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

February 27, 2015

Vice President, Operations
Entergy Nuclear Operations, Inc.
Palisades Nuclear Plant
27780 Blue Star Memorial Highway
Covert, MI 49043-9530

SUBJECT: PALISADES NUCLEAR PLANT – ISSUANCE OF AMENDMENT REGARDING TRANSITION TO A RISK-INFORMED, PERFORMANCE-BASED FIRE PROTECTION PROGRAM IN ACCORDANCE WITH 10 CFR 50.48(c) (TAC NO. MF0382)

Dear Sir or Madam:

The U.S. Nuclear Regulatory Commission (NRC) has issued the enclosed Amendment No. 254 to Renewed Facility Operating License No. DPR-20 for the Palisades Nuclear Plant (PNP). The amendment changes the license and technical specifications (TSs) of the unit in response to your application dated December 12, 2012, as supplemented by letters dated February 21, September 30, October 24, and December 2, 2013; April 2, May 7, June 17, August 14, November 4, and December 18, 2014. Entergy Nuclear Operations, Inc. (Entergy, the licensee) submitted a license amendment request to revise the fire protection program in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.48(c), for PNP and to change the license and TSs accordingly.

The amendment authorizes the transition of the PNP fire protection program to a risk-informed, performance-based program based on National Fire Protection Association Standard 805 (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 amendment revises the fire protection license condition in PNP's license and TS 5.4.1.c. As a result of placing the new license condition in the license, the NRC is issuing additional pages due to repagination of subsequent license pages. The only changes to the license are the changes to the fire protection license condition.

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

Sincerely,

Jennivine K. Rankin, Project Manager
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-255

Enclosures:
1. Amendment No. 254 to DPR-20
2. Safety Evaluation

cc w/encls: Distribution via Listserv

ENCLOSURE 1

AMENDMENT NO. 254

TO RENEWED FACILITY OPERATING LICENSE NO. DPR-20

ENTERGY NUCLEAR OPERATIONS, INC.

PALISADES NUCLEAR PLANT

DOCKET NO. 50-255

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

ENTERGY NUCLEAR OPERATIONS, INC.

DOCKET NO. 50-255

PALISADES NUCLEAR PLANT

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 254
Renewed License No. DPR-20

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

   A. The application for amendment by Entergy Nuclear Operations, Inc. (the licensee), dated December 12, 2012, as supplemented by letters dated February 21, September 30, October 24, and December 2, 2013; April 2, May 7, June 17, August 14, November 4, and December 18, 2014, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

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

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

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

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

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and Paragraph 2.C.(2) of Renewed Facility Operating License No. DPR-20 is hereby amended to read as follows:

> The Technical Specifications contained in Appendix A, as revised through Amendment No. 254, and the Environmental Protection Plan contained in Appendix B are hereby incorporated in the license. ENO shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

In addition, the license is amended as indicated in the attachment to this license amendment, and Paragraph 2.C.(3) of Renewed Facility Operating License No. DPR-20 is hereby amended to read as follows:

> Fire Protection
>
> ENO shall implement and maintain in effect all provisions of the approved fire protection program that comply with 10 CFR 50.48(a) and 10 CFR 50.48(c), as specified in the license amendment request dated December 12, 2012, as supplemented by letters dated February 21, 2013, September 30, 2013, October 24, 2013, December 2, 2013, April 2, 2014, May 7, 2014, June 17, 2014, August 14, 2014, November 4, 2014, and December 18, 2014, as approved in the safety evaluation dated February 27, 2015. Except where NRC approval for changes or deviations is required by 10 CFR 50.48(c), and provided no other regulation, technical specification, license condition or requirement would require prior NRC approval, the licensee may make changes to the fire protection program without prior approval of the Commission if those changes satisfy the provisions set forth in 10 CFR 50.48(a) and 10 CFR 50.48(c), the change does not require a change to a technical specification or a license condition, and the criteria listed below are satisfied.
>
> (a) Risk-Informed Changes that May Be Made Without Prior NRC Approval
>
> A risk assessment of the change must demonstrate that the acceptance criteria below are met. The risk assessment approach, methods, and data shall be acceptable to the NRC and shall be appropriate for the nature and scope of the change being evaluated; be based on the as-built, as operated, and maintained plant; and reflect the operating experience at 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.

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

2. Prior NRC review and approval is not required for individual changes that result in a risk increase less than $1x10^{-7}$/year (yr) for CDF and less than $1x10^{-8}$/yr for LERF. The proposed change must also be consistent with the defense-in-depth philosophy and must maintain sufficient safety margins. The change may be implemented following completion of the plant change evaluation.

(b) Other Changes that May Be Made Without Prior NRC Approval

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

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

   The licensee may use an engineering evaluation to demonstrate that changes to certain NFPA 805, Chapter 3, elements are acceptable because the alternative is "adequate for the hazard." Prior NRC review and approval would not be required for alternatives to four specific sections of NFPA 805, Chapter 3, for which an engineering evaluation demonstrates that the alternative to the Chapter 3 element is adequate for the hazard. A qualified fire protection engineer shall perform the engineering evaluation and conclude that the change has not affected the functionality of the component, system, procedure, or physical arrangement, using a relevant technical requirement or standard. The four specific sections of NFPA 805, Chapter 3, are as follows:

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

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

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

   Prior NRC review and approval are not required for changes to the licensee's fire protection program that have been demonstrated to have no more than a minimal risk impact. The licensee may use its screening process as approved in the NRC safety evaluation dated February 27, 2015, to determine that certain fire protection program changes meet the minimal criterion. The licensee shall ensure that fire protection defense-in-depth and safety margins are maintained when changes are made to the fire protection program.

(c) Transition License Conditions

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

2. The licensee shall implement the modifications to its facility, as described in Table S-2, "Plant Modifications Committed," of ENO letter PNP 2014-080 dated August 14, 2014, to complete the transition to full compliance with 10 CFR 50.48(c) before the end of the second full operating cycle after NRC approval. The licensee shall maintain appropriate compensatory measures in place until completion of these modifications.

3. The licensee shall implement the items listed in Table S-3, "Implementation Items," of ENO letter PNP 2014-097 dated November 4, 2014, within six months after NRC approval, or six months after a refueling outage if in progress at the time of approval with the exception of Implementation Items 3 and 8 which will be completed once the related modifications are installed and validated in the PRA model.

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

FOR THE NUCLEAR REGULATORY COMMISSION

David L. Pelton, Chief
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Renewed Facility
Operating License No. DPR-20
and Technical Specifications

Date of Issuance: February 27, 2015

ATTACHMENT TO LICENSE AMENDMENT NO. 254

TO RENEWED FACILITY OPERATING LICENSE NO. DPR-20

DOCKET NO. 50-255

Replace the following pages of Renewed Facility Operating License No. DPR-20 with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

REMOVE	INSERT
Pages 3 through 6	Pages 3 through 6

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

REMOVE	INSERT
5.0-5	5.0-5

(1) Pursuant to Section 104b of the Act, as amended, and 10 CFR Part 50, "Licensing of Production and Utilization Facilities," (a) ENP to possess and use, and (b) ENO to possess, use and operate, the facility as a utilization facility at the designated location in Van Buren County, Michigan, in accordance with the procedures and limitation set forth in this license;

(2) ENO, pursuant to the Act and 10 CFR Parts 40 and 70, to receive, possess, and use source and special nuclear material as reactor fuel, in accordance with the limitations for storage and amounts required for reactor operation, as described in the Updated Final Safety Analysis Report, as supplemented and amended;

(3) ENO, pursuant to the Act and 10 CFR Parts 30, 40, and 70, to receive, possess, and use byproduct, source, and special nuclear material as sealed sources for reactor startup, reactor instrumentation, radiation monitoring equipment calibration, and fission detectors in amounts as required;

(4) ENO, 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 for sample analysis or instrument calibration, or associated with radioactive apparatus or components; and

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

C. This renewed operating license shall be deemed to contain and is subject to the conditions specified in the Commission's regulations in 10 CFR Chapter I and is subject to all applicable provisions of the Act; to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) ENO is authorized to operate the facility at steady-state reactor core power levels not in excess of 2565.4 Megawatts thermal (100 percent rated power) in accordance with the conditions specified herein.

(2) The Technical Specifications contained in Appendix A, as revised through Amendment No. 254, and the Environmental Protection Plan contained in Appendix B are hereby incorporated in the license. ENO shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

(3) Fire Protection

ENO shall implement and maintain in effect all provisions of the approved fire protection program that comply with 10 CFR 50.48(a) and 10 CFR 50.48(c), as specified in the license amendment request dated December 12, 2012, as supplemented by letters dated February 21, 2013, September 30, 2013, October 24, 2013, December 2, 2013, April 2, 2014, May 7, 2014, June 17, 2014, August

14, 2014, November 4, 2014, and December 18, 2014, as approved in the safety evaluation dated February 27, 2015. Except where NRC approval for changes or deviations is required by 10 CFR 50.48(c), and provided no other regulation, technical specification, license condition or requirement would require prior NRC approval, the licensee may make changes to the fire protection program without prior approval of the Commission if those changes satisfy the provisions set forth in 10 CFR 50.48(a) and 10 CFR 50.48(c), the change does not require a change to a technical specification or a license condition, and the criteria listed below are satisfied.

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

A risk assessment of the change must demonstrate that the acceptance criteria below are met. The risk assessment approach, methods, and data shall be acceptable to the NRC and shall be appropriate for the nature and scope of the change being evaluated; be based on the as-built, as operated, and maintained plant; and reflect the operating experience at 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.

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

2. Prior NRC review and approval is not required for individual changes that result in a risk increase less than $1x10^{-7}$/year (yr) for CDF and less than $1x10^{-8}$/yr for LERF. The proposed change must also be consistent with the defense-in-depth philosophy and must maintain sufficient safety margins. The change may be implemented following completion of the plant change evaluation.

(b) Other Changes that May Be Made Without Prior NRC Approval

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

Prior NRC review and approval are not required for changes to the NFPA 805, Chapter 3, fundamental fire protection program elements and design requirements for which an engineering evaluation demonstrates that the alternative to the Chapter 3

element is functionally equivalent or adequate for the hazard. The licensee may use an engineering evaluation to demonstrate that a change to an NFPA 805, Chapter 3, element is functionally equivalent to the corresponding technical requirement. A qualified fire protection engineer shall perform the engineering evaluation and conclude that the change has not affected the functionality of the component, system, procedure, or physical arrangement, using a relevant technical requirement or standard.

The licensee may use an engineering evaluation to demonstrate that changes to certain NFPA 805, Chapter 3, elements are acceptable because the alternative is "adequate for the hazard." Prior NRC review and approval would not be required for alternatives to four specific sections of NFPA 805, Chapter 3, for which an engineering evaluation demonstrates that the alternative to the Chapter 3 element is adequate for the hazard. A qualified fire protection engineer shall perform the engineering evaluation and conclude that the change has not affected the functionality of the component, system, procedure, or physical arrangement, using a relevant technical requirement or standard. The four specific sections of NFPA 805, Chapter 3, are as follows:

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

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

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

Prior NRC review and approval are not required for changes to the licensee's fire protection program that have been demonstrated to have no more than a minimal risk impact. The licensee may use its screening process as approved in the NRC safety evaluation dated February 27, 2015, to determine that certain fire protection program changes meet the minimal criterion. The licensee shall ensure that fire protection defense-in-depth and safety margins are maintained when changes are made to the fire protection program.

(c) Transition License Conditions

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

2. The licensee shall implement the modifications to its facility, as described in Table S-2, "Plant Modifications Committed," of ENO letter PNP 2014-080 dated August 14, 2014, to complete the transition to full compliance with 10 CFR 50.48(c) before the end of the second full operating cycle after NRC approval. The licensee shall maintain appropriate compensatory measures in place until completion of these modifications.

3. The licensee shall implement the items listed in Table S-3, "Implementation Items," of ENO letter PNP 2014-097 dated November 4, 2014, within six months after NRC approval, or six months after a refueling outage if in progress at the time of approval with the exception of Implementation Items 3 and 8 which will be completed once the related modifications are installed and validated in the PRA model.

(4) Performance of Technical Specifications Surveillance Requirement SR 3.1.4.3 is not required for control rod drive CRD-22 during cycle 21 until the next entry into Mode 3.

(5) [deleted]

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

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

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

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

(7) Upon implementation of Amendment 230 adopting TSTF-448-A, revision 3, the determination of control room envelope (CRE) unfiltered air inleakage as required by SR 3.7.10.4, in accordance with TS 5.5.16.c.(i), the assessment of CRE habitability as required by Specification 5.5.16.c.(ii), and the measurement of CRE pressure as required by Specification 5.5.16.d, shall be considered met. Following implementation:

(a) The first performance. of SR 3.7.10.4, in accordance with Specification 5.5.16.c.(i), shall be within the specified Frequency of six years, plus the 18-month allowance of SR 3.0.2, as measured from June 26, 2007, the date of the most recent successful tracer gas test, as stated in the August 16, 2007, letter response to Generic Letter 2003-01.

(b) The first performance of the periodic assessment of CRE habitability, Specification 5.5.16.c.(ii), shall be within three years, plus the nine-month allowance of SR 3.0.2, as measured from June 26, 2007, the date of the most recent successful tracer gas test, as stated in the August 16, 2007, letter response to Generic Letter 2003-01.

(c) The first performance of the periodic measurement of CRE pressure, Specification 5.5.16.d, shall be within 18 months, plus the 138 days allowed by SR 3.0.2, as measured from July 16, 2007, the date of the most recent successful pressure measurement test.

(8) Upon implementation of Amendment 237, within one year of completing each of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, Category B-A and B-D reactor vessel weld inspections, submit information and analyses requested in Section (e) of the final 10 CFR 50.61a (or the proposed 10 CFR 50.61a, given in 72 FR 56275 prior to issuance of the final 10 CFR 50.61a) to the NRC.

D. The facility has been granted certain exemptions from Appendix J to 10 CFR Part 50, "Primary Reactor Containment Leakage Testing for Water Cooled Power Reactors." This section contains leakage test requirements, schedules and acceptance criteria for tests of the leak-tight integrity of the primary reactor containment and systems and components which penetrate the containment. These exemptions were granted in a letter dated December 6, 1989.

These exemptions granted pursuant to 10 CFR 50.12, are authorized by law, will not present an undue risk to the public health and safety, and are consistent with the common defense and security. With these exemptions, the facility will operate, to the extent authorized herein, in conformity with the application, as amended, the provisions of the Act, and the rules and regulations of the Commission.

E. ENO shall fully implement and maintain in effect all provisions of the Commission-approved physical security, training and qualification, and safeguards contingency plans including amendments made pursuant to provisions of the Miscellaneous Amendments and Search Requirements revisions to 10 CFR 73.55 (51 FR 27817 and 27822) and to the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The combined set of plans, which contains Safeguards Information protected under 10 CFR 73.21, is entitled: "Entergy Nuclear Palisades Nuclear Plant Physical Security Plan."

ENO 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 Palisades CSP was approved by License Amendment No. 243 as supplemented by changes approved by License Amendment Nos. 248 and 253.

F. [deleted]

G. ENP and ENO shall have and maintain financial protection of such type and in such amounts as the Commission shall require in accordance with Section 170 of the Atomic Energy Act of 1954, as amended, to cover public liability claims.

5.0 ADMINISTRATIVE CONTROLS

5.4 Procedures

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

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

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

c. Not used;

d. All programs specified in Specification 5.5.

ENCLOSURE 2

SAFETY EVALUATION BY THE

OFFICE OF NUCLEAR REACTOR REGULATION

TRANSITION TO A RISK-INFORMED, PERFORMANCE-BASED

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

AMENDMENT NO. 254 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-20

ENTERGY NUCLEAR OPERATIONS, INC.

PALISADES NUCLEAR PLANT

DOCKET NO. 50-255

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UNITED STATES
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SAFETY EVALUATION BY THE

OFFICE OF NUCLEAR REACTOR REGULATION

TRANSITION TO A RISK-INFORMED, PERFORMANCE-BASED

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

AMENDMENT NO. 254 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-20

ENTERGY NUCLEAR OPERATIONS, INC.

PALISADES NUCLEAR PLANT

DOCKET NO. 50-255

1.0 INTRODUCTION

1.1 Background

The U.S. Nuclear Regulatory Commission (NRC) started developing fire protection requirements in the 1970s, and in 1976, the NRC published comprehensive fire protection guidelines in the form of Branch Technical Position (BTP) APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants" (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 evaluation reports (SERs) or supplements to SERs. In 1980, to resolve issues identified in those reports, the NRC amended its regulations for fire protection in operating nuclear power plants and published its Final Rule, Fire Protection Program for Operating Nuclear Power Plants, in the *Federal Register* (FR) on November 19, 1980 (45 FR 76602), adding Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.48, "Fire Protection," and Appendix R to 10 CFR Part 50, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979." Section 50.48(a)(1) requires each holder of an operating license, and holders of a combined operating license issued under Part 52 to have a fire protection plan that satisfies General Design Criterion (GDC) 3 of Appendix A to 10 CFR Part 50 and states that the fire protection plan must describe the overall fire protection program; identify the positions responsible for the program and the authority delegated to those positions; outline the plans for fire protection, fire detection and suppression capability, and limitation of fire damage. Section 50.48(a)(2) states that the fire protection plan must describe the specific features necessary to implement the program described in paragraph (a)(1) including administrative controls and personnel requirements 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 fire protection program (FPP) design requirements and elements, determining required fire protection systems and features, applying PB requirements, and administering fire protection for existing light-water reactors during operation, decommissioning, and permanent shutdown. It provides for the establishment of a minimum set of fire protection requirements, but allows PB or deterministic approaches to be used to meet performance criteria.

Regulatory Guide (RG) 1.205, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants," Revision 1 (RG 1.205) (Reference 4), states, in part, that:

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

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, the licensee identifies fire areas and fire hazards through a plant-wide analysis, and then applies either a PB or a deterministic approach to meet the performance criteria. As part of a PB approach, the licensee will use engineering evaluations, probabilistic safety assessments, and fire modeling calculations to show that the criteria are met. Chapter 4 of NFPA 805 establishes the methodology to determine the fire protection systems and features required to achieve the performance criteria. It also specifies that at least one success path to achieve the nuclear safety performance criteria (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 safety evaluation (SE), where the NRC staff states that the licensee's FPP element is in compliance with (or meets the requirements of) NFPA 805, the NRC staff is referring to NFPA 805 with the exceptions, modifications, and supplements described in 10 CFR 50.48(c)(2).

RG 1.205 also states, in part, that:

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

RG 1.205 provides the NRC staff's position on NEI 04-02, Revision 2 (Reference 7), 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, Rev. 2, subject to certain exceptions, as providing methods acceptable to the NRC staff for adopting a FPP consistent with the 2001 edition of NFPA 805 and 10 CFR 50.48(c).

Accordingly, Entergy Nuclear Operations, Inc. (Entergy), requested a license amendment to allow the licensee to revise the Palisades Nuclear Plant (PNP), FPP in accordance with 10 CFR 50.48(c) and change the license and technical specifications (TSs) accordingly.

1.2 Requested Licensing Action

By letter dated December 12, 2012 (Reference 8), as supplemented by letters dated February 21, 2013 (Reference 9), September 30, 2013 (Reference 10), October 24, 2013 (Reference 11), December 2, 2013 (Reference 12), April 2, 2014 (Reference 13), May 7, 2014 (Reference 14), June 17, 2014 (Reference 15), August 14, 2014 (Reference 16), November 4, 2014 (Reference 17), and December 18, 2014 (Reference 18), the licensee submitted an application for a license amendment to transition the PNP 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 August 8, 2013 (Reference 19), March 11, 2014 (Reference 20), May 21, 2014 (Reference 21) and October 23, 2014 (Reference 22). The licensee's supplemental letters dated April 2, May 7, June 17, August 14, November 4, and December 18, 2014, provided additional information that clarified the

application, but did not expand the overall scope of the application as originally noticed, and did not change the NRC staff's original proposed opportunity for a hearing on the initial application as published in the FR on February 27, 2014 (79 FR 11148).

The licensee requested an amendment to the PNP renewed operating license and TSs in order 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 all provisions of the approved FPP as described in the Final Safety Analysis Report (FSAR) for the facility and as approved in the SERs dated September 1, 1978 (Reference 23), March 19, 1980 (Reference 24), February 10, 1981 (Reference 25), May 26, 1983 (Reference 26), July 12, 1985 (Reference 27), January 29, 1986 (Reference 28), December 3, 1987 (Reference 29), and May 19, 1989 (Reference 30) 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 PNP is referred to as RI/PB throughout this SE.

In its license amendment request (LAR), the licensee has 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 orders, license conditions, and the technical specifications that must be revised or superseded, and that any necessary revisions are adequate, 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 NPFA 805 (including all required evaluations and analyses), and the NRC staff has approved the licensee's modified FPP, which reflects the decision to comply with NFPA 805, as required by 10 CFR 50.48(a); and

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

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

2.0 REGULATORY EVALUATION

Section 50.48, "Fire protection," of 10 CFR provides the NRC requirements for nuclear power plant fire protection. 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, 69 FR 33536, 33548 (June 16, 2004), 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).

The regulation at 10 CFR 50.48(c)(3)(i), states that the Director of the Office of Nuclear Reactor Regulation (NRR), or a designee of the Director, may approve the application if the Director or designee determines that the licensee has identified orders, license conditions, and the TSs that must be revised or superseded, and that any necessary revisions are adequate.

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

> 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 (DID) (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 a LAR in accordance with 10 CFR 50.48(c)(4).

> 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 DID (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 a 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 DID philosophy, that the NRC's fire protection objectives are satisfied. 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:

(1) Preventing fires from starting;

(2) Rapidly detecting fires 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.

2.1 Other Applicable Regulations

The following regulations address fire protection:

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

  Structures, systems, and components important to safety shall be designed and located to minimize, consistent with other safety requirements, the probability and effect of fires and explosions. Noncombustible and heat resistant materials shall be used wherever practical throughout the unit, particularly in locations such as the containment and control room. Fire detection and fighting systems of appropriate capacity and capability shall be provided and designed to minimize the adverse effects of fires on structures, systems, and components important to safety. Firefighting systems shall be designed to assure that their rupture or inadvertent operation does not significantly impair the safety capability of these structures, systems, and components.

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

- 10 CFR 50.48(c) incorporates NFPA 805 (2001 Edition) by reference, with certain exceptions, modifications and supplementation. This regulation establishes the requirements for using a RI/PB fire protection program 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, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants," 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 that comply with 10 CFR 50.48 and the referenced 2001 Edition of the NFPA standard. It endorses portions of NEI 04-02, Revision 2 (Reference 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 provides exceptions to the NEI 04-02 guidance where required. Should a conflict occur between NEI 04-02 and this RG, the regulatory positions in RG 1.205 govern. This RG also indicates that Chapter 3 of NEI 00-01, "Guidance for Post-Fire Safe Shutdown Circuit Analysis," Revision 2, issued May 2009, when used in conjunction with NFPA 805 and the RG, provides on 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), specifies the minimum fire protection requirements for existing light-water nuclear power plants during all phases of plant operations, including shutdown, degraded conditions, and decommissioning, which had not been explicitly addressed by previous requirements and guidelines. NFPA 805 was developed to provide a comprehensive RI/PB standard for fire protection. The NFPA 805 Technical Committee on Nuclear Facilities is composed of nuclear plant licensees, the NRC, insurers, equipment manufacturers, and subject matter experts. The standard was developed in accordance with NFPA processes, and consisted of a number of technical meetings and reviews of draft documents by committee and industry representatives. The scope of NFPA 805 includes goals related to nuclear safety, radioactive release, life safety, and plant damage/business interruption. The standard addresses fire protection requirements for nuclear plants during all plant operating modes and conditions, including shutdown and decommissioning, which had not been explicitly addressed by previous requirements and guidelines. NFPA 805 became effective on February 9, 2001.

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

- NEI 00-01, "Guidance for Post Fire Safe Shutdown Circuit Analysis," Revision 2, (Reference 31), 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 1.174, "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 32), provides the NRC staff's recommendations for using risk information in support of licensee-initiated licensing basis changes to a nuclear power plant that require such review and approval. The guidance provided does not preclude other approaches for requesting licensing basis changes. Rather, RG 1.174 is intended to improve consistency in regulatory decisions in areas in which the results of risk analyses are used to help justify regulatory action. As such, the RG provides general guidance concerning one approach that the NRC has determined to be acceptable for analyzing issues associated with proposed changes to a plant's licensing basis and for assessing the impact of such proposed changes on the risk associated with plant design and operation.

- RG 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," Revision 2, issued March 2009 (Reference 33), which provides guidance to licensees for use in determining the technical adequacy of the base probabilistic risk assessment (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.

- American Society of Mechanical Engineers/American Nuclear Society (ASME/ANS) RA-Sa-2009, "Addenda to ASME/ANS RA-S-2008, Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications" (Reference 34), provides guidance for PRAs used to support RI decisions for commercial light-water reactor nuclear power plants and prescribes a method for applying these requirements for specific applications. The Standard gives guidance for a Level 1 PRA of internal and external hazards for all plant operating modes. In addition, the Standard provides guidance for a limited Level 2 PRA sufficient to evaluate large early release frequency (LERF). The only hazards explicitly excluded from the scope are accidents resulting from purposeful human-induced security threats (e.g., sabotage). The Standard applies to PRAs used to support applications of RI decision-making related to design, licensing, procurement, construction, operation, and maintenance.

- RG 1.189, "Fire Protection for Nuclear Power Plants," Revision 2, issued October 2009 (Reference 35), 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 NRC staff would consider acceptable for nuclear power plants.

- NUREG-0800, Section 9.5.1.1, "Fire Protection Program," Revision 0, issued February 2009, (Reference 36), provides the NRC staff with guidance for evaluating LARs related to deterministic FPPs. Previous revisions of this section of NUREG-0800 were issued as Section 9.5.1.

- NUREG-0800, Section 9.5.1.2, "Risk-Informed, Performance-Based Fire Protection Program," Revision 0, issued December 2009 (Reference 37), 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 Results for Risk-Informed License Amendment Requests After Initial Fuel Load," Revision 3, issued September 2012 (Reference 38), 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," issued June 2007 (Reference 39), provides the NRC staff with guidance for evaluating the risk information used by a licensee to support permanent RI changes to the licensing basis.

- NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities," Volumes 1 and 2 and Supplement 1 (Reference 40), (Reference 41), and (Reference 42), presents a compendium of methods, data, and tools to perform a fire probabilistic risk assessment (FPRA) and develop associated insights. In order to address the need for improved methods, the NRC Office of Nuclear Regulatory Research (RES) and Electric Power Research Institute (EPRI) embarked upon a program to develop a state-of-art FPRA methodology. Both RES and EPRI provided specialists in fire risk analysis, fire modeling (FM), electrical engineering, human reliability analysis, and systems engineering for methods development. A formal technical issue resolution process was developed to direct the deliberative process between RES and EPRI. The process ensures that divergent technical views are fully considered, yet encourages consensus at many points during the deliberation. Significantly, the process provides that each party maintain its own point of view if consensus is not reached. Consensus was reached on all technical issues documented in NUREG/CR-6850. The methodology documented in this report reflects the current state-of-the-art in FPRA. These methods are expected to form a basis for RI analyses related to the plant FPP. Volume 1, the Executive Summary, provides general background and overview information, project insights and conclusions. Volume 2 provides the detailed discussion of the recommended approach, methods, data, and tools for conduct of an FPRA.

- 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 43), discusses that, based on new experimental information documented in NUREG/CR-6931 "Cable Response to Live Fire (CAROLFIRE)" issued April 2008 (Reference 44), and NUREG/CR-7100 "Direct Current Electrical Shorting in Response to Exposure Fire (DESIREE-Fire): Test Results," issued April 2012 (Reference 45), 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-1805, "Fire Dynamics Tools (FDT^s): Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program" (Reference 46), provides quantitative methods, known as FDT^s, to assist regional fire protection inspectors in performing fire hazard analysis. The FDT^s are intended to assist fire protection inspectors in performing RI evaluations of credible fires that may cause critical damage to essential safe shutdown (SSD) equipment.

- NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," Volumes 1 through 7, (Reference 47), which provide technical documentation regarding the predictive capabilities of a specific set of fire models for the analysis of fire hazards in nuclear power plant (NPP) scenarios. This report is the result of a collaborative program with the EPRI and the National Institute of Standards and Technology (NIST). The selected models are:

    1. FDT^s developed by NRC (Volume 3);
    2. FIVE-Rev1 developed by EPRI (Volume 4);
    3. The zone model 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 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 48), describes Phase 1 of the CHRISTIFIRE testing program conducted by NIST. The overall goal of this multiyear program is to quantify the burning characteristics of grouped electrical cables installed in cable trays. This first phase of the program focuses on horizontal tray configurations. CHRISTIFIRE addresses the burning behavior of a cable in a fire beyond the point of electrical failure. The data obtained from this project can be used for the development of fire models to calculate the heat release rate (HRR) and flame spread of a cable fire.

- NUREG-1855, Volume 1, "Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decision Making" (Reference 49), provides guidance on how to treat uncertainties associated with PRA in RI decision-making. The objectives of this guidance include fostering an

understanding of the uncertainties associated with PRA and their impact on the results of PRA and providing a pragmatic approach to addressing these uncertainties in the context of the decision-making. To meet the objective of the NUREG, it is necessary to understand the role that PRA results play in the context of the decision process. To define this context, NUREG-1855 provides an overview of the RI decision-making process itself.

- NUREG-1921, "EPRI/NRC-RES Fire Human Reliability Analysis Guidelines – Final Report" (Reference 50), presents the state-of-the-art in fire human reliability analysis (HRA) practice. This report was developed jointly between RES and EPRI to develop the methodology and supporting guidelines for estimating human error probabilities (HEPs) for human failure events (HFEs) following the fire-induced initiating events of an FPRA. The report builds on existing HRA methods, and is intended primarily for practitioners conducting a fire HRA to support an FPRA.

- NUREG-1934, "Nuclear Power Plant Fire Modeling Analysis Guidelines (NPP FIRE MAG)" (Reference 51), 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 52), 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 101, "Life Safety Code" (Reference 53), provides the minimum requirements for egress, features of fire protection, sprinkler systems, alarms, emergency lighting, smoke barriers, and special hazard protection.

- NFPA 20, "Standard for the Installation of Stationary Pumps for Fire Protection" (Reference 54), provides requirements for the selection and installation of pumps to ensure that systems will work as intended to deliver adequate and reliable water supplies in a fire emergency.

- NFPA 30, "Flammable and Combustible Liquids Code." (Reference 55), provides safeguards to reduce the hazards associated with the storage, handling, and use of flammable and combustible liquids.

- NFPA 12, "Standard on Carbon Dioxide Extinguishing Systems," (Reference 56), provides requirements for carbon dioxide fire-extinguishing systems to help ensure that such equipment will function as intended throughout its life. It is

intended for those who purchase, design, install, test, inspect, approve, list, operate, or maintain these systems.

- NFPA 10, "Standard for Portable Fire Extinguishers" (Reference 57), provides requirements to ensure that portable fire extinguishers will work as intended to provide a first line of defense against fires of limited size.

2.3 NFPA 805 Frequently Asked Questions

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

Table 2.3-1: NFPA 805 Frequently Asked Questions

FAQ #	FAQ Title and Summary	Reference No.	SE Section
07-0030	"Establishing Recovery Actions" • This FAQ provides an acceptable process for determining the recovery actions (RAs) for NFPA 805 Chapter 4 compliance. The process includes: ▪ Differentiation between RAs and activities in the main control room or at primary control stations (PCS). ▪ 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 58)	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 NSCA to include MSOs of concern. ▪ Step 4 – Evaluate for NFPA 805 compliance. ▪ Step 5 – Document the results.	(Reference 59)	3.2.4 3.2.7

FAQ #	FAQ Title and Summary	Reference No.	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 SSD strategy to the endorsed industry guidance, NEI 00-01, "Guidance for Post-Fire Safe Shutdown Circuit Analysis," Revision 1 (Reference 60). In short, the process has the licensee: ▪ 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 61)	3.2.1
07-0040	"Non-Power Operations (NPO) Clarifications" • This FAQ clarifies an acceptable NFPA 805 NPO program. The process includes: ▪ Selecting NPO equipment and cabling. ▪ Evaluation of NPO Higher Risk Evolutions (HRE). ▪ Analyzing NPO key safety functions (KSF). ▪ Identifying plant areas to protect or "pinch points" during NPO HREs and actions to be taken if KSFs are lost.	(Reference 62)	3.5.3 3.5.4
08-0052	"Transient Fires - Growth Rates and Control Room Non-Suppression" • This FAQ clarifies and updates the treatment of transient fires in terms of both manual suppression and time-dependent fire growth modeling.	(Reference 63)	3.4.2.3.2
08-0054	"Demonstrating Compliance with Chapter 4 of NFPA 805" • This FAQ provides an acceptable process to demonstrate Chapter 4 compliance for transition: ▪ Step 1 – Assemble documentation ▪ Step 2 – Document Fulfillment of NSPC ▪ Step 3 – Variance From Deterministic Requirements (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 64)	3.4.3 3.4.6 3.5.1.4

FAQ #	FAQ Title and Summary	Reference No.	SE Section
10-0059	"NFPA 805 Monitoring Program" • This FAQ provides clarification regarding the implementation of an NFPA 805 monitoring program for transition. It includes: ▪ Monitoring program analysis units; ▪ Screening of low SSCs; ▪ Action level thresholds; and ▪ The use of existing monitoring programs.	(Reference 65)	3.7
12-0062	"Updated Final Safety Analysis Report (UFSAR) Content" • This FAQ provides guidance on the content and necessary level of detail for the transition of the fire protection sections within the UFSAR.	(Reference 66)	2.4.4

2.4 Orders, License Conditions, and Technical Specifications

Section 50.48(c)(3)(i) of 10 CFR states, in part, that the LAR "... must identify any orders and license conditions that must be revised or superseded, and contain any necessary revisions to the plant's technical specifications and the bases thereof."

2.4.1 Orders

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

The licensee requested that six exemptions be rescinded and that the engineering evaluation for one of the six exemptions be transitioned into the NFPA 805 FPP. The licensee also determined that no orders needed to be superseded or revised to implement a FPP at PNP that complies with 10 CFR 50.48(c).

The licensee's review included an assessment of docketed correspondence files and electronic searches, including the NRC's Agencywide Documents Access and Management System (ADAMS). The review was performed to ensure that compliance with the physical protection requirements, security orders, and adherence to commitments applicable to PNP are maintained. The NRC staff accepts the licensee's determination that the engineering evaluation for one exemption should be transitioned into the NFPA 805 FPP and that six exemptions should be rescinded as listed in LAR Attachment K, "Existing Licensing Action Transition," of the LAR, and that no orders need to be superseded or revised to implement NFPA 805 at PNP. See SE Section 2.5 for the NRC staff's detailed evaluation of the exemptions being rescinded.

In addition, the licensee performed a specific review of the license amendment that incorporated the mitigation strategies required by 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 PNP. The licensee's review of this order and the related license amendment demonstrated that changes to the FPP during transition to NFPA 805 will not affect the mitigation measures required by Commission Order EA-02-026. The NRC staff concludes that the licensee's determination in regard to Commission Order EA-02-026 is acceptable.

2.4.2 License Conditions

The NRC staff reviewed LAR Section 5.2.1, "License Condition Changes," LAR Attachment M, "License Condition Changes," and the licensee's letter dated December 18, 2014 (Reference 18), regarding changes the licensee seeks to make to the PNP 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 PNP 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," and 2.4.4, "Plant Change Evaluation." These sections establish the requirements for the content and quality of the engineering evaluations to be used for approval of changes.

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

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

LAR, as discussed in Section 2.7 of this SE. Section 4.0 of this SE provides the NRC staff's review of the proposed PNP 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 PNP TSs that are being revised or superseded during the NFPA 805 transition process. According to the LAR, the licensee conducted a review of the PNP TSs to determine which, if any, TS sections will be impacted by the transition to a RI/PB FPP based on 10 CFR 50.48(c). The licensee identified changes to the TSs needed for adoption of the new fire protection licensing basis and provided applicable justification listed in LAR Attachment N. The licensee identified one change to the TS that involved deleting part of TS 5.4.1.c, which requires that procedures be established, implemented, and maintained for FPP implementation. Specifically, the licensee stated that deleting TS 5.4.1.c is acceptable for adoption of the new fire protection licensing basis since the requirement for establishing, implementing, and maintaining fire protection procedures is contained in 10 CFR 50.48(a) and 10 CFR 50.48(c). The regulations in 10 CFR 50.48(c) approve 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 FPP".

Based on the information provided by the licensee, the NRC staff concludes that the proposed deletion is acceptable because TS 5.4.1.c 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 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 PNP. 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. See Section 4.0 of this SE.

2.4.4 Updated Final Safety Analysis Report

The NRC staff reviewed LAR Section 5.4 "Revision to the UFSAR", which states "After the approval of the LAR, in accordance with 10 CFR 50.71(e), the PNP Updated Final Safety Analysis Report (UFSAR) will be revised." The LAR further states that "The format and content will be consistent with FAQ 12-0062".

The NRC staff concludes that the licensee's method to update the UFSAR is acceptable because the licensee will update the UFSAR after approval of the LAR in accordance with 10 CFR 50.71(e), and the format and content will be consistent with the guidance contained in FAQ 12-0062.

2.5 Rescission of Exemptions

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 the transition to a RI/PB FPP licensing basis in conformance with NFPA 805 will supersede. These exemptions will no longer be required since upon approval of the RI/PB FPP, Appendix R will not be part of the licensing basis for PNP.

The licensee previously requested and received NRC approval for six exemptions from 10 CFR Part 50 Appendix R. These exemptions are discussed in detail in LAR Attachment K. The licensee requested that six exemptions be rescinded and that one exemption be rescinded but the engineering evaluation of the underlying condition be transitioned to the new licensing basis under 10 CFR 50.48(a) and 50.48(c) as previously approved (NFPA 805, Section 2.2.7) and compliant with the new regulation.

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 are rescinded as requested by the LAR and the underlying condition has been evaluated using RI/PB methods and found to be acceptable with no further actions because DID and safety margins will be maintained:

- Existing Licensing Action 6.1, Engineered Safeguards Room, this exemption is no longer required based on the PB NFPA 805 Chapter 4 compliance strategy for the Engineering Safeguards Panel Room, which does not consider fixed suppression in the area.

- Existing Licensing Action 6.2, Charging Pump Corridor, this exemption is no longer required based on the PB NFPA 805 Chapter 4 compliance strategy for the area, which does not consider fixed suppression.

- Existing Licensing Action 6.3, Control Room, this exemption is no longer required based on the PB NFPA 805 Chapter 4 compliance strategy for the Control Room, which addresses the lack of automatic suppression in the area.

- Existing Licensing Action 6.4, Cable Separation in Containment, this exemption is no longer required based on the PB NFPA 805 Chapter 4 compliance strategy for Containment, which addresses the separation of these redundant trains of cables.

- Existing Licensing Action 6.5, Containment Air Room, this exemption is no longer required based on the PB NFPA 805 Chapter 4 compliance strategy for

Containment, which addresses the separation of this redundant equipment.

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:

- Existing Licensing Action 6.6, PCP Oil Collection System, Appendix R Exemption for capacity of primary coolant pump oil collection system (Section III.O)

2.6 Self Approval Process for FPP Changes (Post-Transition)

Upon completion of the implementation of the RI/PB FPP and issuance of the license condition discussed in Section 2.4.2 of this SE, changes to the approved FPP must be evaluated by the licensee to ensure that they are acceptable.

NFPA 805 Section 2.2.9, "Plant Change Evaluation," states 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 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's change process is based on the guidance provided in NFPA 805 Sections 2.2(h), 2.2.9, 2.4.4, A.2.2(h), A.2.4.4, and D.5; NEI 04-02, Section 5.3, "Plant Change Process," as well as Appendices B, I, and J; and RG 1.205, Regulatory Positions 2.2.4, 3.1, 3.2, and 4.3.

LAR Section 4.7.2 states that the plant change evaluation 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 currently in place. 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 67), and that the process will address most administrative changes (e.g., changes to the combustible control program, organizational changes, etc.).

The licensee stated that once the screening process is completed, it is followed by engineering evaluations that may include fire modeling 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 (see LAR Attachment M) 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 require that the resultant change in core damage frequency (CDF) and LERF be consistent with the license condition, and that the acceptance criteria also includes 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 may 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 ΔCDF (change in core damage frequency) and ΔLERF (change in large early release frequency) criteria from the license conditions 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 its FPP configuration is defined by the program documentation and, to the greatest extent possible, the existing configuration control processes for modifications, calculations and analyses, and FPP licensing basis reviews will be utilized to maintain configuration control of the FPP documents. The licensee further stated that the configuration control procedures which govern the various documents and databases that currently exist will be revised to reflect the new NFPA 805 licensing bases requirements. The licensee included the action to "revise or develop technical documents and administrative procedures as needed for implementation of NFPA 805" in LAR Attachment S, Table S-3, Implementation Item 1 and the NRC staff concludes this action is acceptable because the licensee included the action as an implementation item which would be required by the proposed license condition.

The licensee stated that several NFPA 805 document types such as: NSCA supporting information, Non-Power Mode NSCA Treatment, etc., generally require new control procedures and processes to be developed since they are new documents and databases created as a result of the transition to NFPA 805. The licensee further stated that the new procedures will be modeled after the existing processes for similar types of documents and databases and that system level design basis documents will be revised to reflect the NFPA 805 role that the system components now play. The licensee included the actions to "revise or develop technical documents and administrative procedures as needed for implementation of NFPA 805," and to "develop fire protection design basis document," in LAR Attachment S, Table S-3, Implementation Items 1 and 5 (respectively) and the NRC staff concludes the actions are acceptable because the actions 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 will be an initial screening for process users to determine if there is a potential to impact the FPP as defined under NFPA 805 through a series of screening questions/checklists contained in one or more procedures depending upon the configuration control process being used. The licensee further stated that reviews that identify potential FPP impacts will be sent to qualified individuals (e.g., Fire Protection, 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 2 and 4.2.3 requirements; or

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

The licensee stated that this process follows the requirements in NFPA 805 and the guidance outlined in RG 1.174, (Reference 32), which requires the use of qualified individuals, procedures that require calculations be subject to independent review and verification, record retention, peer review, and a corrective action program that ensures appropriate actions are taken when errors are discovered.

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 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 plant change evaluation process is considered acceptable because it meets the guidance in NEI 04-02, Revision 2, (Reference 7), as well as RG 1.205, Revision 1, (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 a 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 plant change evaluations must use methods that are acceptable to the NRC staff. Acceptable methods to assess the risk of the proposed plant change may include methods that have been used in developing the peer-reviewed FPRA model, methods that have been approved by the NRC via a plant-specific license amendment or through NRC approval of generic methods specifically for use in NFPA 805 risk assessments, or methods that have been demonstrated to bound the risk impact.

Based on the information provided by the licensee in the LAR, the process established to evaluate post-transition plant changes meets the guidance in NEI 04-02, Revision 2, (Reference 7), as well as RG 1.205, Revision 1, (Reference 4). The NRC staff concludes that the proposed PCE process 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 a 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 completing the plant modifications and implementation items discussed in SE Section 2.7 (i.e., during full implementation of the transition to NFPA 805), the proposed license condition would provide 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 condition requires the licensee to ensure 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, Revision 1, (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 condition states that prior NRC review and approval is not required for changes to the NFPA 805 Chapter 3 fundamental FPP elements and design requirements for which an engineering evaluation demonstrates that the alternative to the NFPA 805 Chapter 3 element is functionally equivalent or adequate for the hazard. The licensee may use an engineering evaluation to demonstrate that a change to an NFPA 805 Chapter 3 element is functionally equivalent to the corresponding technical requirement. A qualified fire protection engineer shall perform the engineering evaluation and conclude that the change has not affected the functionality of the component, system, procedure, or physical arrangement (i.e., has not impacted its contribution toward meeting the nuclear safety and radioactive release performance criteria), using a relevant technical requirement or standard.

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

Alternatively, the licensee may use an engineering evaluation to demonstrate that changes to certain NFPA 805 Chapter 3 elements are acceptable because the changes are "adequate for the hazard." Prior NRC review and approval would not be required for alternatives to four specific sections of NFPA 805 Chapter 3 listed below, for which an engineering evaluation demonstrates that the alternative to the Chapter 3 element is adequate for the hazard. A qualified fire protection engineer shall perform the engineering evaluation and conclude that the change has not affected the functionality of the component, system, procedure, or physical arrangement (with respect to the ability to meet the nuclear safety and radioactive release performance criteria), using a relevant technical requirement or standard. NFPA 805 Section 2.4 states that engineering analysis is an acceptable means of evaluating 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 a FPRA to evaluate the risk of proposed future plant changes. Section 3.4.2 of this SE, "Quality of the Fire Probabilistic Risk Assessment," discusses the technical adequacy of the FPRA, including the licensee's process to ensure that the FPRA remains current. The NRC staff determined that the quality of the licensee's FPRA and associated administrative controls and processes for maintaining the quality of the PRA model is sufficient to support self-approval of future RI changes to the FPP under the proposed license conditions, the 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 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 3.4.2, "Quality of the Fire Probabilistic Risk Assessment"). Accordingly, these cause and effect relationship models may be used after transition to NFPA 805 as a part of the PCEs conducted to determine the change in risk associated with proposed plant changes.

2.7 Modifications and Implementation Items

Regulatory Position C.3.1 of RG 1.205, Revision 1, (Reference 4), says that a license condition included in a NFPA 805 LAR should include: (1) a list of modifications being made to bring the plant into compliance with 10 CFR 50.48(c); (2) a schedule detailing when these modifications will be completed; and (3) a statement that the licensee shall maintain appropriate compensatory measures in place until implementation of the modifications are completed.

The list of modifications and implementation items originally submitted in the LAR have been updated by the licensee with the final version of LAR Attachment S, "Plant Modifications and Items to be Completed during Implementation." The updated LAR Attachment S is provided in the licensee's letters dated August 14, 2014 (Reference 16), and November 4, 2014 (Reference 17).

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 NFPA 805 licensing basis, as proposed. These modifications are identified in the LAR as necessary to bring PNP into compliance with either the deterministic or PB requirements of NFPA 805. As described below, 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's review confirmed that the modifications identified in LAR Attachment C, Table B-3, "Fire Area Transition," on a fire area basis, are also identified in LAR Attachment S, Table S-2, and are 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 associated completion schedule are the same as those provided in the proposed NFPA 805 license condition.

LAR Attachment S, Table S-2 provides a detailed listing of the plant modifications that must be completed in order for PNP 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 PNP will complete implementation of the modifications before the end of the second full operating cycle after NRC approval and that appropriate compensatory measures will be maintained 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 Section 2.7.3 of this SE 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 the implementation items listed in LAR Attachment S, Table S-3, will be completed within six months after NRC approval, or six months after a refueling outage if in progress at the time of approval, with the exception of Implementation Items 3 and 8 which will be completed once the related modifications are installed and validated in the PRA model.

The NRC staff, through an onsite audit or during a future fire protection inspection, may choose to examine the closure of the implementation items, with the expectation that any variations

discovered during this review, or concerns with regard to adequate completion of the implementation item, would be tracked and dispositioned appropriately under the licensee's corrective action program. Any discrepancies identified during onsite audits or fire protection inspections examining dispositioning of the implementation items could be subject to appropriate NRC enforcement action as completion of the implementation items would be required by the proposed license conditions.

2.7.3 Schedule

Section 5.5 of the LAR provides the overall schedule for completing the NFPA 805 transition at PNP. 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 within six months after NRC approval, or six months after a refueling outage if in progress at the time of approval. The updated LAR Attachment S, provided in the licensee's letter dated November 4, 2014 (Reference 17), indicated that Implementation Items 3 and 8 will be completed once the related modifications are installed and validated in the PRA model.

Section 5.5 of the LAR also states that modifications will be implemented before the end of the second full operating cycle after NRC approval and that appropriate compensatory measures will be maintained until the modifications are complete.

3.0 TECHNICAL EVALUATION

The following sections evaluate the technical aspects of the requested license amendment to transition the FPP at PNP 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 37), to determine whether the licensee had provided sufficient information in both scope and level of detail to adequately demonstrate compliance with the requirements of NFPA 805, as well as the other associated regulations and guidance documents discussed in Section 2.0 of this SE. Specifically:

- Section 3.1 provides the results of the NRC staff review of the licensee's transition of the FPP from the existing deterministic guidance to that of NFPA 805 Chapter 3, "Fundamental 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 nuclear safety capability assessment (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.

Attachments A and B of the SE provide additional detailed information that was evaluated and/or dispositioned 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); and

- 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 fire protection program elements and minimum design requirements of NFPA 805, Chapter 3 may be subject to the PB methods permitted elsewhere in the standard.

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

3.1.1 Compliance with NFPA 805 Chapter 3 Requirements

The licensee used the systematic approach described in NEI 04-02, Revision 2 (Reference 7), as endorsed by the NRC in Regulatory Guide 1.205, Revision 1 (Reference 4), to assess the proposed PNP 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 PNP 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 PNP, and others are provided with multiple compliance statements to fully document compliance with the element.

The methods used by PNP 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 FPP and Design Elements," (also called the B-1 Table), as "Complies." (see discussion in SE Section 3.1.1.1)

2. The existing FPP element complies through the use of an explanation or clarification: noted in the "Compliance Basis" in the B-1 Table as "PNP complies with clarification." (see discussion in SE Section 3.1.1.2)

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 with use of EEEEs." (see discussion in SE Section 3.1.1.3)

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 by previous NRC approval." (see discussion in SE Section 3.1.1.4)

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 "Submit for NRC approval." (see discussion in SE Section 3.1.1.5)

6. The existing FPP element does not comply with the requirement, but will be in direct compliance with the completion of an action; noted in the B-1 Table as "Will Comply with the Use of Commitment." These outstanding actions are

identified as implementation items in LAR Attachment S, Table S-3, and in SE Section 2.7. (see discussion in SE Section 3.1.1.6)

Compliance approach 6, "Will Comply with the Use of Commitment," is a modification from the NEI 04-02 based approach in that it is a new category not included in NEI 04-02. The intent of this choice is to identify FPP elements that will comply after completion of an action by the licensee. The actions are identified in LAR Attachment S as modifications (Table S-2) or implementation (Table S-3) items 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 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 licensee stated in Section 4.2.2 of the LAR, "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 PNP configuration. The licensee determined that no EEEE used to support compliance with NFPA 805 required NRC approval.

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

Additionally, the licensee stated in Section 4.2.3 of the LAR, "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.

Attachment A of the LAR (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 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.

In FPE RAI 02 (Reference 19), the NRC staff requested that the licensee provide a more detailed description of the limits on the types and quantities of combustible material stored in Combustible Control Zones, in accordance with LAR Attachment A, Table B-1, Section 3.3.1.2(4). In its response to FPE RAI 02 (Reference 10), the licensee stated the combustible control levels described in its procedures are:

- Level 1 Area – a fire sensitive plant area where transient combustible loading is prohibited unless evaluated and approved using controls within procedures.
- Level 2 Area – a plant area where combustibles are permitted, but only with strict combustible controls.
- Level 3 Area – a plant area where formal combustible controls are in place, but to a lesser extent than a Level 2 area.
- Level 4 Area – a plant area where there are no formal combustible controls. Standard industrial housekeeping practices are sufficient to control fire hazards due to combustible materials.

The licensee further stated that the types of combustible materials are broken down into four categories with general requirements for handling as stated in its procedure, including maximum amounts of combustibles based on a specific combustible control area. Additionally, the licensee revised the compliance strategy previously submitted in LAR Attachment A, Table B-1, Section 3.3.1.2(4) from "Complies with Clarification" to "Complies." The NRC staff concludes that the licensee's response to the RAI is acceptable because it meets the intent of NFPA 805, Section 3.3.1.2(4), which is to place limits on the types and quantities of stored combustible materials.

In FPE RAI 04 (Reference 19), the NRC staff requested that the licensee provide additional information regarding the prohibition of bulk storage of flammable and combustible liquids in the power block. In its response to FPE RAI 04 (Reference 10), the licensee stated that there is no bulk storage of flammable and/or combustible liquids inside structures containing systems, equipment, or components important to nuclear safety. The licensee further stated that it considers bulk storage to be flammable and/or combustible liquid storage in tanks that are at a staged location and not connected to a system. In addition, the licensee stated that flammable and/or combustible liquid storage vessels that are installed as part of a designed system (e.g., day tanks for diesel generators or fire pumps, turbine lube oil tanks) do not constitute bulk storage and are not considered to be under the requirements of Section 3.3.8 of NFPA 805. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated compliance with NFPA 805, Sections 3.3.1.2(4) and 3.3.8 for bulk storage of flammable and combustible liquids.

In FPE RAI 05 (Reference 19), the NRC staff requested that the licensee describe how the requirements of NFPA 805 Section 3.4.1(c) are met with regard to training and qualifications for the brigade leader and at least two of the brigade members. In its response to FPE RAI 05, (Reference 10), the licensee stated that each fire brigade shift consists of a fire brigade leader and a minimum of four fire brigade members and that the fire brigade leader is a qualified

nuclear plant operator with plant operating experience and seniority that supports the individual's position as a brigade leader. The licensee further stated that a minimum of four other fire brigade members are also qualified nuclear plant operators. In addition, the licensee stated that training addresses multiple areas of study including communication, nuclear technology, power plant fundamentals, plant systems, and fire brigade training and that in addition to study, the qualification requirements include extensive on the job training to reinforce class room skills and establish operating knowledge and skills in such areas as operating equipment, procedure use and control room communications. The licensee further stated that based on the initial and continued training and experience provided to non-licensed operators and fire brigade members, PNP complies with the NFPA 805 Section 3.4.1 (c) requirement that the fire brigade leader and at least two brigade members have sufficient training and knowledge of nuclear safety systems to understand the effects of fire and fire suppressants on NSPC. The NRC staff concludes that the licensee's response to the RAI is acceptable and that the fire brigade leaders and members' training and level of knowledge is acceptable because the licensee demonstrated that the fire brigade qualification and training program provides sufficient knowledge and training as required by NFPA 805, Section 3.4.1(c).

3.1.1.2 Compliance Strategy -- Complies with Clarification

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

3.1.1.3 Compliance Strategy -- Complies with Use of EEEEs

For certain NFPA 805, Chapter 3 requirements, the licensee demonstrated compliance with the fundamental FPP element through the use of EEEEs. 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 following NFPA 805 sections identified in LAR Table B-1 as complying via this method required additional review by the NRC staff:

- 3.3.6

In FPE RAI 03 (Reference 19), the NRC staff requested that the licensee justify the use of the alternate requirement for compliance with LAR Attachment A, Table B-1, Section 3.3.6 regarding metal roof coverings, including a discussion of how the requirements of Class A are met. In its response to FPE RAI 03 (Reference 10), the licensee revised the compliance strategy from "Complies with Clarification" to "Complies with the use of EEEE" and stated that an evaluation was prepared to justify the acceptability of the roofs and their equivalency to NFPA 256 Class A. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee revised the compliance strategy and demonstrated compliance with NFPA 805, Section 3.3.6 through acceptable level of compliance (i.e., NFPA 256, Class A).

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 basis for the Appendix A to BTP APCSB 9.5-1 SER, dated September 1, 1978, FPP Safety Evaluation Report (Reference 23), (2) Supplement 1 (Reference 24) to the original report, which was issued in March 19, 1980, and subsequent SERs dated February 10, 1981 (Reference 25), May 26, 1983 (Reference 26), July 12, 1985 (Reference 27), January 29, 1986 (Reference 28), December 3, 1987 (Reference 29), and May 19, 1989 (Reference 30), or (3) SERs in February 8, 1983 (Reference 68), and July 23, 1985 (Reference 69), approving Appendix R exemptions. The LAR Section 2.2 contains further details of the current licensing basis.

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, Revision 1 (Reference 4). 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.

The licensee identified licensing actions which required LAR Attachment T clarifications for the following Chapter 3 elements:

- 3.5.2 and 3.5.5, service water pump and diesel fire pump separation.
- 3.5.11 and 3.5.13, primary and backup fire suppression separation.

For 3.5.2 and 3.5.5 in the LAR Attachment T, the licensee submitted Prior Approval Clarification Request 1 so the NRC staff would formally document as "prior approval" the separation of the service water pumps and diesel fire pump.

For 3.5.11 and 3.5.13 in the LAR Attachment T, the licensee submitted Prior Approval Clarification Request 2 so the NRC staff would formally document as "prior approval" the single failure of both the primary and backup fire protection system water supplies in the charging pump room.

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

- 3.5.5

In FPE RAI 06 (Reference 19), the NRC staff requested that the licensee clarify fire pump and service water pump separation. In its response to FPE RAI 06 (Reference 10), the licensee stated that the prior approval of the protection and separation of the service water pumps and diesel fire pump is acceptable under the new licensing basis. The licensee further stated that in an NRC safety evaluation report (SER) dated September 1, 1978 (Reference 23), the fire pump configuration was acceptable provided the diesel fire pump fuel oil day tank was moved to a separate building outside the Intake Structure and sprinkler protection was provided for the area. In response to this SER the licensee moved the diesel fire pump fuel oil day tanks to a

separate building outside the Intake Structure and a sprinkler system was installed in the Intake Structure to provide protection to the area. The licensee stated that the conditions of the 1978 SER remain in place in that the diesel fuel oil day tanks are still located outside the Intake Structure and a sprinkler system remains installed in the area. The licensee further stated that additional features such as ultraviolet detection, a suppression system protecting the fuel oil transfer pumps, the installation of a radiant heat shield, and low levels of combustible material in the area between the fire pumps, further support the fire pump configuration. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated continued acceptability of the previous approval for the separation and protection of the fire pump.

The NRC staff review and evaluation of the compliance strategies approvals in LAR Attachment T, "Prior Approval Requests," are documented in Section 3.5.1.3 of this SE.

3.1.1.5 Compliance Strategy -- Submit for NRC Approval

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

- 3.2.3(1), which concerns the establishing of procedures for inspection, testing, and maintenance for fire protection systems and features. The licensee requested NRC staff approval for the use of a performance-based method to justify the use of EPRI Technical Report (TR) 1006756, "Fire Protection Equipment Surveillance Optimization and Maintenance Guide," Final Report, July 2003 (Reference 70), to modify fire protection system surveillance frequencies, thereby meeting the requirements of NFPA 805, Section 3.2.3(1). See Section 3.1.4.1 of this SE for the NRC staff's evaluation of this request.

- 3.3.1.2(1), which concerns the use of non-listed pressure-impregnated or non-fire-retardant wood within the power block. The licensee requested NRC staff approval for the use of a performance-based method to justify the ability to administratively control instances where minor use of non-treated wood in limited quantities may be necessary, thereby meeting the requirements of NFPA 805, Section 3.3.1.2(1). See SE Section 3.1.4.2 for the NRC staff's evaluation of this request.

- 3.3.1.3.1, which concerns 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 71), and NFPA 241, "Standard for Safeguarding Construction, Alteration, and Demolition Operations" (Reference 72). The licensee requested NRC staff approval for the use of a performance-based method to perform hot work procedures in sprinklered buildings while the protection is impaired thereby meeting the requirements of NFPA 805, Section 3.3.1.3.1. See SE Section 3.1.4.3 for the NRC staff's evaluation of this request.

- 3.3.3, which concerns the classification of interior floor finishes required to be in accordance with NFPA 101, "Life Safety Code" (Reference 53), requirements for Class I interior floor finishes. The licensee requested NRC staff approval for the use of a performance-based method to justify the use of an epoxy floor coating system, thereby meeting the requirements of NFPA 805 Section 3.3.3. See Section 3.1.4.4 of this SE for the NRC staff's evaluation of this request.

- 3.3.5.1, which concerns minimizing wiring above suspended ceilings and, where installed, requires electrical wiring to be listed for plenum use or routed in armored cable, metal conduit, or cable trays with solid metal top and bottom covers. The licensee requested NRC staff approval for the use of a performance-based method to justify the use of limited amounts of wiring above suspended ceilings in the power block, thereby meeting the requirements of NFPA 805, Section 3.3.5.1. See SE Section 3.1.4.5 for the NRC staff's evaluation on this request.

- 3.3.5.2, which concerns the use of metal trays and conduits for electrical raceways. The licensee requested NRC staff approval for the use of a performance-based method to justify the use of embedded or underground plastic conduit, exposed electrical metal tubing to route power, instrumentation, and control cables, and exposed plastic conduit for some cooling-tower-related applications, thereby meeting the requirements of NFPA 805, Section 3.3.5.2. See SE Section 3.1.4.6 for the NRC staff's evaluation of this request.

- 3.3.7.2, which concerns the storage of outdoor high-pressure flammable gas storage containers. The licensee requested NRC staff approval for the use of a performance-based method to justify its outdoor hydrogen bulk storage, thereby meeting the requirements of NFPA 805, Section 3.3.7.2. See SE Section 3.1.4.7 for the NRC staff's evaluation of this request.

- 3.5.3, which concerns available fire pump flow rate and pressure assuming failure of the largest pump or pump power source. The licensee requested NRC staff approval for the use of a performance-based method to justify the use of diesel fire pump exhaust piping that is approximately 4" in diameter for more than 15 feet, thereby meeting the requirements of NFPA 805 Section 3.5.3. See SE Section 3.1.4.8 for the NRC staff's evaluation of this request.

- 3.5.6, which concerns providing fire pumps with automatic start and manual stop only at the fire pump. The licensee requested NRC staff approval for the use of a performance-based method to justify the use of diesel fire pumps that can be manually stopped in the Control Room if the pumps have been manually started in the Control Room, thereby meeting the requirements of NFPA 805, Section 3.5.6. See SE Section 3.1.4.9 for the NRC staff's evaluation of this request.

- 3.5.16, which concerns the fire protection water supply system being dedicated for fire protection use only. The licensee requested NRC staff approval for the use of a performance-based method to justify the use of the fire protection water

supply for certain emergency back-up uses, and some non-emergency purposes to support systems in the power block, thereby meeting the requirements of NFPA 805, Section 3.5.16. See SE Section 3.1.4.10 for the NRC staff's evaluation of this request.

- 3.11.4(b) which concerns conduits being provided with an internal fire seal that has an equivalent fire-resistive rating to that of the fire barrier through opening fire stop and being installed on either side of the barrier in a location that is as close to the barrier as possible with certain exceptions. The licensee requested NRC staff approval for the use of a performance-based method to justify the use of proposed criteria to use for conduit fire and smoke sealing based on fire testing with certain criteria, thereby meeting the requirements of NFPA 805, Section 3.11.4(b). See SE Section 3.1.4.11 for the NRC staff's evaluation of this request.

As discussed in Section 3.1.4 of the SE 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 – Comply with the Use of Commitment

In several NFPA 805, Chapter 3 requirements, the licensee demonstrated compliance with the fundamental FPP element through the use of a commitment. The following NFPA 805 sections identified in LAR B-1 Table, as complying via this method, and the applicable NFPA 805, Chapter 3 in LAR Attachment S; Table S-2 "Plant Modifications" or Table S-3 "Implementation Items," required additional review by the NRC staff:

- 3.2.3(1)
- 3.2.3(3)
- 3.3.1.2(2)
- 3.3.1.2(3)
- 3.3.1.2(5)
- 3.3.1.2(6)
- 3.3.1.3.1
- 3.3.3
- 3.3.5.1
- 3.3.5.2
- 3.3.7.1
- 3.3.9
- 3.3.10
- 3.4.3(a)(4)
- 3.5.16
- 3.7
- 3.8.1
- 3.8.2
- 3.9.1
- 3.11.1
- 3.11.3
- 3.11.4(a)&(b)

NFPA 805, Section 3.2.3(1) requires that inspection, testing, and maintenance for fire protection systems and features be credited by the FPP. The licensee identified an action to incorporate the use of EPRI TR-10006756, "Fire Protection Surveillance Optimization and Maintenance Guide for Fire Protection Systems and Features" (Reference 70). This item is addressed in LAR Attachment S, Table S-3, Implementation Item 7, and is considered acceptable because the action will incorporate the provisions of NFPA 805 in the FPP and is included as an implementation item which would be required by the proposed license condition.

NFPA 805, Section 3.2.3(3) requires that procedures be established for reviews of FPP related performance and trends. The licensee identified an action to develop a monitoring program as required by NFPA 805 to include a process that monitors and trends the FPP based on specific goals established to measure effectiveness. This item is addressed in LAR Attachment S, Table S-3, Implementation Item 4, and is considered acceptable because the action will incorporate the provisions of NFPA 805 in the FPP and is included as an implementation item which would be required by the proposed license condition.

NFPA 805, Section 3.3.1.2(2) requires that plastic sheeting materials used in the power block be fire-retardant types that have passed NFPA 701, "Standard Methods of Fire Tests for Flame Propagation of Textiles and Films" (Reference 73), large-scale tests, or equivalent. The licensee identified an action to revise its procedures to ensure the requirements of NFPA 701 are met. This item is addressed in LAR Attachment S, Table S-3, Implementation Item 1, and is considered acceptable because the action will incorporate the provisions of NFPA 805 in the FPP and is included as an implementation item which would be required by the proposed license condition.

NFPA 805, Section 3.3.1.2(3) requires that waste, debris, scrap, packing materials, or other combustibles be removed from an area immediately following the completion of work or at the end of the shift, whichever comes first. The licensee identified an action to revise its procedures to ensure the requirements of NFPA 805 are met. This item is addressed in LAR Attachment S, Table S-3, Implementation Item 1, and is considered acceptable because the action will incorporate the provisions of NFPA 805 in the FPP and is included as an implementation item which would be required by the proposed license condition.

NFPA 805, Section 3.3.1.2(5) requires that controls on use and storage of flammable and combustible liquids be in accordance with NFPA 30, "Flammable and Combustible Liquids Code" (Reference 55), or other applicable NFPA standards. The licensee identified an action to revise its procedures to include requirements for water-reactive materials. This item is addressed in LAR Attachment S, Table S-3, Implementation Item 1, and is considered acceptable because the action will incorporate the provisions of NFPA 805 in the FPP and is included as an implementation item which would be required by the proposed license condition.

NFPA 805, Section 3.3.1.2(6) requires that controls on use and storage of flammable gases be in accordance with applicable NFPA standards. The licensee identified actions to perform modifications to: 1) move the Room 139 (Gas Storage East) hydrogen system vent discharge line 15 feet from electrical equipment, extending upward while being appropriately protected against weather intrusion, 2) move ignition sources that are potential hazards to the outdoor hydrogen storage system, in accordance with NFPA 50A, "Standard for Gaseous Hydrogen Systems at Consumer Sites" 1969 Edition (Reference 74), and 3) modify Room 139, to ensure adequate explosion venting is provided. These items are addressed in LAR Attachment S, Table S-2, Modification Items S2-29 and S2-30, and are considered acceptable because the actions are included as modification items which will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

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 71), and NFPA 241, "Standard for Safeguarding Construction, Alteration, and Demolition Operations" (Reference 72). The licensee identified an action to revise its hot work control procedure to incorporate the following: "Hot work that is performed on pipes or other metal that is in contact with combustible walls, partitions, ceilings, roofs, or other combustibles shall not be undertaken if the work is close enough to cause ignition by conduction." This item is addressed in LAR Attachment S, Table S-3, Implementation Item 1, and is considered acceptable because the action will incorporate the provisions of NFPA 805 in the FPP and is included as an implementation item which would be required by the proposed license condition.

NFPA 805, Section 3.3.3 requires that interior walls or ceiling finish classification be in accordance with NFPA 101, "Life Safety Code" (Reference 53), requirements for Class A materials. Interior floor finishes shall be in accordance with NFPA 101 requirements for Class I interior floor finishes. The licensee identified an action to update a fire protection implementing procedure to ensure the requirements of NFPA 101 are met for epoxy floors. This item is addressed in LAR Attachment S, Table S-3, Implementation Item 1, and is considered acceptable because the action will incorporate the provisions of NFPA 805 in the FPP and is included as an implementation item which would be required by the proposed license condition.

NFPA 805, Section 3.3.5.1 requires that wiring above suspended ceilings be kept to a minimum. Where installed, electrical wiring shall be listed for plenum use, routed in armored cable, routed in metallic conduit, or routed in cable trays with solid metal top and bottom covers. The licensee identified an action to include steps in its procedures to address wiring above suspended ceilings to make sure it complies with the requirements of NFPA 805. This item is addressed in LAR Attachment S, Table S-3, Implementation Item 1, and is considered acceptable because the action is included as an implementation item which will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

NFPA 805, Section 3.3.5.2 requires that only metal tray and metal conduits be used for electrical raceways. Thin wall metallic tubing shall not be used for power, instrumentation, or control cables. Flexible metallic conduits shall only be used in short lengths to connect components. The licensee identified an action to revise its procedures to ensure compliance with this requirement. This item is addressed in LAR Attachment S, Table S-3, Implementation Item 1, and is considered acceptable because the action is included as an implementation item that will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

NFPA 805, Section 3.3.7.1 requires that storage of flammable gas be located outdoors, or in separate detached buildings, so that a fire or explosion will not adversely impact systems, equipment, or components important to nuclear safety. NFPA 50A, "Standard for Gaseous Hydrogen Systems at Consumer Sites," 1969 Edition (Reference 74), shall be followed for hydrogen storage. The licensee identified actions to perform to 1) Move the Room 139 (Gas Storage East) hydrogen system vent discharge line 15 feet from electrical equipment, extending upward while being appropriately protected against weather intrusion, 2) Move ignition sources that are potential hazards to the outdoor hydrogen storage system, in accordance with NFPA 50A, and 3) Modify Room 139, to ensure adequate explosion venting is provided. These items are addressed in LAR Attachment S, Table S-2, Modification Items S2-29 and S2-30, and are considered acceptable because the actions will incorporate the provisions of NFPA 805 in the FPP and are included as modification items which would be required by the proposed license condition.

NFPA 805, Section 3.3.9 requires that, where provided, transformer oil collection basins and drain paths be periodically inspected to ensure that they are free of debris and capable of performing their design function. The licensee identified an action to create a preventive maintenance item with the information required to perform the inspection of the transformer oil collection basins and drain paths to ensure they are compliant with NFPA 805. This item is addressed in LAR Attachment S, Table S-3, Implementation Item 2, and is considered

acceptable because the action will incorporate the provisions of NFPA 805 in the FPP and is included as an implementation item which would be required by the proposed license condition.

NFPA 805, Section 3.3.10 requires that combustible liquids, including high flashpoint lubricating oils, be kept from coming in contact with hot pipes and surfaces, including insulated pipes. Administrative controls shall require the prompt cleanup of oil on insulation. The licensee identified an action to revise its procedures to include controls for eliminating the possibility of combustible liquids, including high flashpoint lubricating oils, from coming into contact with hot pipes and surfaces, and controls for ensuring the prompt cleanup of oil on insulation. This item is addressed in LAR Attachment S, Table S-3, Implementation Item 1, and is considered acceptable because the action will incorporate the provisions of NFPA 805 in the FPP and is included as an implementation item which would be required by the proposed license condition.

NFPA 805, Section 3.4.3(a)(4) requires that written records that include but are not limited to initial industrial fire brigade classroom and hands-on training, refresher training, special training schools attended, drill attendance records, and leadership training for industrial fire brigades be maintained for each industrial fire brigade member. The licensee identified an action to revise fire suppression training procedures to ensure the required written records are maintained and also an action to track the document change to closure. These items are addressed in LAR Attachment S, Table S-3, Implementation Item 1, and are considered acceptable because the actions will incorporate the provisions of NFPA 805 in the FPP and are included in an implementation item which would be required by the proposed license condition.

NFPA 805, Section 3.5.16 requires that the fire protection water supply system be dedicated for fire protection use only. Where deviations are approved to this requirement, the licensee has committed to revise various procedures to support the conclusions identified by the EEEEs. The licensee identified an action to revise all applicable procedures. This item is addressed in LAR Attachment S, Table S-3, Implementation Item 1, and is considered acceptable because the action will incorporate the provisions of NFPA 805 in the FPP and is included as an implementation item which would be required by the proposed license condition.

NFPA 805, Section 3.7 requires that, where provided, fire extinguishers of the appropriate number, size, and type be provided in accordance with NFPA 10, "Standard for Portable Fire Extinguishers" (Reference 57). The licensee identified actions to comply with this requirement. A modification will be performed to install additional fire extinguishers to various areas of the power block. This item is addressed in LAR Attachment S, Table S-2, Modification Item S2-32, and is considered acceptable because the action will incorporate the provisions of NFPA 805 in the FPP and is included as a modification item which would be required by the proposed license condition. The licensee also identified the need to revise any applicable site procedures that will be impacted by the addition of new fire extinguishers. This item is addressed in LAR Attachment S, Table S-3, Implementation Item 1, and is considered acceptable because the action will incorporate the provisions of NFPA 805 in the FPP and is included as an implementation item which would be required by the proposed license condition.

NFPA 805, Section 3.8.1 and 3.8.2 require that automatic fire detection systems be installed in accordance with NFPA 72, "National Fire Alarm and Signaling Code" (Reference 75). The licensee identified an action to replace required detection systems, as necessary, to meet the requirements of NFPA 72. The licensee also identified the need to develop a procedure to

periodically clean, test, and inspect all smoke detection systems for the required systems in the power block. These items are addressed in LAR Attachment S, Table S-2, Modification Item S2-18, and LAR Attachment S, Table S-3, Implementation Items 1 and 2. The NRC staff concludes that these actions are acceptable because the actions are included in LAR Attachment S, and would be required by the proposed license condition.

NFPA 805, Section 3.9.1 requires that sprinkler systems used to meet NFPA 805 Chapter 4 be installed in accordance with NFPA 13, "Standard for the Installation of Sprinkler Systems" (Reference 76). The licensee identified an action to replace an upright-type head installed in the pendent position under the north edge of the boiler in the south boiler room. A work order was created to install the appropriate head type. This item is addressed in LAR Attachment S, Table S-2, Modification Item S2-27 and is considered acceptable because the action will incorporate the provisions of NFPA 805 in the FPP and is included as a modification item which would be required by the proposed license condition.

NFPA 805, Section 3.11.1 requires that each major building within the power block be separated from the others by barriers having a designated fire resistance rating of 3 hours, by open space of at least 50 feet, or by space that meets the requirements of NFPA 80A, "Recommended Practice for Protection of Buildings from Exterior Fire Exposures" (Reference 77). The licensee identified actions to pursue plant modifications, where applicable, to ensure compliance with NFPA 805 Chapter 3, Section 3.11.1. Additionally, a modification will be performed to seal penetrations between the southwest area of the Turbine Building and transformer areas. These items are addressed in LAR Attachment S, Table S-2, Modification Items S2-20, S2-24, S2-37, S2-38, S2-39, and S2-42, and are considered acceptable because the actions will incorporate the provisions of NFPA 805 in the FPP and are included as modification items which would be required by the proposed license condition.

NFPA 805, Section 3.11.3 requires that penetrations in fire barriers be provided with listed fire-rated door assemblies or fire dampers having a fire resistance rating consistent with the designated fire resistance rating of the barrier as determined by the performance requirements established by Chapter 4. The licensee identified actions to be completed to achieve compliance with this requirement that include: (1) Modification of fire barrier segments 229S/233N and 214S/229N; (2) Replace damper D-25 with a fire-rated barrier; (3) Repair Door-44 and repair or replace a non-compliant closer installed on Door-82; and (4) Replace fire dampers CD-23 & CD-24. These items are addressed in LAR Attachment S, Table S-2, Modification Items S2-22, S2-25, S2-31 and S2-40, and are considered acceptable because the actions will incorporate the provisions of NFPA 805 in the FPP and are included as modification items which would be required by the proposed license condition.

NFPA 805, Sections 3.11.4(a) and (b) requires that through penetration fire stops for penetrations such as pipes, conduits, bus ducts, cables, wires, pneumatic tubes and ducts, and similar building service equipment that pass through fire barriers be protected. The licensee identified actions and documentation changes required to comply with this requirement that include 1) A modification to internally seal 5 conduits, 2) Modifications based on inspection results of conduit internal seals, 3) A modification to seal various penetrations between FA 17, Spent Fuel Pool, and FA 27, Radwaste Addition, and 4) a document change to reflect actual plant configurations. These items are addressed in LAR Attachment S, Table S-2, Modification Items S2-28, S2-34, S2-35, S2-36, and S2-41 and are considered acceptable because the

actions will incorporate the provisions of NFPA 805 in the FPP and are included as modification items which would be required by the proposed license condition.

Based on the licensee's statement of compliance and the associated modification and implementation items described in LAR Attachment A and LAR Attachment S for the individual attributes described above, as well as the statements that these items will be complete prior to full implementation, the NRC staff concludes the licensee's statements of compliance are acceptable because completion of these items will bring these attributes into compliance with the requirements and the items are included as either implementation items or modification items which would be required by the proposed license condition.

3.1.1.7 Compliance Strategy -- Multiple Strategies

In certain compliance statements of the NFPA 805, Chapter 3 requirements, the licensee used more than one of the above strategies to demonstrate compliance with aspects of the fundamental FPP and design elements. In each of these cases, the NRC staff concludes that the individual compliance statements are acceptable, for the reasons outlined above, that the combination of compliance strategies is acceptable, and that holistic compliance with the fundamental FPP element is assured.

3.1.1.8 Chapter 3 Sections Not Reviewed

Some NFPA 805, Chapter 3 sections either do not apply to the transition to 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 3.4.1 and 3.11).
- Sections that are not applicable because of the following:
  - The licensee states that it does not have systems of this type installed (e.g., NFPA 805 Section 3.6.5 which applies to seismic designed hose stations that are cross-connected to seismic non-fire protection essential water 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 applies to the fire brigade standards used since they depend on the type of brigade specified in the FPP).

3.1.1.9 Compliance with Chapter 3 Requirements Conclusion

As discussed above, the NRC staff evaluated the results of the licensee's assessment of the proposed 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 the 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.

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

  — Through the use of an EEEE.

  — 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 structures identified in LAR Table I-1 "Palisades Power Block Definition" as composing 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 PNP RI/PB FPP that have additional requirements in accordance with 10 CFR 50.48(c) and NFPA 805. As stated in LAR, Section 4.1.3, any area that contains equipment or cables that are necessary to achieve "safe and stable" condition is considered a power block area. The LAR also stated that the safe and stable condition applies to all modes of operation, including NPO modes, and that areas with equipment or cables that are required for nuclear plant operations that do not support "safe and stable" were excluded from the power block. The NRC staff concludes that based on the information provided the licensee has appropriately evaluated the structures and equipment at PNP, and adequately documented a list of those structures that fall under the definition of "power block" in NFPA 805.

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

Generic Letter 2006-03 requested that licensees evaluate their facilities to confirm compliance with existing applicable regulatory requirements in light of the results of NRC testing that

determined that both Hemyc™ and MT™ fire barriers failed to provide the protective function intended for compliance with existing regulations, for the configurations tested using the NRC's thermal acceptance criteria. Hemyc™ or MT™ electrical raceway fire barrier systems (ERFBS) are not used as the licensee indicated in LAR Attachment A, Section 3.11.5 and therefore, the generic issue (GL 2006-03 – (Reference 52)) related to the use of ERFBS is not applicable.

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. The Director or designee may approve PB methods if the Director or designee determines that the PB 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 DID (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown 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 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.

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 requirement of 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 3.2.3(1) – Inspection, Testing, and Maintenance Procedures

The licensee requested review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement of NFPA 805, Section 3.2.3(1). Specifically, the licensee requested approval to use EPRI TR-1006756, (Reference 70), to modify fire protection system surveillance frequencies as part of the NFPA 805 Section 2.6, "Monitoring".

In LAR Attachment L, Approval Request 1, the licensee stated that 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. The licensee stated that this request does not involve the use of the TR-1006756 to establish the scope of those activities as that is determined by the required systems review identified in LAR Section 4.8.1, Table 4-3.

The licensee stated that the target tests, inspections, and maintenance will be those activities for the NFPA 805 required fire protection systems and features 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. The licensee further stated that data collection and analysis will follow the TR-1006756 document guidance and that the failure probability will be determined based on the TR-1006756 guidance and a 95 percent confidence level will be utilized. The licensee further stated that 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 listed Implementation Item 4 in LAR Attachment S, Table S-3 to develop and implement the NFPA 805 monitoring program and the NRC considers this acceptable because the action will incorporate the provisions of NFPA 805 in the FPP and is included as an implementation item which would be required by the proposed license condition.

The licensee stated that there will be no adverse impact on the NFPA 805 NSPC because the use of PB test frequencies established per TR-1006756 methods, combined with NFPA 805 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 ensure that there is no impact on the system's and feature's ability to perform their function.

The licensee stated that the radiological release performance criteria are satisfied based on the determination of limiting radioactive release. The licensee further stated that the use of the PB test frequencies established, with the new Monitoring Program, will ensure that the availability and reliability of the systems and features are maintained to the levels assumed in the analyses credited for meeting the Radioactive Release performance criteria and therefore, there is no adverse impact on meeting these criteria.

The licensee further stated that the use of PB test frequencies will ensure that the availability and reliability of the systems and features are maintained to the levels assumed in the original NFPA 805 engineering analyses, which includes those assumptions credited in the risk evaluation safety margin discussions. In addition, the licensee stated that the use of these methods in no way invalidates the inherent safety margins contained in the codes 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 TR-1006756 methods and that the use of performance based test frequencies established per TR-1006756 methods combined with the NFPA 805 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 the 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 safety margins; and maintains fire protection DID (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown capability).

3.1.4.2 NFPA 805, Section 3.3.1.2(1) – Fire-Retardant Wood

The licensee requested review and approval of a PB method to demonstrate an equivalent level of fire protection for the NFPA 805 Section 3.3.1.2(1) which requires that listed pressure-impregnated or fire-retardant wood shall be used within the power block.

In LAR Attachment L, Approval Request 2, the licensee stated that an administrative procedure allows the use of non-treated wood in limited quantities and that while the code section is prescriptive in the transient use of fire treated wood/lumber, the plant may experience field conditions where non-treated wood may be needed to address unique situations during plant operation or during outages.

In FPE RAI 01 (Reference 19), the NRC staff requested the licensee describe the additional administrative controls and any compensatory measures that will be put in place when using untreated wood in the power block and to include a description of the controls that will prevent the permanent installation of untreated wood. In its response to FPE RAI 01 (Reference 10), the licensee stated that currently, there are a few limited cases of permanently installed non-treated wood accounted for in fire protection combustible loading documentation and that the bounding combustible load per fire area is calculated and future modifications to the plant that impact fire protection will use the engineering change process. The licensee further stated that changes impacting fire protection, such as changes to combustible loading, require approval by qualified fire protection personnel. The NRC staff concludes that the licensee's response to the

RAI is acceptable because the controls described by the licensee for untreated wood are appropriate.

The licensee stated that procedural controls are in place to administer the requirements for transient combustible controls and that there is recognition that requirements concerning the control of transient wood/lumber are managed within the bounds of the site administrative controls and within the FPP, however, there may be instances where minor non-compliances of use of non-treated wood in limited quantities may be necessary. The licensee further stated that administrative procedures may permit this condition based on added compensatory measures, additional engineering approvals or other administrative actions to manage the conditions and minimize the risk and that managing plant conditions and protecting SSD systems in risk significant areas with preventive measures and/or administrative controls is within the requirements and responsibilities of the FPP. In addition, the licensee stated that the combustible control levels for specific areas are generally assigned by fire area, however, there are a few cases where large areas were subdivided and that areas of concern, based upon risk and fire protection insights, have more restrictive transient combustible controls. The licensee further stated that four combustible control levels are described in the combustible control procedure and are defined as follows:

- Level 1 Area – a fire sensitive area of a plant where transient combustible loading is prohibited unless evaluated and approved via this procedure.

- Level 2 Area – a plant area where combustibles are permitted, but only with strict combustible controls.

- Level 3 Area – a plant area where formal combustible controls are in place, but to a lesser extent than a level 2 area.

- Level 4 Area – an area (not defined as level 1, 2, or 3) where there are no formal combustible controls. Standard industrial housekeeping practices are sufficient to control fire hazards due to combustible materials.

The licensee stated that untreated wood is considered an ordinary combustible and each combustible control level has a threshold for ordinary combustible limits and that fire retardant wood is also restricted based on the combustible control level. The licensee further stated that an evaluation is required as part of the transient combustible approval process and that the evaluation offers some suggested compensatory measures to consider including no hot work or ignition sources within 35 feet, fire watch (hourly or continuous), and metal storage container. In addition, the licensee stated that the procedural controls state that combustible materials should be kept to a minimum by using non-combustible materials whenever practical and that to monitor and help ensure procedure requirements are being met, fire protection inspections are completed monthly and documented per the procedural process.

The licensee stated that the use of limited amounts of untreated wood in selected risk significant areas is restricted by administrative and engineering procedures with suitable fire protection features present in the area that ensure the control of transient combustibles, separation distance, suppression, fire barriers and protection of the NSPC as applicable, identified by the

licensee and NFPA 805 Section 1.5. The licensee further stated that the use of combustible materials such as wood in a radiological area is closely reviewed and limited due to potential effects of fire and ALARA and that there is no nuclear safety or radiological concern from transient non-treated wood that is not under strict review and controls.

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 for Echelon 1, the site procedures are established to limit the amount of untreated wood and ignition sources that would be allowed in the plant and fire protection/designee approval is required. The licensee further stated that for Echelon 2, the criteria being established for allowance of untreated wood has no impact on the ability of the automatic suppression systems to perform their functions, portable fire extinguishers, and hose reel stations are available for manual firefighting activities by the site fire brigade that if a fire was to occur the damage from the fire would be limited. The licensee further stated that for Echelon 3, the criteria being established for the allowance of untreated wood does not allow fire propagation through the barrier, and does not result in compromising automatic fire suppression functions, manual fire suppression functions, or post-fire SSD capability and will not prevent essential safety functions from being performed.

The licensee stated that the margin of safety that is inherent within the NFPA 805 FPRA and performance based review is acceptable to ensure that no conditions are inadvertently produced that would challenge the ability of the fire protection features individually or combined as DID. There would be no effect on active fire suppression activities and these transient conditions would be within the limitations and assumptions of the FPRA.

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

3.1.4.3 NFPA 805, Section 3.3.1.3.1 – Hot Work

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 71), and NFPA 241, "Standard for Safeguarding Construction, Alteration, and Demolition Operations" (Reference 72). The licensee requested review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement. Specifically, the licensee requested that hot work be allowed in sprinklered buildings while such protection is impaired.

In LAR Attachment L, Approval Request 3, the licensee stated that certain situations dictated by safe operation and maintenance warrant system impairments and/or isolations to support major modifications and prevent inadvertent sprinkler system actuations during hot work activities. The licensee further stated that hot work activities requiring a sprinkler system be disabled or

removed from service need written approval and guidance from the fire protection engineer/designee prior to commencing work. The licensee further stated that the non-functional fire sprinkler system/deluge system which requires compensatory measures be added to the fire tour in accordance with fire protection procedures for fire protection systems and equipment and that for safety related areas, the compensatory measure is a continuous fire watch with backup fire suppression equipment in the unprotected area(s) that shall be established within one hour. In addition, the licensee stated that for non-safety related areas, the compensatory measure is an hourly fire tour of the affected area that shall be established within one hour except when: 1) a functional fire detection system is located in the area of the non-functional fire sprinkler system or deluge system, or 2) the non-functional fire sprinkler system or deluge system is in an area outside the protected area and the area is occupied. The licensee further stated that hot work activities require, but are not limited to, a combustible free area of 35 feet or covering of combustibles in the area of the hot work, a trained fire watch, fire extinguishers available for the fire watch, hot work equipment and the work location inspected and any combustible materials or sensitive equipment identified and removed or protected.

The licensee stated that controls established in fire protection procedures ensure hot work activities are carried out in a manner that reduces the likelihood of fire and if a fire occurs, prompt action is taken to quickly extinguish the fire and therefore, there is no impact on the NSPC.

The licensee stated that the procedures also establish controls that are utilized before and during the performance of these tasks to prevent fires from starting and that precautions are taken when performing hot work activities in sprinklered buildings while such protection is impaired. The licensee further stated that the radiological release review was performed based in part on manual fire suppression activities and is not dependent on hot work activities, that hot work is controlled and does not add additional radiological materials to the area or challenge system boundaries, and that hot work activities do not change the radiological release evaluation.

The licensee stated that compensatory actions such as a fire watch, covering or removing combustible material, and protecting sensitive equipment are implemented in order to minimize fire risk. The licensee further stated that trained fire watch personnel are assigned continuous fire watch duties along with the personnel performing the hot work in accordance with administrative procedures and therefore, the safety margin inherent in the analysis for the fire event 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 it meets the three echelons of DID by implementing an ENO procedure and that echelon 1 is met by assuring all floor or wall openings including gaps under and around doors are adequately covered to contain sparks, slag and molten metal within the immediate work area; combustible or flammable materials within 35 feet are removed or protected; fire protection engineer/designee written approval and guidance when hot work activities require a fire protection system or component to be disabled or removed from service are obtained. The licensee further stated that echelon 2 is met by implementing compensatory actions for all hot work consisting of a trained fire watch

which, along with their continuous fire watch duties, also ensures that a fire extinguisher is available for the hot work area. The licensee further stated that personnel performing the hot work remain at the work area for the required cool down period (normally 30 minutes after the hot work is completed) and that if a fire occurs, one of the hot work personnel shall notify the Control Room while the fire watch employee attempts to extinguish the fire. The licensee further stated that echelon 3 is met through the level of fire protection for the work area, the hot work permit initiation, and the written approval of the fire protection engineer/designee along with guidance assuring that the hot work requirements are adhered to, the work location inspected and the identification of any combustible materials or sensitive equipment needing protection or removal is adequately performed. The licensee further stated that these actions ensure that hot work activities do not directly result in a degradation of fire prevention functions, manual fire suppression activities (if needed), 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 is an acceptable alternative to the corresponding NFPA 805, Section 3.3.1.3.1 requirement because it satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains safety margins, and maintains fire protection DID (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown capability).

3.1.4.4 NFPA 805, Section 3.3.3 – Interior Finishes

In LAR Attachment L, Approval Request 4, the licensee requested review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement of NFPA 805, Section 3.3.3 regarding the use of an epoxy floor coating as an interior finish.

NFPA 805 Section 3.3.3 states that interior wall or ceiling finish classification shall be in accordance with NFPA 101, Life Safety Code requirements for Class A materials and that interior floor finishes shall be in accordance with NFPA 101 requirements for Class I interior floor finishes.

The licensee stated that NFPA 101 requirements for interior floor finishes state that the floor finish shall be characterized by a critical radiant flux not less than 0.45 W / cm2. The licensee further stated that the NRC issued Information Notice (IN) 2007-26 to address the combustibility of epoxy floor coatings at commercial nuclear power plants and that per IN 2007-26 (Reference 78), the NRC defined a noncombustible material as: 1) material having a structural base of noncombustible material, 2) an American Society for Testing and Materials (ASTM) E-84 flame spread rating not higher than 50, and 3) is not over 1/8" (125 mils) thick. The licensee further stated that NFPA 805 has re-defined the IN 2007-26 definition of non-combustible material to limited combustible as follows: 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 further stated that NFPA 805 defines non-combustible material as follows: material that, in the form in which it is used

and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat.

The licensee stated that numerous areas use a Keeler & Long KL-5500 Series epoxy floor coating system. The licensee further stated that the Material Safety Data Sheet (MSDS) states that the film per coat is 34.0 to 122.0 mils (0.034" to 0.122") which meets the NFPA 805, Section 3.3.3 requirement. The licensee further stated that review of manufacturer data of the coatings used indicates that the ASTM E-84 (Reference 79), flame spread value for a 50 mils thick epoxy floor coating system is 37 which meets the NFPA 805 Section 3.3.3 requirement however, the ASTM E-84 flame spread value and the critical radiant flux of the epoxy floor coating system is not known for thicknesses up to 122.0 mils. The licensee further stated that the current work instruction states a maximum floor coating thickness of 50 mils, however, there is no guarantee that the coating thickness is 50 mils or less.

The licensee stated that the basis for the approval request is that the form in which the epoxy floor coating is used and conditions anticipated would meet the definition of a limited combustible material (NFPA 805) and the current work instruction has a maximum floor coating thickness of 50 mils. The licensee further stated that the appropriate procedure will be revised to ensure adequate controls are in place for epoxy floors and has included an action in LAR Attachment S, Table S-3 in Implementation Item 1 to ensure completion. The NRC staff concludes that the action is acceptable because the action will incorporate the provisions of NFPA 805 in the FPP and is included as an implementation item which would be required by the proposed license condition.

The licensee justified the use of the epoxy floor coating by explaining that the epoxy floor coating is at floor level and that the ASTM E-84 test is conducted with the material on the ceiling of a tunnel. The licensee further stated that this configuration would allow the flame to directly impinge on the ceiling surface, enhancing flame spread and that with the material on the floor, the heat flux to the surface is much less than would be expected in the ceiling configuration since the convective flame is directing the heat away from the surface. The licensee further stated that this would mean that the overall flame spread would be expected to be much less, even with a slightly greater thickness. In addition, the licensee stated that the epoxy coating would not result in propagation across barriers or between redundant success paths and that the potential for fire spread via floor coatings has been evaluated for fire barrier configurations without physical barriers. The licensee stated that the epoxy floors are located in various rooms in the Turbine and Auxiliary Buildings and that the only area that does not have a rated barrier between fire areas and has epoxy floors is a hallway between FA-13, Auxiliary Building, and FA-27, Radiation Waste Facilities that connects the two. The licensee further stated that there are no ignition sources or other combustibles at the floor level and that there are procedural limits in place to limit transient combustible materials from being brought into this area. The licensee further stated that for fire area boundaries where there is a physical boundary, there would be a sealed fire barrier and that the barrier would inhibit the propagation across fire barriers.

The licensee stated that the use of epoxy floor coating does not affect nuclear safety as it meets the definition of a limited combustible material and that application of epoxy floor coatings is controlled via plant specifications to ensure that the amount of material does not add appreciable amounts of combustible material to the plant. The licensee further stated that the

epoxy coatings would not result in propagation across barriers or between redundant success paths and therefore, there is no impact on the NSPC.

The licensee further stated that the use of epoxy floor coatings 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 floor coating materials. The licensee further stated that the floor coatings do not change the results of the radiological release evaluation performed that concluded that potentially contaminated water is contained and smoke is monitored and that the epoxy floor coatings do not add additional radiological materials to the area or challenge systems boundaries.

The licensee stated that the use of epoxy floor coatings does not affect the safety margin as it meets the definition of a limited combustible material and that the floor coating materials were evaluated to have a negligible effect on combustibility. The licensee further stated that the application of epoxy floor coatings is controlled via installation specification and work instruction and that the areas with epoxy floor coatings have been analyzed in their current configuration. The licensee further stated that the precautions and limitations on the use of these materials do not impact the analysis of the fire event and therefore, the inherent safety margin and conservatisms in these analyses 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 use of epoxy floor coatings does not affect echelons 1, 2, and 3 and that the use of epoxy floor coatings does not directly result in compromised automatic fire suppression functions, manual fire suppression functions, or post-fire SSD capability. The licensee stated that it meets the three echelons of DID because:

- Site procedures are established to limit the epoxy floor finishing material used and the epoxy floors minimally increase the amount of combustibles in any area; however, the epoxy used meets the definition of a limited combustible material.

- The criteria being established for the epoxy floor interior finish has no impact on the ability of the automatic suppression systems to perform their functions. Portable fire extinguishers and hose reel stations are available for manual firefighting activities by the site fire brigade and therefore if a fire was to occur, the damage from the fire would be limited.

- The epoxy floor coating criteria being established meets the definition of a limited combustible material (NFPA 805) and therefore will not allow fire propagation through a barrier, and does not result in compromised automatic fire suppression functions, manual fire suppression functions, or post-fire SSD capability and will not prevent essential safety functions from being performed. The fire area boundaries are separated by barriers that would limit fire propagation from one fire area to another, however, fire propagation is unlikely because the epoxy acts as a limited combustible material.

The licensee stated that the use of this alternative interior finish would have no adverse impact on combustibility or fire propagation considerations associated with floor finishes and concluded that the combustible loading in safety related areas and the integrity of plant fire barriers will not be adversely impacted.

Based on its review of the information submitted by the licensee, and in accordance with Title 10 *Code of Federal Regulations* (CFR) 50.48(c)(2)(vii), the U.S. Nuclear Regulatory Commission (NRC) staff concludes that the proposed performance-based (PB) method is an acceptable alternative to the corresponding National Fire Protection Association (NFPA) 805, Section 3.3.3 requirement because it satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains safety margins, and maintains fire protection defense-in-depth (DID) (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown capability).

3.1.4.5 NFPA 805, Section 3.3.5.1 – Wiring above Suspended Ceilings

NFPA 805 Section 3.3.5.1 requires that wiring above suspended ceilings be kept to a minimum and shall be listed for plenum use, or routed in armored cable, metal conduit, or cable trays with solid metal top and bottom covers. In LAR Attachment L, Approval Request 5, the licensee requested review and approval of a PB method to demonstrate an equivalent level of fire protection for the installation of minimal amounts of wiring above suspended ceilings in the power block that is not listed for plenum use; or not routed in armored cable, metal conduit, or cable trays with solid metal top and bottom covers.

The licensee stated that an inspection of the spaces above the suspended ceilings in Fire Area 1, Control Room Elev. 625; Fire Area 23, Turbine Building, Elev. 590, 607, and 625; Fire Area 27, Radiation Waste Facilities; and, Fire Area 33, Technical Support Center, Elev. 625, revealed the existence of minimal quantities of wiring (cables).

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

- Only a minimal amount of the cable installed above the suspended ceilings in these areas is not rated for plenum use or routed in conduit.
- The majority of the cables are low voltage video, communication, or data cables and therefore, less susceptible to self-ignition and electrical shorts that could result in a fire in the enclosed space.
- Cables that are in open cable trays are located in areas with automatic fire suppression.
- Video/communication/data cables in Rooms 320, 321, 322, 323, 324, and 325 are protected with automatic detection systems.
- Video/communication/data cables in Rooms 126, 128, 129, and 130 are protected with automatic suppression systems.

- There are no additional ignition sources in the listed areas above the suspended ceilings.

- Administrative transient combustible controls are in place via procedures.

- Although IEEE 383 was not in existence at the time the electrical cabling was purchased and installed, the cable was specified to meet the vertical flame tests in accordance with Insulated Power Cable Engineers Association Standard S-19-81.

- Plant procedures will be revised to ensure future exposed cables installed above the suspended ceilings are rated for plenum use per NFPA 805 Section 3.3.5.1.

The licensee stated that the presence of non-rated plenum cables above the identified suspended ceiling locations does not adversely affect nuclear safety capability. The licensee further stated that the quantities of non-rated plenum cable are minimal and do not present a fire hazard and that there are no additional ignition sources above the suspended ceilings and therefore, there is no adverse impact on the nuclear safety performance criteria (NSPC) due to the non-rated plenum cabling in these areas. The licensee further stated that the location of non-rated plenum wiring above suspended ceilings also has no impact on the radiological release performance criteria and that the radiological review was performed based on the potential location of radiological concerns and is not dependent on the type or location of wiring.

The licensee stated that the quantity of non-rated plenum cables above the identified suspended ceiling locations is not significant and that the safety margin inherent in the analysis for the fire event has been preserved. The licensee further stated that the introduction of the non-rated plenum cable routed above the suspended ceilings does not impact fire protection DID and that the limited quantity of combustibles associated with this cabling, is considered insignificant with regard to combustible loading in the affected areas.

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 for echelon 1, the video, communication, and data cables installed above the suspended ceilings that are not rated for plenum use are low voltage cables and are less susceptible to self-ignition and electrical shorts that could result in a fire in the enclosed space and that there are no additional ignition sources in the listed areas above the suspended ceilings. The licensee stated that for echelon 2, the areas with open bottom ladder type cable trays have automatic suppression systems installed as part of the area fire protection and that most of the areas that have video, communication, and data cables installed above suspended ceilings, have automatic detection systems. The licensee further stated that all areas have portable fire extinguishers and hose reel stations that are available for manual firefighting activities by the site fire brigade which provides assurance that if a fire was to occur, the damage from the fire would be limited. In addition, the licensee stated that for echelon 3, the introduction of the non-rated plenum cables routed above the suspended ceilings does not prevent essential safety functions from being performed and that the quantity of combustibles associated with the non-rated cabling is

considered insignificant with regard to combustible loading in the affected areas. The licensee further stated that the non-rated plenum cabling does not compromise automatic or manual fire suppression functions or the nuclear capability assessment.

Based on the review of the information submitted by the licensee, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the proposed PB method is an acceptable alternative to the corresponding NFPA 805, Section 3.3.5.1 requirement because it satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains safety margins, maintains adequate fire protection DID (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown capability), and because the action to revise plant procedures is included in LAR Attachment S, Table S-3, Implementation Item 1, which will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

3.1.4.6 NFPA 805, Section 3.3.5.2 – Metal Trays and Conduit

Section 3.3.5.2 of NFPA 805 requires the use of metal trays and metal conduit for electrical raceways. The licensee requested review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement.

In LAR Attachment L, Approval Request 6, the licensee stated that it currently uses embedded or underground plastic conduit and uses exposed electrical metallic tubing (EMT) to route power, instrumentation, and control cables and also has exposed plastic conduit for some cooling-tower-related applications.

The licensee stated that the basis for this request is that, when embedded or buried, although it is combustible, plastic conduit is not subject to damage from external fire/heat exposure that would result in structural failure, contribution to fire load, or damage to the circuits routed in the conduit; EMT is non-combustible; and, NFPA 70, "National Electrical Code" (Reference 80), permits the use of plastic conduit in embedded and underground applications and permits the use of EMT in applications where it is not subject to physical damage. The licensee further stated that the 2010 edition of NFPA 805 (Reference 81), allows the use of EMT.

The licensee stated that when embedded or underground, plastic conduit is surrounded by material that is not subject to failure mechanisms resulting in damage to the internal circuits or resulting in damage to external targets. The licensee further stated that when EMT is installed such that it is not subject to physical damage, it is not subject to failure mechanisms resulting in damage to the internal circuits or to external targets. In addition, the licensee stated that EMT is non-combustible and due to the metal composition it has some fire resistant properties; however, EMT is not as robust as a traditional metal conduit. The licensee concluded that the use of embedded or underground plastic conduit and the use of EMT do not impact NSPC. The licensee further stated that exposed plastic conduit is used in cooling tower related applications and that the cooling tower functions are not relied upon to satisfy NSPC or fire probabilistic risk assessment (FPRA).

The licensee stated that the plastic conduits or the use of EMT does not add additional radiological materials to the area or challenge system boundaries and therefore, the use of plastic conduits or the use of EMT does not impact radiological release performance criteria.

The licensee stated that the plastic conduit is embedded in a non-combustible configuration, and the EMT is non-combustible due to being metallic. The licensee further stated that exposed cooling tower related plastic conduit is not credited by the FPRA or relied upon to satisfy the NSPC and therefore, the inherent safety margin remains 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 for echelon 1 that embedded or underground plastic conduit is not subject to damage from external fire/heat exposure that would result in structural failure, contribution to fire load, or damage to the circuits routed in the conduit. EMT is non-combustible, so it would be resistant to the external fire/heat exposure that would result in structural failure, contribution to fire load, or damage to the circuits routed in the conduit when installed such that it is not subject to physical damage. The licensee stated for echelon 2 that areas where exposed plastic conduit exist, have portable fire extinguishers and hose reel stations that are available for manual firefighting activities by the site fire brigade, to assure that if a fire was to occur that the damage from the fire would be limited. The licensee stated for echelon 3, that these types of conduits do not directly result in compromising automatic fire suppression functions, manual fire suppression functions, or post-fire safe shutdown (SSD) 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 3.3.5.2 requirement because it satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains safety margins, and maintains fire protection DID (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown capability).

3.1.4.7 NFPA 805, Section 3.3.7.2 – Flammable Gas Storage

NFPA 805 Section 3.3.7.2 requires outdoor high-pressure flammable gas storage containers be located so that the long axis is not pointed at buildings. The licensee requested review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement.

In LAR Attachment L, Approval Request 7, the licensee stated that its outdoor hydrogen bulk storage consists of six cylinders and that the cylinders are orientated such that the long axis is pointing towards a metal structure that contains electrical buses F and G used to power equipment for the site cooling towers. The licensee further stated that the diesel generator 1-3 is behind electrical buses F and G.

The licensee stated that the basis for the approval request for the deviation of section 3.3.7.2 is as follows:

- The site fire brigade is trained on hydrogen fires based on lessons learned from industry operating experience.

- Operating procedures are in place and ensure technicians properly vent and purge the lines and use the appropriate tools to preclude an inadvertent ignition.

- The design and installation of the relief and rupture piping, including environmental protective covers, meet NFPA 50A, "Standard for Gaseous Hydrogen Systems at Consumer Sites" and NFPA 55, "Compressed Gases and Cryogenic Fluids Code."

- The F and G electrical buses power cooling tower equipment. This equipment is not credited in the fire safe shutdown analysis (SSA) or equipment list. There are no nuclear safety consequences if inadvertent damage is sustained by these electrical buses.

- Diesel Generator 1-3 is located approximately 40 feet from the hydrogen bulk storage. The F and G buses are located in between Diesel Generator 1-3 and the hydrogen bulk storage. It is unlikely that an event involving hydrogen bulk storage to take out the F and G buses and take out Diesel Generator 1-3.

- Administrative procedures address the electrical installations and static charge buildup precautions related to hydrogen storage.

- The frames that support the hydrogen cylinders have electrical grounding to reduce any static electrical charge build up.

The licensee stated that the loss of buses F and G does not adversely affect nuclear safety capability and that this equipment is not credited in the fire SSA or equipment list. The licensee concluded that there are no nuclear safety consequences if inadvertent damage is sustained by these electrical buses.

The licensee stated that the location of the bulk hydrogen storage area has no impact on the radiological release performance criteria. The licensee further stated that the radiological review was performed based on the potential location of radiological concerns and is not dependent on the outdoor location of the hydrogen cylinder storage area.

The license stated that the safety margin inherent in the analysis for this deviation has been preserved, since the potentially impacted cooling tower equipment is not relied upon to satisfy the NSPC.

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 for echelon 1, piping arrangements and safety relief devices are installed to meet the code requirements, the hydrogen cylinders are electrically grounded, and operating procedures are in place to ensure technicians properly vent and purge the lines and use the appropriate tools to preclude an inadvertent ignition. The licensee stated for echelon 2, the site fire brigade is trained on hydrogen fires and pre-fire plans have been established to assist the fire brigade with strategies

for hydrogen fires. The licensee stated for echelon 3, there is no electrical equipment powered from the F and G buses that is credited in the Safe Shutdown Equipment List (SSEL) and therefore a fire 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 3.3.7.2 requirement because it satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains safety margins, and maintains fire protection DID (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown capability).

3.1.4.8 NFPA 805, Section 3.5.3 – Water Supply

Section 3.5.3 of NFPA 805 requires that fire pumps be designed and installed in accordance with NFPA 20, "Standard for the Installation of Stationary Pumps for Fire Protection" (Reference 54), and be provided to ensure that 100 percent of the required flow rate and pressure are available assuming failure of the largest pump or pump power source. In LAR Attachment L, Approval Request 8, the licensee requested review and approval of a PB method to demonstrate an equivalent level of fire protection for this requirement.

The licensee stated that NFPA 20 (1966 & 1972 editions) states that the exhaust piping should not be greater than 15 feet unless the diameter is increased at least one pipe size and properly insulated from combustibles. The licensee further stated that its exhaust piping is approximately 4" in diameter for a length of more than 15 feet. In LAR Attachment L, Approval Request 8, the licensee provided additional information to demonstrate that the increased length of exhaust piping does not impact engine performance nor the ability of the pump to meet the 100 percent flow rate and pressure requirement of NFPA 805.

The licensee stated that the basis for the approval request for the deviation of section 3.5.3 is based on the pump performance records. The licensee further stated that both diesels (P-9B and P-41) provide sufficient power to meet their manufacturer's pump performance curves of pressure and flow, even though the exhaust piping diameter was not increased for being in excess of 15 feet in length. The licensee further stated that for this configuration, increasing the exhaust pipe diameter does not provide any additional margin of conservatism and that the annual test of the fire pumps confirms that the exhaust system has had no effect on pump performance.

Further, the licensee stated that it has three fire pumps, two diesel driven (P-9B and P-41) and one electric (P-9A) and that it is unlikely that both diesel driven fire pumps would be disabled due to a flow or pressure issue and if they were, P-9A would still be available. The licensee further stated that the location of the fire pumps has no impact on the radiological release performance criteria because the radiological review was performed based on the potential location of radiological concerns and is not dependent on the location of the fire pumps.

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 for echelon 1, site personnel are responsible to take the necessary precautions to prevent fires from starting during all work activities. The licensee stated that for echelon 2, the criteria being established for fire pump exhaust piping has no impact on the ability of the automatic suppression systems to perform their functions and portable fire extinguishers and hose reel stations are available for manual firefighting activities by the site fire brigade so if a fire was to occur the damage from the fire would be limited. The licensee stated that for echelon 3, the diameter being used for fire pump exhaust piping does not result in compromised automatic fire suppression functions, manual fire suppression functions, or post-fire SSD capability and will not prevent essential safety functions from being performed.

Based on the information provided by the licensee, the NRC staff concludes that the licensee has adequately demonstrated that the increased length of exhaust piping does not impact engine performance or the ability of the plant to have 100 percent of the required flow rate and pressure available, assuming failure of the largest pump or power source, in accordance with NFPA 805 section 3.5.3.

Based on its review of the information submitted by the licensee, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the proposed PB method is an acceptable alternative to the corresponding NFPA 805, Section 3.5.3 requirement because it satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains safety margins, and maintains fire protection DID (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown capability).

3.1.4.9 NFPA 805, Section 3.5.6 – Fire Pump Stop from Control Room

NFPA 805 Section 3.5.6 requires that fire pumps be provided with automatic start and manual stop only. The licensee requested review and approval of a PB method to demonstrate an equivalent level of fire protection for this requirement.

In LAR Attachment L, Approval Request 9, the licensee stated that the diesel fire pumps are provided with an automatic start feature and a manual stop at the fire pumps. The licensee further stated that in the Control Room the diesel pumps can be manually stopped if the pumps have been manually started in the Control Room and there is no auto start for low pressure signal.

The licensee stated that the basis for the approval request for the deviation of section 3.5.6 is that the manual stop in the Control Room can only be performed when the pump has been started from the Control Room; that if the pump started automatically due to a low pressure signal, then the pump would need to be manually stopped at the pump; that the code does not specifically state where the manual stop needs to be located; and that there should only be one.

The licensee stated that it has three fire pumps, two diesel driven (P-9B and P-41) and one electric (P-9A) and that fire water is credited as a backup to Service Water and Auxiliary Feedwater in various fire scenarios. The licensee further stated that there are fire systems that are also credited for the FPRA and that one fire pump can handle the largest demands of the credited fire suppression system.

The licensee stated that the location of the fire pumps has no impact on the radiological release performance criteria because the radiological review was performed based on the potential location of radiological concerns and is not dependent on the location of the fire pumps.

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 for echelon 1, in the event that a diesel fire pump is required to support fire suppression activities, the automatic start would begin on the low pressure signal and the only means by which to stop the pump would have to be performed locally at the pump. The licensee stated that a modification has been performed to only allow stop of the diesel fire pumps from the Control Room when an automatic start is not in place. The licensee stated that for echelon 2, the criteria being established for the diesel fire pump remote stop in the Control Room has no impact on the ability of the automatic suppression systems to perform their functions because if suppression is needed the automatic start would override the manual stop in the Control Room. The licensee stated that for echelon 3, the hydraulic requirements of the fire protection system are always met even if there is a remote stop capability in the Control Room.

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 3.5.6 requirement because it satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains safety margins, and maintains fire protection DID (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown capability).

3.1.4.10 NFPA 805, Section 3.5.16 – Dedicated Fire Water Supply

NFPA 805 Section 3.5.16 requires that the fire protection water supply system be dedicated for fire protection use only. The licensee requested review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement.

In LAR Attachment L, Approval Request 10, the licensee stated that the fire protection water supply system is not completely dedicated for fire protection use only. The licensee further stated that the fire protection water system is available to be used as an emergency back-up to supply the service water system (SWS), the auxiliary feedwater system, the plant air compressors, and the spent fuel pool (SFP) in accordance with established site procedures.

In fire protection engineering (FPE) request for additional information (RAI) 07 (Reference 19), the NRC staff requested that the licensee provide a definitive list of non-emergency uses of the fire protection system and an estimated, total or bounding, flow and pressure demand for such non-emergency uses and a discussion of any administrative or work controls that will be used to ensure the fire protection water supply is available when needed for fire protection. In its response to FPE RAI 07 (Reference 10), the licensee stated that LAR Attachment L, Approval Request 10 contains the definitive list of non-emergency uses of fire protection water and that these uses are traveling screen cleaning, cooling tower screen cleaning, traveling screen basket cleaning, traveling screen trough cleaning, back flushing electro-hydraulic control coolers, back

flushing condensate pump cooling coils, filling vacuum trucks, cleaning main condenser tubes, supplying condensate pump heat exchangers, cooling the feed water purity air compressors, cleaning seal oil heat exchangers, and spraying down containment and/or the courtyard in an extreme emergency situation. The licensee further stated that it plans to implement procedural controls that will require securing the alternate use upon the presence of a fire protection demand. The licensee further stated that the largest demand is the Start-up 1-1, 1-2, and 1-3 transformer deluge system and that the alternate uses are bounded by the largest demand and will be limited to less than 500 gpm which is hose stream flow postulated when determining fire suppression water flow requirements. The licensee stated its current procedures require that in the event of a non-functional diesel fire pump, the remaining diesel fire pump will be verified functional and that it has two diesel driven fire pumps and one electric fire pump, each with the capacity to handle the largest demand plus an additional 500 gpm allowance for manual fire suppression demands. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated the appropriate administrative controls to ensure availability of sufficient fire protection water when the system is being used for alternative purposes.

The licensee stated that the basis for the approval request for deviation of section 3.5.16 is as follows:

- Three fire pumps are rated for 1500 gpm at 125 psig. A single pump has the capacity to supply the largest suppression system demand, including an allowance of 500 gpm for hose streams.

- A limitation of less than 500 gpm is allowed, which is equal to the hose stream postulated in determining fire suppression water flow requirements. This ensures that the hydraulic requirements of the fire protection system are always available to be met for even the largest system requirement. Therefore, there is no adverse impact on the flow and pressure available to any automatic water based suppression systems.

- There is sufficient margin in the PNP fire water system above the required fire suppression demands. The largest design demand of any sprinkler or fixed water spray system in the power block is the deluge system for Start-up Transformers, for which the required demand of 1869.1 gpm at 85.6 psig includes 500 gpm for hose stream demands.

- Operations procedures will be revised to limit alternate uses to one non-fire protection use at a time. Fire protection personnel shall be notified prior to the approval of an alternate use.

- Personnel utilizing the fire protection water are in contact with the control room, ensuring the ability to secure the non-fire protection water system should a fire occur.

- Use of the fire protection system for non-fire uses shall only be used if there is no demand to support fire protection suppression activities, unless the fire protection water supply is needed to support a site emergency.

- Any non-fire applications of the fire water system are infrequently utilized, with Shift Manager/Control Room Supervisor approval required and documented.

- An item has been included in the Implementation Table S-3 under Item 1 to create/update procedures for the fire water uses as outlined above. These procedures will offer clear and concise guidance to strengthen the controls that are currently in place within Operator procedures.

The licensee stated that the non-fire use of the fire water system is an occurrence requiring Shift Manager/Control Room Supervisor review and concurrence and that the flow limitations ensure that there is no impact on the ability of the automatic suppression systems to perform their functions. The licensee further stated that the ability to isolate the non-fire protection flows ensures there is no impact on manual fire suppression efforts and therefore, there is no impact on the NSPC.

The licensee stated that the use of fire water for non-fire applications requires Shift Manager/Control Room Supervisor review and concurrence to ensure the suppression function is maintained and that the use of the fire water system for non-fire applications does not add additional radiological materials to the area or challenge system boundaries and therefore, has no impact on the radiological release performance criteria.

The licensee stated that the non-fire use of the fire water system has no impact on the ability of the automatic suppression systems to perform their functions and flow will be available for the manual fire suppression demands when needed. Therefore the safety margin inherent in the analysis for a fire event 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 for echelon 1, site personnel are responsible for taking the necessary precautions to prevent fires from starting during all work activities including the use of the fire water system for non-fire purposes (less than 500 gpm), which is controlled by precautions and prerequisites within each of the applicable procedures and work orders. The licensee stated that for echelon 2, non-fire use of the fire water system has no impact on the ability of the automatic suppression systems to perform their functions and flow will be available for the manual fire suppression demands when needed. The licensee stated that for echelon 3, the hydraulic requirements of the fire protection system are always available to be met for even the largest system requirement and that the time between securing the non-fire protection uses and the application of manual firefighting (i.e., 500 gpm hose stream) ensure the fire protection system will be capable of performing its design function, and that a fire 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 3.5.16 requirement because it satisfies the

performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains safety margins, and maintains fire protection DID (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown capability).

3.1.4.11 NFPA 805, Section 3.11.4(b) – Penetration Fire Stops

NFPA 805 Section 3.11.4(b) states that conduits shall be provided with an internal fire seal that has an equivalent fire-resistive rating to that of the fire barrier through opening fire stop and shall be permitted to be installed on either side of the barrier in a location that is as close to the barrier as possible. The licensee requested review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement.

In LAR Attachment L, Approval Request 11, the licensee requested approval for the use of internal conduit seal design guidance provided in the detailed fire test and report for alternative internal conduit seal configurations.

The licensee has proposed the following alternative design configurations for internal conduit seals. The licensee stated that every conduit is to be provided with fire sealing that has an equivalent fire-resistive rating to that of the fire barrier with the following exceptions:

1. Conduits that terminate in a junction box or other noncombustible closure do not require fire or smoke sealing. Conduits that run through an area but do not terminate in that area do not require fire or smoke sealing.

2. Conduits smaller than 2 inches in diameter that terminate 5 feet or greater from the barrier do not require fire or smoke sealing.

3. Conduits 2 inches in diameter that terminate 5 feet or greater from the barrier do not require fire sealing, but do require smoke sealing.

4. Conduits greater than 2 inches in diameter that terminate 5 feet or greater from the barrier and have a cable fill of 40 percent or greater do not require fire sealing, but do require smoke sealing. If the cable fill is less than 40 percent, fire sealing is required.

The licensee stated that these alternative conduit sealing configurations are based on fire tests and a report dated June 1, 1987. The licensee stated that this report established guidelines for conduit fire and smoke sealing based on fire testing conducted by a group of nuclear utilities and that the testing evaluated the importance of factors such as distance of conduit termination from the barrier, conduit diameter, cable fill, conduit termination, and type of conduit.

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

- The proposed criteria are based on rigorous testing aimed at determining the importance of conduit characteristics to propagation of fire, smoke, and hot gases through the conduit.

- Conduits that terminate in a noncombustible closure such as a junction box will not allow the passage of fire, smoke, or hot gases. The closure prevents fire, smoke, and hot gases from escaping the conduit system and penetrating the fire barrier.

- Conduits smaller than 2 inches in diameter significantly restrict the propagation of fire, smoke, and hot gases through the conduit. A conduit of this size extending 5 ft. or greater from the barrier will not allow the passage of fire, smoke, or hot gases through the barrier.

- High cable loadings within a conduit act as an effective seal to the propagation of fire, smoke, and hot gases. Cables restrict the flow of smoke and hot gases and also act as a heat sink. A cable fill of 40 percent or greater is adequate to prevent the propagation of fire (but not smoke and hot gases) in conduits greater than 2 inches in diameter.

- An Attachment S (Table S-2, "Plant Modifications Committed") item has been created to modify seals that do not meet the acceptance criteria outlined above. Attachment S (Table S-3, "Implementation Items") has been created to update the penetration seal procedures to use the acceptance criteria above.

The licensee stated that following the above criteria for conduit sealing ensures that the integrity of the fire barrier is not compromised by the penetrating conduits. The licensee further stated that the report results show that none of the conduit configurations tested allowed the propagation of fire through the barrier and therefore, the application of the sealing criteria does not impact NSPC.

The licensee stated that the radiological release review was performed based on activities in areas containing or potentially containing radioactive materials and is not dependent on how conduits are sealed at fire barriers. The licensee further stated that the conduit seals do not add additional radiological materials to the area or challenge system boundaries and therefore, the application of the sealing criteria does not impact radiological release performance criteria.

The licensee stated that 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 for echelon 1, site procedures are established to limit exposure to ignition sources, the internal seals do not increase the amount of combustibles in any area, and none of the conduit configurations tested allowed the propagation of fire through the barrier. The licensee stated that for echelon 2, criteria being established for internal conduit seals have no impact on the ability of the automatic suppression systems to perform their functions, none of the conduit configurations tested allowed the propagation of fire through the barrier, and portable fire extinguishers and hose reel stations are available for manual firefighting activities by the site fire brigade so that if a fire was to occur the damage from the fire would be limited. The licensee stated that for echelon 3, the criteria being established for internal conduit seals does not allow fire propagation through the barrier and does not result in compromised automatic fire suppression functions, manual fire

suppression functions, or post-fire SSD 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 3.11.4(b) requirement because it satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains safety margins, and maintains fire protection DID (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown capability).

3.2 Nuclear Safety Capability Assessment (NSCA) Methods

The 2001 Edition of NFPA 805 (Reference 3), is a risk-informed, performance-based (RI/PB) standard that allows engineering analyses to be used to show that fire protection program (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 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 [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.

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 NSPC in Chapter 1;
>
> (2) Selection of cables necessary to achieve the NSPC in Chapter 1;
>
> (3) Identification of the location of nuclear safety equipment and cables; and

(4) Assessment of the ability to achieve the NSPC given a fire in each fire area.

This safety evaluation (SE) section evaluates the first three steps listed above. Section 3.5 of this SE addresses the assessment of the fourth step.

Regulatory Guide (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 31), and describes 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 Worksheet" 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 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, Revision 1, endorses NEI 00-01, Revision 2, (Reference 31), the licensee's review was performed to the guidance in NEI 00-01, Revision 1 (Reference 60), as discussed in LAR, Section 4.2.1.1. In addition, the licensee stated that a review of NEI 00-01, Revision 2, Chapter 3, was conducted against the substantive changes applicable to an NFPA 805 FPP in the guidance from NEI 00-01, Revision 1. Based on the information provided in the licensee's submittal, as supplemented, a systematic process to evaluate the post-fire SSD analysis (SSA) against the requirements of NFPA 805, Section 2.4.2, and the licensee used subsections (1), (2), and (3), which meets the methodology outlined in the latest NRC-endorsed industry guidance.

Frequently asked question (FAQ) 07-0039 (Reference 61), 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 B-2 Table in accordance with NEI 04-02, Revision 2 (Reference 7), as modified by FAQ 07-0039.

The categories used by the licensee 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 Table B-2 as "Aligns."

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

3. The SSA will directly align with the attribute when an action is taken: noted in LAR Table B-2 as "Will comply, With the Use of Commitment."

Alignment approach 3, "Will comply, With the Use of Commitment," is a change from the NEI 04-02 based approach in that it is a new category not included in NEI 04-02, Revision 2. The intent of this choice is to identify FPP elements that will align after completion of an action by the licensee.

The licensee stated in LAR Section 4.2.1.1, "Compliance with NFPA 805 Section 2.4.2" that no applicable sections were determined to not align with the guidance.

Some attributes may not be applicable to the SSA (e.g., the attribute may be applicable only to BWRs or PWRs) and are noted in LAR Table B-2 as "N/A."

As described in the LAR Section 4.2.1.1, the licensee also performed a review of NEI 00-01, Revision 2, Chapter 3, against the following substantive changes applicable to an NFPA 805 FPP in the guidance from NEI 00-01, Revision 1:

- 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 its evaluation and LAR Attachment G, Table G-1 "Recovery Actions Required to Resolve VFDRs to Meet Risk Criteria" indicates that there are three required RAs on rising stem motor-operated valves taken within the fire area of concern. The licensee determined that the valves would not be susceptible to direct fire effects and would remain operable post-fire.

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

  The licensee concluded that high voltage on the secondary side of a current transformer (CT), as a result of an open circuited secondary, will not cause the CT to fail in a manner that starts a secondary fire or damages nearby SSD equipment, and therefore, CT circuit cables are therefore not considered to be a common enclosure concern.

- Analysis of control power for switchgear with respect to breaker coordination (NEI 00-01 Section 3.5.2.4).

The licensee stated that control power for switchgear is modeled in the SSD circuit selection and documented in plant reports and that fire area compliance issues have been identified as VFDRs.

The licensee's response stated that, based on its review against the endorsed criteria as described above, it aligns with the guidance provided in NEI 00-01, Revision 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

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 information provided by the licensee in the LAR, as supplemented, and the information provided during the NFPA 805 site audit (that is, the documents reviewed, discussions held with the licensee, and the plant tours performed), the NRC staff concludes that the licensee's statements of alignment are acceptable because the analyses are consistent with regulatory guidance for selecting the systems and equipment and their interrelationships necessary to achieve the NSPC, selection of the cables necessary to achieve the NSPC, and the identification of the location of nuclear safety equipment and cables.

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 Pressurizer Heaters
- 3.1.1.10 Manual Initiation of Systems
- 3.2.1.5 Instrument Failure
- 3.2.1.6 Spurious Operation
- 3.3.1.2 Cable Failures Affecting Multiple Safe Shutdown Equipment

- 3.4.1.4 Manual Actions

For attribute 3.1.1.3, pressurizer heaters, the alignment basis addresses primary coolant system pressure control and does not require the use of pressurizer heaters, with the exception of tripping and maintaining positive control. Pressure control is maintained by the use of a charging pump and pressurizer power operated relief valves or auxiliary spray valve. The NRC staff concludes that, based on the information provided by the licensee in the LAR Table B-2, as supplemented; the documents reviewed, and discussions held with the licensee's technical staff during the on-site NFPA 805 audit (Reference 82), that the licensee's statements of alignment with the endorsed guidance in NEI 00-01 are acceptable because the licensee has demonstrated that its FPP features and systems provide sufficient capability to meet the requirements of 10 CFR 50.48(c).

For attributes 3.1.1.10 manual initiation of system and attribute 3.3.1.2, cable failures affecting multiple SSD equipment, the licensee maintains that automatic initiation is not credited in the analysis. System and component operation are generally controlled from the main control room (MCR) or the alternate hot shutdown panel, if evacuation of the MCR is required. Additionally, the circuit analysis identified all cables, including associated circuits, which could potentially affect each SSD component. Each cable is listed with the component affected. The licensee has incorporated the post-fire SSA into a computerized SSA tool which maintains success path models of performance goals, systems, equipment, and cables. The analysis software identifies all of the SSD components and cables that are located in the analysis area and fail as a direct consequence of the fire. The effect of these location failures is then propagated by the software through the cable logic, component logic, system logic, and finally the performance goal logic in order to evaluate the overall impact upon SSD capability. This iterative process identifies the equipment, systems, and performance goals that fail as an indirect consequence of the fire. The results of the analysis are documented and any VFDR identified during the analysis are evaluated under the fire risk evaluation (FRE) process. These results are documented in LAR Attachment C, Table B-3. The NRC staff concludes that, based on the information provided by the licensee in Table B-3, as supplemented, the documents reviewed, and discussions held with the licensee's technical staff during the on-site NFPA 805 audit, that the licensee's statements of alignment with the endorsed guidance in NEI 00-01 are acceptable because the licensee has demonstrated that its FPP features and systems provide sufficient capability to meet the requirements of 10 CFR 50.48(c).

For attribute 3.2.1.5, instrument failure, fire induced faults causing a current or voltage signal within the normal operating range of the instrumentation to be superimposed on the circuits are assumed not to occur. Grounded, shielded cable is used for instrumentation circuits and an external signal would need to find a path through the shield to cause a potential problem. Additionally, it is assumed that a wire to wire short internal to a shielded cable will be accomplished by those wires shorting to the grounded shield. Due to the above assumptions, direct acting current to pneumatic signal converters and voltage to pneumatic signal converters are assumed to fail electrically in all cases such that their pneumatic output signal will be at its lowest value. The licensee stated that instruments exposed to a fire suffer damage which results in failure of the instruments. The instrument fluid boundary associated with these devices, however, remains intact. Instrument sensing lines exposed to a fire may cause an erratic or unreliable indication. Sight glass indicators are considered to be mechanical equipment, and, as such, are not susceptible to fire damage. The NRC staff concludes that,

based on the information provided by the licensee in the LAR Table B-2, as supplemented, the documents reviewed, and discussions held with the licensee's technical staff during the on-site NFPA 805 audit, that the licensee's statements of alignment with the endorsed guidance in NEI 00-01 are acceptable because the licensee's analysis continues to identify and assess the fire-induced impact on instruments as required by NFPA 805. The NRC staff also concludes that the licensee identified instrument circuits needed to meet the NSPC in accordance with NFPA 805 Section 2.4.2.1, performed circuit analysis to determine the failure mode of those instruments in accordance with NFPA 805, Section 2.4.2.2, and addressed the fire-induced impacts on those instruments in the FREs performed during transition, in accordance with NFPA 805, Section 2.4.2.4.

For attribute 3.2.1.6, spurious operations, equipment is identified that could spuriously operate or mal-operate and impact the performance of equipment on a required SSD path during the equipment selection phase. NEI 00-01 requires consideration of conductor to conductor shorts in the same cable and conductor to conductor shorts in different cables when both have thermoplastic insulation. The licensee's circuit analysis did not exclude any shorts on the basis of cable insulation type, and used the "hot probe" method of NEI 00-01 when considering hot shorts. The NRC staff concludes that, based on the information provided by the licensee in the LAR Table B-2, as supplemented, the documents reviewed, and discussions held with the licensee's technical staff during the on-site NFPA 805 audit, that the licensee's statements of alignment with the endorsed guidance in NEI 00-01 are acceptable because the licensee has demonstrated that FPP features and systems provide sufficient capability to meet the requirements of 10 CFR 50.48(c).

For attribute 3.4.1.4, manual actions, the licensee stated that NEI 00-01 directs the licensee to use manual actions where appropriate to achieve and maintain post-fire SSD conditions in accordance with NRC requirements. The original analysis methodology was performed against the separation requirements of Appendix R, and was not consistent with staff interpretations. As part of NFPA 805 transition, the licensee has incorporated the post-fire SSA in to a computerized SSA tool, which maintains success path models of performance goals (methods), systems, equipment, and cables. This iterative process identifies the equipment, system, and performance goals that fail as a direct consequence of the fire. Any VFDRs identified during the analysis are documented and evaluated under the FRE process and the results documented in LAR Attachment C, Table B-3. The NRC staff concludes that, based on the information provided by the licensee in the LAR Attachment C, Table B-3, as supplemented, the documents reviewed, and discussions held with the licensee's technical staff during the on-site NFPA 805 audit, that the licensee's statements of alignment with the endorsed guidance in NEI 00-01 are acceptable because the licensee has demonstrated that its FPP features and systems provide sufficient capability to meet the requirements of 10 CFR 50.48(c).

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

The licensee did not identify any attributes in this category.

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

The licensee did not identify any attributes in this category.

3.2.1.5 Attribute Alignment -- Not in Alignment

The licensee did not identify any attributes in this category.

3.2.1.6 Attribute Alignment – Will comply, With the Use of Commitment

For two of the NEI 00-01, Chapter 3 attributes, the licensee determined that the SSA will align with the attribute when an identified action is completed. 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 attributes identified in LAR Table B-2 as having this condition are as follows:

- 3.3.1.7 Associated Circuits
- 3.5.2.4 Circuit Failures Due to Inadequate Circuit Coordination

LAR Table B-2 states that the licensee methodology will align with the attributes of Sections 3.3.1.7 and 3.5.2.4 when the modification and issues required to be addressed have been completed. Condition reports were written with detailed corrective actions identified by the plant. For attributes 3.3.1.7 and 3.5.2.4, the coordination of all credited power supplies has been evaluated. Issues identified were documented in condition reports and the required modification has been identified in LAR Attachment S, Table S-2, as item S2-23. The NRC staff concludes that, based on the information provided by the licensee in the LAR Table B-2, as supplemented, the documents reviewed, and discussions held with the licensee's technical staff during the on-site NFPA 805 audit, that the licensee's statements of alignment with the endorsed guidance in NEI 00-01 are acceptable because the licensee's analysis continues to identify and assess the fire-induced impact on associated circuits and circuit failure due to inadequate circuit coordination required by NFPA 805. The NRC staff also concludes that the licensee identified electrical circuits needed to meet the NSPC in accordance with NFPA 805, Section 2.4.2.1, performed circuit analysis to determine the failure mode of those circuits in accordance with NFPA 805, Section 2.4.2.2, and addressed the fire-induced impacts on those circuits in the FREs performed during transition in accordance with NFPA 805, Section 2.4.2.4. In addition, the licensee identified a modification that is included in LAR Attachment S which will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

3.2.1.7 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 NSCA methodology requirements using NEI 00-01, Revision 1 with a gap analysis to the NRC-endorsed process in Chapter 3 of NEI 00-01 Revision 2. The results of the review are documented in LAR Attachment B, Table B-2, in accordance with NEI 04-02, Revision 2 along with the gap analysis for NEI 00-01, Revision 2, as discussed in LAR Section 4.2.1. The licensee identified three main issues that are specific substantive changes in the guidance from NEI 00-01 Revision 1, and summarized these issues and resolutions in LAR Section 4.2.1.

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 accepts the licensee's method because it either:

- Met the NRC-endorsed guidance directly;
- Met the intent of the endorsed guidance and adequate justification was provided;
- Will comply upon completion of an action.

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 83), since NFPA 805 only requires the licensee to maintain the fuel in a safe and stable condition rather than achieve and maintain cold shutdown in 72 hours. In LAR Section 4.2.1.2, the licensee stated that the NFPA 805 licensing basis is to maintain safe and stable conditions for extended periods and that some success sequences require long term make-up to the primary coolant system, sustaining auxiliary feedwater system water sources, or maintaining long term fuel supply for the emergency diesel generators. The nuclear safety goal of NFPA 805 is to provide reasonable assurance that, should a fire occur during any operational mode or aligned configuration, the plant will not be prevented from achieving and maintaining the fuel in a safe and stable condition. A safe and stable condition is defined as the ability to maintain Keff <0.99, with a reactor coolant temperature at or below the requirements for hot standby. In LAR Attachment C, Table B-3, the licensee identified its ability to achieve and maintain NFPA 805 safe and stable conditions following shutdown from full power conditions and that safe and stable conditions can be maintained "long term" with forced or natural circulation via the steam generators.

In SSA RAI 05 (Reference 19), the NRC staff requested that the licensee provide clarification regarding repairs required, system capacity limitations, and a qualitative description of the risk associated with safe and stable conditions. In its response to SSA RAI 05 (Reference 11), the licensee stated that recovery actions (RAs) are credited to restore equipment functions, but that repair of equipment is not credited in this assessment as being relied upon to achieve safe and stable conditions. The licensee further stated that for capacity limitations, the instrument and service air system as a whole is not credited for maintaining NFPA 805 safe and stable conditions and that for air controlled valves supporting SSD conditions, selected valve controls have been supplied with backup nitrogen or compressed air supplies. The licensee further stated that these alternate supplies are connected to the valve's air supply line and isolated only with check valves and should the air supply fail, the alternate supply will align without the need for operator action.

In addition, the licensee stated that the remote hot shutdown monitoring and control panels are powered from one of two 125 VDC buses and that RAs address use of the shunt trip to protect the battery associated with their power supply. The licensee further stated that once the main 125 VDC bus has been removed from the battery, the battery has been shown to be able to

power the panel for at least 72 hours and that modification S2-19 to allow the connection of a remote generator to these panels for extended operation beyond battery life is included LAR Attachment S, Table S-2. The licensee further stated that for events where a battery may lose charging capability, RAs are established to cross connect a battery charger from the opposite train's AC power to restore the 125 VDC Bus power supply and that loss of a given battery charger may occur if operation is aligned in a cross connected configuration where one charging train is connected to the opposite train's battery and that modification S2-26 to provide the capability to align a cross-train battery charger to the same train power supply is included in LAR Attachment S, Table S-2.

The licensee further described the risk associated with achieving safe and stable conditions. The licensee stated that operator actions are established in the NSCA with respect to the equipment required to achieve and maintain NFPA 805 safe and stable conditions and that the analysis addresses equipment failure and actions that may be required for recovery. The licensee further stated that the equipment and associated operator actions are then evaluated in the FPRA, establishing the risk associated with achieving safe and stable conditions and that once safe and stable conditions have been achieved, maintaining these conditions parallels actions associated with plant shutdown. The licensee further stated that site emergency organizations, as well as off-site resources, will be aligned to support evaluation, planning, and performance of ongoing operating activities needed to maintain the plant in a safe and stable condition and that operation under these conditions presents a low risk environment for maintaining safe and stable conditions as activities have shifted from immediate, time critical response actions, to an evaluated and planned state of operation.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated it has appropriately identified a process and actions related to maintaining fuel in a safe and stable condition and because the actions are included in LAR Attachment S as modifications which would be required by the proposed license condition.

Based on a review 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 References," and LAR Attachment C, "NEI 04-02 Table B-3 – Fire Area Transition," to evaluate whether the licensee meets the feed and bleed requirements. In LAR Table 5-3, the licensee stated that feed and bleed is not utilized as the sole fire protected SSD path for any scenario.

The NRC staff confirmed this by reviewing the designated SSD path listed in LAR Attachment C for each fire area. This review confirmed that all fire area analyses include the SSD equipment necessary to provide decay heat removal without relying on feed and bleed and that 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 was acceptable. The NRC staff concludes that, based on the information provided in LAR Table 5-3 as well as the fire area analyses documented in LAR Attachment C, that 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.

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 NSPC, including spurious operation and signals.

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

The NRC staff reviewed LAR Section 4.2.1.4, "Evaluation of Multiple Spurious Operations," and LAR Attachment F, "Fire-Induced Multiple Spurious Operations Resolution," to determine whether the licensee has adequately addressed MSO concerns. The licensee stated that a review and evaluation of susceptibility to fire induced MSOs was performed and that the process was conducted in accordance with NEI 04-02 (Reference 7), and RG 1.205 (Reference 4), as supplemented by FAQ 07-0038, Revision 1 (Reference 59), and that the PWR Generic MSO lists dated March 25, 2008, and July 12, 2010, were utilized. LAR Attachment F describes the process undertaken for evaluation of the MSO concerns required to be addressed as part of the NFPA 805 transition. The licensee stated that the preparation phase for the MSO expert panel review included developing a list of scenarios to consider during the onsite review meeting and ensuring that the appropriate expertise/experience was represented. The licensee further stated that both the initial and follow up expert panel included individuals with expertise in Fire Protection, PRA, NPP Operations, System Engineering, Thermal-Hydraulics, Neutronics, Circuit Analysis, Electrical Engineering, and Appendix R SSA.

The licensee stated that an initial expert panel review was conducted in July 2008 and a follow up expert panel was convened on March 15, 2011, to address all additions, deletions, and/or changes to the MSO assessment that had occurred due to post-expert panel reviews and consideration of the most current information available from the Pressurized Water Reactors Owner's Group (PWROG). The licensee further stated that all scenarios identified as new or changed were reviewed and dispositioned by the reconvened expert panel and changes or clarifications to the MSO report were incorporated as needed. The licensee stated that the expert panel conducted a step-by-step discussion, reviewing plant documents, postulating scenarios, identifying potential consequences and likelihoods, discussing operator responses and proposing various courses of action and that the results of the expert panel reviews of each potential MSO are documented.

The licensee stated that a comprehensive review of each of the MSO items was undertaken and that the process and the associated analyses resulted in some items no longer being recommended for inclusion in the model while others were confirmed to warrant inclusion in the model. The licensee further stated that as the specific reviews were completed and documented, additional logic was added to the FPRA model. The licensee further stated that the PRA model changes and the basis for inclusion or exclusion of the identified MSOs are documented in the MSO report and that the rationale for inclusion or exclusion of MSOs from the SSA is documented in the MSO evaluation.

In SSA RAI 03 (Reference 19), the NRC staff requested that the licensee describe the process used to review final documents to ensure no changes had occurred to the draft documents listed in the LAR Attachment F, that could affect the results, and also to confirm the completion of that activity, or the identification of future work in LAR Attachment S. In its response to SSA RAI 03 (Reference 10), the licensee stated that following the initial expert panel review and prior to the issuance of the MSO report, the latest list of generic PWR MSOs was reviewed by members of the FPRA team. The licensee further stated that a final reconvening of the expert panel was performed in March 2011 to address all additions, deletions and/or changes to the MSO assessment that have occurred due to post-expert panel reviews and in consideration of the most current information available from the PWROG. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee confirmed that changes to the MSO assessment since the original expert panel have been appropriately reviewed and evaluated.

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 licensee's process provides reasonable assurance that the FREs appropriately identify and include risk significant MSO combinations and that the licensee's approach for assessing the potential for MSO combinations is acceptable.

3.2.5 Establishing Recovery Actions

NFPA 805, Section 1.6.52, "Recovery Action," defines a 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 [Sections] 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 58), and RG 1.205 (Reference 4), the methodology used to determine RAs required for compliance consisted of the following steps:

1. Defining the primary control station(s) (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 RAs.

OMAs meeting the definition of a 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.

In LAR, Attachment G, the licensee described the FRE process, which identified important OMAs in four categories:

- Table G-1 – RAs Required to Resolve VFDRs to Meet Risk Criteria;
- Table G-2 – RAs Required to Meet DID Criteria;
- Table G-3 – Operator Actions Required for Additional Risk Reduction; and
- Table G-4 – Operator Actions taken at PCSs.

The licensee stated that all VFDRs were identified by fire area in LAR Attachment C, Table B-3 and that each VFDR was evaluated using the PB approach of NFPA 805, Section 4.2.4. The licensee further stated that the PB evaluations resulted in the need for RAs to meet the risk acceptance criteria or maintain a sufficient level of DID.

The licensee defined RAs required to resolve VFDRs to meet risk criteria, identified in the LAR, Attachment G, Table G-1, as actions taken outside the PCS and to directly resolve a VFDR of NFPA 805 Section 4.2.3. The licensee stated that these actions are taken to demonstrate the availability of a success path for the NSPC in the fire area and are required because the resulting delta risk of the VFDR may be significant absent the RA.

The licensee defined defense-in-depth recovery actions (DID-RAs), identified in LAR Attachment G, Table G-2 as, "actions are taken outside the primary control station and directly resolve a variance from the deterministic requirements of NFPA 805 Section 4.2.3. These actions are taken to demonstrate the availability of a success path for the nuclear safety performance criteria in the fire area. However, the resulting delta risk of the VFDR is not significant and these actions are only required based on defense-in-depth considerations."

The licensee stated that all credited RAs, as listed in LAR Attachment G (including DID-RAs), were subjected to a feasibility review. In accordance with the NRC-endorsed guidance in NEI 04-02, the feasibility criteria used in the licensee's assessment process were based on each of the feasibility criteria in FAQ 07-0030 and were assessed for the RAs listed in LAR Attachment G, Tables G-1, "Recovery Actions Required to Resolve VFDRs to Meet Risk Criteria" and Table G-2, "Recovery Actions Required to Meet Defense-in-Depth Criteria." The licensee included Implementation Items 1 and 3 in LAR, Attachment S, Table S-3 to revise post-fire SSD procedures and training as necessary to incorporate updated NSCA strategies.

Based on the above considerations, the NRC staff concludes that the licensee 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 Implementation Items 1 and 3 described in LAR, Attachment S, Table S-3, because the implementation items would be required by the proposed license condition.

3.2.6 Plant Specific Treatments or Technologies

3.2.6.1 Very Early Warning Fire Detection System

The licensee proposed the installation of several very early warning fire detection systems (VEWFDS) to monitor conditions, as well as provide indication and alarms for general area fire detection during the incipient stage of a fire. VEWFDS will be installed in the following fire areas:

- FA-1 (Control Room)
- FA-2 (Cable Spreading Room)
- FA-3 (1D Switchgear Room)
- FA-4 (1C Switchgear Room)
- FA-11 (Battery Room #2)
- FA-12 (Battery Room #1)
- FA-21 (Electrical Equipment Room)

The use of area wide VEWFDS is not credited in the fire probabilistic risk assessment (FPRA) as indicated in LAR, Attachment S, Table S-2, Modification Item S2-18. The licensee stated that this modification will remove the existing obsolete fire detection systems and install new systems as necessary to meet the requirements of NFPA 72.

3.2.6.2 Use of Fuel Fired Temporary Fans

In SSA RAI 07 (Reference 19), the NRC staff identified provisions for use of fuel fired portable fans as a means for cooling the MCR in certain fire scenarios. Specifically, the NRC staff identified that the use of gasoline near the MCR does not align with GDC-3 because it presents a hazard to equipment important to nuclear safety. The use and refueling of a portable gasoline-powered blower presents a hazard to SSCs important to nuclear safety. In its response to SSA RAI 07 (Reference 13), the licensee stated that "ENO determined that an alternate approach to resolve VFDRs that rely on the use of gasoline powered portable fans for temporary control room ventilation was necessary at PNP. Implementation of an alternate approach, consistent with the requirements of GDC-3, will be included as part of the overall NFPA 805 implementation timeline." Additionally, the licensee provided confirmation that there are no other VFDRs/RAs, beyond temporary MCR ventilation, that relied on the use of gasoline powered portable fans. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee indicated that it will develop an alternative approach, consistent with the requirements of GDC-3 regarding the use of gasoline-powered blowers near SSCs important to nuclear safety and because development of that alternative approach is included in LAR Attachment S, Table S-3, Implementation Item 1 which will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

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 concludes that the licensee's declared safe and stable condition proposed is acceptable because the licensee's analysis process has adequately and appropriately identified and located 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 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, as supplemented, the process used to identify and analyze MSOs is considered comprehensive and thorough. Through the use of an expert panel process, in accordance with the guidance of RG 1.205, NEI 04-02, and FAQ 07-0038, potential MSO combinations were identified and included as necessary 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 consistent with NRC-endorsed guidance.

The NRC staff reviewed the proposed installation of a VEWFDS to monitor conditions in certain key fire areas. Based on the information provided in the LAR, as supplemented, the NRC staff concludes that the fire protection aspects of the proposed VEWFDS installation are acceptable because the installation will meet the requirements of NFPA 72.

The NRC staff concludes that, based on the information provided in the LAR, as supplemented, and the information obtained during the NFPA 805 site audit (documents reviewed and discussions with the licensee's staff) that the process used by the licensee to review, categorize and address RAs during the transition from the existing deterministic fire protection licensing basis to a RI/PB FPP is consistent with the NRC-endorsed guidance contained in NEI 04-02 and RG 1.205, regarding the identification of RAs and other actions required to be taken at a PCS. The licensee has identified the actions to be taken at a PCS as well as identified those actions that meet the definition of a RA provided in NFPA 805 Section 1.6.52. Upon completion of the modifications and implementation items as described in LAR Attachment S, Tables S-2 and S-3, the NRC staff concludes that there is reasonable assurance that the regulatory requirements of 10 CFR 50.48(c) and NFPA 805 for NSCA methods are met.

3.3 Fire Modeling

NFPA 805 (Reference 3), allows both fire modeling (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 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 SSCs based on the conservation equations or empirical data."

The NRC staff reviewed the 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, 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, to determine whether the FM used to support transition to NFPA 805 is acceptable.

In LAR Section 4.5.2.1, the licensee indicated that the FM approach (NFPA 805 Section 4.2.4.1) was not used for the NFPA 805 transition. The licensee used the FRE PB method (i.e., FPRA) with input from FM analyses. Therefore, the NRC staff reviewed the technical adequacy of the 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 to support compliance with NFPA 805, Section 4.2.4.1, as part of this LAR supporting the transition to NFPA 805 at PNP.

3.4 Fire Risk Evaluations

This section addresses the licensee's fire risk evaluation performance-based method, which is based on NFPA 805 (Reference 3), Section 4.2.4.2. The licensee chose to use only the FRE PB method in accordance with NFPA 805, Section 4.2.4.2. The fire modeling PB method of NFPA 805 Section 4.2.4.1 was not used for this application.

NFPA 805, Section 4.2.4.2, "Use of Fire Risk Evaluations," states 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 [DID], 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 [NPFA 805,] 2.4.3 ["Fire Risk Evaluations"].

3.4.1 Maintaining DID and Safety Margins

NFPA 805, Section 4.2.4.2, states 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." DID and safety margins are discussed in the below sections. Integrated assessment of the acceptability of risk is discussed in SE Section 3.4.6.

3.4.1.1 Defense-in-Depth

NFPA 805, Section 1.2, 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:
>
> (1) Preventing fires from starting
>
> (2) Rapidly detecting fires and controlling and extinguishing promptly those fires that do occur, thereby limiting fire damage
>
> (3) Providing an adequate level of fire protection for structures, systems, and components important to safety, so that a fire that is not promptly extinguished will not prevent essential plant safety functions from being performed

The NRC staff reviewed LAR (Reference 8), Section 4.5.2.2, "Fire Risk Approach", 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 PNP.

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's methodology for evaluating DID refers to each of the three DID elements identified in LAR Section 4.5.2.2, and in more detail in the response to SSA RAI 04 (Reference 10), as echelons 1, 2, and 3, respectively. The licensee provided several examples of fire protection features for the three echelons as well as a discussion of the considerations used in assessing those features.

As described in the response to SSA RAI 04 (Reference 10), this method for addressing DID was implemented in the FREs performed on each PB fire area. The licensee evaluated fire area risk and scenario consequences to identify general DID echelon imbalances, and additional fire protection systems and features were credited, if necessary, to improve the balance between the echelons. To aid in the assessment of DID, the FPRA quantification for each fire area considered whether any FPRA scenario credited manual or automatic detection suppression, had a high conditional core damage probability (CCDP) (i.e., greater than 0.1), or had a high core damage frequency (CDF) (i.e., greater than 1.0E-06/year). The licensee stated that adequate balance is considered achieved if, for each fire scenario, there is not an overreliance on any one echelon.

Based on its review of the LAR, the response to SSA RAI 04, and the review of the FREs during the audit, 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, in part, 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 [the change] provides sufficient margin to account for analysis and data uncertainty.

LAR Section 4.5.2.2, "Fire Risk Approach," 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 VFDRs.

LAR Section 4.5.1.2 states that the FPRA, including fire modeling performed to support the FPRA, applies methodologies consistent with the guidance in NUREG/CR-6850 (Reference 40), (Reference 41), and (Reference 42), and, according to LAR Attachment H, NRC-approved FAQs. LAR Attachment J explains that fire modeling, including verification and validation (V&V), performed in support of the FPRA utilized accepted codes and standards including NUREG/CR-6850, NUREG-1805 (Reference 46), NUREG-1824 (Reference 47), etc. In a letter dated September 30, 2013 (Reference 10), the licensee responded to SSA RAI 04 and further described the methodology used to evaluate safety margins in the FREs to include the following evaluations and determinations:

- Codes and standards or their alternatives accepted for use by the NRC: Applicable codes and standards were reviewed against plant configuration and process. Changes for each fire area were identified and actions were established to modify plant configuration to meet code requirements, or the condition was evaluated as being acceptable for the configuration.

- Safety analysis acceptance criteria in the licensing basis (e.g., Final Safety Analysis Report (FSAR), supporting analyses) are met, or provide sufficient margin to account for analysis and data uncertainty, thereby establishing that the safety margins inherent in the analyses for the plant design basis events have been preserved in the analysis for fire events.

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 32), and 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 the review of the FREs during the audit, 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 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) PRA during at-power conditions. For the development of the FPRA, the licensee modified its IEPRA model to capture the effects of fire. In LAR Section 4.8.2, the licensee stated 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.

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 consisted of a full scope peer review that was performed in October 2009 using the NEI 05-04 process (Reference 84), and Section 2 of the combined ASME/ANS PRA standard as clarified by RG 1.200, Revision 2 (Reference 33), as discussed in LAR Section 4.5.1.1 and confirmed by the response to PRA RAI 22 (Reference 11). 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.

For many supporting requirements (SRs), there are three degrees of "satisfaction" referred to as Capability Categories (CC) (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 other 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. For each SR, the PRA reviewer from the peer review team designates one of the CCs or indicates that the SR is met or not met.

LAR Attachment U, Table U-1 provides the licensee's dispositions to all 78 facts and observations (F&Os) related to the IEPRA, which include 52 F&Os characterized as findings and 26 F&Os characterized as suggestions per peer review guidelines (Reference 84). 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, consistent with RG 1.200, Revision 2.

As described in LAR Attachment U, the licensee dispositioned each F&O by assessing the impact of the F&O on the FPRA and the results for the LAR. By letter dated August 8, 2013 (Reference 19), the NRC staff requested additional information to assess the adequacy of some of the F&O dispositions for the review. The NRC staff evaluated each F&O and the licensee's disposition in LAR Attachment U to determine whether the F&O had any significant impact. The NRC staff's review and conclusions for PNP's resolution of each F&O is summarized in the NRC's Record of Review dated January 16, 2015 (Reference 85). A summary of the NRC staff's evaluation of one IEPRA RAI response that resulted in a change to a PRA method is provided below.

In PRA RAI 28.a (Reference 19), the NRC staff discussed that pre-initiator human failure events (HFEs) utilized scoping values lower than those recommended by NUREG-1792 (Reference 86), for individual and multiple HFEs. In response to PRA RAI 28.a.01 (Reference 12), the licensee developed detailed HEPs for risk-significant pre-initiator HFEs and updated the PRA database with these values. The licensee also performed a sensitivity analysis adjusting all remaining pre-initiator scoping values to be consistent with guidance in NUREG-1792 and determined that the aggregate impact of retaining its scoping values is not risk significant. The NRC staff concludes that this issue is resolved because the licensee further evaluated its scoping values, replaced risk-significant values with the results of detailed HEP evaluations, and determined the aggregate impact of replacing the non-risk significant scoping values with the NUREG-1792 values is not risk-significant.

As a result of the review of the LAR and the responses to RAIs dated December 2, 2013 (Reference 12), the NRC staff concludes that the IEPRA is technically adequate because 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 and are acceptable. To reach this conclusion, the NRC staff has reviewed all F&Os provided by the peer reviewers and determined that the resolution of every F&O supports the 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

The licensee evaluated the technical adequacy of the FPRA model by conducting a series of peer reviews of the FPRA model using the NEI 07-12 process (Reference 87), and the FPRA part (Part 4) of ASME/ANS-RA-Sa-2009 (Reference 34), as clarified by RG 1.200, Revision 2 (Reference 33). The peer reviews of the FPRA were performed in January 2010, August 2010, and March 2011.

LAR Attachment V, Table V-1, as supplemented (Reference 9), provides the licensee's dispositions to all 75 F&Os related to the FPRA, which includes 60 F&Os characterized as findings and 15 F&Os characterized as suggestions. LAR Attachment V, Table V-2, as supplemented (Reference 9), provides the licensee's dispositions to FPRA F&Os written against SRs that were determined by the peer review to be met only at CC-I. The supplemental information also identified four SRs with a status of not-reviewed and dispositioned them as not needing further peer review. The NRC staff evaluated each of the licensee's dispositions to determine the technical adequacy of the FPRA for the NFPA 805 application. The NRC staff's review and conclusions for the dispositions are summarized in the NRC's Record of Review dated January 16, 2015 (Reference 85). A summary of the NRC staff's evaluation of the RAI responses that resulted in a change to the PRA model or methods is provided below.

In PRA RAI 01.a (Reference 19), the NRC staff requested clarification on whether supplemental cable analysis cited in F&O CS-A9-01 to address multiple hot short failures had been fully incorporated into the FPRA and whether this supplemental analysis considered proper polarity hot shorts on ungrounded DC circuits up to and including two independent faults. In its response to PRA RAIs 01.a and 03 (Reference 12) and PRA RAI 30 (Reference 16), the licensee confirmed that the analysis had been completed and integrated into the baseline FPRA model. The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), reflect the supplemental cable analysis cited in F&O CS-A9-01, which considers proper polarity hot shorts on ungrounded direct current (DC) circuits.

In PRA RAI 01.c (Reference 19), the NRC staff requested clarification on whether the results of the cable routing data verification performed in response to F&O CS-C1-01 had been fully incorporated into the baseline FPRA model. In its response to PRA RAIs 01.c (Reference 12), PRA RAI 03 (Reference 12), and PRA RAI 30 (Reference 16), the licensee confirmed that the verification had been completed and any changes integrated into the FPRA model. The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), reflect the results of the completed cable routing data verification.

In PRA RAI 01.d (Reference 19), the NRC staff requested clarification regarding the incomplete treatment of interlock and permissive circuits cited in F&O ES-A2-01. In response to PRA RAIs 01.d (Reference 12), and PRA RAI 30 (Reference 16), the licensee confirmed that the evaluation of circuits had been completed and any changes integrated into the baseline PRA model. The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), address those circuits that could potentially affect accident mitigating equipment, including interlock and permissive circuits.

In PRA RAI 01.dd (Reference 19), the NRC staff described that the HRA used to support the FPRA made exclusive use of screening values inconsistent with NRC accepted guidance. In its response to PRA RAI 01.dd (Reference 12), the licensee updated the HRA to employ screening, scoping and detailed methods consistent with guidance in NUREG-1921 (Reference 50). In its response to PRA RAI 01.ee (Reference 12), the licensee further clarified that human

error probabilities (HEPs) are quantified at a level of detail, (i.e., screening, scoping and detailed), commensurate with their risk significance. In its response to PRA RAI 30 (Reference 16), the licensee confirmed that NUREG-1921 methods had been incorporated into the baseline PRA. The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), reflects an HRA that assigns HEPs consistent with accepted guidance.

In PRA RAI 01.h (Reference 19), the NRC staff requested clarification on the methods used and assumptions made in identifying and evaluating the level of dependency between HFEs modeled in the FPRA. In its response to PRA RAI 01.h (Reference 12), the licensee described a treatment of location in the HRA dependency analysis that differed from NUREG-1921 by assuming that actions take place at different locations even if they are performed in the same room. The NRC staff could not conclude that there was sufficient justification for this deviation from NUREG-1921 guidance. In its response to PRA RAI 01.h.01 (Reference 15), the licensee explained that the analysis's treatment of location would be updated to be consistent with guidance in NUREG-1921. In its response to PRA RAI 30.01 (Reference 17), the licensee clarified that the LAR Attachment W results, provided in response to PRA RAI 30 (Reference 16), and updated on November 4, 2014 (Reference 17), did not include an updated HRA dependency analysis. However, the licensee added the action to update the analysis in LAR Attachment S, Table S-3, Implementation Item 3, which is to be completed before using the FPRA for self-approval. The NRC staff finds the licensee's disposition of this issue acceptable because the licensee uses a minimum joint HEP, as discussed below; therefore, any risk increase caused by using unacceptable joint HEP estimation methods is not expected to change the large transition risk decrease into an unacceptable risk increase.

In PRA RAI 01.h.02 (Reference 21), the NRC staff requested additional information about minimum (or "floor") values for joint HEPs. In its response to PRA RAI 01.h.02 (Reference 15), the licensee updated the FPRA to apply a floor value of 1.0E-05 to all HEP combinations in the FPRA. In its response to PRA RAI 30 (Reference 16), the licensee stated that the impact of this was negligible. The NRC staff finds this issue to be resolved because the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), use a floor value consistent with the guidance in NUREG-1921.

In PRA RAI 01.bb (Reference 19), the NRC staff requested clarification on the completeness of talk-throughs performed with plant operations and training personnel. In its response to PRA RAIs 01.bb and 28.b (Reference 12), the licensee stated that detailed reviews were completed with plant operations and training personnel and that the reviews confirmed that the FPRA's interpretation of current and planned procedures relevant to modeled actions is consistent with plant operational and training practices. In its response to PRA RAI 30 (Reference 16), the licensee confirmed that reviews have been completed for credited HEPs. The NRC staff finds this issue to be resolved because the FPRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), model actions consistent with plant operational and training practices.

In PRA RAIs 01.cc and 01.ff (Reference 19), the NRC staff requested clarification on whether operator actions modeled in the FPRA take into account accident scenario context and relevant

fire effects. In its response to PRA RAIs 01.cc and 01.ff (Reference 12), the licensee stated that the definition and quantification of HFEs modeled in the FPRA would be consistent with guidance in NUREG-1921. In its response to PRA RAI 30 (Reference 16), the licensee incorporated this treatment of accident scenario context and relevant fire effects into the integrated analysis. The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), address accident scenario context and relevant fire effects consistent with NUREG-1921 methods for modeled actions.

In PRA RAIs 01.f (Reference 19), the NRC staff requested clarification on the treatment of fire-induced instrument failures. In its response to PRA RAI 01.f (Reference 12), and PRA RAI 01.f.01 (Reference 15), the licensee stated that instrumentation needed to support modeled operator actions was identified through procedure reviews and reviewed by operations and training personnel. Additionally, the licensee performed circuit analyses of identified instrumentation. The licensee further clarified that if supporting instrumentation is either not included in the FPRA model or not available for a given fire scenario (i.e., failed by the fire), then the associated action is assumed to be failed for that scenario. In its response to PRA RAI 30 (Reference 16), the licensee incorporated the revised treatment into the PRA. The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), address fire-induced instrument failures for credited operator actions.

In PRA RAI 01.g (Reference 19), the NRC staff requested clarification on the process used to identify and define HFEs that may result in an undesired operator response. In its response to PRA RAI 01g (Reference 12), the licensee clarified that based on a review of alarm response procedures and emergency operating procedures consistent with NUREG-1921, Section 3.4.1, as well as a simulator exercise of operator responses to postulated instrumentation failures and spurious indications, no undesired operator actions would occur in response to a single spurious indication failure. Additionally, the licensee further clarified that although annunciators are not credited as primary cues in the FPRA, the fire response procedures developed for NFPA 805 implementation are to include information regarding indication availability and reliability as well as the need for condition validation prior to taking action. As clarified in the response to PRA RAI 31 (Reference 15), the development of fire response procedures is addressed in LAR Attachment S, Table S-3, Implementation Item 1. The NRC staff finds this issue to be resolved because the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), reflect a process to identify HFEs that may result in an undesired operator response consistent with guidance in NUREG-1921 and because fire response procedures address indication availability and reliability.

In PRA RAI 01.j.01 (Reference 19), the NRC staff described that a subset of Bin 15 electrical cabinets were not assumed to propagate fire, namely motor control centers (MCCs) above 440V determined by the licensee to be well-sealed and robustly secured. In its response to PRA RAI 01.j.01.01 (Reference 17), the licensee updated the FPRA to include the NRC comments on MCC treatment (Reference 88). For fires originating in MCCs above 440V or greater, a conditional probability of 0.1 was used for damage outside the cabinet, and immediate damage was considered for targets within 6 inches from the top of the cabinet. Furthermore, the licensee's response also demonstrated that incorporating this revised treatment into the

integrated analysis maintains a total negative plant transition risk. The licensee updated LAR Attachment S, Table S-3, Implementation Item 3, to include verification that the treatment of the potential for fire damage external to well-sealed cabinets that complies with current guidance will be included in the FPRA to be used for self-approval. The NRC staff finds this issue to be resolved because the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), address propagation outside of well-sealed and robustly secured MCCs above 440V consistent with relevant NRC Staff comments provided in (Reference 88).

In PRA RAI 18 (Reference 19), the NRC staff requested justification for the assumption that fires following HEAF events in physical analysis units (PAUs) 03 and 04 are bounded by detailed fire modeling scenarios performed to determine the fire impacts of non-HEAF electrical cabinet fires. In its response (Reference 12), the licensee updated the fire scenarios postulated for HEAF events in PAUs 03 and 04 to be consistent with guidance provided in NUREG/CR-6850, Appendix M. This same change is applied to other PAUs in response to FM RAI 09 as described in Section 3.4.2.3 of this SE. The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), address HEAF scenarios consistent with guidance in NUREG/CR-6850.

In response to PRA RAIs 01.m (Reference 12), PRA RAI 11 (Reference 10), and PRA RAI 30 (Reference 16), the licensee stated that the treatment of junction boxes was being updated to be consistent with guidance provided in FAQ 13-0006 (Reference 89). The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), treat junction boxes consistent with accepted guidance in FAQ 13-0006.

In PRA RAI 08 (Reference 19), the NRC staff requested further clarification regarding the development of scenarios for self-ignited cable fires and cable fires due to hot work. In its response to PRA RAIs 08 (Reference 12), and 11 (Reference 10), as well as PRA RAI 30 (Reference 16), the licensee stated that the scenarios for self-ignited cable fires and cable fires due to hot work in the FPRA were updated in accordance with the guidance in FAQ 13-0005 (Reference 90). The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), address cable fires due to self-ignition or hot work consistent with accepted guidance in FAQ 13-0005.

In PRA RAI 01.o (Reference 19), the NRC staff requested clarification on the treatment of sensitive electronics. In response to PRA RAIs 01.o (Reference 12), PRA RAI 11 (Reference 10), and PRA RAI 30 (Reference 16), the licensee stated that the treatment of sensitive electronics in adjacent cabinets was updated to be consistent with guidance in NUREG/CR-6850, Appendix S. In addition, the licensee clarified that FAQ 13-0004 (Reference 91), is applied for sensitive electronics mounted inside cabinets that are not directly exposed to the convective and/or radiant energy of a fire. For any sensitive electronics that may be directly exposed to the convective and/or radiant energy of a fire, the licensee added that they are treated consistent with guidance in NUREG/CR-6850, Section H.2, regarding damage thresholds for sensitive electronics. The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14,

2014 (Reference 16), and updated on November 4, 2014 (Reference 17), address sensitive electronics consistent with accepted guidance.

In PRA RAI 01.q (Reference 19), the NRC staff requested clarification regarding the target damage methodology discussed in F&O FSS-D1-01. In its response to PRA RAI 01.q.01 (Reference 15), the licensee stated that it would revise the Fire PRA response model to use the damage accrual method. The damage accrual method is a method to evaluate fire growth and target damage times. It includes non-suppression probabilities, using the target damage times and addresses dependencies between suppression activities and the impact of detection system failure, which is consistent with guidance in NUREG/CR-6850. The damage accrual method is discussed in further detail in SE Section 3.4.2.3.2, FM RAI 01.p. The NRC staff finds this issue to be resolved because the PRA models and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), use an acceptable method for time to target damage (SE Section 3.4.2.3) and non-suppression probabilities (NSPs).
In PRA RAI 01.s (Reference 19), the NRC staff requested further clarification on the treatment of transient fire locations. In its response to PRA RAI 01.s (Reference 12), the licensee clarified that the assumption that all transients are located one foot above the floor was re-assessed. During the assessment, the licensee identified specific plant locations where a higher transient combustible base (up to 30 inches) exists. For these specific plant locations, the FPRA model was revised such that transient fires are assumed to be 30 inches above the floor. The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), reflect plant and location specific attributes in the determination of transient fire location.

In PRA RAI 06 (Reference 19), the NRC staff requested clarification on transient fire placement within PAUs. In its response to PRA RAI 06 (Reference 11), the licensee stated that twenty-two PAUs were analyzed with bounding, full-PAU burn-up scenarios such that specific transient fire scenarios were not needed and that for the remaining 18 PAUs (including the MCR), transient fires were postulated in locations in which a 98th-percentile (i.e., 317 kW) transient fire could damage a set of targets not otherwise already captured by a fixed ignition source. Upon review of transient fire treatments in response to this RAI, the licensee identified PRA credited cables in locations where transient scenarios were not postulated but stated that transient fire scenarios would be developed for these locations. In its response to PRA RAI 17.e (Reference 12), the licensee further clarified that the placement of transients in the MCR would be expanded to include open, wall and corner transients as part of the MCR abandonment analysis. In its response to PRA RAI 30 (Reference 16), the licensee stated that the additional transient scenarios were incorporated into the integrated analysis. The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), incorporate a method for locating transient fires that appropriately captures all pinch points.

In PRA RAI 07 (Reference 19), the NRC staff requested clarification on the treatment of transient and fixed ignition sources in the cable spreading room (i.e., PAU 02), noting that associated scenarios were defined according to a grid system related to the arrangement of sprinkler heads within the PAU. In its response to PRA RAIs 01.m and 07 (Reference 12), the licensee stated that the treatment of general transients and transients due to hotwork was

revised such that a single scenario is postulated at each intersection point of the defined grid system. The licensee further clarified that to ensure all credible target sets are analyzed, the corresponding target damage set of each scenario encompasses all targets in the four grid sections that touch each intersection point. The ignition frequencies for general transients and transients due to hotwork are equally distributed to each scenario. For fixed ignition sources, the licensee stated that their treatment was revised such that a scenario is postulated whose target damage set corresponds to all targets in grid sections that lie within the NUREG/CR-6850 98th-percentile HRR zone of influence (ZOI). If further refinement is desired, then the licensee used severity factors to limit the fraction of fire scenarios assigned to the 98th-percentile HRR ZOI consistent with NUREG/CR-6850. The severity factors are either based on the HRR cases developed for the generic fire modeling treatments (e.g., the 98th and 75th percentiles) or developed using the method discussed in this SE under the response to PRA RAI 01.q.01 (Reference 15), (i.e., the damage accrual method). For either transient or fixed ignition sources, the corresponding target damage set is expanded to the entire PAU if the credited wet-pipe suppression system fails. In its response to PRA RAI 30 (Reference 16), the licensee incorporated this revised treatment of transient and fixed ignition sources in the cable spreading room into the PRA model. The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), incorporate accepted methods for fixed ignition scenarios in the cable spreading room that encompass all targets within each scenario's corresponding ZOI and a method for transient sources that appropriately demonstrates that no pinch points are omitted.

In PRA RAI 01.t (Reference 19), the NRC staff requested justification for using generic unreliability estimates reported in NUREG/CR-6850 to reflect the total system unavailability of fire detection and suppression systems credited in the FPRA. In its response to PRA RAIs 01.t (Reference 12), and PRA RAI 30 (Reference 16), the licensee indicated that a review of plant records (e.g. work orders, operations logs, etc.) and the PNP fire impairment list was performed and verified the validity of using generic estimates from NUREG/CR-6850. The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), address the total system unavailability for fire detection and suppression systems credited in the FPRA consistent with NUREG/CR-6850 and plant-specific operating experience.

In PRA RAI 01.r (Reference 19), the NRC staff requested clarification regarding the time to detection used within the FPRA. In its response to PRA RAI 01.r (Reference 12), the licensee indicated that the FPRA would be updated to apply a one minute time to detection for those fire areas that credit automatic detection systems. The one minute delay is based on a conservative evaluation of smoke detector response times using correlations in NUREG-1805 along with representative or bounding input parameters. In its response to PRA RAI 01.r.01 (Reference 15), the licensee further clarified that the FPRA would be updated so that NSPs applied to fire scenarios crediting automatic detection take into account the failure probabilities of these automatic detection systems as well as the resulting impact on detection times. In response to PRA RAI 30 (Reference 16), the licensee incorporated these updates into the PRA model. The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and

updated on November 4, 2014 (Reference 17), treat automated detection systems in fire scenario development consistent with guidance in NUREG/CR-6850, Appendix P.

In PRA RAI 19 (Reference 19), the NRC staff requested further clarification on the impact of suppression system activation on component operation. In its response to PRA RAI 19 (Reference 12), the licensee stated that guidance in NUREG/CR-6850, Section 11.5.1.2, was evaluated, with the support of plant walk downs, to identify the impacts of suppression activities on components credited in the FPRA. In its response to PRA RAI 30 (Reference 16), the licensee incorporated component failures that may result from fire suppression activities into the PRA model. The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), address component failures that may result from fire suppression activities consistent with guidance in NUREG/CR-6850, Section 11.5.1.2.

In PRA RAI 01.w (Reference 19), the NRC staff requested further clarification on the catastrophic turbine/generator (T/G) fire frequency analysis, including any credit given for manual suppression. In its response to PRA RAI 01.w (Reference 12), the licensee stated that the catastrophic T/G fire frequency analysis would be revised to be consistent with that provided in NUREG/CR-6850, Table O-2, and to take no credit for suppression beyond that which is quantified in NUREG/CR-6850 (i.e., failure of fixed suppression with a probability of 0.02). In its response to PRA RAI 30 (Reference 16), the licensee incorporated this revised treatment of catastrophic T/G fires into the PRA model. The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), treat catastrophic T/G fires consistent with accepted guidance, namely NUREG/CR-6850, Appendix O.

In PRA RAI 01.x (Reference 19), the NRC staff described that some highly compartmentalized PAUs (e.g., PAU 13) were screened from the hot gas layer (HGL) multi-compartment analysis (MCA) based on the approximate volume of the entire PAU. In its response to PRA RAI 01.x (Reference 12), the licensee stated that the MCA would be updated to apply screening criteria consistent with guidance in NUREG/CR-6850, Section 11.5.4, to compartments (or sub-volumes) instead of PAUs. In its response to PRA RAIs 01.x (Reference 12), and PRA RAI 30 (Reference 16), the licensee confirmed that the revised MCA screening analysis was incorporated into the PRA model. The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), incorporate an MCA that applies screening criteria consistent with accepted guidance to address locations within a PAU that may have the potential to form a HGL.

In PRA RAI 01.y (Reference 19), the NRC staff requested justification for the barrier failure probabilities assigned to passive barriers in the MCA. In its response to PRA RAI 01.y (Reference 12), the licensee clarified that failure probabilities assigned to credited fire rated barriers are consistent with generic barrier failure probabilities reported in NUREG/CR-6850, Table 11-3. If found to be adequate for the hazard, non-rated barriers are also assigned the generic failure probabilities; otherwise, a value of 0.1 is assigned. In its response to PRA RAI 01.y.01 (Reference 15), the licensee stated that the MCA would be updated consistent with

NUREG/CR-6850 to apply the sum of the barrier failure probabilities for each type of barrier present in lieu of the single most limiting barrier failure probability. In its response to PRA RAI 30 (Reference 16), the licensee confirmed this revised treatment of barrier failure probabilities has been incorporated into the FPRA. The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), include barrier failure probabilities assigned to barriers in the MCA that are consistent with guidance in NUREG/CR-6850.

In PRA RAI 13 (Reference 19), the NRC staff identified inconsistencies in the generic fire ignition frequencies assigned to Bins 24 and 26 relative to the values provided in NUREG/CR-6850, Supplement 1 (Reference 42), and the June 21, 2012, NRC letter to NEI (Reference 92), respectively. In its response to PRA RAI 13 (Reference 12), the licensee stated that the PRA was updated to include generic fire ignition frequencies for Bins 24 and 26 to match the respective sources. The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), make use of generic fire ignition frequencies for Bins 24 and 26 that are consistent with those values provided in accepted guidance.

In PRA RAI 01.aa (Reference 19), the NRC staff requested clarification regarding how the fire ignition frequency for miscellaneous hydrogen fires was apportioned. In its response to PRA RAI 01.aa (Reference 12), the licensee updated the method used to apportion the fire ignition frequency for miscellaneous hydrogen fires to be consistent with the guidance in NUREG/CR-6850, Section 6.5.7.3. Specifically, the licensee counted the various components of the complex (e.g., piping, valves, tanks, etc.) and rated them by a scheme that discriminates by the relative likelihood of ignition. In its response to PRA RAI 30 (Reference 16), the licensee stated the revised frequency apportionment method of miscellaneous hydrogen fires was incorporated in the PRA. The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), use a frequency apportionment method for miscellaneous hydrogen fires that is consistent with accepted guidance in NUREG/CR-6850, Section 6.5.7.3.

In PRA RAIs 17.a and 17.d (Reference 19), the NRC staff requested clarification regarding the definition of the main control board (MCB) and treatment of MCB fires. In its response to PRA RAI 17.a (Reference 12), the licensee clarified that the definition of the MCB is consistent with FAQ 14-0008 (Reference 93). In its response to PRA RAI 17.d (Reference 12), the licensee explained that fire propagation in the MCB was analyzed in accordance with NUREG/CR-6850, Appendix L, for non-abandonment scenarios and consistent with the guidance in NUREG/CR-6850, Appendix S, for abandonment scenarios. The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), treat MCB fire scenarios consistent with guidance in NUREG/CR-6850 and FAQ 14-0008.

In PRA RAI 17.b.01 (Reference 21), the NRC staff identified that the licensee's MCB frequency analysis deviated from NUREG/CR-6850, Appendix L, in that the Bin 4 frequency was apportioned to each of the three MCB sections based on the length of each section. In its

response to PRA RAI 17.b.01 (Reference 16), the licensee stated that the MCB frequency analysis was changed to be consistent with FAQ 14-0008 (Reference 93), by recalculating the conditional probability provided in NUREG/CR-6850, Table L-1, based on the control surface area of each panel. The NRC staff finds this issue to be resolved because the PRA model and that transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), incorporate a MCB frequency analysis that is consistent with guidance in NUREG/CR-6850, Appendix L, and FAQ 14-0008.

In PRA RAI 17.h (Reference 19), the NRC staff requested clarification regarding the treatment of the MCR HVAC, including both fire-induced and random failures, in the MCR abandonment analysis. In its response to PRA RAIs 17.h and 28.h (Reference 12), the licensee stated that the MCR abandonment analysis would be updated to consider both random and fire-induced failures of the MCR HVAC system explicitly when calculating the likelihood of MCR abandonment. For each fire scenario, a logic model of the MCR HVAC system is quantified with fire-induced failures applied to determine the conditional probability that the HVAC system remains functional; an additional conditional probability is applied for purge mode. In its response to PRA RAI 30 (Reference 16), the licensee stated that this revised treatment of MCR HVAC has been incorporated into the PRA. The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), explicitly consider both random and fire-induced failures of the MCR HVAC system in the MCR abandonment analysis.

In PRA RAIs 01.e (Reference 19), and 01.e.01 (Reference 21), the NRC staff requested clarification on the primary coolant pump (PCP) seal failure model used in the FPRA. In response to PRA RAI 01.e.01 (Reference 15), the licensee clarified that PCP seal failure has two elements: a plant-specific element, such as losing cooling to the seals, and a generic element characterizing seal failure probabilities given loss of cooling. The licensee stated that the plant-specific element is modelled using general PRA methods and that the generic element is modeled consistent with the WCAP-16175-P-A (Reference 94), consensus model endorsed by the NRC. The plant-specific element differs between the post-transition and the compliant plant because modification S2-5 (Provide Alternate Method of Tripping Primary Coolant Pumps during Fire Event) as described in LAR Attachment S, Table S-2 is being implemented as part of transition to NFPA 805. The generic element is the same in the post-transition and the compliant plant. The NRC staff, therefore, finds that this issue is resolved since the seal failure probabilities are consistent with the endorsed topical report and the FPRA reflects the PCP modification.

In its response to PRA RAI 01.k.01 (Reference 15), the licensee stated that MCR abandonment due to loss-of-control or function is not credited by the FPRA. In its response to PRA RAI 01.l (Reference 12), the licensee clarified that a detailed scenario analysis was performed to address MCR abandonment risk due to loss-of-habitability and that the resulting scenarios were modeled in the FPRA. The human reliability analysis (HRA) performed on operator actions for MCR abandonment was updated to the screening, scoping and detailed methods of NUREG-1921 (Reference 50), and a feasibility assessment of operator actions associated with HFEs was completed for all HFEs credited in the FPRA. The NRC staff finds that not crediting MCR abandonment operator actions for fire-related loss-of-control scenarios is conservative

and, therefore, acceptable. The NRC staff finds that the MCR loss-of-habitability fire risk evaluation was a systematic approach capable of evaluating the MCR abandonment fire scenarios and is therefore acceptable. In its response to PRA RAI 30 (Reference 16), the licensee stated that this revised treatment of MCR HRA has been incorporated into the PRA. The NRC staff finds this issue to be resolved because the PRA model and the transition change-in-risk estimates, submitted by the licensee on August 14, 2014 (Reference 16), and updated on November 4, 2014 (Reference 17), include the revised treatment of MCR abandonment scenarios.

In PRA RAI 12 (Reference 19), the NRC staff requested that the licensee identify any changes made to the FPRA that are consistent with the definition of a "PRA upgrade," as defined by the ASME/ANS PRA Standard (Reference 34), since the last full-scope peer review of the FPRA. In its response to PRA RAI 12 (Reference 12), the licensee discussed revisions made since last full-scope peer review, and in its response to PRA RAI 12.01 (Reference 15), identified the use of the NUREG-1921 scoping method as the only candidate requiring a focused-scope peer review, further clarifying that PRA configuration control procedure ensures that any PRA upgrade will receive an appropriate peer review. The licensee provided a follow-up response to PRA RAI 12.01 as part of the response to PRA RAI 30 (Reference 16), stating that an HRA focused-scope peer review had been completed on the use of the NUREG-1921 scoping method. The licensee further stated that the peer review's six findings do not impact the conclusions of the FPRA and that they will be addressed as part LAR Attachment S, Table S-3, Implementation Item 3. The NRC staff concludes that, since there is no expected impact on the total negative plant transition risk analyses, and because the licensee has included the action to address the peer review findings in LAR Attachment S which will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition, addressing these findings prior to self-approval is acceptable.

As a result of its review of the LAR, as supplemented, the NRC staff concludes that the PNP FPRA possesses 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 and is acceptable.

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

The NRC staff performed detailed reviews of the FM used to support the FRE in order to gain further assurance that the methods and approaches used for the application to transition to NFPA 805 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 [probabilistic safety assessment] approach, methods, and data shall be acceptable to the AHJ [authority having jurisdiction].

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 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 review 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 Fire Risk Evaluations

The ZOI around ignition sources was determined based on tables in the Generic Fire Modeling Treatments (GFMTs) approach. These tables provide the horizontal and vertical dimensions of the ZOI for various ignition sources (transient fuel packages, small liquid fuel fires, open cabinets and cable trays) and different types of targets (i.e., thermoplastic and thermoset cables as defined in NUREG/CR-6850) (Reference 40), and Class A combustibles. The GFMTs approach also contains a set of tables that are used to determine if and when the hot gas layer (HGL) temperature exceeds the damage threshold of specified targets depending on fire size, room volume, and ventilation conditions. The GFMTs approach was used as a basis for the scoping or screening evaluation as part of the FM to support the FREs.

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 are the following:

- Heskestad Flame Height Correlation (Reference 95);
- Heskestad Plume Temperature Correlation (Reference 95); and
- Shokri and Beyler Solid Flame Radiation Model (Reference 96)

These algebraic models are described in NUREG-1805, "Fire Dynamics Tools (FDT^s): "Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program" (Reference 46). Validation and Verification (V&V) of these

algebraic models is documented in NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," Volume 3 (Reference 47). The FM V&V used to support the FPRA is discussed in SE Section 3.8.3.2.

The Consolidated Model of Fire and Smoke Transport (CFAST) computational fire model, Version 6, (Reference 97), was used to generate the HGL tables in the GFMTs approach. The FREs used these calculations to further screen ignition sources, fire scenarios, and compartments that would not be expected to generate an HGL, and to identify the ignition sources that have the potential to generate a HGL for further analysis. CFAST was also used for the MCR abandonment time calculations, to determine the maximum fire size for plant-specific target damage time calculations in Switchgear Rooms 1-C and 1-D, and in the exposed structural steel analysis to estimate the temperature rise of a column exposed to a lube oil pool fire. The V&V of CFAST is documented in NUREG-1824, Volume 5 (Reference 47).

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:

- Mudan flame radiation model (Reference 98).
- Plume heat flux correlation by Wakamatsu et al. (Reference 99).
- Yokoi plume centerline temperature correlation (Reference 100) and (Reference 101).
- Hydrocarbon spill fire size correlation (Reference 102).
- Flame extension correlation (Reference 103).
- Delichatsios line source flame height model (Reference 104).
- Corner flame height correlation (Reference 103).
- Kawagoe natural vent flow equation (Reference 105).
- Yuan & Cox line fire flame height and plume temperature correlations (Reference 106).
- Lee cable fire model (Reference 107).
- Babrauskas method to determine ventilation-limited fire size (Reference 108).

The following fire models were used to determine the ZOI and HGL timing for fires that involve secondary combustibles (cable trays):

- 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 48).

- CFAST Version 6 to calculate the times to reach various HGL temperature thresholds.

- Heskestad's correlation to calculate the plume temperature at a fixed elevation above an ignition source.

Fire Dynamics Simulator (FDS), Version 5, and the Thermally-Induced Electrical Failure (THIEF) model were used for plant-specific target damage time calculations in switchgear rooms 1-C and 1-D. The V&V of FDS is documented in NUREG-1824, Volume 7 (Reference 47). The V&V of the THIEF model is described in NUREG/CR-6931, Volume 3 (Reference 44). The V&V of all correlations and FM used in support of the FREs are discussed 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. The licensee stated that qualified personnel performed a plant walk-down to identify ignition sources, surrounding targets, and safety related SSCs. Then applied the GFMTs approach to assess whether the SSCs were within the ZOI of each fire scenario. Based on the fire hazard present in the fire areas, these generalized ZOIs were used to screen from further consideration those 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 HRR from the NUREG/CR-6850 methodology.

3.4.2.3.2 RAIs Pertaining to Fire Modeling in Support of the Fire Risk Evaluation

By letters dated August 8, 2013 (Reference 19), and March 11, 2014 (Reference 20), the NRC staff requested additional information concerning the FM conducted to support the FREs. By letters dated September 30, 2013 (Reference 10), December 2, 2013 (Reference 12), and May 7, 2014 (Reference 14), the licensee responded to these RAIs.

- In FM RAI 01.a (Reference 19), the NRC staff requested that the licensee provide the basis for the assumption that the fire brigade is expected to arrive at the MCR within 15 minutes, and to explain how the uncertainty of this assumption affects the FPRA.

  In its response to FM RAI 01.a (Reference 12), the licensee indicated that a review of fire brigade drills conducted between January 25, 2012, and December 4, 2012, validated that the average likely (fire brigade) control room response time is 8.2 minutes with a minimum time of six minutes and a maximum time of ten minutes. The licensee stated that a sensitivity analysis shows that decreasing the time when the door is opened from 15 to 10 minutes reduces the probability for abandonment by up to 27 percent in all but one scenario for which the probability increases by 4 percent, which the licensee stated is not considered significant. The licensee stated that the sensitivity analysis shows that increasing the time when the door is opened to 20 minutes has no effect on the probability for abandonment. The licensee further stated that the FPRA uses

the natural ventilation condition that produces the shortest abandonment time to define the baseline scenarios.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that there is no impact on MCR abandonment by using the 15 minute fire brigade response time.

- In FM RAI 01.b (Reference 19), the NRC staff requested that the licensee provide technical justification for using transient fire growth rates in the MCR abandonment time calculations that are different from those specified in FAQ 08-0052 (Reference 63), and to discuss the effect of these differences on plant risk.

  In its response to FM RAI 01.b (Reference 12), the licensee stated that the MCR abandonment calculations for transient fire scenarios were revised based on the assumption that the peak heat release rate (HRR) is reached in 2 minutes and that this assumption is consistent with the guidance for loose trash provided in FAQ 08-0052. The licensee stated that the revised MCR abandonment time calculations also include a sensitivity case which assesses the effect of assuming a time to peak HRR of 8 minutes.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the transient fire growth rates used are consistent with NRC endorsed guidance.

- In FM RAI 01.c (Reference 19), the NRC staff requested that the licensee explain how wall and corner effects were accounted for in the CFAST MCR abandonment time calculations.

  In its response to FM RAI 01.c (Reference 12), the licensee stated that there are no fixed ignition sources that are within two feet of a wall or corner so that location effects would need to be accounted for. The licensee further stated that the MCR abandonment time calculations were revised to include transient fires against a wall or in a corner and that the "image" method was used to account for location effects in the CFAST calculations for these transient fires. The licensee further stated that the additional CFAST calculations show that wall and corner transient fires result in shorter abandonment times (compared to transient fires with the same HRR in the open) and have a significant effect (greater than fifteen percent) on the probability for MCR abandonment. In addition, the licensee stated in its response to PRA RAI 30 (Reference 16), that the Fire PRA model and Table W-2 were updated to account for the changes made as a result of resolving FM RAI 01.c.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that wall and corner fire effects were properly accounted for in the updated CFAST MCR abandonment time calculations.

- In FM RAI 01.d (Reference 19), the NRC staff requested that the licensee explain how the results of the CFAST sensitivity analysis in the MCR abandonment time study were used in the FPRA.

  In its response to FM RAI 01.d (Reference 12), the licensee stated that the sensitivity results in the initial MCR abandonment time calculation were not used in the FPRA. The licensee further explained that the sensitivity analysis in the revised MCR abandonment time calculation was updated to provide a basis for the baseline fire scenarios considered in the calculation and that input parameters were considered to have a significant adverse effect on the calculated abandonment times if the sensitivity case results in an increase of the probability for abandonment of 15 percent or more over the corresponding baseline. The licensee further stated that two parameters were identified in the revised sensitivity analysis as having a significant adverse effect: 1) the initial ambient temperature in the MCR, and 2) the fire base height for closed multiple bundle electrical cabinets and that since the elevated control room temperature corresponding to a 15 percent increase in the probability for abandonment is outside accepted operating conditions, no baseline scenarios were adjusted for this input parameter. The licensee further stated that to address the second parameter, the control room abandonment probability was increased by 25 percent in the FPRA for propagating multiple bundle panel fires that involve half-height Main Control Boards.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the results of the sensitivity analysis in the MCR abandonment time study were appropriately used in the FPRA.

- In FM RAI 01.e (Reference 19), the NRC staff requested that the licensee explain how the modification to the critical heat flux for a target that is immersed in a thermal plume described in the GFMTs approach was used in the ZOI determination.

  In its response to FM RAI 01.e (Reference 12), the licensee explained that the modified critical heat flux was implemented using a two point treatment for the updated fire scenarios in the FPRA model and that for HGL temperatures between ambient and 80°C the ZOI tables in the GFMTs approaches are applied without any adjustments. The licensee further stated that if the HGL temperature exceeds 80°C, full room burnout is assumed.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated an appropriate method to assess the damage of targets immersed in a hot gas environment.

- In FM RAI 01.f (Reference 19), the NRC staff requested that the licensee demonstrate that the GFMTs approach as used to determine the ZOI of fires that involve multiple burning items is conservative and bounding.

In its response to FM RAI 01.f (Reference 12), the licensee explained that, if secondary combustibles are involved, the current approach to determine the ZOI based on the GFMTs approach is not conservative for a number of fires originating in an electrical cabinet, and for most fire scenarios with transient ignition sources. The licensee further stated that to address this problem, new ZOI tables were developed that are applicable to ignition source-cable tray configurations. The licensee stated that the ZOI was calculated for a range of ignition sources without any intervening combustibles, and in combination with various cable tray configurations and that the ZOI dimensions are tabulated as a function of time and for different fire locations (open, wall and corner) and ambient temperatures.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated an appropriate method to determine the ZOI of fires that involve secondary combustibles (cable trays).

- In FM RAI 01.g (Reference 19), the NRC staff requested that the licensee describe how the flame spread and fire propagation in cable trays and the corresponding HRR of cables were determined, and to explain how these calculations affect the ZOI determination and HGL temperature calculations.

  In its response to FM RAI 01.g (Reference 12), the licensee explained that new ZOI and HGL tables were developed for the ignition source-cable tray configurations. The licensee further stated that supplemental plant walkdowns were conducted to incorporate the new ZOI dimensions which are described in response to FM RAI 01.f. The licensee stated that the times to HGL conditions were calculated and tabulated for different compartment volumes, vent sizes and fire locations (open, wall and corner) and that to develop the new ZOI and HGL tables, the fire propagation in cable trays and corresponding HRR were determined based on the models described in NUREG/CR-6850, Appendix R and NUREG/CR-7010 (FLASH-CAT). The licensee stated that the new ZOI and HGL tables are used to characterize the target sets where secondary combustibles (cable trays) are ignited by an ignition source and replace those provided in the GFMTs approach.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated an appropriate method to calculate fire propagation in cable trays.

- In FM RAI 01.h (Reference 19), the NRC staff requested that the licensee describe how transient combustibles in an actual plant setting are characterized in terms of the three fuel package groupings in the GFMTs approach; to identify areas, if any, where the NUREG/CR-6850 transient combustible HRR characterization may not encompass typical plant configurations; and to explain if any administrative action will be used to control the type of transients in a fire area.

In its response to FM RAI 01.h (Reference 12), the licensee explained that transient combustibles are categorized as miscellaneous materials that do not contain combustible liquids (Group 3 and Group 4 in the GFMTs approach). The licensee stated that it does not differ in any significant manner from other plants with respect to its transient combustible controls to warrant a significant increase or decrease of the 98th percentile HRR of 317 kW recommended in NUREG/CR-6850. The licensee summarized the combustible control procedure that will be used to limit the combustible configurations in high hazard areas to configurations that are bound by the analysis provided in generic fire modeling treatments (GFMTs) approach or, where impractical, to provide for the necessary compensatory measures via a prescribed transient combustible analysis. The licensee stated that the workstation fire scenario in the main control room (MCR) abandonment calculation involves a transient fuel package with a higher heat release rate (HRR) than the NUREG/CR-6850 98th percentile for transient fires and that this transient fuel package is unique to the MCR area.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee used an acceptable approach to categorize transient combustibles in terms of their nature and HRR characteristics.

- In FM RAI 01.i (Reference 19), the NRC staff requested that the licensee provide technical justification for the use of CFAST to determine the maximum fire size that can be sustained in a cubicle inside a switchgear cabinet, and to explain why the method described in the GFMTs approach was not used for that purpose.

  In its response to FM RAI 01.i (Reference 12), the licensee explained that the objective of the CFAST analysis was to determine the maximum internal and external HRR based on the upper limit to the equivalence ratio in the cubicle and that the estimated maximum HRR was used as an input parameter in the FDS analysis of fires in Switchgear Rooms 1-C and 1-D. The licensee referred to the work by Utiskul (Reference 109), to justify the use of CFAST in the single-zone mode to determine the maximum fire size in the cubicle. The licensee further stated that the maximum internal HRR calculated with CFAST is within 10 percent of the maximum fire size estimated from Kawagoe's correlation for fully-developed compartment fires (Reference 105). The licensee further stated that the method described in the GFMTs was not used because it generically assumes that there is a small outflow vent at the ceiling and a small inflow vent at the floor of the enclosure and that CFAST was used because it allowed for the actual vent configuration to be specified, and because it provided a more accurate estimate of the heat losses through the cubicle boundaries.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the license appropriately used CFAST in the single-zone mode to determine the maximum fire size in a switchgear cubicle.

- In FM RAI 01.j (Reference 19), the NRC staff requested that the licensee explain how the time to ignition of the first horizontal cable tray above the ignition source was determined in the FDS analysis for the 1-C and 1-D switchgear rooms, and

to provide justification for using a vertical flame spread rate of 0.0258 m/s as opposed to 0.258 m/s specified in NUREG/CR-6850.

In its response to FM RAI 01.j (Reference 12), the licensee stated that the ignition delay is the time for the fire to propagate from the ignition source up the vertical airdrop to the bottom of the stack of horizontal cable trays. The licensee explained why the vertical flame spread rates in NUREG/CR-6850 are very conservative. The licensee summarized the results of a series of 38 tests on vertical cable tray configurations conducted by Tewarson and Kahn (Reference 110), and stated that the highest flame spread rate that was observed for thermoplastic cable was 0.014 m/s.

The NRC staff concludes that the licensee's response to the request for additional information (RAI) is acceptable because the licensee used an acceptable approach to model fire propagation from the ignition source to a stack of horizontal cable trays above the source in the FDS analysis for the 1-C and 1-D switchgear rooms.

- In the fire modeling (FM) RAI 01.k (Reference 19), the NRC staff requested that the licensee explain how non-cable intervening combustibles were identified and accounted for in the FM analysis.

  In its response to FM RAI 01.k (Reference 12), the licensee explained that a combination of document reviews and walkdowns were performed to identify fire areas where the involvement of non-cable secondary combustibles could result in additional target damage. The licensee further stated that the fire scenarios for these areas and the FPRA response model were then updated accordingly.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the potential contribution of non-cable intervening combustibles was properly accounted for in the FM analysis.

- In FM RAI 01.m (Reference 19), the NRC staff requested that the licensee describe the criteria and methodology that were used to account for location effects of fixed or transient ignition sources near a wall or corner.

  In its response to FM RAI 01.m (Reference 12), the licensee explained that when a fuel package is within two feet of a wall, the HRR is doubled and the fire is centered at the fuel package edge adjacent to the wall. The licensee further stated that when a fuel package is within two feet of a corner, the HRR is quadrupled and the fire is centered at the fuel package corner closest to the two walls.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated the use of appropriate criteria and methodology to account for wall and corner effects.

- In FM RAI 01.o (Reference 19), the NRC staff requested that the licensee describe the methodology used to assess damage to targets for non-abandonment fire scenarios in the MCR envelope.

  In its response to FM RAI 01.o (Reference 12), the licensee stated that non-abandonment fire scenarios for ignition sources other than the main control board (MCB) were analyzed using the GFMTs approach. The licensee further stated that in addition to the targets located within the ZOI, cables terminating at the electrical cabinets were postulated to fail. The licensee further stated that the FPRA model was updated to include transient fire scenarios which are discussed in the response to probabilistic risk assessment (PRA) RAI 06.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated the use of an acceptable methodology to assess target damage in MCR non-abandonment fire scenarios.

- In FM RAI 01.p (Reference 19), the NRC staff requested that the licensee describe the "damage accrual method" that was used to convert the damage times in Appendix H of NUREG/CR-6850 to a percent of damage function for targets exposed to a time-varying heat flux.

  In its response to FM RAI 01.p (Reference 12), the licensee explained that the method was revised to address some of the uncertainties in the underlying assumptions of the original methodology. The licensee referred to the response to PRA RAI 01.q for further discussion of the revised methodology and its impact on CDF, LERF, ΔCDF, and ΔLERF. In its response to FM RAI 02.b (Reference 12), the licensee provided a list of the six fire areas where the damage accrual method was applied.

  The damage accrual method was developed to estimate the time to damage of a target that is located at a specified distance above a cabinet fire. The original method as described in a paper by Zucal et al. (Reference 111), consists of the following four steps:

  (1) Determine the HRR curve of the cabinet fire for the 15 bins. This is taken directly from Appendices E and G in NUREG/CR-6850.

  (2) Determine for a range of cabinet HRRs how the heat flux to a target varies as a function of elevation above the fire. A line is fitted through four data points that are obtained from the GFMTs. The first point is at half the flame height. In the GFMTs the heat flux at this height is assumed to be 120 kW/m^2. The other three points are based on the vertical ZOI in the GFMTs for thermoset cable targets (11 kW/m^2), class A combustibles (9 kW/m^2), and thermoplastic cable targets (5.7 kW/m^2).

  (3) Determine how the heat flux at the target varies as a function of time. For each bin the heat flux at the target is determined as a function of time

based on the heat release rate as a function of time (from #1) and the heat flux as a function of the heat release rate (from #2).

(4) Determine the time to damage. For each bin the time to damage is estimated as a function of the time-varying heat flux calculated in #3 and the failure time-heat flux relationship in Tables H-7 (for thermoset cable targets) and H-8 (for thermoplastic cable targets) in NUREG/CR-6850. The inverse of the failure time is assumed to represent the amount of damage accrued per minute (D_R), or the "damage rate", at the corresponding heat flux. The time to failure of a target exposed to a time-varying heat flux is determined as the time when the integral of the damage rate is equal to one.

The original method assumed that no damage is accrued when the heat flux at the target is below the NUREG/CR-6850 damage threshold, (i.e., 11 kW/m^2 for thermoset and 5.7 kW/m^2 for thermoplastic cable targets.) Since this assumption is non-conservative, the last step of the method was revised to address the non-conservatism. In its response to PRA RAI 01.q.01 (Reference 15), the licensee stated that the method that is used retains the first three steps described above but was revised to incorporate elements of a damage accrual methodology that more accurately accounts for the damage accrued at a target over time and when the HRR is not at a steady state as assumed in NUREG/CR-6850.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee revised the damage accrual method to incorporate elements that more accurately account for the damage accrued at a target over time and when the HRR is not at a steady state.

- In FM RAI 01.q (Reference 19), the NRC staff requested that the licensee provide technical justification for not having to consider structural collapse of the compartment as a result of the failure of one structural steel column due to a fire at the 590-ft elevation of the turbine building.

  In its response to FM RAI 01.q (Reference 12), the licensee explained that the assumption is justified based on statements by its senior civil engineer, indicating that due to the safety margin and redundancy in the structural design, multiple adjacent column failures would be necessary to cause the entire structure to collapse. The licensee concluded that because sound engineering judgment has been provided, additional technical justification for not having to consider structural collapse of the compartment as a result of the failure of one structural steel column is not required.

  In FM RAI 01.01 (Reference 20), the NRC staff requested that the licensee substantiate the assumption with a summary of the actual structural analysis of the building.

  In its response to FM RAI 01.01 (Reference 14), the licensee explained that instead of providing a detailed structural analysis of its turbine building, it was

decided to update the FPRA model based on the assumption that the compartment will collapse when one structural steel column fails. The licensee indicated that this change did not result in a significant risk increase. In addition, the licensee stated in its response to PRA RAI 30 (Reference 16), that the Fire PRA model and Table W-2 were updated to include the assumed structural collapse upon failure of one structural steel column as a result of the applicable fire scenario.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated an acceptable approach to address fire scenarios in the turbine building resulting in structural failure of a column.

- In FM RAI 02.a (Reference 19), the NRC staff requested that the licensee describe how the installed cabling in the power block was characterized.

  In its response to FM RAI 02.a (Reference 12), the licensee explained that due to the plants age, the majority of the cables used during initial installation are thermoplastic. The licensee further stated that although more recent cable installations may be thermoset, in light of the guidance in NUREG/CR-6850 for situations of mixed cable types, it assumed thermoplastic damage criteria for all cabling in the power block.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee appropriately characterized the power block cabling.

- In FM RAI 02.c (Reference 19), the NRC staff requested that the licensee provide technical justification for using cable damage thresholds for temperature sensitive equipment inside cabinets.

  In its response to FM RAI 02.c (Reference 12), the licensee explained that the FPRA used the NUREG/CR-6850 damage threshold for thermoplastic cables (6 kW/m^2) for all targets, including mounted sensitive electronics.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee's approach to assess damage to temperature sensitive equipment inside cabinets is conservative when compared to the guidance provided in FAQ 13-0004 (Reference 91).

- In FM RAI 07 (Reference 20), the NRC staff requested that the licensee justify the assumption that propagating panel fires in the MCR spread to adjacent panels in 15 minutes which is inconsistent with the guidance in NUREG/CR-6850.

  In its response to FM RAI 07 (Reference 14), the licensee stated that it recalculated the MCR abandonment times for propagating panel fire scenarios using 10 minutes for the fire to spread to adjacent panels.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee properly accounted for propagating panel fire scenarios in the determination of the probability for MCR abandonment.

- In FM RAI 09 (Reference 20), the NRC staff requested that the licensee explain how HEAF-initiated fires were modeled in the HGL development timing calculations, and to confirm that the guidance provided in NUREG/CR-6850, Appendix M was followed.

  In its response to FM RAI 09 (Reference 14), the licensee explained that the fire dynamics simulator (FDS) analysis of HEAF scenarios in Switchgear Rooms 1-C and 1-D assumes that the peak HRR is reached immediately, that the lowest cable tray and other cable trays in the ZOI ignite without delay, and that subsequent cable tray ignition and fire spread are modeled to occur when the cable is predicted to fail, as this represents the specific configurations analyzed. The licensee further stated that the HGL analysis for HEAF-initiated fires in the remaining areas was revised using the techniques described in the GFMTs approach and also following the guidance described in NUREG/CR-6850. The licensee further stated that the peak HRR used for the FDS and CFAST HEAF analyses is equal to the NUREG/CR-6850, Appendix E, 98th percentile HRR for the electrical cabinet in which the HEAF is postulated to occur.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that its analysis to model HEAF-induced fires either followed the NUREG/CR-6850 guidance or is more conservative.

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 process for performing FM in support of the FREs, the NRC staff concludes that the licensee's approach for meeting the requirements of NFPA 805, Section 2.4.3.3 is acceptable.

3.4.2.4 Conclusions Regarding Fire PRA Quality

Based on NUREG-0800, Section 19.2 (Reference 39), Section III.2.2.4.1, summarizing the NRC staff's review of PRA Quality required for a LAR, the NRC staff concludes that the licensee's revised 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 for 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 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 to the applicable industry PRA standards for internal events and fires, considering the acceptable disposition of the peer review and NRC staff review findings; and (3)

the fire modeling used to support the development of the FPRA has been confirmed as appropriate and acceptable.

The FPRA used to support risk-informed (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 updated baseline FPRA model (Reference 17), to incorporate acceptable methods, as detailed in the response to PRA RAI 30 (Reference 16), and discussed above, as well as LAR Attachment S, Table S-3, Implementation Item 3, to include current guidance on well-sealed cabinets and HRA dependency updates prior to self-approval, demonstrate that NFPA 805 criteria are satisfied and the PRA is acceptable for use to support self-approval changes to the FPP program.

Finally, 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 can assure that the quality of the PRA is sufficient 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 nuclear safety performance criteria (NSPC), the licensee used fire risk evaluations (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 Risk Insights."

Plant configurations that did not meet the deterministic requirements of NFPA 805, Section 4.2.3.1, were considered variance from deterministic requirements (VFDRs). VFDRs that will be brought into deterministic compliance through plant modifications need no risk evaluation. The licensee identified in LAR Attachment C, "NEI 04-02 Table B-3 – Fire Area Transition, as supplemented by the letter dated August 14, 2014 (Reference 16), the VFDRs that it does not intend to bring into deterministic compliance under NFPA 805. For these VFDRs, the licensee performed evaluations using the RI approach, in accordance with NFPA 805, Section 4.2.4.2, to address FPP non-compliances and demonstrate that retaining the VFDRs is acceptable.

As discussed in LAR Attachment W, Section W.2.1, and in its response to PRA RAI 23.a.01 (Reference 16), all of the VFDRs evaluated by the FPRA were categorized as separation issues. The 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 its response to PRA RAIs 23 (Reference 12), and 23.a.01 (Reference 16), the licensee described how an FRE is performed for VFDRs. 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 variant (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 for each unit to the RG 1.174 acceptance guidelines. The licensee explained that some modifications are planned that do not resolve a VFDR (non-VFDR modifications) but which do reduce risk.

The variant plant is modeled with fire-induced component 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 components and cables required to resolve a VFDR are not affected by a fire. With VFDRs resolved, RAs are maintained in the compliant plant at their nominal values to recover random failures of associated VFDR components. Non-VFDR modifications are not included in the compliant case.

These calculations require the difference between the variant (post-transition) plant risk and the compliant plant risk. For the employed method, conservative FPRA modeling may lead to underestimation of the change in risk in some instances. In its response to PRA RAI 23.a.01.b (Reference 16), the licensee stated that modeling simplifications have not been used to achieve conservative risk estimates in either the compliant plant or the post-transition plant.

In its response to PRA RAI 01.l (Reference 12), and PRA RAI 01.l.01 (Reference 16), the licensee provided MCR abandonment scenarios in detail. In its response to PRA RAI 23.f (Reference 12), the licensee stated that the same general approach is used to calculate the change in risk from CR abandonment scenarios and summarized the approach as applied to MCR abandonment.

For those VFDRs that are considered to have no or an insignificant change in risk based on qualitative evaluation, the change in risk, as discussed in the licensee's responses to PRA RAI 23 (Reference 12), and PRA RAI 23.c.01 (Reference 16), is not estimated with the PRA but rather designated as no impact or epsilon, respectively.

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, and FAQ 08-0054 (Reference 64). The staff further concludes that the results of these calculations for each fire area, which are summarized in LAR Attachment W, Table W-2, 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 K, "Existing Licensing Action Transition," 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 for addressing RAs which included the definition of primary control station (PCS) and RA. Accordingly, any actions required to transfer control to, or operate equipment from, the PCS, while required as part of the RI/PB FPP, were not considered RAs per the RG 1.205 guidance and in accordance with NFPA 805. Conversely, any 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 recovery actions.

The licensee identified the recovery actions required to meet risk and defense-in-depth (DID) criteria in LAR Attachment G, Tables G-1 and G-2, respectively, thus indicating which RAs were required to resolve VFDRs and which were required for DID only. Operator actions that are performed locally or in the MCR to provide additional risk reduction (i.e., not to resolve VFDRs) as well as those that are performed at the PCS following MCR abandonment are identified in LAR Attachment G, Tables G-3 and G-4, respectively, but as explained above, these actions are not considered RAs.

The additional risk of RAs for each fire area is presented in a supplement to LAR Attachment W provided in the licensee's response to PRA RAI 30 (Reference 16). In its response to PRA RAI 23 (Reference 12), the licensee clarified that the additional risk of RAs associated with each fire area is calculated similarly to the change in risk for that area except that the compliant plant configuration is modified to credit non-VFDR modifications. The total additional risk of RAs was obtained by summing the additional risk for each fire area. According to the updated LAR Attachment W, Table W-2 (Reference 16), the licensee reported a total additional risk of RAs of 1.4E-06/year for CDF and 6.8E-08/year for LERF. In its response to PRA RAI 30.c.01 (Reference 17), the licensee confirmed that RAs identified in the letter dated August 14, 2014 (Reference 16), were included in these updated results. The NRC staff finds these results acceptable because they are less than the Region II acceptance guidelines depicted in Figure 4 and Figure 5 of RG 1.174.

Per LAR Attachment G, the licensee reviewed all of the RAs for adverse impact on plant risk per FAQ 07-0030 (Reference 58), and stated that no RAs listed in LAR Attachment G, Table G-1 were found to have an adverse impact. Furthermore, all RAs listed in LAR Attachment G were evaluated against the feasibility criteria provided in NEI 04-02 (Reference 7), FAQ 07-0030, and RG 1.205 (Reference 4). The actions in LAR Attachment S, Table S-3, Implementation Items 1 and 3, will update the post-fire shutdown procedures and incorporate the results of a confirmatory demonstration of RA feasibility evaluation, respectively.

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 estimated values are less than the acceptance guidelines and therefore the NRC concludes that 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/PB alternatives to comply with NFPA 805.

3.4.6 Cumulative Risk and Combined Changes

The licensee identified planned NFPA 805 transition modifications in LAR Attachment S, Table S-2, as supplemented. The licensee included modifications that resolved VFDRs and other modifications not associated with resolving VFDRs (i.e., risk-reduction modifications). In its response to PRA RAI 23 (Reference 12), the licensee identified the four risk-reduction modifications as modifications S2-1, S2-8, S2-12, and S2-14. The licensee credited the risk reduction from these modifications by including them in the post-transition risk but not the compliant plant risk. The licensee's application to transition to a RI/PB FPP is, therefore, a combined change request per RG 1.174, Revision 1, Section 2.1.1, and is consistent with RG 1.174.

The licensee provided the delta (Δ) CDF and Δ LERF estimated for each fire area with VFDRs using the FRE PB method. In letters dated August 14, 2014 (Reference 16), and November 4, 2014 (Reference 17), the licensee provided change-in-risk estimates based on the FPRA after implementing a number of FPRA model and method refinements to use NRC accepted methods. The risk estimates for these fire areas address the completed and planned modifications and administrative controls that will be implemented as part of the transition to NFPA 805, as well as RAs, to reduce VFDR risk.

In its response to PRA RAI 23.01 (Reference 16), the licensee stated that the estimated risk of retained (or unresolved) VFDRs was calculated as the risk of the plant with only the planned modifications removing VFDRs modeled in the PRA minus the risk of a compliant plant with all VFDRs removed from the PRA model. The licensee estimated the risk increase associated with unresolved VFDRs as 5.1E-03/year and 3.1E-4/year for CDF and LERF respectively. The licensee estimated the risk decrease associated with the risk reduction modification to be -5.3E-3/year and -3.3E-04/year for CDF and LERF, respectively. The estimated risk decrease is greater than the estimated risk increase. The licensee estimated the cumulative or net change in risk associated with transition to NFPA 805 as -2.3E-04/year and -1.2E-05/year for CDF and LERF, respectively. These calculations are consistent with the guidance in FAQ 08-0054 (Reference 64), and therefore acceptable.

The reported change-in-risk values indicate that the licensee could achieve a substantial risk reduction by bringing the plant into deterministic compliance, but has proposed instead to achieve an even larger risk reduction by implementing the selected risk-reduction modifications. The flexibility to select modifications based on risk instead of compliance is a central element of NFPA 805 and therefore an acceptable approach. Although the risk increase associated with the combined change request is substantially greater than the acceptable risk increases in RG 1.174, the net change in risk is also a substantial risk decrease compared to bringing the plant into deterministic compliance. Similar change-in-risk values are estimated for some individual fire areas but only five of the 40 areas have a net positive risk increase in either CDF or LERF or both. The largest fire area risk increases are 2.2E-07/year and 4.2E-07/year for CDF and LERF, respectively, and are below the RG 1.174 acceptance guidelines. The total change in CDF and LERF for this application is a net negative, and as a result, RG 1.174 does

not require a total CDF and LERF to be considered. Based on the results of the licensee's fire risk assessments, the cumulative change in risk for all fire areas subject to a PB approach is within the RG 1.174 risk acceptance guidelines.

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 satisfies 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 RAIs.

In the LAR, the licensee used the updated fire bin frequencies provided in NUREG/CR-6850, Supplement 1 (Reference 42). In its response to PRA RAIs 20 (Reference 12), PRA RAI 20.01 (Reference 16), and PRA RAI 01.j.01.01 (Reference 17), the licensee performed a sensitivity study to calculate the change in risk associated with use of the fire ignition frequency values in NUREG/CR-6850 for those ignition frequency bins having an alpha factor less than or equal to one. Given that the change in total CDF and total LERF for this application remains a net negative change from contributions of all VFDR risk and plant changes as described previously, the NRC staff concludes that the revised risk results for the sensitivity analysis continue to meet the acceptance guidelines in RG 1.174.

In its response to PRA RAIs 01.nn and 03 (Reference 12), the licensee stated that the statistical propagation of parametric uncertainty would be performed for FPRA parameters and that the state of knowledge correlation would be addressed for those that are correlated. In its response to PRA RAI 30 (Reference 16), the licensee did not propagate uncertainty as the change in uncertainty was expected to have negligible impact on the FPRA results. The NRC staff concludes that, due to the large negative transition risk, this is a reasonable conclusion.

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 the following:

- The licensee's PRA used to perform the risk assessments in accordance with NFPA 805, Section 2.4.4 (plant change evaluations) and Section 4.2.4.2 (fire risk evaluations), 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 and are 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 license amendment request (LAR) review with acceptable approaches, data, and methods as described. Therefore, the NRC staff finds that the baseline PRA model may be used to support post-transition self-approval

of changes because the identified acceptable methods will be used until and unless replaced by other acceptable methods. Self-approval, however, is conditional on completing the relevant implementation items in LAR Attachment S.

- Implementation Item 8 of LAR Attachment S, Table S-3, as supplemented, indicates that the licensee will re-evaluate the risk and change-in-risk results after completing implementation items and modifications for transition to NFPA 805 and confirm that risk metrics do not exceed RG 1.174 risk acceptance guidelines.

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

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

- The risk presented by the use of RAs was determined and provided in accordance with NFPA 805 Section 4.2.4, and the guidance in RG 1.205, Revision 1. The NRC staff concluded that the additional risk associated with the NFPA 805 RAs is acceptable because the risk is below the acceptance guidelines in RG 1.174 and therefore meets the acceptance criteria in RG 1.205, Revision 1.

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

The licensee's application to transition to NFPA 805 is a combined change, as defined by RG 1.205, Revision 1 which includes risk increases identified in the FREs with risk decreases resulting from non VFDR related modifications. Based on the combination of these risk values, the changes associated with NFPA 805 meet the guidance contained in RG 1.205, Regulatory Position 3.2.5, related to meeting the requirements for cumulative risk and combined plant changes.

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:

> 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 safety evaluation (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," also 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 (Reference 8), 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, "Plant Modifications and Items to be Completed During Implementation," and LAR Attachment W, "Fire PRA Insights," during its evaluation of the ability of each fire area to meet the nuclear safety performance of NFPA 805.

PNP is a single unit PWR with 40 individual fire areas including the outside the buildings, within the Protected Area. There is an outside area called the "Yard." Each fire area is composed of one or more fire zones. Based on the information provided by the LAR, as supplemented, the licensee performed the NSCA on each fire area. LAR Attachment C provides the results of these analyses on a fire area basis and also identified 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, Table B-3, "Fire Area Transition."

Table 3.5-1 Fire Area and Compliance Strategy Summary

Fire Area	Area Description	NFPA 805 Compliance Basis
1	Control Room	Performance Based
2	Cable Spreading Room	Performance Based
3	1-D Switchgear Room	Performance Based
4	1-C Switchgear Room	Performance Based
5	1-1 Diesel Generator Room	Performance Based
6	1-2 Diesel Generator Room	Performance Based

7	Diesel Generator 1-1 Fuel Oil Day Tank Room	Performance Based
8	Diesel Generator 1-2 Fuel Oil Day Tank Room	Performance Based
9	Screen House (Intake Structure)	Performance Based
10	East Engineered Safeguards Room	Performance Based
11	Battery Room #2 (A)	Performance Based
12	Battery Room #1 (B)	Performance Based
13	Auxiliary Building	Performance Based
14	Reactor Containment Building	Performance Based
15	Engineered Safeguards Panel Room	Performance Based
16	Component Cooling Water Rooms	Performance Based
17	Refueling and Spent Fuel Pool Area	Performance Based
18	Demineralizer Area	Performance Based
19	Track Alley	Performance Based
21	Electrical Equipment Room	Performance Based
22	Turbine Lube Oil Room	Performance Based
23	Turbine Building	Performance Based
24	Auxiliary Feedwater Pump Room	Performance Based
25	South and North Heating Boiler Room	Performance Based
26	Southwest Cable Penetration Room	Performance Based
27	Radwaste Facilities Building VRS Rooms	Performance Based
28	West Engineered Safeguards Room	Performance Based
29	Center Mechanical Equipment Room	Performance Based
30	East Mechanical Equipment Room	Performance Based
31	West Mechanical Equipment Room	Performance Based
32	SIRW Tank Roof Area	Performance Based
33	Technical Support Center	Performance Based
34	Manhole #1	Performance Based
35	Manhole #2	Performance Based
36	Manhole #3	Performance Based
38	Cooling Tower Pump House	Performance Based
39	Feedwater Purity Building	Performance Based
40	Switchyard	Performance Based
41	Outside Area within Protected Area (Yard)	Performance Based
56	Diesel Fire Pump Fuel Oil Day Tank Room	Performance Based

LAR Attachment C and LAR Table 4-3 provide the results of these analyses on a fire area basis. For each fire area, the licensee documented the following:

- The approach was used in accordance with NFPA 805 (i.e., the PB approach in accordance with NFPA 805, Section 4.2.4);

- The structures, systems, and components (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; and
- 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 NSPC

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

The licensee performed a detailed analysis of fire protection features and identified the fire suppression and detection systems required to meet the NSPC for each fire area. LAR Table 4-3, "Summary of NFPA 805 Compliance Basis and Required Fire Protection Systems and Features," lists the fire areas, and identifies if the fire suppression and detection systems are installed in these areas to meet the required criteria for separation, DID, risk, licensing actions, and/or existing engineering equivalency evaluations (EEEEs).

The NRC staff reviewed LAR Attachment C for each fire area to ensure fire detection and suppression met the principles of DID in regard to the planned transition to NFPA 805. Based on the statements provided in LAR Attachment C, as supplemented, the NRC staff concludes that the 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. Each fire area was evaluated for the effects of fire suppression activities on the NSPC considering the following:

- Automatic fire suppression coverage;
- Drainage of the compartment;
- Access to the compartment and manual fire suppression features;
- Previously prepared internal flooding reviews;
- Impact on area equipment; and
- Mitigating features such as seals, procedures, curbs, and tray type.

The licensee stated that fire suppression activities should not adversely affect achievement of the NSPC.

The NRC staff concludes that the licensee's evaluation of the suppression effects on the NSPC is acceptable because the licensee evaluated the fire suppression effects on meeting the NSPC and determined that fire suppression activities will not adversely affect achievement of the NSPC.

3.5.1.3 Licensing Actions

Based on the information provided in the LAR Attachment C, as supplemented, the licensee identified one exemption from Appendix R, that was previously approved by the NRC and will be transitioned with the NFPA 805 FPP. The exemption is summarized in LAR Attachment C, on a fire area basis and described in further detail in LAR Attachment K, "Existing Licensing Action Transition."

The licensing action being transitioned is summarized in SE Table 3.5-2. The licensee has two proposed clarifications to the previously approved compliance configurations identified in SE Section 3.1 and documented these clarifications in LAR Attachment T, "Clarification of Prior NRC Approvals."

Table 3.5-2 Previously Approved Licensing Actions Being Transitioned

Licensing Action Description	**Applicable Fire Areas**	**Clarification**	**NRC Staff Evaluation**
Exemption from Section III.O of Appendix R - Capacity of Primary Coolant Pump Oil Collection System	14 - Reactor Containment Building	None	Based on the previous staff approval of this exemption and the statement by the licensee that the basis remains valid, the NRC staff concludes that the applicability of this licensing action is acceptable.

The licensee identified licensing actions which required LAR Attachment T clarifications for the following Chapter 3 elements:

- 3.5.2 and 3.5.5 service water pump and diesel fire pump separation.
- 3.5.11 and 3.5.13 primary and backup fire suppression separation.

For NFPA 805 Sections 3.5.2 and 3.5.5 in LAR Attachment T, the licensee submitted "Prior Approval Clarification Request 1," requesting the NRC formally document as "prior approval" the separation of the service water pumps and diesel fire pump as identified in the enclosure of inspection report No. 50-255/88012(DRS) dated August 8, 1988 (Reference 112). In LAR Attachment T, the licensee stated the following:

> In closure of Inspection Report Open Item 255/86022-07, dated August 1988, the NRC states:
>
> The inspectors observed that in the Intake Structure, the diesel powered fire pump was not sufficiently protected from the service water pumps to provide reasonable assurance that a single fire would not damage both normal and alternate shutdown capability. However, the licensee had previously identified this condition and requested an NRC staff evaluation of the adequacy of the in-place protection.
>
> By letter dated October 14, 1986, the licensee committed to the following:
>
> (1) To install a fire detection system in the Intake Structure before startup from the present outage,
>
> (2) To cover the control and annunciator cables for the diesel fire pump with one hour rated fire resistant material before March 1, 1987,
>
> (3) To install a fire suppression system directly over the fuel transfer pumps before March 1, 1987,
>
> (4) An analysis showing that extending the radiant shield to the west was not necessary would be completed by October 16, 1986; and
>
> (5) An analysis showing an additional drain at the fuel oil transfer pumps was not required would be completed by October 16, 1986.
>
> During this inspection, the inspector visually verified that Items (1), (2), and (3) mentioned above have been completed. In addition, a review of the licensee's analysis to satisfy Items (4) and (5) mentioned above were also reviewed and determined to be satisfactory. Further with regard to Item (2), the inspectors confirmed through review of Drawing Nos. E-375, Revision 38, dated March 9, 1987; E-739, Revision 6, dated March 13, 1987; and E-797, Revision 9, dated September 20, 1974, that the proper diesel fire pump cables were wrapped as stated.

For NFPA 805 Sections 3.5.11 and 3.5.13 in LAR Attachment T, the licensee submitted "Prior Approval Clarification Request 2," requesting the NRC to formally document as "prior approval" the single failure of both the primary and backup fire protection system water supplies in the charging pump room. The licensee stated that this lack of compliance was conveyed to the NRC by letter dated July 31, 1989 (Reference 113), as supplemented on October 26, 1989 (Reference 114), and was approved by SE dated August 21, 1992 (Reference 115). The licensee further stated that because the SE does not specifically reiterate the information that was provided to the NRC, it is requesting clarification that the charging pump room configuration described above is still considered acceptable under the new licensing basis. The licensee further stated that the plant configuration has not changed since the SE dated August 21, 1992, and that the overall basis for the NRC approval is maintained by this existing configuration without isolation between the automatic and manual suppression systems due to the low fire loading involved. The licensee further stated that the above clarification is provided to ensure an accurate representation for the new licensing basis under NFPA 805 and that LAR Attachment S, Table S-3, Implementation Item 1, includes an action to revise fire protection implementing procedures to clarify the necessary compensatory actions required should the primary and secondary water supplies be removed from service.

Based on the NRC staff's review of the licensing actions identified and described in LAR Attachments C and K, and the clarifications provided by the licensee in LAR Attachment T, the NRC staff concludes that the licensing actions identified by applicable fire area remain valid to support the proposed license amendment because the licensee utilized the process described in NEI 04-02 (Reference 7), as endorsed by RG 1.205 (Reference 4), which discusses a determination of the basis of acceptability and a determination that the basis is still valid and because the licensee identified an implementation item that will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

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 and basis for approval of the exemption. In LAR Section 4.2.3, and in LAR Attachment K, the licensee stated 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.

Based on the previous NRC staff approval of the exemptions and the statement by the licensee that the basis remains valid, 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 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 FAQ 08-0054 (Reference 64), 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 Attachment L for NRC review and approval.

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

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

3.5.1.5 Variances from Deterministic Requirements

For all fire areas, VFDRs were identified and evaluated using PB methods. VFDR identification, characterization, and resolutions were identified and summarized in LAR Attachment C for each fire area. Documented variances were all represented as separation issues. The following strategies were used by the licensee in resolving the VFDRs:

- A FRE determined that applicable risk, DID, and safety margin criteria were satisfied without further action; or
- A FRE determined that applicable risk, DID, and safety margin criteria were satisfied with a credited RA; or

- A FRE determined that applicable risk, DID, and safety margin criteria were satisfied with a DID RA; or

- A FRE determined that applicable risk, DID, and safety margin criteria were satisfied with a plant modification(s), as identified in the 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's 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 are acceptable, see SE Sections below.

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 Section 3.5.1.7 of this SE.

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 recovery actions (RAs) are described in SE Section 3.2.5 "Establishing Recovery Actions." The NRC staff's evaluation of the additional risk of RAs credited to meet the risk acceptance guidelines is provided in Section 3.4.4 of this SE.

3.5.1.7 Recovery Actions Credited for Defense-in-Depth

The licensee defined defense-in-depth recovery actions (DID-RAs), identified in LAR Attachment G, Table G-2, as actions taken outside the primary control station (PCS) to "directly resolve a variance from the deterministic requirements of NFPA 805 Section 4.2.3." The licensee stated that these actions are taken to demonstrate the availability of a success path for the NSPC in the fire area, however the resulting delta risk of the VFDR is not significant and these actions are only required based on DID considerations.

In LAR Attachment G the licensee stated that DID-RAs have been conservatively retained to provide plant operations with written guidance where such actions will enhance echelon 3 of DID and to provide additional assurance that one success path of SSD capability can be restored in the event that echelon 1 and echelon 2 of DID become degraded or rendered ineffective.

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, "Establishing Recovery Actions."

3.5.1.8 Plant Fire Barriers and Separations

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

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

3.5.1.9 Electrical Raceway Fire Barrier Systems

The licensee stated that the ERFBS comply with the deterministic requirements of NFPA 805, Chapter 3. The licensee identified the fire area using ERFBS in LAR, Table 4-3, "Summary of NFPA 805 Compliance Basis and Required Fire Protection Systems and Features," and LAR Attachment C, Table B-3. In the fire area with PB compliance, the ERFBS were analyzed using the PB approach in accordance with NFPA 805, Section 4.2.4. Each PB fire area utilizing ERFBS, as identified in LAR Attachment C, included a discussion of any VFDR analysis used to evaluate the acceptability of this feature.

3.5.1.10 Conclusion for Section 3.5.1

As documented in LAR Attachment C, all fire areas use 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 that compliance with the NFPA 805 requirements was demonstrated as follows:

- Deviations 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.

- 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, the NRC staff concludes that each fire area utilizing the PB approach meets the applicable requirements of NFPA 805, Section 4.2.4.

3.5.2 Clarification of Prior NRC Approvals

The elements of the pre-transition FPP licensing basis for which specific NRC previous approval needs clarification are included in LAR Attachment T. Included is sufficient detail to demonstrate how those elements of the pre-transition FPP licensing basis meet the requirements in 10 CFR 50.48(c) (RG 1.205, Revision 1, Regulatory Position 2.2.1). (See Section 3.5.1.3 of this SE)

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 Table F-1 Non-Power Operational Modes Transition," to evaluate the licensee's treatment of potential fire impacts during non-power operational (NPOs) modes. The licensee used the process described in NEI 04-02, as modified by FAQ 07-0040 (Reference 62), for demonstrating that the NSPC are met for higher risk evolutions (HREs) during NPO modes.

HREs are "outage activities, plant configurations, or conditions during shutdown where the plant is more susceptible to an event causing the loss of a key safety function (KSF)." The strategy contains specific actions to address reduced inventory conditions that consider short time to boil, limited methods for decay heat removal, and low Reactor Coolant System (RCS) inventory.

3.5.3.1 NPO 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 FAQ 07-0040. In LAR Section 4.3.1, the licensee stated that the process undertaken to demonstrate that the NSPC was met during NPO modes included:

1) Reviewing the existing outage management processes;

2) Identifying necessary equipment and cables;

3) Performing fire area assessments to identify plant locations where a single fire may damage all success paths of a KSF; and

4) Managing those locations (called pinch-points) that are associated with fire-induced vulnerabilities during an outage. The licensee implemented the process outlined in NEI 04-02 and FAQ 07-0040, "Clarification on Non-Power Operations."

As described in LAR Attachment D, each independent path capable of ensuring that a KSF can be met was reviewed to identify the required components. The licensee stated that the majority of the equipment required to maintain the KSFs was determined to be nuclear safety capability assessment (NSCA) or PRA credited, with the same functional requirements and that components not credited by the NSCA or PRA, or with different functional requirements, were cable selected and logically associated with supporting cables, equipment, and systems in the database, consistent with the NSCA analysis model. The licensee further stated that component and cable selection, location and routing methodology aligns with NEI 00-01 "Guidance for Post-Fire Safe Shutdown Analysis," Revision 2 (Reference 31). In SSA RAI 08.b (Reference 19), the NRC staff requested that the licensee describe the difference between the at-power safe shutdown (SSD) function and the NPO function for any new components that were added to the analysis. In its response to SSA RAI 08 (Reference 10), the licensee stated that, in most cases, the difference in function did not result in a change to the selected cables, but in all cases the cable selection was reviewed, evaluated, and updated as required for all credited functions and that differences in equipment and functions are typically attributable to the difference in plant operating state.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee described the difference between the at-power SSD function and the NPO function and also demonstrated an acceptable approach for component selection. In addition, the NRC staff concludes that the NPO process described and documented by the licensee in LAR Section 4.3 and LAR Attachment D is acceptable because it is consistent with FAQ 07-0040.

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 a HRE and it is possible to lose a KSF due to fire. LAR Section 4.3 discusses these additional controls and measures; however, the licensee indicated that during low risk periods, normal risk management controls as well as fire prevention and fire protection processes and procedures will be used.

The licensee stated that based on FAQ 07-0040 and its procedures; plant operational states considered for equipment and cable selection were developed, starting at the point when Shutdown Cooling is placed in service. The licensee further stated that KSFs were developed based on its procedures and that NPO equipment selection was developed using plant procedures, design basis documents, technical specifications (TSs), and engineering judgment to determine which systems and equipment to include or exclude from the NPO equipment list. The licensee further stated that a software application was used for the NPO assessment given

the list of equipment associated with each KSF and plant operation state and that the analysis was performed using a deterministic method and that no FM was used to limit the scope of fire damage to cables or equipment within a fire area.

The NRC staff concludes that the licensee's process to identify NPO systems, components, and cables, as described in LAR Section 4.3.2, and LAR Attachment D, is consistent with the guidance in FAQ 07-0040. The staff also concludes that NPO systems, components and cables are logically related to KSFs and are appropriately identified in the NPO analysis database.

3.5.3.3 NPO Key Safety Functions and SSCs Used to Achieve Performance

LAR Section 4.3.2, states that after the fire area analyses identified the credited paths, an assessment was performed to identify which KSFs had fire areas where a single fire could result in a loss of all credited paths for a given KSF.
The licensee stated that the analysis process recovers the path with the least fire impact, but the plant may select a path to protect other than the path recovered based on the particular HRE and that from this assessment, a pinch point matrix was developed showing the KSF path status on a fire area basis. The licensee further stated that fifty-eight (58) fire areas were analyzed, twenty-nine (29) fire areas were determined to have no pinch points, and twenty-nine (29) fire areas were found to have one or more pinch points.

Based on its review of the information provided in the LAR, as supplemented, the NRC staff concludes that the licensee used methods consistent with the guidance in FAQ 07-0040 and RG 1.205 to identify the equipment required to achieve and maintain the fuel in a safe and stable condition during NPO modes. Furthermore, the NRC staff concludes that the licensee has a process in place to ensure that fire protection DID measures will be implemented to achieve the KSFs during applicable plant modes and that any required action will be completed through an implementation item identified in LAR Attachment S, which would be required by the proposed license condition.

3.5.3.4 NPO Pinch Point Resolutions and Program Implementation

In SSA RAI 08 (Reference 19), the NRC staff requested that the licensee provide additional detail regarding the analysis and results of the NPO analysis performed. In its response to SSA RAI 08 (Reference 10), the licensee stated that no procedure changes are anticipated for the expanded use of RAs beyond those in existing procedures. The licensee further stated that RAs are credited to recover the loss of Heating, Ventilation, and Air Conditioning (HVAC). The licensee further stated that it has been determined that adequate procedural guidance exists in plant system operating and off-normal operating procedures and that the procedures address failed equipment and provide options to either recover the component or operate other equipment to address the lost function. The licensee further stated that HVAC RAs are not critically time sensitive as to require action concurrent with firefighting efforts.

The licensee stated that there is currently no reliance on any pre-positioning of components prior to entry into a HRE to minimize the impact of fire-induced spurious actuations and that credit is taken in the NPO analysis for the positioning of certain components by existing procedures during the normal shutdown sequence to mitigate spurious operation of those components. The licensee further stated that these components include closed containment

spray header isolation valves to prevent transfer of the Safety Injection Refueling Water tank contents to the containment sump should spurious operation of shutdown cooling components occur, and a closed dilution water supply valve to prevent inadvertent dilution. The licensee further stated that RAs have only been credited to recover the loss of HVAC and that RA feasibility is evaluated in a manner consistent with the NSCA credited RAs and no procedural updates are anticipated for these actions.

The licensee identified that appropriate site procedures will be revised to provide additional guidance to be used specifically for HRE activities and that changes will provide plant outage management and fire protection with mitigation strategies that can be put in place based on the specific conditions of a planned activity. The licensee stated that the strategies may include:

- Prohibition or limitation of hot work;
- Prohibition or limitation of combustible materials;
- Establishment of additional fire watches as appropriate;
- Verification of operable detection and/or suppression in the vulnerable areas;
- Rescheduling of work to a period with lower risk or higher DID; and
- Plant configuration changes (including pre-positioning).

The licensee included the action to "revise or develop technical documents and administrative procedures as needed for implementation of NFPA 805" in LAR Attachment S, Table S-3, Implementation Item 1 and the NRC staff concludes this action is acceptable because the action will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

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

- Identified the KSFs required to support the NSPC during NPOs;
- Identified the plant operating states where further analysis is necessary during NPOs;
- Identified the SSCs required to meet the KSFs during the plant operating states analyzed;
- Identified the location of these SSCs and their associated cables;
- Performed analyses on a fire area basis to identify pinch points were one or more KSF could be lost as a direct result of fire-induced damage; and

- 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 adequate justification that the NSPC are met during NPO modes and HREs at PNP.

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 the PB approach, in accordance with NFPA 805, Section 4.2.4.

For all fire areas the NRC staff confirmed 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) 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, based on the above, the NRC staff concludes that there is reasonable assurance that each fire area utilizing the PB approach does so in accordance with NFPA 805, Section 4.2.4.

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 a RA for HVAC restoration is required during NPO modes and that the licensee's overall approach for fire protection during NPO modes is acceptable.

3.6 Radioactive Release Performance Criteria

NFPA 805 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 nuclear power plant.

Radioactive Release Goal

> 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.

Radioactive Release Objective

> 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.

Radioactive Release Performance Criteria

> 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 order to assess whether the FPP to be implemented under NFPA 805 meets the above requirements, the licensee reviewed the existing fire pre-plans and fire brigade training materials. Fire pre-plans that address fire areas where there is no possibility of radioactive materials being present (outside of the radiologically controlled area) were screened from further review. All other fire pre-plans were reviewed to ascertain whether existing engineering controls are adequate to ensure that radioactive materials (contamination) generated as a direct result of fire suppression activities are contained and monitored before release to unrestricted areas, such that the release would meet the NFPA 805 radioactive release performance criteria. A list of areas containing, or potentially containing, contamination were verified by the licensee's Radiation Protection personnel and several pre-fire plans were updated to identify the radiological concerns for these areas.

The licensee's review determined that existing engineering controls, such as curbs, sumps, and forced air ventilation, were adequate to meet the NFPA 805 radioactive release requirements. In addition, the licensee updated each of the fire pre-plans addressing fire areas where radioactive materials may be present to include provisions for containment and monitoring of smoke and fire suppression agent runoff should the effectiveness of the installed engineering controls be challenged or impacted by fire suppression activities.

The licensee's review determined the current FPP is compliant with the radiological release requirements of NFPA 805 and the guidance in RG 1.205. LAR Attachment E, Table E-1 provides the details of the licensee's qualitative assessment on a fire zone, by fire zone basis.

With the exception of those fire zones discussed below, the licensee's qualitative review determined that the licensee's buildings and structures provide sufficient capacity to contain the liquid and gaseous fire-fighting effluents such that the radioactive release performance criteria are not exceeded. The licensee's review verified that plant features, such as exterior doors, which could potentially release contaminated liquid runoff to the environment, are addressed in the FPP.

LAR Attachment E, Table E-1 identifies several fire areas where containment/confinement is not provided for radioactive materials which are released in the form of liquid or gaseous effluents due to fire or firefighting activities. These include, the radiologically controlled area (RCA) Access Control /Administration Building, Dry Fuel Storage Building, East Storage Building, East Radwaste Storage Building, and outside areas within the protected area, used for staging materials in metal boxes and Sealand containers. The licensee has implemented fleet procedures that direct the use and storage of radioactive material. These procedures ensure the regular removal of combustible trash so there is no accumulation of contaminated trash outside of approved trash containers. Materials that contain radioactivity are stored in closed metal containers (including approved containers for flammable liquids) and located away from ignition sources, minimizing the chance they will be impacted by a fire. Due in part to these administrative controls, the licensee determined that a fire in the East Radwaste Building would constitute the bounding scenario, most likely to result in an offsite release of radioactive materials in effluents. Using the dose calculation methods in the licensee's Offsite Dose Calculation Manual, the licensee performed a quantitative evaluation of this bounding scenario, and concluded that a fire in the East Radwaste Building would result in offsite doses that are within the limits of 10 CFR 50, Appendix I for both gaseous and liquid effluents. Since the limits in Appendix I are well within the dose limit for a member of the public in 10 CFR 20, the NRC staff concludes that the radioactive release criterion in NFPA 805 is met.

The licensee reviewed the existing pre-fire plans, fire brigade training material, fire protection procedures, and radiation protection procedures, to determine if they ensure necessary actions to control radioactive releases. In areas with specific risk of radioactive release due to fire or firefighting activities, applicable precautions were provided in the FPP. The FPP has been revised to include precautions and strategies to prevent or minimize cross-contamination, and to assure that manual actions are taken (e.g., cover or place berms around storm drains) to prevent offsite releases in those fire areas where there is such a potential. The licensee stated that monitoring of potentially contaminated combustion products and suppression agents in the event of a fire in an area with radiological hazards is controlled in HP 2.8, "Response to Unusual Radiological Occurrences." The licensee's review also determined that the current fire brigade training materials are adequate to meet the requirements for transition to NFPA 805.

NFPA 805 requires the licensee to address the nuclear safety and radioactive release goals, objectives and performance criteria in any operational mode. The licensee stated that all modes of operation (including non-power/outage operations) were considered in the radioactive release review. During power and non-power operations, the north area of the plant is used for staging metal boxes and Sealand containers with contaminated materials and equipment. In addition, during outages, areas outside both the east and south sides of the Administrative Building are used for staging metal boxes, Sealand containers, and semi-tractor trailers that hold contaminated outage-related equipment. The use of these plant areas for staging radioactive materials are addressed in the pre-fire plans.

Based on (1) the information provided in the LAR, as supplemented, (2) the licensee's use of fire pre-plans, (3) the results of the NRC staff's evaluation of the identified engineered controls used to manage suppression water and combustion products, and (4) the development and implementation of newly revised fire brigade training procedures, the NRC staff concludes that the licensee's FPP provides reasonable assurance that radiation releases to any unrestricted area resulting from the direct effects of fire suppression activities are as low as reasonably achievable and are not expected to exceed the radiological dose limits in 10 CFR Part 20. The staff concludes that the licensee's FPP complies with the requirements of NFPA 805, Sections 1.3.2, 1.4.2, and 1.5.2.

3.7 NFPA 805 Monitoring Program

For this SE section, the following requirements from NFPA 805, 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 its FPP systems and features after the transition to NFPA 805. The focus of the NRC staff review was on the critical elements related to the monitoring program, including the selection of FPP systems and features to be included in the program, the attributes of those systems and features that will be monitored, and the methods for monitoring those attributes. Implementation of the monitoring program will

occur on the same schedule as the NFPA 805 RI/PB FPP implementation, which the NRC staff concludes is acceptable.

The licensee stated that it will develop an NFPA 805 monitoring program consistent with FAQ 10-0059 (Reference 65). Development of the monitoring program will include a review of existing surveillance, inspection, testing, compensatory measures, and oversight processes for adequacy. The review will examine adequacy of the scope of SSCs within the existing plant programs, performance criteria for availability and reliability of SSCs, and the adequacy of the plant corrective action program. The monitoring program will incorporate phases for scoping, screening using risk criteria, risk target value determination, and monitoring implementation. The scope of the program will include fire protection systems and features, NSCA equipment, SSCs relied upon to meet radioactive release criteria, and fire protection programmatic elements. The NRC staff concludes that the action to develop the NFPA 805 monitoring program is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and is included in LAR Attachment S, Table S-3, Implementation Item 4, which would be required by the proposed license condition.

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

Based on the information provided in the LAR, as supplemented, the NRC staff concludes that the licensee's NFPA 805 monitoring program development and implementation process is acceptable and assures that the licensee will implement an effective program for monitoring risk significant fire SSCs because it:

- Establishes the appropriate performance monitoring groups to be monitored;
- Uses an acceptable screening process for determining the SSCs to be included in the performance monitoring groups;
- Establishes availability, reliability and performance criteria for the SSCs being monitored; and
- Requires corrective actions when SSC availability, reliability, and performance criteria targets are exceeded in order 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 licensee's NFPA 805 Monitoring Program is an implementation item, as described in LAR, Attachment S, Table S-3, Implementation Item 4, and as discussed above.

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 with the other implementation items as described in LAR Attachment S, Table S-3, within six months after NRC approval (or six months after a refueling outage if in progress at the time of approval), which is prior to completion of the modifications to achieve full compliance with 10 CFR 50.48(c).

3.7.1 Conclusion for Section 3.7

The NRC staff reviewed the licensee's RI/PB FPP and concludes that there is reasonable assurance that the licensee will develop a monitoring program that meets the requirements specified in Sections 2.6.1, 2.6.2, and 2.6.3 of NFPA 805 because the licensee identified an action to develop and implement the NFPA 805 monitoring program per NFPA 805 Section 2.6, and included that action as an implementation item, which 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 PNP FPP transition to NFPA 805.

3.8.1 Documentation

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

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

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

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

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

3.8.2 Configuration Control

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

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

The LAR stated that the configuration control process includes provisions for appropriate design, engineering reviews and approvals, and that approved analyses are considered controlled documents available through the PNP document control system. The LAR also stated that analyses based on the PRA program, which includes the FRE, are issued as formal analyses subject to these same configuration control processes, and are additionally subjected to the PRA peer review process specified in the ASME/ANS PRA standard (Reference 34).

Configuration control of the existing FPP during the transition period is maintained by the change evaluation process, as defined in existing configuration management and configuration control procedures. LAR Attachment S, Table S-3 includes Implementation Item 1 to revise or develop technical documents and administrative procedures as needed for implementation of NFPA 805. The NRC staff concludes that this action is acceptable because it is included as an implementation item in LAR Attachment S, Table S-3, which would be required by the proposed license condition.

The NRC staff review of the licensee's process for updating and maintaining the FPRA in order to reflect plant changes made after completion of the transition to NFPA 805 is in included in SE Section 3.4.

Based on the description of the PNP configuration control process, which indicates that the new FPP design basis and supporting documentation will be controlled and that plant changes will be reviewed for impact on the FPP, the NRC staff concludes that the requirements of NFPA 805 Sections 2.7.2.1 and 2.7.2.2 will be met.

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 FPP to NFPA 805 based on the requirements outlined above. The individual sections of this SE provide the NRC staff's evaluation of the application of the NFPA 805 quality requirements to the licensee's FPP, as appropriate.

3.8.3.1 Review

NFPA 805 requires that each analysis, calculation, or evaluation performed be independently reviewed. The licensee stated that its procedures require independent review of analyses, calculations, and evaluations, including those performed in support of compliance with 10 CFR 50.48(c). The licensee further 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 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 (V&V)

NFPA 805 requires that each calculational model or numerical method used be V&V through comparison to test results or other acceptable models. The licensee stated that the calculational models and numerical methods used in support of the transition to NFPA 805 were V&V, and that the calculational models and numerical methods used post-transition will be similarly V&V. As an example, the licensee provided extensive information related to V&V of fire models used to support the development of the FREs. The NRC staff's evaluation of this information is discussed below.

3.8.3.2.1 General

NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications", Volumes 1-7 (Reference 47), documents the V&V of five selected fire models commonly used to support applications of RI/PB fire protection 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) as part of an approved PB approach in accordance with NFPA 805, Chapter 4.

Accordingly, for those FM elements performed by the licensee using the V&V applications contained in NUREG-1824 to support the transition to NFPA 805, the NRC staff concludes that the use of these models is acceptable, provided that the intended application is within the appropriate limitations of the model, as identified in NUREG-1824.

In LAR Section 4.5.2, the licensee also identified the use of several empirical correlations that are not addressed in NUREG-1824. The NRC staff reviewed these correlations, as well as the related material provided in the LAR, in order to determine whether the licensee adequately demonstrated alignment with specific portions of the applicable NUREG-1824 guidance.

Table 3.8-1, "V&V Basis for Fire Modeling Correlations Used at PNP," in SE Attachment A and Table 3.8-2, "V&V Basis for Other Fire Models and Related Calculations Used at PNP," in SE Attachment B identify these empirical correlations and algebraic models, respectively, as well as a staff disposition 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, or national research laboratory reports (References 95 – 108). SE Tables 3.8-1 and 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 FRE used empirical correlations that provide bounding solutions for the ZOI and used conservative input parameters, that produced conservative results for the FM analysis. The empirical correlations and models were used to develop a generic methodology to determine the ZOI from pre-calculated tables which is documented in the GFMTs approach. See section 3.4.2.3 for further discussion of the licensee's FM method.

3.8.3.2.2 Discussion of RAIs

By letters dated August 8, 2013 (Reference 19), and March 11, 2014 (Reference 20), the NRC staff requested additional information concerning the FM conducted to support the FREs. By letters dated September 30, 2013 (Reference 10), December 2, 2013 (Reference 12), and May 7, 2014 (Reference 14), the licensee responded to these RAIs.

- In FM RAI 03.a (Reference 19), the NRC staff requested that the licensee confirm that the Froude number was within the NUREG-1824 validated range for the fire scenarios that were modeled with CFAST, or to provide technical justification for the use of CFAST with a Froude number outside the validated range.

  In its response to FM RAI 03.a (Reference 12), the licensee discussed the Froude numbers calculated for the different types of ignition sources that were specified in the CFAST runs, (i.e., closed electrical panels, transient ignition sources, electric motors, pumps and cable trays). The licensee stated that for closed electrical panels there is no meaningful way to define the area of the fire and, therefore, no meaningful way to calculate the Froude number since combustion occurs inside the panel. The licensee further stated that closed electrical panel fires were therefore conservatively modeled as open source fires with a Froude number that is within the NUREG-1824 validated range. The licensee's calculations show that the Froude number for transient fires calculated based on a characteristic diameter that is consistent with the HRR, and for cable tray fires based on the tray width as the characteristic dimension is either within or below the NUREG-1824 validated range. The Froude number for electric motor fires and pump fires is below the NUREG-1824 validated range. The licensee provided arguments to show that the cases with low Froude numbers produce results that are more conservative than comparable cases with a Froude number that falls within the NUREG-1824 validated range.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee provided appropriate justification for the use of CFAST to model fire scenarios with a Froude number outside the NUREG-1824 validated range.

- In FM RAI 03.b (Reference 19), the NRC staff requested that the licensee identify cases where CFAST was used to model fires with flames that impinge on the ceiling, and to provide technical justification for applying CFAST in these cases.

  In its response to FM RAI 03.b (Reference 12), the licensee explained that three model output parameters affected by the occurrence of direct flame impingement on a ceiling surface were not used in the CFAST models developed for the PNP Fire PRA.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee did not apply CFAST modeling results in its analysis that are affected by direct flame impingement on the ceiling.

- In FM RAI 03.c (Reference 19), the NRC staff requested that the licensee provide a validation basis for the use of CFAST to calculate the temperature rise of an exposed structural steel column exposed to a lube oil fire on the 590 ft. elevation of the turbine building.

  In its response to FM RAI 03.c (Reference 12), the licensee explained that in lieu of providing a validation basis, an alternative analysis was performed to estimate the temperature rise of the steel column. The licensee stated that the alternative analysis used the heat flux models in NUREG-1805 (Reference 46), to estimate the thermal exposure conditions of the column and that the temperature rise of the column was then calculated from a lumped capacity heat balance as described in Appendix F of NUREG-1934 (Reference 51). The licensee further stated that the results of the alternative analysis support the conclusion from the CFAST calculation that the target steel column exposed to the heat flux from the postulated pool fire will not fail. In the response, the licensee showed that either the NUREG-1805 heat flux models were applied within the NUREG-1824 validated range, or provided justification for their use outside the validated range. However, in its subsequent responses to FM RAI 01.01 (Reference 14), and PRA RAI 30 (Reference 16), the licensee stated that the Fire PRA model and Table W-2 were updated to include the assumed structural collapse upon failure of one structural steel column as a result of the applicable fire scenario.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the heat flux models were applied within the validated range, or provided justification for their use outside the validated range. The licensee's subsequent responses on this topic indicate that the alternative analysis was ultimately not used to support the Fire PRA model and the NRC staff finds this acceptable.

- In FM RAI 03.d (Reference 19), the NRC staff requested that the licensee provide a validation basis for using the single zone approximation in CFAST to simulate the fires in the upper cubicles of switchgear panels.

  In its response to FM RAI 03.d (Reference 12), the licensee explained that the objective of the CFAST analysis was to determine the maximum internal and external HRR based on the upper limit to the equivalence ratio in the cubicle. The licensee stated that the estimated maximum HRR was then used as an input parameter in the FDS analysis of fires in switchgear rooms 1-C and 1-D. The licensee further stated that the result of the CFAST analysis (37 kW) is within 10 percent of the maximum HRR estimated from Kawagoe's correlation (34 kW) and contended that this comparison validates the use of CFAST in the single-zone mode to determine the maximum HRR in the switchgear cubicle.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated the appropriate use of CFAST in single zone mode to simulate fires in the upper cubicles of a switchgear cabinet.

3.8.3.2.3 Post-Transition

The licensee also stated that it will revise the appropriate processes and procedures to include NFPA 805 quality requirements for use during the performance of post-transition FPP changes, including those for V&V. Revision of the applicable post-transition processes and procedures to include NFPA 805 requirements for V&V are identified in LAR Attachment S, Table S-3, Implementation Item 1 and the NRC staff considers this action acceptable because it will incorporate the provisions of NFPA 805 in the FPP and is included as an implementation item which would be required by the proposed license condition.

3.8.3.2.4 Conclusion for Section 3.8.3.2

Based on the licensee's description of the PNP process for V&V of calculational models and numerical methods and their commitment for continued use post-transition, the NRC staff concludes that the licensee's approach to meeting the requirements of NFPA 805 Section 2.7.3.2, is acceptable because the models are consistent with approved uses in NRC guidance or other authoritative publications and the licensee has identified actions that will incorporate the provisions of NFPA 805 in the FPP and those actions would be required by the proposed license condition.

The NRC staff concludes that the licensee's FM approach used in the development of the fire scenarios for the FPRA is appropriate and thus acceptable for use in transition to NFPA 805 because the V&V of the empirical correlations used by the licensee were consistent with either NUREG-1824, or other authoritative publications, peer reviewed journal articles, or national laboratory research reports.

3.8.3.3 Limitations of Use

NFPA 805 requires that only acceptable engineering methods and numerical models be used for transition to the extent that these methods have been subject to V&V and that they are

applied within the scope, limitations, and assumptions prescribed for that method. The LAR stated that the engineering methods and numerical models used in support of the transition to NFPA 805 were subject to the limitations of use outlined in NFPA 805, Section 2.7.3.3, and that the engineering methods and numerical models used post-transition will be subject to these same limitations of use. As an example, in LAR Section 4.5.2, "Fire Modeling," the licensee stated that the fire models developed to support the NFPA 805 transition fall within their V&V limitations.

3.8.3.3.1 General

The NRC staff assessed the acceptability of empirical correlation and fire model in terms of the limits of its use. Table 3.8-1 in SE Attachment A and Table 3.8-2 in SE Attachment B, summarize the fire models used, how each was applied in the PNP FRE, the V&V basis for each, and the NRC staff evaluation for each.

3.8.3.3.2 Discussion of RAIs

By letters dated August 8, 2013 (Reference 19), and March 11, 2014 (Reference 20), the NRC staff requested additional information concerning the FM conducted to support the FREs. By letters dated September 30, 2013 (Reference 10), December 2, 2013 (Reference 12), and May 7, 2014 (Reference 14), the licensee responded to these RAIs.

- In FM RAI 04.a (Reference 19), the NRC staff requested that the licensee identify any uses of the GFMTs approach, and CFAST outside the limits of applicability of the method, and to explain for those cases how the use of the GFMTs approach or CFAST was justified.

  In its response to FM RAI 04.a (Reference 12), the licensee explained that there are two broad categories of limitations that are applicable to the GFMTs approach and that these include limitations associated with the implementation of the ZOI and limitations associated with the CFAST fire modeling of HGL conditions. The licensee stated that limitations apply to the CFAST fire modeling conducted in support of the MCR abandonment calculations and the structural steel analysis in the turbine building. The licensee identified and explained six basic limitations that should be considered when applying the original GFMT ZOIs that represent conditions or configurations for which the GFMT ZOI data may potentially be non-conservative if applied outside the particular limitation. The licensee also identified the CFAST limitations that apply to the HGL and MCR abandonment calculations, and explained that the FPRA was updated to account for uses of CFAST outside its range of applicability that may lead to non-conservative results. The licensee referred to the responses to FM RAI 01.q and FM RAI 03.c for further details on the structural steel analysis.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee applied the GFMTs approach and CFAST within their limits of applicability, or rectified unjustified uses outside the limits of applicability.

3.8.3.3.3 Post-Transition

The licensee also stated that it will revise the appropriate processes and procedures to include NFPA 805 quality requirements for use during the performance of post-transition FPP changes, including those for limitations of use. The licensee included the action to "revise or develop technical documents and administrative procedures as needed for implementation of NFPA 805" in LAR Attachment S, Table S-3, Implementation Item 1 and the NRC staff concludes this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and the licensee included the action as an implementation item which would be required by the proposed license condition.

3.8.3.3.4 Conclusion for Section 3.8.3.3

Based on the licensee's statements that the fire models used to support development of the FRE were used within their limitations, and the description of the PNP 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 because the models are consistent with approved uses in NRC guidance or other authoritative publications and the licensee has identified actions that will incorporate the provisions of NFPA 805 in the FPP and those actions would be required by the proposed license condition.

3.8.3.4 Qualification of Users

NFPA 805 requires that personnel performing engineering analyses and applying numerical methods (e.g. FM) shall be competent in that field and experienced in the application of these methods as they relate to NPPs, NPP fire protection, and power plant operations. The licensee's procedures require that cognizant personnel who use and apply engineering analyses and numerical models be competent in the field of application and experienced in the application of the methods, including those personnel performing analyses in support of compliance with 10 CFR 50.48(c).

3.8.3.4.1 General

Specifically, these requirements are being addressed through the implementation of an engineering qualification process at PNP. The licensee has developed procedures that require that cognizant personnel who use and apply engineering analyses and numerical models be competent in the field of application and experienced in the application of the methods, including those personnel performing analyses in support of compliance with 10 CFR 50.48(c). These requirements are being addressed through the implementation of an engineering qualification process. PNP has developed qualification or training requirements for personnel performing engineering analyses and numerical methods.

3.8.3.4.2 Discussion of RAIs

The NRC staff requested that the licensee provide additional information pertaining to qualifications of the personnel who supported PNP fire modeling. Applicable RAIs and responses are discussed below:

- In FM RAI 05.a (Reference 19), the NRC staff requested that the licensee describe the necessary qualifications of the engineers performing the FM.

  In its response to FM RAI 05.a (Reference 10), the licensee explained that the qualification requirements for the technical leads are consistent with and often exceed those described in NEI 07-12 (Reference 87), for qualification of peer reviewers. The licensee further stated that it ensured each task was performed by individuals with the appropriate education, experience and training in the FM area being performed.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the personnel performing the FM are appropriately qualified.

- In FM RAI 05.b (Reference 19), the NRC staff requested that the licensee describe the process for ensuring the adequacy of the appropriate qualifications of the engineers and personnel performing the fire analyses and modeling activities.

  In its response to FM RAI 05.b (Reference 10), the licensee explained that, prior to assigning the task, individuals selected to perform FM were required to have the appropriate background for these activities as described in the response to FM RAI 05.a.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the personnel performing the FM are appropriately qualified.

- In FM RAIs 05.c and 05.d (Reference 19), the NRC staff requested that the licensee describe the communication process between the FM analysts and PRA personnel and between consultants and plant personnel, and any measures taken to assure that the FM was performed adequately and will continue to be performed adequately during post-transition.

  In its response to FM RAIs 05.c and 05.d (Reference 10), the licensee explained that, during the preparation of the LAR, meetings were held between PRA and FM staff to review the FM. The licensee further stated that FM reports were reviewed in accordance with the appropriate quality assurance programs and the FM calculations were reviewed by individuals who are qualified to the respective engineering processes and by PRA personnel before the results were incorporated in the FPRA model. The licensee stated that a similar process will be used post-transition.

  The NRC staff concludes that the licensee's responses to the RAIs are acceptable because the licensee demonstrated appropriate interactions between FM staff and PRA staff to ensure that FM was adequately performed.

The NRC staff concludes that appropriately competent and experienced personnel developed the PNP FREs, including the supporting FM calculations and including the additional documentation for models and empirical correlations not identified in previous NRC-approved V&V documents.

3.8.3.4.3 Post-Transition

Further, LAR Section 4.7.3, "Compliance with Quality Requirements in Section 2.7.3 of NFPA 805" states, in part, that:

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

The post-transition qualification training program will be implemented to include NFPA 805 requirements for qualification of users as described in LAR Attachment S, Table S-3, Implementation Item 6, and the NRC staff considers this acceptable because the action will incorporate the provisions of NFPA 805 in the FPP and is included as an implementation item which would be included in 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.

3.8.3.5 Uncertainty Analysis

NFPA 805 requires that an uncertainty analysis be performed to provide reasonable assurance that the performance criteria have been met. (Note: 10 CFR 50.48(c)(2)(iv) states that an uncertainty analysis performed in accordance with NFPA 805, Section 2.7.3.5, is not required to support calculations used in conjunction with a deterministic approach.) The licensee stated that an uncertainty analysis was performed for the analyses used in support of the transition to NFPA 805, and that an uncertainty analysis will be performed for post-transition analyses.

3.8.3.5.1 General

The industry consensus standard for PRA development, (i.e., the ASME/ANS PRA standard, (Reference 34)) includes requirements to address uncertainty. Accordingly, the licensee addressed uncertainty as a part of the development of the PNP FRE. The NRC staff's evaluation of the licensee's treatment of these uncertainties is discussed in SE Section 3.4.7.

According to NUREG-1855, Volume 1, "Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decision Making," (Reference 49) 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, "Nuclear Power Plant Fire Modeling Analysis Guide (NPP FIRE MAG)" (Reference 51).

(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 RAIs

By letters dated August 8, 2013 (Reference 19), and March 11, 2014 (Reference 20), the NRC staff requested additional information concerning the fire modeling conducted to support the FREs. By letters dated September 30, 2013 (Reference 10), December 2, 2013 (Reference 12), and May 7, 2014 (Reference 14), the licensee responded to these RAIs.

- In FM RAI 06.a (Reference 19), the NRC staff requested that the licensee explain how the uncertainty associated with the fire model input parameters was accounted for in the FM analyses.

  In its response to FM RAI 06.a (Reference 12), the licensee stated that the uncertainty associated with the fire model input parameters was implicitly accounted for through the use of a conservative and bounding analysis. The licensee provided a detailed discussion of the approach for the five primary FM activities where parameter uncertainty is applicable, (i.e., the MCR abandonment analysis, the HGL tabulations, the ZOI tabulations, plant-specific FM in switchgear rooms 1-C and 1-D, and the structural steel analysis). For the MCR abandonment analysis, the licensee's assessment was used to limit the increase in the probability of abandonment to fifteen percent or less for credible model input parameter variations. Cases in which the sensitivity is shown to be greater than fifteen percent were used to establish model application limits or a basis that the parameter variation was not applicable.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the approach used by the licensee demonstrated that fire modeling parameter uncertainty was properly accounted for.

- In FM RAI 06.b (Reference 19), the NRC staff requested that the licensee explain how the "completeness" and "model" uncertainty were accounted for in the fire modeling analyses.

  In its response to FM RAI 06.b (Reference 12), the licensee explained that the combined model and completeness uncertainty is applicable to the five fire modeling activities discussed in the response to FM RAI 06.a. The licensee provided a detailed discussion to show that this uncertainty in all five cases either does not (significantly) contribute to the risk uncertainty or is bounded by the conservatisms in the analysis.

  The NRC staff concludes that the licensee's responses to the RAIs are acceptable because the licensee demonstrated that model uncertainty and completeness uncertainty were properly accounted for.

3.8.3.5.3 Post-Transition

The licensee also stated that it will revise the appropriate processes and procedures to include the NFPA 805 quality requirements for use during the performance of post-transition FPP changes, including those regarding uncertainty analysis. Revision of the applicable post-transition processes and procedures to include NFPA 805 requirements regarding uncertainty analysis are identified in LAR Attachment S, Table S-3, Implementation Item 1, and the NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and is included as an implementation item which would be required by the proposed license condition.

3.8.3.5.4 Conclusion for Section 3.8.3.5

Based on the licensee's description of the PNP 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 upon completion of the implementation items, the PNP RI/PB fire protection quality assurance (QA) program will meet 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

GDC 1 of Appendix A to 10 CFR Part 50 requires, in part, the following:

> Structures, systems, and components important to safety shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed.

The licensee established its fire protection quality assurance program in accordance with the guidelines of NUREG-0800, Section 9.5.1 position C.4, "Quality Assurance Program," (Reference 37). In addition, the guidance in Appendix C to NEI 04-02 (Reference 7), suggests that the LAR include a description of how the existing fire protection quality assurance program will be transitioned to the new NFPA 805 RI/PB FPP, as discussed below.

The LAR stated that the fire protection quality assurance program is included within and implemented by the PNP nuclear quality assurance program, although certain aspects of that program are not applicable to the FPP. Further, the LAR stated that no changes to the fire protection quality assurance program were needed to meet the applicable requirements of Section 2.7.3 of NFPA 805. The licensee stated that the PNP quality assurance program will be updated in accordance with the requirements of NFPA 805 Section 2.7.3, and those updates are identified in LAR Attachment S, Table S-3, Implementation Items 1, 4, and 5, and the NRC staff concludes that these actions are acceptable because they will incorporate the provisions of NFPA 805 in the FPP and are included as implementation items which would be required by the proposed license condition.

Based on its review and the above explanation, the NRC staff concludes that the licensee's changes to the fire protection quality assurance program are acceptable because they include the expansion of the existing program to include those fire protection systems that were previously not included within the scope of the fire protection quality assurance program that are required by NFPA 805 for transition and post-transition.

3.8.5 Conclusion for Section 3.8

The NRC staff reviewed the licensee's RI/PB FPP as described in the LAR, as supplemented, to evaluate the NFPA 805 program documentation content, the associated configuration control process, and the appropriate quality assurance requirements and the NRC staff concludes that, upon completion of the implementation items in LAR Table S-3 related to the quality assurance 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 FPP license condition regarding transition to a RI/PB FPP under NFPA 805, in accordance with 10 CFR 50.48(c)(3)(i). The new license condition adopts the guidelines of the standard fire protection license condition promulgated in RG 1.205, Revision 1, Regulatory Position C.3.1, as issued on December 18, 2009 (74 FR 67253). Plant-specific changes were made to the sample license condition; however, NRC staff concludes that the proposed plant-specific FPP license condition is consistent with the standard fire protection license condition, incorporates all of the relevant features of the transition to NFPA 805 at PNP and is, therefore, acceptable.

The following license condition is included in the revised license for PNP, and will replace Operating License No. DPR-20 Condition 2.C.3:

Fire Protection

ENO shall implement and maintain in effect all provisions of the approved fire protection program that comply with 10 CFR 50.48(a) and 10 CFR 50.48(c), as specified in the license amendment request dated December 12, 2012, as supplemented by letters dated February 21, 2013, September 30, 2013, October 24, 2013, December 2, 2013, April 2, 2014, May 7, 2014, June 17, 2014, August 14, 2014, November 4, 2014, and December 18, 2014, as approved in the safety evaluation dated February 27, 2015. Except where NRC approval for changes or deviations is required by 10 CFR 50.48(c), and provided no other regulation, technical specification, license condition or requirement would require prior NRC approval, the licensee may make changes to the fire protection program without prior approval of the Commission if those changes satisfy the provisions set forth in 10 CFR 50.48(a) and 10 CFR 50.48(c), the change does not require a change to a technical specification or a license condition, and the criteria listed below are satisfied.

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

A risk assessment of the change must demonstrate that the acceptance criteria below are met. The risk assessment approach, methods, and data shall be acceptable to the NRC and shall be appropriate for the nature and scope of the change being evaluated; be based on the as-built, as-operated, and maintained plant; and reflect the operating experience at 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.

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

2. Prior NRC review and approval is not required for individual changes that result in a risk increase less than $1x10^{-7}$/year (yr) for CDF and less than $1x10^{-8}$/yr for LERF. The proposed change must also be consistent with the defense-in-depth philosophy and must maintain sufficient safety margins. The change may be implemented following completion of the plant change evaluation.

(b) Other Changes that May Be Made Without Prior NRC Approval

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

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

The licensee may use an engineering evaluation to demonstrate that changes to certain NFPA 805, Chapter 3, elements are acceptable because the alternative is "adequate for the hazard." Prior NRC review and approval would not be required for alternatives to four specific sections of NFPA 805, Chapter 3, for which an engineering evaluation demonstrates that the alternative to the Chapter 3 element is adequate for the hazard. A qualified fire protection engineer shall perform the engineering evaluation and conclude that the change has not affected the functionality of the component, system, procedure, or physical arrangement, using a relevant technical requirement or standard. The four specific sections of NFPA 805, Chapter 3, are as follows:

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

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

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

Prior NRC review and approval are not required for changes to the licensee's fire protection program that have been demonstrated to have no more than a minimal risk impact. The licensee may use its screening process as approved in the NRC safety evaluation dated February 27, 2015, to determine that certain fire protection program changes meet the minimal criterion. The licensee shall ensure that fire protection defense-in-depth and safety margins are maintained when changes are made to the fire protection program.

(c) Transition License Conditions

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

2. The licensee shall implement the modifications to its facility, as described in Table S-2, "Plant Modifications Committed," of ENO letter PNP 2014-080 dated August 14, 2014, to complete the transition to full compliance with 10 CFR 50.48(c) before the end of the second full operating cycle after NRC approval. The licensee shall maintain appropriate compensatory measures in place until completion of these modifications.

3. The licensee shall implement the items listed in Table S-3, "Implementation Items," of ENO letter PNP 2014-097 dated November 4, 2014, within six months after NRC approval, or six months after a refueling outage if in progress at the time of approval with the exception of Implementation Items 3 and 8 which will be completed once the related modifications are installed and validated in the PRA model.

5.0 SUMMARY

The NRC staff reviewed the licensee's application, as supplemented by various letters, to transition to a RI/PB FPP in accordance with the requirements established by NFPA 805. The NRC staff concludes that, subject to implementation items in LAR Attachment S, the applicant's approach, methods, and data are acceptable to establish, implement, and maintain a RI/PB FPP in accordance with 10 CFR 50.48(c).

Implementation of the RI/PB 50.48(c) FPP must be in accordance with the new fire protection license condition, which identifies a list of modifications and 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) must be achieved. Before the licensee is able to fully implement the transition to a FPP based on NFPA 805 and apply the new fire protection license

condition, to its full extent, the modifications and implementation items must be completed within the timeframe specified.

6.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Michigan State official was notified on January 5, 2015, 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 February 27, 2014 (79 FR 11148). 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

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Date: February 27, 2015

Attachments:
A. Table 3.8-1 – V&V Basis for Fire Modeling Correlations Used at PNP
B. Table 3.8-2 – V&V Basis for Other Fire Models and Related Calculations Used at PNP
C. Abbreviations and Acronyms

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at PNP

Correlation	Application at PNP	V&V Basis	NRC Staff Evaluation of Acceptability
Heskestad flame height correlation	Development of ZOI tables in GFMTs Treatments	NUREG-1805 Chapter 3 (Reference 46) NUREG-1824 Volume 3 (Reference 47) SFPE Handbook Chapter 2-1 (Reference 95)	• The V&V is discussed in LAR Attachment J. • The correlation is validated in NUREG-1824 and an authoritative publication. Based on its review and evaluation, the NRC staff concludes that the use of this correlation in the PNP application is acceptable.
Heskestad plume temperature correlation	Development of ZOI tables in GFMTs Treatments	NUREG-1805 Chapter 9 (Reference 46) NUREG-1824 Volume 3 (Reference 47) SFPE Handbook Chapter 2-1 (Reference 95)	• The V&V is discussed in LAR Attachment J. • The correlation is validated in NUREG-1824 and an authoritative publication. Based on its review and evaluation, the NRC staff concludes that the use of this correlation in the PNP application is acceptable.
Shokri and Beyler flame radiation model	Development of ZOI tables in GFMTs approach	Peer-reviewed journal article (Reference 96)	• The correlation is validated in an authoritative publication. Based on its review and evaluation, the NRC staff concludes that the use of this correlation in the PNP application is acceptable.

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at PNP

Correlation	Application at PNP	V&V Basis	NRC Staff Evaluation of Acceptability
Mudan flame radiation model	Development of ZOI tables in GFMTs approach	Peer-reviewed journal article (Reference 98)	• The correlation is validated in an authoritative publication. Based on its review and evaluation, the NRC staff concludes that the use of this correlation in the PNP application is acceptable.
Plume heat flux correlation by Wakamatsu et al.	Development of ZOI tables in GFMTs approach	Peer-reviewed conference paper (Reference 99)	• The correlation is validated in an authoritative publication. Based on its review and evaluation, the NRC staff concludes that the use of this correlation in the PNP application is acceptable.
Yokoi plume centerline temperature correlation	Development of ZOI tables in GFMTs approach	National research laboratory report (Reference 100) Peer-reviewed journal article (Reference 101)	• The correlation is validated in an authoritative publication. Based on its review and evaluation, the NRC staff concludes that the use of this correlation in the PNP application is acceptable.
Hydrocarbon spill fire size correlation	Development of ZOI tables in GFMTs approach	SFPE Handbook Chapter 2-15 (Reference 102)	• The correlation is validated in an authoritative publication. Based on its review and evaluation, the NRC staff concludes that the use of this correlation in the PNP application is acceptable.
Flame extension correlation	Development of ZOI tables in GFMTs approach	SFPE Handbook Chapter 2-14 (Reference 103)	• The correlation is validated in an authoritative publication. Based on its review and evaluation, the NRC staff concludes that the use of this correlation in the PNP application is acceptable.
Delichatsios line source flame height model	Development of ZOI tables in GFMTs approach	Peer-reviewed journal article (Reference 104)	• The correlation is validated in an authoritative publication. Based its review and explanation, the NRC staff concludes that the use of this correlation in the PNP application is acceptable.

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at PNP

Correlation	Application at PNP	V&V Basis	NRC Staff Evaluation of Acceptability
Corner flame height correlation	Development of ZOI tables in GFMTs approach	SFPE Handbook Chapter 2-14 (Reference 103)	• The correlation is validated in an authoritative publication. Based on its review and evaluation, the NRC staff concludes that the use of this correlation in the PNP application is acceptable.
Kawagoe natural vent flow equation	Development of ZOI tables in GFMTs approach	National research laboratory report (Reference 105)	• The correlation is validated in an authoritative publication. Based on its review and evaluation, the NRC staff concludes that the use of this correlation in the PNP application is acceptable.
Yuan and Cox line fire flame height and plume temperature correlations	Development of ZOI tables in GFMTs approach	Peer-reviewed journal article (Reference 106)	• The correlation is validated in an authoritative publication. Based on its review and evaluation, the NRC staff concludes that the use of this correlation in the PNP application is acceptable.
Lee cable fire model	Development of ZOI tables in GFMTs approach	NBSIR 85-3196 (Reference 107)	• The correlation is validated in an authoritative publication. Based on its review and evaluation, the NRC staff concludes that the use of this correlation in the PNP application is acceptable.
Babrauskas method to determine ventilation-limited fire size	Development of ZOI tables in GFMTs approach	Peer-reviewed journal article (Reference 108)	• The correlation is validated in an authoritative publication. Based on its review and evaluation, the NRC staff concludes that the use of this correlation in the PNP application is acceptable.

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at PNP

Correlation	Application at PNP	V&V Basis	NRC Staff Evaluation of Acceptability
Correlation for Flame Spread over Horizontal Cable Trays (FLASH-CAT)	The FLASH-CAT method was used to calculate the growth and spread of a fire within a vertical stack of horizontal cable trays	NUREG/CR-7010 (Reference 48)	• The modeling technique is validated in an authoritative publication of NIST. Based on its review and evaluation, the NRC staff concludes that the use of this correlation in the PNP application is acceptable.

Attachment B: Table 3.8-2, V&V Basis for Other Fire Models and Related Calculations Used at PNP

Model	Application at PNP	V&V Basis	NRC Staff Evaluation of Acceptability
CFAST (Version 6)	Development of HGL tables, MCR abandonment times calculations, to determine the maximum fire size for plant-specific target damage time calculations in switchgear rooms, and in the exposed structural steel analysis to estimate the temperature rise of a column in a lube oil pool fire	NUREG-1824, Volume 5 (Reference 47) NIST Special Publication 1086 (Reference 97)	The V&V is discussed in Attachment J of the LAR. The modeling technique is validated in NUREG-1824 and an authoritative publication. Based on its review and evaluation, the NRC staff concludes that the use of this correlation in the PNP application is acceptable.
Fire Dynamics Simulator (Version 5)	Plant-specific target damage calculations in switchgear rooms 1-C and 1-D.	NUREG-1824, Volume 7 (Reference 47) NIST Special Publication 1018-5 Volume 2 (Reference 116) NIST Special Publication 1018-5 Volume 3 (Reference 117)	• The V&V is discussed in Attachment J of the LAR. • The modeling technique is validated in NUREG-1824 and authoritative publications. Based on its review and observations, the NRC staff concludes that the use of this correlation in the PNP application is acceptable.

Attachment B: Table 3.8-2, V&V Basis for Other Fire Models and Related Calculations Used at PNP

Model	Application at PNP	V&V Basis	NRC Staff Evaluation of Acceptability
Structural Steel Temperature Rise Calculation	Calculate the temperature rise of a steel column exposed to a lube oil fire in the turbine building	NUREG-1934 (Reference 51)	Based on its review and observations, the NRC staff concludes that the use of this correlation in the PNP application is acceptable.
Thermally-Induced Electrical Failure model (THIEF)	Determine the failure time of selected targets in the 1-C and 1-D switchgear FDS analysis	NUREG/CR-6931 Volume 3 (Reference 44)	• The V&V is discussed in Attachment J of the LAR. • The modeling technique is validated in NUREG/CR-6931. Based on its review and observations, the NRC staff concludes that the use of this correlation in the PNP application is acceptable.

Attachment C: Abbreviations and Acronyms

ADAMS	Agencywide Documents Access and Management System
AHJ	authority having jurisdiction
ANS	American Nuclear Society
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BTP	Branch Technical Position
BWR	boiling-water reactor
BWRVIP	Boiling Water Reactor Vessels and Internals Project
CC	Capability Categories
CCDP	conditional core damage probability
CDF	core damage frequency
CFAST	consolidated model of fire and smoke transport
CFR	Code of Federal Regulations
CHRISTIFIRE	Cable Heat Release, Ignition, and Spread in Tray Installations During Fire
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
EEEE	existing engineering equivalency evaluation
EMT	electrical metallic tubing
EPRI	Electric Power Research Institute
ERFBS	electrical raceway fire barrier system
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
GDC	general design criteria
GFMT	generic fire modeling treatments
GL	generic letter
HEP	human error probability
HFE	human failure events
HGL	hot gas layer
HRA	human reliability analysis
HRE	high(er) risk evolution
HRR	heat release rate
HVAC	heating, ventilation, and air conditioning
IEEE	Institute of Electrical and Electronics Engineers
IEPRA	internal events PRA
IN	Information Notice
KSF	key safety function
kV	kilovolt

kW	kilowatt
LAR	license amendment request
LER	license event report
LERF	large early release frequency
MCA	multi-compartment analysis
MCB	main control board
MCC	motor control centers
MCR	main control room
min	minute(s)
MSDS	Material Safety Data Sheet
MSO	multiple spurious operation
NEI	Nuclear Energy Institute
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
No.	number
NPO	non-power operation
NPP	nuclear power plant
NRC	U.S. Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
NSCA	nuclear safety capability assessment
NSP	non-suppression probability
NSPC	nuclear safety performance criteria
PAU	physical analysis unit
PB	performance-based
PCE	plant change evaluation
PCP	primary coolant pump
PCS	primary control station
PNP	palisades nuclear plant
PRA	probabilistic risk assessment
PSA	probabilistic safety assessment
PWR	pressurized-water reactor
PWROG	Pressurized Water Reactors Owner's Group
QA	quality assurance
RA	recovery action
RAI	request for additional information
RCA	radiologically controlled area
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
SE	safety evaluation
SER	safety evaluation report
SFP	spent fuel pool
SFPE	Society of Fire Protection Engineers
SOP	standard operating procedure

SR	supporting requirement
SSA	safe shutdown analysis
SSC	structures, systems, and components
SSD	safe shutdown
SSEL	Safe Shutdown Equipment List
SWS	service water system
THIEF	Thermally-Induced Electrical Failure
TR	technical report
TS	Technical Specification
UFSAR	updated final safety analysis report
V	Volt
V&V	verification and validation (verified and validated)
VEWFDS	very early warning fire detection system
VFDR	variance from deterministic requirements
yr	year
ZOI	zone of influence

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

Sincerely,

/RA/

Jennivine K. Rankin, Project Manager
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-255

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2. Safety Evaluation

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