.3.2

FAQ #	FAQ Title and Summary	Reference	SE Section
08-0054	"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 NSPC. ▪ Step 3 – Variance from Deterministic Requirement (VFDR) Identification, Characterization, and Resolution Considerations. ▪ Step 4 – PB Evaluations. ▪ Step 5 – Final VFDR Evaluation. ▪ Step 6 – Document Required Fire Protection Systems and Features.	(Reference 70)	3.4.3 3.5.1.4
09-0056	"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.	(Reference 71)	3.6
09-0057	"New Shutdown Strategy" • This FAQ provides an alternative basis for Change Evaluation.	(Reference 72)	3.4.3
10-0059	"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 SSCs; ▪ Action level thresholds; and ▪ The use of existing monitoring programs.	(Reference 73)	3.7
12-0062	"Updated Final Safety Analysis Report (UFSAR) Content" • This FAQ provides the necessary level of detail for the transition of the fire protection sections within the UFSAR.	(Reference 74)	2.4.4
13-0004	"Clarifications on Treatment of Sensitive Electronics" • This FAQ provides supplemental guidance for application of the damage criteria provided in Sections 8.5.1.2 and H.2 of NUREG/CR-6850 for solid-state components.	(Reference 75)	3.4.2.2 3.4.2.3.2

FAQ #	FAQ Title and Summary	Reference	SE Section
13-0005	"Cable Fires Special Cases: Self-Ignited and Caused by Welding and Cutting" • This FAQ provides additional guidance for detailed FPRA/FM concerning self-ignited cable fires and cable fires caused by welding and cutting.	(Reference 76)	3.4.2.2
13-0006	"Modeling Junction Box Scenarios in a Fire PRA" • This FAQ provides a definition for junction boxes that allow the characterization and quantification of junction box fire scenarios in plant physical access units (PAUs) requiring detailed FPRA/FM analysis and also describes a process for quantifying the risk associated with junction box fire scenarios in such plant locations.	(Reference 77)	3.4.2.2
14-0009	"Treatment of Well Sealed MCC Electrical Panels Greater Than 440V" • This FAQ provides clarification for the treatment of fire propagation from well-sealed MCC electrical cabinets with voltage levels at 440V or greater.	(Reference 78)	3.4.2.2

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 TSs and the bases thereof."

2.4.1 Orders

The NRC staff reviewed LAR Section 5.2.3, "Orders and Exemptions" and LAR Attachment O, "Orders and Exemptions," with regard to NRC-issued Orders pertinent to HBRSEP that are being revised or superseded by the NFPA 805 transition process. The LAR stated that the licensee conducted a review of 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 are maintained. The licensee discussed the affected orders and exemptions in LAR Attachment O.

The licensee's review included an assessment of docketed correspondence files. The review was performed to ensure that compliance with the physical protection requirements, security orders, and adherence to commitments applicable to HBRSEP are maintained.

The licensee determined that no Orders need to be superseded or revised to implement an FPP at HBRSEP that complies with 10 CFR 50.48(c). The NRC staff accepts the licensee's determination that no orders need to be superseded or revised to implement NFPA 805 at HBRSEP.

The licensee also performed a specific review of the license amendment that incorporated the mitigation strategies required by Section B.5.b of Commission Order EA-02-026 (subsequently incorporated into 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 HBRSEP. 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 measures required by Section B.5.b of Commission Order EA-02-026 (10 CFR 50.54(hh)(2)). 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 Commission Order EA-02-026 (10 CFR 50.54(hh)(2)) is acceptable.

Based on the information provided by the licensee, the NRC staff finds the licensee's conclusions regarding the revisions or superseding of orders acceptable.

2.4.2 License Conditions

The NRC staff reviewed LAR Section 5.2.1, "License Condition Changes," and LAR Attachment M, "License Condition Changes," regarding changes the licensee seeks to make to the HBRSEP 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 HBRSEP 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 NFPA 805 Sections 2.4, "Engineering Analyses," 2.4.3, "Fire Risk Evaluations [FREs]" and 2.4.4, "Plant Change Evaluation [PCE]." 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 revised license condition provides structure and detailed criteria to allow self-approval for FPP changes that meet the requirements of NFPA 805 with regard to engineering analyses, FREs, and PCEs. The 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 HBRSEP 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 modification and implementation schedules are identical to those identified elsewhere in the LAR, as discussed in SE Sections 2.7.1 and 2.7.2, and explicitly reviewed in SE Section 3.0.

SE Section 4.0 provides the NRC staff's review of the HBRSEP FPP license condition.

2.4.3 Technical Specifications

The NRC staff reviewed LAR Section 5.2.2, "Technical Specifications," and LAR Attachment N, "Technical Specification Changes," with regard to proposed changes to the HBRSEP TSs that are being revised or superseded during the NFPA 805 transition process. According to the LAR, the licensee conducted a review of the HBRSEP 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 HBRSEP adoption of the new fire protection licensing basis and provided applicable justification listed in LAR Attachment N. The licensee identified one change to the TSs that involved deleting TS 5.4.1.d, which requires that procedures be established, implemented, and maintained for FPP implementation.

Specifically, the licensee stated that deleting TS 5.4.1.d is adequate for adoption of the new fire protection licensing basis because the requirement for establishing, implementing, and maintaining fire protection procedures would be contained in 10 CFR 50.48(a) and 10 CFR 50.48(c). Section 50.48(c) of 10 CFR approves the incorporation of NFPA 805 by reference and NFPA 805, Section 3.2.3, "Procedures," states that "Procedures shall be established for implementation of the fire protection program."

Based on the information provided by the licensee, the NRC staff concludes that the proposed deletion is acceptable because TS 5.4.1.d is an administrative control (i.e., a procedure the licensee puts in place to establish, implement, and maintain the FPP as required by the licensee's fire protection license condition and 10 CFR 50.48(a), 10 CFR 50.48(c), and NFPA 805, Section 3.2.3), and therefore, would be redundant to the NFPA 805 requirement to establish FPP procedures. NFPA 805 requires the licensee to establish FPP procedures, and 10 CFR 50.48(a) and 10 CFR 50.48(c) would become the fire protection licensing basis of HBRSEP. In addition, failure by the licensee to establish FPP procedures would result in non-compliance with 10 CFR 50.48(c)(1), which is the licensee's fire protection licensing basis. Changes to fire protection administrative controls are controlled by the proposed fire protection license condition. For the NRC staff's evaluation of the proposed license condition, see SE Section 4.0.

2.4.4 Updated Final Safety Analysis Report

The NRC staff reviewed LAR Section 5.4, "Revision to the UFSAR" with regard to changes the licensee is proposing to make to the UFSAR. LAR Section 5.4 states that in accordance with 10 CFR 50.71(e), the UFSAR will be revised and the format and content will be consistent with NEI 04-02 and FAQ 12-0062 (Reference 74).

The NRC staff concludes that the licensee's method to update the UFSAR is acceptable because the licensee will update the UFSAR in accordance with 10 CFR 50.71(e), and the content will be consistent with the guidance contained in NEI 04-02.

2.5 Rescission of Exemptions

Since HBRSEP was licensed to operate on July 31, 1970, the HBRSEP FPP is based on compliance with 10 CFR 50.48(a) and 10 CFR 50.48(b) (Appendix R), and the HBRSEP fire protection license condition.

The NRC staff reviewed LAR Section 5.2.3, "Orders and Exemptions," LAR Attachment O, "Orders and Exemptions," and LAR Attachment K, "Existing Licensing Action Transition," with regard to previously-approved exemptions to Appendix R to 10 CFR Part 50, which will be superseded by the transition to an FPP licensing basis in conformance with NFPA 805. 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 HBRSEP.

The licensee previously requested and received NRC approval for several exemptions from 10 CFR Part 50 Appendix R. These exemptions were discussed in detail in LAR Attachment K. The licensee stated that the exemptions are either compliant with 10 CFR 50.48(c) or are no longer necessary. The licensee requested in accordance with the requirements of 10 CFR 50.48(c)(3)(i), that six exemptions be rescinded and that the engineering evaluation for one of the six exemptions be transitioned to NFPA 805. The NRC staff accepts the licensee's determination that six exemptions be rescinded and that the engineering evaluation for one of the six exemptions be transitioned to NFPA 805.

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 issued by the NRC on November 25, 1983 (Reference 26), October 25, 1984 (Reference 79), March 7, 1985 (Reference 80), September 17, 1986 (Reference 81), and October 17, 1990 (Reference 82), are rescinded as requested by the LAR because the underlying condition has been evaluated using RI/PB methods and found to be acceptable with no further actions because DID and sufficient safety margin is maintained:

- Area C Exemption to Section III.G.2 of Appendix R to 10 CFR Part 50 (October 17, 1990), regarding additional intervening cable combustibles in the component cooling water pump room.

- Area C Exemption to Section III.G.2 of Appendix R to 10 CFR Part 50 (October 25, 1984), regarding area-wide automatic suppression in the component cooling water pump room.

- Area F Exemption from the Requirements of Section III.G.2.f of Appendix R to 10 CFR 50 (September 17, 1986), regarding Rockbestos cables inside

containment be kept free of fire damage.

- Area G3 Exemption from the requirements of Section III.G.2 of Appendix R to 10 CFR Part 50 (November 25, 1983), for 1- hour barrier, 20 feet separation, or automatic suppression.

- Area H Exemption from the requirements of Section III.G.2 of Appendix R to 10 CFR Part 50 regarding 3-hour rated barriers be installed to separate redundant trains (November 25, 1983).

The following exemption is rescinded as requested by the LAR, but the engineering evaluation of the underlying condition will be used as a qualitative engineering evaluation for transition to NFPA 805:

- Exemption from the Requirements of Section III.O of Appendix R to 10 CFR Part 50 (March 7, 1985), reactor coolant pump lube oil collection system.

2.6 Self Approval Process for Fire Protection Program Changes (Post-Transition)

Upon completion of the implementation of the RI/PB FPP and issuance of the license condition discussed in SE Section 2.4.2, 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 that:

> 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 PCE process requirements to address potential changes to the NFPA 805 RI/PB FPP after implementation is completed. The licensee indicated that it developed a change process that is based on the guidance provided in NEI 04-02 (Reference 7), Section 5.3, "Plant Change Process," as well as Appendices B, I, and J, as modified by RG 1.205 (Reference 4), Regulatory Positions 2.2.4, 3.1, 3.2, and 4.3.

LAR Section 4.7.2 states that the PCE process consists of four steps:

1. Defining the change;

2. Performing the preliminary risk screening;

3. Performing the risk evaluation; and

4. Evaluating the acceptance criteria.

In the LAR, the licensee stated that the PCE process begins by defining the change or altered condition in the LAR to be examined and the baseline configuration. The baseline is defined by the design basis and licensing basis. The licensee also stated that the baseline is defined as that plant condition or configuration that is consistent with the design basis and licensing basis 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 is then performed to identify and resolve minor changes to the FPP and that the screening is consistent with fire protection regulatory review processes in place at nuclear plants under traditional licensing bases. The licensee further stated that the screening process is modeled after NEI 02-03, "Guidance for Performing a Regulatory Review of Proposed Changes to the Approved Fire Protection Program," June 2003 (Reference 83), and that the process will address most administrative changes (e.g., changes to the combustible control program, organizational changes, etc.).

The licensee stated that the screening is followed by engineering evaluations that may include FM and risk assessment techniques and that the results of these evaluations are then compared to the acceptance criteria. The licensee further stated that changes that satisfy the acceptance criteria of NFPA 805, Section 2.4.4 and the license condition can be implemented within the framework provided by NFPA 805, 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 core damage frequency (CDF) and LERF be consistent with the 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 and 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 the PCEs are assessed for acceptability using the delta (Δ) CDF (change in CDF) and Δ LERF (change in LERF) criteria from the license condition and that the proposed changes are also assessed to ensure they are consistent with the DID philosophy and that sufficient safety margins were maintained.

The licensee stated that the FPP configuration is defined by the program documentation and the existing configuration control processes for modifications, calculations and analyses, and FPP license basis reviews will be utilized to maintain configuration control of the FPP documents. The licensee further stated that the configuration control procedures that govern the various HBRSEP documents and databases that currently exist will be revised to reflect the new NFPA 805 licensing bases requirements. In LAR Attachment S, Table S-3, Implementation

Item 6, the licensee included the action to "update configuration control procedures to reflect the new NFPA 805 licensing bases requirements," which the NRC considers acceptable because the action will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

The licensee stated that several NFPA 805 document types, such as NSCA supporting information and Non-Power Mode NSCA Treatment, generally require new control procedures and processes to be developed since they are new documents and databases created as a result of the transition to NFPA 805. The licensee further stated that 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. In LAR Attachment S, Table S-3, Implementation Item 6, the licensee included the action to "update configuration control procedures to reflect the new NFPA 805 licensing bases requirements," which the NRC staff considers acceptable because the action will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

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 is 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, SSD/NSCA, FPRA) 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: Comply with NFPA 805 Chapter 3 and 4.2.3 requirements.

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

The licensee stated that this process follows the requirements in NFPA 805 and the guidance outlined in RG 1.174 (Reference 31). NFPA 805 requires the use of qualified individuals, procedures that require calculations be subject to independent review and verification, record retention, peer review, and a corrective action program that ensures appropriate actions are taken when errors are discovered.

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 HBRSEP 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.

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 (Reference 7), as well as RG 1.205, (Reference 4), and addresses attributes for using FREs in accordance with NFPA 805. NFPA 805, Section 2.4.4 requires that PCEs consist of an integrated assessment of risk, DID and safety margins. NFPA 805, Section 2.4.3.1 requires that the probabilistic safety assessment (PSA) use CDF and LERF as measures for risk. NFPA 805, Section 2.4.3.3 requires that the risk assessment approach, methods, and data shall be acceptable to the authority having jurisdiction (AHJ) which is the NRC. NFPA 805, Section 2.4.3.3 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 margins as discussed above.

2.6.2 Requirements for the Self Approval Process Regarding Plant Changes

Risk assessments performed to evaluate PCEs must utilize methods that are acceptable to the NRC staff. Acceptable methods to assess the risk of the proposed plant change may include (1) methods that have been used in developing the peer-reviewed FPRA model, (2) 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 (3) 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 (Reference 7) as well as RG 1.205 (Reference 4). The NRC staff concludes that the proposed PCE process at HBRSEP, which includes defining the change, a preliminary risk screening, a risk evaluation, and an acceptability determination, as described in SE 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 margins.

However, before achieving full compliance with 10 CFR 50.48(c) by implementing the plant modifications and implementation items discussed in SE Section 2.7.1 (i.e., during full implementation of the transition to NFPA 805), the proposed license condition provides that 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 proposed license condition ensures that fire protection DID and safety margins 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, (Reference 4), 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 quantitative basis. Specifically, the license conditions 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. NFPA 805 Section 1.7 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 AHJ 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, in part, that "[e]ngineering analysis is an acceptable means of evaluating a 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:

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. The NRC staff's review of the licensee's compliance with NFPA 805, Sections 2.7.1 and 2.7.3 is provided in SE Section 3.8.

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 condition, and 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 HBRSEP 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 assure 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 FREs conducted to determine the change in risk associated with proposed plant changes.

2.7 Modifications and Implementation Items

Regulatory Position C.3.1 of RG 1.205, Revision 1, (Reference 4), states 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 list of modifications and implementation items originally submitted in the LAR has been updated by the licensee with the final version of LAR Attachment S, "Plant Modifications and Items to be Completed during Implementation," provided in the licensee's letters dated May 25, 2016 (Reference 17) and October 5, 2016 (Reference 19).

2.7.1 Modifications

The NRC staff reviewed LAR Attachment S, "Plant Modifications and Items to be Completed during Implementation," which describes the plant modifications necessary to implement the proposed NFPA 805 licensing basis. These modifications are identified in the LAR as necessary to bring HBRSEP into compliance with either the deterministic or PB requirements of NFPA 805. LAR Attachment S, Table S-2 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 confirmed that the modifications identified in LAR Attachment S, Table 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 Attachment S, Table S-2 modifications, and the associated completion schedule are the same as those provided in the proposed NFPA 805 license condition.

As depicted in LAR Attachment S, Table S-1, the licensee has completed 19 modifications 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 HBRSEP 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). The modifications will be completed in accordance with the schedule provided in the proposed NFPA 805 license condition, which states that all modifications will be completed by the end of the unit refueling outage currently scheduled for September/October 2020. In addition, the licensee has agreed to keep the appropriate compensatory measures in place until the modifications are complete.

2.7.2 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). The licensee identified the implementation items in LAR Attachment S, Table S-3. 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. Completion of these items in accordance with the schedule discussed in SE Section 2.7.3 does not change or impact the bases for the safety conclusions made by the NRC staff in the SE.

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) which states that implementation items described in LAR Attachment S, Table S-3, will occur within 365 days after receipt of the safety evaluation/license amendment with the exception of implementation items S-3.11, 12, and 14, which are associated with modifications and will be completed after all procedure updates, modifications and training are complete.

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 and could be subject to appropriate NRC enforcement action as they would be required by the proposed license conditions.

2.7.3 Schedule

LAR Section 5.5, as supplemented, provides the overall schedule for completing the NFPA 805 transition at HBRSEP. The licensee stated that it will complete the implementation of new

NFPA 805 FPP to include procedure changes, process updates, and training to affected plant personnel 12 months after NRC approval, except for items S-3.11, 12, and 14, which are associated with modifications and will be completed after all procedure updates, modifications, and training are complete.

LAR Section 5.5, as supplemented, states that the modifications will be completed by the startup of the third refueling outage after issuance of the SE currently scheduled for September/October 2020, and that appropriate compensatory measures will be maintained until the modifications are complete.

Based on the information provided by the licensee, the NRC staff concludes that the completion schedules proposed by the licensee for the modifications and implementation items are acceptable.

3.0 TECHNICAL EVALUATION

The following sections evaluate the technical aspects of the LAR to transition the FPP to one based on NFPA 805 (Reference 3) 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 35), 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 SE Section 2.0. 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 Fire Protection Program 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 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 a 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 a 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 a 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 (QA).

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

3.1 NFPA 805 Fundamental FPP Elements and Minimum Design Requirements

NFPA 805 (Reference 3), 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, 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) specifically permits 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 (which is 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 (Reference 7), as endorsed by the NRC in RG 1.205 (Reference 4), to assess the proposed HBRSEP 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 HBRSEP FPP and provided specific compliance statements for each NFPA 805, 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 HBRSEP, and others are provided with multiple compliance statements to fully document compliance with the element.

The methods used by HBRSEP for achieving compliance with the 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 & Design Elements" (also called the B-1 Table), as "Complies."

2. The existing FPP element complies through the use of an explanation or clarification: noted in the B-1 Table 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 the B-1 Table as "Complies via Engineering Evaluation."

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 the B-1 Table as "Complies via 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 the B-1 Table as "License Amendment Required."

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 on 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 it evaluated the EEEEs used to demonstrate compliance with the NFPA 805, Chapter 3 requirements in order to ensure continued appropriateness, quality, and applicability to the current HBRSEP plant configuration. The licensee determined that no EEEE used to support compliance with NFPA 805 required NRC approval.

EEEEs (previously known as GL 86-10 (Reference 84) evaluations) were 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 LAR Attachment K.

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 validity of the licensee's statements, the NRC staff concludes that the licensee's statements of compliance are acceptable.

The following NFPA 805 sections identified in the LAR Table B-1 as complying via this method required additional review by the NRC staff:

- 3.4.1(c)

NFPA 805, Section 3.4.1(c) requires the fire brigade leader and two members to have sufficient training and knowledge of nuclear safety systems. In Fire Protection Engineering (FPE) RAI 03 (Reference 20) the NRC staff requested additional information regarding the training provided to the HBRSEP fire brigade leader and members that addresses their ability to assess the effects of fire and fire suppressants on NSPC. In its response to FPE RAI 03 (Reference 10), the licensee stated that the brigade leader and at least two brigade members of the on-shift fire brigade shall have sufficient training and knowledge of nuclear safety systems to understand the effects of fire and fire suppressants on nuclear safety performance, which is consistent with NFPA 805 Chapter 3 Section 3.4.1(c) and described in fleet procedures. The licensee stated the procedures provide an equivalent knowledge of the plant systems for a pressurized water reactor that represent the minimum plant knowledge for a Non-Licensed Operator fire brigade member or leader to understand the effects of fire and fire suppressants on NSPC. The licensee stated that these systems include:

- Reactor Coolant System
- Steam Generator System
- Auxiliary Feed System
- Charging and Volume Control System
- Residual Heat Removal System
- Safety Injection System
- Containment Spray System
- Component Cooling Water System
- Emergency Service Water System
- Electrical System Overview - AC & DC
- Emergency Core Cooling Systems

Based on the information provided by the licensee in response to FPE RAI 03, the NRC staff concludes that the licensee's statement of compliance is acceptable, because the fire brigade leader and at least two fire brigade members have the minimum plant knowledge for a Non-Licensed Operator, which includes knowledge of the plant systems identified above and are trained to understand the effects of fire and fire suppressants on NSPC; and therefore, meet the requirement of NFPA 805, Section 3.4.1(c).

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 will meet the underlying requirement for the FPP element as clarified.

The following NFPA 805 sections identified in LAR, Attachment A, Table B-1 as complying via this method required additional review by the NRC staff:

- 3.3.1.3.1
- 3.4.4
- 3.9.4
- 3.3.5.3
- 3.5.2
- 3.10.7
- 3.4.2.4
- 3.6.4
- 3.11.3(3)
- 3.4.3(b)
- 3.9.2

NFPA 805 Section 3.3.1.3.1 requires that a hot work safety procedure be developed, implemented, and periodically updated as necessary in accordance with NFPA 51B, "Standard for Fire Prevention During Welding, Cutting, and Other Hot Work" (Reference 56), and NFPA 241, "Standard for Safeguarding Construction, Alteration, and Demolition Operations" (Reference 59). The licensee stated that compliance with NFPA 241 is by clarification and is addressed through compliance with NFPA 51B on the basis that NFPA 241 references NFPA 51B with respect to responsibility for hot work operations and fire prevention precautions. The NRC staff concludes that the licensee's statement of compliance with NFPA 805 Section 3.3.1.3.1 is acceptable because it meets the intent of this element, which is to ensure that appropriate controls are in place for hot work and these controls are based on the referenced standards.

NFPA 805 Section 3.3.5.3 requires that electric cable construction shall comply with a flame propagation test as acceptable to the AHJ. The licensee stated that FAQ 06-0022 provides an appendix to evaluate currently recognized flame propagation tests to Institute of Electrical and Electronics Engineers (IEEE) Standard 383, "Qualifying Class 1E Electric Cables and Field Splices for Nuclear Power Generating Stations" (Reference 85). In FPE RAI 01 (Reference 20) the NRC staff requested that the licensee describe the specific application of FAQ 06-0022 and which aspects of the FAQ are being credited in lieu of meeting NFPA 805, Section 3.3.5.3. In its response to FPE RAI 01 (Reference 12), the licensee stated that non-IEEE 383-1974 qualified cables used at HBRSEP are IEEE-383-1974 equivalent since they meet the cable standards identified in Table 2 of FAQ 06-0022, except for some original polyvinyl chloride (PVC) jacketed cabling. The licensee stated that depending on when the PVC jacketed cables were installed, the cables may not meet the requirements of IEEE-383-1974 or equivalent standards. The licensee further stated that the original cables not meeting the requirements of IEEE-383 or equivalent were coated with fire retardant material that meets or exceeds the original cable coating requirements to prevent propagation and was previously approved as described in LAR Attachment A for this attribute. Lastly, the licensee provided a revision to LAR Attachment A, Section 3.3.5.3, to incorporate the information described in its response to the

RAI. The NRC staff finds that the use of a flame-retardant coating in lieu of installing cables meeting flame propagation tests as required by this attribute of NFPA 805 is acceptable per the requirement in 10 CFR 50.48(c)(2)(v). Based on the licensee's response to FPE RAI 01, and the revision to LAR Attachment A, the NRC staff concludes that the licensee's statement of compliance with NFPA 805, Section 3.3.5.3, is acceptable because the installed cables meet equivalent standards described in FAQ 06-0022 or alternatively, the cables are coated with a fire retardant material that was previously approved and meets the requirements of 10 CFR 50.48(c)(2)(v).

NFPA 805 Section 3.4.2.4 requires that pre-fire plans shall address coordination with other plant groups during fire emergencies. The licensee stated that HBRSEP has a procedure, which is not specifically a fire pre-plan, and that this procedure provides specific instructions for actions required from key groups at HBRSEP supporting the fire brigade/fire emergency actions. The licensee further stated that the procedure includes detailed response coordination actions specified for control room, radiological controls personnel, and the security group, and that any other coordination actions would be initiated by the control room personnel as needed for any plant emergency. The NRC staff concludes that the licensee's statement of compliance with NFPA 805, Section 3.4.2.4 is acceptable because it meets the intent of this element, which is to ensure that appropriate controls are in place to provide coordination of appropriate plant groups during a fire emergency.

NFPA 805 Section 3.4.3(b) requires that plant personnel who respond with the industrial fire brigade shall be trained as to their responsibilities, potential hazards to be encountered, and interfacing with the industrial fire brigade. The licensee stated that guidance for non-industrial fire brigade members is provided in a procedure that defines the actions needed to be taken by personnel discovering a fire, security personnel actions, and duty health physics contact actions. In FPE RAI 02 (Reference 20), the NRC staff requested the licensee provide additional detail regarding the elements of this procedure and training that demonstrates compliance with the requirements for training on responsibilities, potential hazards to be encountered, and interfacing with the industrial fire brigade. In its response to FPE RAI 02 (Reference 10), the licensee stated that the clarification to the NFPA 805 Section 3.4.3(b) requirements is that HBRSEP has a dedicated fire brigade and does not have personnel responding who are not active fire brigade members. The licensee further stated that the clarification element being addressed is how a non-industrial fire brigade member is trained in the event a fire is discovered or indication/suspicion of a fire by plant personnel. The licensee stated that the guidance provided in the procedure includes steps that should be taken, which include reporting the fire event immediately to the control room, and then a person who is knowledgeable in fire extinguisher use, may attempt to extinguish a non-plant equipment related fire (e.g., trash can fire) with an appropriate fire extinguisher. The licensee further clarified that if the fire cannot be readily extinguished, then plant personnel are to remain in the vicinity at a safe distance until arrival of the fire brigade and inform the Fire Brigade Incident Commander of the circumstances. Based on the licensee's response to FPE RAI 02, the NRC staff concludes that the licensee's statement of compliance with NFPA 805, Section 3.4.3(b) is acceptable because training is provided to plant personnel who discover a fire and no additional non-fire brigade personnel respond with the industrial fire brigade.

NFPA 805 Section 3.4.4 requires that protective clothing, respiratory protective equipment, radiation monitoring equipment, personal dosimeters, and fire suppression equipment such as hoses, nozzles, fire extinguishers, and other needed equipment shall be provided for the industrial fire brigade and that this equipment shall conform to the applicable NFPA standards. The licensee stated that HBRSEP has not committed to following any NFPA standards

pertaining to firefighting equipment. The licensee further stated that firefighting equipment is provided and a monthly inspection/inventory of fire protection equipment and supplies located in the fire equipment staging areas to meet the demands of the site fire brigade is conducted per procedure. The licensee stated that personnel dosimeters are issued in accordance with the plant radiation protection program and procedures and health physics personnel, who provide fire brigade support, provide radiation monitoring equipment in accordance with the fire emergency procedure. In FPE RAI 14 (Reference 20), the NRC staff requested a description of the requirements or standards that will be established when purchasing replacement protective clothing, hoses, nozzles, fire extinguishers and other equipment for the fire brigade use in order to ensure suitable products are procured. In its response to FPE RAI 14 (Reference 10), the licensee stated that HBRSEP will follow its fleet procedure, which follows the guidance found in NFPA standards associated with fire-fighting personal protective equipment, such as hoses, nozzles, fire extinguishers and other equipment, and the fleet procedure meets the requirements of Chapter 3. The licensee also revised LAR Attachment A, Section 3.4.4 (Reference 13), to incorporate the information provided in its response to FPE RAI 14. The NRC staff concludes that the licensee's statement of compliance with NFPA 805, Section 3.4.4 and LAR Attachment A, as revised, is acceptable because it meets the intent of this element to ensure that appropriate and suitable fire protection equipment is provided to the fire brigade.

NFPA 805 Section 3.5.2 requires that fire water tanks shall be interconnected such that fire pumps can take suction from either or both tanks and that a failure in one tank or its piping shall not allow both tanks to drain. The licensee stated that fire water is obtained directly from Lake Robinson via a single intake structure, and that two physically separated automatic fire pumps are provided with separate suction lines. The licensee stated that HBRSEP complies with Exception No. 1 of NFPA 805 Section 3.5.2, which states that water storage tanks shall not be required when fire pumps are able to take suction from a large body of water (such as a lake), provided each fire pump has its own suction and both suctions and pumps are adequately separated. The NRC staff concludes that the licensee's statement of compliance with NFPA 805, Section 3.5.2 is acceptable because it meets Exception 1 of the requirement, and therefore complies with the requirement.

NFPA 805 Section 3.6.4 requires that provisions shall be made to supply water at least to standpipes and hose stations for manual fire suppression in all areas containing systems and components needed to perform the nuclear safety functions in the event of a SSD earthquake. The licensee stated that seismic standpipes are not an original commitment for HBRSEP and that Appendix A to BTP APCSB 9.5-1 did not require seismically qualified standpipes and hose stations for operating plants and plants with construction permits issued prior to July 1, 1976. Therefore, the requirement in Section 3.6.4 of NFPA 805 is not applicable to licensees with non-seismic standpipes and hose stations previously approved in accordance with Appendix A to BTP APCSB 9.5-1. The NRC staff concludes that the licensee's statement of compliance with NFPA 805 Section 3.6.4 is acceptable because the requirement to design standpipes and hose stations to SSD earthquake criteria was not applicable to plants originally licensed to meet the guidelines of Appendix A to BTP APCSB 9.5–1.

NFPA 805 Section 3.9.2 requires that automatic and manual water-based fire suppression systems be equipped with a water flow alarm. The licensee stated that some automatic water-based fire suppression systems do not have water flow alarms. The licensee stated that these systems are not required to have water flow alarms per NFPA 13," Standard for the Installation of Sprinkler Systems" (Reference 54) which only requires water flow alarms to be provided on sprinkler systems having more than 20 sprinklers. In FPE RAI 05 (Reference 20), the NRC staff identified that NEI 04-02 defines "complies with clarification" as an editorial issue

and compliance should be explained in the compliance basis field. The NRC staff does not consider the lack of water flow alarms an editorial issue and requested that the licensee provide a compliance strategy commensurate with the guidance of NEI 04-02. In its response to FPE RAI 05 (Reference 10), the licensee revised its compliance strategy for NFPA 805 Section 3.9.2 to "Compliance via Engineering Evaluation." The licensee also revised LAR Attachment A, Section 3.9.2 to incorporate the change to the compliance basis (Reference 13). The NRC staff concludes that the licensee's revised statement of compliance with NFPA 805 Section 3.9.2 and LAR Attachment A, as supplemented, is acceptable because the evaluation of a lack of water flow alarms was performed using an engineering evaluation, which is an acceptable compliance strategy in accordance with the requirements of NFPA 805 and the guidance in NEI 04-02, Section 4.3.1.

NFPA 805, Section 3.9.4 requires that the diesel-driven fire pumps shall be protected by automatic sprinklers. In LAR Attachment A, the licensee stated that the diesel-driven fire pump is located outdoors and is separated from other important equipment and therefore "complies with clarification." In FPE RAI 06 (Reference 20), the NRC staff identified that NEI 04-02 defines "complies with clarification" as an editorial issue and compliance should be explained in the compliance basis field. The NRC staff does not consider the lack of automatic sprinklers for the diesel fire pump an editorial issue, and requested that the licensee provide a compliance strategy commensurate with the guidance in NEI 04-02. In its response to FPE RAI 06 (Reference 10), the licensee revised its compliance strategy for NFPA 805 Section 3.9.4 to "Compliance via Engineering Evaluation." The licensee also revised LAR Attachment A, Section 3.9.4 to incorporate the change to the compliance basis (Reference 13). The NRC staff concludes that the licensee's revised statement of compliance with NFPA 805 Section 3.9.4 and LAR Attachment A, as supplemented, is acceptable because the evaluation of lack of automatic sprinkler protection for the diesel-driven fire pumps was performed using an engineering evaluation, which is an acceptable compliance strategy in accordance with the requirements of NFPA 805 and the guidance in NEI 04-02, Section 4.3.1.

NFPA 805 Section 3.10.7 requires that automatic total flooding carbon dioxide systems are equipped with an audible pre-discharge alarm, a discharge delay sufficient to permit egress of personnel, and an odorizer. The licensee stated that a modification will be performed to comply with this requirement. The modification is identified in LAR Attachment S, Table S-2, Item 9. On the basis that the required action as described by the licensee will incorporate the provisions of NFPA 805, Chapter 3 in the FPP, and the action is included as a modification in LAR Attachment S, which would be required by the proposed license condition, the NRC staff concludes that the licensee's statement of compliance is acceptable.

NFPA 805 Section 3.11.3(3) requires that passive fire protection devices such as doors and dampers shall conform to NFPA 101, "Life Safety Code" (Reference 55). The licensee stated that HBRSEP complies with clarification with NFPA 101. HBRSEP complies with NFPA 101 regarding fire rated door assemblies because NFPA 101, Section 8.3.3.1 refers to NFPA 80, "Standard for Fire Doors and Other Opening Protectives" (Reference 86), and complies with NFPA 101 regarding fire dampers since NFPA 101, Section 9.2.1 refers to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems" (Reference 87). The NRC staff concludes that the licensee's statement of compliance with NFPA 805, Section 3.11.3(3) is acceptable because by complying with applicable sections of NFPA 80 and NFPA 90A for fire doors and fire dampers HBRSEP meets the applicable requirements of NFPA 101.

3.1.1.3 Compliance Strategy -- Complies with Use of EEEEs

In several NFPA 805, Chapter 3 requirements, the licensee demonstrated compliance with the fundamental FPP element through the use of EEEEs. The NRC staff reviewed the licensee's statement of continued validity for the EEEEs and the statement on the quality and appropriateness of the evaluations, and concludes that the licensee's statements of compliance in these instances are acceptable. The licensee indicated that none of the transitioning EEEEs require NRC approval.

3.1.1.4 Compliance Strategy -- Complies via Previous NRC Approval

Certain NFPA 805, Chapter 3 requirements were supplanted by an alternative that was previously approved by the NRC. The approval was documented in (1) the original 1978 FPP NRC SE dated February 28, 1978 (Reference 88), (2) Open issues from this SE were documented in supplements to the SE dated September 4, 1979 (Reference 89), February 21, 1980 (Reference 90), and December 8, 1980 (Reference 91), and (3) Exemptions from certain requirements of Section III.G.2 and III.G.3 were also granted by the NRC in letters dated November 13, 1981 (Reference 92), November 25, 1983 (Reference 26), October 25, 1984 (Reference 79), September 17, 1986 (Reference 93), June 30, 1988 (Reference 94), and October 17, 1990 (Reference 95).

In each instance, 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 had been demonstrated using suitable documentation that meets the approved guidance contained in RG 1.205. 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 the transition to NFPA 805 at HBRSEP. The NFPA 805 sections identified in LAR Attachment A, Table B-1 as complying via this method are as follows:

- 3.3.5.1, which concerns the requirement that electrical wiring above suspended ceilings be listed for plenum use, routed in armored cable, routed in metallic conduit, or routed in cable trays with solid metal top and bottom covers. The licensee requested NRC approval for the use of a PB method to justify the use of wiring above suspended ceilings, thereby meeting the requirements of NFPA 805, Section 3.3.5.1. See SE Section 3.1.4.1 for the NRC staff's evaluation of this request.

- 3.3.5.2, which concerns the requirement that only metal tray and metal conduits shall be used for electrical raceways; that thin wall metallic tubing shall not be used for power, instrumentation, or control cables; and that flexible metallic conduits shall only be used in short lengths to connect components. The licensee requested NRC approval for the use of a PB method to justify the use of PVC and high density polyethylene (HDPE) type ducts (conduits) in embedded

configurations, thereby meeting the requirements of NFPA 805, Section 3.3.5.2. See SE Section 3.1.4.2 for the NRC staff's evaluation of this request.

- 3.5.16, which concerns the requirement that the fire protection water supply system shall be dedicated for fire protection use only. The licensee requested NRC approval for the use of a PB method to justify the use of fire protection water for non-fire protection system water demands, thereby meeting the requirements of NFPA 805, Section 3.5.16. See SE Section 3.1.4.3 for the NRC staff's evaluation of this request.

- 3.2.3(1), which concerns procedures for inspection, testing, and maintenance for fire protection systems and features credited by the FPP. The licensee requested approval to use EPRI Technical Report TR-1006756, "Fire Protection Surveillance Optimization and Maintenance Guide for Fire Protection," (Reference 96), for establishing frequencies for fire protection equipment, thereby meeting the requirements of NFPA 805, Section 3.2.3(1). See SE Section 3.1.4.4 for the NRC staff's evaluation of this request.

- 3.3.4, which concerns the requirement that thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials be non-combustible or limited combustible. The licensee requested NRC approval for the use of a PB method to justify the use of thermal insulation materials such as AP Armaflex, Insul-Tube180, and Insul-Sheet thermal insulation materials, thereby meeting the requirements of NFPA 805, Section 3.3.4. See SE Section 3.1.4.5 for the NRC staff's evaluation of this request.

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

3.1.1.6 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 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.

3.1.1.7 Chapter 3 Sections Not Reviewed

Some NFPA 805, Chapter 3 sections either do not apply to the transition to a 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 Sections 3.4.5 and 3.11).

- Sections that are not applicable to HBRSEP because of the following:

— The licensee stated that it does not have systems of this type installed [e.g., NFPA 805 Section 3.10.1(3) Clean Agent Fire Extinguishing Systems, and Section 3.9.1(4) NFPA 16, Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems].

— The type of system, while installed, is not required under the RI/PB FPP (e.g., NFPA 805 Section 3.10.4 Gaseous Suppression System Single Failure - No areas are required to be protected by both primary and backup gaseous fire suppression systems).

— The requirements are structured with an applicability statement (e.g., NFPA 805 Sections 3.4.1(a)(2) and 3.4.1(a)(3), which apply to the type of fire brigade specified in the FPP).

3.1.1.8 Compliance with Chapter 3 Requirements Conclusion

As discussed above, the NRC staff evaluated the results of the licensee's assessment of the proposed HBRSEP 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 accomplished the following:

- 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 HBRSEP's state of compliance with the NFPA 805, Chapter 3 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) given adequate justification or after the completion of an implementation item.

  — Via previous NRC staff approval of an alternative to the requirement.

  — Through the use of an engineering equivalency evaluation.

  — Through the use of a combination of the above methods.

  — Through the use of a PB method that the NRC staff has specifically approved in accordance with 10 CFR 50.48(c)(2)(vii).

3.1.2 Identification of Power Block

The NRC staff reviewed the HBRSEP structures identified in LAR Attachment I, Table I-1 "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 HBRSEP RI/PB FPP that have additional requirements in accordance with 10 CFR 50.48(c) and NFPA 805. As stated in the LAR, Section 4.1.3, the term power block refers to structures that have equipment required for nuclear plant operations, such as Containment, Auxiliary Building, Service Building, Control Building, Fuel Building, Radioactive Waste, Water Treatment, Turbine Building and intake structures or structures that are identified in the facility's pre-transition licensing basis. In LAR Attachment I, the licensee stated that the structures in the Owner Controlled Area were evaluated to determine those structures that contain equipment that is required to meet the NSPC and radioactive release performance criteria described in Section 1.5 of NFPA 805. The licensee identified these structures in LAR Attachment I, Table I-1. Additionally, the licensee stated that the Independent Spent Fuel Storage Installation Area was considered for radioactive release firefighting activities, and that this area is not included in the NFPA 805 definition of power block or any analysis because it is licensed under 10 CFR Part 72. The NRC staff concludes that the licensee has appropriately evaluated the structures and equipment at HBRSEP, and adequately documented a list of those structures that fall under the definition of "power block" in NFPA 805.

3.1.3 Plant Specific Treatments or Technologies

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

GL 2006-03 (Reference 53), 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.

In a letter dated June 8, 2006 (Reference 97), the licensee stated that Hemyc is used as a 1-hour electrical raceway fire barrier system (ERFBS) for conduits and is credited for separation of SSD cables in a single fire area in accordance with the plants licensing basis. The licensee further stated that the installation is relied upon in NRC exemptions dated October 25, 1984, and October 17, 1990. The licensee further stated that it also uses MT fire barrier material on both sides of two (2) penetration seals and that the MT fire barrier was applied over the surface of the penetrations to supplement the existing silicone foam seal design. The licensee further stated that the penetrations contain steam generator blowdown lines that are subject to movement as they heat up and cool down and that these installations are relied upon in support of engineering evaluations of penetration seal designs in accordance with GL 86-10, "Implementation of Fire Protection Requirements" (Reference 84), and are not used for protection of electrical raceway circuits. The licensee further stated that it submitted a letter of intent to transition to NFPA 805 and that as a proactive measure, the Hemyc fire wrap is being replaced by a new ERFBS that will provide a 1-hour fire rating that has been tested and qualified in accordance with GL 86-10, Supplement 1 (Reference 98), and the replacement fire wrap will be installed by December 1, 2007.

In FPE RAI 07 (Reference 20), the NRC staff identified that LAR Attachment S, Table S-1, Item 3 indicates that Hemyc fire barrier wrap was replaced with Interam E54A™ for protecting the Component Cooling Water pumps A and C power supply raceways. However, in LAR Attachment C, the licensee identified an EEEE for fire area A3, A6, and A11 that evaluates the use of Promatec MT protection of the Steam Generator Blowdown System lines and penetrations. In FPE RAI 07, the NRC staff requested HBRSEP to provide a description of any other credited Hemyc or Promatec MT fire barriers used for the nuclear safety capabilities assessment. In its response to FPE RAI 07.a (Reference 12), the licensee stated that Promatec MT material is used as part of the configuration of several fire barrier penetration seals, including those accommodating the steam generator blowdown lines, and that the combination of the silicone foam seal within the barrier itself, and the coverage and shielding provided by the Promatec MT blanket wrap on both sides of the penetrations provides assurance that the composite assembly is capable of withstanding the fire challenge that would be imposed by the fire hazards present within the associated fire zones. In its response to FPE RAI 07.b (Reference 12), the licensee stated that no Hemyc or Promatec MT materials are credited for ERFBS barriers or any other uses other than the non-standard fire barrier penetration seal configuration that were evaluated to meet NFPA 805 Section 3.11.4 requirements as described in LAR Attachment A. The licensee stated that it evaluated these non-standard penetration seal configurations in an EEEE as adequate for the hazards present in these fire areas and are acceptable based on a DID approach that utilizes the fire resistance characteristics of the as built conditions, presence of ignition sources, arrangement, quantity, and type of combustibles present, active and passive fire protection features present, segregation of SSD trains, and fire brigade response for both sides of the fire barriers in question. Based on the licensee's response to FPE RAI 07, the NRC staff concludes that the licensee does not utilize Hemyc or MT as an ERFBS because the EEEE evaluates the Promatec MT material that is installed as part of a fire barrier penetration seal configuration and as such has been evaluated to meet NFPA 805, Section 3.11.4.

3.1.3.2 Very Early Warning Fire Detection Systems

The licensee proposed the installation of VEWFDS to monitor conditions, as well as provide indication and alarms, inside key electrical cabinets and fire areas during the incipient stage of a fire. In LAR Attachment S, the licensee indicated that the VEWFDS will be installed in the unit 2 cable spreading room; safeguards cabinets 50-64; Hagan room cabinets 1 – 30 and the turbine supervisory cabinet; and rod control room in sources 0314, 0315, 0317, and 0319.

In FPE RAI 10.a (Reference 20), the NRC staff requested that the licensee provide the design features for the proposed systems along with a comparison of these specified design features to their role in satisfying or supporting the risk reduction features described in FAQ 08-0046, including the testing criteria to be met prior to operation. In its response to FPE RAI 10.a (Reference 12), the licensee stated that the VEWFDS will be an air-aspirated smoke detection system, and the design will support satisfying the risk reduction features described in FAQ 08-0046 for in-cabinet systems. The licensee also stated that no FPRA credit will be taken for the VEWFDS in the MCR. In its response to PRA RAI 16.01.01 (Reference 17), the licensee stated that for area-wide VEWFDS during transition, the FPRA will assume no credit. However, an implementation item to update the FPRA with an NRC-accepted method for crediting area-wide VEWFDS prior to self-approval in areas crediting an area-wide VEWFDS has been added to LAR Attachment S. Subsequently, in its letter dated October 5, 2016 (Reference 19), the licensee submitted a revised LAR Attachment S, Table S-3, Implementation Item 14, which states that "Prior to the use of the FPRA to support self-approval of FPP changes that rely on incipient detection, update the FPRA to incorporate the NRC-accepted method and confirm that

the transition change-in-risk estimates do not exceed the RG 1.174 acceptance guidelines." The licensee stated that the testing criteria will meet NFPA 72, "National Fire Alarm and Signaling Code (Reference 57) and specifically NFPA 76, "Standard for the Fire Protection of Telecommunications Facilities" (Reference 58), for the transport time and obscuration requirements.

The licensee further stated that plant procedures will be developed to ensure that VEWFDS alarms are promptly addressed with qualified plant personnel who will be present in the immediate area prior to fire growth, allowing for fire prevention or prompt fire response. The NRC staff concludes that the licensee's response to FPE RAI 10.a is acceptable relative to compliance with applicable fire protection fundamental design elements of NFPA 805, because the licensee has stated that the design features of the VEWFDS modification will meet the guidance in FAQ 08-0046, including NFPA 72 and NFPA 76. Detailed discussion of the VEWFDS is in contained in SE Section 3.2.6.

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 of 10 CFR 50.48(c)(2)(vii) that 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 DID (fire prevention, fire detection, fire suppression, mitigation, and post-fire SSD capability).

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 1.3.2, "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 1.4.1, "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 1.4.2, "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.
>
> (2) The source term is capable of being limited.

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 PWR [pressurized-water reactor] and shall be capable of maintaining or rapidly restoring reactor water level above top of active fuel for a BWR [boiling-water reactor] 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.

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.

In LAR Attachment L, "NFPA 805, Chapter 3, Requirements for Approval (10 CFR 50.48(c)(2)(vii)," the licensee requested NRC staff review and approval of PB methods to demonstrate an equivalent level of fire protection for the elements identified in SE, Section 3.1.1.5. The NRC staff evaluation of these proposed methods is provided below.

3.1.4.1 NFPA 805 Section 3.3.5.1 – Wiring Above Suspended Ceiling

In LAR Attachment L, Approval Request 1, the licensee requested approval of a PB method to demonstrate an equivalent level of fire protection for the NFPA 805 Section 3.3.5.1 requirement for 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 to have wiring above suspended ceilings that may not comply with the requirements of this section of NFPA 805. The licensee stated that suspended ceilings are non-combustible and exist only in the Control Room (Fire Zone 23), Inside Auxiliary Operator office and old Turbine Building RCA [radiologically controlled area] Entrance (Fire Zone 25A), and that combustibles in concealed spaces are minimal.

The licensee stated that the Inside Auxiliary Operator Office and old Turbine Building RCA Entrance (Fire Zone 25A) are not risk significant, and that neither of the rooms nor the cables are safety-related. The licensee further stated that most electrical wiring above the Control Room partial suspended ceiling is in conduit except for short flexible connectors to lighting fixtures, and that there is one 8-ft length of 8-inch diameter Underwriters Laboratory approved flexible air duct with flame spread rating of 25 or less. The licensee stated that the quantity of cabling above the suspended ceilings in the Control Room is very low and results in limited combustible loading. The licensee stated that the existing fire detection capability and/or the Control Room operators, who are continuously present in the area, would identify the presence of smoke.

The licensee stated that the wiring above the suspended ceilings includes that needed for lighting, power, control, and video/communication/data. The licensee further stated that power and control cables at HBRSEP are IEEE-383-1974 or equivalent, and that FAQ 06-0022 identified acceptable electrical cable construction tests. The licensee stated that plenum rated cable is tested to NFPA 262 "Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces" (Reference 60), and that the FAQ concluded that the NFPA 262 test is equivalent to the IEEE-383-1974 test. Therefore, IEEE 383 cable is inherently equivalent to plenum rated cable and acceptable to be routed above suspended ceilings.

In FPE RAI 09 (Reference 20), the NRC staff identified that a cable that passes the IEEE-383 flame test will not necessarily pass the NFPA 262 test; and therefore, the NRC requested that the licensee describe whether the assumption of equivalency between the IEEE-383-1974 and NFPA 262 tests is relied upon, and if so, revise the request as needed (i.e., clarify that this is no longer the case). In its response to FPE RAI 09 (Reference 12) the licensee stated that the assumption of equivalence between the IEEE-383-1974 and NFPA 262-2002 stated in the LAR Attachment L, Request 1 is not accurate. The licensee stated that the bases of the request is that all electrical wiring above the control room partial suspended ceiling is in conduit except for short flexible connectors to lighting fixtures. The licensee stated that according to FAQ 06-0021 (Reference 61), cable air drops of limited length (~3 feet) are considered acceptable. The licensee further stated that there is limited quantity of cabling and wiring above the suspended ceilings, and no equipment important to nuclear safety is located in the vicinity of these cables. The licensee further stated that the Inside Auxiliary Operator Office and old Turbine Building

RCA Entrance (Fire Zone 25A) are not risk significant, and that neither of the rooms nor the cables are safety related. The licensee stated that in addition, the existing fire detection capability and/or the control room operators who are continuously present in the area would identify the presence of smoke. The licensee revised LAR Attachment L Approval Request 1 and the Basis for the Request (Reference 13), to incorporate the changes discussed in its response to FPE RAI 09. The NRC staff concludes that the licensee's response to FPE RAI 09, is acceptable because the licensee concurred with the NRC staff position that the assumption of equivalence between the IEEE-383-1974 and NFPA 262-2002 tests is not accurate and revised LAR Attachment L, Approval Request 1 accordingly.

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

The licensee stated that basis for the approval request of this deviation is:

- All electrical wiring above the control room partial suspended ceiling is in conduit except for short flexible connectors to lighting fixtures. According to FAQ 06-0021, cable air drops of limited length (~3 feet) are considered acceptable.
- No equipment important to nuclear safety is located in the vicinity of these cables.
- Minimum amount of cables exist above Control Room ceiling, which results in limited combustible loading.
- Smoke detectors are installed both above and below the partial suspended ceiling in the Control room.
- The Inside AO Office and old Turbine Building RCA Entrance (FZ 25A) are not risk significant. Neither of the rooms nor the cables are safety-related.
- Existing fleet procedures will be used to ensure that changes moving forward are considered for NFPA 805 impacts. (FIR-NGGC-0010)"

The licensee stated that the location of wiring above suspended ceilings does not affect nuclear safety. The licensee further stated that power and control cables comply with NFPA 805 Section 3.3.5.1, and that other wiring, while it may not be in armored cable, in metallic conduit, or plenum rated, is low voltage cable not susceptible to shorts that would result in a fire. Therefore, the licensee stated that there is no impact on the NSPC.

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

The licensee stated that the power and control cables meet the requirements of NFPA 805 Section 3.3.5.1, and that the use of these materials has been defined by the limitations of the analytical methods used in the development of the FPRA. The licensee, therefore, stated that the inherent safety margin and conservatisms in these methods remain unchanged.

The licensee stated that the three echelons of DID are: 1) to prevent fires from starting, 2) rapidly detect, control and extinguish fires that do occur thereby limiting damage, and 3) provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed. The licensee stated that the prior introduction of non-listed video/communication/data cables routed above suspended ceilings does not impact fire protection DID. The licensee stated that echelon 1 is maintained by the current cable installation procedures documenting the requirements of NFPA 805 Section 3.3.5.1, and that the control room is a continuously manned area of the plant. The licensee further stated that the introduction of cables above suspended ceilings does not affect echelons 2 and 3. The licensee stated that the video/communication/data cables routed above suspended ceilings does not result in compromising automatic fire suppression functions, manual fire suppression functions, fire protection for systems and structures, or post-fire SSD 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, as supplemented, is an acceptable alternative to the corresponding NFPA 805, Section 3.3.5.1 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 (fire prevention, fire detection, fire suppression, mitigation, and post-fire SSD capability).

3.1.4.2 NFPA 805 Section 3.3.5.2 – Metal Tray and Metal Conduit

In LAR Attachment L, Approval Request 2, the licensee requested NRC staff approval of a PB method to demonstrate an equivalent level of fire protection for the NFPA 805 Section 3.3.5.2 requirement that only metal tray or conduit be used for electrical raceways. Specifically, the licensee requested approval of a PB method to use of PVC for underground embedded conduit as permitted by the licensee's electrical raceway installation drawing. The licensee stated that PVC or HDPE type ducts (conduits) are permitted when embedded in compacted sand or reinforced concrete, and that some PVC conduit was found in reinforced concrete wall. The licensee further stated that PVC/HDPE conduit is embedded within a non-combustible enclosure, which provides protection from mechanical damage and from damage resulting from either an exposure fire or from a fire within the conduit impacting other targets.

The licensee stated that the basis for the approval request is:

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

- Failure of circuits within the conduit resulting in a fire would not result in damage to external targets.

The licensee stated that the use of PVC/HDPE conduit in embedded locations does not affect nuclear safety as the material in which conduits are run within an embedded location is not subject to the failure mechanisms potentially resultant in circuit damage or resultant damage to external targets; and therefore, there is no impact on the NSPC.

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

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

The licensee stated that the three echelons of DID are: 1) to prevent fires from starting, 2) rapidly detect, control and extinguish fires that do occur thereby limiting damage, and 3) provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed. The licensee stated that PVC/HDPE conduit in embedded installations does not affect echelons 1, 2, and 3. The licensee stated that PVC/HDPE conduits do not directly result in compromising automatic fire suppression functions, manual fire suppression functions, or post-fire SSD capability. Although the licensee did not specifically address echelon 1 of DID, the NRC staff found that plastic conduit, as described by the licensee, although a combustible material, does not contribute to fire or compromise fire prevention when embedded in a non-combustible material such as concrete or below ground; and therefore, does not compromise echelon 1 of DID.

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 3.3.5.2 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 (fire prevention, fire detection, fire suppression, mitigation, and post-fire SSD capability).

3.1.4.3 NFPA 805 Section 3.5.16 – Dedicated Fire Water Supply

In LAR Attachment L, Approval Request 3, the licensee requested NRC staff approval of a PB method to demonstrate an equivalent level of fire protection for the NFPA 805 Section 3.5.16 requirement that the fire protection supply system shall be dedicated for fire protection use only. Specifically, the licensee requested approval of a PB method to justify the use of the fire protection water supply system to supply other plant systems.

The licensee stated that the review of plant flow diagrams shows no hard connections to other plant systems, besides those for fire protection use, and that it should be noted that although there are no hard pipe connections to other plant systems, there are procedures that utilize the fire protection water supply for non-fire uses. In LAR Attachment L, the licensee identified a number of procedures that utilize the fire protection water supply.

The licensee stated that the use of the fire protection water for these non-fire protection system water demands would have no adverse impact on the ability of the fire protection system to provide required flow and pressure. The licensee further stated that the station procedure details the restrictions and allowances for use of the fire protection water supply system at HBRSEP.

In FPE RAI 15 (Reference 20) the NRC staff requested more detail to justify that the listed non-fire uses of fire protection water will not impair the ability of the fire protection system to provide required flow and pressure. Specifically, the NRC staff requested additional information on whether the uses are considered to be routine, non-emergency, or non-abnormal operations; the description of any engineering controls, alarms and indications, and training that supports "no adverse impact" statement; the description of any of these operations that may be performed simultaneously in conjunction with the largest fire demand or conducted at the expense of the availability of the fire protection water system; and the description of the administrative controls, limitations, allowances, procedures, compensatory actions, dedicated communications, equipment, and work control practices that are in place to preclude interference with the ability of the fire protection systems to meet demand. In its response to FPE RAI 15 (Reference 10), the licensee stated that it is not routine to use fire water outside of the emergency or abnormal operating procedure, and that the use of fire water for non-fire protection plant evolutions is an occurrence that requires the Shift Manager's review and concurrence per plant administrative procedure.

The licensee stated that, as stipulated in the plant administrative procedure, when fire water use is deemed necessary, sufficient justification must be provided to show that the use of the fire water system for the activity does not cause the fire water system to be in a condition outside of the design bases such that the quantity of water does not exceed the supply and pressure requirements in the UFSAR. The licensee further stated that, in the unlikely event fire water is used for a non-fire protection purpose without notification or concurrence from the Shift Manager, the Control Room will get an alarm indicating that the motor driven fire water pump has started, and an immediate investigation is initiated to determine the unapproved source is in use.

The licensee stated that when a need to use fire water is identified, HBRSEP Fire Protection Engineering is requested to review the activity, in addition to the Shift Manager's final permission, and that stipulations are provided to ensure that flow rates for the requested job are not exceeded. The licensee stated that the basis for determining the acceptability of a temporary non-fire protection related fire water use is the UFSAR Section 9.5.1, which specifies the minimum pressure in the plant loop with the largest deluge system in operation including fire hose demand. The licensee further stated that if a fire alarm is received during the use of the fire water system outside of emergency use, stipulations are provided to cease the use of the fire water system, and that this is strictly adhered to so the quantity of water does not drop the supply pressure below the defined limits in the UFSAR, Section 9.5.1. The licensee further stated that since the fire water system is prohibited by procedure for routine usage not related to fire protection plant evolutions, it is not relied upon for any conditions other than fire suppression and emergent or abnormal procedures. Based on the licensee's response to FPE RAI 15, the NRC staff concludes that the additional information provided is acceptable because the information provides assurance that the use of the fire water system for non-fire conditions is controlled and will not adversely impair the ability to deliver the required fire water demand in the event of a fire condition.

The licensee stated that the basis for the approval request is:

The use of fire protection water for these non-fire protection system water demands would have no adverse impact on the ability of the fire protection system to provide required flow and pressure, and that this is based on the following ways that fire water usage is restricted:

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

The licensee stated that the water supply system is capable of maintaining the pressure in the main plant loop at 70 pounds per square inch or higher with the largest deluge system in operation and with the system supplying an additional 1000 gallons per minute to hoses.

The licensee stated that the use of fire protection water for non-fire protection plant evolutions is an occurrence that requires the Shift Manager's review and concurrence, and that the flow limitations to those non-fire protection functions ensure that there is no impact in the ability of the automatic suppression systems to perform. The licensee stated that, therefore, there is no impact on the NSPC.

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

As described in NFPA 805, Section 1.2, the three elements of DID are: 1) to prevent fires from starting, 2) rapidly detect, control and extinguish fires that do occur thereby limiting damage, and 3) provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed. The licensee stated that the use of the fire water system, including the use of hydrants and hose, for non-fire protection uses does not impact fire protection DID. The licensee stated that the fire pumps have the excess capacity to supply the demands of the fire protection system as well as the non-fire protection uses identified above. The licensee further stated that this does not compromise automatic or manual fire suppression functions, fire suppression for systems and structures, or the NSCA. Finally, the licensee stated that since both the automatic and manual fire suppression functions are maintained, DID is maintained. Although Element 1 of DID was not specifically addressed by the licensee, the NRC staff found that fire suppression system usage does not impact fire prevention elements; and therefore, does not compromise Element 1 of DID.

The licensee stated that the methods, input parameters, and acceptance criteria used in this analysis were reviewed and found to be in accordance with NFPA 805 Chapter 3, and that the methods, input parameters, and acceptance criteria used to calculate flow requirements for the

automatic and manual suppression systems were not altered. Therefore, the safety margin inherent in the analysis for the fire event has been preserved.

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, as supplemented, is an acceptable alternative to the corresponding NFPA 805, Section 3.5.16 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 (fire prevention, fire detection, fire suppression, mitigation, and post-fire SSD capability).

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

In LAR Attachment L, Approval Request 4, the licensee requested NRC staff approval of a PB method to demonstrate an equivalent level of fire protection for the NFPA 805, Section 3.2.3(1) requirement to establish procedures for inspection, testing, and maintenance of credited fire protection systems and features. Specifically, the licensee requested approval to use PB methods to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features required by NFPA 805. The licensee stated that PB inspection, testing, and maintenance frequencies will be established as described in Electric Power Research Institute (EPRI) Technical Report TR-1006756, "Fire Protection Surveillance Optimization and Maintenance Guide for Fire Protection Systems and Features," (Reference 96).

The licensee stated that the basis for the approval request is:

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

The licensee stated that the request is specific to the use of EPRI TR-1006756 to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features credited by the FPP. The licensee stated that the goal of EPRI TR-1006756 Section 10.1 is to have a PB surveillance program that can adjust test and inspection frequencies commensurate with equipment performance and desired reliability, which is consistent with the stated requirements of NFPA 805 Section 2.6. The licensee stated that EPRI TR-1006756 provides a method to establish appropriate inspection, testing, and maintenance frequencies that ensure the required NFPA 805 availability, reliability, and performance goals are maintained.

The licensee stated that the target tests, inspections, and maintenance will be those activities for the fire protection systems and features required by NFPA 805 engineering analysis, and that the reliability and frequency goals will be established to ensure the assumptions in the NFPA 805 engineering analysis remain valid. The licensee further stated that the failure criterion will be established based on the required fire protection systems and features credited functions and will ensure those functions are maintained, and that data collection and analysis will follow the EPRI TR-1006756 document guidance. The licensee further stated that the failure probability will be determined based on EPRI TR-1006756 guidance and a 95-percent

confidence level will be utilized. The licensee stated that the performance monitoring will be performed in conjunction with the monitoring program required by NFPA 805 Section 2.6 and it will ensure site specific operating experience is considered in the monitoring process.

The licensee stated that it does not intend to revise any fire protection surveillance, test or inspection frequencies until after transitioning to NFPA 805, and that existing fire protection surveillance, test, and inspection will remain consistent with applicable station, Insurer, and NFPA Code requirements. The licensee further stated that it is the intent of HBRSEP to obtain approval to use EPRI TR-1006756 guideline in the future as opportunities arise, and that HBRSEP reserves the ability to evaluate fire protection features with the intent of using the PB methods to provide evidence of equipment performance beyond that achievable under traditional prescriptive maintenance practices to ensure optimal use of resources while maintaining reliability.

The licensee stated that the use of PB test frequencies established per EPRI 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; and therefore, there is no adverse impact to NSPC by the use of the PB methods in EPRI TR-1006756.

The licensee stated that the radiological release performance criteria are satisfied based on the determination of limiting radioactive release. The licensee stated that fire protection systems and features may be credited as part of that evaluation and that the use of PB test frequencies established per EPRI TR-1006756 methods, combined with the NFPA 805, Section 2.6 monitoring program, will ensure that the availability and reliability of the fire protection systems and features are maintained to the levels assumed in the NFPA 805 engineering analyses, which includes those assumptions credited to meet the radioactive release performance criteria. The licensee stated that, therefore, there is no adverse impact to meeting the radioactive release performance criteria.

The licensee stated that the use of PB test frequencies established per EPRI TR-1006756 methods combined with NFPA 805, Section 2.6 monitoring program will ensure that the availability and reliability of the fire protection systems and features are maintained to the levels assumed in the NFPA 805 engineering analyses which includes those assumptions credited in the FRE safety margin discussions. In addition, the licensee stated the use of these methods should in no way invalidate the inherent safety margins contained in the NFPA codes used for design and maintenance of fire protection systems and features, and therefore, the safety margin inherent and credited in the analyses has been preserved.

The licensee stated that the three echelons of DID are: 1) to prevent fires from starting, 2) rapidly detect, control and extinguish fires that do occur thereby limiting damage, and 3) provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed. The licensee stated that echelon 1 is not affected by the use of the EPRI TR-1006756 methods. The licensee further stated that the use of PB test frequencies established per EPRI TR-1006756 methods combined with NFPA 805 Section 2.6, Monitoring Program, will ensure that the availability and reliability of the fire protection systems and features credited for DID are maintained to the levels assumed in the NFPA 805 engineering analysis, and therefore, there is no adverse impact to echelons 2 and 3 for DID.

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 (fire prevention, fire detection, fire suppression, mitigation, and post-fire SSD capability).

3.1.4.5 NFPA 805 Section 3.3.4 – Insulation Materials

In LAR Attachment L, Approval Request 5, which the licensee included in letters dated May 25, 2016 (Reference 17), July 25, 2016 (Reference 18), and October 5, 2016 (Reference 19), the licensee requested NRC staff approval of a PB method to demonstrate an equivalent level of fire protection for the NFPA 805, Section 3.3.4 requirement that thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials be non-combustible or limited combustible. Specifically, the licensee requested approval to use PB methods to use thermal insulation materials such as AP Armaflex, Insul-Tube180, and Insul-Sheet thermal insulation materials because these materials meet the flame spread rating criteria, but do not meet the NFPA 805, Section 3.3.4 definition of non-combustible or limited combustible regarding heat content value.

The licensee stated that NFPA 805, Section 1.6.36 has re-defined earlier definitions of non-combustible material to the now current definition of limited combustible material:

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

The licensee stated that the basis for the approval request is that in several areas, exposed thermal insulation materials are installed for industrial personnel safety, and on miscellaneous system piping to prevent sweating and that these materials met the BTP APCSB 9.5.1 guidelines and Appendix R requirements for limited combustibles by meeting the flame spread rating of 25 or less as measured using the test method of American Society for Testing and Materials (ASTM) E-84, "Standard Test Method for Surface Burning Characteristics of Building Materials" (Reference 99), but they do not meet the current decreased heat value content requirement based on the definition of a limited combustible due to the heat value exceeding 3,500 Btu/Lb. The licensee further stated that typical thermal insulation materials were noted as having heat contribution values of approximately 9,000-11,000 Btu/Lb, which, while higher than the definition, is not considered to contribute appreciably to the spread of fire, nor represent a secondary combustible beyond those currently analyzed in the FPRA due to the limited applications.

The licensee stated that the forms in which the thermal insulation are installed and the conditions anticipated meet the intent of the revised limited combustible material definition, and that the insulation materials have fuel contribution, flame spread, and smoke developed ratings of 25, 25, and 50 per ASTM E-84, respectively. The licensee further stated that although the thermal insulation materials exceed the NFPA 805 heat value of 3500 Btu/Lb, AP Armaflex will not contribute significantly to fire per ASTM E-84, and Insul-Tube 180 and Insul-Sheet are

self-extinguishing per ASTM D635 "Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position," (Reference 100).

The licensee stated that the forms in which the thermal insulation materials are installed and the conditions anticipated do not impact nuclear safety and that the limited applications of exposed thermal insulation materials do not compromise post-fire safe shutdown capability as previously designed, reviewed and considered. The licensee further stated that adequate DID measures are in place to ensure that essential safety functions are maintained and capable of being performed.

The licensee stated that it evaluated identified installations against the fire scenarios supporting the FPRA and that in all instances, the supporting analyses and existing fire scenarios were found to be bounding or there were no FPRA credited targets in the area. The licensee further stated that it has procedures in place to review future installation impacts to the FPP and FPRA which would result in updates to the applicable analyses and calculations as required.

The licensee stated that a number of plant locations were identified where insulation material is used for low point obstruction or head-bump protection and that these applications include less than one pound of material affixed to pipes, conduits, and structural components. The licensee further stated that it identified additional limited anti-sweat applications primarily in the turbine building on piping associated with heating, ventilation, and air conditioning (HVAC) systems supporting power block structures including:

- System 8150 – Containment Building HVAC
- System 8210 – Auxiliary Building HVAC
- System 8220 – Control Room HVAC
- System 8260 – Turbine Building HVAC

The licensee stated that non-HVAC anti-sweat applications were limited to systems (System 4011, Condenser Ball Cleaning) supporting the condenser located on or adjacent to the waterboxes.

The licensee stated that it evaluated all of the identified locations against the fire scenarios supporting the FPRA and that in all instances, the supporting analyses and existing fire scenarios were found to be bounding or there were no FPRA credited targets in the area. The licensee further stated that the limited applications of exposed thermal insulation material were not of a quantity that would impact the fire scenarios or zones of influence (ZOIs) and target failures developed in support of the fire and PRA analysis. The licensee further stated that it has procedures in place to review future installation impacts to the FPP and FPRA that would result in updated to the applicable analyses and calculations as required.

The licensee stated that the use of thermal insulation material other than non-combustible and more than limited combustible in the plant does not affect nuclear safety, that the limited applications of exposed thermal insulation materials do not compromise post-fire SSD capability and that essential safety functions are maintained and capable of being performed.

The licensee stated that the forms in which the thermal insulation materials are installed and the conditions anticipated meet the intent of the revised limited combustible material definition because the materials have a flame spread rating of 25 or less and will not support continued progressive combustion. The licensee further stated that the selection and application of

thermal insulation material is controlled per its piping and equipment thermal insulation specification. The licensee further stated that the FPRA development requires the inclusion of the effect of intervening or secondary combustibles to be documented and included in the analysis where determined to have fire effects as part of the PB approach and that Duke Fleet Procedures that govern the Engineering Change Process are in place to review future installation impacts to the FPP and FPRA, resulting in updates to the applicable analyses and calculations as required.

The licensee stated that plant walkdowns and personnel interviews concluded that there were no large concentration installation of thermal insulation in the plant and that the most common applications included less than a pound for industrial safety and anti-sweat installations on small diameter piping. The licensee further stated that the impact of the negligible quantities of exposed materials was noted to be bounded by the currently analyzed fire scenario ZOIs, and did not result in new or expanded ZOIs that impacted additional FPRA targets. The licensee further stated that no existing fire scenarios considered in the FPRA were adversely impacted.

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

The licensee stated that the forms in which the thermal insulation are installed and the conditions anticipated meet the intent of the revised limited combustible material definition because the materials have a flame spread rating of 25 or less and will not support continued progressive combustion. The licensee further stated that the insulation material, and specifically the increase in heat contribution in conjunction with the limited applications, does not compromise automatic fire suppression functions, manual fire suppression functions, or post-fire SSD capability, and that the safety margin inherent in the analysis for the fire event has been preserved.

The licensee stated that the insulation materials in the current configurations are considered as non-cable intervening combustibles and are bound by the FPRA, and safety margin is not affected. The licensee further stated that the selection and application of thermal insulation material is controlled per its piping and equipment thermal insulation specification, and that Duke Fleet Procedures that govern the Engineering Change Process are in place to review future installation impacts to the FPP and FPRA, resulting in updates to the applicable analyses and calculations as required. The licensee further stated that the precautions and limitations on the use of these materials do not impact the fire safety analysis of the fire event, and that the inherent safety margin and conservatisms in these analysis methods remain unchanged.

The licensee stated that the three echelons of DID are: 1) to prevent fires from starting, 2) to rapidly detect, control and extinguish fires that do occur thereby limiting damage, 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. The licensee further stated that the use of insulation material which is non-combustible or more than limited combustible does not affect echelons 1, 2, and 3 and that the increase in heat contribution in conjunction with the limited

applications, does not directly result in compromising automatic fire suppression functions, manual fire suppression functions, or post-fire SSD capability as previous designed, reviewed, and considered.

In regards to Echelon 1, the licensee stated that the thermal insulation does not introduce new ignition sources and presents a negligible hazard in terms of secondary or intervening combustibles. The licensee further stated that the forms in which the thermal insulation are installed and the conditions anticipated meet the intent of the revised limited combustible material definition because the materials have a flame spread rating of 25 or less and will not support continued progressive combustion. The licensee further stated that the thermal insulation materials have fuel contribution, flame spread, and smoke developed ratings of 25, 25, and 50 per ASTM E-84, respectively and that although the thermal insulation materials exceed the NFPA 805 heat value of 3500 Btu/lb, AP Armaflex will not contribute significantly to fire per ASTM E-84, and Insul-Tube 180 and Insul-Sheet are self-extinguishing per ASTM D635.

In regards to Echelon 2, the licensee stated that the limited applications of exposed thermal insulation materials installed for industrial personnel safety and on miscellaneous system piping do not result in increased combustible loading which would challenge the design bases of the installed fire protection systems. The licensee further stated that the presence of the thermal insulation and associated procedural controls do not impact the ability of the automatic suppression and detection systems to perform credited functions, as the materials are limited in application and will not support continued progressive combustion. The licensee further stated that portable fire extinguishers and hose stations are available for manual firefighting activities by the site fire brigade, and that if a fire was to occur, damage would be limited.

In regards to Echelon 3, the licensee stated that the limited applications of exposed thermal insulation materials installed for industrial personnel safety and on miscellaneous system piping do not adversely impact the installed fire protection systems and features, and essential safety functions are maintained and capable of being performed. The licensee further stated that the insulation material does not compromise post-fire safe shutdown capability as previously designed, reviewed and considered. The licensee further stated that the forms in which the thermal insulation are installed and the conditions anticipated meet the intent of the revised limited combustible material definition because the materials have a flame spread rating of 25 or less and will not support continued progressive combustion. The licensee further stated that the identified installations were evaluated against the fire scenarios supporting the FPRA and that in all instances, the supporting analyses and existing fire scenarios were found to be bounding (expanded (ZOIs) would not fail additional FPRA targets) or there were no FPRA credited targets in the area. The licensee further stated that Duke Fleet Procedures that govern the Engineering Change Process are in place to review future installation impacts to the FPP and FPRA, resulting in updates to the applicable analyses and calculations as required and that the presence of the thermal insulation does not compromise automatic/manual fire protection functions, or post-fire safe shutdown capability and will not prevent essential safety functions from being performed.

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 3.3.4 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 (fire prevention, fire detection, fire suppression, mitigation, and post-fire SSD capability).

3.2 Nuclear Safety Capability Assessment Methods

NFPA 805 (Reference 3) is a 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 PWR and shall be capable of maintaining or rapidly restoring reactor water level above top of active fuel for a 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 Nuclear Safety Capability Assessment Methods

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

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 SE section evaluates the first three of the topics listed above. SE Section 3.5 addresses the assessment of the fourth topic.

RG 1.205, Revision 1 (Reference 4) endorses NEI 04-02, Revision 2 (Reference 7), and Chapter 3 of NEI 00-01, Revision 2, (Reference 28), and promulgates the method outlined in NEI 04-02 for conducting a NSCA. 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," 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 SSD. It provides detailed guidance for:

- Selecting systems and components required to meet the NSPC;
- Selecting the cables necessary to achieve the NSPC;
- Identifying the location of nuclear safety equipment and cables; and,
- 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 endorses NEI 00-01, Revision 2, the licensee's review was performed to the guidance in NEI 00-01, Revision 1 (Reference 65). In LAR Section 4.2.1.1, the licensee stated that the NSCA methodology was evaluated against the guidance provided in NEI 00-01 Revision 1, Chapter 3 "Deterministic Methodology," and a review of NEI 00-01, Revision 2, Chapter 3 was performed to identify substantive changes from Revision 1 that are applicable to an NFPA 805 FPP. The NRC staff concludes that, based on the information provided in the licensee's submittal, a systematic process to evaluate the post-fire SSA against the requirements of NFPA 805, Section 2.4.2, Subsections (1), (2), and (3), was used, which meets the methodology outlined in the latest NRC-endorsed industry guidance.

FAQ 07-0039, "Incorporation of Pilot Plant Lessons Learned – Table B-2" (Reference 66) 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 NEI 04-02.

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

1. The SSA directly aligns with the attribute: noted in LAR Attachment B, Table B-2 as "Aligns."
2. The SSA aligns with the intent of the attribute: noted in LAR Attachment B, Table B-2 as "Aligns with Intent."

Finally, some attributes may not be applicable to the SSA (for example, the attribute may be applicable only to BWRs or PWRs). These are noted in the B-2 Table as "N/A."

As described in the LAR Section 4.2.1.1, the licensee performed an additional review of NEI 00-01, Revision 2, Chapter 3, for specific substantive changes in the guidance from

NEI 00-01, Revision 1 that are applicable to an NFPA 805 transition. The licensee summarized the results of the review as follows:

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

  The licensee stated that a review of the NSCA results indicated that there are DID RAs that require manual operation of a rising stem valve in the fire area of concern, and that there are no ignition sources or in situ combustibles that would affect these valves, and operation of the valves would not be required for about 2 hours.

- Analysis of open circuits on high voltage (e.g., 4.16 kV) ammeter current transformers (CT) (NEI 00-01 Section 3.5.2.1).

  The licensee performed an evaluation and concluded that this failure mode is unlikely for CTs that could pose a threat to SSD equipment. SE Section 3.2.1.1 includes additional discussion on this attribute.

The licensee stated that the method used to perform the existing post-fire SSA with respect to selection of systems and equipment, selection of cables, and identification of the location of equipment and cables, either meets the NRC endorsed guidance from NEI 00-01, Revision 1, Chapter 3 (as supplemented by the additional review to Revision 2) directly or met the intent of the endorsed guidance with adequate justification as documented in LAR Attachment B, Table B-2.

The NRC staff has determined that, taken together, these methods compose an acceptable approach for documenting compliance with the NFPA 805, Section 2.4.2 "Nuclear Safety Capability Assessment," requirements, because the licensee has followed the alignment 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 NEI 00-01, Chapter 3, allowing the licensee to provide significant detail in how the program meets the requirements. In addition to the basic strategy of "Aligns," 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.

3.2.1.1 Attribute Alignment -- Aligns

RG 1.205 states that Chapter 3 of NEI 00-01, Revision 2, when used in conjunction with NFPA 805 and the RG, provides one acceptable approach to circuit analysis for a plant implementing a FPP under 10 CFR 50.48(c). For the majority of the NEI 00-01, Chapter 3, attributes, the licensee determined that the SSA aligns directly with the attribute. In these instances, based on the validity of the licensee's statements, the NRC staff concludes that the licensee's statements of alignment are acceptable.

The following attributes identified in LAR Attachment B, Table B-2 as aligning via this method required additional review by the NRC staff:

- 3.5.2.1

Attribute 3.5.2.1 – Circuit Failures due to an Open Circuit: The licensee stated that the potential CT circuits of concern have been identified, and the final disposition of this potential fire scenario will be assessed as part of the SSA/FPRA transition to NFPA 805, and referred to an Implementation item in LAR Attachment S, Table S-3. Additionally, in LAR Section 4.2.1.1, the licensee stated that the analysis of open circuits on high voltage ammeter CT circuits concluded that this failure mode is unlikely for CTs that could pose a threat to SSD equipment. In SSA RAI 07 (Reference 20), the NRC staff requested that the licensee clarify whether the CT analysis has been completed, and if not, to provide the appropriate implementation item in LAR Attachment S, Table S-3 for this attribute. In its response to SSA RAI 07 (Reference 12), the licensee stated that an evaluation considering the potential for secondary fires resulting from an open circuit on all CT secondary circuits has been performed, and used the following design considerations:

1. For CT turn ratios of < [less than] 1200:5, the results of EPRI document NUREG/CR-7150, "Joint Assessment of Cable Damage and Quantification of Effects of Fire," Vol. 1 (Reference 48) was referenced, and based on theoretical evaluation and test data this study concludes that this theoretical failure mode (secondary fire caused by a CT secondary open circuit) is incredible for CTs with low turn ratios (1200:5).

2. For CTs with high turn ratios (> [greater than] 1200:5), EPRI document NUREG/CR-7150 states that "other than internal CT damage, no further adverse effects are expected to occur as a result of the open circuit condition." The licensee noted that the study concluded that though the likelihood of secondary fires in higher ratio CTs is very low, the absence of test data suggests that the failure mode of concern could not be classified as incredible and that to permanently resolve the concern, the PIRT panel recommends that additional testing be performed.

3. CTs whose secondary circuit does not leave the fire area which contains the power supply of concern were excluded, and the technical basis for exclusion is that the SSA assumes fire damage throughout the fire area. This exclusion applies to deterministically dispositioned fire areas.

4. Fire-induced damage to transformer and differential CT circuits will result in protective actuation of the parent component thereby isolating power to the CT.

5. CTs located in switchgear or components that are not credited for SSD were excluded.

The licensee stated that its evaluation also considers that, to date, there continues to be no operational experience substantiating this theoretical failure mode in any nuclear on non-nuclear application. The licensee further stated that there will not be any additional implementation item associated with its alignment basis for attribute 3.5.2.1 and provided a revised LAR Attachment B to remove reference to the implementation item (Reference 13).

In SSA RAI 07.01 (Reference 21), the NRC staff requested that the licensee address the potential fires caused by open circuited CTs, regardless of whether or not the CT has been credited for SSD. In its response to SSA RAI 07.01 (Reference 13), the licensee stated that the

majority of CTs installed in the plant with ratios >1200:5, are designed such that they supply electrical circuitry (protective/indication) that is enclosed within the switchgear, and no "external to switchgear" cables are utilized in the design. The licensee further stated that CTs with turn ratios >1200:5 located in switchgear or components that are not credited for SSD, but with secondary wiring that does extend into fire areas containing SSD equipment, will not cause damage to any SSD related components. The licensee further stated that should an open secondary circuit be created by a fire event along the cable route, the cable breakdown due to the high voltage created by the CT would also occur at the point where the insulation is damaged, and that should the secondary fire be caused by catastrophic failure of the CT itself, the damage would be contained within the CT enclosure and would not propagate outside the enclosure or damage any adjacent equipment.

Based on the licensee's response to SSA RAIs 07 and 07.01, the NRC staff concludes that the licensee has adequately addressed the concern of secondary fires associated with open circuits on CTs because the methods used by the licensee are consistent with the guidance in NEI 00-01 as endorsed by RG 1.205 and the results of the PIRT panel as documented in NUREG/CR-7150 and secondary fires associated with CTs will not affect SSD equipment.

3.2.1.2 Attribute Alignment -- Aligns with Intent

For certain of the NEI 00-01, Chapter 3, attributes, the licensee determined that the SSA aligns with the intent of the attribute, and provided additional clarification when describing its means of alignment. The attributes identified in LAR Attachment B, Table B-2 as having this condition are as follows:

- 3.1.1.3
- 3.3.3.2
- 3.5.1.5

Attribute 3.1.1.3 – Pressurizer Heaters: This NEI 00-01 attribute states that hot shutdown can be maintained without the use of pressurizer heaters with pressure control provided by controlling the makeup/charging pumps. The attribute further states that hot shutdown conditions can be maintained via natural circulation of the reactor coolant system (RCS) through the steam generators by controlling feedwater flow rates and steam release such that the cooldown rate prevents the formation of a bubble in the reactor head. The licensee stated that in most fire areas, HBRSEP does not rely on the use of pressurizer heaters to maintain hot shutdown. The licensee further stated that the RCS pressure is controlled during hot shutdown and cool down by controlling the rate of charging to the RCS. The licensee stated that pressurizer heaters and/or auxiliary spray reduces operator burden but neither component is required to provide adequate pressure control if charging is available. However, the licensee stated that the use of the safety injection pumps in lieu of the charging pumps may be required for certain shutdown scenarios, and that the pressurizer heaters are credited to stabilize the pressurizer transients when safety injection pumps are operated intermittently. The licensee stated that the guidance does not prevent the use of pressurizer heaters, but only serves to note that they are generally not required. The NRC staff concludes that the methods, as described by the licensee, are acceptable because they are sufficiently similar to the specific methods in NEI 00-01 for use of pressurizer heaters, and therefore, align with the intent of NRC endorsed guidance.

Attribute 3.3.3.2 - Identify Interlocked Circuits and Cables: This NEI 00-01 attribute states that in reviewing control circuits, investigate interlocks that may lead to additional circuit schemes, cables and equipment and assign to the equipment any cables for interlocked circuits that can

affect the equipment. The attribute further specifies that investigating interlocked circuits may result in additional equipment or power sources to be included in the SSD equipment list if they can impact the operation of the equipment under consideration. The licensee stated that as an alternative to adding the interlocked equipment to the SSD equipment list, it is acceptable to include the cables that are required for the interlocking function (or that could cause the spurious actuation) with the main component that was originally under consideration, and that adding them to the components may ease the development of a suitable mitigating strategy in areas where the interlocked cables may be damaged by the fire. The licensee further stated that interlocked circuits were either included in the analysis, or the interlocked contact or relay was assumed to be in its worst-case position, and that associated circuits identified for each component are either included in the main circuit analysis, or are included by listing the applicable circuit in other circuit evaluation documentation. The NRC staff concludes that the methods, as described by the licensee, are acceptable because they are sufficiently similar to the specific methods in NEI 00-01 for treatment of interlocked circuits, and therefore, align with the intent of NRC endorsed guidance.

Attribute 3.5.1.5 – [C, Likelihood of Undesired Consequences]: This NEI 00-01 attribute states that the determination of the potential consequences of the damaged associated circuits is based on the examination of specific piping and instrumentation diagrams and review of components that could prevent operation or cause maloperation, such as flow diversions, loss of coolant, or other scenarios that could significantly impair the ability to achieve and maintain hot shutdown. The NEI 00-01 guidance also indicates that when considering the potential consequence of such failures, the analyst should also consider the time at which the prevented operation or maloperation occurs, and that failures that impede hot shutdown within the first hour of the fire tend to be most risk significant in a first-order evaluation. The licensee stated that its analysis limits the evaluation of MSOs, implementing the design strategy of any and all potential spurious operation, on a one at a time basis, and that as part of the manual action feasibility study, two concurrent spurious operations were evaluated. The licensee further stated that it considered MSOs for a variety of scenarios by the MSO Expert panel, and that it identified components for consideration and possible inclusion in the SSA and the FPRA. The licensee further stated that any MSOs that were determined to be risk-significant by the PRA were analyzed accordingly. The NRC staff concludes that the methods, as described by the licensee, are acceptable because they are sufficiently similar to the specific methods in NEI 00-01, and therefore, align with the intent of NRC endorsed guidance. The NRC staff's review of the assessment of MSOs is provided in SE Section 3.2.4.

3.2.1.3 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 and the gap analysis of NEI 00-01, Revision 2, as discussed in LAR Section 4.2.1.1.

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 either:

- Met the NRC-endorsed guidance directly; or
- Met the intent of the endorsed guidance with adequate justification.

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 101), 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 the LAR Section 4.2.1.2 the licensee stated that the NFPA 805 licensing basis is to achieve and maintain hot shutdown conditions following any fire occurring prior to establishing cold shutdown, and specifically includes the following conditions:

- The reactor operating at power;
- A shutdown condition prior to aligning the residual heat removal (RHR) system for shutdown cooling; or,
- The "transition" mode between these two operation phases.

The licensee stated that immediately following the reactor scram, RCS inventory and pressure control is maintained using the charging system, or the safety injection system if the charging pumps are not available (applies to one fire area). The licensee further stated that pressurizer safety relief valves provide overpressure protection for the RCS and main steam line safety relief valves provide for initial decay heat removal. The licensee further stated that cycling of the steam generator power-operated relief valves (PORVs) provides for continued decay heat removal, with steam generator inventory replenished by either the steam driven auxiliary feedwater (AFW) pump or the motor-driven AFW pumps. The licensee further stated that when the Condensate Storage Tank is depleted, the suction of the AFW pumps is manually aligned to the service water system. The licensee stated that these actions are required in about two hours, and are considered DID recovery actions (RAs), and that since the valves requiring operation are all manual valves and are not electrically supervised, they are not considered to be VFDRs.

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

The licensee stated that long-term actions required to maintain safe and stable conditions are largely routine and are within the normal capabilities of site personnel. These long-term actions involve aligning the suction of the AFW pump(s) to the service water system, opening CVC-358 to maintain the charging pump suction path to the Refueling Water Storage Tank. The licensee stated that LCV-115B will initially provide this suction path, but is conservatively assumed to fail closed after about four hours. The licensee further stated that the long-term actions are straightforward, performed by operators and covered by plant procedures. The licensee stated that repairs to SSD equipment would not be required and the management of the onsite

inventories of makeup water, nitrogen and diesel fuel would not require resources beyond those available from normal operations staff, maintenance, and emergency response personnel.

The licensee stated that demonstration of the NSPC for safe and stable conditions was performed in two analyses:

- At-Power analysis, Modes 1-4, which goes beyond safe and stable to include Mode 4; and
- Non-Power Operations analysis that includes cold shutdown and below (Modes 5 and 6).

In SSA RAI 01 (Reference 20), the NRC requested clarification with regard to the mode identified for safe and stable conditions (i.e., hot standby or hot shutdown) because the licensee stated that the NFPA 805 licensing bases for HBRSEP is to achieve and maintain hot shutdown conditions, and also stated that following stabilization in hot standby, a long term strategy for decay heat removal and inventory/pressure control would be determined based on the extent of equipment damage. In its response to SSA RAI 01 (Reference 12), the licensee clarified that safe and stable conditions correspond to hot standby and that decay heat is removed from the RCS via the steam generators and the auxiliary feed system. The licensee further stated that as defined in the plant TSs, hot standby is $k_{eff} < 0.99$ and an average reactor coolant temperature of $\geq$ 350°F. The licensee further clarified that safe and stable does not include the RHR system for shutdown cooling. Based on the licensee's response to SSA RAI 01, the NRC staff concludes that the licensee's clarification of safe and stable conditions is acceptable because it meets the definition of safe and stable described in NFPA 805 Section 1.6.56.

On the basis of the licensee's analysis as described in the LAR, as supplemented, the NRC staff concludes that the licensee has provided reasonable assurance 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

As stated below, 10 CFR 50.48(c)(2)(iii) limits the use of feed and bleed:

> In demonstrating compliance with the performance criteria of Sections 1.5.1(b) and (c), a high-pressure charging/injection pump coupled with the pressurizer power-operated relief valves (PORVs) as the sole fire-protected safe shutdown path for maintaining reactor coolant inventory, pressure control, and decay heat removal capability (i.e., feed-and-bleed) for pressurized-water reactors (PWRs) is not permitted.

The NRC staff reviewed LAR Table 5-3, "10 CFR 50.48(c) – Applicability/Compliance Reference," and LAR Attachment C, "NEI 04-02 Table B-3 – Fire Area Transition," to evaluate whether HBRSEP meets the feed and bleed requirements. The licensee stated in LAR Table 5-3 that feed and bleed is not utilized as the sole fire protected SSD path at HBRSEP for any scenario. The NRC staff verified this by reviewing the designated SSD path listed in LAR Attachment C for each fire area. This review confirmed that all fire areas analyses include the SSD equipment necessary to provide decay heat removal without relying on feed and bleed. In addition, all fire areas either met the deterministic requirements of NFPA 805, Section 4.2.3, or the PB evaluation performed in accordance with NFPA 805, Section 4.2.4, demonstrated that the integrated assessment of risk, DID, and safety margins for the fire area were acceptable.

Therefore, the NRC staff determined that, based on the information provided in LAR Table 5-3 as well as the fire area analyses documented in LAR Attachment C, the licensee meets the requirements of 10 CFR 50.48(c)(2)(iii) because feed and bleed is not utilized as the sole fire-protected SSD path at HBRSEP.

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 ["Nuclear Safety Capability Systems and Equipment Selection"]. 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 PSA evaluation shall address the risk contribution associated with all potentially risk-significant fire scenarios. Because the RI/PB approach taken used FREs in accordance with NFPA 805 Section 4.2.4.2, "Use of Fire Risk Evaluation," the PSA evaluation is required to address all potentially risk-significant fire scenarios including potential MSO combinations.

The NRC staff reviewed LAR Section 4.2.1.4, "Evaluation of Multiple Spurious Operations," and LAR Attachment F, "Fire-Induced Multiple Spurious Operations Resolution," to determine whether the licensee has adequately addressed MSO concerns at HBRSEP. As described in LAR Section 4.2.1.4, the process for the review and evaluation of HBRSEP's susceptibility to fire-induced MSOs was conducted in accordance with the guidance of NEI 04-02, RG 1.205, and FAQ 07-0038, "Lessons Learned on Multiple Spurious Operations," Revision 3 (Reference 64).

As described in LAR Section 4.2.1.4 and LAR Attachment F, the process the licensee utilized to address MSOs includes 5 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.

For Step 1, the licensee stated that it used the information from the following documents to identify the potential HBRSEP MSOs of concern: Post-fire SSA analysis, MSO expert panel results from Harris Nuclear Plant and Crystal River 3, results of the previous MSO expert panel at HBRSEP, the PWR Owners Group Generic MSO list, and internal events PRA insights. The licensee stated that its staff also provided extensive plant specific experience and considerations.

For Step 2, the licensee stated that it conducted an initial expert panel review on April 27-May 1, 2009 and a follow-on expert panel review in May 2012. The initial expert panel performed on

2009 included individuals from plant site and corporate engineering, plant operations department, corporate PRA, and industry consultants. The licensee stated that the panel discussed fire-induced MSOs that could potentially impact fire safety and reviewed system flow diagrams to postulate and discuss new potential MSOs not previously considered. The licensee stated it used the guidance included in NEI 00-01, Revision 1 and FAQ 07-0038.

The licensee stated that training for the initial 2009 Expert Panel was conducted in the form of an introductory overview and discussed the following topics: purpose and scope of the SSA; PRA overview and results; overview training on the MSO issue; results of fire tests including likelihood of various spurious operation probabilities, timing (including the likelihood that failures will occur close together in time and issues affecting time to damage), and duration; and overview of plant thermal hydraulic analysis that support SSD. The licensee further stated that the following key points were discussed:

- The proposed scenarios should not have presupposed limits on the number of fire induced hot shorts or spurious operations (e.g., do not assume only one or two, one at a time, etc.).

- The focus would not be on individual fire area locations, but would focus on system/component interactions.

The licensee stated that the MSO Expert Panel conducted "what if" discussions based on a review of system flow drawings to postulate/discuss new potential MSOs not previously considered. The licensee further stated that the PWR Generic MSO List, which includes scenarios related to reactivity control, reactor coolant makeup control, RCS pressure control, decay heat removal, support systems, and process monitoring, was used as guidance for reviewing simplified flow diagrams, control diagrams, and system flow diagrams. The licensee stated that the process included postulating scenarios, discussing the potential consequences and likelihood scenario, discussing operator response, and recommending additional courses of action. The licensee stated that it took into consideration whether the MSO scenario of concern was currently modeled in the HBRSEP SSA, whether procedures addressed the potential scenarios of concern, and additional analysis or justification that may be necessary to document exclusion of a particular scenario. The licensee further stated that consensus was achieved in the expert panel process by discussing individual scenarios, reaching a conclusion, and asking for any dissenting opinions.

The licensee stated that the follow-on Expert Panel performed in May 2012 used the same information, but with an updated PWR Generic List from NEI 00-01 Revision 3 (Reference 102), and current lessons learned from the MSO process in FAQ 07-0038, Revision 3, and NFPA 805 pilot plants. The licensee further stated that the training for the 2012 Expert Panel involved an introductory overview and included the topics discussed in 2009, which consisted of reviewing outstanding action items and items added or changed from the Pressurized-Water Reactor Owners Group Generic MSO List. Consensus was achieved in the expert panel process by discussing individual scenarios, reaching a conclusion, and asking for any dissenting opinions.

For Step 3, the licensee stated that the NSCA and FPRA were updated to reflect the treatment of applicable MSO scenarios, which included the identification of equipment, identification of cables, and the routing of cables by plant locations. The licensee stated that it documented the results in the HBRSEP SSA and FPRA.

For Step 4, the licensee stated that it evaluated the MSO Combination components of concern as part of the NSCA. The licensee stated that for cases where the pre-transition MSO combination components did not meet deterministic compliance, the MSO combination components were added to the scope of the FREs.

For step 5, the licensee stated that the results of the MSO review were documented in MSO Expert Panel Reports, the NSCA, the FPRA and the Fire Safety Analyses.

The NRC staff reviewed the licensee's expert panel process for identifying circuits susceptible to MSOs as described above and concludes that the licensee adopted a systematic and comprehensive process for identifying MSOs to be analyzed using available industry guidance. Furthermore, the NRC staff concludes that the process used provides reasonable assurance that the FRE appropriately identifies and includes risk-significant MSO combinations. Based on these conclusions, 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 an 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 performance-based 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 LAR Attachment G, "Recovery Actions Transition," to evaluate whether the licensee meets the associated requirements for the use of RAs per NFPA 805. In LAR Attachment G, the licensee stated that, in accordance with the guidance provided in NEI 04-02 (Reference 7), FAQ 07-0030 Revision 5 (Reference 63), and RG 1.205 (Reference 4), the following methodology was used to determine RAs required for compliance (i.e., determining the population of post-transition RAs). The methodology consisted of the following steps:

1. Defining the PCSs and determining which pre-transition operator manual actions (OMAs) are taken at PCS(s) (Activities that occur in the MCR are not considered pre-transition OMAs). Activities that take place at PCS(s), including the MCR, are not RAs by definition.

2. Determining the population of RAs that are required to resolve VFDRs, to meet the risk acceptance criteria, or maintain a sufficient level of DID.

3. Evaluating the additional risk presented by the use of RAs required to demonstrate the availability of a success path.

4. Evaluating the feasibility of the RAs.

5. Evaluating the reliability of the RAs.

OMAs meeting the definition of an RA are required to comply with the NFPA 805 requirements outlined above. Some of these 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 DID considerations described in Section 1.2 of NFPA 805. Accordingly, the licensee defined a DID-RA as an action that is not needed to meet the NSPC, but is retained to provide DID because CDF or LERF risk threshold had been exceeded. 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 in LAR Attachment G that the PCSs were reviewed and approved in SER dated August 8, 1984 (Reference 103), which included the following panels:

- The Dedicated Shutdown Panel located in the 4kV Switchgear Room in the Turbine Building, which contains the necessary controls to align the Dedicated Shutdown Diesel Generator to the 480V Dedicated Shutdown Bus.

- The Secondary Control Panel located on the Turbine Deck in the Turbine Building, which has controls for operating the steam generator PORVs and the AFW flow control valves that are nearby. The panel also contains indication of pressurizer pressure, pressurizer level, RCS Loop A temperatures, steam generator levels, and Condensate Storage Tank level, and mechanical pressure gauges for monitoring steam generator pressures, which are located inside the secondary control panel doors.

- The Charging Pump Room Control Panel, which contains local controls for Charging Pump A, Component Cooling Water (CCW) Pump A, Service Water Pump D, Service Water valve V6-12D, along with the ability to monitor RCS pressurizer pressure, pressurizer level, RCS Loop A temperatures, steam generator levels, and source range nuclear instrumentation.

The licensee stated that LAR Attachment G, Table G-1 – Recovery Actions and Activities Occurring at the Primary Control Station(s) identifies the activities that occur at the PCS and that activities necessary to enable the PCSs following Control Room abandonment are also identified in Table G-1 as PCS activities. The licensee stated that these PCS activities do not require the treatment of additional risk.

The licensee stated that all credited RAs, as listed in LAR Attachment G (including RA-DIDs) were subject 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 in FAQ 07-0030 and each of the 11 individual feasibility attributes were addressed. The FAQ 07-0030 attributes used to assess feasibility are:

- Demonstrations - The proposed RAs should be verified in the field to ensure the action can be physically performed under the conditions expected during and after the fire event.

- Systems and Indications - Consider availability of systems and indications essential to perform the RA.

- Communications - The communications system should be evaluated to determine the availability of communication, where required for coordination of RAs.

- Emergency Lighting - The lighting (fixed and/or portable) should be evaluated to ensure sufficient lighting is available to perform the intended action.

- Tools-Equipment - Any tools, equipment, or keys required for the action should be available and accessible. This includes consideration of self-contained breathing apparatus (SCBA) and personal protective equipment if required. (This includes staged equipment for repairs.)

- Procedures - Written procedures should be provided.

- Staffing - Walk-through of operations guidance (modified, as necessary, based on the analysis) should be conducted to determine if adequate resources are available to perform the potential RAs within the time constraints (before an un-recoverable condition is reached), based on the minimum shift staffing. The use of essential personnel to perform actions should not interfere with any collateral industrial fire brigade or control room duties.

- Actions in the Fire Area - When RAs are necessary in the fire area under consideration or require traversing through the fire area under consideration, the analysis should demonstrate that the area is tenable and that fire or fire suppressant damage will not prevent the RA from being performed.

- Time - Sufficient time to travel to each action location and perform the action should exist. The action should be capable of being identified and performed in the time required to support the associated shutdown function(s) such that an unrecoverable condition does not occur. Previous action locations should be considered when sequential actions are required.

- Training - Training should be provided on the post-fire procedures and implementation of the RAs.

- Drills - Periodic drills, which simulate the conditions to the extent practical (e.g., communications between the control room and field actions, the use of SCBAs if credited, appropriate use of operator aids) should be performed.

The licensee stated that all credited RAs were evaluated against the feasibility criteria provided in FAQ 07-0030, Revision 5. LAR Attachment G, Table G-1, 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 licensee stated that the results of the assessment of NSCA RAs that were also credited in the pre-transition SSA are also included in plant documentation.

In SSA RAI 03 (Reference 20), the NRC staff indicated that RAs listed in LAR Attachment G, Table G-1 appeared to have inconsistencies with the VFDR dispositions provided in LAR Attachment C, for Fire Areas A15 and A16, for components LI-474, LI-476, and LT477 to monitor steam generator level using local instruments. Specifically, the NRC found that in LAR Attachment C, VFDRs in Fire Area 15 for components LI-474, LI-476, and LT-477 are resolved by the use of RAs; however, there were no RAs for LI-474 and LI-476 identified in LAR Attachment G for these components. For Fire Area A16, components LI-474, LI-476 and LI-477 are dispositioned with DID-RAs in LAR Attachment C; however, each of these actions are identified as RAs in LAR Attachment G, Table G-1. In its response to SSA RAI 03 (Reference 11), the licensee stated that the RAs discussed in LAR Attachment C for Fire Area A15 to monitor steam generator level locally are included in LAR Attachment G; however, only the LT-477 entry was included in LAR Attachment G, Table G-1. The licensee stated that with no specific entry in LAR Attachment G, Table G-1 for LI-474 and LI-476 it was not clear that the RAs discussed in LAR Attachment C for these components were in fact included in LAR Attachment G. The licensee provided revised pages to LAR Attachment C and LAR Attachment G in its response to PRA RAI 03 (Reference 17) that corrected the identified discrepancies described in SSA RAI 03 and other apparent discrepancies and inconsistencies between LAR Attachment C and LAR Attachment G, including updated VFDR lists and revised dispositions. The NRC staff concludes that the licensee's response to SSA RAI 03 is acceptable because the licensee clarified or corrected the identified discrepancies between LAR Attachment C and LAR Attachment G and revised the LAR accordingly.

In SSA RAI 04 (Reference 20), the NRC identified that LAR Attachment G references both LAR Attachment S, Table S-2, "Committed Modifications," and LAR Attachment S, Table S-3, "Implementation Items," in the discussion for the same implementation items related to incorporating RAs in plant procedures and processes, assessing the physical feasibility of new NSCA actions, and updating the plant calculation. In its response to SSA RAI 04 (Reference 12), the licensee stated that the reference to LAR Attachment S, Table S-2 should be LAR Attachment S, Table S-3, and that the implementation items to update the NSCA are captured in LAR Attachment S, Table S-3, Implementation Items 7 and 8. The NRC staff concludes that that LAR Attachment S, Table S-3, Implementation Items 7 and 8 are acceptable because they will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition. In addition, the NRC staff concludes that the licensee's response to SSA RAI 04 is acceptable because the implementation items include actions that will involve an update to post-fire SSD procedures to reflect the NSCA and reduction in the scope of RAs, update training processes to provide clarification on drills for RAs; assess the physical feasibility of the new NSCA-RAs and DID-RAs, and revise plant documentation, as necessary, to incorporate updated NSCA strategies.

Based on the above considerations, the NRC staff concludes that the licensee has followed the endorsed guidance of NEI 04-02 and RG 1.205 to identify and evaluate RAs in accordance with NFPA 805, and therefore, there is reasonable assurance of meeting the regulatory requirements of 10 CFR 50.48(c). 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 LAR Attachment S, Table S-3, Implementation Items 7 and 8.

3.2.6 Plant Specific Treatments or Technologies

3.2.6.1 Very Early Warning Fire Detection System

The licensee proposed the installation or upgrade of VEWFDS to monitor conditions, as well as provide indication and alarms inside key electrical cabinets and fire areas at HBRSEP during the incipient stage of a fire. The following discussion is based on the information provided by the licensee in LAR Sections 4.8.3.2.4 – 4.8.3.2.6 and LAR Attachment S, Table S-2, "Plant Modifications Committed," Items 1, 2, and 3.

As described by the licensee, the VEWFDS applications include cabinets in the MCR, Hagan room, and rod control room, as well as area-wide application in the cable spreading room. The licensee stated in LAR Section 4.8.3.2.4 that the FPRA applies guidance from FAQ 08-0046 when evaluating the risk reduction for incipient detection. In LAR Section 4.8.3.2.5 the licensee stated that the FPRA credits the use of VEWFDS for area wide detection in the cable spread room as permitted by Appendix P of NUREG/CR-6850 Volume 2. The licensee further stated that plant procedures will be developed and implemented to ensure that VEWFDS alarms are promptly addressed with qualified plant personnel who will be present in the immediate area prior to fire growth, allowing for fire prevention or prompt fire response.

In FPE RAI 10 (Reference 20), the NRC requested the licensee provide a more detailed description with regard to the proposed installation of VEWFDS, including the types of VEWFDSs to be installed and how they will meet the provisions of FAQ 08-0046 for credit assumed in the FPRA; the design, installation, operation, and testing of the systems; and the operator actions necessary to limit fire impact and allow SSD of the plant from the control room. The NRC staff also requested the licensee identify an implementation item for procedure development and training for the VEWFDS. In its response to FPE RAI 10 (Reference 12), the licensee stated that the VEWFDS will be an air-aspirated detection system, and that the design will support satisfying the risk reduction features described in FAQ 08-0046 for in-cabinet systems. The licensee stated that no FPRA credit will be taken for VEWFDS in the MCR. The licensee stated that the testing criteria will meet NFPA 72 and specifically, NFPA 76 for the transport time and obscuration requirements. In its response to PRA RAI 16.01.01 (Reference 17), the licensee stated that for area-wide VEWFDS during transition, the FPRA will assume no credit.

In its letter dated October 5, 2016 (Reference 19), the licensee submitted new LAR Section 4.8.3.3 "FPRA Credit for In-Cabinet VEWFDS," to discuss the sensitivity analysis for the credit given for in-cabinet VEWFDS. The licensee stated that based on the sensitivity results, the CDF and LERF values generally increase, however there are no excessive changes and it is reasonable to continue using the current LAR as the basis to continue forward with the LAR approval process and subsequent self-approval. See SE Section 3.4.2.2 for additional discussion regarding the VEWFDS credit.

The licensee stated that each cabinet in which in-cabinet VEWFDS is being installed will be physically separated from adjoining cabinets and that each individual cabinet will have one or two sample ports inside. The licensee further stated that physical separation in cabinets outside the MCR, is sheet metal, typically found in cabinet construction, that create separation barriers between panel sections.

The licensee stated that the VEWFDS will be addressable on a zone basis, and that each VEWFDS detector will be comprised of one to four zones. The licensee further stated that each addressable zone will have as little as one cabinet and at most nine cabinets, and that each zone, regardless of the number of cabinets it is monitoring, will have one header.

The licensee stated that when an alert or alarm signal is received, an operator and a plant technician immediately respond to the area. At this point, the licensee stated that a continuous fire watch has been established, and will remain in place until the event is concluded. The licensee further stated that all responding operators are qualified to use a fire extinguisher, if needed and, additionally, are fire brigade qualified. The licensee further stated that the responding operator will be in constant contact with the control room, constantly assessing the situation and communicating back to the control room operators.

The licensee stated that area-wide VEWFDS design will consist of four zones, and that two zones will be located at the ceiling and cover one half of the room each and the other two zones will be located in close proximity to the two open relay racks. The licensee further stated that there will also be sampling ports located at the room's exhaust vents. The licensee stated that operator response to the area-wide VEWFDS will be immediate for any signal (trouble, alert, and alarm), and a plant technician with the portable sensing equipment, which is a handheld VEWFDS detector, will immediately respond to alerts and alarms.

The licensee stated that the NFPA codes of record for the design, installation, and testing of VEWFDS will be NFPA 72 and NFPA 76 will be used specifically for transport time and obscuration requirements only.

The licensee stated that the LAR Attachment S, Table S-2, Items 1 and 2, which involve the installation of the VEWFDS, will include revisions to the operating procedures used for personnel responding to fire (trouble, alert, and alarm) and training (in-class and practical) required for plant personnel who will respond to alert and alarms with the portable sensing equipment to assist the operator with pin-pointing the exact location of the fire.

In the licensee's response to FPE RAI 10.a (Reference 12), it stated that no FPRA credit will be taken for VEWFDS in the MCR. In LAR Attachment S, Table S-2, Item 3, the licensee stated that it will upgrade the existing VEWFDS detection in the Main Control Board to ensure consistency through the plant.

The NRC staff concludes that the licensee's response to FPE RAI 10 (Reference 12), is acceptable because the information as provided by the licensee is sufficient for the NRC staff to conclude that the design installation, and operation, of the VEWFDS will meet the guidance in FAQ 08-0046 and implementation of the modifications and related procedures is addressed in LAR Attachment S, Table S-2, Items 1-3.

The NRC staff concludes that the fire protection aspects related to the proposed installation of the VEWFDS at HBRSEP are acceptable because:

- The installation of the VEWFDS at HBRSEP will be performed in accordance with the appropriate NFPA codes and the equipment manufacturers' 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 HBRSEP 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 NFPA 72 and NFPA 76 requirements.

- Operations first responders to VEWFDS indications are qualified to use a fire extinguisher, if needed, and additionally are fire brigade qualified.

- The licensee's procedure will require the first responders to respond to the signal (alert or alarm) and establish a continuous fire watch until the event is concluded.

In addition, the HBRSEP FPRA modeled the installation of the VEWFDS and took credit for its use in assessing the risk of various fire areas during certain scenarios. SE Section 3.4 addresses the technical review of the treatment of the VEWFDS in the HBRSEP FPRA, as well as the acceptability of the risk credit taken for the associated fire areas.

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 confirmed, through review of the documentation provided in the LAR, that feed and bleed was not relied upon as the sole fire-protected SSD path for maintaining reactor coolant inventory, pressure control, and decay heat removal capability, in accordance with 10 CFR 50.48(c)(2)(iii).

The NRC staff also reviewed the licensee's process to identify and analyze MSOs. Based on the LAR, 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 in the NSCA, as well as the applicable FREs. The NRC staff also considers the approach the licensee uses for assessing the potential for MSO combinations acceptable, because it was performed in accordance with NRC-endorsed guidance.

The NRC staff concludes that 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 provides reasonable assurance that the regulatory 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 and areas at HBRSEP. Based on the information provided in the LAR, as supplemented, the NRC staff concludes that the fire protection aspects regarding installation, testing, and operation of the proposed VEWFDS installation are acceptable because the installation will be done in accordance with appropriate NFPA codes and the guidance of FAQ 08-0046; testing and response procedures will be developed; and training of staff will be provided. The modifications to install VEWFDS are identified in LAR Attachment S, Table S-2, Items 1, 2, and 3.

3.3 Fire Modeling

NFPA 805 (Reference 3) 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 8) Section 4.5.2, "Performance-Based Approaches," which describes how the licensee used FM as part of the transition to NFPA 805 at HBRSEP, 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 HBRSEP, 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 PB approach (NFPA 805 Section 4.2.4.1) was not utilized for demonstrating compliance with NFPA 805 for HBRSEP. 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 HBRSEP FREs, including the supporting FM analyses, as documented in SE Section 3.4.2, 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 HBRSEP.

3.4 Fire Risk Evaluations

This section addresses the licensee's FRE PB method, which is based on NFPA 805 (Reference 3), Section 4.2.4.2, "Use of Fire Risk Evaluations." The licensee chose to use only the FRE PB method in accordance with NFPA 805, Section 4.2.4.2. The fire modeling (FM) PB method of NFPA 805, Section 4.2.4.1, "Use of Fire Modeling," was not used for this application.

NFPA 805, Section 4.2.4.2 states in part that:

> 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 NFPA 805, Section 2.4.4.1 ["Risk Acceptance Criteria"]. The fire risk shall be calculated using the approach described in NFPA 805, Section 2.4.3 ["Fire Risk Evaluations"].

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 performance-based 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

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

> 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 (Reference 8), Section 4.2.4, "Fire Area Transition," LAR Section 4.5.2.2, "Fire Risk Approach," LAR Section 4.8.1, "Results of the Fire Area Review," and LAR 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 HBRSEP.

When implementing the PB approach, the licensee followed the guidance contained in NEI 04-02 (Reference 7), Section 5.3, "Plant Change Process," which includes a detailed consideration of DID and safety margins as part of the change process. The licensee documented the method used to meet the DID requirements of NFPA 805 in LAR Attachment C. LAR Attachment C, Table B-3, "Fire Area Transition," documents the results of the licensee's review of fire suppression and fire detection systems at HBRSEP.

The licensee's methodology for evaluating DID refers to each of the three DID elements identified in NFPA 805, Section 1.2. In LAR Attachment C, the licensee provided a table where, for each of the three elements, several examples of fire protection features that addressed that element 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

element has been satisfactorily achieved or whether reliance on features in other elements 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 FPP 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.

As described in LAR Attachment C, this method for addressing DID was implemented in the FREs performed on each PB fire area. Per LAR Attachment C, the FRE 1) documents the fire protection systems/features required to either meet the deterministic criteria of NFPA 805, Section 4.2.3, "Deterministic Approach," or to support the FPRA, 2) notes whether changes or improvements are necessary for each fire protection system/feature to maintain a balance among the DID elements, and 3) provides a justification or basis for why the required fire protection systems/features are adequate for DID. As such, the FRE is the licensee's internal record of the systems required to meet the NSPC and DID requirements of NFPA 805.

Based on its review of the LAR and the FREs, 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 states that:

> 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 margins:

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

LAR Section 4.5.2.2 discusses how safety margins are 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 (Reference 4). An FRE was performed for each fire area containing a VFDR. The FREs contain the details of the licensee's review of safety margins for each PB fire area.

As discussed in LAR Attachment C and the licensee's response to PRA RAI 33 (Reference 12), the FPRA, including FM performed to support the FPRA, applies methodologies consistent with the guidance in NUREG/CR-6850 (Reference 38), (Reference 39), and (Reference 40), and NRC-approved FAQs. LAR Attachment J, "Fire Modeling V&V," explains that FM, including V&V, performed in support of the FPRA utilized accepted codes and standards including NUREG/CR-6850, NUREG-1805 (Reference 45), and NUREG-1824 (Reference 46). In LAR

Attachment C, the licensee further describes the methodology used to evaluate safety margins in the FREs to include the following evaluations and determinations:

- Fire Modeling: The FM in support of the FREs (i.e., as part of the FPRA) was part of a qualitative safety margin review;

- Plant System Performance: Plant system performance under the specific demands associated with postulated fire events was evaluated to determine whether the safety margin established in the plant design basis events was preserved;

- PRA Logic Model: The PRA logic model was reviewed against the ASME/ANS RA-Sa-2009 PRA standard (Reference 33), and RG 1.200, Revision. 2 (Reference 32); and

The results of the licensee's safety margin assessment by fire area are provided in LAR Attachment C, Table B-3.

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 31), and are therefore acceptable. The licensee used appropriate codes and standards (or NRC guidance), and met the safety analyses acceptance criteria in the licensing basis. Based on its review of the LAR and a review of the FREs, the NRC staff concludes that the licensee's approach has adequately addressed the issue of safety margins in the implementation of the FRE process.

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 NFPA 805 LAR, as supplemented, 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," LAR Section 4.7, "Program Documentation, Configuration Control, and Quality Assurance," LAR Attachment C, "NEI 04-02 Table B-3 – Fire Area Transition," LAR Attachment U, "Internal Events PRA Quality," LAR Attachment V, "Fire PRA Quality," and LAR Attachment W, "Fire PRA Insights," as well as associated supplemental information.

The licensee developed its internal events PRA (IEPRA) during the individual plant examination process and continued to maintain and improve the PRA as RG 1.200, and supporting industry standards have evolved. The licensee developed its FPRA model for both Level 1 (core damage) and partial Level 2 (large early release) PRAs during at-power conditions. For the development of the FPRA, the licensee modified its IEPRA model to capture the effects of fire.

The licensee identified administrative controls and processes used to maintain the FPRA model current with plant changes and to evaluate any outstanding changes not yet incorporated into the PRA model for potential risk impact as a part of the routine change evaluation process. In LAR Section 4.8.2, "Plant Modifications and Items to be Completed during the Implementation Phase," the licensee clarified that no plant changes (beyond those identified and scheduled to be implemented as part of the transition to a FPP based on NFPA 805) are outstanding with

respect to their inclusion in the FPRA model. Further, as described in SE Section 3.8.3, 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 FREs to support, for example, 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 the portions of its IEPRA model used to support development of the FPRA model, as discussed in LAR Attachment U, consisted of a full scope peer review that was performed in May 2010 using the NEI 05-04 process (Reference 29), and the combined ASME/ANS PRA standard (Reference 33), as clarified by RG 1.200, Revision 2. The IEPRA model that was reviewed for the full scope peer review serves as the basis of the FPRA used in performing PRA evaluations for the LAR. In its response to PRA RAI 32 (Reference 12), the licensee stated that since the last full-scope peer review, no changes have been made to the IEPRA that are consistent with the definition of a "PRA upgrade" as defined by the ASME/ANS PRA Standard.

For Supporting Requirements (SRs) in the PRA standard, there are three degrees of "satisfaction" referred to as capability categories (CCs) (i.e., CC-I, CC-II, and CC-III), with CC-I being the minimum, CC-II considered widely acceptable, and CC-III indicating the maximum achievable scope/level of detail, plant specificity, and realism. For many SRs, the CCs may be combined (e.g., the requirement for meeting CC-I may be combined with CC-II), or the requirement may be the same across all CCs so that the requirement is simply met or not met.

LAR Attachment U, Table U-1 provides the licensee's resolutions to 50 facts and observations (F&Os) from the IE peer review, all of which are characterized in LAR Attachment U as findings per NEI 05-04 peer review guidelines. In general, an F&O is written for any SR that is judged not to be met or does not fully satisfy CC-II of the ASME standard and RG 1.200, Revision 2.

In LAR Attachment U, the licensee resolved F&O by either providing a description of how the F&O was resolved or providing an assessment of the impact of resolution of the F&O on the FPRA and the results for the NFPA 805 LAR. The NRC staff evaluated each F&O and the licensee's resolutions in LAR Attachment U to determine whether the F&O had any significant impact for the LAR. The NRC staff's review and conclusion for the licensee's resolution of each F&O and basis of acceptability of SRs that are "not met" or only meet CC-I are summarized in the NRC's Record of Review dated February 3, 2017 (Reference 104).

In PRA RAI 02.a (Reference 20), associated with F&O IE-C3-01, the NRC staff found that the opening of a PORV due to pressure transmitter failure was screened from the IEPRA and requested clarification as to whether this spurious operation was considered in the FPRA. In its response to PRA RAI 02.a (Reference 12), the licensee performed additional circuit analysis and determined that fire-induced pressure transmitter failure could lead to spurious PORV opening and updated the FPRA. In its response to PRA RAI 03 (Reference 17), and PRA RAI 03.b.01 (Reference 16), the licensee indicated that it incorporated this update in its integrated analysis. The NRC staff concludes that the licensee's response to PRA RAI 02.a is acceptable because the licensee demonstrated that the FPRA includes consideration of spurious PORV opening due to pressure transmitter failure.

As a result of the review of the LAR and responses to RAIs, the NRC staff concludes that the IEPRA has sufficient technical adequacy and that its quantitative results, considered together

with sensitivity study results, 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. To reach this conclusion, the NRC staff reviewed all F&Os provided by the peer reviewers and determined that the resolution of every F&O supports the determination that the quantitative results are adequate or have no significant impact on the FPRA. Accordingly, the NRC staff concludes that the licensee has demonstrated that the IEPRA meets the guidance in RG 1.200, Revision 2, that it 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 LAR.

3.4.2.2 Fire PRA Model

In LAR Attachment V and the response to PRA RAI 31 (Reference 12), the licensee evaluated the technical adequacy of the FPRA model by conducting peer reviews of the FPRA model using the NEI 07-12 process (Reference 30), and the FPRA part (Part 4) of the ASME/ANS-RA-Sa-2009 PRA Standard, as clarified by RG 1.200, Revision 2. A March 2013 full-scope peer review and a July 2013 focused-scope peer review of the FPRA serve as the basis for the quantitative risk evaluations presented in the LAR. In its response to PRA RAI 32 (Reference 12), the licensee stated that since the last full-scope peer review, no changes, other than those addressed as part of the July 2013 focused-scope peer review, have been made to the FPRA that are consistent with the definition of a "PRA upgrade" as defined by the ASME/ANS PRA Standard.

LAR Attachment V, Table V-1 provides the licensee's resolutions to all 31 F&Os that were written against SRs of Part 4 of the ASME/ANS RA-Sa-2009 PRA standard as clarified by RG 1.200, Revision 2 and not resolved and removed by the follow-on focused-scope peer review. In its response to PRA RAI 31 (Reference 12), the licensee explained that these F&Os represent all the findings from both the initial full-scope and follow-up focused-scope peer reviews and encompass all SRs that were determined by the peer review to be not met or only met at CC-I.

As described in LAR Attachment V, as supplemented, the licensee resolved each F&O by assessing the impact of the F&O on the FPRA and on the results for the LAR. The NRC staff requested additional information to assess the adequacy of some of the resolutions for the review. The NRC staff evaluated each F&O as well as the licensee's respective resolution in LAR Attachment V to determine whether the issue had any significant impact for the LAR. The NRC staff's review and conclusion for the resolution of each F&O is summarized in the NRC's Record of Review dated February 3, 2017 (Reference 105).

In PRA RAI 01.b (Reference 20), associated with F&O CS-A1-01, the NRC staff requested that the licensee provide clarification as to whether some equipment had been excluded from the cable selection and routing database and thus not properly reflected in the FPRA. In its response to PRA RAI 01.b (Reference 12), the licensee clarified that the cable routing was not included for the diesel-driven AFW pump and the deepwell pump diesel generators. The licensee further stated that the cable selection and routing database, and thus the FPRA, would be updated to reflect this routing. In its response to PRA RAI 03 (Reference 17), and PRA RAI 03.b.01 (Reference 16), the licensee indicated that it incorporated the impact of these changes in its integrated analysis. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the FPRA reflects cable routing performed for equipment credited in the FPRA.

In PRA RAI 01.f (Reference 20), associated with F&O FSS-B1-01 as well as PRA RAI 01.k (Reference 20), and PRA RAI 01.k.01 (Reference 23), associated with F&O PRM-B11-01, the NRC staff requested that the licensee provide justification for the modeling of fire scenarios in which abandonment of the MCR is credited. In its response to PRA RAI 01.f (Reference 12), the licensee indicated that MCR abandonment is only credited in the FPRA for loss of MCR habitability and not loss of control. Abandonment on loss of control is not modeled because fire damage in the MCR may render some shutdown functions unavailable from the MCR, and require actions outside the MCR but there is no need for MCR abandonment. In its response to PRA RAI 01.k (Reference 11), the licensee stated that there is only one loss of habitability scenario, and that one scenario is modeled in the FPRA based on the single procedure written to address MCR abandonment. Only the equipment credited in the control room abandonment procedure is used for the scenario and the same scenario is modeled in the variant and compliant plant models. In its response to PRA RAI 01.l (Reference 12), and PRA RAI 20 (Reference 10), the licensee indicated that the MCR analysis on loss of habitability also includes HEPs based on detailed HRAs consistent with NUREG-1921 (Reference 51). Additionally, the FPRA conservatively assumes core damage should any one credited abandonment action be unsuccessful. The NRC staff concludes the licensees responses to the RAIs are acceptable because the licensee demonstrated that the effects of individual fires in the MCR are evaluated, and should loss of MCR habitability occur, the FPRA appropriately models the scenario based on the single procedure that would be followed upon MCR abandonment in both the variant and complaint plant PRA models. Furthermore, according to the response to PRA RAI 30.02 (Reference 16) procedure revisions will be reflected in the post-transition Fire PRA model as necessary to reflect the as-designed and as-operated plant.

In PRA RAI 04 (Reference 20), the NRC staff requested that the licensee provide clarification regarding whether the FPRA made use of any deviations from NRC accepted methods and approaches. In its response to PRA RAI 04 (Reference 12), the licensee identified all deviations from accepted methods and approaches. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that other than those deviations addressed in this SE section, there are no other deviations from NRC accepted methods and approaches.

In PRA RAI 05 (Reference 20), the NRC staff requested that the licensee provide clarification regarding the FPRA's treatment of fire propagation from well sealed and robustly secured electrical cabinets. In its response to PRA RAI 05 (Reference 12), the licensee stated that electrical cabinets were identified as well sealed and robustly secured consistent with guidance in Section 8 of Supplement 1 to NUREG/CR-6850 (Reference 40). Additionally, for well-sealed and robustly secured electrical cabinets below 440V, the licensee updated the FPRA to exclude such cabinets from the Bin 15 count, thus making the licensee's overall Bin 15 counting methodology and treatment of fire propagation with regard to these cabinets consistent with guidance in NUREG/CR-6850. In its response to PRA RAI 05 (Reference 12), and PRA RAI 05.a.01 (Reference 13), in regards to well-sealed and robustly secured motor control centers (MCCs) above 440V, the licensee provided clarification that the FPRA used a probability of 0.1 to characterize the probability that a fire can breach a well-sealed and robustly secured MCC and propagate outside the cabinet (i.e., impact targets external to the MCC). The NRC staff finds that the use of this PRA modeling approach is consistent with guidance in FAQ 14-0009 (Reference 78), because the probability applied is consistent with the conservative and bounding values provided in the FAQ and therefore acceptable. In its response to PRA RAI 05.c (Reference 12), PRA RAI 05.c.01 (Reference 15), and PRA RAI 05.c.01.01 (Reference 16), in regards to all other well sealed and robustly secured electrical cabinets housing circuits greater than 440V (i.e., non-MCC cabinets to which the

FAQ does not apply), the licensee indicated that it updated the FPRA to model fire propagation consistent with guidance in NUREG/CR-6850. In its response to PRA RAI 03 (Reference 17) and PRA RAI 03.b.01 (Reference 16), the licensee confirmed it incorporated that the revised Bin 15 counting methodology and treatment of fire propagation into its integrated analysis. The NRC staff concludes that the licensee's responses to the RAIs are acceptable because the licensee demonstrated that the FPRA's treatment of fire propagation from well-sealed and robustly secured electrical cabinets is consistent with accepted guidance in NUREG/CR-6850 and FAQ 14-0009.

In PRA RAI 06 (Reference 20), the NRC staff requested that the licensee provide further clarification regarding the treatment of sensitive electronics. In its response to PRA RAI 06 (Reference 11), the licensee indicated that it updated the FPRA to be consistent with the guidance in FAQ 13-0004 (Reference 75). In its response to PRA RAI 06.01 (Reference 15), the licensee further clarified that it adhered to the caveats in FAQ 13-0004 regarding the applicability of the FAQ and that it applied the guidance in NUREG/CR-6850 to those configurations where the FAQ was not applicable. In its response to PRA RAI 03 (Reference 17), and PRA RAI 03.b.01 (Reference 16), the licensee also confirmed that it incorporated this revised treatment in the integrated analysis. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the FPRA's treatment of sensitive electronics is consistent with NRC accepted guidance.

In PRA RAI 08 (Reference 20), the NRC staff requested that the licensee provide further clarification regarding the treatment of transient fire locations. In its response to PRA RAI 08 (Reference 12), the licensee stated that the FPRA considered general transient fires and transient fires caused by welding and cutting anywhere within a compartment and confirmed that it considered transient ignition sources at all potential pinch points, consistent with the guidance in Section 11.5.1.6 of NUREG/CR-6850. The NRC staff concludes the licensee's response to the RAI is acceptable because the licensee demonstrated that its method for locating transient fires appropriately addresses pinch points, consistent with accepted guidance.

In PRA RAI 09 (Reference 20), the NRC staff requested that the licensee provide clarification regarding the methods used to develop main control board (MCB) scenarios. In its response to PRA RAI 09 (Reference 12), the licensee clarified that it developed MCB fire scenarios using the guidance in Appendix L of NUREG/CR-6850 and encompassed the risk-significant scenarios for the MCB. In its response to PRA RAI 16.02 (Reference 15), and (Reference 17), the licensee indicated that it updated the FPRA to remove credit for incipient detection from all MCB fire scenarios. In its response to PRA RAI 03 (Reference 17), and PRA RAI 03.b.01 (Reference 16), the licensee confirmed that it removed such credit from the integrated analysis. The NRC staff concludes the licensee's response to the RAI is acceptable because the licensee demonstrated that the FPRA developed MCB fire scenarios consistent with accepted guidance in Appendix L to NUREG/CR-6850 and does not include credit for incipient detection in the MCR.

In PRA RAI 10 (Reference 20), the NRC staff requested that the licensee provide clarification regarding the treatment of junction box fires. In its response to PRA RAI 10 (Reference 11), the licensee indicated that it updated the FPRA to be consistent with the guidance in FAQ 13-0006 (Reference 77). In its response to PRA RAI 03 (Reference 17), and PRA RAI 03.b.01 (Reference 16), the licensee confirmed that it incorporated the revised treatment of junction box fires in its integrated analysis. The NRC staff concludes the licensee's response to the RAI is acceptable because the licensee demonstrated that the FPRA's treatment of junction box fires is consistent with accepted guidance in FAQ 13-0006.

In PRA RAI 11 (Reference 20), the NRC staff requested that the licensee provide justification for not postulating high energy arcing fault (HEAF) scenarios for 480V buses E1 and E2. In its response to PRA RAI 11 (Reference 12), the licensee justified this exclusion, clarifying that amptectors are installed on all of the load-side and incoming feed breakers to the E1 and E2 switchgear that reduce the amount of energy available to faults. The licensee further explained that additional protection in the form of in-line fuses are also installed on all the load circuits. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that while the cabinet itself may fail, there is sufficient DID built in to prevent an energetic HEAF event from propagating because there are three layers of protection that contribute to limiting the duration and amount of available energy of a fault: 1) the normal overcurrent protection system, 2) amptectors, and 3) in-line fuses.

In PRA RAI 12 (Reference 20), the NRC staff requested that the licensee provide justification for the FPRA's treatment of bus duct fires. In its response to PRA RAI 12 (Reference 11), and PRA RAI 12.01 (Reference 15), the licensee indicated that it updated the FPRA's treatment of bus duct fires, including ignition of exposed combustibles from molten slag, to be consistent with the guidance in Chapter 7 of Supplement 1 to NUREG/CR-6850 (Reference 40). In its response to PRA RAI 03 (Reference 17), and PRA RAI 03.b.01 (Reference 16), the licensee confirmed that it incorporated the revised treatment in the integrated analysis. The NRC staff concludes the licensee's responses to the RAIs is acceptable because the licensee demonstrated that the FPRA's treatment of bus duct fires is consistent with accepted guidance.

In PRA RAI 14 (Reference 20), the NRC staff requested that the licensee provide justification for the FPRA's application of circuit failure probabilities (CFPs) and modeling of hot short durations. In its response to PRA RAI 14 (Reference 10), the licensee justified the FPRA's treatment of CFPs and hot short durations relative to guidance contained in NUREG/CR-7150 (Reference 48), and (Reference 49). For cases in which the FPRA's assumptions did not bound guidance in NUREG/CR-7150, the licensee indicated that it updated the FPRA to be consistent with the accepted guidance. In its response to PRA RAI 03 (Reference 17), and PRA RAI 03.b.01 (Reference 16), the licensee confirmed that it incorporated the revised treatment of CFPs and hot short durations in the integrated analysis. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the FPRA's treatment of CFPs and hot short durations is either consistent with or bounds accepted guidance in NUREG/CR-7150.

In PRA RAI 15 (Reference 20), PRA RAI 15.01 (Reference 21), PRA RAI 15.01.01 (Reference 23), and PRA RAI 15.01.01.01 (Reference 24), the NRC staff requested that the licensee provide clarification regarding the FPRA's treatment of identified breaker fuse coordination and circuit protection issues, including modeling approaches used to assess the risk of secondary fires. In its response to PRA RAI 15 (Reference 12), PRA RAI 15.01 (Reference 13), PRA RAI 15.01.01 (Reference 15), and PRA RAI 15.01.01.01 (Reference 17), the licensee indicated that it evaluated the adequacy of breaker fuse coordination and circuit protection associated with SSA and FPRA equipment as well as other equipment important to operation. Where breaker fuse coordination issues were identified, the licensee clarified that fire damage was assumed by failing all uncoordinated power supplies upstream of the fire damaged cable. In the case of inadequate circuit protection, the licensee explained that it modeled secondary fires by conservatively assuming that all cables within the same common enclosure(s) as those cables having inadequate overcurrent circuit protection were simultaneously failed and added to the failures associated with fire scenarios involving the unprotected circuit. In its response to PRA RAI 03 (Reference 17), and PRA RAI 03.b.01 (Reference 16), the licensee confirmed that it

incorporated this revised treatment of breaker fuse coordination and circuit protection issues in its integrated analysis. The NRC staff concludes that the licensee's responses to the RAIs are acceptable because the licensee demonstrated that the modeling of inadequate breaker coordination and circuit protection reflects the as-built plant and was conducted using the guidance from NUREG/CR-6850.

In PRA RAI 16 (Reference 20), the NRC staff requested that the licensee provide clarification regarding how area-wide incipient detection is credited in the Fire PRA results presented in LAR Attachment W. In its response to PRA RAI 16.01 (Reference 15), the licensee clarified that the FPRA was updated to credit the area-wide incipient detection system using guidance in the draft version of NUREG-2180 (Reference 106). In its response to PRA RAI 03 (Reference 17), the licensee indicated that it incorporated this revised treatment in its integrated analysis. The licensee revised LAR Attachment S, Table S-3, Implementation Item 14, to incorporate an NRC-accepted method for incipient detection prior to self-approval and to require confirmation that the transition risk results do not exceed RG 1.174 risk acceptance guidelines. The NRC staff concludes that this action is acceptable because it would be required by the proposed license condition. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee used the best available PRA guidance to estimate the associated change-in-risk and will confirm RG 1.174 risk acceptance guidelines with replacement of an NRC-accepted method when one becomes available.

In PRA RAI 16 (Reference 20), the NRC staff requested that the licensee provide clarification regarding the credit given to incipient detection systems housed within electrical cabinets located outside the MCR. In its response to PRA RAI 16 (Reference 11), the licensee clarified that it credited the in-cabinet incipient detection systems in the FPRA consistent with guidance in FAQ 08-0046 (Reference 68). Subsequently, FAQ 08-0046 was retired by the NRC staff (Reference 107). As a result, the licensee credited in-cabinet incipient detection systems using guidance in pre-publication NUREG-2180 (Reference 108), as a sensitivity study in LAR Section 4.8.3.3 (Reference 19), because insufficient time was available to formally incorporate the changes into the FPRA. The NRC staff finds that these aggregate results represent the best current estimate of the risk results associated with transition to NFPA 805. The licensee revised LAR Attachment S, Table S-3, Implementation Item 14, to incorporate an NRC-accepted method for crediting incipient detection systems prior to self-approval and to require confirmation that the transition risk results do not exceed RG 1.174 risk acceptance guidelines. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee used the best available PRA guidance to estimate the associated change-in-risk and will confirm RG 1.174 risk acceptance guidelines with replacement of an NRC-accepted method.

In PRA RAI 18 (Reference 20), the NRC staff requested that the licensee provide clarification regarding the FPRA's treatment of self-ignited cable fires and cable fires due to welding and cutting. In its response to PRA RAI 18 (Reference 12) and PRA RAI 18.01 (Reference 13) and (Reference 16), the licensee clarified that such fires are treated consistent with the guidance in FAQ 13-0005 (Reference 76). In its response to PRA RAI 03 (Reference 17), and PRA RAI 03.b.01 (Reference 16), the licensee confirmed that it incorporated this treatment in its integrated analysis. The NRC staff concludes the licensee's responses to the RAIs are acceptable because the licensee demonstrated that the FPRA's treatment of self-ignited cable fires and cable fires due to welding and cutting is consistent with accepted guidance.

In PRA RAI 22 (Reference 20), the NRC staff requested that the licensee provide justification with respect to the establishment of acceptable minimum (or "floor") values for HEP

combinations (i.e., joint HEPs). In its response to PRA RAI 22 (Reference 10), the licensee clarified that there are no joint HEP values in the FPRA below 1.0E-06 and that only 16 are below 1.0E-5, the NUREG-1792 (Reference 44), lower value guideline. For those joint HEP values below 1.0E-05, the licensee confirmed that each has its own justification that demonstrates the inapplicability of the NUREG-1792 guideline. Two examples of such justification include those combinations in which HFEs have intervening successful operator actions and those in which HFEs are separated by a very long duration in time. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the FPRA includes the use of floor values consistent with guidance in NUREG-1921.

In PRA RAI 28 (Reference 20), the NRC staff requested that the licensee provide clarification regarding the reactor coolant pump (RCP) seal failure model used in the FPRA. In its response to PRA RAI 28 (Reference 12), the licensee indicated that a Generation III Westinghouse SHIELD RCP seal PRA model was developed for the RCP seal upgrade that is identified in LAR Attachment S, Table S-1, as supplemented, and credited in the FPRA for both the post-transition and compliant plant configurations. Additionally, in its response to PRA RAI 30.01 (Reference 15), the licensee revised LAR Attachment S, Table S-3 to include Implementation Item 12, which replaces this Generation III Westinghouse SHIELD RCP seal PRA model with the final, NRC-approved PRA model, prior to self-approval, and requires the licensee to confirm that the risk results do not exceed RG 1.174 risk acceptance guidelines. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that it used the best available PRA model based on current technical evaluations to estimate the associated change-in-risk and established an implementation item which would be required by the proposed license condition that will confirm if replacement of the current model with the final, NRC-approved PRA model increases risk results beyond risk acceptance guidelines.

As a result of its review of the LAR, as supplemented, the NRC staff concludes that the FPRA is of sufficient technical adequacy 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 in RG 1.174. To reach this conclusion, the NRC staff reviewed all F&Os provided by the peer reviewers and determined that the resolution of every F&O supports the determination that the quantitative results are adequate. In addition, the NRC staff reviewed FPRA-related issues, and determined that the licensee's resolution of the issues supports the determination that the quantitative results are adequate to transition to NFPA 805 and to support subsequent self-approval as described in the applicable license condition. Accordingly, the NRC staff concludes that the licensee has demonstrated that the FPRA meets the guidance in RG 1.200, Revision 2, and that it is technically adequate to support the FREs and other risk calculations required for NFPA 805.

3.4.2.3 Fire Modeling in Support of the Development of Fire Risk Evaluations

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 3), 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, states, in part, that:

> The PSA approach, methods, and data shall be acceptable to the AHJ.

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

> 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," states that:

> 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," states that:

> 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," states that:

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

The following SE 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 SE Sections 3.8.3.2 through 3.8.3.5.

3.4.2.3.1 Overview of Fire Models Used to Support the FREs

FM was used to develop the 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 FPRA.

Heskestad's flame height and plume temperature correlations were used to determine the vertical dimensions of the ZOI for various ignition sources and different types of targets (e.g., thermoplastic cables as defined in NUREG/CR-6850, Volume 2 (Reference 39)). These algebraic models are described in NUREG-1805 (Reference 45). V&V of these algebraic models is documented in NUREG-1824, Volume 3 (Reference 46).

A refined approach based on the solid flame model described in NUREG-1805 was used to determine the radial ZOI as a function of the height of the target in relation to the elevation of the fire. V&V of the solid flame model for targets above ground level is also documented in NUREG-1824, Volume 3.

The ZOI for oil fires was determined based on information in the generic FM treatments (GFMTs) approach, which provides tables of pre-calculated values of the horizontal and vertical dimensions of the ZOI for various ignition sources and different types of targets. The ZOI tables in the GFMTs approach were obtained by using a collection of algebraic models and empirical correlations. The primary algebraic fire models and empirical correlations that were used for

this purpose (Heskestad's flame height and plume temperature correlations, and Modak's point source radiation model) are described in NUREG-1805. V&V of these algebraic models is documented in NUREG-1824, Volume 3. The point source radiation model was also used in the structural steel analysis to determine the minimum distance from electrical cabinet and transient fires to avoid damage to structural steel.

In addition, the licensee developed screening approaches for the evaluation of ignition sources to determine the potential for the generation of a hot gas layer (HGL) in the compartment or fire area being analyzed. The FPRA used these 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; and
- Method of Beyler for closed compartments.

These HGL correlations are also described in NUREG-1805 and their V&V is documented in NUREG-1824, Volume 3. The licensee's approach to determine the potential for the development of an HGL includes a damage time adjustment to account for the thermal inertia of cable targets. This adjustment, referred to as the "heat soak" method, is based in part on Table H-5 in NUREG/CR-6850, Volume 2. A similar adjustment was used in assessing the damage time of cables located above a burning electrical cabinet or transient ignition source.

The licensee also identified the use of the following empirical models that are not addressed in NUREG-1824, in the development of the GFMTs approach:

- Shokri and Beyler Solid Flame Model (Reference 109);
- Mudan flame radiation model (Reference 110);
- Plume heat flux correlation by Wakamatsu et al. (Reference 111);
- Yokoi plume centerline temperature correlation (Reference 112) and (Reference 113);
- Hydrocarbon spill fire size correlation (Reference 114);
- Flame extension correlation (Reference 115);
- Delichatsios line source flame height model (Reference 116);
- Corner flame height correlation (Reference 115);
- Kawagoe natural vent flow equation (Reference 117);
- Yuan and Cox line fire flame height and plume temperature correlations (Reference 118);

- Lee cable fire model (Reference 119); and
- Babrauskas method to determine ventilation-limited fire size (Reference 120).

CFAST Version 6 (Reference 121), was used for the MCR abandonment time calculations, and for the evaluation of the development and timing of damaging HGL conditions for sensitive electronics in the battery room, the E1/E2 switchgear room, and the safeguards room. V&V of CFAST is documented in NUREG-1824, Volume 5.

In addition to CFAST, the following fire model was used in the HGL timing evaluation for sensitive electronics in the battery room, the E1/E2 switchgear room, and the safeguards room:

- 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 47).

A similar model was used in the HGL timing calculations for cable targets and scenarios that involve secondary combustibles (cable trays). The V&V of the FLASH-CAT model is not addressed in NUREG-1824, but is discussed in NUREG/CR-7010.

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

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 assess whether these targets and 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 HBRSEP-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.

3.4.2.3.2 RAIs Pertaining to FM in Support of the HBRSEP FPRA

By letters dated October 23, 2014 (Reference 20), March 26, 2015 (Reference 21), April 23, 2015 (Reference 22), and July 7, 2015 (Reference 23), the NRC staff issued RAIs to the licensee. By letters dated December 22, 2014 (Reference 10), January 22, 2015 (Reference 11), March 16, 2015 (Reference 12), April 1, 2015 (Reference 13), May 19, 2015 (Reference 14), July 31, 2015 (Reference 15), and March 16, 2016 (Reference 16), the licensee responded to these RAIs.

- In FM RAI 01.a (Reference 20), the NRC staff requested that the licensee identify any FM tools and methods that have been used in the development of the LAR and that are not discussed in LAR Attachment J.

  In its response to FM RAI 01.a (Reference 10), the licensee explained that it updated LAR Attachment J, Table J-1 to include the point source radiation model, which was used in structural steel-analysis, and confirmed that all other

FM tools and methods that have been used in the development of the LAR are discussed in LAR Attachment J.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee updated LAR Attachment J to include a discussion of all fire models and fire model applications used in the development of the LAR.

- In FM RAI 01.b (Reference 20), the NRC staff requested that the licensee explain how it accounted for the effect of the increased HRR due to fire propagation in cable trays in the ZOI, HGL, and multi-compartment analysis (MCA) calculations.

  In its response to FM RAI 01.b (Reference 12), the licensee explained that it used the method in Appendix R of NUREG/CR-6850 to calculate when the first tray ignites, at what times the fire spreads vertically to higher trays, and the length of each tray that ignites (35° cone). The licensee further explained that it used the HRR per unit area for thermoplastic cables from NUREG/CR-7010 (250 kW/m^2), and that lateral flame spread in each tray was assumed to be offset by the burnout. Finally, the licensee's response implied that the effect of the additional HRR from cable trays was only accounted for in the HGL and MCA calculations.

  In FM RAI 01.b.01 (Reference 21), the NRC staff requested that the licensee provide technical justification for the assumption that horizontal fire spread in cable trays is assumed to be offset by the burnout, and explain how it accounted for the effect of the increased HRR due to fire propagation in cable trays in the ZOI calculations.

  In its response to FM RAI 01.b.01 (Reference 13), the licensee referred to Figure 9-2 of NUREG/CR-7010 as an example to show that, as the progression of the fire extends outwards, the burning region remains somewhat constant. The licensee further explained that the vertical ZOI was extended to the ceiling if there are multiple trays in the ZOI of the ignition source, and that it calculated the HRR of cable trays based on the model in NUREG/CR-6850, Appendix R, assuming a tray width of 0.61 m [meter] and an initial burning length of the lowest tray of 1 m.

  The NRC staff concluded that the licensee's response to FM RAI 01.b.01 was not acceptable because:

  (1) Figure 9.2 in NUREG/CR 7010 shows that between the 15th and 30th minute, flames have spread laterally while no sections of the trays have burnt out. According to the FLASH-CAT model, lateral flame spread begins as soon as a tray ignites and occurs at a rate of 0.9 mm/s for thermoplastic cable. Cables do not burn out until the polymer has been completely consumed.

  (2) The licensee did not account for the effect of the increased HRR due to fire propagation in cable trays on the horizontal ZOI.

  In FM RAI 01.b.01.01 (Reference 23), the NRC staff requested that the licensee re-evaluate the target damage for all scenarios that involve secondary

combustibles (i.e., cable trays) taking horizontal flame spread into account, determine the expanded ZOI that corresponds to the combined HRR from the ignition source and the cable trays, and identify any targets that are in the expanded ZOI.

In its response to FM RAI 01.b.01.01 (Reference 15), the licensee explained that the FPRA was reviewed to identify all fixed and transient ignition source fire scenarios that do not propagate but are capable of propagating to raceways, and that the FPRA was updated to incorporate scenarios in which the revised cable tray fire propagation calculations may accelerate the estimated time to develop damaging HGL conditions or in which a HGL is not generated but additional targets are damaged as a result of the expanded ZOI due to the HRR contribution of cable fires. The licensee further explained that the additional HRR contribution from cable trays to each fire scenario was determined based on the models described in NUREG/CR-6850, Appendix R and NUREG/CR-7010. The licensee further explained that the updated risk results are reported as part of PRA RAI 03.

The NRC staff concludes that the licensee's response to FM RAI 01.b.01.01 is acceptable because the licensee re-evaluated target damage for all scenarios that involve secondary combustibles, and in this re-evaluation calculated fire propagation and the resulting HRR of cable trays based on the models described in NUREG/CR-6850, Appendix R and NUREG/CR-7010.

In its review of the documentation supporting the response to FM RAI 01.b.01, the NRC staff identified two additional issues that required follow-up:

(1) The licensee's method to determine the time to damaging HGL conditions for scenarios involving cable trays was found to be non-conservative.

(2) The licensee's method to determine the time to ignition of the lowest tray in a stack accounted for the thermal inertia of the cables based on the delay times in Table H-6 in NUREG/CR-6850, Appendix H, but appeared to ignore the effect of the preheat during the initial period when the ignition source plume temperature is below the damage threshold.

In FM RAI 01.b.01.02 (Reference 23), the NRC staff therefore requested that the licensee provide a detailed description of the methodology that was used to determine the time to damaging HGL conditions for scenarios that do and those that do not involve secondary combustibles, and provide technical justification for the underlying assumptions of the approach for both types of scenarios.

In its response to FM RAI 01.b.01.02 (Reference 16), the licensee explained that the time to the development of a damaging HGL was determined as the time when the HRR of the ignition source, in combination with the HRR of secondary combustibles (cable trays) for scenarios that involve secondary combustibles, reaches the limiting HRR. The licensee further explained that the limiting HRR is the minimum steady HRR that is required to create a damaging HGL in 30 minutes; and that it was pre-calculated as a function of target type (thermoplastic or thermoset), floor area of the compartment, and ceiling height using the MQH correlation for naturally vented compartments and Beyler's

correlation for closed compartments, and crediting the thermal inertia of cable targets based on the delay times in Tables H-5 and H-6 of NUREG/CR-6850 using an approach referred to by the licensee as the "heat soak" method. The licensee also described the model that was used to calculate fire propagation in stacks of horizontal cable trays, and explained that it is identical to the model described in Appendix R of NUREG/CR-6850 except that the delay times in Tables H-5 and H-6 of NUREG/CR-6850 are accounted for in the determination of the ignition time of the bottom tray. The licensee further explained that in the determination of the ignition time of the lowest tray, the assumed HRR profiles for fixed and transient ignition sources were based on the guidance and test data in Appendix G of NUREG/CR-6850, Vol. 2 and NUREG/CR-6850, Supplement 1.

The NRC staff concludes that the licensee's response to FM RAI 01.b.01.02 is acceptable because the licensee's approach is based on conservative assumptions and uses methods that are described in NUREG/CR-6850.

In FM RAI 01.b.01.03 (Reference 23), the NRC staff requested that the licensee explain how its method to determine the time to ignition of the lowest tray in a stack accounts for the effect of the preheat that would occur during the initial period when the plume temperature is below the ignition/damage threshold.

In its response to FM RAI 01.b.01.03 (Reference 15), the licensee described the method in detail, stating that it was based on the damage delay times for constant temperature exposure of thermoplastic cables in Tables H-5 and H-6 of NUREG/CR-6850, showed that the preheat is excluded from the damage delay, and illustrated the method with an example. The licensee further justified the assumption that ignition and damage occur at the same time based on the fact that the electrical shorts and sparks generated when cables are damaged due to fire generate the pilot flame necessary to ignite the cables.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee's method to determine the time to ignition of the lowest tray in a stack is conservative and based on guidance in NUREG/CR-6850, and the assumption that ignition and damage occur at the same time is reasonable based on the fact that reported ignition temperatures of thermoplastic cable jacket and insulation materials are generally well above the damage threshold of 205 degrees Celsius (°C).

- In FM RAI 01.c (Reference 20), the NRC staff requested that the licensee explain how it identified non-cable intervening combustibles and accounted for them in the FM analyses.

  In its response to FM RAI 01.c (Reference 12), the licensee explained that it identified intervening combustibles during walkdowns, and that it incorporated the HRR contribution from intervening combustibles determined to be in the ignition source ZOI in the FM analyses.

  In FM RAI 01.c.01 (Reference 21), the NRC staff requested that the licensee describe the methodology it used to estimate the HRR from non-cable intervening combustibles in the ZOI, HGL, and MCA calculations.

In its response to FM RAI 01.c.01 (Reference 13), the licensee indicated that no contributing non-cable intervening combustibles were found during the walkdowns.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that there was no need to estimate the HRR of non-cable secondary combustibles, since none were found during the walkdowns.

- In FM RAI 01.d (Reference 20), the NRC staff requested that the licensee explain how it accounted for wall and corner effects in the HGL and MCA calculations.

  In its response to FM RAI 01.d (Reference 12), the licensee explained that it did not account for wall and corner effects in the HGL calculations because the MQH and Beyler correlations on average over-predict the HGL temperature rise by 44 percent or more (as shown in Table 4 -1 of NUREG-1934, (Reference 52)), and showed that this is a significantly higher HGL temperature increase than what could result from wall and corner effects. The licensee further explained that the MCA used the same approach as the HGL analysis.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the bias of the MQH and Beyler correlations bound any potential increase of the HGL temperature due to wall or corner effects.

- In FM RAI 01.e (Reference 20), the NRC staff requested that the licensee provide technical justification for the assumed fire areas and elevations that were used in the ZOI calculations for transient combustible fires.

  In its response to FM RAI 01.e (Reference 12), the licensee explained that the diameter used in the calculation of the vertical ZOI of transient fires was approximately 1 foot (ft), and that transient fires were placed at floor level. The licensee further explained that placing transient combustibles on the floor is consistent with the plant's transient combustible control procedures, and that a 1 ft diameter transient combustible on the floor is equivalent, in terms of the elevation of the vertical ZOI above the floor, to a 3.3 ft diameter transient combustible at 2.3 ft above the floor.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the conservatism in the vertical ZOI due to the assumed transient fire diameter is likely to offset the potentially non-conservative assumption of zero transient elevation in terms of impact on CDF, ΔCDF, LERF and ΔLERF.

- In FM RAI 01.f (Reference 20), the NRC staff requested that the licensee provide the basis for the assumption in the MCR abandonment time calculations that the fire brigade is expected to arrive within 15 minutes.

  In its response to FM RAI 01.f (Reference 10), the licensee explained that, based on drill times obtained over a period of several years, nominal fire brigade

response time is estimated to be between 10 and 11 minutes. The licensee further explained that because this compares very favorably with the 10 minutes for full fire brigade response which was assumed in FAQ 08-0050 (Reference 69), to generate the non-suppression curves, use of the approach described in FAQ 08-0050 was judged to be appropriate.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the fire brigade response time assumed in the MCR time abandonment calculations is conservative compared to the nominal response times resulting from fire drills.

- In FM RAI 01.g (Reference 20), the NRC staff requested that the licensee provide technical justification for not considering fires originating in the kitchen in the MCR abandonment calculations.

  In its response to FM RAI 01.g (Reference 10), the licensee demonstrated that fire scenarios originating in the kitchen with the door propped open are bounded by the workstation fire scenarios located within the MCR.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the severe transient fire scenarios already considered in the MCR abandonment calculations are bounding, and therefore can be used to characterize the effects of a kitchen fire.

- In FM RAI 01.h (Reference 20), the NRC staff requested that the licensee show that the assumption of using the thermoplastic cable HRR in the MCR abandonment calculations is consistent with the actual cable types used in the MCR electrical cabinets.

  In its response to FM RAI 01.h (Reference 10), the licensee explained that 8 percent or less of the cables in the MCR cabinets are thermoset, and that it treated cabinet fire scenarios in the MCR as thermoplastic electrical panel fires. The licensee further showed that a non-MCB fully thermoset panel would have an adverse effect on the risk compared to a fully thermoplastic panel, and that the reverse is true for MCB panel ignition source fire scenarios. The licensee further demonstrated that assuming a weighted average of the soot yield based on a mix of 8 percent thermoset and 92 percent thermoplastic increases the risk for the non-MCB panel fire scenarios by 15 percent or less over the 100 percent thermoplastic baseline, and argued that this increase is acceptable because it is of the same order as the uncertainty of the HRR per Chapter 2 in Section 3 of the Society of Fire Protection Engineers (SFPE) handbook (4^{th} Edition) (Reference 122).

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that a sensitivity study shows that an increased soot yield and reduced heat of combustion result in a slight increase of the abandonment times, and a 20 percent reduction of the probability of MCR abandonment for non-MCB panel fires.

- In FM RAI 01.i (Reference 20), the NRC staff requested that the licensee provide details about the flow opening between the MCR volume and the interstitial

space above the MCR acoustic ceiling assumed in the MCR abandonment calculations, and show that the assumed opening is consistent with plant conditions.

In its response to FM RAI 01.i (Reference 10), the licensee explained that it based the flow connection between the MCR and the interstitial space on the actual configuration of the MCR, and that for fires in the MCBs it used a single volume representation of the interstitial space and the MCR area because the large opening in the false ceiling above the MCBs dominates the scenarios. The licensee further explained that for fires outside the MCBs a sensitivity analysis showed that a configuration with the false ceiling in place provides a more conservative result, and that for these fires only a small boundary leakage opening was used.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the flow opening between the MCR volume and the interstitial space above the MCR acoustic ceiling assumed in the MCR abandonment calculations was either consistent with plant conditions, or resulted in conservative MCR abandonment times.

- In FM RAI 01.j (Reference 20), the NRC staff requested that the licensee justify using a uniform leakage factor for the bounding walls, floor, and ceiling in the MCR abandonment calculations.

  In its response to FM RAI 01.j (Reference 10), the licensee explained that the intent was to use different leakage factors for the wall and ceiling surfaces, but that it used a single factor since a sensitivity analysis showed that it is a minor parameter that does not significantly affect the abandonment time results.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the leakage areas for the walls is based on values in the SFPE handbook and accounts for 50-75 percent of the total leakage, and the assumed reduced floor/ceiling leakage fraction was found to affect the MCR abandonment times by not more than approximately 1 percent.

- In FM RAI 01.k (Reference 20), the NRC staff requested that the licensee justify why the sensitivity study did not evaluate the effect of realistic variations of wall tightness in the MCR abandonment calculations.

  In its response to FM RAI 01.k (Reference 10), the licensee explained that the uncertainty in the leakage fraction is in the direction of more leakage, and may be an order of magnitude larger than what was considered. The licensee further explained that, given that increased leakage improves the risk, there was no further need to investigate the uncertainty of this parameter.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the leakage fraction assumed in the baseline case was conservatively biased.

- In FM RAI 01.l (Reference 20), the NRC staff requested that the licensee explain whether cabinet fires in the MCR were assumed to propagate to adjacent

cabinets within 10 or 15 minutes, and provide technical justification for the fire propagation time that was assumed.

In its response to FM RAI 01.l (Reference 10), the licensee explained that it assumed a propagation time between panels of 10 minutes.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that it assumed a fire propagation time between adjacent cabinets that is consistent with the guidance in NUREG/CR-6850, Vol. 2.

- In FM RAI 01.m (Reference 20), the NRC staff requested that the licensee explain in detail how it derived the fuel properties used in the MCR abandonment calculations, and to confirm that these values are representative of the cable materials and Class A combustibles in the MCR, or that they are otherwise bounding.

  In its response to FM RAI 01.m (Reference 10), the licensee explained that the fuel properties for electrical panels are based on the properties in the SFPE handbook for polyethylene/PVC cable, and that the lowest value for the effective heat of combustion and the highest value for the soot yield were selected to maximize the calculated soot generation rate. The licensee further explained that the transient fuel package was assumed to consist of equal portions of wood and polyethylene, and that a sensitivity analysis showed that the baseline abandonment times are conservative for the assumed fuel properties and are not sensitive to uncertainties in the fuel properties.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the fuel properties used in the MCR abandonment calculations are consistent with the fuels that are present in the MCR, and lead to conservative estimates of the abandonment times.

- In FM RAI 01.n (Reference 20), the NRC staff requested that the licensee provide technical justification to demonstrate that the transient fire HRRs for the polyethylene SCBA containers in the MCR assumed in the MCR abandonment calculations bound the expected HRRs.

  In its response to FM RAI 01.n (Reference 10), the licensee explained that it evaluated a fire scenario involving the SCBA gear as part of the MCR abandonment calculations, and that it was shown that the baseline fire scenario involving the severe transient (workstation) is applicable to the SCBA fuel packages.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that a scenario involving the SCBA containers is bounded by the workstation fire scenario.

- In FM RAI 01.o (Reference 20), the NRC staff requested that the licensee provide technical justification for not considering fire spread between back panel electrical cabinets in the MCR abandonment analysis.

In its response to FM RAI 01.o (Reference 10), the licensee explained that the cabinets that are referred to in the RAI are "individual panels that are effectively separated by double wall constructions," and that propagating fire scenarios are therefore not applicable.

The approach recommended in Section S.1 of NUREG/CR-6850, Appendix S is to assume no fire spread when the cabinets are separated by a double wall with an air gap. Since the licensee did not state that there is an air gap between the cabinets, the NRC staff requested in FM RAI 01.o.01 (Reference 22), that the licensee confirm that the individual panels considered in the MCR abandonment analysis are separated by a double wall with an air-gap, or provide technical justification for not assuming fire propagation between cabinets.

In its response to FM RAI 01.o.01 (Reference 14), the licensee explained that the response to FM RAI 01.o referred to the MCBs and the cabinets located at the ends of the horseshoe that have the same configuration as the MCBs (in-core instrument racks, radiation control panels, and nuclear instrument racks). The licensee further explained that baseline fire scenarios involving these panels are characterized using fires that propagate to adjacent panels and that non-propagating fire scenarios are applicable to the other panels within the MCR because they are individual panels that are effectively separated by a double wall with an air gap construction.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee confirmed that the MCR panels in question either had both an air gap and double wall construction, which is one of the cases for which the recommended guidance in NUREG/CR-6850 does not require the consideration of cabinet to cabinet fire propagation, or were included in an analysis that considered propagation to adjacent panels.

- In FM RAI 01.p (Reference 20), the NRC staff requested that the licensee explain how it used the GFMTs approach in the FM analysis.

  In its response to FM RAI 01.p (Reference 12), the licensee explained that it used the GFMTs to determine the ZOI for oil fires, but that the HRR for unconfined oil spill fires determined for the spill size calculated based on the guidance in NUREG/CR-6850, Appendix G was reduced by a factor of 5 to account for the heat losses to the concrete floor. The licensee further explained that it used the GFMTs approach in the PRA to calculate initial severity factors.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that a factor of 5 reduction of the HRR for unconfined spill fires is consistent with a recommendation in the chapter of the SFPE handbook on which the NUREG/CR-6850 guidance for determining the size of an unconfined spill fire is based (Reference 114).

- In FM RAI 01.q (Reference 20), the NRC staff requested that the licensee provide technical justification for using CFAST to compare the calculated HGL temperature with smoke detector activation time in fire zone 20.

In its response to FM RAI 01.q (Reference 11), the licensee explained why it is acceptable to use CFAST for this purpose based on the V&V basis and limitations of use of the model, and included a brief discussion to show why the approach is conservative and bounding. The licensee further referred to a conference paper by Geiman and Gottuk (Reference 123), to justify using the optical density calculated by CFAST to estimate the time to actuation of an ionization smoke detector.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that it used CFAST within its limitations, and the approach that it used to determine smoke detector actuation time is described in an authoritative publication.

- In FM RAI 01.r (Reference 20), the NRC staff requested that the licensee provide technical justification for not using a bounding ambient temperature in the FM analysis of fire zone 20.

  In its response to FM RAI 01.r (Reference 11), the licensee explained that it assumed the initial ambient temperature for fire zone 20 of 32 °C (90 °F), and that this, although it may not be bounding, represents an elevated temperature in the space relative to normal operating conditions. The licensee further explained that a sensitivity analysis was performed to demonstrate that the model output parameters are not sensitive to the assumed ambient temperature.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the assumed initial ambient temperature is relatively high, and that its sensitivity analysis showed that realistic variations in the initial ambient temperature have a negligible effect on the model output.

- In FM RAI 01.s (Reference 20), the NRC staff requested that the licensee provide technical justification for using the calculated HGL optical density in fire zone 20, given that CFAST significantly overestimates the soot concentration in the HGL.

  In its response to FM RAI 01.s (Reference 11), the licensee explained that it updated the analysis in fire zone 20, and adjusted the soot yields to offset the HGL optical density bias. The licensee further explained that a combined sensitivity and uncertainty analysis was performed to demonstrate that the detector timing calculated based on the revised soot yields is adequately representative or otherwise bounding the anticipated actual performance of the system.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that it updated the analysis of fire zone 20 and accounted for the non-conservative CFAST HGL optical density bias.

- In FM RAI 01.t (Reference 20), the NRC staff requested that the licensee provide technical justification for the soot yield and heat of combustion (HOC) assumed for the cables in fire zone 20.

In its response to FM RAI 01.t (Reference 11), the licensee explained that the sensitivity analysis shows that the results of the fire zone 20 analysis are not sensitive to the assumed HOC, and re-iterated that it revised the soot yield of the cables to produce conservative detection actuation timing estimates (see discussion regarding FM RAI 01.s).

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that it took the HOC from the applicable literature, the results of the analysis are not sensitive to the exact value of the HOC, and it chose the soot yields to obtain conservative detector actuation timing estimates.

- In FM RAI 01.u (Reference 20), the NRC staff requested that the licensee explain how the uncertainty of the calculated smoke detector actuation times in fire zone 20 is affected by the assumed HRR and ventilation conditions.

  In its response to FM RAI 01.u (Reference 11), the licensee referred to the combined sensitivity and uncertainty analysis, and explained that it performed the analysis following the guidance contained in NUREG-1934. The licensee further re-iterated that the combined analysis demonstrated that the revised detector timing calculations are adequately representative or otherwise bounding the anticipated actual performance of the system given the expected variability in the model input parameters.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that it adequately accounted for the effect of the assumed HRR and ventilation conditions on the uncertainty of the calculated detector actuation times.

- In FM RAI 01.v (Reference 20), the NRC staff requested that the licensee provide justification for not postulating HEAF scenarios as part of the analysis in fire zone 20.

  In its response to FM RAI 01.v (Reference 11), the licensee explained that, based on its evaluation of the potential for HEAFs in fire zone 20, the FPRA only considers bus duct HEAF scenarios and no electrical panel HEAF scenarios in fire zone 20. The licensee further explained how the bus duct HEAF scenarios compare to the electrical panel scenarios considered in the fire zone 20 analysis, and showed that the cabinet HRRs either bound or are representative of the potential bus duct HEAF fires.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the cabinet HRRs considered in the fire zone 20 analysis bound or are representative of the potential bus duct HEAF fires, and detection actuation times for bus duct HEAF scenarios are (much) shorter than for non-HEAF electrical cabinet fires.

- In FM RAI 02.a (Reference 20), the NRC staff requested that the licensee describe how it characterized the installed cabling in the power block, specifically with regard to the critical damage threshold temperatures and critical heat flux for thermoset and thermoplastic cables as described in NUREG/CR-6850.

In its response to FM RAI 02.a (Reference 12), the licensee explained that it assumed thermoplastic damage criteria for all cabling, including in cases where there is a mixture of thermoset and thermoplastic cables.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee conservatively assumed thermoplastic cable damage thresholds throughout.

- In FM RAI 02.b (Reference 20), the NRC staff requested that the licensee explain how it determined the damage thresholds for non-cable components (i.e., pumps, valves, electrical cabinets, etc.).

  In its response to FM RAI 02.b (Reference 12), the licensee explained that the vulnerability of active components is governed by the cables connected to them, and that these components are therefore assumed to fail when the damage thresholds for thermoplastic cables are reached. The licensee further explained that passive components are assumed not to be damaged by fire.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that its approach is consistent with the guidance in contained in NUREG/CR-6850, Appendix H.

- In FM RAI 02.c (Reference 20), the NRC staff requested that the licensee describe the damage criteria that it used for exposed temperature-sensitive equipment, and explain how it treated temperature-sensitive equipment inside an enclosure.

  In its response to FM RAI 02.c (Reference 12), the licensee made reference to PRA RAI 06. In its response to PRA RAI 06 (Reference 11), the licensee stated that it did not model sensitive electronics in the FPRA, but they will be incorporated into the FPRA consistent with the guidance contained in FAQ 13-0004, "Clarifications on Treatment of Sensitive Electronics" (Reference 75), and the results will be included in the response to PRA RAI 03. In its response to PRA RAI 03 (Reference 17), the licensee indicated that this has been completed.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee modeled sensitive electronics based on the guidance contained in FAQ 13-0004.

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 HBRSEP 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 FPRA Quality

Based on NUREG-0800, Section 19.2 (Reference 37), Section III.2.2.4.1, summarizing the NRC staff's review of PRA Quality required for an LAR, the NRC staff concludes that the licensee's

PRA satisfies the guidance in RG 1.174, Section 2.3, and RG 1.205, Section 4.3 regarding the technical adequacy of the PRA used to support risk assessment to support transition to NFPA 805.

The NRC staff concludes that the PRA approach, methods and data are acceptable, and, therefore, that NFPA 805 Section 2.4.3.3 is satisfied for the request to transition to NFPA 805. The NRC staff based this conclusion on the findings that: (1) the PRA model meets the criteria in that it 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 model conforms sufficiently 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 FPRA has been confirmed as appropriate and acceptable.

The FPRA used to support RI self-approval of changes to the FPP must use an acceptable PRA approach and acceptable methods and data. The NRC staff concludes that the changes already made to the baseline FPRA model to incorporate acceptable methods, as detailed in the licensee's response to PRA RAI 03 and PRA RAI 03.b.01 discussed above and following completion of all implementation items described in LAR Attachment S, Table S-3, as supplemented, demonstrate that NFPA 805 criteria are satisfied and the PRA is acceptable for use to support self-approval changes to the FPP program.

Based on the licensee's administrative controls to maintain the PRA models current and assure continued quality, using only qualified staff and contractors (as described in SE Section 3.8.3), the NRC staff concludes that the PRA maintenance process is adequate to maintain the quality of the PRA to support self-approval of future RI changes to the FPP under the NFPA 805 license condition following completion of all implementation items described in LAR Attachment S, Table S-3, as supplemented.

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 (Reference 4), Section C.2.2.4, "Risk Evaluations," the licensee used a RI approach to justify acceptable alternatives to complying with NFPA 805 deterministic criteria. The NRC staff reviewed the following information during its evaluation of the FREs: LAR Section 4.5.2, "Performance-Based Approaches," LAR Attachment C, "NEI 04-02 Table B-3 – Fire Area Transition," and 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. VFDRs that will be brought into deterministic compliance through plant modifications do not require a risk evaluation. The licensee identified the affected components of the VFDRs that it does not intend to bring into deterministic compliance in LAR Attachment C. For these VFDRs that will be retained and become part of the licensing basis, the licensee used the RI approach, in accordance with NFPA 805, Section 4.2.4.2, to demonstrate that the increased risk from the retained VFDRs is acceptable.

All of the VFDRs identified by the licensee were separation issues. Separation-related VFDRs can generally be categorized into the following four 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; and (4) combinations of the above configurations.

In LAR Attachment W and various RAI responses, the licensee described how an FRE is performed for VFDRs. In its response to PRA RAI 29 (Reference 10), the licensee clarified that FREs were performed consistent with guidance in FAQ 09-0057 (Reference 72), which describes one acceptable method to simplify transition from a self-induced station blackout strategy. The licensee explained that the change in risk associated with each fire area is obtained by calculating the difference between the CDF and LERF of a compliant plant configuration and the post-transition plant configuration. The total change in risk was obtained by summing the change in risk for each fire area and comparing the total to the RG 1.174 acceptance guidelines. The licensee further explained that some risk reduction modifications (i.e., non-VFDR modification) are planned that do not resolve a VFDR but, instead, reduce risk.

The post-transition plant is modeled with fire-induced cable failures included for retained VFDRs, with all RAs at their nominal values, and with all non-VFDR modifications incorporated into the FPRA. VFDRs are removed from the compliant plant by assuming that the cables associated with a VFDR are not affected by a fire or that RAs that effectively mitigate the failures associated with a VFDR always succeed. Non-VFDR modifications are also included in the compliant case.

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 RG 1.205, Section 2.2.4.1, "Fire Risk Evaluations (Including Recovery Actions) by Fire Area," and FAQ 08-0054 (Reference 70). The NRC staff further concludes that the results of these calculations for each fire area, which are summarized in LAR Attachment W, Table W-5, as supplemented, 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," LAR Attachment G, "Recovery Actions Transition," and LAR Attachment W, "Fire PRA Insights," during its evaluation of the additional risk presented by the NFPA 805 RAs. SE Section 3.2.5 describes the identification and evaluation of RAs.

The licensee used the guidance in RG 1.205, Revision 1, and FAQ 07-0030 (Reference 63), for addressing RAs, which included the definition of PCS and RA. Accordingly, any actions required to transfer control to the PCS, or operate equipment from the PCS were not considered RAs per the RG 1.205 guidance and in accordance with NFPA 805. Conversely, any operator manual actions required to be performed outside the control room to resolve a VFDR to meet risk criteria and not at the PCS were considered RAs.

In LAR Attachment G, the licensee identified which RAs were required to meet the risk criteria and which RAs were required for DID only. In its responses to PRA RAI 24.e (Reference 12), and PRA RAI 25.a (Reference 11), the licensee indicated that DID-RAs are retained in the

procedures but not modeled in the FPRA. Operator actions that are performed at the PCS following MCR abandonment are also identified in LAR Attachment G, Table G-1, but they are considered PCS action and not RAs.

The additional risk of RAs for each fire area is presented in LAR Attachment W, as supplemented. In its response to PRA RAI 23.b (Reference 11), and PRA RAI 24.01 (Reference 13), and (Reference 16), the licensee clarified that the additional risk of RAs associated with each fire area is obtained by calculating the difference in risk between the post-transition plant configuration with all RAs at their nominal values and this same configuration with all RAs assumed to always succeed. The total additional risk of RAs was obtained by summing the additional risk for each fire area.

In LAR Attachment W, as supplemented, the licensee indicated that the additional risk of RAs is an increase in CDF of 3.1E-06/year and an increase in LERF of 3.3E-07/year. These values are below the change-in-risk acceptance guidelines in RG 1.174. RG 1.205 Regulatory Position 2.4.2.5 states that the RG 1.174 guidelines are also applicable to the additional risk of RAs and the NRC staff found that the additional risk of RAs in each area is also below the RG 1.174 acceptance guidelines.

In LAR Attachment G, the licensee indicated that it reviewed all of the RAs for adverse impact on plant risk per FAQ 07-0030 and stated that no RAs listed in LAR Attachment G, Table G-1 were found to have an adverse impact. Furthermore, the licensee indicated that all RAs listed in LAR Attachment G were evaluated against the feasibility criteria provided in NEI 04-02, FAQ 07-0030, and RG 1.205. LAR Attachment S, Table S-3, Implementation Items 7 and 8, include actions to revise the technical and administrative procedures and documents that relate to the NSCA compliance strategies and perform a feasibility study for new actions taken to reduce self-induced station blackout areas, and the NRC staff concludes that these actions are acceptable because they will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

The NRC staff concludes that the licensee's methods for determining the additional risk of RAs is acceptable because they are consistent with RG 1.205, Section 2.2.4.1 and FAQ 07-0030. Furthermore, the NRC staff concludes that the estimated values are less than the acceptance guidelines, and, therefore, the additional risk of RAs meets the requirements of NFPA 805 Section 4.2.4 and 2.4.4.1.

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 comply with NFPA 805.

3.4.6 Cumulative Risk and Combined Changes

In LAR Attachment S, Tables S-1 and S-2, as supplemented, the licensee identified completed and planned NFPA 805 transition modifications that decrease risk rather than bring the plant into compliance with the deterministic requirements of NFPA 805. LAR Attachment W, Section W.2.1, as supplemented, and the licensee's response to PRA RAI 26 (Reference 12), the licensee explained that these non-VFDR modifications are credited in both the compliant and post-transition plant PRA models used to calculate the fire area change-in-risk estimates presented in LAR Attachment W, Table W-5. The NRC staff found that non-VFDR modifications are not used to offset the change in risk. The NRC staff concludes that the licensee's

application to transition to a RI/PB FPP is not a combined change request per RG 1.174, Revision 2, Section 1.1, "Combined Change Requests."

The total CDF and total LERF are estimated by adding the risk assessment results for internal events, internal flooding, internal fire, seismic, high winds, and other external hazard events. With the exception of seismic risk, which was not calculated, the licensee provided an estimate of contributors to the total CDF and LERF in LAR Attachment W, as supplemented. In its response to PRA RAI 03 (Reference 17), and PRA RAI 03.b.01 (Reference 16), the licensee identified a number of modifications made to the PRA and its methods, as discussed above, and provided revised estimates of total fire CDF and LERF. As discussed in SE Section 3.4.2.2, the licensee credited in-cabinet incipient detection using guidance in the pre-publication version of NUREG-2180 (Reference 108). The licensee reported the results as a sensitivity study in LAR Section 4.8.3 because insufficient time was available to formally incorporate the changes into the FPRA. The NRC staff finds these results represent the best current estimate of the risk results associated with transition to NFPA 805. The aggregate results are discussed below.

Total CDF and LERF results including the revised estimates for total fire CDF and LERF, are summarized in SE Table 3.4. The estimated total CDF and LERF are below the RG 1.174 risk guidelines for Region II of 1E-04/year and 1E-05/year, respectively. The NRC staff found that this conclusion is still applicable even if the seismic risk is estimated using the preliminary results for the weakest link model from the NRC staff's safety/risk assessment for Generic Issue 199 (GI-199), "Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants" (Reference 124).

Table 3.4: CDF and LERF for HBRSEP after Transition to NFPA 805

Hazard Group	HBRSEP	
	CDF(/year)[1]	LERF (/year)[1]
Internal Events	3.4E-06	5.8E-07
External Flood	Negligible[2]	Negligible[2]
High Wind	2.0E-06	3.0E-07[3]
Seismic	Not calculated	Not calculated
Internal Fire	3.48E-05[4]	4.03E-06[4]
TOTAL	4.02E-05[5]	4.91E-06[5]

(1) Per LAR Table W-1, as supplemented by the letter dated May 25, 2016 (Reference 17), unless otherwise indicated.
(2) Per LAR Table W-1, this assessment is based on the HBRSEP Individual Plant External Events Examination (IPEEE).
(3) Per LAR Table W-1, LERF for High Winds was assumed to be 15% of the CDF.
(4) Per LAR Section 4.8.3, as supplemented by the letter dated October 5, 2016 (Reference 19).
(5) Summation of each hazard group.

In its letter dated May 25, 2016 (Reference 17), the licensee provided an updated LAR Attachment W, Table W-5, for each fire area that is not deterministically compliant, in accordance with NFPA 805, Section 4.2.3, "Deterministic Approach." The risk estimates for these fire areas result from planned modifications and administrative controls that will be implemented as part of the transition to NFPA 805. The estimates reported in LAR Attachment W, Table W-5 are based on the FPRA after implementing a number of FPRA model and method refinements to use NRC-accepted methods but include the subsequently retired in-cabinet FAQ 08-0046 and draft NUREG-2180 (Reference 106) area-wide incipient detection methods. As discussed in SE Section 3.4.2.2, the licensee's letter dated October 5, 2016 (Reference 19), provided the final LAR Section 4.8.3.3 with aggregate estimates of total CDF,

LERF, ΔCDF and ΔLERF that also included the best currently available PRA guidance for in-cabinet and area-wide incipient detection systems. LAR Section 4.8.3.3 reported a total CDF increase of 6.35E-06/year and a LERF increase of 5.42E-07/year. The estimated ΔCDF and ΔLERF are below the RG 1.174 acceptable risk guidelines values of 1.0E-5/year and 1.0E-6/year respectively and are therefore acceptable.

Individual fire area change-in-risk estimates provided in LAR Attachment W, Table W-5 (Reference 17), also remain below the RG 1.174 acceptance guidelines. The licensee did not provide individual fire area change-in-risk estimates based on the best available PRA guidance for in-cabinet and area-wide incipient detection systems. However, the licensee's application to transition to a RI/PB FPP is not a combined change request and, as a result, there are no individual fire area risk decreases. Therefore, if the sum remains below the acceptable change-in-risk, the individual fire areas increases are all less than the acceptable change-in-risk estimates and therefore meet the RG 1.174 guidelines and are acceptable.

Based on the information above, the NRC staff concludes that the risk associated with the proposed alternatives to compliance with the deterministic criteria of NFPA 805 is acceptable and in accordance with NFPA 805, Section 2.4.4.1. Additionally, the NRC staff concludes that the licensee has satisfied RG 1.174, Section 2.4, and NUREG-0800, Section 19.2 regarding acceptable risk.

3.4.7 Uncertainty and Sensitivity Analyses

The licensee evaluated key sources of uncertainty and sensitivity in response to several RAIs.

As described in the LAR and clarified in its response to PRA RAI 34 (Reference 12), the licensee clarified that the FPRA made use of the updated fire bin frequencies provided in NUREG/CR-6850, Supplement 1. In LAR Section 4.8.3.2.1, as supplemented, the licensee provided the results of a sensitivity analysis using the fire ignition frequency values in NUREG/CR-6850 for those ignition frequency bins having an alpha factor less than or equal to one. The sensitivity analysis is based on the FPRA after implementing a number of FPRA model and method refinements as described in the licensee's response to PRA RAI 03 (Reference 17), and PRA RAI 03.b.01 (Reference 16), to use NRC-accepted methods. The results of the sensitivity analysis show that the RG 1.174 risk guidelines for Region II of 1E-05/year and 1E-06/year, for CDF and LERF, respectively, continue to be met. The NRC staff concludes that the licensee response to the RAI is acceptable because the licensee demonstrated that the results of the sensitivity analysis continue to meet the acceptance guidelines in RG 1.174.

In its response to PRA RAI 01.a (Reference 11), PRA RAI 02.c (Reference 12), PRA RAI 03 (Reference 17), and PRA RAI 3.b.01 (Reference 16), the licensee clarified that the statistical propagation of parametric uncertainty was evaluated. The licensee explained that this evaluation addressed both the correlation of fire-specific parameters, as applicable, and the uncertainty associated with LERF parameters based on expert opinion. The licensee further clarified that for some parameters, such as circuit failure probabilities, it applied factors addressing the state-of-knowledge correlation directly to quantification results during post-processing. The NRC staff finds that the licensee's responses to the RAIs are acceptable because the licensee demonstrated that the FPRA and its quantification addresses the statistical propagation of parametric uncertainty, including the state-of-knowledge correlation.

In PRA RAI 01.c (Reference 20), associated with F&Os CS-A11-01 and FSS-E4-01, the NRC staff requested that the licensee provide clarification regarding the FPRA's treatment of assumed cable routing and its impact on ΔCDF and ΔLERF. In its response to PRA RAI 01.b (Reference 12), the licensee clarified that cables with assumed routing were conservatively failed for all scenarios within compartments that they were known to traverse. In its response to PRA RAI 03 (Reference 17), and PRA RAI 3.b.01 (Reference 16), the licensee provided a sensitivity study on this treatment and demonstrated that the FPRA's treatment of assumed cable routing has an insignificant impact on ΔCDF and ΔLERF. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the FPRA's treatment of assumed cable routing has an insignificant impact on ΔCDF and ΔLERF.

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, the NRC staff concludes that:

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

- The licensee stated that it has completed the changes to the baseline PRA model, which replaces unacceptable approaches, data, and methods identified during the LAR review with acceptable approaches, data, and methods as described. Therefore, the NRC staff concludes that the baseline PRA model may be used to support post-transition self-approval of FPP changes following completion of all implementation items because acceptable methods will be used until and unless replaced by other acceptable methods.

- LAR Attachment S, Table S-3, Implementation Item 11, states that the licensee will validate/update the FPRA model to reflect the as-built modifications and completed implementation items. As clarified, if the RG 1.174 risk acceptance guidelines are not met, the licensee will take actions to restore compliance with the guidelines. The actions may include re-analysis, additional modeling, procedure changes, or hardware changes to the plant.

- The licensee's PRA maintenance process is adequate to support self-approval of future RI changes to the FPP.

- The transition process included a detailed review of fire protection DID and safety margin as required by NFPA 805. The NRC staff concludes the licensee's evaluation of DID and safety margin to be acceptable. The licensee's process followed the NRC-endorsed guidance in NEI 04-02 and is consistent with the approved NRC staff guidance in RG 1.205 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, and the licensee has satisfied the guidance contained in RG 1.205, RG 1.174, Section 2.4, and NUREG-0800, Section 19.2, regarding acceptable risk. By meeting this guidance, the NRC staff concludes that the changes in risk are acceptable and therefore meet the requirements of NFPA 805.

- The risk presented by the use of RAs was determined to be in accordance with NFPA 805 Section 4.2.4, and the guidance in RG 1.205. The NRC staff concludes that the additional risk associated with the NFPA 805 RAs is acceptable because the risk for each fire area that relies on an RA is below the acceptance guidelines in RG 1.174 and therefore meets the acceptance criteria in RG 1.205.

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

3.5 Nuclear Safety Capability Assessment Results

NFPA 805 (Reference 3), Section 2.2.3, "Evaluating Performance Criteria" states that:

> 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 that:

> 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 that:

> 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," states that:

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

NFPA 805, Section 2.4.2.4, "Fire Area Assessment," states that:

> 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 that:

> 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 utilize deterministic methods for simplifying assumptions within the fire area.

This SE section 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," LAR Attachment C, "NEI 04-02 Table B-3 – Fire Area Transition," LAR Attachment G, "Recovery Actions Transition," LAR Attachment S, "Modifications and Implementation Items," and LAR Attachment W, "Fire PRA Insights," during its evaluation of the ability of each fire area to meet the NSPC of NFPA 805.

HBRSEP is a single unit PWR with 32 individual fire areas including the Yard (which includes Unit 1 Switchyard, Deepwell Pump "B" area southwest Corner of Unit 2 Switchyard, Oil Dispensing Building, Secondary Sampling Building, Nitrogen Storage Building and "C" Auxiliary Boiler House, Condensate Polisher Building, Deepwell Pump "A" Area South of Unit 1 Service Building, Deepwell Pump "C" area North side of Operation and Maintenance Facility, Deepwell Pump "D" Enclosure and Personnel Access Point East) and each fire area is composed of one or more fire zones. Based on the information provided by the licensee 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 fire zones within the fire areas.

SE Table 3.5-1 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, "NEI 04-02 Table B-3 - Fire Area Transition."

Table 3.5-1 Fire Area and Compliance Strategy Summary

Fire Area	Area Description	NFPA 805 Compliance Basis
A1	Diesel Generator B Room	Deterministic
A2	Diesel Generator A Room	Deterministic
A3	Ground Floor Auxiliary Building Hallway	Performance-Based
A4	Solid Waste Handling Room and Waste Evaporator Area	Deterministic
A5	Auxiliary Building Second Level	Performance-Based
A6	Auxiliary Feedwater Pump Room	Performance-Based
A7	Chemical Storage Area and Boric Acid Batching Tank	Deterministic
A8	Boron Injection Tank Room	Deterministic
A9	Safety Injection Pump Room	Deterministic
A10	Unit 1 Cable Spreading Room	Deterministic
A11	Pipe Alley	Deterministic
A12	Waste Holdup Tank, RHR Heat Exchangers	Deterministic
A13	Battery Room	Performance-Based
A14	HVAC Equipment Room for Control Room	Performance-Based
A15	Unit 2 Cable Spreading Room	Performance-Based
A16	Emergency Switchgear Room and Electrical Equipment Area	Performance-Based
A17	Rod Control Room	Performance-Based
A18	Control Room and Hagan Room	Performance-Based
A19	Component Cooling Water Surge Tank Room	Deterministic
B	Charging Pump Room, Volume Control Tank Room, and Non-regenerative Heat Exchanger Room	Performance-Based
C	Component Cooling Pump Room	Performance-Based
D	North Cable Vault	Performance-Based
E	South Cable Vault	Performance-Based
F	Containment	Performance-Based
G1	Turbine Building, Station Transformers, and Condensate Storage Tank	Performance-Based
G2	Diesel Fuel Oil Storage Tank	Deterministic
G3	Service Water Pump Area (Intake Structure)	Performance-Based
G4	Fuel Handling Building, Refueling Water Storage Tank, Primary Water Storage Tank, Battery C Enclosure, Radwaste Building, Rad Monitor Room, Purge Inlet Valve Room, and Diesel Fuel Oil Unload/Transfer Area	Deterministic
G5	115kV and 230kV Switchyards	Deterministic
G7	Dedicated Shutdown Diesel Generator	Deterministic
H	Residual Heat Removal Pump Room	Deterministic
Yard	Building Exterior and other Exterior Areas	Deterministic

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

- 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 committed) or the performance of a FRE in accordance with NFPA 805, Section 4.2.4.2.

3.5.1.1 Fire Detection and Suppression Systems Required to Meet the Nuclear Safety Performance Criteria

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 Attachment C for each fire area identifies if fire suppression and detection is installed, and if the installed systems are required. LAR Attachment C also includes a table of "Regulatory Required Systems" for each fire area that lists the fire zones, the required systems, 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.

In FPE RAI 04 (Reference 20), the NRC requested that the licensee provide the fire protection features by fire area that are required by the FPRA and their respective compliance bases. LAR Section 4.8.1 states that a summary of the NFPA 805 compliance basis and the required fire protection systems and features is provided in LAR Attachment C. However, LAR Attachment C only identifies the required suppression and detection systems for a fire area and there appears to be no discussion or description of other fire protection features (e.g., ERFBS, radiant shields, intumastic coatings, enhanced combustible controls, or transient limitations) that may be credited or required relative to the fire area analyses. In its response to FPE RAI 04 (Reference 10), the licensee stated that its response to FPE RAI 07 (Reference 12) describes the use of Hemyc™ and MT™ ERFBS at HBRSEP and its response to FPE RAI 13 (Reference 12) describes the physical barriers for fire delay in the Electrical Equipment Room and Cable

Spread Room. The licensee's response to FPE RAI 07 is addressed below in SE Section 3.5.1.9. The licensee stated in its response to FPE RAI 04 regarding FPE RAI 13 that when these modifications [sic: those described in response to FPE RAI 13 (see discussion below)] are complete, the fire safety analysis for these areas will be updated to reflect the type of barrier credited for the 10 minute time delay assumed by PRA in each room. The licensee further stated that these are currently the only two areas where the FPRA credits other fire protection features. The licensee revised LAR Attachment C (Reference 17), to identify the required fire protection features. Based on the licensee's response to FPE RAI 04 and the updated LAR Attachment C, the NRC staff concludes that the licensee's response is acceptable because the updated LAR Attachment C identifies the required fire protection systems or features required to achieve the performance criteria of NFPA 805 Section 1.5, which meets the requirements of NFPA 805, Section 4.1.

In FPE RAI 13 (Reference 20), the NRC requested additional information on LAR Attachment S, Table S-2, Item 5, which proposes a modification to "ensure configuration meets crediting 10-minute delay on cables in the Cable Spread Room and the E1/E2 Switchgear Rooms." Specifically, the NRC staff requested the licensee to provide a description of the barriers to be installed, the rated configuration for the barriers, the standard met by the barriers, and the purpose of the 10-minute delay. In its response to FPE RAI 13 (Reference 12), the licensee stated that the physical barriers installed for cables in the Cable Spread Room and the E1/E2 Switchgear Room will delay cable damage for at least 10 minutes, and that the purpose of the 10-minute time delay is to allow time for the Halon System to actuate in the fire area and extinguish the fire before any damage to cables would occur. The licensee further stated in its response to FPE RAI 13 that depending on the solution chosen, the appropriate standard will be applied for that installation to ensure the configuration complies with the FPRA assumptions. The NRC staff concludes that the licensee's response to FPE RAI 13, is acceptable because the plant modification in LAR Attachment S, Table S-2, Item 5, as described by the licensee, in addition to intumastic cable coating, will provide assurance that the FPRA assumption of a 10-minute delay time before any cable damage would occur will be preserved.

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.

Based on the statements provided in LAR Attachment C, as supplemented, the NRC staff concludes that the HBRSEP 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 Nuclear Safety Performance Criteria

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 damage to plant areas and equipment from the accumulation of water discharged from manual and automatic fire protection systems and the discharge of manual suppression water to adjacent compartments is controlled. The combination of curbs, floor drains, fire pre-plans, and procedures to mitigate flooding from fire suppression systems provide controls to prevent affecting SSD equipment. Therefore, fire suppression activities will not adversely affect achievement of the NSPC.

Based on the information provided by the licensee in the LAR, 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 LAR Attachment C, as supplemented, the licensee identified exemptions from the deterministic licensing basis for each fire area that were previously approved by the NRC and will be transitioned with the NFPA 805 FPP. Each of the these exemptions is summarized in LAR Attachment C on fire area basis and described in further detail in LAR Attachment K, "Existing Licensing Action Transition."

The licensee does not have any elements of the current FPP for which NRC clarification is needed. The licensing actions being transitioned are summarized in Table 3.5-2.

Table 3.5-2 Previously Approved Licensing Actions Being Transitioned

Licensing Action Description	**Applicable Fire Areas**	**NRC Staff Evaluation**
Exemption from the Requirements of Section III.O of Appendix R to 10 CFR Part 50 (Lack of reactor coolant pump lube oil collection system)	F – U2 Containment	The basis for approval as described by the licensee in LAR Attachment K is the following features: • Fire Detection System (flame detector and heat detectors) in each RCP bay • Fire Suppression system (preaction water sprinkler system) in each RCP bay; • 6-inch dikes at the 231-ft elevation in RCP Bay B and Bay C; and • Use of containment spray system as a backup fire suppression system with the sodium hydroxide isolated Based on the previous staff approval of the engineering justification for this exemption in a SE dated 3/7/1985 (Reference 80), and the statement by the licensee that the basis remains valid, the NRC staff concludes that the transition of this licensing action is acceptable.

The NRC staff reviewed the exemption from the pre-NFPA 805 licensing basis identified in Table 3.5-2, including the description of the previously approved exemption from the deterministic requirements, the basis for and continuing validity of the exemption, and the NRC staff's original evaluation or basis for approval of the exemption. The licensee stated in LAR Section 4.2.3, that the review of these existing licensing actions included a determination of the basis of acceptability and a determination that the basis of acceptability was still valid.

In SSA RAI 08 (Reference 20), the NRC staff indicated that LAR Section 4.2.3 "Licensing Action Transition," stated that since the exemptions are either compliant with 10 CFR 50.48(c) or no longer necessary, in accordance with the requirements of 10 CFR 50.48(c)(3)(i), the licensee requests that the exemptions listed in LAR Attachment K be rescinded as part of the LAR process; however, LAR Attachment K, "Exemption from the Requirements of Section III.O of Appendix R to 10 CFR Part 50," is identified as necessary for transition. In its response to SSA RAI 08 (Reference 12), the licensee confirmed that it is transitioning the exemption from the requirements of Section III.O of Appendix R to 10 CFR 50, into the new NFPA 805 licensing bases. The NRC staff concludes that the licensee's response is acceptable because it clarifies that the licensing action discussed above and identified in LAR Attachment C and LAR Attachment K will be transitioned to the NFPA 805 licensing basis in accordance with the guidance provided in NEI 04-02 (Reference 7), as endorsed by RG 1.205 (Reference 4).

Based its review of the licensing action identified and described in LAR Attachments C and K, the NRC staff concludes that the licensing action is identified by applicable fire area and remains valid to support the proposed license amendment because the licensee utilized the process described in NEI 04-02 as endorsed by RG 1.205, which requires a determination of the basis of acceptability and a determination that the basis is still valid.

Based on the previous NRC staff approval of the exemption and the statement by the licensee that the basis remains valid, as presented in the appropriate fire area, the NRC staff concludes that the engineering evaluation being carried forward supporting the NFPA 805 transition, as identified in Table 3.5-2, is acceptable. See SE Section 2.5 for further discussion.

3.5.1.4 Existing Engineering Equivalency Evaluations

The EEEEs that support compliance with NFPA 805 Chapter 3 or 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, the licensee stated that the guidance in RG 1.205, Regulatory Position 2.3.2, and NEI 04-02, as clarified by FAQ 08-0054 (Reference 70) 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 an "adequate for the hazard" EEEE, then the EEEE is referenced where required and a brief description of the evaluated condition is provided.

- If requesting specific NRC approval for an "adequate for the hazard" EEEE, 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 stated that none of the transitioning EEEEs require NRC approval.

Based on its 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 and 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. As described in LAR Attachment C, HBRSEP categorized all VFDRs into two types:

- Type 1 Unprotected cable

  Cases where the cable separation did not meet the deterministic requirements of NFPA 805 where identified as Type 1 VFDRs. These cases were identified during the at power NSCA analysis. The following is a summary of their treatment in the FPRA:

  - VFDR cables that are subject to fire damage in a particular Fire Area were "protected" from fire damage in the risk model.
  - New risk numbers were calculated for the protected cable scenario.
  - The changes in CDF and LERF represented the risk value of the unprotected cables on a Fire Area basis.

- Type 2 Control Room Abandonment Recovery Actions

  These VFDRS are the dedicated shutdown RAs used in the event the control room is abandoned due to a fire. The actions taken at a remote shutdown location that does not meet the definition of a PCS are considered VFDRs. These only apply to habitability in the MCR. In LAR Attachment G, the components affected by this type of VFDR are recovered using the RA listed. The following is a summary of their treatment in the FPRA:

  - The FPRA model took credit for RAs that resulted in the isolation of damaged cables from various remote control locations other than the PCS (Remote Shutdown Panel).
  - HEPs were applied to the RAs.
  - The changes in CDF and LERF quantified the risk value of the applicable VFDRs in the Control Room and Hagan Room.

In PRA RAI 23.d (Reference 20), the NRC staff requested additional information on the description of the type of VFDRs identified. In its response to PRA RAI 23.d (Reference 13), the licensee stated that Type 1 VFDRs are for unprotected cables, where damage to these cables would cause failure to meet the deterministic requirements of NFPA 805. The licensee further stated that some of the Type 1 VFDRs identified in Table B-3, "Fire Area Transition," of LAR

Attachment C were dispositioned as "Not a VFDR", and that these VFDRs were determined to be "Not a VFDR" within the NSCA with the following justifications:

- There is a redundant component available to support the ability to achieve and maintain the NSPC.
- Failure of the component can be recovered by action(s) taken in the MCR
- Fire damage to the component will not prevent the component from performing its nuclear safety function.

Based on the licensee's justifications for dispositioning the VFDRS, the NRC staff concludes that the removal of the VFDRs from LAR Attachment C is acceptable because the components meet the deterministic requirements of NFPA 805.

The licensee stated that the acceptability of these VFDRs is based on the measured change in CDF and LERF and the maintenance of DID and safety margins. The licensee further stated that the FRE determined that the applicable risk, DID, and safety margin criteria were satisfied with the implementation of the specified RAs, completion of proposed modifications, and the existence of installed suppression and detection systems.

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-RA; and

- An FRE determined that applicable risk, DID, and safety margin criteria were satisfied with a plant modification(s), as identified in LAR, as supplemented.

For all fire areas where the licensee used the PB approach to meet the NSPC, each VFDR and the associated disposition has been described in LAR Attachment C. Based on the NRC staff 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 DID (see SE Section 3.5.1.7 below).

The NRC staff reviewed LAR Section 4.2.1.3, "Establishing Recovery Actions," and LAR 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 SE Section 3.2.5. The NRC staff's evaluation of the additional risk of RAs credited to meet the risk acceptance guidelines is provided in SE Section 3.4.4.

3.5.1.7 Recovery Actions Credited for Defense-in-Depth

In LAR Attachment C the licensee stated that RAs credited for DID are actions that are not required for risk reduction, but are deemed important to achieving and maintaining safe and stable conditions. The licensee further stated that RAs that were specified for a particular fire area were considered for screening as DID only if the FPRA results were at least CDF > 1.00E-8 and LERF > 1.00E-9. The licensee further stated that the relevant importance of the actions with respect to their effect on either achieving nuclear safety performance goals or on system alignment was also evaluated, and that typically, this evaluation included conditions where the action:

- Isolates or disables equipment for pre-emptive reasons; or
- Is time critical for any reason; or
- Is related to establishing RCS injection; or
- Must be performed to establish decay heat removal; or
- Is associated with establishing the ultimate heat sink.

The licensee stated that, notably, fire scenario specific factors related to the availability of offsite power, the likelihood of multiple failures from a single ignition source, and MSOs may also have influenced the RA-DID screening.

In LAR Attachment G, the licensee stated that to develop Table G-1, the evaluation began with the complete list of operator actions credited in the pre-transition SSA, and that the actions not required to achieve and maintain safe and stable were screened from further consideration. The licensee further stated that all actions needed to forcibly cooldown the plant were eliminated from consideration as RAs or DID-RAs.

In LAR Attachment G, the licensee stated that the final PRA quantification results were then reviewed, and areas were screened from further consideration provided their risk did not exceed 1.00E-8 CDF or 1.00E-9 LERF. The licensee further stated that if the risk exceeded these numbers, then the action was considered for retention as a DID action. Particular attention was placed on those actions directly related to decay heat removal, RCS inventory and pressure control, and vital auxiliaries (electrical).

The licensee described that 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 LAR 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.

3.5.1.8 Plant Fire Barriers and Separations

With the exception of the ERFBS, passive fire protection features include the fire barriers used to form fire area boundaries (and barriers separating SSD trains) that were established in accordance with the plant's pre-NFPA 805 deterministic FPP. For the transition to NFPA 805, the licensee retained 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, and as such are addressed in SE Section 3.1.

3.5.1.9 Electrical Raceway Fire Barrier Systems

The licensee stated that the ERFBS used at HBRSEP met the deterministic requirements of NFPA 805, Chapter 3. Each fire area using ERFBS is identified in LAR Attachment C. In fire areas with deterministic compliance, ERFBS were not credited to meet the requirements of NFPA 805, Section 4.2.3. In fire areas with PB compliance, the ERFBS were analyzed using the PB approach in accordance with NFPA 805 Section 4.2.4. There were no VFDRs associated with ERFBS.

In FPE RAI 07 (Reference 20), the NRC staff indicated that LAR Attachment S, Table S-1, Item 3 states that Hemyc fire barrier wrap was replaced with Interam E54A for protecting the CCW pump power cables; however, Promatec "MT" wrap is also described in LAR Attachment C, in an EEEE for fire areas A3, A6, and A11, addressing protection of the Steam Generator Blowdown System lines and penetrations. The NRC staff requested that the licensee provide additional details on the use of Hemyc, MT, and other ERFBS or passive fire protection features that are credited in the NSCA, including the basis and justification for crediting these features and any proposed modifications. The licensee's response to FPE RAI 07a-b (Reference 12) regarding the use of Hemyc and MT is evaluated in SE Section 3.1.3.1.

In FPE RAI 07.c (Reference 20), the NRC staff requested that the licensee describe any other ERFBS and passive fire protection features that are credited for the NSCA and to explain how they were identified as being required for this purpose and to provide the technical justification (e.g., test certification, for their use or credit). In its response to FPE RAI 07.c (Reference 12) the licensee stated that the only ERFBS configurations credited are the completed modifications to the A and C CCW Pump power supplies that are detailed in the LAR Attachment S, Table S-1, Item 3. The licensee stated that the configurations are not credited in the PRA or NSCA and are only credited for DID during the FRE in the Fire Safety Analysis. The licensee stated that this modification previously replaced the existing Hemyc fire barrier wrap materials with a 1-hour rated barrier configuration on the CCW Pumps A and C power supply raceways and the Hemyc wrap was replaced with Interam E54A material. The licensee indicated that the required equipment will remain available to support SSD in the event of a fire because of the 1-hour rated ERFBS for the power cables to CCW pumps A and C, the automatic smoke and heat detection, and the partial area coverage wet pipe sprinkler system over the CCW pumps. The licensee stated that fire tests were performed as the primary qualification bases for the Interam wrap, and that these tests were performed to meet the acceptance criteria specified GL 86-10, Supplement 1 (Reference 98).

In FPE RAI 07.d (Reference 20), the NRC staff requested the licensee identify and describe any proposed plant modifications for the ERFBS barriers. In its response to FPE RAI 07.d (Reference 12), the licensee stated that no modifications are planned or were credited as ERFBS barriers other than the A and C CCW pump power supplies detailed in the LAR Attachment S, Table S-1, Item 3, that were completed and discussed previously and only credited for DID.

In FPE RAI 07.e (Reference 20), the NRC staff requested the licensee discuss the safety margin and DID considered, if PB methods are used. In its response to FPE RAI 07.d, the licensee stated that an evaluation of DID and safety margin was performed for all fire areas, and that this evaluation was performed for all areas, regardless of whether NFPA 805 compliance was demonstrated using a PB approach or a deterministic approach. The licensee stated that LAR Attachment C includes a summary description of the methodology and criteria used to determine which RAs and other fire protection features were retained as DID and the process for determining safety margin.

The NRC staff concludes that the licensee's response to FPE RAI 07c-e is acceptable because it provided the information requested by the staff to understand the use and credit assumed in the licensee's analysis for the use of Hemyc and MT fire barrier materials and the credit for the ERFBS that was installed as described in LAR Attachment S, Table S-1, Item 3.

3.5.1.10 Issue Resolution

3.5.1.10.1 Fuel Fired Generators

In SSA RAI 02 (Reference 20) the NRC staff found that in LAR Attachment G, Table G-1, Fire Areas A5 and C, a DID-RA may be required to set up a portable 4kW generator and portable fans for cooling the MCR. The NRC staff indicated that the use and refueling of the portable generators present a hazard to equipment important to nuclear safety and requested that the licensee describe and justify how the use of portable fuel-fired equipment is consistent with the fire protection criteria of GDC 3 or to provide an alternative approach to resolving the subject VFDRs and providing control room ventilation that is consistent with the requirements of GDC 3. In its response to SSA RAI 02 (Reference 10), the licensee stated that the equipment associated with providing temporary cooling for the MCR consists of a small generator, twenty inch smoke ejector/fan, (2) twenty foot duct sections, and (2) fifty foot extension cords, and that the equipment is located on the Turbine Building Mezzanine Level in a metal storage cabinet.

The licensee stated that when the equipment is used to provide temporary cooling for the MCR, the generator is located on the east end of the Turbine Building Mezzanine level, which is down one level from the MCR. The licensee stated that the fan is placed outside the east MCR entrance door, the duct sections from the fan are positioned to direct cooling air flow into the control room, and extension cords provide power from the generator on the Turbine Building Mezzanine level to the fan. The licensee stated that the Turbine Building is an open structure and this location is open to the atmosphere, and that exhaust from the generator and any vapors during refueling of the generator will not accumulate in the area. The licensee further stated that due to the physical distance that the generator is located from the MCR and the fan suction, exhaust gases will not be introduced into the MCR. The licensee stated that these actions are contained in their emergency operating procedure and when the generator is removed from the storage location and placed on the east end of the Turbine Mezzanine level, transient combustible controls are placed into effect per procedure. The licensee stated that this procedure addresses minimizing the introduction of transient fire loads and reducing the fire

hazards involved with the handling, use, and storage of combustible material to a degree consistent with personnel and plant safety.

The NRC staff concludes that the licensee's response to SSA RAI 02 regarding the licensee's method of implementing the RA to provide temporary cooling to the MCR is acceptable because the licensee demonstrated that the placement of the fuel-fired equipment (i.e., generator) on the open mezzanine of the Turbine Building in conjunction with controlling procedures provides acceptable protection of equipment important to nuclear safety.

3.5.1.10.2 Feasibility Reviews

In SSA RAI 05 (Reference 20), the NRC staff indicated that LAR Attachment S, Table S-3, Implementation Item 8 involves the performance of a feasibility study specifically for new actions taken to reduce self-induced station blackout areas in the plant. The NRC staff requested that the licensee clarify if this implementation item is the same, or has the same scope, as the physical feasibility assessment of new NSCA RAs, as described in LAR Attachment G, and to provide additional information to clarify any remaining feasibility analysis described in LAR Attachment S, Table S-3 and the potential impact on the NSCA, if any.

In its response to SSA RAI 05 (Reference 12), the licensee clarified that LAR Attachment S, Table S-3, Implementation Item 8 is the same action as described in LAR Attachment G. The licensee stated that it had previously developed a calculation to document feasibility for 10 CFR 50 Appendix R response time critical manual operator actions that are credited with mitigating postulated fire induced damage. The licensee further stated that the calculation identified the required times in which the actions need to be performed, as well as a feasibility check for the individual actions. The licensee stated that for those actions that are not changed for NFPA 805, the feasibility performed under 10 CFR 50 Appendix R is still applicable, and that new RAs will be incorporated into the calculation. The licensee further stated that the transition to NFPA 805 will provide the vehicle for updates to the calculation and any additional procedure revisions required for the transition, including the Dedicated Shutdown Procedures (DSPs).

The licensee stated that for transition to NFPA 805, DSPs are being revised or developed to eliminate reliance on the self-induced station blackout strategy. The licensee further stated that changes to DSPs that affect time critical actions in the field require a walk through validation, as well as a time critical action validation to ensure the actions can be performed within the time requirements identified in the calculation for that particular action.

The NRC staff concludes that the licensee's response to SSA RAI 05 is acceptable because the licensee clarified that the action described in LAR Attachment G is the same scope as Implementation Item 8 of LAR Attachment S, Table S-3, which involves the performance of a feasibility study for new actions taken to reduce Self-Induced Station Blackout Areas in the Plant.

3.5.1.10.3 Modifications

In SSA RAI 06 (Reference 20), the NRC staff indicated that a few of the completed modifications identified in LAR Table S-1 (i.e., Items 8, 14, and 15) are described merely as "protect the ...." with no description of how the components/cables were protected. The NRC staff requested that the licensee provide more detailed information regarding the means of protection performed for those completed modifications. In its response to SSA RAI 06

(Reference 12), the licensee provided the following detailed information for the following modifications:

- LAR Attachment S, Table S-1, Item 8: The problem statement was that hot short cases were identified for a postulated fire in the Turbine Building that could result in the loss of capability of the Emergency Diesel Generators to supply electrical power to the Emergency Buses, which potentially results in unrecoverable plant conditions. The modification to protect the E-bus incoming line breakers from spurious operation for a postulated fire in the Turbine Building involved a re-design of the closing control circuit of the Emergency Bus incoming line breakers by adding an auxiliary relay in the reactor and turbine generator board- breaker closing circuit.

- LAR Attachment S, Table S-1, Item 14: The problem statement was to resolve the issue of the loss of wide range steam generator level indication for a postulated fire in the Turbine Building and the AFW Pump Room. The modification to protect the steam generator wide range level indication from a postulated fire in the motor driven AFW Pump Room and the Turbine Building involved installing isolators for steam generator wide range level indicators.

- LAR Attachment S, Table S-1, Item 15: The problem statement was that due to postulated fires in Fire Areas A5, E, and G1, cables that are required to close the main steam isolation valves (MSIVs) from the control room are subject to the fire-induced hot shorts that could cause the MSIVs to fail "as-is" in the open position. The modification to protect steam isolation valve circuits involved physically separating the target conductors from their source in each of the affected MSIV control circuits to prevent fire induced circuit spurious operations.

The NRC staff concludes that the information provided in the licensee's response to SSA RAI 06 is acceptable because it provides the necessary clarification for LAR Attachment S, Table S-1, Items 8, 14 and 15 to understand how the modifications provided protection of the NSCA component and function required to meet the NSPC of NFPA 805 Section 1.5

3.5.1.11 Conclusion for Section 3.5.1

As documented in LAR Attachment C, for those fire areas that used 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:

- The licensee's documented compliance with NFPA 805, Section 4.2.3;

- The licensee's assertion that the success path will be free of fire damage without reliance on RAs;

- The licensee's assessment that the suppression systems in the fire area will have no impact on the ability to meet the NSPC; and

- 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 each fire area has been properly analyzed, and compliance with the NFPA 805 requirements demonstrated as follows:

- Exemptions from the pre-NFPA 805 fire protection licensing basis that were transitioned to the NFPA 805 licensing basis were reviewed for applicability, as well as continued validity, and found acceptable.

- VFDRs were evaluated and either found to be acceptable based on an integrated assessment of risk, DID, and safety margins, 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 NSPC 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 NSPC, 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.

- ERFBS credited were documented on a fire area basis, verified to be installed consistent with tested configurations and rated accordingly.

Accordingly, 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 margins.

3.5.2 Clarification of Prior NRC Approvals

As stated in LAR Attachment T, "Clarification of Prior NRC Approvals," there are no elements of the current FPP for which NRC clarification is needed.

3.5.3 Fire Protection during Non-Power Operational Modes

NFPA 805, Section 1.1 "Scope," states that:

> 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 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.

The NRC staff reviewed LAR Section 4.3, "Non-Power Operational Modes" and LAR Attachment D, "NEI 04-02 Non-Power Operational Modes Transition," to evaluate the licensee's treatment of potential fire impacts during NPO modes. The licensee used the process described in NEI 04-02 (Reference 7) as modified by FAQ 07-0040 (Reference 67), for demonstrating that the NSPC are met for HREs during NPO modes.

3.5.3.1 Non-Power Operation Strategy and Plant Operating States

In LAR Section 4.3 and LAR 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 LAR Attachment D, the goal is to ensure that contingency plans are established when the plant is in a NPO mode where the risk is intrinsically high.

In LAR Attachment D, the licensee defined HREs as outage activities, plant configurations, or plant conditions during shutdown where the loss of a key safety function is, or could be, threatened (cause the loss of the function). The licensee stated that this HRE is typically an Orange condition which is defined as the primary system is threatened with no backup system available. The licensee stated that a HRE is not defined as a specific plant condition, but a general one. The licensee further stated that in comparison, Green or Yellow conditions are those in which the key safety function has full redundancy or less than full redundancy, respectively, and a Red condition is one where neither primary nor backup systems are available.

The licensee stated that FAQ 07-0040 identified those plant operating states with respect to NFPA 805 for PWRs that need to be considered and evaluated as part of the NPO process, and the three basic plant operational states are:

- POS 1 - This POS [plant operational state] starts when the RHR system is put into service. The RCS is closed such that a steam generator could be used for decay heat removal, if the secondary side of a steam generator is filled. The RCS may have a bubble in the pressurizer. This POS ends when the RCS is vented such that the steam generators cannot sustain core heat removal. This POS typically includes Mode 4 (hot shutdown) and portions of Mode 5 (cold shutdown).

- POS 2 - This POS starts when the RCS is vented such that: (1) the steam generators cannot sustain core heat removal and (2) a sufficient vent path exists for feed and bleed. This POS includes portions of Mode 5 (cold shutdown) and Mode 6 (refueling). Reduced inventory operations and midloop operations with a vented RCS are subsets of this POS.

- POS 3 - This POS represents the shutdown condition when the refueling cavity water level is at or above the minimum level required for movement of irradiated fuel assemblies within containment as defined by TSs. This POS occurs during Mode 6.

In LAR Attachment D, the licensee stated that for HBRSEP, POS 1 corresponds to Hot and Cold Shutdown (Modes 4 and 5, respectively), and that since the HBRSEP SSA addresses the ability to achieve both hot and cold shutdown, to minimize duplication and overlap, the NPO Analysis focused only on that part of POS 1 corresponding to Mode 5, as well as POS 2 and

POS 3. The licensee further stated that based on these POSs and FAQ 07-0040, the NPO analysis included the following Key Safety Functions (KSFs) for evaluation:

- Decay Heat Removal;
- Reactivity Control;
- Inventory Control;
- Pressure Control;
- Spent Fuel Pit Cooling, Reactivity and Inventory Control; and,
- Electric Power Availability (as necessary to support the other KSFs).

The licensee stated that while their NPO shutdown procedure does not define RCS pressure control as a KSF, it is identified in the NPO analysis as necessary to prevent an overpressure condition in the RCS. The licensee further stated that to address this need, RCS pressure control has been included in the NPO analysis.

The licensee stated that the review resulted in the exclusion of the Containment Control KSF from further consideration because maintenance of this KSF does not directly support the nuclear safety goal of NFPA 805, and excluding a fuel handling accident, which is not considered as part of this review, containment closure would not be required until the onset of fuel damage, which would not occur until after core cooling is lost, or a significant loss of RCS inventory occurred. The licensee stated that by managing the Decay Heat Removal and Inventory Control KSFs, the need to rapidly establish closure is eliminated.

3.5.3.2 NPO Analysis Process

The licensee stated that its goal is to ensure that contingency plans are established when the plant is in an HRE and it is possible to lose a KSF due to fire. LAR Section 4.3 discusses the additional controls and measures. During low risk periods, normal risk management controls and fire prevention/protection processes and procedures will be utilized.

In LAR Section 4.3.2, the licensee stated that the HBRSEP outage management processes were reviewed to identify the Plant Operating States that were considered for equipment and cable selection which were incorporated into a computer-aided fault tree analysis (CAFTA) model. The licensee stated that the CAFTA fault tree models NPO requirements, systems and components, which were identified to provide the following KSFs: Decay Heat Removal; Reactivity Control; Inventory Control; Pressure Control; Spent Fuel Pit Cooling; and Electrical Power Availability (to the extent that it supports the other KSFs). The licensee further stated that for those components not already in the HBRSEP database for the at-power analysis or those with a functional state for NPOs differing from that in the At-Power Analysis; circuit analysis, cable selection, and routing were performed as described in the plant's NSCA methodology. A fire area analysis of the NPO fault tree was used to determine KSF 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 system's 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.

LAR Attachment D states that a deterministic, area-by-area assessment was performed to identify pinch points. The affected KSFs, by fire area, are documented in the NPO calculation.

3.5.3.3 NPO Key Safety Functions and Structures, Systems, and Components Used to Achieve Performance

LAR Attachment D defines the KSFs, the success paths to achieve the KSFs, and the components required for the success paths. The licensee stated that after the list of KSFs was finalized, the required system components, their power supplies, and their required functional states were identified. The licensee further stated that since the equipment and power supplies needed to maintain NPO KSFs are similar to those required to safely shutdown the plant while at power, the HBRSEP SSA was used as the basis for equipment selection, and that the list of NPO equipment was refined since some SSD components are not required for NPO, whereas other non-SSD components (e.g., Spent Fuel Pool cooling system) were identified for inclusion. The licensee further stated that the circuit analyses and cable routing process used for the SSA was also used for the new electrically-operated components and those whose functional state for NPO was different from that required for at-power SSD.

As described in the LAR Attachment D, the licensee performed a deterministic area-by-area assessment to identify pinch points. The licensee stated that FM was not used to eliminate any fire area from being a pinch point and that RAs were not used in any fire area to restore a KSF path in order to eliminate a pinch point.

In SSA RAI 10 (Reference 20), the NRC staff indicated that in LAR Attachment D, Section F.3, the licensee stated that RAs were not used in any fire area to restore a KSF path in order to eliminate a pinch point; however, in the same section, the licensee proposed several RAs or other actions to (1) ventilate the emergency diesel generator room, (2) energize supplemental plant equipment, and (3) remove power from certain motor operated valves. The NRC staff requested that the licensee describe how the feasibility evaluation will be performed if the proposed RAs are finalized.

In its response to SSA RAI 10 (Reference 12), the licensee stated that the RAs that were identified in LAR Attachment D and called "RAs or other actions" are beneficial actions that could be taken, but are not used by the analysis to recover pinch points. The licensee further stated that pinch points are addressed by fire risk management actions that are identified in plant outage procedures with additional actions to be taken for high risk evolutions, and discussed in LAR Attachment D, Implementation Guidance F.4. The licensee further clarified that no additional actions beyond normal plant operating procedures are credited for NPOs. The licensee stated that a proposed change to de-energize components in the shutdown cooling flowpath to prevent spurious operation and potential loss of shutdown cooling (i.e., SI-860A(B) and SI-861A(B)) could be considered pre-emptive actions but were not used to recover a pinch point by the analysis. The licensee further stated that because no RAs are used to restore a pinch point following a fire event during NPO, evaluation of feasibility was not required.

The NRC staff concludes that the licensee's response to SSA RAI 10 is acceptable because the need to perform a feasibility review is not required for the RAs in LAR Attachment D that are beneficial actions and not used to recover pinch points, which meets the guidance provided in NEI 04-02 which is endorsed by RG 1.205 and FAQ 07-0040.

As described in LAR Attachment D, the licensee stated that the results of the NPO assessments for each of the 32 fire areas are summarized below:

- There are 14 areas where each KSF would still have at least one success path following the postulated fire (i.e., no Pinch Points).
- There are 14 areas for where a postulated fire could cause a loss of one or more KSFs. Recommendations for more conservative fire controls during NPO in these areas are proposed.
- There are five areas (A18 – incorporating the HBRSEP MCR, A3 – Auxiliary Building lower hallway, A13 – Battery Room, A15 – Cable Spreading Room, and A16 – the Emergency Switchgear Room) where redundant trains of NPO equipment exist and all KSFs could be threatened due to a postulated fire. Fires in these areas would be mitigated by existing transient and in-situ combustible controls, limitation of hot work, as well as personnel access controls.

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

3.5.3.4 NPO Pinch Point Resolutions and Program Implementation

In LAR Section 4.3.2, the licensee stated that for those components not already in the SSD database or those with a functional state for NPOs differing from that in the at-power analysis; circuit analysis, cable selection, and routing were performed as described in the HBRSEP NSCA methodology. Once all information had been entered into the database, NPO CAFTA fault tree was used to determine KSF pinch points.

The licensee stated that the NPO analysis provides recommendations for changes to fire risk and outage management procedures and other administrative controls, which include:

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

The licensee further stated that RAs or other actions proposed for NPO are summarized as follows:

- In areas where ventilation to an emergency diesel generator room may be lost and offsite power is not available, locally open doors to supply outside air.
- In fire areas where offsite power may not be available, consider using procedure EPP-25 "Energizing Supplement Plant Equipment Using the DSDG [Dedicated Shutdown Diesel Generator]," to energize equipment (such as the Spent Fuel Pit Cooling Pumps) that are powered from non-emergency buses.
- To preclude spurious operation, remove power from motor-operated valve(s) under certain conditions (e.g., SI-860A(B) and SI-861A(B) when the plant enters Mode 5).

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

- 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 procedures in order to employ a fire protection strategy for reducing risk at these pinch points during HREs.

Accordingly, based on the information provided in the LAR, as supplemented, the NRC staff concludes that the licensee has provided reasonable assurance that the NSPC are met during NPO modes and HREs at HBRSEP.

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.
- All DID RAs were properly documented for each fire area.

- The required automatic fire suppression and automatic fire detection systems were appropriately documented for each fire area.

Accordingly, the NRC staff concludes that there is reasonable assurance 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:

- The engineering evaluation for the exemption from the existing FPP was evaluated and found to be valid and acceptable for meeting the requirements of NFPA 805, as allowed by NFPA 805, Section 2.2.7.

- 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.

- All 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 found to be acceptable.

- All 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.

- All DID-RAs were properly documented for each fire area.

- 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, the associated FREs meet the requirements for risk, DID, and safety margin.

The NRC staff concludes that the licensee's analysis and outage management process during NPO modes provides reasonable assurance that the NSPC will be met during NPO modes and HREs, and that the licensee used methods consistent with the guidance provided in RG 1.205 and FAQ 07-0040. The NRC staff also concludes that no RAs are required during NPO modes, and that the normal FPP DID actions are credited for addressing the risk impact of those fires which potentially affect one or more trains of equipment that provide a KSF required during NPO modes, but would not be expected to cause the total loss of that KSF. The NRC staff concludes that this overall approach for fire protection during NPO modes is acceptable.

3.6 Radioactive Release Performance Criteria

NFPA 805 (Reference 3) Chapter 1 defines the radioactive release goals, objectives, and performance criteria that must be met by the FPP in the event of a fire at a NPP in any plant operational mode as follows:

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.
>
> (2) The source term is capable of being limited.

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 NEI 04-02 as providing methods acceptable to the staff for establishing a RI/PB FPP consistent with NFPA 805 and 10 CFR 50.48(c). Using these methods, the licensee 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 71).

In order to assess whether the HBRSEP FPP to be implemented under NFPA 805 meets the above requirements, the licensee established a review panel consisting of representatives from Operations, Engineering (i.e., Fire Protection Systems and Programs, HVAC Systems), Training, and Radiation Protection to review pre-fire plans, fire brigade training materials and engineering controls being credited during all plant operating modes, including full power and non-power conditions. The licensee's review identified the pre-fire plans for those areas where there is no possibility of radioactive materials (contamination) being present (outside of the RCA), and screened them out from further review. Areas where there was a potential for generation of radioactive effluents created by fire-fighting activities were identified and included (screened in) for further evaluation. The NRC staff concludes that the scope of the licensee's assessment was adequate because the review included all modes of plant operation and all plant areas.

For each screened-in area where radioactive materials were present such as in the Containment Building, Auxiliary Building, Radwaste Building, and Fuel Handling Building, the licensee's review determined these areas had adequate engineered controls for containment of liquid and gaseous effluent. Engineering controls credited for containment of gaseous effluents (e.g., forced air ventilation and filtered ventilation exhaust), and liquid effluents (e.g., floor drains and sumps routed to the radioactive waste system) are documented in LAR Attachment E, "NEI 04-02 Radioactive Release Transition." Operator actions were not credited for mitigating a potential radioactive release. The NRC staff determined that the existing engineering controls in these areas were adequate because prior to discharge, the gaseous effluent is contained, monitored, and filtered to remove radioactive materials and the liquid effluent is collected, processed, and monitored prior to release.

There are radioactive materials stored in other plant areas such as the yard within the RCA, the Contaminated Storage Building and the Outage Contaminated Storage Building for which there were limited or no engineered controls to contain radioactive gaseous and liquid effluents. The licensee performed a quantitative analysis of the potential public dose from the release of contaminated gaseous and liquid effluents resulting from a fire. The analysis results bound the dose consequences for all types of low specific activity containers stored in the RCA yard area and buildings where radioactive materials are stored.

The bounding case was a fire in a sea land storage container fully loaded with radioactive waste. The licensee performed a quantitative dose assessment based on the type and maximum quantity of radionuclides that are stored in a sea land storage container whose contents were then assumed to be released during a fire. The NRC staff's evaluation of the licensee's analysis determined that the bounding assessment was based on conservative assumptions regarding the source term, the dispersion and dilution factors, and the effluent concentration limits in 10 CFR Part 20, Appendix B. The NRC staff concludes that the analysis was performed using acceptable methodologies, and the results demonstrate that the maximum offsite dose from the gaseous and liquid effluents at the exclusion area boundary are less than the 10 CFR Part 20 dose limits for members of the public and is therefore acceptable.

The licensee reviewed the pre-fire plans and determined that the plans need to be revised to provide general guidance for containment and monitoring of smoke and fire suppression agent runoff when the effectiveness of the installed engineered controls may be challenged or impacted by fire suppression activities. This includes guidance on the need to monitor airborne contamination levels before and during venting operations, ensuring that liquid runoff from any fire-fighting activity is monitored and sampled for radioactive contamination, and guidance for contamination control for fires that may occur in outside yard areas where radioactive materials are stored in sea land-type containers.

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 licensee determined that the existing fire brigade training materials referenced in LAR Attachment E, provide adequate training guidance for containment and monitoring of potentially radioactive effluents and have been implemented in the fire brigade training program.

The actions to revise the pre-fire plans to address the radioactive release requirements of NFPA 805 are included in LAR Attachment S, Table S-3, Implementation Items 2 and 3. The NRC staff concludes that these actions are acceptable because the actions will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

3.6.1 Conclusion for Section 3.6

Based on: (1) the information provided in the LAR, as supplemented, (2) the use of installed and manual engineered controls to contain and monitor potential releases, (3) the development and implementation of newly revised pre-fire plans and fire brigade training procedures, and (4) the results of the quantitative analysis, 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 at HBRSEP are as low as reasonably achievable and are not expected to exceed the public dose limits in 10 CFR Part 20. The NRC staff also

concludes that the licensee's RI/PB FPP complies with the requirements of NFPA 805, Sections 1.3.2, 1.4.2, and 1.5.2, and is acceptable.

3.7 NFPA 805 Monitoring Program

For this SE section, the following requirements from NFPA 805 (Reference 3), Section 2.6, are applicable to the NRC staff's review of the LAR:

NFPA 805 Section 2.6: "Monitoring," states that:

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

NFPA 805 Section 2.6.1: "Availability, Reliability, and Performance Levels," states that:

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

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

> 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," states that:

> 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 (Reference 8), Section 4.6, "Monitoring Program," that the licensee developed to monitor availability, reliability, and performance of HBRSEP 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. The licensee stated that the monitoring program will be implemented after issuance of the SE as part of the FPP transition to NFPA 805.

The licensee stated that the monitoring process is comprised of four phases that include: 1) Scoping; 2) Screening using risk criteria; 3) Risk target value determination; and, 4) monitoring implementation. The licensee further stated that the results of these phases will be documented in the monitoring program scoping document developed during implementation.

The licensee stated that the monitoring program failure criteria and action level targets will be documented as described in FAQ 10-0059 (Reference 73).

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 scope of the program will include fire protection systems and features, NSCA equipment, SSCs relied upon to meet radioactive release criteria, and fire protection programmatic elements.

Based on the information provided in the LAR, the NRC staff concludes that the licensee's NFPA 805 monitoring program development and implementation process, provides reasonable assurance that HBRSEP will implement an effective program for monitoring risk significant fire SSCs because the monitoring program development and implementation process ensures that the monitoring program:

- Establishes the appropriate scope of SSCs to be monitored;
- Utilizes an acceptable screening process for determining the SSCs to be included in the program;
- Establishes availability, reliability, and performance criteria for the SSCs being monitored; and,
- Requires corrective actions when SSC availability, reliability, or performance criteria targets are exceeded 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 monitoring program is an action included in LAR Attachment S, Table S-3, Implementation Item 4. The NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

The NRC staff concludes that the completion of the monitoring program on the same schedule as the implementation of NFPA 805 is acceptable because the monitoring program will be completed prior to the implementation of the new NFPA 805 FPP, as defined in LAR Section 5.5.

3.7.1 Conclusion for Section 3.7

The NRC staff reviewed the licensee's RI/PB FPP and concludes that the licensee's approach for meeting the requirements of NFPA 805, Section 2.6, regarding the monitoring program is acceptable and that there is reasonable assurance that the licensee will develop a monitoring program that meets the requirements specified in NFPA 805, Sections 2.6.1, 2.6.2, and 2.6.3 because the licensee identified an action to develop and implement the monitoring program per NFPA 805, Section 2.6 and included that action as an implementation item which will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

3.8 Program Documentation, Configuration Control, and Quality Assurance

For this SE section, the requirements from NFPA 805 (Reference 3), Section 2.7, "Program Documentation, Configuration Control and Quality," are applicable to the NRC staff's review of the LAR (Reference 8), as supplemented, in regard to the appropriate content, configuration control, and quality of the documentation used to support the HBRSEP FPP transition to NFPA 805.

NFPA 805, Section 2.7.1.1, "General," states that:

> The analyses performed to demonstrate compliance with this standard shall be documented for each nuclear power plant. The intent of the documentation is that the assumptions be clearly defined and that the results be easily understood, that results be clearly and consistently described, and that sufficient detail be provided to allow future review of the entire analyses. Documentation shall be maintained for the life of the plant and be organized carefully so that it can be checked for adequacy and accuracy either by an independent reviewer or by the AHJ.

NFPA 805, Section 2.7.1.2, "Fire Protection Program Design Basis Document," states that:

> A fire protection program design basis document shall be established based on those documents, analyses, engineering evaluations, calculations, and so forth that define the fire protection design basis for the plant. As a minimum, this document shall include fire hazards identification and nuclear safety capability assessment, on a fire area basis, for all fire areas that could affect the nuclear safety or radioactive release performance criteria defined in Chapter 1.

NFPA 805, Section 2.7.1.3, "Supporting Documentation," states that:

> Detailed information used to develop and support the principal document shall be referenced as separate documents if not included in the principal document.

NFPA 805, Section 2.7.2.1, "Design Basis Document," states that:

> The design basis document shall be maintained up-to-date as a controlled document. Changes affecting the design, operation, or maintenance of the plant shall be reviewed to determine if these changes impact the fire protection program documentation.

NFPA 805, Section 2.7.2.2, "Supporting Documentation," states that:

> Detailed supporting information shall be retrievable records. Records shall be revised as needed to maintain the principal documentation up-to-date.

NFPA 805, Section 2.7.3.1, "Review," states that:

> Each analysis, calculation, or evaluation performed shall be independently reviewed.

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

> 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," states that:

> 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," states that:

> 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," states that:

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

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 HBRSEP FPP design basis document and supporting documentation.

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

The licensee stated that analyses, as defined by NFPA 805 Section 2.4, performed to demonstrate compliance with 10 CFR 50.48(c) will be maintained for the life of the plant and organized to facilitate review for accuracy and adequacy.

The licensee stated that the fire protection design basis document described in Section 2.7.1.2 of NFPA 805 and necessary supporting documentation described in Section 2.7.1.3 of NFPA 805 have been created as part of transition to 10 CFR 50.48(c) to ensure program implementation following receipt of the SE, and identified these documents in LAR Figure 4-9, "NFPA 805 Planned Post-Transition Documents and Relationships.".

Specifically, this design analysis and calculation procedure provides 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 HBRSEP's document control system. Being analyses, they are also subject to review and revision consistent with the other HBRSEP calculations and analyses, as required by the plant design change process.

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 HBRSEP configuration control process for the new NFPA 805 FPP.

The licensee stated that program documentation established, revised, or utilized in support of compliance with 10 CFR 50.48(c) is subject to its configuration control processes that meet the requirements of Section 2.7.2 of NFPA 805, and that this includes the appropriate procedures and configuration control processes for ensuring that changes impacting the FPP are reviewed appropriately. The licensee further stated that the RI/PB post transition change process methodology is based upon the requirements of NFPA 805, and industry guidance contained in NEI 04-02, and RG 1.205.

The licensee stated that configuration control is and will be maintained going forward in accordance with existing procedures and processes which satisfy the NFPA 805 requirements and that it has a procedure that provides review of configuration, process, and procedure changes to ensure applicable requirements of the NFPA 805 FPP (fundamental elements, NSCA, NPO, radioactive release and FPRA) are maintained.

The licensee stated that the HBRSEP FPP configuration is defined by the program documentation and that the existing configuration control processes for modifications, calculations and analyses, and FPP license basis reviews will be utilized to maintain configuration control of the FPP documents. The licensee further stated that the configuration control procedures that govern the various HBRSEP documents and databases that currently exist will be revised to reflect the new NFPA 805 licensing bases requirements. The licensee included this action in LAR Attachment S, Table S-3, Implementation Item 6 and the NRC staff considers this action acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

The licensee stated that configuration control of the FPRA model will be maintained by integrating the FPRA model into the existing processes used to ensure configuration control of the IEPRA model and that its process complies with Section 1-5 of the ASME PRA Standard and ensures that it maintains an as-built, as-operated PRA model of the plant. See SE Section 3.4 for the NRC staff's review of the licensee's process for updating and maintaining the HBRSEP FPRA in order to reflect plant changes made after completion of the transition to NFPA 805.

Based on the description of the HBRSEP configuration control process, which indicate 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 there is reasonable assurance that the requirements of NFPA 805 Sections 2.7.2.1 and 2.7.2.2 will be met subject to completion of LAR Attachment S, Table S-3, Implementation Item 6.

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 HBRSEP 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, Section 2.7.3.1 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 HBRSEP 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, Section 2.7.3.2, 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 it verified and validated the calculational models and numerical methods used in support of the transition to NFPA 805, 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 HBRSEP FREs. The NRC staff's evaluation of this information is discussed below.

3.8.3.2.1 General

NUREG-1824 (Reference 46), documents the V&V of five selected fire models commonly used to support applications of RI/PB FPP at NPPs. 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 NPP 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 verified and validated applications contained in NUREG-1824 to support the transition to NFPA 805 at HBRSEP, the

NRC staff concludes that the use of these models is acceptable, provided that the intended application is within the appropriate limitations, as identified in NUREG-1824.

In LAR Attachment J, the licensee 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.

Table 3.8-1, "V&V Basis for Fire Modeling Correlations Used at HBRSEP," in SE Attachment A and Table 3.8-2, "V&V Basis for Other Fire Models and Related Calculations Used at HBRSEP," in SE Attachment B, identify these empirical correlations and algebraic models, respectively, as well as a staff resolution for each.

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, peer reviewed journal articles, peer reviewed conference papers, and national research laboratory reports (Reference 109), (Reference 110), (Reference 111), (Reference 112), (Reference 113), (Reference 114), (Reference 115), (Reference 116), (Reference 115), (Reference 117), (Reference 118), (Reference 119), (Reference 120), and (Reference 125). SE Attachment A, Table 3.8-1 and SE Attachment B, Table 3.8-2 summarize the additional fire models, and the NRC staff's evaluation of the acceptability of each.

The FM employed by the licensee in the development of the HBRSEP FREs used empirical correlations that provide bounding solutions for the ZOI and conservative input parameters, which produced conservative results for the FM analysis. See SE Section 3.4.2.3 for further discussion of the licensee's FM method.

Based on the above, the NRC staff concludes that this approach provides reasonable assurance that the FM used in the development of the fire scenarios for the HBRSEP FPRA is appropriate, and thus acceptable for use in the licensee's transition to NFPA 805.

3.8.3.2.2 Discussion of RAIs

By letters dated October 23, 2014 (Reference 20), March 26, 2015 (Reference 21), April 23, 2015 (Reference 22), and July 7, 2015 (Reference 23), the NRC staff requested additional information (RAIs) from the licensee. By letters dated December 22, 2014 (Reference 10), January 22, 2015 (Reference 11), March 16, 2015 (Reference 12), April 1, 2015 (Reference 13), May 19, 2015 (Reference 14), July 31, 2015 (Reference 15), and March 16, 2016 (Reference 16), the licensee responded to these RAIs.

- In FM RAI 03.a (Reference 20), the NRC staff requested that the licensee provide technical details to demonstrate that the point source model as used in the structural steel analysis has been applied within the validated range of input parameters, or to justify the application of the model outside the NUREG-1824 validation range.

  In its response to FM RAI 03.a (Reference 10), the licensee explained that it updated LAR Attachment J, Table J-1, to include the use of the point source radiation model in the structural steel analysis. The licensee provided technical details to demonstrate that it applied the point source model in the structural steel

analysis within the NUREG-1824 validation range, or provided justification for use of the model outside the validated range reported in NUREG-1824.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee added the point source model as used in the structural steel analysis to LAR Attachment J, and demonstrated that it used the model within its NUREG-1824 validated range or provided justification for any uses of the model outside the NUREG-1824 validated range.

- In FM RAI 03.b (Reference 20), the NRC staff requested that the licensee provide the verification basis for the custom workbook that it developed to calculate the HGL temperature based on the FDTs for naturally vented and closed compartments.

  In its response to FM RAI 03.b (Reference 12), the licensee explained that it verified the custom workbook based on a comparison with the results of selected FDT calculations.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the custom workbook produces the same results as the applicable FDTs.

- In FM RAI 03.c (Reference 20), the NRC staff requested that the licensee provide the V&V basis for the fire models that are identified in its response to FM RAI 01.a, demonstrate that it applied the models within the validated range, or provide justification for the use of the models outside the validated range.

  In its response to FM RAI 03.c (Reference 10), the licensee explained that the point source radiation model as used in the structural steel analysis was added to LAR Attachment J, Table J-1, and provided justification for uses of the model outside the NUREG-1824 validated range.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee updated LAR Attachment J to include the V&V basis and a discussion of model applications outside the NUREG-1824 validated range for all fire models that it used in support of the development of the LAR.

3.8.3.2.3 Post-Transition

In LAR Section 4.7.3, the licensee stated that it verified and validated calculational models and numerical methods used in support of compliance with 10 CFR 50.48(c) as required by Section 2.7.3.2 of NFPA 805, and that that post-transition it will perform work in accordance with the requirements of NFPA 805, Section 2.7.3.

3.8.3.2.4 Conclusion for Section 3.8.3.2

Based on the licensee's description of the HBRSEP process for V&V of calculational models and numerical methods and the licensee's continued use of V&V post-transition, the NRC staff concludes that the licensee's approach for meeting the requirements of NFPA 805 Section 2.7.3.2 is acceptable.

3.8.3.3 Limitations of Use

NFPA 805, Section 2.7.3.3, requires that acceptable engineering methods and numerical models only be used for applications 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. In LAR Section 4.7.3, the licensee stated that it applied the engineering methods and numerical models used in support of compliance with 10 CFR 50.48(c), appropriately as required by NFPA 805, Section 2.7.3.3.

3.8.3.3.1 General

The NRC staff assessed the acceptability of the empirical correlations and fire models in terms of their limitations of use. Table 3.8-1 in SE Attachment A and Table 3.8-2 in SE Attachment B, summarize the empirical correlations and the fire models used, respectively, how each was applied in the HBRSEP FREs, the V&V basis for each, and the NRC staff evaluation for each.

3.8.3.3.2 Discussion of RAIs

By letters dated October 23, 2014 (Reference 20), March 26, 2015 (Reference 21), April 23, 2015 (Reference 22), and July 7, 2015 (Reference 23), the NRC staff requested additional information (RAIs) from the licensee. By letters dated December 22, 2014 (Reference 10), January 22, 2015 (Reference 11), March 16, 2015 (Reference 12), April 1, 2015 (Reference 13), May 19, 2015 (Reference 14), July 31, 2015 (Reference 15), and March 16, 2016 (Reference 16), the licensee responded to these RAIs.

- In FM RAI 04.a (Reference 20), the NRC staff requested that the licensee identify uses, if any, of the FDTs outside the limits of applicability of the model and explain how the use of the FDT was justified.

  In its response to FM RAI 04.a (Reference 10), the licensee explained that it generally used the FDTs within their range of applicability, and provided technical justification following the guidance in NUREG-1824 and NUREG-1934 (Reference 52) for applications of the FDTs outside the range of applicability.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee provided adequate justification for any applications of the FDTs outside the range of applicability of the model.

- In FM RAI 04.b (Reference 20), the NRC staff requested that the licensee identify uses, if any, of CFAST outside the limits of applicability of the model and explain how the use of CFAST was justified.

  In its response to FM RAI 04.b (Reference 10), the licensee explained that it generally used CFAST within its range of applicability, and provided technical justification following the guidance in NUREG-1824 and NUREG-1934 for applications of CFAST outside the range of applicability.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee provided adequate justification for any applications of CFAST outside the range of applicability of the model.

- In FM RAI 04.c (Reference 20), the NRC staff requested that the licensee identify uses, if any, of the GFMTs outside their limits of applicability and explain how the use of the GFMTs in those cases was justified.

  In its response to FM RAI 04.c (Reference 10), the licensee explained that it generally used the GFMTs within their range of applicability, and provided technical justification following the guidance in NUREG-1824 and NUREG-1934 for applications of the GFMTs outside the range of applicability.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee provided adequate justification for any applications of the GFMTs outside their range of applicability.

3.8.3.3.3 Post-Transition

In LAR Section 4.7.3, the licensee stated that it applied engineering methods and numerical models used in support of compliance with 10 CFR 50.48(c) appropriately as required by NFPA 805, Section 2.7.3.3 and that post transition, it will perform work in accordance with the requirements of NFPA 805, Section 2.7.3.

3.8.3.3.4 Conclusion for Section 3.8.3.3

Based on the licensee's statements that it used the fire models to support development of the FREs within their limitations, and the description of the HBRSEP 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, Section 2.7.3.4 requires that personnel performing engineering analyses and applying numerical methods (e.g., FM) be competent in that field and experienced in the application of these methods as they relate to NPPs, NPP fire protection, and power plant operations.

3.8.3.4.1 General

In LAR Section 4.7.3, the licensee stated that cognizant personnel who use and apply engineering analysis and numerical methods in support of compliance with 10 CFR 50.48(c) are competent and experienced as required by NFPA 805, Section 2.7.3.4. The licensee further stated that during the transition to 10 CFR 50.48(c), it performed work in accordance with the quality requirements of NFPA 805, Section 2.7.3 and that personnel who used and applied engineering analysis and numerical methods (e.g. FM) in support of compliance with 10 CFR 50.48(c) are competent and experienced as required by NFPA 805 Section 2.7.3.4.

3.8.3.4.2 Discussion of RAI Responses

By letters dated October 23, 2014 (Reference 20), March 26, 2015 (Reference 21), April 23, 2015 (Reference 22), and July 7, 2015 (Reference 23), the NRC staff requested additional information (RAIs) from the licensee. By letters dated December 22, 2014 (Reference 10),

January 22, 2015 (Reference 11), March 16, 2015 (Reference 12), April 1, 2015 (Reference 13), May 19, 2015 (Reference 14), July 31, 2015 (Reference 15), and March 16, 2016 (Reference 16), the licensee responded to these RAIs.

- In FM RAI 05.a (Reference 20), the NRC staff requested that the licensee explain what constitutes the necessary qualifications for the personnel performing and reviewing FM analyses.

  In its response to FM RAI 05.a (Reference 12), the licensee described the qualifications for fire protection engineers and contractors to perform and review FM analyses, and explained that the qualification requirements consist of successful completion of specific training programs, completing specific reading assignments, meeting specific education requirements, and demonstrating comprehension and proficiency in FM. The licensee further stated that the contractor's QA process ensures that contract personnel performing the FM are qualified and trained.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee's qualification requirements are adequate to ensure that FM personnel meet the requirements of NFPA 805, Section 2.7.3.4.

- In FM RAI 05.b (Reference 20), the NRC staff requested that the licensee describe the process and procedures for ensuring that the personnel performing and reviewing FM analyses have the necessary qualifications.

  In its response to FM RAI 05.b (Reference 12), the licensee explained that FM calculations are required to be performed by a fire protection engineer who meets the qualification requirements of NFPA 805, Section 2.7.3.4. The licensee further described a number of internal programs that are designed to provide the minimum training necessary to perform FM as required by NFPA 805, Section 2.7.3.4, and indicated that the NFPA 805 requirements will continue to be met and adhered to through its procedures and project management of contractor support staff.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that it has procedures in place to ensure that FM personnel and contractors meet the requirements of NFPA 805, Section 2.7.3.4.

- In FM RAI 05.c (Reference 20), the NRC staff requested that the licensee explain the communication process between the FM analysts and PRA personnel and any measures taken to assure the FM was performed adequately and will continue to be performed adequately during post-transition.

  In its response to FM RAI 05.c (Reference 12), the licensee explained that throughout the NFPA 805 transition process, the fire protection engineers who conducted the FM and the PRA engineers maintained frequent communications and worked closely together developing the necessary data, documentation, and quantification infrastructure. The licensee further explained that this process will continue during transition implementation and future established activities as it is

based on a systematic methodology that is consistently applied throughout its fleet of nuclear plants.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that its communication process between the FM analysts and PRA personnel was adequate throughout the NFPA 805 transition process, and will continue during implementation and post-transition.

Based on its review and above explanation, the NRC staff concludes that appropriately competent and experienced personnel developed the HBRSEP FREs, including the supporting FM calculations and the additional documentation for models and empirical correlations not identified in previous NRC approved V&V documents.

3.8.3.4.3 Post-Transition

In LAR Section 4.7.3, the licensee stated that cognizant personnel who use and apply engineering analysis and numerical methods in support of compliance with 10 CFR 50.48(c) are competent and experienced as required by NFPA 805, Section 2.7.3.4 and that post-transition, it will perform work in accordance with the requirements of NFPA 805, Section 2.7.3.

The licensee stated that post-transition, for personnel performing FM or FPRA development and evaluation, it will develop and maintain qualification requirements for individuals assigned various tasks and that 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. The licensee included this action in LAR Attachment S, Table S-3, Implementation Item 6. The NRC staff considers this action acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

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, subject to completion of LAR Attachment S, Table S-3, Implementation Item 6.

3.8.3.5 Uncertainty Analysis

NFPA 805 Section 2.7.3.5, 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.) In LAR Section 4.7.3, the licensee stated that uncertainty analyses were performed as required by NFPA 805, Section 2.7.3.5 and the results were considered in the context of the application.

3.8.3.5.1 General

The industry consensus standard for PRA development (i.e., the ASME/ANS PRA standard, (Reference 33) includes requirements to address uncertainty. Accordingly, the licensee

addressed uncertainty as a part of the development of the HBRSEP 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 (Reference 50), 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 52).

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 FM RAIs

By letters dated October 23, 2014 (Reference 20), March 26, 2015 (Reference 21), April 23, 2015 (Reference 22), and July 7, 2015 (Reference 23), the NRC staff requested additional information (RAIs) from the licensee. By letters dated December 22, 2014 (Reference 10), January 22, 2015 (Reference 11), March 16, 2015 (Reference 12), April 1, 2015 (Reference 13), May 19, 2015 (Reference 14), July 31, 2015 (Reference 15), and March 16, 2016 (Reference 16), the licensee responded to these RAIs.

- In FM RAI 06.a (Reference 20), the NRC staff requested that the licensee describe how the uncertainty associated with the FM input parameters was accounted for in the FM analyses.

  In its response to FM RAI 06.a (Reference 10), the licensee explained that it addressed parameter uncertainty by using conservative inputs or by varying input parameters in sensitivity cases, and provided a brief discussion to illustrate how it addressed parameter uncertainty in the MCR abandonment calculations.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that it adequately accounted for parametric uncertainty in the FM analysis performed in support of the NFPA 805 transition.

- In FM RAI 06.b (Reference 20), the NRC staff requested that the licensee describe how the "model" and "completeness" uncertainties were accounted for in the FM analyses.

In its response to FM RAI 06.b (Reference 10), the licensee explained that it addressed model uncertainty by using models within their validated range, or by providing justification for their use outside the validated range, and through the sensitivity analysis supporting the FPRA. The licensee further explained that it addressed completeness associated with fire models in the FPRA within the overall quantification process, and provided some examples to illustrate how the completeness uncertainty associated with FM calculations was addressed outside of the FM by conservatively failing targets in the fire scenarios such that the risk contribution is bounding.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that it adequately accounted for model and completeness uncertainty in the FM analysis performed in support of the NFPA 805 transition.

3.8.3.5.3 Post-Transition

In LAR Section 4.7.3, the licensee stated that uncertainty analyses were performed as required by NFPA 805, Section 2.7.3.5 and the results were considered in the context of the application and that post-transition it will perform work in accordance with the requirements of NFPA 805, Section 2.7.3.

3.8.3.5.4 Conclusion for Section 3.8.3.5

Based on the licensee's description of the HBRSEP 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 HBRSEP RI/PB fire protection QA program adequately addresses each of the requirements of NFPA 805, Section 2.7.3, which includes 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

The guidance in Appendix C to NEI 04-02 (Reference 7), 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.

In LAR Section 4.7.3, the licensee stated that it will maintain the existing fire protection QA program and that during the transition to 10 CFR 50.48(c), it performed work in accordance with the quality requirements of NFPA 805, Section 2.7.3. The licensee further stated that any future NFPA 805 analyses will be conducted in accordance with the quality requirements described in NFPA 805, section 2.7.3 under the design controls in place and required by the fire protection portions of its QA program manual.

The LAR described how the fire protection QA program meets the applicable requirements of NFPA 805, Sections 2.7.3.1 through 2.7.3.5, and indicated that post-transition the licensee will perform work in accordance with the requirements of NFPA 805, Section 2.7.3. The licensee further stated that post-transition, for personnel performing FM or FPRA development and evaluation, it will develop and maintain qualification requirements for individuals assigned various tasks and that 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. The licensee included this action in LAR Attachment S, Table S-3, Implementation Item 6. The NRC staff considers this action acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

Based on its review and the above explanation, the NRC staff concludes that the licensee's fire protection QA program is acceptable subject to completion of LAR Attachment S, Table S-3, Implementation Item 6, because the license demonstrated that it met the requirements of NFPA 805, Section 2.7.3 during the transition process, and that it will perform work in accordance with the requirements of NFPA 805, Section 2.7.3, post-transition.

3.8.5 Conclusion for Section 3.8

The NRC staff reviewed the licensee's RI/PB FPP as described in the LAR, as supplemented, to evaluate the NFPA 805 program documentation content, the associated configuration control process, and the appropriate QA requirements and the NRC staff concludes that, subject to completion of the implementation item in LAR Attachment S, Table S-3 related to the QA program, the licensee's approach for meeting the requirements specified in NFPA 805, Section 2.7, is acceptable.

4.0 FIRE PROTECTION LICENSE CONDITION

The licensee proposed a fire protection program license condition regarding transition to an risk-informed, performance-based fire protection program 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 fire protection program license condition is consistent with the standard fire protection license condition, incorporates all of the relevant features of the transition to NFPA 805 at HBRSEP, and is, therefore, acceptable.

The following license condition is included in the revised license for HBRSEP, and will replace Operating License No. DPR-23, Condition 3.E:

> E. Fire Protection Program
>
> Duke Energy Progress, LLC 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 licensee amendment request dated September 16, 2013, as supplemented by letters dated November 24, 2014, December 22, 2014, January 22, 2015, March 16, 2015, April 1, 2015, May 19, 2015, July 31, 2015, March 16, 2016, May 25, 2016, July 25, 2016, and October 5, 2016, and as approved in the SE dated February 3, 2017. 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.

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

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

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

   b) 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.

2. Other Changes that May Be Made Without Prior NRC Approval

   a) Changes to NFPA 805, Chapter 3, Fundamental Fire Protection Program

      Prior NRC review and approval is 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.

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

Prior NRC review and approval is 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 SE dated February 3, 2017, 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.

3. Transition License Conditions

a) Before achieving full compliance with 10 CFR 50.48(c), as specified by 3.b) and 3.c) below, risk-informed changes to the licensee's fire protection program may not be made without prior NRC review and approval unless the change has been demonstrated to have no more than a minimal risk impact, as described in 2.b) above.

b) The licensee shall implement the modifications described in Attachment S, Table S-2, "Plant Modifications Committed," of Duke Energy letter dated May 25, 2016, by the end of the unit refueling outage currently scheduled for September/October 2020 (R232). The licensee shall maintain appropriate compensatory measures in place until completion of the modifications delineated above.

c) The licensee shall implement the items as listed in Attachment S, Table S-3, "Implementation Items," of Duke Energy letters dated May 25,

2016, and October 5, 2016, within 365 days after receipt of the safety evaluation/license amendment with the exception of implementation items S-3.11, 12, and 14, which are associated with modifications and will be completed after all procedure updates, modifications and training are complete.

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, subject to completion of the modifications and implementation items in LAR Attachment S, 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).

Accordingly, implementation of the RI/PB FPP in accordance with 10 CFR 50.48(c) is reflected by a new fire protection license condition, which identifies the list of implementation items that must be completed in order to support the conclusions made in this SE, and establishes a 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 South Carolina official was notified on December 20, 2016, 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 December 26, 2013 (78 FR 78405). 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 U.S. Nuclear Regulatory Commission, "Branch Technical Postion, APCSB 9.5-1, Guidlelines for Fire Protection For Nuclear Power Plants," May 1, 1976 (ADAMS Accession No. ML070660461).

2 U.S. Nuclear Regulatory Commission, "Appendix A to BTP APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants Docketed Prior to July 1, 1976," February 24, 1977 (ADAMS Accession No. ML070660458).

3 National Fire Protection Association, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," Standard 805 (NFPA 805), 2001 Edition, Quincy, Massachusetts.

4 U.S. Nuclear Regulatory Commission, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants," Regulatory Guide 1.205, Revision 1, December 2009 (ADAMS Accession No. ML092730314).

5 U.S. Nuclear Regulatory Commission, "Development of a Risk-Informed, Performance-Based Regulation for Fire Protection at Nuclear Power Plants," SECY-98-058, March 26, 1998 (ADAMS Accession No. ML992910106).

6 U.S. Nuclear Regulatory Commission, "Rulemaking Plan, Reactor Fire Protection Risk-Informed, Performance-Based Rulemaking," SECY-00-0009, January 13, 2000 (ADAMS Accession No. ML003671923).

7 Nuclear Energy Institute, "Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c), Revision 2," Washington, DC, NEI 04-02, Revision 2, April 2008 (ADAMS Accession No. ML081130188).

8 Gideon, W. R., Duke Energy Progress, Inc., letter to U.S. Nuclear Regulatory Commission, "License Amendment Request (LAR) to Adopt National Fire Protection Association (NFPA) 805 Performance-Based Standard for Fire Protection for Light-Water Reactor Generating Plants," September 16, 2013 (ADAMS Accession No. ML13267A211).

9 Glover, R. Michael, Duke Energy Progress, Inc., letter to U.S. Nuclear Regulatory Commission, "Response (60-Day) to Request for Additional Information Association with the LAR to Adopt National Fire Protection Association (NFPA) Standard 805," November 24, 2014 (ADAMS Accession No. ML14337A098), not publicly available.

10 Glover, R., Michael, Duke Energy Progress, Inc., letter to U.S. Nuclear Regulatory Commission, "Response (90-Day) to Request for Additional Information Associated with LAR to Adopt NFPA Standard 805," December 22, 2014 (ADAMS Accession No. ML15005A073).

11 Glover, R., Michael, Duke Energy Progress, Inc., letter to U.S. Nuclear Regulatory Commission, "Response (120-Day) to Request for Additional Information Associated with License Amendment Request to Adopt NFPA Standard 805," January 22, 2015 (ADAMS Accession ML15036A059).

12 Glover, R., Michael, Duke Energy Progress, Inc., letter to U.S. Nuclear Regulatory Commission, "Response (60-Day) to Request for Additional Information Associated with License Amendment Request to Adopt NFPA Standard 805," March 16, 2015 (ADAMS Accession No. ML15079A025).

13 Glover, R., Michael, Duke Energy Progress, Inc., letter to U.S. Nuclear Regulatory Commission, "Supplemental Response to 120-Day Response Submittal to Request for Additional Information Associated with LAR to Adopt NFPA Standard 805," April 1, 2015 (ADAMS Accession ML15099A454).

14 Glover, R., Michael, Duke Energy Progress, Inc., letter to U.S. Nuclear Regulatory Commission, "Response to Follow-up Request for Additional Information Associated with Response to 90-Day RAI Related to LAR to Adopt NFPA Standard 805," May 19, 2015 (ADAMS Accession No. ML15149A265).

15 Glover, R., Michael, Duke Energy Progress, Inc., 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, "Performance-Based Standard for Light Water Reactor Electric Generating Plants," July 31, 2015 (ADAMS Accession No. ML15212A136).

16 Glover, R., Michael, Duke Energy Progress, Inc., 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, "Performance-Based Standard for Light Water Reactor Electric Generating Plants," March 16, 2016 (ADAMS Accession No. ML16076A033).

17 Glover, R., Michael, Duke Energy Progress, Inc., 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, "Performance-Based Standard for Light Water Reactor Electric Generating Plants," May 25, 2016 (ADAMS Accession No. ML16158A006).

18 Glover, R., Michael, Duke Energy Progress, Inc., 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, "Performance-Based Standard for Light Water Reactor Electric Generating Plants," July 25, 2016 (ADAMS Accession No. ML16230A234).

19 Glover, R., Michael, Duke Energy Progress, LLC., letter to U.S. Nuclear Regulatory Commission, "Response to Request for Additional Information Regarding LAR to Adopt NFPA Standard 805, Performance-Based Standard for Light Water Reactor Electric Generating Plants," October 5, 2016 (ADAMS Accession No. ML16279A210).

20 Barillas, Martha, U.S. Nuclear Regulatory Commission, letter to Site Vice President, Duke Energy Progress, Inc., "H.B. Robinson Steam Electric Station, Unit 2, Request for Additional Information On License Amendment Request to Adopt National Fire Protection Association Standard 805, Performance-Based Standard for Fire Protection (TAC No. MF2746)," October 23, 2014 (ADAMS Accession No. ML14289A260).

21 Barillas, Martha, U.S. Nuclear Regulatory Commission, letter to Richard Michael Glover, Duke Energy Progress, Inc., "H.B. Robinson Steam Electric Station, Unit 2, Request for Additional Information On License Amendment Request to Adopt National Fire Protection Association Standard 805, Performance-Based Standard for Fire Protection (TAC No. MF2746)," March 26, 2015 (ADAMS Accession No. ML15057A403).

22 Barillas, Martha, U.S. Nuclear Regulatory Commission, email to Richard Hightower, Duke Energy Progress, Inc., "Robinson NFPA - 805 Follow-up 90 Day Fire Modeling and Radioactive Release Requests for Additional Information," April 23, 2015 (ADAMS Accession No. ML15114A041).

23 Barillas, Martha, U.S. Nuclear Regulatory Commission, letter to Richard Michael Glover, Duke Energy Progress, Inc., "H.B. Robinson Steam Electric Plant Unit No. 2 - Request for Additional Information Regarding License Amendment Request to Adopt National Fire Protection Association Standard 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," (TAC No. MF2746)," July 7, 2015 (ADAMS Accession No. ML15182A193).

24 Galvin, Dennis, J., U.S. Nuclear Regulatory Commission, letter to Richard Michael Glover, Duke Energy Progress, Inc., "H.B. Robinson Steam Electric Plant Unit No. 2 - Request For Additional Information Regarding License Amendment Request to Adopt NFPA Standard 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," (CAC MF2746)," March 2, 2016 (ADAMS Accession No. ML16048A349).

25 Galvin, Dennis, J., U.S. Nuclear Regulatory Commission, email to Scott Connelly, Duke Energy Progress, Inc., "H.B. Robinson Steam Electric Plant Unit No. 2 - Request for Additional Information Regarding License Amendment Request to Adopt NFPA Standard 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," (CAC MF 2746)," June 28, 2016 (ADAMS Accession No. ML16181A147).

26 Varga, Steven, A., U.S. Nuclear Commission, letter to Utley, E. E., Carolina Power and Light Company, "H.B. Robinson, Issuance of Exemption to Certain Requirements of 10 CFR 50, Appendix R, Subsection III.G and III.M," November 25, 1983 (ADAMS Accession No. ML020520069).

27 Staff Requirements Memorandum for SECY-92-223 U.S. Nuclear Regulatory Commission, "Resolution of Deviations Identified during the Systematic Evaluation Program," September 18, 1992 (ADAMS Accession No. ML003763736).

28 Nuclear Energy Institute, "Guidance for Post Fire Safe Shutdown Circuit Analysis," NEI 00-01, Revision 2, May 2009 (ADAMS Accession No. ML091770265).

29 Nuclear Energy Institute, "Process for Performing Internal Events PRA Peer Reviews Using the ASME/ANS PRA Standard," NEI 05-04, Revision 2, November, 2008 (ADAMS Accession No. ML083430462).

30 Nuclear Energy Institute, "Fire Probabilistic Risk Assessment (FPRA) Peer Review Process Guidelines," NEI 07-12, Revision 1, June 2010 (ADAMS Accession No. ML102230070).

31 U.S. Nuclear Regulatory Commission, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," RG 1.174, Revision 2, May 2011 (ADAMS Accession No. ML100910006).

32 U.S. Nuclear Regulatory Commission, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," RG 1.200, Revision 2, March 2009 (ADAMS Accession No. ML090410014).

33 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," Februrary 2, 2009.

34 U.S. Nuclear Regulatory Commission, "Fire Protection for Nuclear Power Plants," RG 1.189, Revision 2, October 2009 (ADAMS Accession No. ML092580550).

35 U.S. Nuclear Regulatory Commission, "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," NUREG-0800, Revision 0, December 2009 (ADAMS Accession No. ML092590527).

36 U.S. Nuclear Regulatory Commission, "Standard Review Plan for the Review of Safety Analysis Reports for NPP: LWR Edition Section 19.1, Determining the Technical Adequacy of Probabilistic Risk Assessment for Risk-Informed License Amendment Requests after Initial Fuel Load," NUREG-0800, Revision 3, September 2012 (ADAMS Accession No. ML12193A107).

37 U.S. Nuclear Regulatory Commission, "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," NUREG-0800, Revision 0, June 2007 (ADAMS Accession No. ML071700658).

38 U.S. Nuclear Regulatory Commission, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities, Volume 1: Summary & Overview," NUREG/CR-6850, September 2005 (ADAMS Accession No. ML052580075).

39 U.S. Nuclear Regulatory Commission, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities, Volume 2: Detailed Methodology," NUREG/CR-6850, September 2005 (ADAMS Accession No. ML052580118).

40 U.S. Nuclear Regulatory Commission, "Fire Probabilistic Risk Assessment Methods Enhancements," NUREG/CR-6850, Supplement 1, September 2010 (ADAMS Accession No. ML103090242).

41 Correia, R. P., memorandum to Joseph G. Giitter, U.S. Nuclear Regulatory Commission, "Interim Technical Guidance on Fire-Induced Circuit Failure Mode Likelihood Analysis," June 14, 2013 (ADAMS Accession No. ML13165A194).

42 U.S. Nuclear Regulatory Commission, "Cable Response to Live Fire (CAROLFIRE)," NUREG/CR-6931, Volumes 1, 2, and 3, April 2008 (ADAMS Accession Nos. ML081190230, ML081190248, and ML081190261).

43 U.S. Nuclear Regulatory Commission, "Direct Current Electrical Shorting in Response to Exposure Fire (DESIREE-Fire): Test Results," NUREG/CR-7100, April 2012 (ADAMS Accession No. ML121600316).

44 U.S. Nuclear Regulatory Commission, "Good Practices for Implementing Human Reliability Analysis (HRA)," NUREG-1792, April 2005 (ADAMS Accession No. ML051160213).

45 U.S. Nuclear Regulatory Commission, "Fire Dynamics Tools (FDTs): Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program," NUREG-1805, December 2004 (ADAMS Accession No. ML043290075).

46 U.S. Nuclear Regulatory Commission , "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," NUREG-1824, May 2007. Volume 1: Main Report, Volume 2: Experimental Uncertainty, Volume 3: Fire Dynamics Tools (FDTs), Volume 4: Fire-Induced Vulnerability Evaluation (FIVE-Rev. 1), 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).

47 U.S. Nuclear Regulatory Commission, "Cable Heat Release, Ignition, and Spread in Tray Installations during Fire (CHRISTIFIRE), Phase 1: Horizontal Trays," NUREG/CR-7010, Volume 1, July 2012 (ADAMS Accession No. ML12213A056).

48 U.S. Nuclear Regulatory Commission, "Joint Assessment of Cable Damage and Quantification of Effects from Fire (JACQUE-FIRE), Volume 1: Phenomena Identification and Ranking Table (PIRT) Exercise for Nuclear Power Plant Fire-Induced Electrical Circuit Failure," NUREG/CR-7150, Vol. 1 (also designated EPRI 1026424 and BNL-NUREG-98204-2012), October 2012 (ADAMS Accession No. ML12313A105).

49 U.S. Nuclear Regulatory Commission, "Joint Assessment of Cable Damage and Quantification of Effects from Fire (JACQUE-FIRE), Volume 2: Expert Elicitation Exercise for Nuclear Power Plant Fire-Induced Electrical Circuit Failure," NUREG/CR-7150, Vol. 2

(also designatedas EPRI 3002001989 and BNL-NUREG-98204-2012), May 2014 (ADAMS Accession No. ML14141A129).

50 U.S. Nuclear Regulatory Commission, "Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decision Making," NUREG-1855, Volume 1, March 2009 (ADAMS Accession No. ML090970525).

51 U.S. Nuclear Regulatory Commission, "EPRI/NRC-RES Fire Human Reliability Analysis Guidelines," NUREG-1921, July 2012 (ADAMS Accession No. ML12216A104).

52 U.S. Nuclear Regulatory Commission, "Nuclear Power Plant Fire Modeling Analysis Guidelines (NPP FIRE MAG)," NUREG-1934, November 2012 (ADAMS Accession No. ML12314A165).

53 U.S. Nuclear Regulatory Commission, Generic Letter 2006-03, "Potentially Nonconforming HEMYC and MT Fire Barrier Configurations," April 10, 2006 (ADAMS Accession No. ML053620142).

54 National Fire Protection Association, "Standard for the Installation of Sprinkler Systems," Standard 13 (NFPA 13), Quincy, Massachusetts.

55 National Fire Protection Association, "Life Safety Code," Standard 101 (NFPA 101), Quincy, Massachusetts.

56 National Fire Protection Association, "Standard for Fire Prevention During Welding, Cutting, and Other Hot Work," NFPA Standard 51B (NFPA 51B), Quincy, Massachusetts.

57 National Fire Protection Association, "National Fire Alarm and Signaling Code," Standard 72 (NFPA 72), Quincy, Massachusetts.

58 National Fire Protection Association, "Standard for the Fire Protection of Telecommunications Facilities," NFPA Standard 76 (NFPA 76), Quincy, Massachusetts.

59 National Fire Protection Association, "Standard for Safeguarding Construction, Alteration, and Demolition Operations," NFPA Standard 241 (NFPA 241), Quincy, Massachusetts.

60 National Fire Protection Association, "Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces," NFPA Standard 262 (NFPA 262), Quincy, Massachusetts.

61 Klein Alexander, R., U.S. Nuclear Regulatory Commission, memorandum to file, "Closure of National Fire Protection Association 805 Frequently Asked Question Number 06-0021," November 13, 2007 (ADAMS Accession No. ML072420306).

62 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of National Fire Protection Association Standard 805 Frequently Asked Question 06-0022 on Electrical Cable Flame Propagation Tests," May 5, 2009 (ADAMS Accession No. ML091240278).

63 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," February 4, 2011 (ADAMS Accession No. ML110070485).

64 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," February 3, 2011 (ADAMS Accession No. ML110140242).

65 Nuclear Energy Institute, "Guidance for Post Fire Safe Shutdown Circuit Analysis," NEI 00-01, Revision 1, January 2005 (ADAMS Accession No. ML050310295).

66 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," January 15, 2010 (ADAMS Accession No. ML091320068).

67 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," August 11, 2008 (ADAMS Accession No. ML082200528).

68 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Closure of National Fire Protection Association Standard 805 Frequently Asked Question 08-0046: Incipient Fire Detection Systems," November 23, 2009 (ADAMS Accession No. ML093220426).

69 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of National Fire Protection Association Standard 805 Frequently Asked Question 08-0050 on Manual Non-Suppression Probability," September 14, 2009 (ADAMS Accession No. ML092190555).

70 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," March 10, 2015 (ADAMS Accession No. ML15016A280).

71 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," January 14, 2011 (ADAMS Accession No. ML102920405).

72 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of National Fire Protection Association Standard 805 Frequently Asked Question 09-0057 on Safe Shutdown Strategy Change," April 19, 2010 (ADAMS Accession No. ML100960568).

73 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," March 19, 2012 (ADAMS Accession No. ML120750108).

74 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," September 5, 2012 (ADAMS Accession No. ML121980557).

75 Hamzehee, Hossein, G., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of Fire Probabilistic Risk Assessment Frequently Asked Question 13-0004 on Clarifications Regarding Treatment of Sensitive Electronics," December 3, 2013 (ADAMS Accession No. ML13322A085).

76 Hamzehee, Hossein, G., U.S. Nuclear Regulatory Commission, Memorandum to file, "Close-out of Fire Probabilistic Risk Assessment Frequently Asked Question 13-0005 on Cable Fires Special Cases: Self-Ignited and Caused by Welding and Cutting," December 3, 2013 (ADAMS Accession No. ML13319B181).

77 Hamzehee, Hossein, G., U.S. Nuclear Regulatory Commission, Memorandum to file, "Close-out of Fire Probabilistic Risk Assessment Frequently Asked Question 13-0006 on Modeling Junction Box Scenarios in a Fire PRA," December 12, 2013 (ADAMS Accession No. ML13331B213).

78 Hamzehee, Hossein, G., memorandum to files, "Close-Out of Fire Probabilistic Risk Assessment Frequently Asked Question 14-0009 on Treatment of Well Sealed MCC

Electrical Panels Greater Than 440V," April 29, 2015 (ADAMS Package Accession No. ML15119A176).

79 Varga, Steven, A., U.S. Nuclear Regulatory Commission, letter to Utley, E., E., Carolina Power and Light Company, "Exemption to Certain Requirements of Appendix R to 10 CFR Part 50," October 25, 1984 (ADAMS Accession No. ML16330A402).

80 Varga, Steven, A., U.S. Nuclear Regulatory Commission, letter to Utley, E., E., Carolina Power and Light Company, "Exemption from Section III.O of Appendix R to 10 CFR 50 to the Extent it Requires an Oil Collection System for the Reactor Coolant Pumps," March 7, 1985 (ADAMS Accession No. ML020520374).

81 Rubenstein, Lester, S., U.S. Nuclear Regulatory Commission, letter to Utley, E., E., Carolina Power and Light Company, "Exemption from Certain Requirements of 10 CFR Part 50, Appendix R, Sections III.G.2 and III.G.3 - H.B. Robinson Steam Electric Plant, Unit No. 2," September 17, 1986 (ADAMS Accession No. ML020530054).

82 Lo, Ronnie, H., U.S. Nuclear Regulatory Commission, letter to Eury, Lynn, W., Carolina Power and Light Company, "Exemption from Requirements of Section III.G.2 of Appendix R of 10 CFR Part 50 - H.B. Robinson Steam Electric Plant Unit No. 2 (TAC No. 77310)," October 17, 1990 (ADAMS Accession No. ML020530140).

83 Marion, Alexander, Nuclear Energy Institute, letter to Hannon, John, U.S. Nuclear Regulatory Commission, "Guidance for Performing a Regulatory Review of Proposed Changes to the Approved Fire Protection Program," NEI 02-03, Revision 0, June 17, 2003 (ADAMS Accession No. ML031780500).

84 U.S. Nuclear Regulatory Commission, "Implementation of Fire Protection Requirements," Generic Letter 86-10, April 24, 1986 (ADAMS Accession No. ML031150322).

85 Institute for Electrical and Electronics Engineers, "Standard for Type Test of Class 1E Electric Cables and Field Splices and Connections for Nuclear Power Generating Stations," Standard 383 (IEEE-383), New York, NY.

86 National Fire Protection Association, "Standard for Fire Doors and Other Opening Protectives," Standard 80 (NFPA 80), Quincy, Massachusetts.

87 National Fire Protection Association, "Standard for the Installation of Air-Conditioning and Ventilating Systems," Standard 90A, (NFPA 90A), Quincy, Massachusetts.

88 Reid, Robert, W., U.S. Nuclear Regulatory Commission, letter to Jones, J., A., Carolina Power and Light Company, "Issuance of Amendment No. 31 to Facility Operating License No. DPR-23 for the H.B. Robinson Steam Electric Plant, Unit No. 2," February 28, 1978 (ADAMS Accession No. ML020500686).

89 Schwencer, A., U.S. Nuclear Regulatory Commission letter to Jones, J., A., Carolina Power and Light Company, "Issuance of Amendment No. 40 to Facility Operating License No. DPR-23 for the H.B. Robinson Steam Electric Plant, Unit No. 2," September 4, 1979 (ADAMS Accession No. ML020500693).

90 Schwencer, A., U.S. Nuclear Regulatory Commission, letter to Jones, J., A., Carolina Power and Light Company, "H.B. Robinson Steam Electric Power Plant, Unit No. 2, Fire Protection Program," February 21, 1980 (ADAMS Accession No. ML14184A179).

91 Varga, Steven, A., U.S. Nuclear Regulatory Commission, letter to Jones, J., A., Carolina Power and Light Company, "H.B. Robinson Steam Electric Plant Fire Protection Program," December 8, 1980 (ML14192A101).

92 Denton, Harold, R., U.S. Nuclear Commission, letter to Jones, J.A., Carolina Power and Light Company, "H.B. Robinson, Unit No. 2 - Exemption to Certain Requirements of

Section 10 CFR 50.48 and Appendix R to 10 CFR 50," November 13, 1981 (ADAMS Accession No. ML091310050).

93 Rubenstein, Lester, S., U.S. Nuclear Regulatory Commission, letter to Utley, E. E., Carolina Power and Light Company, "Exemption from Certain Requirements of 10 CFR Part 50, Appendix R, Sections III.G.2 and III.G.3 - H.B. Robinson Steam Electric Plant, Unit No. 2," September 17, 1986 (ADAMS Accession No. ML020530054).

94 Adensam, Elinor G., U.S. Nuclear Regulatory Commission, letter to Utley, E. E, Carolina Power & Light Company, "Revised Exemptions From Certain Requirements of 10 CFR Part 50, Appendix R, Section III.J - H.B. Robinson Steam Electric Plant, Unit No. 2 (TAC No. 55440)," June 30, 1988 (ADAMS Accession No. ML020530074).

95 Lo, Ronnie H., U.S. Nuclear Regulatory Commission, letter to Eury, L., W., Carolina Power and Light Company, "Exemption from Requirements of Section III.G.2 of Appendix R to 10 CFR 50 - H.B. Robinson Steam Electric Plan Unit No. 2 (TAC No. 77310)," October 17, 1990 (ADAMS Accession No. ML020530140).

96 Electric Power Research Institute , "Fire Protection Equipment Surveillance Optimization and Maintenance Guide for Fire Protection Systems and Features," Palo Alto, California, TR-1006756, Final Report July 2003.

97 Lucas, Jan, F., Progress Energy, letter to U.S. Nuclear Regulatory Commission, "Response to NRC Generic Letter 2006-03, "Potentially Nonconforming Hemyc and MT Fire Barrier Configurations"," June 8, 2006 (ADAMS Accession No. ML061640136).

98 U.S. Nuclear Regulatory Commission, "Fire Endurance Test Acceptance Criteria for Fire Barrier Systems Used to Separate Redundant Safe Shutdown Trains Within the Same Fire Area," Generic Letter 86-10, Supplement 1, March 25, 1994 (ADAMS Accession No. ML031130661).

99 American Society for Testing and Materials, "Standard Test Method for Surface Burning Characteristics of Building Materials," Standard E-84 (ASTM E-84), West Conshohocken, PA.

100 American Society for Testing and Materials, "Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position," Standard D635 (ASTM D635), West Conshohocken, PA.

101 U.S. Nuclear Regulatory Commission, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition, Section 9.5.1.1, Fire Protection Program," NUREG-0800, Revision 0, February 2009 (ADAMS Accession No. ML090510170).

102 Nuclear Energy Institute, "Guidance for Post-Fire Safe Shutdown Circuit Analysis," NEI 00-01, Revision 3, October 2011 (ADAMS Accession No. ML112910147).

103 Varga, Steven, A., U.S. Nuclear Regulatory Commission, letter to Utley, E., E., Carolina Power and Light Company, "Fire Protection Rule - Alternative Safe Shutdown Capability - Section III.G.3 and III.L of Appendix R to 10 CFR 50 - H. B. Robinson Steam Electric Plant Unit No. 2," August 8, 1984 (ADAMS Accession No. ML14192A545).

104 U.S. Nuclear Regulatory Commission, "H.B. Robinson Steam Electric Plant, Unit 2, Record of Review, Findings and Observations, Internal Events Probabilistic Risk Assessment," February 3, 2017 (ADAMS Accession No. ML16336A796).

105 U.S. Nuclear Regulatory Commission, "H.B. Robinson Steam Electric Plant, Unit 2, Record of Review, Findings and Observations, Fire Probabilistic Risk Assessment," February 3, 2017 (ADAMS Accession No. ML16336A799).

106 U.S. Nuclear Regulatory Commission, "Determining the Effectiveness, Limitations, and Operator Response for Very Early Warning Fire Detection Systems in Nuclear Facilities, (Delores-VEWFIRE), Report for Comment," NUREG-2180, June 2015 (ADAMS Accession No. ML15162A416).

107 Giitter, Joseph, G., U.S. Nuclear Regulatory Commission, letter to Tschiltz, Michael, D., Nuclear Energy Institute, "Retirement of National Fire Protection Association 805 Frequently Asked Question 08-0046, "Incipient Detection Systems"," July 1, 2016 (ADAMS Accession No. ML16167A444).

108 U.S. Nuclear Regulatory Commission, "Determining the Effectiveness, Limitations, and Operator Response for Very Early Warning Fire Detection Systems in Nuclear Facilities, (Delores-VEWFIRE), Final (Pre-Publication) Report," (to be designated NUREG-2180) September 2016 (ADAMS Accession Nos. ML16286A000 and ML16286A002).

109 Shokri, M., and Beyler, C., "Radiation from Large Pool Fires," SFPE Journal of Fire Protection Engineering, Volume 1, pp. 141-150, 1989.

110 Mudan, K., *Thermal Radiation Hazards from Hydrocarbon Pool Fires.*, Progress in Energy and Combustion Science, Vol. 10, pp. 59-80, 1984.

111 Wakamatsu, T., Hasemi, Y., Kagiya, K., and Kamikawa, D, "Heating Mechanism of Unprotected Steel Beam Installed Beneath Ceiling and Exposed to a Localized Fire: Verification Using the Real-Scale Experiment and Effects of the Smoke Layer," Proceedings of the Seventh International Symposium on Fire Safety Science, International Association for Fire Safety Science, London, UK, 2003, pp. 1099-1110.

112 Yokoi, S., *Study on the Prevention of Fire Spread Caused by Hot Upward Current.*, Report Number 34, Building Research Institute, Tokyo, Japan, 1960.

113 Beyler, C., "Fire Plumes and Ceiling Jets," Fire Safety Journal, Vol. 11, pp. 53-75, 1986.

114 Gottuk, D., and White, D., "Liquid Fuel Fires," Chapter 2-15, The SFPE Handbook of Fire Protection Engineering, 3rd Edition, National Fire Protection Association, Quincy, Massachusetts, 2002.

115 Lattimer, B. , "Heat Fluxes from Fires to Surfaces," Chapter 2-14, The SFPE Handbook of Fire Protection Engineering, 4th Edition, National Fire Protection Association, Quincy, Massachusetts, 2008.

116 Delichatsios, M., "Flame Heights in Turbulent Wall Fires with Significant Flame Radiation," Combustion Science and Technology, Volume 39, pp. 195-214. 1984.

117 Kawagoe, K., *Fire Behavior in Rooms.*, Report Number 27, Building Research Institute, Tokyo, Japan, 1958.

118 Yuan, L., and Cox, F., "An Experimental Study of Some Line Fires," Fire Safety Journal, Volume 27, pp. 123-139, 1996.

119 Lee, B., "Heat Release Rate Characteristics of Some Combustible Fuel Sources in Nuclear Power Plants," NBSIR 85-3196, U.S. Department of Commerce, National Bureau of Standards (NBS), Washington, DC July, 1985.

120 Babrauskas, V., *Estimating Room Flashover Potential.*, Fire Technology, Vol. 16, pp. 94-104, 1980.

121 Peacock, R., Jones, W., and Reneke, P., "CFAST – Consolidated Model of Fire Growth and Smoke Transport (Version 6) Software Development and Model Evaluation Guide ," NIST Special Publication 1086, U.S. Department of Commerce, National Institute of Standards and Technology (NIST), Gaithersburg, Maryland, 2010.

122 Janssens, Marc, "Calorimetry," in *The SFPE Handbook of Fire Protection Engineering.* Quincy, Massachusetts: National Fire Protection Association, 2008, ch. 3-2.

123 Geiman, J., and Gottulk, D., "Alarm Thresholds for Smoke Detector Modeling, Fire Safety Science: Proceedings of the 7th International Symposium," in *International Association for Fire Safety Science*, 2002, pp. 197-208.

124 Hiland, P., U.S. Nuclear Regulatory Commission, memo to Sheron, B. W., U.S. Nuclear Regulatory Commission, "Safety/Risk Assessment Results for Generic Issue 199, Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants," September 2, 2010 (ADAMS Accession No. ML100270582 (package)).

125 Beyler, C., "Fire Hazard Calculations for Large, Open Hydrocarbon Fires," in *SFPE Handbook of Fire Protection Engineering*, 4th ed. Quincy, Massachusetts, 2008, ch. 3-10.

126 Heskestad, G., "Fire Plumes, Flame Height, and Air Entrainment," Chapter 2–1 of The SFPE Handbook of Fire Protection Engineering, 4th Edition, National Fire Protection Association, Quincy, Massachusetts, 2008.

127 Walton W., and Thomas, P., "Estimating Temperatures in Compartment Fires ," Chapter 3–6 of The SFPE Handbook of Fire Protection Engineering, 4th Edition, P. J. DiNenno, Editor-in-Chief, National Fire Protection Association, Quincy, Massachusetts, 2008.

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Attachments:
A. Table 3.8-1 – V&V Basis for Fire Modeling Correlations Used at HBRSEP
B. Table 3.8-2 – V&V Basis for Other Fire Models and Related Calculations Used at HBRSEP
C. Abbreviations and Acronyms

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at HBRSEP

Correlation	Application at HBRSEP	V&V Basis	NRC Staff Evaluation of Acceptability
Heskestad flame height correlation	Vertical ZOI calculations for various ignition sources	NUREG-1805 (Reference 45) NUREG-1824 (Reference 46) SFPE Handbook (Reference 126)	• The correlation is validated in NUREG-1824 and the SFPE Handbook. • The licensee stated that in most cases, it applied the correlation within the validated range reported in NUREG-1824. The licensee provided justification for cases where it used the correlation outside the validated range reported in NUREG-1824 (Response to FM RAI 04.a, (Reference 10)). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.
Heskestad plume temperature correlation	Vertical ZOI calculations for various ignition sources	NUREG-1805 (Reference 45) NUREG-1824 (Reference 46) SFPE Handbook (Reference 126)	• The correlation is validated in NUREG-1824 and the SFPE Handbook. • The licensee stated that in most cases, it applied the correlation within the validated range reported in NUREG-1824. The licensee provided justification for cases where it used the correlation outside the validated range reported in NUREG-1824 (Response to FM RAI 04.a, (Reference 10)). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.
Modak point source radiation model	Radial ZOI profile calculations for various ignition sources and structural steel analysis	NUREG-1805 (Reference 45) SFPE Handbook (Reference 125)	• The correlation is validated in the SFPE Handbook. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the V&V basis documents. The licensee provided justification for cases where it used the correlation outside this validated range (Responses to FM RAI 03.a and FM RAI 04.a, (Reference 10)). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at HBRSEP

Correlation	Application at HBRSEP	V&V Basis	NRC Staff Evaluation of Acceptability
Hot Gas Layer (Method of McCaffrey, Quintiere, and Harkleroad)	The Hot Gas Layer (Method of McCaffrey, Quintiere, and Harkleroad) correlation was used to calculate the hot gas layer temperature for a room with natural ventilation.	NUREG-1805 (Reference 45) NUREG-1824 (Reference 46) SFPE Handbook (Reference 127)	• The correlation was implemented in a custom workbook that the licensee verified (Response to FM RAI 03.b, (Reference 12)). • The correlation is validated in NUREG-1824 and the SFPE Handbook. • The licensee stated that in most cases, it applied the correlation within the validated range reported in NUREG-1824. The licensee provided justification for cases where it used the correlation outside the validated range reported in NUREG-1824 (Response to FM RAI 04.a, (Reference 10)). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.
Hot Gas Layer (Method of Beyler)	The Hot Gas Layer (Method of Beyler) correlation was used to calculate the hot gas layer temperature for a room with no ventilation.	NUREG-1805 (Reference 45) NUREG-1824 (Reference 46) SFPE Handbook (Reference 127)	• The correlation was implemented in a custom workbook that the licensee verified (Response to FM RAI 03.b, (Reference 12)). • The correlation is validated in NUREG-1824 and the SFPE Handbook. • The licensee stated that in most cases, it applied the correlation within the validated range reported in NUREG-1824. The licensee provided justification for cases where it used the correlation outside the validated range reported in NUREG-1824 (Response to FM RAI 04.a, (Reference 10)). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at HBRSEP

Correlation	Application at HBRSEP	V&V Basis	NRC Staff Evaluation of Acceptability
Shokri and Beyler flame radiation model	Development of ZOI tables in GFMTs approach	Peer-reviewed journal article (Reference 109)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR, Attachment J). • The correlation is validated in a peer-reviewed journal article. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the journal article. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04.c, (Reference 10)). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.
Mudan flame radiation model	Development of ZOI tables in GFMTs approach	Peer-reviewed journal article (Reference 110)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR Attachment J). • The correlation is validated in a peer-reviewed journal article. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the journal article. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04.c, (Reference 10)). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.
Plume heat flux correlation by Wakamatsu et al.	Development of ZOI tables in GFMTs approach	Peer-reviewed conference paper (Reference 111)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR Attachment J). • The correlation is validated in a peer-reviewed conference paper. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the conference paper. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04.c, (Reference 10)). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at HBRSEP

Correlation	Application at HBRSEP	V&V Basis	NRC Staff Evaluation of Acceptability
Yokoi plume centerline temperature correlation	Development of ZOI tables in GFMTs approach	National research laboratory report (Reference 112) Peer-reviewed journal article (Reference 113)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR Attachment J). • The correlation is validated in a national research laboratory report and a peer-reviewed journal article. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the report/article. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04.c, (Reference 10)). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.
Hydrocarbon spill fire size correlation	Development of ZOI tables in GFMTs approach	SFPE Handbook (Reference 114)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR Attachment J). • The correlation is validated in the SFPE Handbook. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the Handbook. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04.c, (Reference 10)). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.
Flame extension correlation	Development of ZOI tables in GFMTs approach	SFPE Handbook (Reference 115)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR Attachment J). • The correlation is validated in the SFPE Handbook. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the Handbook. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04.c, (Reference 10)). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at HBRSEP

Correlation	Application at HBRSEP	V&V Basis	NRC Staff Evaluation of Acceptability
Delichatsios line source flame height model	Development of ZOI tables in GFMTs approach	Peer-reviewed journal article (Reference 116)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR Attachment J). • The correlation is validated in a peer reviewed journal article. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the journal article. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04.c, (Reference 10)). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.
Corner flame height correlation	Development of ZOI tables in GFMTs approach	SFPE Handbook (Reference 115)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR Attachment J). • The correlation is validated in the SFPE Handbook. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the Handbook. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04.c, (Reference 10)). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.
Kawagoe natural vent flow equation	Development of ZOI tables in GFMTs approach	National research laboratory report (Reference 117)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR Attachment J). • The correlation is validated in a national research laboratory report. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the report. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04.c, (Reference 10)). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at HBRSEP

Correlation	Application at HBRSEP	V&V Basis	NRC Staff Evaluation of Acceptability
Yuan and Cox line fire flame height and plume temperature correlations	Development of ZOI tables in GFMTs approach	Peer-reviewed journal article (Reference 118)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR Attachment J). • The correlation is validated in a peer-reviewed journal article. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the journal article. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04.c, (Reference 10)). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.
Lee cable fire model	Development of ZOI tables in GFMTs approach	NBSIR 85-3196 (Reference 119)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR Attachment J). • The correlation is validated in a national research laboratory report. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the report. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04.c, (Reference 10)). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.
Babrauskas method to determine ventilation-limited fire size	Development of ZOI tables in GFMTs approach	Peer-reviewed journal article (Reference 120)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR Attachment J). • The correlation is validated in a peer reviewed journal article. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the journal article. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04.c, (Reference 10)). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.

Attachment B: Table 3.8-2, V&V Basis for Other Fire Models and Related Calculations Used at HBRSEP

Calculation	Application at HBRSEP	V&V Basis	NRC Staff Evaluation of Acceptability
CFAST (Version 6)	MCR abandonment times calculations, and evaluation of development and timing of HGL conditions in the battery room, the E1/E2 switchgear room, and the safeguards room	NUREG-1824 (Reference 46) NIST Special Publication 1086 (Reference 121)	• The model is validated in NUREG-1824 and a National Institute of Standards and Technology report. • The licensee stated that in most cases, it applied the model within the validated range reported in NUREG-1824. The licensee provided justification for cases where it used the model outside the validated range reported in NUREG-1824 (Response to FM RAI 04.b, (Reference 10)). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.
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 (Reference 47)	• The model is validated in NUREG/CR-7010. • The licensee stated that it applied the model within the validated range reported in NUREG/CR-7010. Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.

Attachment C: Abbreviations and Acronyms

ADAMS	Agencywide Documents Access and Management System
AFW	auxiliary feedwater
AHJ	authority having jurisdiction
Amp	amperes
ANS	American Nuclear Society
APCSB	Auxiliary and Power Conversion Systems Branch
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BTP	Branch Technical Position
BWR	boiling-water reactor
CAFTA	computer-aided fault tree analysis
CAROLFIRE	Cable Response to Live Fire
CC	Capability Categories
CCW	Component Cooling Water
CDF	core damage frequency
CFAST	consolidated model of fire and smoke transport
CFP	circuit failure probability
CFR	Code of Federal Regulations
CHRISTIFIRE	Cable Heat Release, Ignition, and Spread in Tray Installations during Fire
CT	current transformer
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
DSPs	Dedicated Shutdown Procedures
EEEE	existing engineering equivalency evaluation
EPRI	Electric Power Research Institute
ERFBS	electrical raceway fire barrier system
ESF	engineered safety features
F&O	facts and observations
FAQ	frequently asked question
FDS	fire dynamics simulator
FDT	fire dynamics tool
FM	fire modeling
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
FSS	fire scenario selection
ft	foot/feet
GDC	general design criterion/criteria
GFMT	generic fire modeling treatments
GL	generic letter
HBRSEP	H. B. Robinson Steam Electric Plant, Unit No. 2
HDPE	high density polyethylene
HEAF	high energy arcing fault
HEP	human error probability

HFE	human failure event
HGL	hot gas layer
HOC	heat of combustion
HRA	human reliability analysis
HRE	high(er) risk evolution
HRR	heat release rate
HVAC	heating, ventilation, and air conditioning
IA	instrumental air
IEEE	Institute of Electrical and Electronics Engineers
IEPRA	internal events probabilistic risk assessment
IN	Information Notice
JACQUE-FIRE	Joint Assessment of Cable Damage and Quantification of Effects from 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
MCC	motor control center
MCR	main control room
MQH	McCaffrey, Quintiere, and Harkleroad
MSDS	Material Safety Data Sheet
MSIV	main steam isolation valves
MSO	multiple spurious operation
NEC	National Electric Code
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
NRC	U.S. Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
NSCA	nuclear safety capability assessment
NSPC	nuclear safety performance criteria
OCT	overcurrent trip
OMA	operator manual action
PB	performance-based
PCE	plant change evaluation
PCS	primary control station
PIRT	phenomena identification and ranking table
PORV	power-operated relief valve
POS	plant operational state
PRA	probabilistic risk assessment
PSA	probabilistic safety assessment
PVC	polyvinyl chloride
PWR	pressurized-water reactor
QA	quality assurance
RA	recovery action
RAI	request for additional information

RCA	radiologically controlled area
RCP	reactor coolant pump
RCS	reactor coolant system
RES	Office of Nuclear Regulatory Research
RG	Regulatory Guide
RHR	residual heat removal
RI	risk-informed
RI/PB	risk-informed, performance-based
SCBA	self-contained breathing apparatus
SE	safety evaluation
SER	safety evaluation report
SFPE	Society of Fire Protection Engineers
SR	supporting requirement
SSA	safe shutdown analysis
SSC	structures, systems, and components
SSD	safe shutdown
SWS	service water system
TR	technical report
TS	Technical Specification
UFSAR	updated final safety analysis report
V	Volt
V&V	verification and validation
VEWFDS	Very Early Warning Fire Detection System
VFDR	variance from deterministic requirements
yr	year
ZOI	zone of influence

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