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

June 16, 2014

Mr. Louis P. Cortopassi
Site Vice President and Chief Nuclear Officer
Omaha Public Power District
Fort Calhoun Station
9610 Power Lane, Mail Stop FC-2-4
Omaha, NE 68008

SUBJECT: FORT CALHOUN STATION – ISSUANCE OF AMENDMENT REGARDING TRANSITION TO A RISK-INFORMED, PERFORMANCE-BASED FIRE PROTECTION PROGRAM IN ACCORDANCE WITH 10 CFR 50.48(c) (TAC NO. ME7244)

Dear Mr. Cortopassi:

The U.S. Nuclear Regulatory Commission (NRC) has issued the enclosed Amendment No. 275 to Renewed Facility Operating License No. DPR-40 for the Fort Calhoun Station, Unit No. 1 (FCS). The amendment consists of changes to the license and Technical Specifications (TSs) in response to your application dated September 28, 2011, as supplemented by letters dated December 19 and December 22, 2011; March 20, July 24, August 24, and September 27, 2012; April 23, May 21, July 29, September 12, October 11, November 4, November 11, and December 18, 2013; and January 24, February 28, April 10, and June 11, 2014. Omaha Public Power District (OPPD, the licensee) submitted a license amendment request (LAR) to revise the fire protection program in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.48(c), for FCS and change the license and TSs accordingly.

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

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

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

Sincerely,

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

Docket No. 50-285

Enclosures:
1. Amendment No. 275 to DPR-40
2. Safety Evaluation

cc w/encls: Distribution via ListServ

ENCLOSURE 1

AMENDMENT NO. 275

TO RENEWED FACILITY OPERATING LICENSE NO. DPR-40

OMAHA PUBLIC POWER DISTRICT

FORT CALHOUN STATION, UNIT NO. 1

DOCKET NO. 50-285

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

OMAHA PUBLIC POWER DISTRICT

FORT CALHOUN STATION, UNIT NO. 1

DOCKET NO. 50-285

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 275
License No. DPR-40

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

   A. The application for amendment by Omaha Public Power District (the licensee), dated September 28, 2011, as supplemented by letters dated December 19 and December 22, 2011; March 20, July 24, August 24, and September 27, 2012; April 23, May 21, July 29, September 12, October 11, November 4, November 11, and December 18, 2013; and January 24, February 28, April 10, and June 11, 2014, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

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

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

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

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

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and Paragraph 3.B. of Renewed Facility Operating License No. DPR-40 is hereby amended to read as follows:

B. Technical Specifications and Environmental Protection Plan*

The Technical Specifications contained in Appendix A, as revised through Amendment No. 275, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

In addition, the license is amended as indicated in the attachment to this license amendment, and Paragraph 3.D. of Renewed Facility Operating License No. DPR-40 is hereby amended to read as follows:

D. Fire Protection Program

Omaha Public Power District shall implement and maintain in effect all provisions of the approved fire protection program that comply with 10 CFR 50.48(a) and 10 CFR 50.48(c), as specified in the licensee amendment request dated September 28, 2011 (and supplements dated December 19, 2011, December 22, 2011, March 20, 2012, July 24, 2012, August 24, 2012, September 27, 2012, April 23, 2013, May 21, 2013, July 29, 2013, September 12, 2013, October 11, 2013, November 4, 2013, November 11, 2013, December 18, 2013, January 24, 2014, February 28, 2014, April 10, and June 11, 2014), and as approved in the safety evaluation dated June 16, 2014. Except where NRC approval for changes or deviations is required by 10 CFR 50.48(c), and provided no other regulation, technical specification, license condition or requirement would require prior NRC approval, the licensee may make changes to the fire protection program without prior approval of the Commission if those changes satisfy the provisions set forth in 10 CFR 50.48(a) and 10 CFR 50.48(c), the change does not require a change to a technical specification or a license condition, and the criteria listed below are satisfied.

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

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

risk of the change may include methods that have been used in the peer-reviewed fire PRA model, methods that have been approved by NRC through a plant-specific license amendment or NRC approval of generic methods specifically for use in NFPA 805 risk assessments, or methods that have been demonstrated to bound the risk impact.

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

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

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

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

Prior NRC review and approval 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.

(b) 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 June 16, 2014, to determine that certain fire protection program changes meet the minimal criterion. The licensee shall ensure that fire protection defense-in-depth and safety margins are maintained when changes are made to the fire protection program.

(3) Transition License Conditions

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

(b) The licensee shall implement the modifications to its facility, as described in Enclosure 1, Attachment S, Table S-2, "Plant Modifications Committed," of OPPD letter LIC-14-0042, dated April 10, 2014, to complete the transition to full compliance with 10 CFR 50.48(c) by the end of the second refueling outage following issuance of the license amendment. The licensee shall maintain appropriate compensatory measures in place until completion of these modifications.

(c) The licensee shall implement the items listed in Enclosure 1, Attachment S, Table S-3, "Implementation Items," of OPPD letter LIC-14-0042, dated April 10, 2014, no later than 12 months after issuance of the license amendment.

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

FOR THE NUCLEAR REGULATORY COMMISSION

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

Attachment:
Changes to the Renewed Facility
Operating License No. DPR-40
and Technical Specifications

Date of Issuance: June 16, 2014

ATTACHMENT TO LICENSE AMENDMENT NO. 275

TO FACILITY OPERATING LICENSE NO. DPR-40

DOCKET NO. 50-285

Replace the following pages of Renewed Facility Operating License No. DPR-40 with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

REMOVE	INSERT
3 through 5	3 through 8

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

REMOVE	INSERT
5.0 – Page 2	5.0 – Page 2
5.0 – Page 5	5.0 – Page 5

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

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

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

A. Maximum Power Level

Omaha Public Power District is authorized to operate the Fort Calhoun Station, Unit 1, at steady state reactor core power levels not in excess of 1500 megawatts thermal (rate power).

B. Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 275 are hereby incorporated in the license. Omaha Public Power District shall operate the facility in accordance with the Technical Specifications.

C. Security and Safeguards Contingency Plans

The Omaha Public Power District 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 plans, which contain Safeguards Information protected under 10 CFR 73.21, are entitled: "Fort Calhoun Station Security Plan, Training and Qualification Plan, Safeguards Contingency Plan," submitted by letter dated May 19, 2006.

OPPD 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 OPPD CSP was approved by License Amendment No. 266.

D. Fire Protection Program

Omaha Public Power District shall implement and maintain in effect all provisions of the approved fire protection program that comply with 10 CFR 50.48(a) and 10 CFR 50.48(c), as specified in the licensee amendment request dated September 28, 2011 (and supplements dated December 19, 2011, December 22, 2011, March 20, 2012, July 24, 2012, August 24, 2012, September 27, 2012, April 23, 2013, May 21, 2013, July 29, 2013, September 12, 2013, October 11, 2013, November 4, 2013, November 11, 2013, December 18, 2013, January 24, 2014, February 28, 2014, April 10, and June 11, 2014) and as approved in the safety evaluation dated June 16, 2014. Except where NRC approval for changes or deviations is required by 10 CFR 50.48(c), and provided no other regulation, technical specification, license condition or requirement would require prior NRC approval, the licensee may make changes to the fire protection program without prior approval of the Commission if those changes satisfy the provisions set forth in 10 CFR 50.48(a) and 10 CFR 50.48(c), the change does not require a change to a technical specification or a license condition, and the criteria listed below are satisfied.

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

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

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

(b) Prior NRC review and approval is not required for individual changes that result in a risk increase less than 1×10^{-7}/year (yr) for core damage frequency (CDF) and less than 1×10^{-8}/yr for large early release frequency (LERF). The proposed change must also be consistent with the defense-in-depth philosophy and must maintain sufficient safety margins. The change may be implemented following completion of the plant change evaluation.

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

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

Prior NRC review and approval 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.

(b) 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 June 16, 2014, to determine that certain fire protection program changes meet the minimal criterion. The licensee shall ensure that fire protection defense-in-depth and safety margins are maintained when changes are made to the fire protection program

(3) Transition License Conditions

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

(b) The licensee shall implement the modifications to its facility, as described in Enclosure 1, Attachment S, Table S-2, "Plant Modifications Committed," of OPPD letter LIC-14-0042 dated April 10, 2014, to complete the transition to full compliance with 10 CFR 50.48(c) by the end of the second refueling outage following issuance of the license amendment. The licensee shall maintain appropriate compensatory measures in place until completion of these modifications.

(c) The licensee shall implement the items listed in Enclosure 1, Attachment S, Table S-3, "Implementation Items," of OPPD letter LIC-14-0042, dated April 10, 2014, no later than 12 months after issuance of the license amendment.

E. Updated Final Safety Analysis Report

The Omaha Public Power District Updated Final Safety Analysis Report supplement, submitted pursuant to 10 CFR 54.21 (d), describes certain future activities to be completed prior to the period of extended operation. The Omaha Public Power District shall complete these activities no later than August 9, 2013, and shall notify the NRC In writing when implementation of these activities is complete and can be verified by NRC inspection.

The Updated Final Safety Analysis Report supplement, as revised, shall be included in the next scheduled update to the Updated Final Safety Analysis Report required by 10 CFR 50.71 (e)(4) following issuance of this renewed license. Until that update is complete, the Omaha Public Power District may make changes to the programs and activities described in the supplement without prior Commission approval, provided that the Omaha Public Power District evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59 and otherwise complies with the requirements in that section.

F. Appendix B

The Additional Conditions contained in Appendix B, as revised through Amendment No. 261, are hereby incorporated into this license. Omaha Public Power District shall operate the facility in accordance with the Appendix B Additional Conditions.

Mitigation Strategy License Condition

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

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

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

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

4. This renewed license is effective as of the date of issuance and shall expire at midnight on August 9, 2033.

FOR THE NUCLEAR REGULATORY COMMISSION

Original Signed by:
J. E. Dyer

J. E. Dyer, Director
Office of Nuclear Reactor Regulation

Attachments: 1. Appendix A - Technical Specifications
2. Appendix B - Additional Conditions

Date of Issuance: November 4, 2003

5.0 ADMINISTRATIVE CONTROLS

5.2 Organization (Continued)

b. An Operator or Technician qualified in Radiation Protection Procedures shall be onsite when fuel is in the reactor.

c. All core alterations shall be directly supervised by either a licensed Senior Reactor Operator or Senior Reactor Operator limited to fuel handling who has no other concurrent responsibilities during the operation.

d. DELETED

e. The Manager - Shift Operations, the Shift Managers, and the Control Room Supervisors shall hold a senior reactor operator license. The Licensed Operators shall hold a reactor operator license.

5.3 Facility Staff Qualification

5.3.1 Each member of the plant staff shall meet or exceed the minimum qualifications of ANSI N18.1-1971 for comparable positions, with the exception of the Manager – Radiation Protection (MRP) and the Shift Technical Advisor (STA), the senior reactor operator licensees, and the reactor operator licensees, who shall meet the requirements set forth in Regulatory Guide 1.8, Revision 3, dated May 2000, entitled "Qualification and Training of Personnel for Nuclear Power Plants."

5.0 ADMINISTRATIVE CONTROLS

5.7 Not used.

5.8 Procedures

5.8.1 Written procedures and administrative policies shall be established, implemented and maintained covering the following activities:

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

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

c. Not used.

d. All programs specified in Specification 5.11 through 5.24.

5.8.2 Temporary changes to procedures of 5.8.1 above may be made provided:

a. The intent of the original procedure is not altered.

b. The change is approved by two members of the plant supervisory staff, at least one of whom holds a Senior Reactor Operator's License.

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. 275 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-40

OMAHA PUBLIC POWER DISTRICT

FORT CALHOUN STATION, UNIT NO. 1

DOCKET NO. 50-285

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SAFETY EVALUATION

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 275 TO

RENEWED FACILITY OPERATING LICENSE NO. DPR-40

TRANSITION TO A PERFORMANCE-BASED FIRE PROTECTION

PROGRAM IN ACCORDANCE WITH 10 CFR 50.48(c)

OMAHA PUBLIC POWER DISTRICT

FORT CALHOUN STATION, UNIT NO. 1

DOCKET NO. 50-285

1.0 INTRODUCTION

1.1 Background

The U.S. Nuclear Regulatory Commission (NRC) started developing fire protection requirements in the 1970s, and in 1976, the NRC published comprehensive fire protection guidelines in the form of Branch Technical Position (BTP) APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants" (Agencywide Documents Access and Management System (ADAMS) Accession No. ML070660461), and Appendix A to BTP APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants Docketed Prior to July 1, 1976" (ADAMS Accession No. ML070660458). Subsequently, the NRC performed fire protection reviews for the operating reactors, and documented the results in safety evaluation reports (SERs) or supplements to SERs. In 1980, to resolve issues identified in those reports, the NRC amended its regulations for fire protection in operating nuclear power plants and published its Final Rule, Fire Protection Program for Operating Nuclear Power Plants, in the *Federal Register* (FR) on November 19, 1980 (45 FR 76602), adding Section 50.48, "Fire Protection" and Appendix R to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979."

Section 50.48(a)(1) of 10 CFR Part 50 requires each operating nuclear power plant to have a fire protection plan that satisfies General Design Criterion (GDC) 3 of Appendix A to 10 CFR Part 50 and states that the fire protection plan must describe the overall fire protection program; identify the positions responsible for the program and the authority delegated to those positions; outline the plans for fire protection, fire detection and suppression capability, and limitation of fire damage. Section 50.48(a)(2) states that the fire protection plan must describe the specific features necessary to implement the program described in paragraph (a)(1) including administrative controls and personnel requirements; automatic and manual fire detection and suppression systems; and the means to limit fire damage to structures, systems, and

components (SSCs) to ensure the capability to safely shut down the plant. Section 50.48(a)(3) requires that the licensee retain the fire protection plan and each change to the plan as a record until the Commission terminates the license.

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

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

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

An adoptee of NFPA 805 must meet the performance goals, objectives, and criteria that are itemized in Chapter 1 of NFPA 805 through the implementation of PB or deterministic approaches. The goals include ensuring that reactivity control, inventory and pressure control, decay heat removal, vital auxiliaries, and process monitoring are achieved and maintained. The adoptee then must establish plant fire protection requirements using the methodology in Chapter 2 of NFPA 805, such that the minimum FPP elements and design criteria contained in Chapter 3 of NFPA 805 are satisfied. Next, an adoptee identifies fire areas and fire hazards through a plant-wide analysis, and then applies either a PB or a deterministic approach to meet the performance criteria. As part of a PB approach, an adoptee will use engineering evaluations, probabilistic safety assessments, and fire modeling calculations to show that the criteria are met. Chapter 4 of NFPA 805 establishes the methodology to determine the fire protection systems and features required to achieve the performance criteria. It also specifies that at least one success path to achieve the nuclear safety performance criteria (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 meeting the requirements of) NFPA 805, the NRC staff is referring to NFPA 805 with the exceptions, modifications, and supplements described in 10 CFR 50.48(c)(2).

RG 1.205 also states, in part, that:

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

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

Accordingly, Omaha Public Power District (OPPD, the licensee), requested a license amendment to allow the licensee to revise the Fort Calhoun Station, Unit 1 (FCS) FPP in accordance with 10 CFR 50.48(c) and change the license and technical specifications (TSs) accordingly.

1.2 Requested Licensing Action

By application to the NRC dated September 28, 2011 (Reference 6), as supplemented by letters dated December 19, 2011 (Reference 7), December 22, 2011 (Reference 8), March 20, 2012 (Reference 9), July 24, 2012 (Reference 10), August 24, 2012 (Reference 11), September 27, 2012 (Reference 12), April 23, 2013 (Reference 13), May 21, 2013 (Reference 14), July 29, 2013 (Reference 15), September 12, 2013 (Reference 16), October 11, 2013 (Reference 17), November 4, 2013 (Reference 18), November 11, 2013 (Reference 19), December 18, 2013 (Reference 20), January 24, 2014 (Reference 21), February 28, 2014 (Reference 22), April 10, 2014 (Reference 23), and June 11, 2014 (Reference 106), the licensee submitted an application for a license amendment to transition the FCS 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. Portions of the letters dated September 28 and December 22, 2011; March 20, 2012; April 23, 2013; and February 28, April 10, and June 11, 2014, contain proprietary or security-related information and, therefore, those portions have been withheld from public disclosure. The supplemental letters were in response to the NRC staff requests for additional information (RAIs) dated April 26, 2012 (Reference 24), February 22, 2012 (Reference 25), June 27, 2013 (Reference 26), August 14, 2013 (Reference 27), September 27, 2013 (Reference 28), November 15, 2013 (Reference 29), and December 23, 2013 (Reference 30).

The licensee's supplemental letters dated March 20, July 24, August 24, and September 27, 2012; April 23, May 21, July 29, September 12, October 11, November 4, November 11, and December 18, 2013; January 24, February 28, April 10, and June 11, 2014, provided additional information that clarified the application, did not expand the scope of the application as originally noticed, and did not change the NRC staff's original proposed no significant hazards consideration determination as published in the *Federal Register* (FR) on April 10, 2012 (77 FR 21595).

The licensee requested an amendment to the FCS renewed facility operating license and TSs in order to establish and maintain an RI/PB FPP in accordance with the requirements of 10 CFR 50.48(c). Specifically, the licensee requested to transition from the existing deterministic fire protection licensing basis established in accordance with the Updated Safety Analysis Report (USAR) for the facility (and as approved in the NRC SEs dated February 14, 1978 (Reference 91), August 23, 1978 (Reference 92), November 17, 1980 (Reference 93), April 8, 1982 (Reference 94), August 12, 1982 (Reference 95), July 3, 1985 (Reference 73), November 5, 1985 (Reference 96), July 1, 1986 (Reference 97), December 20,1988 (Reference 98), November 14, 1990 (Reference 99); March 17,1993 (Reference 100), and January 14,1994 (Reference 56), subject to the following provision: *Omaha Public Power District may make changes to the approved Fire Protection Program without prior approval of the Commission only if those changes would not adversely affect the ability to achieve and maintain safe shutdown in the event of a fire.*) to an RI/PB FPP in accordance with 10 CFR 50.48(c), that uses risk information, in part, to demonstrate compliance with the fire protection and nuclear safety goals, objectives, and performance criteria of NFPA 805. As such, the proposed FPP at FCS is referred to as RI/PB throughout this SE.

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

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

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

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

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

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

2.0 REGULATORY EVALUATION

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

> A licensee may maintain a fire protection program that complies with NFPA 805 as an alternative to complying with [10 CFR 50.48(b)] for plants licensed to operate before January 1, 1979, or the fire protection license conditions for plants licensed to operate after January 1, 1979. The licensee shall submit a request to comply with NFPA 805 in the form of an application for license amendment under [10 CFR] 50.90. The application must identify any orders and license conditions that must be revised or superseded, and contain any necessary revisions to the plant's technical specifications and the bases thereof.

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

> The licensee shall complete its implementation of the methodology in Chapter 2 of NFPA 805 (including all required evaluations and analyses) and, upon completion, modify the fire protection plan required by paragraph (a) of this section to reflect the licensee's decision to comply with NFPA 805, before changing its fire protection program or nuclear power plant as permitted by NFPA 805.

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

> This paragraph requires licensees to complete all of the Chapter 2 methodology (including evaluations and analyses) and to modify their fire protection plan before making changes to the fire protection program or to the plant configuration. This process ensures that the transition to an NFPA 805

> configuration is conducted in a complete, controlled, integrated, and organized manner. This requirement also precludes licensees from implementing NFPA 805 on a partial or selective basis (*e.g.*, in some fire areas and not others, or truncating the methodology within a given fire area).

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

The regulations also allow for flexibility that was not included in the NFPA 805 standard. Licensees who choose to adopt 10 CFR 50.48(c), but wish to use the PB methods permitted elsewhere in the standard to meet the fire protection requirements of NFPA 805 Chapter 3, "Fundamental Fire Protection Program and Design Elements," may do so by submitting an 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 (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown capability).

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

> The Director of the Office of Nuclear Reactor Regulation, or designee of the Director, may approve the application if the Director or designee determines that the proposed alternatives:
>
> (i) Satisfy the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release;
>
> (ii) Maintain safety margins; and
>
> (iii) Maintain fire protection defense-in-depth (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown capability).

In addition to the conditions outlined by the rule that require licensees to submit an LAR for NRC review and approval in order to adopt an RI/PB FPP, a licensee may submit additional elements of its FPP for which it wishes to receive specific NRC review and approval, as set forth in

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

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

> Protecting the safety of the public, the environment, and plant personnel from a plant fire and its potential effect on safe reactor operations is paramount to this standard. The fire protection standard shall be based on the concept of defense-in-depth. Defense-in-depth shall be achieved when an adequate balance of each of the following elements is provided:
>
> (1) Preventing fires from starting
>
> (2) Rapidly detecting fires and controlling and extinguishing promptly those fires that do occur, thereby limiting fire damage
>
> (3) Providing an adequate level of fire protection for structures, systems and components important to safety, so that a fire that is not promptly extinguished will not prevent essential plant safety functions from being performed

In addition, in accordance with GDC 3, "Fire protection," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, fire detection and fighting systems must be designed such that their rupture or inadvertent operation does not significantly impair the ability of the SSCs important to safety to perform their intended safety functions.

2.1 Applicable Regulations

The following regulations address fire protection:

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

  > Structures, systems, and components important to safety shall be designed and located to minimize, consistent with other safety requirements, the probability and effect of fires and explosions. Noncombustible and heat resistant materials shall be used wherever practical throughout the unit, particularly in locations such as the containment and control room. Fire detection and fighting systems of appropriate capacity and capability shall be provided and designed to

minimize the adverse effects of fires on structures, systems, and components important to safety. Firefighting systems shall be designed to assure that their rupture or inadvertent operation does not significantly impair the safety capability of these structures, systems, and components.

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

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

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

2.2 Applicable Staff Guidance

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

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

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

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

- NEI 04-02, "Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c)," Revision 2, April 2008 (Reference 5), provides guidance for implementing the requirements of 10 CFR 50.48(c), and represents methods for implementing in whole or in part an RI/PB FPP. This implementing guidance for NFPA 805 has two primary purposes: (1) to provide direction and clarification for adopting NFPA 805 as an acceptable approach to fire protection, consistent with 10 CFR 50.48(c); and (2) to provide additional supplemental technical guidance and methods for using NFPA 805 and its appendices to demonstrate compliance with fire protection requirements. Although there is a significant amount of detail in NFPA 805 and its appendices, clarification and additional guidance for select issues help ensure consistency and effective utilization of the standard. The NEI 04-02 guidance focuses attention on the RI/PB fire protection goals, objectives, and performance criteria contained in NFPA 805 and the RI/PB tools considered acceptable for demonstrating compliance. Revision 2 of NEI 04-02 incorporates guidance from RG 1.205 and approved Frequently Asked Questions (FAQs).

- NEI 00-01, "Guidance for Post Fire Safe Shutdown Circuit Analysis," Revision 2, May 2009 (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), provides guidance to licensees for use in determining the technical adequacy of the base probabilistic risk assessment (PRA) used in a risk-informed regulatory activity, and endorses standards and industry peer review guidance. The RG provides guidance in four areas:

  (1) a definition of a technically acceptable PRA;

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

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

  (4) documentation 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 (ASME)/American Nuclear Society (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 102), provides guidance to licensees on the proper content and quality of engineering equivalency evaluations used to support the FPP. The NRC staff developed the RG to provide a comprehensive fire protection guidance document and to identify the scope and depth of fire protection that the staff would consider acceptable for nuclear power plants.

- NUREG-0800, Section 9.5.1.1, "Fire Protection Program," Revision 0, issued February 2009 (Reference 62), 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 58), provides the NRC staff with guidance for evaluating LARs that seek to implement an RI/PB FPP in accordance with 10 CFR 50.48(c).

- NUREG-0800, Section 19.1, "Determining the Technical Adequacy of Probabilistic Risk Assessment for Risk-Informed License Amendment Requests After Initial Fuel Load," Revision 3, issued September 2012 (Reference 86), provides the NRC staff with guidance for evaluating the technical adequacy of a licensee's PRA results when used to request RI changes to the licensing basis.

- NUREG-0800, Section 19.2, "Review of Risk Information Used to Support Permanent Plant-Specific Changes to the Licensing Basis: General Guidance," Revision 0, issued June 2007 (Reference 87), 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, September 2005 and September 2010, respectively (References 35, 36, and 37), 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, electrical engineering, human reliability analysis, and systems engineering for methods development. A formal technical issue resolution process was developed to direct the deliberative process between RES and EPRI. The process ensures that divergent technical views are fully considered, yet encourages consensus at many points during the deliberation. Significantly, the process provides that each party maintain its own point of view if consensus is not reached. Consensus was reached on all technical issues documented in NUREG/CR-6850. The methodology documented in this report reflects the current state-of-the-art in FPRA. These methods are expected to form a basis for risk-informed analyses related to the plant FPP. Volume 1, the Executive Summary, provides general background and overview information, project insights and conclusions. Volume 2 provides the detailed discussion of the recommended approach, methods, data, and tools for conduct of an FPRA. Supplement 1 provides certain FPRA method enhancements.

- Interim Technical Guidance provided in a Memorandum from Richard P. Correia, RES, to Joseph G. Giitter, NRR, titled "Interim Technical Guidance on Fire-Induced Circuit Failure Mode Likelihood Analysis," dated June 14, 2013 (Reference 38), discusses that, based on new experimental information

documented in NUREG/CR-6931, "Cable Response to Live Fire (CAROLFIRE)" issued April 2008 (Reference 39), and NUREG/CR-7100, "Direct Current Electrical Shorting in Response to Exposure Fire (DESIREE-Fire): Test Results," issued April 2012 (Reference 40), the effect of any control power transformer (CPT) reduction to the hot short-induced spurious operation likelihood could not be substantiated.

- NUREG-1805, "Fire Dynamics Tools (FDT^s): Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program," issued December 2004 (Reference 41), provides quantitative methods, known as FDT^s, to assist regional fire protection inspectors in performing fire hazard analysis. The FDT^s are intended to assist fire protection inspectors in performing RI evaluations of credible fires that may cause critical damage to essential safe shutdown equipment.

- NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," Volumes 1 through 7, issued May 2007 (Reference 42), provide technical documentation regarding the predictive capabilities of a specific set of fire models for the analysis of fire hazards in nuclear power plant scenarios. This report is the result of a collaborative program with the EPRI and the National Institute of Standards and Technology (NIST). The selected models are:

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

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

- NUREG-1855, Volume 1, "Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decision Making," issued March 2009 (Reference 77), 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," issued July 2012 (Reference 43), 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)," issued November 2012 (Reference 78), describes the implications of the verification and validation results from NUREG-1824 for fire model users. The features and limitations of the fire models documented in NUREG-1824 are discussed relative to their use to support nuclear power plant fire hazard analyses. The report also provides information to assist fire model users in applying this technology in the nuclear power plant environment.

- Generic Letter (GL) 2006-03, "Potentially Nonconforming Hemyc and MT Fire Barrier Configurations," dated April 10, 2006 (Reference 44), requested that licensees evaluate their facilities to confirm compliance with the existing applicable regulatory requirements in light of the information provided in this GL and, if appropriate, take additional actions. Specifically, NRC testing revealed that, for the configurations tested, Hemyc and MT fire barriers failed to provide the protective function intended for compliance with existing regulations.

- NFPA 20, "Standard for the Installation of Stationary Pumps for Fire Protection," 1999 Edition (Reference 88), provides requirements for the selection and installation of pumps to ensure that systems will work as intended to deliver adequate and reliable water supplies in a fire emergency.

- NFPA 14, "Standard for the Installation of Standpipe and Hose Systems," 1974 Edition (Reference 89), provides the minimum requirements for the installation of standpipes and hose systems to ensure that systems will work as intended to deliver adequate and reliable water supplies in a fire emergency. NFPA 14 covers all system components and hardware, including piping, fittings, valves, and pressure-regulation devices, as well as system requirements; installation requirements; design; plans and calculations; water supply; and system acceptance.

2.3 NFPA 805 Frequently Asked Questions

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

Table 2.3-1: NFPA 805 Frequently Asked Questions

FAQ #	FAQ Title and Summary	Reference No.	SE Section
07-0030	"Establishing Recovery Actions" • This FAQ provides an acceptable process for determining the recovery actions for NFPA 805 Chapter 4 compliance. The process includes: ▪ Differentiation between recovery actions and activities in the main control room or at primary control station(s). ▪ Determination of which recovery actions are required by the NFPA 805 fire protection program. ▪ Evaluate the additional risk presented by the use of recovery actions. ▪ Evaluate the feasibility of the identified recovery actions. ▪ Evaluate the reliability of the identified recovery actions.	45	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 fire PRA and Nuclear Safety Capability Assessment to include MSOs of concern. ▪ Step 4 – Evaluate for NFPA 805 compliance. ▪ Step 5 – Document the results.	46	3.2.1 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 safe shutdown 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 licensees: ▪ Assemble industry and plant-specific documentation; ▪ Determine which sections of the guidance are applicable; ▪ Compare the existing safe shutdown methodology to the applicable guidance; and ▪ Document any discrepancies.	47	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.	48	3.5.3 3.5.4
08-0048	"Revised Fire Ignition Frequencies" • This FAQ provides an acceptable method for using updated fire ignition frequencies in the licensee's fire PRA. The method involves the use of sensitivity studies when the updated fire ignition frequencies are used.	49	3.4.7
08-0050	"Manual Non-Suppression Probability" • This FAQ updates the treatment of manual suppression and fire brigade response. The update includes a process to adjust the non-suppression analysis for scenario-specific fire brigade responses.	50	3.4.2.2
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.	51	3.4.2.3.2

FAQ #	FAQ Title and Summary	Reference No.	SE Section
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 Nuclear Safety Performance Criteria ▪ Step 3 – Variance From Deterministic Requirements (VFDR) Identification, Characterization, and Resolution Considerations ▪ Step 4 – Performance-Based Evaluations ▪ Step 5 – Final VFDR Evaluation ▪ Step 6 – Document Required Fire Protection Systems and Features	52	3.4.3 3.4.4 3.5.1.4
09-0056	"Radioactive Release Transition" • This FAQ provides an acceptable level of detail and content for the radioactive release section of the LAR. It includes: ▪ Justification of the compartmentation, if the radioactive release review is not performed on a fire area basis. ▪ Pre-fire plan and fire brigade training review results. ▪ Results from the review of engineering controls for gaseous and liquid effluents.	53	3.6
10-0059	"NFPA 805 Monitoring Program" • This FAQ provides clarification regarding the implementation of an NFPA 805 monitoring program for transition. It includes: ▪ Monitoring program analysis units; ▪ Screening of low safety significant structures, systems, and components; ▪ Action level thresholds; and ▪ The use of existing monitoring programs.	54	3.7
06-0008	"Fire Protection Engineering Analyses" • This FAQ provides a general description of the fire protection engineering evaluation (FPEE) process, the different types of FPEEs that may be used under NFPA 805, when prior NRC approval is needed, and how that approval is to be obtained.	55	3.4.1.2

2.4 Orders, License Conditions, and Technical Specifications

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

2.4.1 Orders

The NRC staff reviewed Section 5.2.3, "Orders and Exemptions," and Attachment O, "Orders and Exemptions," of FCS's LAR, with regard to NRC-issued Orders pertinent to FCS 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 FCS are maintained. The licensee discussed the affected orders and exemptions in Attachment O of the LAR.

The licensee requested that 10 exemptions be rescinded, and determined that no Orders need to be superseded or revised to implement an FPP at FCS 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 ADAMS. The review was performed to ensure that compliance with the physical protection requirements, security orders, and adherence to commitments applicable to FCS are maintained. The NRC staff concludes that the licensee's determination that 10 exemptions should be rescinded and that no Orders need to be superseded or revised to implement NFPA 805 at FCS is appropriate. See Section 2.5 of this SE for the NRC staff's detailed evaluation of the exemptions being rescinded.

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

2.4.2 License Conditions

The NRC staff reviewed LAR Section 5.2.1, "License Condition Changes," and Attachment M, "License Condition Changes," regarding changes the licensee seeks to make to the FCS 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 FCS fire protection license condition 3.D, for consistency with the content guidance outlined by

Regulatory Position C.3.1 of RG 1.205, Revision 1, and with the proposed plant modifications identified in the LAR.

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

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

Overall, the licensee's proposed revised license condition allows self-approval for FPP changes that meet the requirements of NFPA 805 with regard to engineering analyses, fire risk evaluations (FREs), and plant change evaluations (PCEs). The NRC staff's evaluation of the self-approval process for FPP changes (post-transition) is contained in Section 2.6 of this SE. The license conditions also reference the plant-specific modifications, and associated implementation schedules that must be accomplished at FCS to complete transition to NFPA 805 and comply with 10 CFR 50.48(c). In addition, the license conditions include a requirement that appropriate compensatory measures will remain in place until implementation of the specified plant modifications is completed. These modifications and implementation schedules are identical to those identified elsewhere in the LAR, as discussed by the NRC staff in Section 2.7, and reviewed in Section 3.0, of this SE.

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

2.4.3 Technical Specifications

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

The NRC staff found that the licensee had previously requested and obtained NRC approval for removal of fire protection requirements from the FCS TSs in Amendment No. 160 dated January 14, 1994 (Reference 56). Although the licensee previously removed fire protection requirements from the FCS TSs, the licensee did identify changes to the TS that involved revising TS 5.8.1.b and c which require written procedures and administrative policies be established, implemented, and maintained for FPP implementation, and also deleting TS 5.2.2.d which required that the plant organization including FPP responsibilities and function be

described in the USAR. The licensee stated that the changes to the TS are adequate for adoption of the new fire protection licensing basis because the requirement for establishing, implementing, and maintaining fire protection procedures is now contained in the regulation (10 CFR 50.48(a) and 10 CFR 50.48(c)).

Based on the information provided by the licensee, the NRC staff concludes that the proposed changes to the TSs are acceptable because the TSs being changed are administrative controls, 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 FCS.

2.4.4 Updated Safety Analysis Report

The NRC staff reviewed the LAR and noted that LAR Figure 4-8 indicates that a revised USAR will be developed as a post-transition document representing the revised license condition. Updates to the USAR are required by 10 CFR 50.71(e), and the licensee stated in its revised USAR that its revised USAR is submitted as required under 10 CFR Part 50.71(e). Since the licensee updates its USAR in accordance with 10 CFR 50.71(e), the NRC staff concludes that the licensee's method to update the USAR is acceptable.

2.5 Rescission of Exemptions

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

The licensee requested and received NRC approval for 10 exemptions from 10 CFR Part 50 Appendix R. These exemptions were discussed in detail in Attachment K of the LAR. The licensee requested that the exemptions be rescinded and 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 (fire modeling and/or fire risk evaluation) 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 exemption is 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 action because the philosophy of defense-in-depth and sufficient safety margin is maintained:

- Fire area 42: control room, lack of area-wide suppression in alternate shutdown area (July 3, 1985; Reference 73). Note: The licensee originally submitted the request for rescission based on previous approval, but subsequently changed the request to PB method. See SE Section 3.5.2.

The following exemptions are rescinded but the engineering evaluation of the underlying condition has been used by the licensee as a qualitative engineering evaluation for transition to NFPA 805:

- Fire area 30: containment, lack of 20-foot separation free of intervening combustibles (July 3, 1985, and July 1, 1986; References 73 and 97).
- Fire area 31: intake structure and pull boxes, lack of a 1-hour fire barrier, lack of area-wide suppression, and lack of detection in pull box area (July 3, 1985; Reference 73).
- Fire area 32: air compressor room, lack of a 1-hour fire barrier (July 3, 1985, and July 1, 1986; References 73 and 97).
- Fire area 34A: electrical penetration area, lack of area-wide suppression (July 3, 1985, and March 17, 1993; References 73 and 100).
- Fire area 34B-1: electrical penetration area, lack of area-wide suppression (July 3, 1985; Reference 73).
- Fire areas 36A, 36B, 36C: switchgear room, lack of 3-hour rated barrier between redundant shutdown divisions (July 3, 1985; Reference 73).
- Fire area 30: Reactor coolant pump (RCP) lube oil collection system, lube oil holdup tank capacity (December 20, 1988; Reference 98).
- Fire area 30: RCP lube oil collection system, unprotected oil leakage sites (May 21, 1998; Reference 103).
- Fire area 47: provision of repair procedures and materials for cold shutdown capability for redundant cold shutdown components within 72 hours (February 6, 2009; Reference 104).

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 the following:

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

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

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

2.6.1 Post-Implementation Plant Change Evaluation Process

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

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

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

In the LAR, the licensee stated that the PCE process begins by defining the change or altered condition to be examined and the baseline configuration. The licensee stated that the baseline is defined as that plant condition or configuration that is consistent with the Design Basis and Licensing Basis (NFPA 805 Licensing Basis post-transition) and that the changed or altered condition or configuration that is not consistent with the Design Basis and Licensing Basis is defined as the proposed alternative.

The licensee stated that once the definition of the change is established, a screening will be performed to identify and resolve minor changes to the FPP and that the screening will be consistent with fire protection regulatory review processes currently in place at FCS. The licensee stated that the screening process is modeled after the NEI 02-03, "Guidance for Performing a Regulatory Review of Proposed Changes to the Approved Fire Protection Program," Revision 0, issued June 2003 (Reference 57), a process that will address most administrative changes (e.g., changes to the combustible control program, organizational changes, etc.). The licensee further stated in LAR Section 4.7.2 that if the characteristics of an acceptable screening process that meets the "assessment of the acceptability of risk"

requirement of Section 2.4.4 of NFPA 805 are not met, the licensee will proceed to the risk evaluation step of the PCE process.

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

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

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

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

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

The licensee stated that the process for capturing the impact of proposed changes to the plant on the FPP will continue to be a multiple step review and that the first step of the review will be an initial screening for process users to determine if there is a potential to impact the FPP as defined under NFPA 805 through a series of screening questions/checklists contained in one or more procedures depending upon the configuration control process being used. The licensee further stated that reviews that identify potential FPP impacts will be sent to qualified individuals

(e.g., Fire Protection Engineer, Fire PRA Engineer, etc.) to ascertain the program impacts, if any, and that if FPP impacts are determined to exist as a result of the proposed change, the issue would be resolved by one of the following:

- Deterministic Approach: Complying with NFPA 805, Chapter 3 and 4.2.3 requirements.

- PB Approach: Utilizing the NFPA 805 change process developed in accordance with NEI 04-02, RG 1.205, and the FCS 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, Revision 2 (Reference 32), which requires the use of qualified individuals, procedures that require calculations and evaluations be subject to independent review and verification, record retention, peer review, and a corrective action program that ensures appropriate actions are taken when errors are discovered.

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

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

2.6.2 Requirements for the Self Approval Process Regarding Plant Changes

Risk assessments performed to evaluate PCEs must use methods that are acceptable to the NRC staff. Acceptable methods to assess the risk of the proposed plant change may include

methods that have been used in developing the peer-reviewed FPRA model, methods that have been approved by the NRC via a plant-specific license amendment or through NRC approval of generic methods specifically for use in NFPA 805 risk assessments, or methods that have been demonstrated to bound the risk impact.

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

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

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

NFPA 805 Section 1.7, "Equivalency" addresses the use of new systems, methods or devices beyond those previously reviewed and accepted by the AHJ. Use of the functionally equivalent or adequate for the hazard approach as described above does not fall under NFPA 805, Section 1.7, "Equivalency," because it does not involve the use of new systems, methods or devices and the condition can be shown to meet the NFPA 805 Chapter 3 requirement using an engineering evaluation. 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 AHJ because not all of these state of the art features are in current use or have relevant operating experience. This is a different situation than the use of functional equivalency since functional equivalency demonstrates that the condition meets the NFPA 805 code requirement.

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

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

1. "Fire Alarm and Detection Systems" (Section 3.8);

2. "Automatic and Manual Water-Based Fire Suppression Systems" (Section 3.9);

3. "Gaseous Fire Suppression Systems" (Section 3.10); and

4. "Passive Fire Protection Features" (Section 3.11).

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

According to the LAR, the licensee intends to use a FPRA to evaluate the risk of proposed future plant changes. Section 3.4.2, "Quality of the Fire Probabilistic Risk Assessment," of this SE discusses the technical adequacy of the FPRA, including the licensee's process to ensure

that the FPRA remains current. The NRC staff determined that the quality of the licensee's FPRA and associated administrative controls and processes for maintaining the quality of the PRA model is sufficient to support self-approval of future risk-informed changes to the FPP under the proposed license conditions. Therefore, the NRC staff concludes that the licensee's process for self-approving future FPP changes is acceptable.

The NRC staff also concludes that the fire risk evaluation methods used at FCS 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 plant change evaluations conducted to determine the change in risk associated with proposed plant changes.

2.7 Implementation

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

The NRC staff noted that the list of modifications and implementation items originally submitted in the LAR have been updated by the licensee with the final version of LAR Attachment S, "Plant Modifications and Items to be Completed during Implementation." The updated LAR Attachment S is provided in the licensee's letter dated April 10, 2014 (Reference 23).

2.7.1 Modifications and Implementation Items

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

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

As depicted in LAR Attachment S, Table S-1, the licensee has not yet completed any modifications as part of the NFPA 805 transition. LAR Attachment S, Table S-2 provides a detailed listing of the plant modifications that must be completed in order for FCS to be fully in

accordance with NFPA 805, implement many of the attributes upon which this SE is based, and thereby meet the requirements of 10 CFR 50.48(c). LAR Attachment S, Table S-3 provides a list of items (procedure changes, process updates, and training to affected plant personnel) that will be completed prior to the implementation of the new NFPA 805 FP program. The modifications will be implemented in accordance with the schedule provided in the proposed NFPA 805 license condition, which states that all modifications will be in place by the end of the second Refueling Outage following issuance of the license amendment. In addition, the licensee has agreed to keep the appropriate compensatory measures in place until the modifications have been fully implemented. The implementation items will be completed in accordance with the schedule provided in the proposed NFPA 805 license condition which states that the implementation items will be completed no later than 12 months after issuance of the license amendment.

2.7.2 Schedule

LAR Section 5.4 provides the overall schedule for completing the NFPA 805 transition at FCS. The licensee stated that implementation of the new program, including any procedure changes, process updates, and training for affected plant personnel to implement the NFPA 805 FPP, within 12 months after NRC approval of the license amendment.

LAR Section 5.4 also states that modifications will be completed by the end of the second Refueling Outage following NRC approval and that appropriate compensatory measures will be maintained until modifications are complete. Based on information provided by the licensee, the NRC staff finds these schedules to be acceptable.

2.8 Summary of Implementation Items

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

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

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

3.0 TECHNICAL EVALUATION

The following sections evaluate the technical aspects of the requested license amendment to transition the FPP at FCS to one based on NFPA 805 (Reference 4) 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 58), to determine whether the licensee had provided sufficient information in both scope and level of detail to adequately demonstrate compliance with the requirements of NFPA 805, as well as the other associated regulations and guidance documents discussed in Section 2.0 of this SE. Specifically:

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

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

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

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

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

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

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

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

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

3.1 NFPA 805 Fundamental FPP and Design Elements

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

- 10 CFR 50.48(c)(2)(v) – Existing cables. In lieu of installing cables meeting flame propagation tests as required by Section 3.3.5.3 of NFPA 805, a flame-retardant coating may be applied to the electric cables, or an automatic fixed fire suppression system may be installed to provide an equivalent level of protection. In addition, the italicized exception to Section 3.3.5.3 of NFPA 805 is not endorsed.

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

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

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

3.1.1 Compliance with NFPA 805, Chapter 3 Requirements

The licensee used the systematic approach described in NEI 04-02, Revision 2 (Reference 5), as endorsed by the NRC in RG 1.205, Revision 1, to assess the proposed FCS 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 FCS FPP and provided specific compliance statements for each Chapter 3 attribute that contained applicable requirements. As discussed below, some subsections of NFPA 805 Chapter 3 do not contain requirements, or are otherwise not applicable to FCS, and others are provided with multiple compliance statements to fully document compliance with the element.

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

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

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

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

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

5. The existing FPP element does not comply with the requirement, but the licensee is requesting specific approval for a PB method in accordance with 10 CFR 50.48(c)(2)(vii): noted in LAR Table B-1 as "Submit for NRC Approval." These requests are described in LAR Attachment L and SE Sections 3.1.1.5 and 3.1.4; and

6. The existing FPP element does not comply with the requirement, but will be in direct compliance with the completion of a required action; noted in LAR Table B-1 as "Complies with Required Action." These outstanding actions are identified as implementation items in Attachment S of the LAR as discussed in Section 2.8 and 3.1.1.6 of this SE.

Compliance approach 6, "Complies with Required Action," 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 required actions are identified in LAR Attachment S as implementation items.

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

The licensee stated in LAR Section 4.2.2, "Existing Engineering Equivalency Evaluation Transition," that the EEEEs that support compliance with NFPA 805 Chapter 3 or Chapter 4

were reviewed using the methodology contained in NEI 04-02 and that the review determined that the EEEEs are not based solely on quantitative risk evaluations; are appropriate use of an engineering equivalency evaluation; are of appropriate quality; meet the standard license condition; are technically adequate; reflect the plant as-built condition; and, basis for acceptability remains valid. In addition, the licensee determined that none of the transitioning EEEEs require NRC approval.

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

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

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

3.1.1.1 Compliance Strategy – Complies

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

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

- 3.2.3, Procedures: In the licensee's response to Fire Protection Engineering RAI 05 (Reference 10), the LAR Table B-1 compliance strategy was updated from "N/A" to "Complies."

- 3.2.3(1), which concerns the inspection, testing, and maintenance procedures and frequencies.

  The NRC staff questioned, during the audit, whether the licensee may want to use the PB methodology, EPRI Technical Report (TR) 1006756, "Fire Protection Equipment Surveillance Optimization and Maintenance Guide" to alter future, post-transition surveillance frequencies. In response to Fire Protection Engineering RAI 06, in a letter dated July 24, 2012 Reference 10), the licensee stated that "OPPD currently has no plans to revise surveillance and maintenance

procedures to use performance based methods." The licensee added that "for NFPA 805 implementation, existing procedures and frequencies will remain unchanged except as previously noted in Attachment S-3 of the Transition Report." The NRC staff noted that these referenced changes of Attachment S-3 are not associated with the use of EPRI TR1006756. The licensee also stated that "if changes are made in the future to incorporate performance based methods, it is planned that the changes would be made in accordance with EPRI TR1006756." The NRC staff concludes that this is acceptable because the licensee stated that they have no plans to use PB methods to revise surveillance and maintenance procedures except as previously noted in LAR Attachment S, Table S-3, and the licensee is not currently requesting the use of a PB method to alter the procedures and frequencies associated with NFPA 805, Section 3.2.3(1).

- 3.3, Prevention: In the licensee's letter dated July 24, 2012, in response to Fire Protection Engineering RAI 05 (Reference 10), the LAR Table B-1 compliance strategy was updated from "N/A" to "Complies."

- 3.3.1.1, General Fire Protection Activities: In the licensee's letter dated July 24, 2012, in response to Fire Protection Engineering RAI 05 (Reference 10), the LAR Table B-1 compliance strategy was updated from "N/A" to "Complies."

- 3.3.1.2, Control of Combustible Materials: In the licensee's letter dated July 24, 2012, in response to Fire Protection Engineering RAI 05 (Reference 10), the LAR Table B-1 compliance strategy was updated from "N/A" to "Complies."

- 3.3.1.2(3), Control of Combustible Materials such as waste, debris, scrap, packing materials or other combustibles: The licensee requested NRC approval to use PB methods to address this attribute. In the licensee's letter dated April 23, 2013, in response to Fire Protection Engineering RAI 22 (Reference 13), the licensee deleted the original LAR Attachment L, Approval Request 2, and changed the LAR Table B-1 compliance statement for NFPA 805, Section 3.3.1.2(3), to state "Complies." For a more complete discussion on the NRC staff's review of this PB request, see Section 3.1.4.2 of this SE.

- 3.4.3, Training and Drills: In the licensee's letter dated July 24, 2012, in response to Fire Protection Engineering RAI 05 (Reference 10), the LAR Table B-1 compliance strategy was updated from "N/A" and "Complies" to only "Complies."

- 3.4.4, Fire Fighting Equipment: In the licensee's letter dated July 24, 2012, in response to Fire Protection Engineering RAI 12 (Reference 10), the licensee clarified that the correct compliance statements for LAR Table B-1, Section 3.4.4, are "Complies" and "Complies with Use of EEEEs." The licensee clarified that an implementation item is not associated with this element.

Based on the licensee's statement of compliance and the associated implementation items as described in LAR Attachment A and listed in LAR Attachment S for the individual attributes

described above, as well as the statements that these items will be complete prior to implementation; the NRC staff concludes the licensee's statements of compliance are acceptable because completion of the implementation items will bring these attributes into compliance with the post-transition requirements.

3.1.1.2 Compliance Strategy – Complies with Clarification

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

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

- 3.11.5 Electrical Raceway Fire Barrier Systems (ERFBS)

  In response to Fire Protection Engineering RAI 18 (Reference 10), in letter dated July 24, 2012, the licensee modified the compliance statements for Section 3.11.5 by deleting "Submit for NRC Approval" (regarding LAR Attachment L, Approval Request 7) and revising the compliance basis to "Complies with Clarification." The licensee clarified that the revised compliance basis identified the following pyrocrete enclosures as acceptable rated enclosures in accordance with Exception No. 2 of Section 3.11.5 of NFPA 805:

  - Overhead horizontal Train B cabling encased in conduit, wrapped in metal lath, and surrounded by 2 inches of pyrocrete in fire area 36A between column lines 3a and 4a, from fire area 36B and terminating at panel AI-109B in fire area 36A.

  - Vertical Train B cable tray sections 22S to 5-4A from fire area 32 (below) to fire area 41 (above) within fire area 36A between column lines 6d and 7a is wrapped in metal lath, and surrounded by 2 inches of pyrocrete.

  - Vertical Train A cable tray sections 10S to 5-4B from fire area 32 (below) to fire area 41 (above) within fire area 36A between column lines 6d and 7a is wrapped in metal lath, and surrounded by 2 inches of pyrocrete.

These enclosures had previously been employed prior to the issuance of Generic Letter 86-10, Supplement 1, and were tested against the end point temperature requirements identified in Generic Letter 86-10, Supplement 1. In the May 21, 2013, response to Fire Protection Engineering RAI 18.01 (Reference 14), the licensee provided more details regarding the end point temperatures used and stated these were similar to the NFPA 251 criteria used in Generic Letter 86-10, Supplement 1. Based on the information submitted by the licensee, the NRC staff concludes that this method of compliance is acceptable because the testing performed demonstrated that the licensee's ERFBS provides protection of electrical cables from the thermal assault due to a fire for the tested duration, since the testing met the requirements of

Exception No. 2 of Section 3.11.5 of NFPA 805. See Sections 3.1.1.4 and 3.1.4.7 of this SE for further evaluation.

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, as well as a 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:

- 3.4.4 Fire-Fighting Equipment

  In the July 24, 2012, response to Fire Protection Engineering RAI 12 (Reference 10), the licensee clarified that the correct compliance statements for Section 3.4.4 are "Complies" and "Complies with Use of EEEEs." The licensee clarified that an implementation item is not associated with this element.

- 3.6.3 Standpipe and Hose Station Nozzle Restrictions

  In the July 24, 2012, response to Fire Protection Engineering RAI 10(c) (Reference 10), regarding the prohibition of straight stream nozzle capability in high voltage settings, the licensee stated that its 250,000 Volt (V) criteria, described in LAR Table B-1, Section 3.6.6, will satisfy all power block areas. In addition, the licensee stated that the yard transformers are equipped with automatic deluge systems and that manual fire suppression is available from hydrants and hose houses located within 500 feet. Hose houses contain two approved adjustable spray-solid stream nozzles equipped with shutoffs for each size hose provided. In its April 23, 2013, response to Fire Protection Engineering RAI 10.01 (Reference 13), regarding further clarification on the use of adjustable spray-solid stream nozzles, the licensee stated that LAR Attachment S, Implementation Item REC-146 (Reference 23), will add fixed fog-only nozzles to plant-wide fire brigade gear bags and hose stations/cabinets that could be used for high voltage electrical fires. This implementation item will also add labels "not for use on electrical fires" to adjustable nozzles and incorporate fog vs. adjustable nozzles into fire brigade training. Based on the information submitted by the licensee, the NRC staff concludes that this method of compliance is acceptable because the licensee will take actions to come into compliance with the NFPA 805 requirement to use electrically safe nozzles in all plant areas where they could be used for high voltage electrical fires and to provide labeling and training regarding the use of adjustable nozzles that can be set to provide straight stream settings (Attachment S, Implementation Items REC-146 and REC-037) (Reference 23).

- 3.9.1 (2) Fire Suppression System Code Requirements – Water Spray Fixed Systems

  In the April 23, 2013, response to Fire Protection Engineering RAI 28 (Reference 13), regarding clarification on the credit applied towards the transformer deluge water spray system, the licensee stated that the transformer deluge spray systems are credited for risk significance and LAR Table B-1 compliance strategy was updated from "N/A" to "Complies with Use of EEEEs" via a NFPA 15 code compliance evaluation.

- 3.11.4(b) Through Penetration Fire Stops – Conduit Seals

  In the July 29, 2013, response to Fire Protection Engineering RAI 29 (Reference 15), regarding clarification on the correct compliance strategy, the licensee stated that "the correct compliance statement for Section 3.11.4(b) is 'Complies with Use of EEEEs.

3.1.1.4 Compliance Strategy – Complies with Previous NRC Approval

Certain NFPA 805, Chapter 3 requirements, or partial requirements, were supplanted by an alternative that was previously approved by the NRC. Remaining portions of an element not directly stated in the previous approval are assumed to comply directly with the stated requirement or otherwise as noted in the compliance statement(s). Previous NRC approval was documented in the following:

- The original August 23, 1978, FPP SE (Reference 92), which included cable flame propagation limits, fire pump suction arrangement and supply capacity, fire pump separation, water supply header and hose station layout, fire hydrant and hose house layout;

- A supplement issued November 17, 1980 (NRC-80-0213; Reference 93), with an exemption allowing the fire brigade complement to be less than the minimum for up to 2 hours;

- A supplement issued July 3 1985 (NRC-85-200; Reference 73), with NRC approved exemptions including the Intake Structure (including fire barriers protecting cables for one of the raw water pumps), Room 19 (including "L" shaped fire barrier around an auxiliary feed pump), numerous pryocrete fire barriers in the switchgear rooms, and fire barrier separating the east and west switchgear rooms;

- A supplement dated July 1, 1986 (NRC-86-211; Reference 97), with clarifications and changes to the SE dated July 3, 1985, approving changes to the separation of redundant equipment in Containment, elimination of an overhead shield intended to protect the motor-driven auxiliary feedwater (AFW) pump from water impingement;

- A supplement issued December 20, 1988 (NRC-88-0457; Reference 98), with NRC exemption approving the RCP Oil Collection System;

- A supplement dated May 21, 1998 (Reference 103), with NRC-approved exemption from Section III.O of Appendix R of 10 CFR 50 for five unpressurized locations on the RCP motor. It also determined that exemptions were not required for lack of a flame arrestor on the RCP oil collection tanks and not having oil collectors at the anti-rotation device housing and the motor cooling air vents on General Electric RCP motors; and

- A 2009 exemption dated February 6, 2009 (Reference 104), clarifies an exemption from Section III.G of Appendix R of 10 CFR 50 for a duct bank, manhole vault numbers 5 and 31, and fire area 31 (intake structure and pull boxes 128T and 129T).

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. 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 in LAR Attachment T several existing licensing actions which required clarification. The NRC staff review and evaluation of these clarifications is documented in Section 3.5.2 of this SE.

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

- 3.3.8 Bulk Storage of Flammable and Combustible Liquids

  In response to Fire Protection Engineering RAI 07 and 15 (Reference 10), regarding the NFPA 805 requirements on bulk storage in certain plant areas, the licensee stated in letter dated July 24, 2012, that the compliance statement has been updated to include "Complies by Previous Approval." The licensee stated that there is no bulk storage of flammable or combustible liquids inside structures containing systems, equipment, components important to nuclear safety with exception of those previously approved. The compliance basis has been revised to include prior approval discussions of the diesel fuel oil and lubricating oil in the Diesel Generator Rooms and the turbine lube oil in the Turbine Building.

- 3.6.1 Standpipe and Hose Station Code Requirements

  By letter dated April 23, 2013, in response to Fire Protection Engineering RAI 27 (Reference 13), regarding clarification on the applicability of LAR Attachment L, Approval Request 6, the licensee stated that the Approval Request 6 is limited to the cable spreading room because the absence of hose stations in containment

was previously approved by the NRC. The licensee's response contains the modified LAR Table B-1, Element 3.6.1. The NRC staff continues to accept the previous approval for absence of hose stations inside containment. For the NRC staff evaluation for the cable spreading room, see Sections 3.1.1.5 and 3.1.4.6 of this SE.

In addition, the licensee's response included a new Attachment T, Prior Approval Clarification Request 13 seeking to remove the containment HVAC charcoal filter deluge system from the post-NFPA 805 FPP. For the NRC staff evaluation of LAR Attachment T, Request 13, see Section 3.5.2 of this SE.

3.1.1.5 Compliance Strategy – Submit for NRC Approval

The licensee 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 LAR approving the transition to NFPA 805 at FCS. The NFPA 805 sections identified in LAR Table B-1 as complying via this method are as follows:

- 3.3.1.2(1), which concerns the use of commonly available equipment containing non fire-retardant wooden components. See Section 3.1.4.1 of this SE for further evaluation. See LAR Attachment L, Approval Request 1.

- 3.3.1.2(3), which concerns the use of temporary scaffolding and combustible equipment/supplies not easily relocated. Per OPPD's letter to the NRC, dated April 23, 2013, in response to Fire Protection Engineering RAI 22 (Reference 13), the licensee has deleted the original LAR Attachment L, Approval Request 2, and changed the LAR Table B-1 compliance statement for NFPA 805, Section 3.3.1.2(3), to state "Complies." See Sections 3.1.1.1 and 3.1.4.2 of this SE for further evaluation.

- 3.3.5.1, which concerns the existence of non-plenum-use wiring above suspended ceilings. See Section 3.1.4.3 of this SE for further evaluation. See LAR Attachment L, Approval Request 3.

- 3.5.3 & 3.5.6, which concerns the ability to stop the electric fire pump remotely. See Section 3.1.4.4 of this SE for further evaluation. See LAR Attachment L, Approval Request 4.

- 3.5.14, which concerns the existing underground yard main loop sectional valves that are not supervised. See Section 3.1.4.5 of this SE for further evaluation. See LAR Attachment L, Approval Request 5.

- 3.6.1, which concerns the use of lengths of hose at hose stations greater than lengths allowed by NFPA 14. See Section 3.1.4.6 of this SE for further evaluation. See LAR Attachment L, Approval Request 6.

- 3.11.5, which concerns overhead cabling encased in conduit, wrapped in metal lath, and surrounded by pyrocrete within fire areas 36A and 36B. Per OPPD's

letter to the NRC, dated July 24, 2012, in response to Fire Protection Engineering RAI 18 (Reference 10), the licensee deleted the original LAR Attachment L, Approval Request 7, and modified the LAR Table B-1 compliance statement for NFPA 805, Section 3.11.5, to add, "Complies with Clarification." The licensee clarified that compliance is met via Exception 2 and then identified the applicable electrical raceway fire barrier systems as required fire protection features. See Sections 3.1.1.2, 3.1.1.4, and 3.1.4.7 of this SE for further evaluation.

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

3.1.1.6 Compliance Strategy – Complies with Required Action

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

The required actions were identified as follows:

- 3.2.2.4 Management Policy on AHJ

  Standing Order SO-G-102, "Fire Protection Program Plan," will be revised to identify the AHJ. Completion of this action is included in LAR Attachment S, Implementation Item REC-001 (Reference 23).

- 3.3.1.2 (1) Control of Combustible Materials – Fire-Retardant Wood

  Standing Order SO-G-91, "Control and Transportation of Combustible Materials," had the original definition of "commonly available equipment" that included untreated "wood that is an integral part of portable tools, equipment, pallets or other apparatus." By letter dated July 29, 2013, in response to Fire Protection Engineering RAI 21.01(a) (Reference 15), regarding the allowance of untreated wood integral to pallets and other apparatus, the licensee stated that based on further review, this definition will be changed to only include small hand tools and portable equipment within the power block. Therefore, as part of implementation, SO-G-91 will be revised accordingly. See also Section 3.1.4.1 of this SE. Completion of this action is included in LAR Attachment S, Implementation Item REC-144 (Reference 23).

- 3.3.1.2 (2) Control of Combustible Materials – Use of Plastic Sheeting Materials Within Power Block

  Standing Order SO-G-91, "Control and Transportation of Combustible Materials," will be revised to include a requirement that plastic sheeting materials used at the plant shall be in accordance with NFPA 701 or equivalent. Completion of this

action is included in LAR Attachment S, Implementation Item REC-002 (Reference 23).

- 3.3.1.2 (3) Control of Combustible Materials – Combustible Waste, Debris Removal

  Standing Order SO-G-91, "Control and Transportation of Combustible Materials," had required the removal of combustible waste, debris, scrap, packing materials, or other combustible material immediately following the completion of work. By letter dated July 29, 2013, in response to Fire Protection Engineering RAI 21.01(c) (Reference 15), regarding the additional requirement for combustible waste removal at the end of each shift, the licensee stated that SO-G-91 will be revised to require that waste, debris, scrap, packing materials, or other combustibles shall be removed from an area immediately following the completion of work or at the end of the shift, whichever comes first. Completion of this action is included in LAR Attachment S, Implementation Item REC-144 (Reference 23).

- 3.3.1.2 (5) Control of Combustible Materials – Use and Storage of Flammable and Combustible Liquids

  Standing Order SO-G-91, "Control and Transportation of Combustible Materials," will be revised to identify that the maximum allowable safety can containing any Class IA liquid is 2 gallons. Completion of this action is included in LAR Attachment S, Implementation Item REC-059 (Reference 23). In addition, Combustible materials located near storage tanks FO-1 and FO-10 will be removed or relocated. Completion of this action is included in LAR Attachment S, Implementation Item REC-061.

- 3.3.1.3.1 Control of Ignition Sources Code Requirements – Hot Work

  Standing Order SO-M-9, "Hot Work Operations," will be revised to specifically address having hot-work operator cease work in the event of unsafe conditions. Completion of this action is included in LAR Attachment S, Implementation Item REC-031 (Reference 23).

  Standing Order SO-M-9, "Hot Work Operations," will also be revised to provide additional clarification that stationary firewatch personnel have the authority to stop hot-work operations if unsafe conditions develop. Completion of this action is included in LAR Attachment S, Implementation Item REC-032 (Reference 23). By letter dated April 23, 2013, in response to Fire Protection Engineering RAI 24 (Reference 13), regarding the allowance for roving fire watches during hot-work activities, the licensee stated that Standing Order SO-M-9, "Hot Work Operations," has been revised to be compliant with the requirements of NFPA 51B with respect to the disallowance of roving hot-work fire watches. The licensee stated that Revision 30 of SO-M-9 removes the definition of "roving fire watch" and associated procedural steps referring to it Standing Order SO-M-9, "Hot Work Operations," will also be revised to specifically require the hot-work

supervisor to inspect the work area at least once per day while the hot-work permit is in effect. Completion of this action is included in LAR Attachment S, Implementation Item REC-034 (Reference 23).

Standing Order SO-M-9, "Hot Work Operations," will also be revised to require a fire watch posted for the duration of work and for 60 minutes thereafter for torch-applied roofing operations. Completion of this action is included in LAR Attachment S, Implementation Item REC-035 (Reference 23).

- 3.3.1.3.4 Control of Ignition Sources on Portable Heaters

  Guideline FCSG-15-11, "Fire Prevention Plan," will be revised to address the control of electric heaters and prohibit the use of portable fuel-fired heaters in the power block. Completion of this action is included in LAR Attachment S, Implementation Item REC-004 (Reference 23).

- 3.3.5.1 Electrical Wiring Above Suspended Ceiling Limitations

  Standing Order SO-G-21, "Modification Control," will be revised to require the use of plenum-rated wiring above suspended ceilings. Completion of this action is included in LAR Attachment S, Implementation Item REC-050 (Reference 23).

- 3.3.7.1 Bulk Flammable Gas Location Requirements

  The licensee plans to rearrange safety relief devices at the hydrogen cylinder station outside the CRP Building to discharge upward and unobstructed to the open air. Completion of this action is included in LAR Attachment S, Modification Item REC-051 (Reference 23).

  The licensee plans to relocate the hydrogen storage. The licensee stated the cylinders will be removed from the bay containing the two liquefied petroleum gas (LPG) tanks and their respective manifold piping system and moved to a different bay to ensure adequate separation is provided. Completion of this action is included in LAR Attachment S, Modification Item REC-052 (Reference 23).

  The licensee plans to relocate/reroute propane and acetylene gas storage and manifold piping to avoid hydrogen storage areas. Completion of this action is included in LAR Attachment S, Modification Item REC-053 (Reference 23).

  The licensee plans to close or reconfigure the exterior ventilation opening for the carbon dioxide (CO_2) bottle storage room to open away from the hydrogen storage area. Completion of this action is included in LAR Attachment S, Modification Item REC-054 (Reference 23).

  The licensee will develop a procedure to perform and document yearly inspection and maintenance of the hydrogen systems in accordance with current NFPA requirements. Completion of this action is included in LAR Attachment S, Implementation Item REC-055 (Reference 23).

The licensee plans to station Operating Instruction OI-ST-6, "Operation of the Generator Gas System," at the hydrogen cylinder station outside the Turbine Building. Completion of this action is included in LAR Attachment S, Implementation Item REC-056 (Reference 23).

- 3.3.8 Bulk Storage of Flammable and Combustible Liquids

The licensee plans to provide FO-38 with grounding in accordance with NFPA 30. Completion of this action is included in LAR Attachment S, Modification Item REC-026 (Reference 23).

The licensee plans to remove/relocate combustible materials located within 15 feet of outdoor diesel oil storage tank FO-1. Completion of this action is included in LAR Attachment S, Modification Item REC-057 (Reference 23).

By letter dated July 24, 2012, in response to Fire Protection Engineering RAI 07 (Reference 10), regarding the NFPA 805 prohibition of bulk storage in certain plant areas, the licensee stated that the compliance basis was revised to also discuss the modifications in the diesel generator rooms (MR-FC-87-42 and FC77-30) regarding dry pipe system coverage and diesel generator separation via a 3-hour rated rollup door. Previous completion of these additional modifications was completed under MR-FC-87-42 and FC77-30.

- 3.3.9 Transformers

The licensee plans to revise Standing Order SO-G-108, "Pollution Prevention and Storm Water Management Program," to specifically require an inspection of transformer oil collection basins to ensure that they are free of debris and capable of performing their design function. Completion of this action is included in LAR Attachment S, Implementation Item REC-039 (Reference 23). By letter dated July 24, 2012, in response to Fire Protection Engineering RAI 14 (Reference 10), regarding inspection of transformer oil basins and LAR Attachment S, Implementation Item REC-039 (Reference 23), the licensee stated that the inspections will be performed in accordance with Institute of Electrical and Electronics Engineers (IEEE) 980-1994 Edition, "IEEE Guide for Containment and Control of Oil Spills in Substations." The frequency of these basin inspections will coincide with the testing of the transformer suppression systems at each refueling outage. The NRC staff concludes that this is acceptable based on the use of a standard, the use of an established frequency, and the lack of a specific frequency in NFPA 805.

- 3.3.10 Hot Pipes and Surfaces

The licensee plans to revise Standing Order SO-G-91, "Control and Transportation of Combustible Materials," to include controls on eliminating the possibility of combustible liquids coming into contact with hot pipes and surfaces

and to control the prompt cleanup of oil on insulation. Completion of this action is included in LAR Attachment S, Implementation Item REC-006 (Reference 23).

- 3.3.11 Electrical Equipment

  The licensee plans to revise Standing Order SO-G-91, "Control and Transportation of Combustible Materials," to require clearance, free of combustibles, around energized equipment. Completion of this action is included in LAR Attachment S, Implementation Item REC-007 (Reference 23).

- 3.4.1 (a)(1) On-Site Fire-Fighting Capability

  The licensee plans to establish a risk management policy document for fire brigade emergency response. Completion of this action is included in LAR Attachment S, Implementation Item REC-027 (Reference 23).

  The licensee plans to revise Standing Order SO-G-64, "Medical Examination Program for Worker Qualification," to include steps for disqualifying Fire Brigade personnel if they fail to meet physical requirements. Completion of this action is included in LAR Attachment S, Implementation Item REC-028 (Reference 23).

- 3.4.1 (b) On-Site Fire-Fighting Capability

  The licensee plans to revise plant documents to specifically address the requirement that fire brigade members shall have no other assigned normal plant duties that would prevent immediate response to a fire or other emergency as required. Completion of this action is included in LAR Attachment S, Implementation Item REC-008 (Reference 23).

- 3.4.1 (c) On-Site Fire-Fighting Capability

  The licensee plans to reconfigure the current fire brigade staffing composition to ensure 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. By letter dated July 24, 2012, in response to Fire Protection Engineering RAI 08 (Reference 10), the licensee clarified that these three members are from operations and that operations personnel would complete Equipment Operator – Nuclear Auxiliary non-license classroom training. The non-operations personnel are not required to take similar training. By letter dated July 29, 2013, in response to Fire Protection Engineering RAI 08.01 (Reference 15), the licensee stated it will ensure the brigade leader's knowledge to assess the potential safety consequences of a fire and advise control room personnel is commensurate with successful completion of Licensed Operator classroom or equivalent certification training while the two other fire brigade members from operations will complete Equipment Operator – Nuclear Auxiliary non-license classroom training.

By letter dated April 10, 2014 (Reference 23), the licensee stated that a fire brigade advisor can also be designated to support the fire brigade and that the fire brigade advisor does not need to meet the qualifications of a fire brigade member because this individual is in addition to the minimum number of qualified fire brigade members. The licensee also stated that the designated fire brigade advisor will be a person with knowledge commensurate with successful completion of licensed operator classroom or equivalent certification training and will have sufficient training and knowledge of nuclear safety systems to understand the effects of fire and fire suppressants on NSPC and that when using the fire brigade advisor, the fire brigade leader will be required at a minimum to have completed incident command training, and an unannounced in-plant drill per NFPA 600, "Standard on Industrial Fire Brigades." The licensee further stated that the use of a fire brigade advisor to support the fire brigade is consistent with the exception described in NFPA 805 Section 3.4.1 (c) which states that during every shift, the brigade leader and at least two brigade members shall have sufficient training and knowledge of nuclear safety systems to understand the effects of fire and fire suppressants on NSPC.

Completion of these actions is included in LAR Attachment S, Implementation Item REC-009 (Reference 23).

- 3.4.2.1 Pre-Fire Plan Contents, 3.4.2.4 Pre-Fire Plan Coordination Needs, 3.4.3(a)(2) Training and Drills, and 3.4.3(c)(2) Training and Drills

  In response to Fire Protection Engineering RAI 09 (Reference 10), dated July 24, 2012 the licensee stated they plan to revise Standing Order SO-G-28, "Station Fire Plan," and associated fire brigade training materials to reflect changes required to meet the NFPA 805 radioactive release performance criteria as identified in the NFPA 805 radioactive release review. Completion of this action is included in LAR Attachment S, Implementation Item REC-100 (Reference 23).

- 3.4.5.2 Site-Specific Training

  The licensee plans to revise the Fire Brigade Training Program Master Plan to include the requirements for annual training with the offsite fire department. Completion of this action is included in LAR Attachment S, Implementation Item REC-011.

- 3.5.3 Water Supply Pump Code Requirements

  The licensee plans to revise the review summary for Section 7-5.2.3 of NFPA 20-1996 Edition in EA-FC-95-022 to reference NRC approval granted in the NFPA 805 SE (see Section 3.1.4.5 of this SE) for the ability to stop the electric motor-driven fire pump remotely from the control room. Completion of this action is included in LAR Attachment S, Implementation Item REC-069 (Reference 23) and LAR Attachment L, Approval Request 4.

- 3.5.15 Water Supply Hydrant Code Requirements

  The licensee plans to revise Surveillance Test OP-ST-FP-0001A, "Fire Protection System Inspection and Test," to show that hose houses should be equipped with the following: 2 – Approved adjustable spray-solid stream nozzles equipped with shutoffs for each size of hose equipped. 1 – Fire axe with brackets. 1 – Hydrant wrench (in addition to wrench on hydrant). 4 – Coupling spanners for each size hose provided. 2 – Hose coupling gaskets for each size hose. Completion of this action is included in LAR Attachment S, Implementation Item REC-037 (Reference 23).

- 3.6.1 Standpipe and Hose Station Code Requirements

  The licensee plans to revise the review summary for Section 2-7.2 of NFPA 14-1996 Edition in EA-FC-95-022 to reference the NRC approval granted in the NFPA 805 SE (see SE Section 3.1.4.7) for the length of hose at hose stations, which is being requested in LAR Attachment L as Approval Request 6. In addition, the licensee plans to revise EA-FC-97-041 to identify that hose lengths greater than those allowed by NFPA 14 have been approved by the NRC in the NFPA 805 SE for the length of hose at hose stations. Completion of these actions is included in LAR Attachment S, Implementation Item REC-080 (Reference 23) and LAR Attachment L, Approval Request 6.

- 3.8.1 Fire Alarm and 3.8.2 Detection

  The licensee plans to revise Calibration Procedure EM-CP-06-FDZH-QA, "Calibration and Function Test of QA Vault Halon Fire Detection and Protection System," to include a step to ensure the QA Vault detectors are clear of dust or dirt. Completion of this action is included in LAR Attachment S, Implementation Item REC-012 (Reference 23).

  The licensee plans to revise Standing Order SO-G-28, "Station Fire Plan," to ensure that detectors suspected of exposure to a fire condition are inspected and tested in accordance with surveillance and calibration procedures. Completion of this action is included in LAR Attachment S, Implementation Item REC-021 (Reference 23).

  The licensee plans to revise Surveillance Test IC-ST-FP-0001, "Calibration and Functional Test of Auxiliary Building, Elevation 1036' (Room 81) Fire Detection System (AI-230 and AI-231)," USAR Section 9.11, and Standing Order SO-G-103, "Fire Protection Operability and Surveillance Requirements," to require that the inspection and maintenance activities of the air sampling system in Room 81 be performed semiannually or every six months. Completion of this action is included in LAR Attachment S, Implementation Item REC-086 (Reference 23).

- 3.10.1 Gaseous Fire Suppression System Code Requirements

  The licensee plans to revise Maintenance Procedure GM-RM-FP-0303, "Semi-Annual CO_2 Cylinders Inspection," to include inspection of the flexible discharge lines from the CO_2 cylinders. Completion of this action is included in LAR Attachment S, Implementation Item REC-067 (Reference 23).

  The licensee plans to revise Calibration Procedure EM-CP-06-FDZ-TG, "Disassembly, Reassembly and Testing of Turbine Generator Fire Detector System," to include instructions for ensuring that the system will remain fully operational until the next inspection and for performing a discharge test if inspection results deem it necessary as determined by the Fire Protection System Engineer. In addition, the licensee plans to revise Standing Order SO-G-102, "Fire Protection Program Plan," to give the Fire Protection System Engineer the responsibility of determining when fire suppression system discharge tests are required as a result of inspection, testing, and maintenance. Completion of these actions is included in LAR Attachment S, Implementation Item REC-068 (Reference 23).

On the basis that the "required actions" as described by the licensee will incorporate the provisions of NFPA 805, Chapter 3 in the licensee's FPP and plant procedures and that the actions are included as modifications or implementation items in LAR Attachment S, which is included in the proposed license condition, the NRC staff concludes that the licensee's statements of compliance are acceptable.

3.1.1.7 Compliance Strategy – Multiple Strategies

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

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

3.1.1.8 Chapter 3 Sections Not Reviewed

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

- Sections that do not contain any technical requirements (e.g., NFPA 805, Chapter 3, Section 3.4.5 and Section 3.11).

- Sections that are not applicable to FCS because the licensee stated that FCS does not have systems of this type installed:

  - 3.6.5, which concerns cross-connection between seismic required hose stations and essential seismic non-fire protection water supply systems. FCS does not have hose stations that are cross-connected to non-fire protection water supply systems.

  - 3.9.1 (3), which concerns water mist systems installed in accordance with NFPA 750. FCS does not have a water mist system installed.

  - 3.9.1 (4), which concerns foam-water systems installed in accordance with NFPA 16. FCS does not have a foam-water system installed.

  - 3.10.1 (3), which concerns clean agent fire extinguishing systems designed and installed in accordance with NFPA 2001. FCS does not have a clean agent fire extinguishing system installed.

  - 3.10.4, which concerns a single active failure shall not impair both the required primary and backup gaseous fire suppression systems (e.g., CO2 systems). FCS does not have areas protected by both primary and backup gaseous suppression systems.

- The requirements are structured with an applicability statement (e.g., NFPA 805, Chapter 3 Section 3.4.1 (a)(2) and Section 3.4.1 (a)(3), wherein the determination of which NFPA code(s) apply to the fire brigade depends on the type of brigade specified in the FPP). Similarly for Section 3.5.1 (b).

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

3.1.2 Identification of the Power Block

The NRC staff reviewed the FCS structures identified in LAR Table I-1, "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 FCS RI/PB FPP that have additional requirements in accordance with 10 CFR 50.48(c) and NFPA 805. As stated in LAR Section 4.1.3, the power block includes all the structures required for nuclear plant operations at FCS. It includes the containment, auxiliary building, service building, control building, fuel building, radioactive waste processing building, water treatment, turbine building, and intake structures or structures identified in the pre-transition licensing phase.

LAR Attachment I also states that structures in the owner controlled area were evaluated to determine those that are required to meet the NSPC and/or the radioactive release performance criteria as described in Section 1.5 of NFPA 805.

LAR Attachment I excluded the 345 kiloVolt (kV) switchyard and substation 1251 control building from the Power Block definition. By letter dated July 24, 2012, in response to Fire Protection Engineering RAI 02 and 03 (Reference 10), the licensee stated that these locations are outside of the protected area and, although within the owner controlled area, the plant staff does not have design control over these locations. In addition, the licensee's response to Fire Protection Engineering RAI 01 dated July 24, 2012 (Reference 10), justifies the exclusion of the outdoor gas storage (i.e., fire area 50) from the power block. The licensee stated that this location is not a structure and does not affect the nuclear safety or radiological release performance criteria. Although fire area 50 is not included in the power block definition, this area is included in LAR Attachment A, Table B-1 based on the NFPA 50A code review performed in this area.

In LAR Attachment I, the licensee excluded the service building (NFPA 805 fire area 45) because it only contains the fuel oil transfer pump for the diesel-driven AFW pump, FW-54. The licensee stated that although FW-54 is included in the NSCA as a potential success path for AFW, this non-safety-related pump is not relied upon in the NSCA for any fire event within the service building. The fuel oil transfer pump for the diesel-driven AFW pump is not required for operation of the station. A fire in the service building would not impact the operation of the station (the fire would not require a power reduction or initiation of nuclear plant shutdown). In addition, the NRC staff notes that this diesel-driven AFW pump is a third AFW pump that is not the primary AFW pump and is not co-located with the other primary AFW pumps. The NRC staff also notes that the remaining components for the diesel-driven AFW pump are not located in the service building with the exception of the fuel oil transfer pump.

The NRC staff concludes that the licensee has appropriately evaluated the structures and equipment at FCS, and adequately documented a list of those structures that fall under the definition of "power block" in NFPA 805.

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

GL 2006-03 requested that licensees evaluate their facilities to confirm compliance with existing applicable regulatory requirements in light of the results of NRC testing that determined that both Hemyc™ and MT™ fire barriers failed to provide the protective function intended for compliance with existing regulations, for the configurations tested using the NRC's thermal acceptance criteria. FCS does not use either the Hemyc™ or MT™ electrical raceway fire barrier systems (ERFBS). Therefore, the generic issue (GL 2006-03; Reference 44) related to the use of these ERFBS is not applicable to FCS.

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 FPP fundamental elements and minimum design requirements of NFPA 805, Chapter 3. Paragraph 50.48(c)(2)(vii) of 10 CFR requires that an acceptable PB approach accomplish the following:

1. Satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release;

2. Maintains safety margins; and

3. Maintains fire protection DID (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown capability).

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 NFPA 805, Chapter 3 elements identified in Section 3.1.1.5 of this SE. The NRC staff evaluation of these proposed methods is provided below.

3.1.4.1 Section 3.3.1.2(1) – Use of Equipment Containing Non Fire-Retardant Wooden Components

In Attachment L, Approval Request 1, the licensee requested NRC staff to review and approve a PB method to demonstrate an equivalent level of fire protection for the requirement of NFPA 805, Section 3.3.1.2(1) regarding the control of combustible materials. Specifically, the licensee has requested approval of a PB method to justify the use of untreated wood within the power block.

As described by the licensee, this would consist of the use of commonly available equipment, such as hand tools, which can contain limited quantities of wooden components, such as handles, that are not treated to resist fire exposure. The licensee stated that the use of this alternative for hand tools would have no adverse impact on the total combustible fire load since this addition is insignificant when compared to the total fire load.

The licensee stated that there will be no impact on the NFPA 805 nuclear safety performance goals, performance objectives, and performance criteria because the amount of untreated wood represents a minimal amount of the overall wood utilized in the plant and does not present a significant combustible load or fire hazard. The licensee also stated that this alternative will have no effect on the NFPA 805 radiological release performance goals, performance objectives, and performance criteria.

The licensee further stated that the proposed alternative maintains the safety margin inherent in the licensee's analyses, because the proposed alternative's introduction of untreated wood is minimal. Finally, the licensee stated that fire protection DID will be maintained, because the introduction of these hand tools that contain portions of untreated wood does not directly result in compromising automatic or manual fire suppression functions. However, if the quantity of untreated wood introduced should challenge any elements of the FPP, then appropriate compensatory measures would be identified during the modification review process.

The NRC staff identified that LAR Attachment L, Approval Request 1, did not contain sufficient discussion concerning "commonly available equipment." By letter dated April 23, 2013, in response to Fire Protection Engineering RAI 21 (Reference 13), the licensee stated that "commonly available equipment," as referred to in LAR Attachment L, Approval Request 1, includes "wood that is an integral part of portable tools, equipment, pallets or other apparatus." The licensee did not provide further information to describe the portable equipment or apparatus for which this request would apply. The NRC staff does not agree that allowing pallets or other apparatus containing untreated wood into the power block is acceptable in maintaining an effective FPP. Items can present a greater than minimal combustible load and hazard. However, the NRC staff accepts the use of portable, single-hand tools. These tools and portable equipment (e.g., screw drivers, hammers, etc.) contain handles or integral pieces made of untreated wood. By letter dated July 29, 2013, in response to Fire Protection Engineering RAI 21.01 (a) (Reference 15), regarding the allowance untreated wood integral to pallets and other apparatus, the licensee stated that based on further review, this definition will be changed to only include small hand tools and portable equipment within the power block. This change of definition will be captured in a revision to SO-G-91 via LAR Attachment S, Implementation Item REC-144 (Reference 23).

The NRC staff noted that the licensee's response to Fire Protection Engineering RAI 21.b (Reference 13) needed additional clarity as to the treatment, use, and storage of wood within the power block. In its July 29, 2013, response to Fire Protection Engineering RAI 21.01 (b) regarding the controls on untreated wood used within the power block, the licensee stated that it meets the NFPA 805, Section 3.3.1.2(1), requirements because SO-G-91, Section 5.2.12, requires all wood within the Protected Area (which encompasses the power block areas) shall be treated with a flame retardant. The licensee added that the statement in SO-G-91, Section 5.2.13, regarding not retaining wood in specific power block areas (i.e., containment, auxiliary building, and intake structure) are additional requirements above and beyond the requirement of NFPA 805, Section 3.3.1.2(1).

The NRC staff expects both untreated and treated wood combustible loads to be accounted for. The licensee must meet the transient combustible limits assumed in any applicable fire hazards analysis, FPRA, and fire modeling analysis relied upon to meet 10 CFR 50.48(c). See also Section 3.3.1.2 (1) of this SE.

The NRC staff concludes that this request is acceptable based on:

- The minimal amount of untreated combustible material (single-hand tools and portable equipment) is expected to be low enough to be accounted for within the existing transient load
- Any combustible loads that exceed an area's combustible load limit are reviewed and appropriate compensatory measures are secured
- All wood other than that covered by this request will be listed pressure-impregnated, coated with a listed fire retardant application, or will be 6 inches by 6 inches or larger in size.
- In addition, all wood within the containment, auxiliary building, or intake structure will not be retained in these areas.

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

3.1.4.2 Section 3.3.1.2(3) – Use of Scaffolding and Combustible Equipment Not Easily Relocated

By letter dated April 23, 2013, in response to Fire Protection Engineering RAI 22 (Reference 13), the licensee deleted the original LAR Attachment L, Approval Request 2, and changed the LAR Table B-1 compliance statement for NFPA 805, Section 3.3.1.2(3), to state "Complies." The basis for this change is a clarification that the approval request scope was limited to temporary scaffolding constructed of treated wood and that the NRC staff does not

consider treated wood a major fire risk in terms of satisfying the control of combustible materials requirements of NFPA 805, Section 3.3.1.2(3). The NRC staff also accepts the use of temporary scaffolding containing treated wood based on the NFPA 805, Section 3.3.1.2(1) allowing use of treated wood. The NRC staff's review did not include other adverse impacts on the FPP, such as potential obstruction of suppression and detection systems or fire brigade access issues. These were not considered because this approval request was limited to NFPA 805, Section 3.3.1.2(3), which requires the prompt removal of combustibles from an area.

Based on the above, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the deletion of the proposed performance-based method as an alternative to the corresponding NFPA 805, Section 3.3.1.2(3), requirement is acceptable.

3.1.4.3 Section 3.3.5.1 – Existence of Non-Plenum-Use Wiring Above Suspended Ceilings

In LAR Attachment L, Approval Request 3, the licensee requested NRC staff review and approval of a performance-based method to demonstrate an equivalent level of fire protection for the requirement of NFPA 805, Section 3.3.5.1 regarding wiring above ceilings in the control room (fire area 42) and personnel complex (fire area 19). Specifically, the licensee has exposed wiring routed above a suspended ceiling in these areas that are not routed in metal conduits, cable trays, armored cable, or rated for plenum use as required by NFPA 805, Section 3.3.5.1.

As described by the licensee, this would consist of existing wiring for non-essential, non-risk-significant systems such as lighting, electrical power outlets, telephone, fire detection, and Gai-tronics system.

The NRC staff identified that LAR Attachment L, Approval Request 3, did not contain sufficient discussions concerning the reliance on Institute of Electrical and Electronics Engineers (IEEE) 383 (Reference 59) or sufficient detail justifying adequate DID and safety margin. By letter dated April 23, 2013, in response to Fire Protection Engineering RAI 16.01 (Reference 13), the licensee stated that the "statement that cabling is IEEE-383 qualified was not intended to imply that IEEE-383 qualification is equivalent to a plenum-use rating," and removed the reference to IEEE-383.

The licensee stated that there will be no impact on NFPA 805 nuclear safety. By letter dated April 23, 2013, in response to Fire Protection RAI 16.01 (Reference 13), the licensee stated that the loss of cables for data and communications, such as Gai-tronics, telephone, and fire detection, is not credible considering these low voltage cables are not susceptible to self-ignition and therefore, self-ignited cable fires are not a concern. The licensee stated there are no other ignition sources and concluded that the air handling unit (VA-67) is not a potential ignition source since this unit is a 2 horsepower unit which is less than the 5 horsepower described in NUREG/CR-6850. The licensee stated that there is only a negligible quantity of non-rated and non-protected cables. Further, the licensee stated that these non-rated and non-protected cables are not credited in the NSCA. Therefore, there is no adverse impact on the NSPC due to the non-rated plenum cabling in these areas. The licensee also stated that the location of this wiring above suspended ceilings has no impact on the NFPA 805 radiological release performance criteria. These criteria are achieved through engineered controls for the

containment of water and smoke and, based on the potential location of radiological concerns, are not affected by the presence of these above suspended ceiling cables.

The licensee further stated that the proposed alternative maintains the safety margin inherent in the licensee's analyses because the proposed alternative's quantity of non-rated and non-protected wiring routed above suspended ceilings is negligible and are not susceptible to self-ignition or any potential ignition sources. Finally, the licensee stated that fire protection DID will be maintained because the wiring located above the suspended ceilings does not directly result in compromising fire protection for systems and structures, automatic fire suppression functions, manual fire suppression functions, or post-fire safe shutdown capability. The licensee added that detection is not provided above these suspended ceilings; however, the Control Room and the personnel complex area are normally occupied and have automatic fire detection systems below the ceilings.

By letter dated April 23, 2013 (Reference 13), the licensee stated that SO-G-21, Modification Control, will be revised to ensure restrictions are in place to mandate the use of plenum-rated wiring above suspended ceilings for future installations. This method of compliance meets the requirement of NFPA 805, Section 3.3.5.1. Additionally, this item has been added to Table S-3 as REC-050, which is included in the proposed license condition and will be implemented within 12 months of approval of the NFPA 805 license amendment.

The NRC staff concludes that this request is acceptable based on:

- The amount of non-compliant wiring above suspended ceilings is small.
- No significant in-situ combustibles exist in these areas above the ceilings. The spaces above ceilings receive little access and are not used for storage/staging of combustibles; therefore reasonable assurance transient combustibles will not be present including during outages.
- There are no ignition sources above suspended ceilings in fire areas 19 and 42, except for air handling unit VA-67. The NRC staff does not consider this 2-horsepower unit to present an ignition source (NUREG/CR-6850 only considers motors 5 horsepower and above).
- Existing wiring not meeting NFPA 805, Section 3.3.5.1 are low voltage which the NRC staff considers a low fire hazard.
- Fire areas 19 (personnel complex) and 42 (control room) are normally occupied which provides for early detection and suppression.
- Future wiring installed in these areas will be required to meet NFPA 805, Section 3.3.5.1 rating requirements.
- The cables above these ceilings are not relied upon to safely shutdown the plant nor would any fire damage to these cables adversely impact the ability to safely shutdown the plant.

Based on the above, 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 sufficient safety margin, and maintains adequate fire protection DID.

3.1.4.4 Sections 3.5.3 and 3.5.6 – Ability to Stop the Electric Fire Pump Remotely

In LAR Attachment L, Approval Request 4, the licensee requested NRC staff review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirements of NFPA 805, Sections 3.5.3 and 3.5.6 regarding the electric fire pump (FP-1A). Specifically, the licensee requested approval of a PB method to justify the use of remote stop (NFPA 805 3.5.3) and automatic start override capabilities (NFPA 805, Section 3.5.6) of the fire pump.

As described by the licensee, the remote stop and automatic start override capabilities consist of the existing ability to remotely stop the electric fire pump (FP-1A) from the control room and to place the control room stop switch in the PULLOUT (i.e., pull-to-lock) position to prevent an automatic start of the electric fire pump (FP-1A).

By letter dated April 23, 2013, in response to Fire Protection Engineering RAI 26(a) (Reference 13), the licensee clarified that its request for a deviation from NFPA 805 Section 3.5.3, which requires compliance with NFPA 20, also consists of a deviation from NFPA 20 Section 7-5.2.3 (1996 Edition), regarding the ability to remotely stop the electric fire pump. In addition, the licensee clarified that the requests for a deviation from the NFPA 805 Section 3.5.6 requirement that "fire pumps shall be provided with automatic start and manual stop only," consists of the ability of the control room PULLOUT switch to prevent automatic start of the electric fire pump (FP-1A) when in the pull-to-lock position.

The licensee stated that there will be no impact on the NFPA 805 nuclear safety because there are strict administrative controls over the control of the fire pumps and the presence of trained operators. In addition, if the electric fire pump (FP-1A) were to stop or did not started on an automatic start signal, then the redundant diesel fire pump (FP-1B) would activate automatically. The diesel fire pump cannot be stopped remotely and cannot have the automatic start signal blocked. The diesel fire pump will activate if fire protection system pressure falls below 100 pounds per square inch (psi) or if the electric fire pump fails to start within 10 seconds after an automatic signal is sent. The licensee also stated that the ability to remotely stop or override the automatic start of the electric fire pump will have no effect on the NFPA 805 radiological release performance criteria.

The licensee further stated that the proposed alternative maintains the safety margin inherent in the licensee's analyses, because the electric fire pump normally operates automatically and is monitored and controlled by trained operators. Finally, the licensee stated that fire protection DID will be not be impacted, because means are available to ensure the electric fire pump, or redundant diesel fire pump, is operable during a fire event.

The NRC staff noted that LAR Attachment L, Approval Request 4, did not contain sufficient discussion concerning impact and failure modes of PULLOUT switch given a fire in the main control room (MCR). By letter dated April 23, 2013, in response to Fire Protection Engineering RAI 26(b) (Reference 13), the licensee stated that failure of electric fire pump (FP-1A) to start can occur as a result of power and/or control cable failures to breaker 1A1-0 cables associated with this switch in any fire area in which these cables are routed. However, there are no circuits in the control room that would disable the diesel fire pump (FP-1B) if damaged due to a fire. In addition, the licensee stated that a failure of the electric fire pump (FP-1A) to start due to failure of the control switch circuit will not have an impact on the fire protection water supply as the diesel fire pump (FP-1B) will remain available.

The NRC staff identified that LAR Attachment L, Approval Request 4, did not contain sufficient discussion concerning the purpose and intended scenarios regarding the use of the electric fire pump (FP-1A) remote pullout switch. By letter dated April 23, 2013, in response to Fire Protection Engineering RAI 26(c) (Reference 13), the licensee stated that the operation of this switch is limited to occasions when a fire is not in progress such as during maintenance or testing or post-fire. The licensee also stated that fire impairment is required and restoration of the fire pump is governed by procedure (SO-G-103) any time the electric pump is not in auto (switch in PULLOUT position).

The NRC staff has reviewed the LAR information and concludes that the request is acceptable based on the following:

- At least one 100-percent capacity fire pump, the diesel fire pump, remains available as its automatic start capability cannot be overridden and there is no remote stop. The NRC staff does not consider a fire event concurrent with maintenance or failure of fire protection system equipment (per NFPA 805 Section 2.2), and therefore assumes the diesel fire pump (FP-1B) will be available.

- Strict procedures govern any remote stoppage or PULLOUT switch operation for the electric fire pump (FP-1A) in order to prevent losing availability of both pumps, including a requirement to record the use of the PULLOUT switch as a fire impairment.

- Only trained operators in the MCR operate the electric fire pump PULLOUT switch position.

- Operation of the PULLOUT switch is limited to maintenance and testing activities when a fire is not in progress or upon the completion of firefighting activities after a fire.

- A warning alarm is received in the control room if the automatic start is overridden.

Based on the above, 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 and 3.5.6, requirements because it satisfies the performance goals, objectives,

and criteria specified in NFPA 805 related to nuclear safety and radiological release; maintains sufficient safety margin; and maintains adequate fire protection DID.

3.1.4.5 Section 3.5.14 – Existing Underground Yard Main Loop Sectional Valves Not Supervised

In LAR Attachment L, Approval Request 5, the licensee requested NRC staff review and approval of a performance-based method to demonstrate an equivalent level of fire protection for the requirement of NFPA 805, Section 3.5.14, regarding the use of yard main valves without valve supervision. Specifically, the licensee has five underground fire main loop sectional valves that are not locked or have valve supervision, or sealed.

As described by the licensee, these fire main loop sectional gate valves are located within the site protected area. A special wrench is required to operate these valves. Only authorized personnel able to enter the protected area would have access to these valves and the required wrench. In addition, the licensee stated that only authorized and trained personnel operate these valves and have access to the required wrench.

The licensee stated that the lack of supervision, seal, or lock on these valves has no impact on the nuclear safety or radiological release performance criteria.

The NRC staff noted that LAR Attachment L, Approval Request 5, did not contain sufficient discussion concerning the description of the sectional gate valve and the specific valve identities. By letter dated July 24, 2012, in response to Fire Protection Engineering RAI 19 (Reference 10), the licensee clarified that these sectional valves are gate valves located within roadway boxes underground. The licensee identified the five valves subject to this approval request:

- Three (3) valves Northeast of the machine shop, and
- Two (2) valves East of the service building.

The licensee further stated that the proposed alternative maintains the safety margin inherent in the licensee's analyses because the valves are within the protected area, operated only by authorized personnel, require a special wrench, and therefore will not affect the flow of fire protection water. Finally, the licensee stated that fire protection DID will be maintained because this condition does not negatively affect the system pressure or flow, and does not result in compromising fire suppression functions, manual fire suppression functions, or post-fire safe shutdown capability.

The NRC staff has reviewed the LAR and supplemental information and concludes that the request is acceptable based on the following:

- Restricted protected area access to these valves prevents inadvertent valve closure;
- Valves can only be operated with use of a special wrench (although common) that is controlled;

- Valves are only operated by appropriate personnel with appropriate training;
- Procedures are in place to verify proper alignment given any maintenance or operation of valves; and
- One sectional yard loop valve in the closed position will not prevent water supply to the fire protection systems.

Based on the above, 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 3.5.14, requirement because it satisfies the performance goals, objectives, and criteria specified in NFPA 805 related to nuclear safety and radiological release; maintains sufficient safety margin; and maintains adequate fire protection DID.

3.1.4.6 Section 3.6.1 – Use of Hose at Hose Stations Greater Than Lengths Allowed by NFPA 14

In LAR Attachment L, Approval Request 6, the licensee requested NRC staff review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement of NFPA 805, Section 3.6.1 regarding hose stations. Specifically, the licensee has lengths of hose at hose stations serving the cable spreading room that are greater than the lengths allowed in NFPA 14, Section 2-7.1 (1996 Edition).

The licensee stated that interior hose stations provide adequate coverage to all safety-related areas of the plant using 100 feet or less of installed 1.5-inch fire hose except for the containment building and the cable spreading room. Regarding the cable spreading room, the licensee provides an additional 150 feet of fire hose stationed at hose station FP-4A. This hose station normally serves other fire areas within reach of the installed 100 feet of fire hose; however, since this hose station also serves the cable spreading room, the licensee added 150 feet (250 feet total hose length) of fire hose in order to provide adequate coverage to all areas of the cable spreading room. The licensee stated that the fire hose is for manual firefighting purposes and is expected to be used by authorized and trained personnel only.

The licensee further stated that the proposed alternative maintains the safety margin inherent in the licensee's analyses, because the additional 150 feet of fire hose (250 feet total fire hose length) will not cause the flow or pressure of the system to drop below the required amounts and maintains a documented calculation of adequate fire hose coverage. Finally, the licensee stated that fire protection DID will be maintained because this condition does not negatively affect the system pressure or flow, and does not result in compromising fire suppression functions, manual fire suppression functions, or post-fire safe shutdown capability.

The licensee stated that the additional 150 feet of fire hose attached to the 100-foot fire hose has no impact on the NSPC because calculation FC06672 ensures that the required flow and pressure can be provided to hose station FP-4A in order to provide adequate protection to the entire cable spreading room and considers the extended length of fire hose.

The licensee stated that the additional 150 feet of fire hose attached to the 100-foot fire hose as a supplement for manual firefighting use has no impact on the radiological release performance criteria since manual firefighting using this hose in the cable spreading room will be maintained within normal specifications since pressure and flow will be maintained.

The NRC staff has reviewed the LAR and supplemental information and concludes that the request is acceptable based on:

- Licensee stated that the 150 feet of hose attached to the 100 foot hose provides adequate fire hose coverage for the cable spreading room from hose station FP-4A.
- Licensee stated that a site-specific calculation ensures that the required flow and pressure can provided to FP-4A fire hose station to properly supply a 250-foot length (100 feet original length plus 150 feet additional length) of 1.5-inch hose.
- NRC staff expects only authorized personnel (i.e., fire brigade members) to operate this fire hose.
- NRC staff expects the fire brigade to be trained on and maintain the ability to control a 250-foot hose.
- Licensee stated that the additional 150 feet of fire hose is maintained and surveyed.

By letter dated April 23, 2013, in response to Fire Protection Engineering RAI 27 (Reference 13), the licensee also clarified that this request for approval only applies to the extended hose lengths used to provide coverage to the cable spreading room from hose station FP-4A. The licensee noted that the hose lengths at hose stations serving the containment will continue to rely on previous approval. The licensee's response included revisions to LAR, Table B-1, Section 3.6.1 such as an added compliance statement, "Complies by Previous NRC Approval," and compliance basis identifying this previous NRC approval.

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

3.1.4.7 Section 3.11.5 – Pyrocrete ERFBS Enclosures in Fire Areas 36A and 36B

By letter dated July 24, 2012, in response to Fire Protection Engineering RAI 18 (Reference 10), the licensee deleted the original LAR Attachment L, Approval Request 7, and modified the compliance statements for LAR Table B-1, Section 3.11.5. These Table B-1 changes include deleting "Submit for NRC Approval" (regarding LAR Attachment L, Approval Request 7) and revising the compliance basis for "Complies with Clarification." The licensee clarified that the

revised compliance basis identified the following pyrocrete enclosures as acceptable 3-hour rated enclosures in accordance with Exception No. 2 of Section 3.11.5 of NFPA 805:

- Overhead horizontal Train B cabling encased in conduit, wrapped in metal lath, and surrounded by 2 inches of pyrocrete in fire area 36A between column lines 3a and 4a, from fire area 36B and terminating at panel AI-109B in fire area 36A.

- Vertical Train B cable tray sections 22S to 5-4A from fire area 32 (below) to fire area 41 (above) within fire area 36A between column lines 6d and 7a is wrapped in metal lath, and surrounded by 2 inches of pyrocrete.

- Vertical Train A cable tray sections 10S to 5-4B from fire area 32 (below) to fire area 41 (above) within fire area 36A between column lines 6d and 7a is wrapped in metal lath, and surrounded by 2 inches of pyrocrete.

By letter dated May 21, 2013, in response to Fire Protection RAI 18.01 (Reference 14), the licensee clarified the endpoint temperature and time-temperature test data, which is similar to the acceptance criteria of NFPA 251 as identified in Generic Letter 86-10, Supplement 1. The basis for this change is a clarification that these fire-rated enclosures were employed prior to the issuance of Generic Letter 86-10, Supplement 1 and were tested against the end point temperature requirements identified in Generic Letter 86-10, Supplement 1. The time-temperature data supplied by the pyrocrete manufacturer and the end point temperature requirement were previously provided in Attachment B to letter LIC-80-0062. Therefore, the licensee contends that these features are acceptable in accordance with Exception No. 2 of Section 3.11.5 of NFPA 805 and that LAR Attachment L, Approval Request 7 is no longer required. See Sections 3.1.1.2 and 3.1.1.4 of this SE.

By letter dated May 21, 2013, in response to Fire Protection RAI 18.01 (b) (Reference 14), the licensee also stated the following pyrocrete enclosure meets Exception 2 of NFPA 805, Section 3.11.5 via previous approval as an un-rated heat shield providing reasonable protection:

- [Horizontal Train A] cable tray 54S, formerly separating fire areas 36B and 36C in the west switchgear room, is wrapped in metal lath and pyrocrete. (Cable tray 54S contains 3A backup pressurizer heater control cables)

The NRC staff concludes that the licensee's responses to Fire Protection Engineering RAIs 17, 18, and 18.01 (References 10 and 14) are acceptable, including the deletion of Approval Request 7. See Sections 3.1.1.2, 3.1.1.4, and 3.1.1.5 of this SE for further evaluation.

Based on the above, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the deletion of this proposed PB method as an alternative to the corresponding NFPA 805, Section 3.11.5, requirement is acceptable because the licensee provided information to show it meets Exception 2 of NFPA 805, Section 3.11.5.

3.2 Nuclear Safety Capability Assessment Methods

NFPA 805, "Performance Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants" (Reference 1), is an RI/PB standard that allows engineering analyses to be used to show that FPP features and systems provide sufficient capability to meet the requirements of 10 CFR 50.48(c).

NFPA 805 Section 2.4, "Engineering Analyses," states the following:

> 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.

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

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

> The nuclear safety goal is to provide reasonable assurance that a fire during any operational mode and plant configuration will not prevent the plant from achieving and maintaining the fuel in a safe and stable condition.

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

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

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

> Fire protection features shall be capable of providing reasonable assurance that, in the event of a fire, the plant is not placed in an unrecoverable condition. To demonstrate this, the following performance criteria shall be met:
>
> (a) *Reactivity Control.* Reactivity control shall be capable of inserting negative reactivity to achieve and maintain subcritical conditions.

Negative reactivity inserting shall occur rapidly enough such that fuel design limits are not exceeded.

(b) *Inventory and Pressure Control.* With fuel in the reactor vessel, head on and tensioned, inventory and pressure control shall be capable of controlling coolant level such that subcooling is maintained for a [pressurized-water reactor (PWR)] and shall be capable of maintaining or rapidly restoring reactor water level above top of active fuel for a [boiling-water reactor (BWR)] such that fuel clad damage as a result of a fire is prevented.

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

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

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

3.2.1 Compliance with NFPA 805 Nuclear Safety Capability Assessment Methods

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

The purpose of this section is to define the methodology for performing a nuclear safety capability assessment. The following steps shall be performed:

(1) Selection of systems and equipment and their interrelationships necessary to achieve the nuclear safety performance criteria in Chapter 1

(2) Selection of cables necessary to achieve the nuclear safety performance criteria in Chapter 1

(3) Identification of the location of nuclear safety equipment and cables

(4) Assessment of the ability to achieve the nuclear safety performance criteria given a fire in each fire area

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

RG 1.205, Revision 1 (Reference 2), endorses NEI 04-02, Revision 2 (Reference 5), and Chapter 3 of NEI 00-01, Revision 2, "Guidance for Post-Fire Safe Shutdown Circuit Analysis"

(Reference 31). This NRC-endorsed method documents in a table format (i.e., NEI 04-02 Table B-2, "NFPA 805 Chapter 2 – Nuclear Safety Transition – Methodology Review") the licensee's comparison of its post-fire safe shutdown analyses to the guidance in NEI 00-01 Chapter 3, which 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 – NSCA – Methodology Review," against these guidelines (Reference 6).

The endorsed guidance provided in NEI 00-01, Revision 2 (Reference 31), provides a framework to evaluate the impact of fires on the ability to maintain post-fire safe shutdown. It provides detailed guidance for:

(1) Selecting systems and components required to meet the NSPC;

(2) Selecting the cables necessary to achieve the NSPC;

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

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

The licensee developed the FCS NFPA 805 LAR based on the guidance provided in the guidance documents cited above. Based on the information provided in the licensee's submittal, as supplemented, the licensee used a systematic process to evaluate the FCS post-fire SSA against the requirements of NFPA 805, Section 2.4.2, Subsections (1), (2), and (3), which meets the methodology outlined in the latest NRC-endorsed industry guidance. The licensee chose to utilize the approach documented in FAQ 07-0039 "Lessons Learned - NEI 04-02 B-2 Table" (Reference 5), which provides on acceptable method for documenting the comparison of the post-fire SSA against the NFPA 805 requirements. This method first maps the existing post-fire SSA to the NEI 00-01, Revision 1, Chapter 3 methodology which, in turn, is mapped to the NFPA 805 Section 2.4.2 requirements.

Although RG 1.205, Revision 1 (Reference 2), endorses NEI 00-01, Revision 2 (Reference 31), the licensee review was performed to the guidance in NEI 00-01, Revision 1 (Reference 60), as discussed below with regard to the NRC staff's SSA RAI 01 (Reference 10).

The licensee performed this evaluation by comparing its updated post-fire 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 5), as modified by FAQ 07-0039, "Lessons Learned – NEI 04-02 B-2 Table."

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

(1) The post-fire SSA directly aligns with the attribute: noted in LAR Attachment B, "NEI 04-02 Table B-2, NFPA 805 Chapter 2 – Nuclear Safety Transition – Methodology Review," as "Aligns."

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

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

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

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

As stated above, the licensee performed the review of the NSCA to the guidance of NEI 00-01, Revision 1 instead of Revision 2 as endorsed by RG 1.205, Revision 1. In SSA RAI 01 dated April 26, 2012 (Reference 24), the NRC staff requested that the licensee perform a gap analysis to demonstrate the methodology applied at FCS meets the guidelines of NEI 00-01, Revision 2. By letter dated July 24, 2012, in response to SSA RAI 01 (Reference 10), the licensee stated, in part, that "based on the gap analysis, there are no significant differences between alignment with NEI 00-01, Revision 1 and NEI 00-01, Revision 2 for FCS."

The licensee's response to SSA RAI 01 dated July 24, 2012 (Reference 10), stated that "a paragraph-by-paragraph review was conducted of the criteria and assumptions presented in NEI 00-01, Revision 1 and Revision 2 to address any potential gaps to demonstrate FCS meets the guidelines of Revision 2, where applicable...The review concluded that the circuit failure criteria set forth in NEI 00-01, Revision 2 does not differ significantly from that in Revision 1, and specifically from that implemented through the use of project procedures." The licensee's response also identified the following clarifications to address differences in criteria and/or assumptions identified in NEI 00-01, Revision 2:

- The FCS NFPA 805 transition project evaluated Multiple Spurious Operations (MSOs) consistent with the process outlined in FAQ 07-0038, Revision 3, "Lessons Learned on Multiple Spurious Operations" (Reference 46).

- Manual operation of valves must consider the effect of a fire on stem lubrication, where applicable. An evaluation should be conducted to justify those instances where hand wheel operation of a valve in the area of the fire is credited. In the response to SSA RAI 01 (Reference 10), the licensee stated that it does not credit Recovery Actions for valves located in the fire affected area.

The licensee's response stated that based on its gap review as described above, OPPD meets the guidance provided in NEI 00-01, Revision 2.

On the basis of the licensee's response to SSA RAI 01 and its statement that there are no significant differences between alignment with NEI 00-01, Revision 1 and NEI 00-01, Revision 2

for FCS, the NRC staff concludes the licensee has reviewed the FCS SSA against the methods endorsed in RG 1.205.

3.2.1.1 Attribute Alignment -- Aligns

For the majority of the NEI 00-01, Chapter 3, attributes, the licensee determined that the post-fire SSA aligns directly with the attribute. In these instances, based on the validity of the licensee's statements, the NRC staff concludes that the licensee's statements of alignment are acceptable.

The following attribute identified in LAR Table B-2 as aligning via this method required additional review by the NRC staff: LAR Table B-2 Section 3.3.3.4, Identify Routing of Cables, indicated "aligns" with the recommended statement in NEI 00-01 to "identify the routing for each cable including all raceway and cable endpoints..." However the NSCA cable selection analysis identified certain cable routing assumptions which needed further clarification.

Safe Shutdown Analysis (SSA) RAI 03 dated April 26, 2012 (Reference 24), was written to identify the scope and justification for certain assumptions for cables without specific routing information and to delineate the process used to include such cables in target selection within the Zone(s) of Influence of nearby ignition sources. By letter dated July 24, 2012, in response to SSA RAI 03 (Reference 10), the licensee provided additional information regarding the number of cables and some suitable justifications for the assumptions; however, for the specific questions regarding how the cables were included as targets, the response referred to PRA RAI 01g responses dated May 21, 2013 (Reference 14). Follow-up RAI responses to PRA RAI 01.g.01 (Reference 14) clarified target selection within the Zone(s) of Influence and the analysis impact regarding cable routing assumptions through sensitivity analyses. The licensee indicated that through the responses to SSA RAI 03 and PRA RAI 01.g.01, OPPD had systematically reviewed its use of cable routing assumptions and demonstrated, with one exception, that the underlying assumptions were either appropriately eliminated (i.e., via walkdown to verify the precise routing), or they were evaluated and determined to pose a negligible source of uncertainty to the FPRA. The review identified one fire scenario in which examining credible cable routes added a component failure that had not been included in the base FPRA quantification. This scenario was re-quantified with the additional failure, and it was demonstrated that the CDF, LERF, ΔCDF, and ΔLERF remain within the RG 1.174, Revision 1, acceptance criteria. Based on the information provided by the licensee, the NRC staff concludes that the licensee's treatment of those cable routing assumptions for identified cables evaluated in the response is acceptable.

3.2.1.2 Attribute Alignment -- Aligns with Intent

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

- *3.1.1.3*
- *3.1.1.5*
- *3.1.1.9*
- *3.1.2.4*
- *3.1.2.5*
- *3.2.1.4*
- *3.2.2.1*
- *3.2.2.2*
- *3.2.2.3*
- *3.4.1.3*
- *3.4.1.5*
- *3.4.1.7*
- *3.4.2.4*

For the elements listed as "aligns with the intent" of the guidance from NEI 00-01, the following is a review of the alignment as applied by the licensee:

- 3.1.1.3 **Criteria/Assumptions.** NEI 00-01 contains guidance that hot shutdown can be maintained without the use of pressurizer heaters. [PWR] Generic Letter 86-10, Enclosure 2, Section 5.3.5 specifies that hot shutdown can be maintained without the use of pressurizer heaters (i.e., pressure control is provided by controlling the makeup/charging pumps). Hot shutdown conditions can be maintained via natural circulation of the reactor coolant system (RCS) through the steam generators. The cooldown rate must be controlled to prevent the formation of a bubble in the reactor head. Therefore, feedwater (either auxiliary or emergency) flow rates as well as steam release must be controlled. Although NEI 00-01 contains guidance that hot shutdown can be maintained without the use of pressurizer heaters, the licensee has design features and procedures to ensure that an adequate source of heat input is maintained for RCS pressure control in sustained Mode 3 (Hot Shutdown Condition) utilizing available combinations of the backup pressurizer heaters. Where the requirement of pressurizer heater input capability cannot be met, the loss of backup pressurizer heater capability is identified as a Variance from the Deterministic Requirement (VFDR) of NFPA 805, Section 4.2.3, which are identified, dispositioned, and documented in LAR Attachment C. The NRC staff concluded that the methods described by the licensee for when pressurizer heaters are available are better than the specific methods in NEI 00-01 since plant operations can be maintained within the envelope of normal RCS operations. When pressurizer heaters are not available, the variance has been addressed using RI/PB methods, which the NRC staff concludes is an acceptable approach.

- 3.1.1.5 **Criteria/Assumptions.** NEI 00-01 contains guidance that at the onset of the postulated fire, all safe shutdown systems (including applicable redundant trains) are assumed operable and available for post-fire safe shutdown, that systems are assumed to be operational with no repairs, maintenance, testing, or Limiting Conditions for Operation in progress, and that the units are assumed to be operating at full power under normal conditions and normal lineups. The licensee has indicated that systems are assumed to be operational with no repairs, maintenance, testing, or with a Limiting Conditions for Operation, in progress and that in cases where the status of equipment is "indeterminate or could change as a result of expected plant conditions, worst-case initial conditions are assumed for the purpose of cable selection." The assumptions used in the engineering analysis for the initial plant equipment status sufficiently meet the intent of NEI 00-01 Section 3.1.1.5 Criteria. The NRC staff concluded that the methods described by the licensee are conservative with respect to the specific methods in NEI 00-01 since the licensee's method would include components and cables that might otherwise not require inclusion, and therefore align with the intent of NEI 00-01.

- 3.1.1.9 **Criteria/Assumptions.** NEI 00-01 contains guidance that post-fire SSA assumes a 72-hour coping period starting with a reactor scram/trip. The 72-hour requirement is not provided in NFPA 805. The licensee has provided in the LAR, as supplemented, sufficient analysis to ensure success path availability in accordance with the NSCA performance goals as required in NFPA 805. Although a "coping time" of 24 hours is stated by the licensee, sufficient explanation has been provided to clarify that for staff and resource capability as supplemented using the Emergency Response Organization (ERO), the plant is sufficiently capable of supporting "safe and stable" conditions as necessary to sustain Mode 3 (Hot Shutdown Condition), beyond 24 hours, or to assess the extent of fire damage, and assist the plant operating staff with implementation of cold shutdown actions and/or cold shutdown repairs for the plant to transition to, and enter, Mode 4 (Cold Shutdown Condition). The NRC staff concluded that the methods described by the licensee are sufficiently similar to the specific methods in NEI 00-01 and, more importantly, consistent with the requirements of NFPA 805 which is acceptable.

- 3.1.2.4 **Decay Heat Removal.** NEI 00-01 contains guidance for selecting systems capable of removing sufficient decay heat from the reactor to reach cold shutdown conditions. The licensee provided adequate system availability and capacity to provide the adequate decay heat removal modeled in the engineering analysis to meet the performance goal in NFPA 805. Core decay heat in the Mode 3 (Hot Shutdown Condition) will be rejected to the secondary plant through one or both of the steam generators, and then to atmosphere through the main steam safety relief valves operating as spring relief valves. Achieving cold shutdown is not a requirement of NFPA 805. The NRC staff concluded that the methods described by the licensee are sufficiently similar to the specific methods in NEI 00-01 to therefore align with the intent of NEI 00-01 and are also consistent with the safe and stable requirements of NFPA 805.

- 3.1.2.5 **Process Monitoring.** NEI 00-01 contains guidance for choosing appropriate instrumentation for process monitoring. The licensee stated that in general, instruments required for the safe shutdown model were directly associated with the component, system, or performance goal that the instrument supports. The licensee stated the process instrumentation availability to ensure adequate monitoring of the safe shutdown process in the analysis to meet the performance goals in NFPA 805 (reactor coolant hot- and cold-leg temperatures, pressurizer pressure and level, neutron flux, steam generator level and pressure, and Emergency Feedwater Storage Tank (EFWST) level). Where some tank level indications were not available, analysis was provided to demonstrate availability by reliance on:

  - Starting inventory controlled by TSs for the Safety Injection Refueling Water Tank (SIRWT) (72 hours), Condensate Storage Tank (CST) (minimum 75,000 gallons), Diesel Generator (DG) Fuel Oil Tank (7 days), and Auxiliary Boiler Fuel Oil Tank (7 days);

- Modeled automatic refill/replenishment availability for DG Fuel Oil Day Tank, Auxiliary Fuel Oil Tank, and AFW Diesel Day Tank, with low level alarm annunciation in the control room and/or;

- Adequate shutdown margin in the Boric Acid Storage Tank (BAST) to assure performance goals were met.

The NRC staff concluded that the methods described by the licensee are acceptable since they are sufficiently similar to the specific methods in NEI 00-01, and therefore align with the intent of NEI 00-01.

- 3.2.1.4 **Criteria/Assumptions.** NEI 00-01 provides guidance that a check valve closes in the direction of potential flow diversion and seats properly with sufficient leak tightness to prevent flow diversion. Therefore, check valves do not adversely affect the flow rate capability of the safe shutdown systems being used for inventory control, decay heat removal, equipment cooling or other related safe shutdown functions. The licensee indicated that valves and dampers constituting system boundaries were included in the Safe Shutdown Equipment List (SSEL). Normally closed manual valves and properly oriented check valves credited as system boundaries are not required to be listed in the SSEL. The NRC staff concluded that the methods described by the licensee are conservative with respect to the specific methods in NEI 00-01, and therefore align with the intent of NEI 00-01.

- 3.2.2.1 **Identify the System Flow Path for Each Shutdown Path.** NEI 00-01 indicates the licensee should mark up and annotate a Piping & Instrumentation Drawings (P&ID) to highlight the specific flow paths for each system in support of each shutdown path. The process of equipment selection used by the licensee was based upon plant P&IDs. The validation activity was performed through a review of flow paths for systems and system boundaries. The licensee indicated that even though P&IDs were not marked up, the process for identification of the equipment and associated flow paths and the subsequent validation activity used P&IDs. The methodology aligns with the intent of the guidance to ensure that system lineups are verified using the appropriate drawings. The NRC staff concluded that the methods described by the licensee are sufficiently similar to the specific methods in NEI 00-01, and therefore align with the intent of NEI 00-01.

- 3.2.2.2 **Identify the Equipment in Each Safe Shutdown System Flow Path Including Equipment That May Spuriously Operate and Affect System Operation.** NEI 00-01 contains guidance to review applicable documentation (e.g. P&IDs, electrical drawings, instrument loop diagrams) to assure that all equipment in each system's flow path has been identified and to designate these new systems with the same safe shutdown path as the primary safe shutdown system under review. However, the licensee indicated that multiple safe shutdown paths typically credit different combinations of redundant safe shutdown systems, with the result that most systems are assigned to more than one safe shutdown path. The methodology and documentation aligns with the

intent of the guidance to ensure that system lineups, equipment, including potential spurious impacts were verified using the appropriate drawings. The NRC staff concluded that the methods described by the licensee are sufficiently similar to the specific methods in NEI 00-01, and therefore align with the intent of NEI 00-01.

- 3.2.2.3 **Develop a List of Safe Shutdown Equipment and Assign the corresponding System and Safe Shutdown Path(s) Designation to Each.** NEI 00-01 contains guidance that the equipment used to perform safe shutdown be appropriately identified and incorporated into the analysis such that individual equipment is assigned to a shutdown path to ensure the path is sequenced with the correct combination of components and support systems to ensure shutdown paths are retained. However, the licensee indicated that multiple safe shutdown paths typically credit different combinations of redundant safe shutdown systems, with the result that most systems are assigned to more than one safe shutdown path. The methodology used by the licensee aligns with the intent of the guidance to ensure that equipment and system lineups are verified using the appropriate drawings. The NRC staff concluded that the methods described by the licensee are sufficiently similar to the specific methods in NEI 00-01, and therefore align with the intent of NEI 00-01.

- 3.4.1.3 **Criteria/ Assumptions.** NEI 00-01 contains guidance to address all cable and equipment impacts affecting the required safe shutdown path in the fire area and that all potential impacts within the fire area must be addressed. In addition, the guidance states that the focus is to determine and assess the potential impacts to the required safe shutdown path selected for achieving post-fire safe shutdown and to assure that the required safe shutdown path for a given fire area is properly protected. The licensee stated that to resolve the deterministic analysis for each fire area, the analyst first reviews the initial area results to determine the least affected electrical distribution and mechanical support systems and then identifies the key equipment and cable failures associated with these electrical distribution and mechanical support systems that must be addressed to recover a least one train of these systems. The licensee further stated that these key failures are further analyzed to determine the true nature of the fire impact and that this process does not require the analyst to address every safe shutdown equipment and/or cable failure in the area. The licensee further stated that the analyst is only required to address the minimum set of fire affected safe shutdown equipment and/or cable to demonstrate the availability of one safe shutdown success path for each performance goal, based on the possible combinations allowed through logical safe shutdown model and that the methodology aligns with the intent of the guidance to ensure that equipment and system lineups are verified using the appropriate drawings. The NRC staff concluded that the methods described by the licensee are sufficiently similar to the specific methods in NEI 00-01, and therefore align with the intent of NEI 00-01.

- 3.4.1.5 **Criteria/Assumptions.** NEI 00-01 contains guidance to achieve and maintain cold shutdown within 72 hours, with the use of repairs to equipment

required in support of post-fire shutdown. NFPA 805 does not require the licensee to achieve and maintain cold shutdown. The licensee has, by analysis, demonstrated the ability to achieve and maintain safe and stable (Mode 3). The NRC staff concluded that the methods described by the licensee are sufficiently similar to the specific methods in NEI 00-01 and, more importantly, consistent with the requirements of NFPA 805, which is acceptable.

- 3.4.1.7 **Criteria/Assumptions.** NEI 00-01 contains guidance to consider selecting other equipment that can perform the same safe shutdown functions as the impacted equipment. The licensee provided a written description of the FCS NFPA 805 NSPC performance goals, systems, and equipment that constitute the NFPA 805 NSPC model. The licensee also identified the plant equipment that has been modeled based on the potential for adverse impact to safe and stable plant operation resulting from one or more spurious operation(s). Component selection at FCS provided selected equipment and systems used to meet the performance goals, systems, and equipment of NFPA 805 including equipment that could impose potential adverse impacts. The NRC staff concluded that the methods described by the licensee are sufficiently similar to the specific methods in NEI 00-01, with the exception of the terminology used and the success criteria, which are specific to NFPA 805, and therefore align with the intent of NEI 00-01.

- 3.4.2.4 **Develop a Compliance Strategy or Disposition to Mitigate the Effects Due to Fire Damage to Each Required Component or Cable.** The intent of this section of NEI 00-01 is to provide a list of valid compliance strategies that can be used to address fire impacts in accordance with the deterministic separation criteria in Appendix R. The available deterministic methods in NEI 00-01 for mitigating the effects of circuit failures are summarized as specific to Appendix R, Section III.G.2.d, e, and f and Generic Letter 86-10 (Reference 66). The licensee stated in LAR Table B-2 Section 3.4.2.4 that cable resolutions may typically include compliance with the deterministic requirements of NFPA 805, Section 4.2.3 (which are essentially identical to those in Appendix R, Section III.G.2) or the performance-based requirements of 4.2.4 as applicable. The licensee's description of the process is sufficient to address the protection schemes available in accordance with NFPA 805 requirements. The NRC staff concluded that the methods described by the licensee are sufficiently similar to the specific methods in NEI 00-01, and therefore align with the intent of NEI 00-01.

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

The licensee did not identify any attributes in this category in LAR Table B-2.

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

The licensee did not identify any attributes in this category in LAR Table B-2.

3.2.1.5 Attribute Alignment -- Not in Alignment

The licensee did not identify any attributes in this category in LAR Table B-2.

3.2.1.6 NFPA 805 Nuclear Safety Capability Assessment Methods Conclusion

The NRC staff reviewed the documentation provided by the licensee describing the process used to perform the NSCA required by NFPA 805, Section 2.4.2. The licensee performed this evaluation by comparing the FCS post-fire SSA against the NFPA 805 NSCA requirements using NEI 00-01, Revision 1 with a gap analysis to the NRC-endorsed process in Chapter 3 of NEI 00-01, Revision 2. The results of the review are documented in the B-2 Table in accordance with NEI 04-02, Revision 2 and the gap analysis of NEI 00-01, Revision 2 was addressed in the response to SSA RAI 01 (Reference 10). 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, or
- Met the intent of the endorsed guidance and adequate justification was provided.

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 (Reference 62), as well as, in part NEI 00-01, Chapter 3, since NFPA 805 only requires the licensee to maintain the fuel in a safe and stable condition rather than achieve and maintain cold shutdown. The licensee stated that the NFPA 805 licensing basis for FCS is to achieve and maintain safe and stable Hot Shutdown Conditions (Mode 3). The licensee stated that safe and stable conditions can be maintained for an initial 24-hour coping time with minimum plant operating shift staff and based on the design capacity of selected systems. The 24-hour coping time has been selected by the licensee based on the design capacity for the backup nitrogen supply for control of the turbine-driven AFW pump. The licensee further stated that the 24-hour coping period allows for the FCS ERO to respond, with adequate time to muster, assess the extent of fire damage, and assist plant staff with actions to sustain hot standby or alternatively to assist the plant operating staff with any necessary repairs and actions to transition and proceed to cold shutdown (Mode 4) if necessary.

In support of sustained Mode 3 operations, the licensee described in LAR Section 4.2.1.2 that FCS design features and plant operating procedures provide the capability to sustain Mode 3 conditions beyond 24 hours. Actions required to sustain hot shutdown conditions, beyond 24 hours include actions to assume local manual control of the turbine-driven AFW pump, and provide diesel fuel oil for the emergency diesel generator and/or the diesel driven AFW pump, as necessary, for those fire areas where offsite power is not free of fire damage, and/or where the diesel driven AFW pump is credited for NFPA 805 safe shutdown. By letter dated July 24, 2012, in response to SSA RAI 02 (Reference 10), the licensee identified manual operator

actions required to maintain safe and stable conditions directed by existing FCS operating procedures, which may be required within 24 hours. These actions include:

- Refill of the EFWST controlled by procedure within approximately 8 hours.

- Loss of instrument air controlled by procedure within approximately 4 hours to isolate flow through the condensate makeup control valve to prevent CST drain-down into the hotwell (only necessary when the CST is used with the diesel-driven AFW pump).

- Loss of instrument air, controlled by procedure within 12 hours to prevent a recirculation actuation signal from a spurious SIRWT low level signals. In the response to SSA RAI 02 (Reference 10), the licensee corrected the LAR to exclude this item because the MCR operator is provided with the capability to prevent a recirculation actuation signal without a field action.

The FCS NFPA 805 NSCA included assessment of the fire impact upon the FCS plant systems and features that are required to achieve and maintain Mode 3. Additional detail regarding safe and stable plant operation for the FCS NFPA 805 NSCA included:

- FCS has design features and procedures to ensure that an adequate source of inventory is provided for decay heat removal in sustained Mode 3 conditions by retaining EFWST refill capability from raw water for the motor-driven AFW pump and the turbine-driven AFW pump, and/or alternate water supply for the diesel-driven AFW pump from the main condenser upon depletion of the CST. The licensee stated dated July 24, 2012 (Reference 10), that the FPRA models human failure to refill the EFWST prior to its depletion within approximately 8 hours following a complete loss of main feedwater. The CDF, LERF, ΔCDF, and ΔLERF results reported in the LAR include failure to perform this action. This is an abnormal action directed by an abnormal operating procedure.

- Core decay heat in Mode 3 will be rejected to the secondary plant through one or both of the steam generators, and then to atmosphere through the main steam safety relief valves operating as spring relief valves.

- The FCS reactor core design ensures that Keff is maintained <0.99 while the plant is in sustained hot shutdown condition. Consequently, maintaining the "safe and stable" plant condition for NFPA 805 will not require boration of the RCS. Gravity insertion of the control rods into the reactor core will ensure reactivity control is achieved and maintained for Mode 3.

- Inventory makeup to the RCS may only be required to account for expected leakage and minimal shrinkage. FCS has design features and procedures to ensure that an adequate source of borated inventory is provided for RCS inventory control in sustained Mode 3 by providing inventory makeup from the SIRWT and/or the BASTs to maintain the RCS subcooled utilizing the chemical and volume control system (CVCS) or the high-pressure safety injection (HPSI) system.

- FCS has design features and procedures to ensure that an adequate source of heat input is maintained for RCS pressure control in sustained hot shutdown using a minimum of 150 kiloWatt (kW) of pressurizer heater input to maintain the RCS sub-cooled with available combinations of the backup pressurizer heaters. The backup pressurizer heaters are capable of being energized from emergency diesel generator power.

LAR Attachment S, Implementation Items REC-096, REC-097, REC-106, REC-139, and REC-140 (Reference 23) address update of post-fire operating procedures, engineering analysis, and associated training necessary to include these NSCA strategies. These implementation items are included as part of the proposed fire protection license condition.

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

3.2.3 Applicability of Feed and Bleed

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 PWRs is not permitted.

The NRC staff reviewed LAR Table 5-3, "10 CFR 50.48(c) – Applicability/Compliance References," and Attachment C, "NEI 04-02 Table B-3 – Fire Area Transition," to evaluate whether FCS meets the feed and bleed requirements. The licensee stated in LAR Table 5-3 that feed and bleed is not utilized as the sole fire protected safe shutdown methodology. The NRC staff reviewed the designated safe shutdown path(s) listed in LAR Attachment C for each fire area. This review confirmed that all fire area analyses include the safe shutdown equipment necessary to provide decay heat removal without relying on feed and bleed. In addition, all fire areas either met the deterministic requirements of NFPA 805, Section 4.2.3, or the PB evaluation performed in accordance with NFPA 805, Section 4.2.4, demonstrated that the integrated assessment of risk, DID, and safety margin for the fire area was acceptable. Therefore, the NRC staff determined that based on the information provided in LAR Table 5-3 as well as the fire area analyses documented in LAR Attachment C, the licensee meets the requirements of 10 CFR 50.48(c)(2)(iii) because feed and bleed is not utilized as the sole fire-protected safe shutdown path at FCS.

3.2.4 Assessment of Multiple Spurious Operations

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

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

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

Accordingly, the NRC staff reviewed LAR Section 4.2.1.4, "Evaluation of Multiple Spurious Operations," and Attachment F, "Fire-Induced Multiple Spurious Operations Resolution," to determine whether the licensee has adequately addressed MSO concerns at FCS.

As described in the LAR, the licensee's process for identification and evaluation of MSOs used an expert panel and followed the guidance of NEI 04-02, RG 1.205, and FAQ 07-0038, "Lessons Learned on Multiple Spurious Operations," Revision 3. The expert panel used by the licensee consisted of subject matter experts with education and experience in electrical engineering, FPRA, PRA, HRA, SSA, fire protection, system engineering, and plant operations.

Attachment F to the LAR states the licensee conducted an initial expert panel review in 2009 and a second review in 2010. Prior to initial review, the panel was provided with training for conducting the review. The expert panel sources for identifying MSOs included the SSA, generic lists (e.g., from Owners Groups), self-assessment results, PRA insights, and operating experience. The results of the initial review were integrated into the NSCA and FPRA. The second review panel dispositioned open items from the initial expert panel review and addressed new MSOs identified since the initial review. In 2009, the MSO report was developed to include the integration of the results into FCS NSCA engineering analysis, SSA, and the FPRA model. An additional update to the MSO list in January 2010 incorporated the disposition of open items and issues of the May 2009 Expert Panel MSO report.

As described in LAR Attachment F, under the results for Steps 3, 4, and 5, the MSOs identified in Steps 1 and 2 were incorporated in the FPRA model. The MSO combination components of concern were then evaluated for inclusion into the FCS NSCA. As necessary, components were added to the NSCA Equipment List and Logics; and circuit analysis and cable routing was performed. For cases where the MSO combination components did not meet the requirements for deterministic compliance, the MSO combination components were added to the scope of the RI/PB risk evaluations. The FCS FPRA quantified the fire-induced risk model containing the MSO pathways. The MSO contribution is included in the FPRA results.

The NRC staff reviewed the licensee's expert panel process for identifying circuits susceptible to MSOs as described above and concluded that the licensee adopted a systematic and comprehensive process for identifying MSOs to be analyzed utilizing available industry guidance. The process used provides reasonable assurance that the FRE appropriately identifies and includes risk-significant MSO combinations. Based on the information provided by the licensee in the LAR, the documents reviewed during the site audit (Reference 107 contains the audit summary), and the discussions with the licensee's staff during the site audit, the NRC staff concluded that the licensee's approach for assessing the potential for MSO combinations is acceptable for use at FCS.

3.2.5 Establishing Recovery Actions

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

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

NFPA 805, Section 4.2.3.1 states that:

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

NFPA 805 Section 4.2.4, "Performance-Based Approach," states the following:

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

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

The licensee based its approach for transitioning operator manual actions (OMAs) into the 10 CFR 50.48(c) RI/PB FPP as RAs on NEI 04-02, Revision 2, Section 4.6, "Regulatory Submittal and Transition Documentation," as endorsed with exceptions by RG 1.205, Revision 1 and the guidance of FAQ 07-0030, "Establishing Recovery Actions," Revision 5 (Reference 45).

The population of OMAs addressed during the NFPA 805 transition process at FCS included the existing OMAs in the deterministic FPP, as well as those being added based on the VFDRs identified in the individual fire area assessments. FCS has three panels designated as primary control stations (PCS) as defined in RG 1.205. They are:

- AI-179, Emergency Auxiliary Feedwater Panel (located in the upper electrical penetration room, fire area 34B-1),
- AI-185, Alternate Shutdown Panel (located in the upper electrical penetration room, fire area 34B-1), and
- AI-212, Wide-Range Flux Panel (located in the upper electrical penetration room, fire area 34B-1).

Activities necessary to enable the PCS are also identified in LAR Table G-1 as PCS activities. These activities do not require the treatment of additional risk and are considered in the risk associated with the off-normal procedures in which they are used.

OMAs meeting the definition of a RA are required to comply with the NFPA 805 requirements outlined above. RAs were evaluated by the licensee, against the feasibility criteria provided in the NEI 04-02, FAQ 07-0030, and RG 1.205. Because actions taken at the PCS are not RAs, their feasibility is evaluated in accordance with procedures for validation of off-normal procedures. LAR Attachment G, "Results of Step 4" lists the criteria used in the feasibility evaluation.

The licensee identified that for fire area 42 (MCR), the RAs that implement the alternate shutdown strategy have been credited for reduction in risk, and have been incorporated in the FPRA quantification for this fire area. The reliability of these RAs has been evaluated in the FPRA quantification for this fire area utilizing a bounding approach for the entirety of the alternate shutdown strategy, evaluated for feasibility, and for adverse risk impact. The NFPA 805 RA feasibility assessment was based on a documentation review only. A confirmatory field verification walk-through of the feasibility for the credited NFPA 805 RAs will be performed and documented as part of LAR Attachment S, Implementation Item REC-106 (Reference 23).

The licensee indicated that 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 the DID considerations described in Section 1.2 of NFPA 805. In LAR Attachment C, Table B-3, (Reference 6) for fire area 41 (cable spreading room), the RAs that implement the alternate shutdown strategy were credited for DID only and were not credited in the FPRA quantification (for risk reduction) However, in a letter dated February 28, 2014 (Reference 22), the licensee provided a revised LAR Attachment C, Table B-3 which indicated that the RAs credited for fire area 41 had changed from DID to risk reduction. Subsequently, in a letter dated June 11, 2014 (Reference 106), the licensee provided revised portions of LAR Attachment C, Table B-3, which indicated that the RAs credited for fire area 41 had changed from risk reduction back to DID. For fire areas 32 (Compressor Area), 34B-1 (Electrical Penetration Area/ QA Vault), and 36B (West Switchgear Area), recovery actions have also been credited for DID only. The DID measures have been

conservatively maintained to provide plant operations with written procedures. These actions will enhance echelon #3 of DID, to provide some assurance that one success path of safe shutdown capability can be restored in the event that echelon #1 and echelon #2 of DID are somehow degraded or rendered ineffective.

Based on the above, the NRC staff concludes that the licensee has followed the endorsed guidance of NEI 04-02 and RG 1.205 to identify and evaluate RAs in accordance with NFPA 805, and has provided information to assure that the regulatory requirements of 10 CFR 50.48(c) are met. The NRC staff concludes that the feasibility criteria applied to RAs are acceptable based on the licensee's conformance with the endorsed guidance contained in NEI 04-02 and successful completion of identified Implementation Items REC-106, REC-135, and REC-139 in Attachment S (Reference 23).

3.2.6 Plant-Specific Treatments or Technologies

The licensee uses an existing incipient fire detection system in their FPP for air sampling detection in fire area 43 (Service and EFWST Area). However, this is identified in LAR Table 4-3 as a required fire protection system for engineering evaluation and DID but not credited for risk reduction.

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 at FCS. First, the NRC staff concluded that the safe and stable condition, proposed by the licensee, is acceptable. Second, the NRC staff concluded that the licensee's process is adequate to appropriately identify and locate the systems, equipment, and cables required to provide reasonable assurance of achieving and maintaining the fuel in a safe and stable condition, as well as to meet the NSPC of NFPA 805, Section 1.5. In addition, the licensee has identified Implementation Items REC-096, REC-097, REC-139, and REC-140 (Reference 23) that must be completed to bring the NSCA into alignment with the requirements of NFPA 805.

The NRC staff reviewed the documentation provided in the LAR to confirm that feed and bleed was not the sole fire-protected safe shutdown 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 reviewed the licensee's process to identify and analyze MSOs. Based on the information provided in the LAR, as supplemented, the NRC staff concludes that the process used by the licensee to identify and analyze MSOs at FCS is comprehensive and thorough. Through the use of an expert panel process in accordance with RG 1.205, NEI 04-02, and FAQ 07-0038, potential MSO combinations were identified and included as necessary into the NSCA as well as the applicable fire risk evaluations. The NRC staff concludes that the licensee's approach for assessing the potential for MSO combinations acceptable because it was performed in accordance with NRC-endorsed guidance and should result in all risk-significant combinations of MSOs being included in the FREs performed as required by NFPA 805 Section 2.4.3.2.

The NRC staff concluded 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) the process used by the licensee to review, categorize and address RAs during the transition from the existing deterministic fire protection licensing basis to an 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 RA provided in NFPA 805 Section 1.6.52. The licensee must complete LAR Attachment S, Implementation Items REC-106, REC-135, and REC-139 (Reference 23), by the end of the implementation window. Upon completion of these implementation items, which are included in the proposed fire protection license condition, the NRC staff concludes that this process, as described by the licensee, is acceptable to assure that the requirements of 10 CFR 50.48(c) and NFPA 805 are met.

3.3 Fire Modeling

NFPA 805 (Reference 4) allows both Fire Modeling 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 fire modeling and FRE are presented as two different approaches for PB compliance, the FRE approach generally involves some degree of fire modeling to support engineering analyses and fire scenario development. NFPA 805, Section 1.6.18, defines a fire model as a "mathematical prediction of fire growth, environmental conditions, and potential effects on structures, systems, or components based on the conservation equations or empirical data."

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

In LAR Section 4.5.2.1, the licensee stated that the fire modeling approach, per NFPA 805 Section 4.2.4.1, was not used for the FCS NFPA 805 transition. The licensee used the FRE PB method (i.e., FPRA) with input from fire modeling analyses. Therefore, the NRC staff reviewed the technical adequacy of the FCS FREs, including the supporting fire modeling analyses, as documented in Section 3.4.2 of this SE, to evaluate compliance with the NSPC.

The licensee did not propose any fire modeling 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 firemodeling methods acceptable for use to support compliance with NFPA 805, Section 4.2.4.1, as part of this licensing action supporting the transition to NFPA 805 at FCS.

3.4 Fire Risk Assessments

This section addresses the licensee's FRE PB method, which is based on NFPA 805, Section 4.2.4.2. The licensee chose to use only the fire risk evaluation PB method in 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 the following:

> Use of fire risk evaluation for the performance-based approach shall consist of an integrated assessment of the acceptability of risk, defense-in-depth, and safety margins.
>
> The evaluation process shall compare the risk associated with implementation of the deterministic requirements with the proposed alternative. The difference in risk between the two approaches shall meet the risk acceptance criteria described in NFPA 805, Section 2.4.4.1 ["Risk Acceptance Criteria"]. The fire risk shall be calculated using the approach described in NFPA 805, Section 2.4.3 ["Fire Risk Evaluations"].

3.4.1 Maintaining Defense-in-Depth and Safety Margin

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

3.4.1.1 Defense-in-Depth

NFPA 805, Section 1.2, states the following:

> Protecting the safety of the public, the environment, and plant personnel from a plant fire and its potential effect on safe reactor operations is paramount to this standard. The fire protection standard shall be based on the concept of defense-in-depth. Defense-in-depth shall be achieved when an adequate balance of each of the following elements is provided:
>
> (1) Preventing fires from starting.
>
> (2) Rapidly detecting fires and controlling and extinguishing promptly those fires that do occur, thereby limiting fire damage.
>
> (3) Providing an adequate level of fire protection for structures, systems, and components important to safety, so that a fire that is not promptly extinguished will not prevent essential plant safety functions from being performed.

The NRC staff reviewed LAR Section 4.2.4, "Fire Area Transition," Section 4.5.2.2, "Fire Risk Approach," Section 4.8.1, "Results of the Fire Area Review," and Attachment C Table B-3,

"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.

When implementing the PB approach, the licensee followed the guidance contained in Section 5.3, "Plant Change Process," of NEI 04-02, which includes a detailed consideration of DID and safety margin as part of the change process. The license documented the method used to meet the DID requirements of NFPA 805 in LAR Attachment C Table B-3. LAR Table 4-3 and LAR Attachment C Table B-3 document the results of the licensee's review of fire suppression and fire detection systems at FCS.

This method for addressing DID was implemented in the FREs performed on each PB fire area. The FREs evaluate VFDRs using an integrated assessment of risk, DID, and safety margin. Accordingly, as described in the response to PRA RAI 9 (Reference 10), each performance-based fire area FRE includes a table documenting the review of DID. The table (1) documents the fire protection systems/features required to either meet the deterministic criteria of NFPA 805 Section 4.2.3 or to support the FPRA, (2) notes whether changes or improvements are necessary for each fire protection system/feature to maintain a balance among the DID echelons, and (3) provides a justification or basis for why the required fire protection systems/features are adequate for DID. As such, the table in the FRE is the licensee's internal record of the systems required to meet the NSPC and DID requirements of NFPA 805.

Based on its review of the response to PRA RAI 9 (Reference 10), and a sample of the FREs during its audit of the FCS NFPA 805 transition RI/PB FPP, 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 Margin

NFPA 805 Section 2.4.4.3 states the following:

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

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

- Codes and Standards or their alternatives accepted for use by the NRC are met, and,

- Safety analyses acceptance criteria in the licensing basis (e.g., FSAR [final safety analysis report] and supporting analyses) are met, or provides sufficient margin to account for analysis and data uncertainty.

LAR Section 4.5.2.2, "Fire Risk Approach," states that safety margin was considered as part of the FRE process and that each retained VFDR was evaluated against the safety margin criteria

of NEI 04-02 and RG 1.205. An FRE was performed for each fire area containing VFDRs. The FREs contain the details of the licensee's review of safety margin for each PB fire area.

By letter dated July 24, 2012, in response to PRA RAI 10 (Reference 10), the licensee further described the methodology used to evaluate safety margin in the FREs to include the following evaluations and determinations:

- Fire protection systems and features determined to be required by NFPA 805 Chapter 4 have been confirmed to meet the requirements of NFPA 805 Chapter 3, and their associated referenced codes and listings, or provided with acceptable alternatives using processes accepted by the NRC (i.e., FAQ 06-0008, FAQ 06-0004, FAQ 07-0033).

- The FPRA, including supporting fire modeling, was developed in accordance with NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities," and 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."

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 and, therefore, acceptable. Based on its review of the LAR and the response to PRA RAI 10 (Reference 10), and a sample of the FREs during its audit of the FCS NFPA 805 transition RI/PB FPP, the NRC staff concludes that the licensee's approach has adequately addressed the issue of safety margin in the implementation of the FRE process.

3.4.1.3 Defense-in-Depth and Safety Margin Conclusion

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

3.4.2 Quality of the Fire Probabilistic Risk Assessment

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

Attachment U, "Internal Events PRA Quality," Attachment V, "Fire PRA Quality," and Attachment W, "Fire PRA Insights."

The licensee developed its internal events PRA during the Individual Plant Examination process and continued to maintain and improve the PRA as RG 1.200, "An Approach For Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," and supporting industry standards have evolved. The licensee developed its FPRA model 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 internal events PRA model to capture the effects of fire.

According to the PRA RAI 12 response dated July 24, 2012 (Reference 10), the licensee did not identify any known outstanding plant changes that would require a change to the FPRA model, or any planned plant changes that would significantly impact the PRA model beyond those identified and scheduled to be implemented as part of the transition to an FPP based on NFPA 805. Based on this information, the NRC staff concludes that the FPRA model for FCS meets the criteria, that it 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.

The licensee identified administrative controls and processes used to maintain the FPRA model current with plant changes and to evaluate any outstanding changes not yet incorporated into the PRA model for potential risk impact as a part of the routine change evaluation process. Further, as described in SE Section 3.8.3, the licensee has a program for ensuring that developers and users of these models are appropriately trained and qualified. Therefore, the NRC staff concludes that the PRA should be capable of supporting post-transition PCEs to support, for example, the self-approval process, after any changes required during implementation are completed.

3.4.2.1 Internal Events PRA Model

The licensee's evaluation of the technical adequacy of the portions of the internal events PRA model used to support development of the FPRA model included a combination of peer reviews and gap assessments. The FCS internal events PRA full scope peer review was performed in 1999 by the Westinghouse and the Combustion Engineering Owners Group (CEOG) peer review using NEI 00-02 (Reference 63), which pre-dated the ASME/ANS PRA standard and RG 1.200. An independent gap assessment was performed in 2006 using the draft ASME RA-Sb-2005 (Reference 64) version of the PRA standard and RG 1.200 (for trial use) (Reference 65) to identify any gaps to meeting the supporting requirements (SRs). SRs are detailed, focused statements of "good PRA practice" which, collectively, comprise what is deemed satisfactory for a technically adequate PRA. A focused-scope peer review of the flooding analysis was performed in 2008, following an upgrade of the FCS internal flooding PRA model, using the ASME RA-Sb-2005 version of the PRA standard, as endorsed by RG 1.200, Revision 1 (Reference 67). A gap assessment was also performed in 2013, based on Revision 11 of the PRA, as given in the response to PRA RAI 14.01 dated April 23, 2013 (Reference 13), using the combined standard, ASME/ANS RA-Sa-2009, and RG 1.200, Revision 2. This gap assessment was performed for 1) all SRs with a grade less than Capability Category II (CC-II) or "not met," 2) all SRs that had not been previously assigned a

grade, and 3) all SRs where there were text changes between the different versions of the PRA standard and RG 1.200. Lastly, another focused-scope peer review was performed in February 2013 on the HRA and LERF portions of the internal events PRA model, as given in the response to PRA RAI 18.01 dated May 21, 2013 (Reference 14), using the combined standard, ASME/ANS RA-Sa-2009, and RG 1.200, Revision 2.

As discussed by the licensee in the response to RAI 15.c dated July 24, 2012 (Reference 10), Revision 12 of the licensee's PRA included updated component boundary definitions and would, therefore, be included in the final PRA implemented in the NFPA 805 application. Subsequently, in a letter dated June 11, 2014 (Reference 106), the licensee stated that it has issued PRA model Revision 13, which also includes the component boundary definitions found in Revision 12. The licensee stated that Revision 13 of the PRA will be included in the PRA as part of the NFPA 805 implementation.

Within each SR, there are three Capability Categories, where each Capability Category addresses the degree of scope and level of detail, the degree of plant specificity, and the degree of realism. Capability Category I is the minimum, II is considered widely acceptable, and III represents the state-of-the-art. For each SR, a PRA reviewer (in the peer review or gap assessment) assigns a particular Capability Category or a rating which represents a requirement which spans several Capability Categories, as may be represented by simply using the term "met".

LAR Attachment U, as supplemented on December 22, 2011 (Reference 8), and the response to PRA RAIs 14.01 dated April 23, 2013 (Reference 13), and 18.01 dated May 21, 2013 (Reference 14), provides the licensee's dispositions to all Level A (important and necessary to address before the next regular PRA update) and Level B (important and necessary to address, but disposition may be deferred until the next PRA update) facts and observations (F&Os) from the 1999 CEOG peer review and 2006 independent gap assessment, and all F&O findings from the 2008 and 2013 focused-scope peer reviews. In general, an F&O is written for any SR that does not fully satisfy the associated Capability Category II requirements of the combined ASME PRA standard. In addition, the licensee provided the basis of acceptability of all SRs that were evaluated to be either "not met" or meeting Capability Category I (CC-I) from the 2013 gap assessment.

As described in LAR Attachment U, as supplemented (Reference 8), and in the responses to PRA RAIs 14.01 (Reference 13) and 18.01 (Reference 14), the licensee dispositioned each F&O by either providing a description of how the F&O was resolved or providing an assessment of the impact of resolution of the F&O on the FPRA and the results for the NFPA 805 application. The NRC staff evaluated each F&O and the licensee's disposition. The NRC staff also evaluated the licensee's basis for acceptability to the NFPA 805 application of SRs that were evaluated to be either "not met" or meeting CC-I. The NRC staff's review and conclusion on the licensee's resolution of each F&O and basis of acceptability of SRs that are "not met" or meet CC-I is summarized in the NRC's Record of Review dated February 20, 2014 (Reference 68). The NRC staff requested supplemental information for the review of some of the F&Os, and issues identified are discussed below.

The licensee assessed SRs QU-A3 and QU-E3 to be CC-I only because state-of-knowledge correlations (SOKCs) were not accounted for in developing the mean CDF and LERF, which is

also the subject of unresolved F&O QU-02-GA from the 2006 independent gap assessment. In response to PRA RAI 15.d (Reference 10), which requested an assessment of the impact of this deficiency on the risk results, the licensee performed a sensitivity analysis that accounted for both internal events and fire events SOKCs. The licensee also accounted for both internal events and fire events SOKCs in the integrated analysis reported in the January 24, 2014, response to PRA RAI 24.01 (Reference 21) and will address SOKCs in accordance with the response in 15.d prior to implementing self-approval by completing LAR Attachment S, Implementation Item REC-159 (Reference 23). The NRC staff concludes that this issue is resolved because the reported estimates for transition change in risk include the SOKCs, and the FPRA will use these or other acceptable methods to account for SOKCs as needed for post-transition self-approval risk evaluations.

The licensee assessed SRs SY-A8 and DA-A2 as not met because component boundary definitions had not been appropriately developed, which is also the subject of unresolved F&O SY-01-GA from the 2006 independent gap assessment. In response to PRA RAI 15.c (Reference 10), which requested the licensee provide an assessment of the impact on the risk results of the inconsistency in the boundary definitions used in the fault trees and the definitions used for component failure data, the licensee stated that updated component boundary definition failure modes have been developed but were not incorporated in the version of the PRA model (i.e., Revision 11) used in the LAR. The licensee included the updated component boundary definitions in the integrated analysis reported in the response to PRA RAI 24.01 (Reference 21) and will address component boundary definitions in accordance with response in 15.c in the post-transition FPRA by completing LAR Attachment S Implementation Item REC-157 and in post-transition PCEs prior to use of the FPRA by completing implementation item REC-159 (Reference 23). The NRC staff concludes that this issue is resolved because the reported estimates for transition change in risk include updated component boundaries, and the FPRA will use these acceptable component boundaries for post-transition self-approval risk evaluations.

In PRA RAI 15, the NRC staff requested further information on the resolution of findings IE-A8 and SY-A4 regarding the lack of interviews with plant personnel as part of the initiating event frequency update process and walkdowns as part of the system analyses respectively. In the responses to PRA RAI 15a and 15b, the licensee stated that it had modified its PRA processes to add interviews and walkdowns as LAR Attachment S, Implementation Items REC-155 and REC-156 (Reference 23), respectively, and, therefore, the NRC staff finds these issues have been resolved.

Unresolved Finding SY-21 from the 1999 CEOG peer review identified a failure mode for the AFW system (i.e., second demand on the fails-to-start failure mode for FW-10 pump) that was not considered in the PRA. The NRC staff requested in PRA RAI 16.b dated April 26, 2012 (Reference 24), that the licensee provide an assessment of the impact on the PRA results of not modeling this failure mode. In response to the RAI (Reference 10), the licensee described the failure mode and its timeline and provided a sensitivity analysis accounting for the second demand of the FW-10 pump given a run failure of the FW-6 pump. The results of the sensitivity analysis were increased total CDF and LERF of less than 0.1 percent and increased ΔCDF and ΔLERF of about 1 percent and 0.1 percent, respectively; each of these risk metrics remained well below the risk acceptance guidelines for Region II (small change) in RG 1.174. However, because the self-approval acceptance guidelines are much smaller than the transition

acceptance guidelines the licensee stated they would include this pump failure upon second demand in the post-transition FPRA by completing LAR Attachment S, Implementation Item REC-158, and in post-transition PCEs prior to use of the FPRA by completing LAR Attachment S, Implementation Item REC-159 (Reference 23). The NRC staff concludes that the final reported risk results are sufficient for use to support transition because the results of the sensitivity study indicate no substantive effect of the transition risk and the FPRA will include acceptable failure modes in self-approval risk evaluations.

As a result of its review of the LAR, as supplemented, the NRC staff concludes that the FCS internal events PRA is technically adequate so that its quantitative results, considered together with the sensitivity study results, can be used to demonstrate that the change in risk due to the transition to NFPA 805 meets the acceptance guidelines in RG 1.174, and that changes will be made to the FPRA by completing the associated implementation items in LAR Attachment S that will increase the technical adequacy to the level needed to support post-transition self-approval. 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. Accordingly, the NRC staff concludes that the licensee has demonstrated that the internal events PRA 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 NFPA 805 application.

3.4.2.2 FPRA Model

The licensee evaluated the technical adequacy of the FCS FPRA model by conducting a peer review of the FPRA model using the SRs of RA-Sa-2009 (Reference 34) as endorsed by RG 1.200, Revision 2 (Reference 33). The full scope peer review of the FPRA was performed by the Pressurized Water Reactor Owner's Group (PWROG) in September/October 2010, and included assignment of a Capability Category assessment to each SR in the FPRA elements. A gap assessment was also performed in 2012, as given in the July 24, 2012, response to PRA RAI 04 (Reference 10), against the RG 1.200, Revision 2 clarifications and qualifications. In addition, the licensee assessed F&Os from the February 2013 internal events PRA focused-scope peer review for their impact on the FPRA, as given in the May 21, 2013, response to PRA RAI 18.01 (Reference 14).

LAR Attachment V, Table V-1 provides the results of the peer review Capability Category assessment for each SR and identifies the F&Os associated with each SR. LAR Attachment V, Table V-2 in the LAR provides the licensee's dispositions to the F&Os. LAR Attachment V, Table V-3 in the LAR identifies all SRs that were assessed by the peer review to be "not met" or met at Capability Category I, identifies the F&Os against each SR, and provides the licensee's disposition to each SR assessment.

The NRC staff reviewed the licensee's dispositions to all of the F&Os to determine the technical adequacy of the fire events PRA for the NFPA 805 application. The NRC staff's review and conclusion for the licensee resolution of each of the F&Os and disposition of SRs that are "not met" or meet CC-I is summarized in a record of review (Reference 68). The NRC staff requested additional information for the review of some of the F&Os, and issues identified are discussed below.

In the LAR, the licensee proposed to transition SR FSS-D7 as CC-I since generic estimates of fire detection and suppression system unreliability and unavailability were implemented without a review of plant-specific operating experience. In addition, Finding FSS-D8-01 suggested that, because of the importance of the Halon system in the switchgear rooms for risk reduction in the FPRA, the system's actual operational history and reliability at FCS be compared with the generic estimates of total system unavailability. In response to PRA RAI 01.e dated July 24, 2012 (Reference 10), the licensee reviewed plant condition reports covering the time period between 1995 and April 2012 for the Halon systems in the switchgear rooms, stating that these systems are subject to routine surveillance testing. The licensee determined that the system had not experienced any "repeated patterns of system unavailability" during this time period, and further explained that if the Halon system is declared non-functional then a continuous fire watch with backup suppression is implemented, judging this to be of similar reliability to the operational Halon system. In PRA RAI 01.e.01 dated February 22, 2013 (Reference 25), the NRC staff disagreed that a continuous fire watch is as reliable as an operating automatic Halon fire suppression system and asked the licensee to explain how any periods of extended unavailability of the Halon system were included in the PRA. In the response to PRA RAI 01.e.01 dated May 21, 2013 (Reference 14), the licensee reviewed Halon system impairment reports between January 1, 2003, and December 31, 2007, and determined that the system had an annual unavailability of 0.02 and incorporated this Halon system unavailability in the integrated analysis reported in the response to PRA RAI 24.01 dated January 24, 2014 (Reference 21). The NRC staff concludes that this issue is resolved because the reported estimates for transition change in risk include this unreliability and the FPRA will use acceptable inputs prior to implementing self-approval by completing Implementation Item REC-159 dated April 10, 2014 (Reference 23).

Finding FSS-E4-01 noted that approximately 300 cables had assumed routing assumptions. By letter dated July 24, 2012, in response to PRA RAI 01.g and SSA RAI 03 (Reference 10), the licensee described seven cable routing assumptions that were applied to these cables and how they were treated in the FPRA, provided further justification for the cable routing assumptions, and judged that these assumptions would negligibly impact the FPRA results and conclusions. In PRA RAI 01.g.01 dated February 22, 2013 (Reference 25), the NRC staff disagreed with the justification for the cable routing assumptions for several of the cables, noted that treatment of these cables is non-conservative and contrary to the requirements of SR CS-A11, Note 11, and asked the licensee to provide further evaluation of the specific cables identified in the RAI. In the response to PRA RAI 01.g.01 dated May 21, 2013 (Reference 14), the licensee performed a further review of the routing of each of the cables identified by the NRC staff in the RAI, including conducting a walkdown if necessary, and provided the results of a sensitivity analysis assessing the impact of the additional routing knowledge for three cables on the FPRA. The results of the analysis showed an increase in total CDF and LERF of less than 0.1 percent. The NRC staff concludes that the final reported risk results are sufficient for use to support transition because the results of the sensitivity study indicate no substantive effect of the transition risk. However, because the self-approval acceptance guidelines are much smaller than the transition acceptance guidelines, the licensee stated it would update the FPRA to incorporate the actual field routing of the three cables in the post-transition FPRA by completing LAR Attachment S, Implementation Item REC-158 and, for post-transition PCEs prior to use of the FPRA, by completing LAR Attachment S, Implementation Item REC-159 (Reference 23).

The resolution to Suggestion FSS-H8-01 explained that the multi-compartment analysis (MCA) assumed the originating fire would grow unsuppressed for 30 minutes before it could spread into an adjacent compartment and that the manual non-suppression probability is based on a manual fire suppression rate of 0.074 per minute. In PRA RAI 01.h dated April 26 2012 (Reference 24), and PRA RAIs 01.h.01 and 01.h.02 dated February 22, 2013 (Reference 25), the NRC staff requested the licensee provide a basis and justification for the assumptions in the MCA. By letters dated August 24, 2012, and May 21, 2013, in response to these RAIs (References 11 and 14), the licensee provided a sensitivity analysis that 1) uses ignition source-specific manual fire suppression rates from NUREG/CR-6850 Supplement 1 (Reference 37), 2) removed credit for gaseous suppression systems in the exposed fire compartment, 3) conservatively excluded all credit for manual suppression in the MCA, and 4) limited the fire-originating compartment fire frequency to the frequency of fires physically capable of generating a hot gas layer within the originating fire compartment. These methods are consistent with the guidance in NUREG/CR-6850 and therefore acceptable to the NRC staff. Furthermore, the licensee also incorporated these revisions to the MCA in the integrated analysis reported in the response to PRA RAI 24.01 dated January 24, 2014 (Reference 21), and therefore they are included in the transition change in risk estimate. The licensee stated that it would implement these methods in the post-transition FPRA prior to use of the FPRA by completing LAR Attachment S, Implementation Item REC-159; and, to integrate the MCA into the base FPRA model by completing LAR Attachment S, Implementation Item REC-149 (Reference 23). The NRC staff concludes that this issue is resolved because the reported estimates for transition change in risk include these methods, and the FPRA will use acceptable methods for post-transition self-approval risk evaluations.

The resolution to Finding HRA-A1-01 explains that the FPRA only credits the alternate shutdown process when the MCR becomes uninhabitable due to a fire. The licensee revised its methodology to evaluate the risk of MCR abandonment due to fire-induced unhabitability in the response to PRA RAI 01.j dated July 24, 2012 (Reference 10), PRA RAI 01.j.01 (Reference 14), PRA RAI 01.j.02 (Reference 17), and PRA RAI 01.j.04 (Reference 20). The licensee performed a feasibility study of MCR abandonment operator actions using its abnormal operating procedure AOP-06 and established feasibility. As a part of that study, the licensee's calculation supports that plant operators have 60 minutes (with margin) post-trip to isolate the power-operated relief valves (PORVs) and establish AFW without core uncovery. AOP-06 provides direction to only align one safe shutdown train, and the licensee concluded that equipment unreliability is the dominant contributor to conditional core damage probability (CCDP) and conditional large early release probability (CLERP). The licensee indicated that CDF and LERF are equivalent since the alternate shutdown process does not include provision for containment isolation. Ultimately, the licensee analyzed the MCR abandonment risk using three distinct scenarios which range from successful shutdown being straightforward to fire-induced failures causing great difficulty for shutdown by failing multiple functions and/or causing complex spurious operations. The NRC staff concludes that the range of CCDPs assigned to these three distinct scenarios appropriately characterizes the complexity of the required operator actions to the extent necessary to differentiate between the failure probabilities associated with achieving safe shutdown, and that the CCDPs are merited predominantly by the plant features which lead to having 60 minutes to isolate PORVs and establish AFW. As identified in the response to PRA RAI 23.01 dated October 11, 2013 (Reference 17), the licensee will review the HRA aspect of MCR abandonment due to inhabitability as a part of the focused-scope peer review on HRA, undertaken as part of

completing LAR Attachment S, Implementation Item REC-145 (Reference 23). The licensee also incorporated these revisions to the MCR abandonment analysis in the integrated analysis reported in the response to PRA RAI 24.01 (Reference 21) and therefore the acceptable method is included in the transition change in risk estimate. The licensee stated it would implement these acceptable methods prior to self-approval by completing LAR Attachment S, Implementation Item REC-159 (Reference 23) prior to self-approval. The NRC staff concludes that this issue is resolved because the reported estimates for transition change in risk include these methods, and the FPRA will use acceptable methods for post-transition self-approval risk evaluations, as required by the license condition.

The resolution to Finding HRA-C1-01 explains that the FPRA HRA process increases the HEPs to 0.1 or to 10 times the internal events value for each HFE/fire compartment combination where the fire could fail more than half the instrumentation associated with the HFE. In PRA RAI 23 dated February 22, 2013 (Reference 25), the NRC staff requested the licensee explain if the FPRA HRA process is in accordance with NUREG/CR-6850. In response to the RAI dated April 23, 2013 (Reference 13), the licensee explained that, while the FPRA HRA process does not rigorously implement the screening approach in Chapter 12 of NUREG/CR-6850, it does account for fire impacts on credited cues, environmental conditions both at the action location and the travel path to the action location, and increased stress due to the fire. The licensee also stated that the fire HRA will be upgraded to NUREG-1921 by completing LAR Attachment S, Implementation Items REC-145 and REC-159 (Reference 23) to upgrade the fire HRA to NUREG-1921 and perform a focused-scope peer review of the upgraded fire HRA prior to self-approval. The NRC staff concludes that the licensee's method accounts for all the important fire impacts on the human actions. The method generally leads to increased HEPs expected to be associated with fire-caused operator activities and that the magnitude of the increases are generally consistent with the NUREG/CR-6850 method. The NRC staff finds the use of this method acceptable to support the FCS transition change in risk estimates because the method and results are reasonably consistent with acceptable methods, and the additional review and reporting provided in the implementation item should identify any substantive errors in the values used.

The resolution to Finding PRM-B9-01 states that one of the reasons the MCR heating, ventilation, and air conditioning (HVAC) system is qualitatively screened in the FPRA is because of low frequency of fires with a potential to damage both HVAC trains. In PRA RAI 21 (Reference 25), the NRC staff requested that the licensee provide additional justification for this screening and to provide a quantitative assessment of the impact of this screening on the PRA results. In response to the RAI (Reference 14), the licensee identified two fire areas where a transient fire could result in fire-induced failure of both MCR HVAC trains and impact the FPRA results. The licensee also provided a sensitivity analysis that placed a transient fire at the pinch point for the two MCR HVAC trains in each of the two fire areas, credited a procedure-directed operator alignment of one of three diverse backup methods of MCR ventilation, and conservatively assumed that failure to align backup cooling resulted in CCDP and CLERP values of 1.0. The results of this sensitivity analysis showed an increase in total CDF and LERF of less than 1 percent and about 4 percent, respectively, while ΔCDF and ΔLERF showed an increase of about 1 percent and 5 percent, respectively. The NRC staff concludes that the final reported risk results are sufficient for use to support transition because the results of the sensitivity study that indicate no substantive effect of the transition risk. However, because the self-approval acceptance guidelines are much smaller than the transition acceptance

guidelines, the licensee stated they would include potential fire-induced failure of the MCR HVAC in the post-transition FPRA by completing LAR Attachment S, Implementation Item REC-158 and in post-transition PCEs prior to use of the FPRA by completing LAR Attachment S, Implementation Item REC-159 (Reference 23).

The resolution of Finding PP-B3 indicates that manual suppression was used to help define compartment boundaries. In response to PRA RAI 01.a the licensee indicated that manual suppression is not credited as a boundary between two physical analysis units (PAUs) but, instead, the basis is lack of combustibles. The licensee stated that it would revise the plant partitioning report to clarify that lack of combustibles in lieu of manual suppression is credited as a partitioning feature by completing LAR Attachment S, Implementation Item REC-148 (Reference 23). The NRC staff concludes that this issue is resolved because the guidance in NUREG/CR-6850 was followed and the documentation will be revised to clarify that the guidance has been followed.

The NRC staff noted in PRA RAI 01.i.02 (Reference 27) that MCR abandonment due to loss of control was being credited for fire area FC41 and requested the licensee provide revised risk results for this fire area removing this credit since no guidance is available on how to model this scenario. In response to PRA RAI 24.01 (Reference 21), the licensee removed credit for MCR abandonment for fire in the MCR (fire area FC42) and the cable spreading room (FC41) due to loss of control in the integrated analysis. This issue is reflected in LAR Attachment S, Implementation Item REC-159 (Reference 23). The licensee stated in LAR Attachment S, Implementation Item REC-153 (Reference 23), that they were not crediting abandonment of the MCR in loss-of-control scenarios in FC41 and FC42 until a method acceptable to the NRC has been published. The NRC staff concludes that this issue is resolved because the reported estimates for transition change in risk do not include credit for MCR abandonment upon loss of control and the FPRA will not use this credit for post-transition self-approval risk evaluations until acceptable methods are available.

In PRA RAI 08 dated April 26, 2012 (Reference 24), the NRC staff noted that new information indicated that the reduction in hot short probabilities for circuits protected by control power transformers (CPT) identified in NUREG/CR-6850 was too high and should be reduced. In response to PRA RAI 24.01 (Reference 21), the license provided revised risk results with no credit for hot short probabilities. The NRC staff concludes that this issue is resolved because the reported estimates for transition change in risk do not include credit for reduced hot-short probabilities and the FPRA will not use reduced probabilities for post-transition self-approval risk evaluations until acceptable methods are available.

In the LAR and its supplement dated December 22, 2011 (Reference 8), the licensee provides a sensitivity analysis of four methods that are deviations from the guidance in NUREG/CR-6850 and NRC-endorsed FAQs: 1) use of a generic severity factor/non-suppression probability for electrical cabinets, 2) use of a pump fire frequency apportioning method that assigns a higher frequency to normally operating pumps and lower frequency to standby pumps, 3) use of a generic severity factor/non-suppression probability for diesel generator fire events, and 4) application of a draft version of FAQ 08-0050 (Reference 50). In response to PRA RAI 24.01 (Reference 21), the license provided revised risk results with all of the above four deviations from NUREG/CR-6850 replaced with the acceptable methods described in NUREG/CR-6850 and its Supplement 1. The licensee also agreed to use these, or alternative, methods

acceptable to the NRC staff in the post-transition FPRA by completing LAR Attachment S, Implementation Item REC-154 and in post-transition PCEs prior to use of the FPRA by completing LAR Attachment S, Implementation Item REC-159 (Reference 23). The NRC staff concludes that this issue is resolved because accepted methods in NUREG/CR-6850 have been used and the FPRA will use these methods for post-transition self-approval risk evaluations until alternative acceptable methods are available.

In response to PRA RAI 07 (Reference 12), the licensee identified two additional deviations from NUREG/CR-6850 and NRC-endorsed FAQs that were used in the LAR. The first deviation involved crediting a non-suppression probability of 0.01 for scenarios for cable fires caused by welding and cutting (CFWC) and for transient fires caused by welding and cutting (TFWC). This credit was applied in FC28, FC32, and FC41. The justification was that a continuous fire watch would be present. The second deviation involved crediting a procedural compliance factor of 0.01 for general transients, CFWC, and TFWC scenarios in fire areas FC32, FC36C, and FC41. To address these deviations, the licensee applied the methods described below:

1. Use of a transient fire heat release rate (HRR)lower than that provided in NUREG/CR-6850, specifically, a 98th percentile 69 kilowatt (kW) probability density function rather than the 98th percentile 317 kW probability density function. In response to letter from NRC Joseph Giitter to NEI Biff Bradley, "Recent Fire PRA Methods Review Panel Decisions and EPRI 1022993, Evaluation of Peak Heat Release Rates in Electrical Cabinet Fires," dated June 21, 2012 (Reference 69), the licensee provided the following:

   - The licensee stated that their justification for using the 69kW probability density function instead of the 317kW probability density function for fire area FC41 (cable spreading room) is as follows: (1) The room has a procedural combustible loading limitation of 5 pounds , (2) a search of corrective actions documents at FCS over the past 5-year period did not indicate any combustible control violations in the room, (3) there is minimal plant equipment in the room (only cable trays, junction boxes, and one small lighting panel are present) and, therefore, maintenance activities are minimized, and (4) heightened sensitivity by plant staff to fire risk in the room. In response to PRA RAIs 07.01.b and 07.01.d (Reference 14), the licensee further stated that the risk (CDF and LERF) for this fire area would not change by using the 317 kW probability density function since all targets in the area are damaged by the smaller HRR fire. The licensee proposed to replace the five pound combustible loading limitation with the requirement to impose a continuous fire watch when transient combustibles with the potential to damage targets are stored in FC41. In response to PRA RAI 07.02 (Reference 17), the licensee described how the existing plant combustible control procedure will be revised and implemented to preclude damage to targets by a transient fire. The changes to the plant combustible control procedure to require a continuous fire watch when transient combustibles with the potential to damage targets are stored in FC41 and prescribing how this

control will be implemented are included as LAR Attachment S, Table S-3, Implementation Item REC-109 (Reference 23).

The NRC staff concludes that the licensee has provided appropriate justification for the use of the lower transient fire HRR for Fire Area FC41 because the accepted guidance of Reference 69 has been followed.

– The licensee stated that their justification for using the 69kW probability density function instead of the 317kW probability density function for fire area FC32 (compressor area) is as follows: (1) No combustible storage is allowed during power operations and continuous fire watches are required anytime transient combustibles are stored in this area, (2) a search of corrective actions documents at FCS over the past 5-year period did not indicate a pattern of combustible control violations in the area, (3) there is no mechanical plant equipment present in this area, (4) the likelihood of combustible storage is remote because of the small area and the area can only be accessed with a ladder or scaffolding, and (5) hot-work is disallowed in this area while the plant is at power. The changes to the plant combustible control procedure to require a continuous fire watch anytime transient combustibles are stored on the roof of Room 18 in FC32 and disallowing hot-work in FC32 while the plant is at power are included as LAR Attachment S, Implementation Item REC-108 (Reference 23).

  The NRC staff concludes that the licensee has provided appropriate justification for the use of the lower transient fire HRR for the roof of Room 18 in fire area FC32 because the accepted guidance of Reference 69 has been followed.

2. For transient fires, the licensee used the NUREG/CR-6850 manual non-suppression probability (NSP) curve for welding fires rather than the curve for transient fires. The NRC staff requested further justification for the use of NUREG/CR-6850 manual NSP curve in light of the requirements for crediting a continuous fire watch and the associated criteria for prompt detection and suppression, as described in PRA RAI 07.01a (Reference 25). In response to the RAI (Reference 14), the licensee stated that the combustible control procedures at FCS will be revised to require a continuous fire watch when the combustible limitations described in item 1. above for fire area FC41 and the roof of Room 18 in fire area FC32 are exceeded (see LAR Attachment S, Table S-3, Implementation Items REC-108 and REC-109) (Reference 23). The licensee further stated that both prompt detection and suppression are credited and also explained that the continuous fire watches meet the criteria for prompt detection (i.e., the combustibles are observable at all times and the fire watch's line of sight is unencumbered such that he/she can easily see the entire area under surveillance) and for prompt suppression (i.e., the fire watch is to extinguish the fire, if possible, the fire watch is trained on the use of fire extinguishers, and the fire watch has a fire extinguisher readily available for use).

> The NRC staff notes that crediting a continuous fire watch for prompt detection and suppression of transient fires is a deviation from the guidance in NUREG/CR-6850. However, based on the licensee's justification that the continuous fire watches meet the NRC's criteria for prompt detection and suppression, the NRC staff concludes that crediting a continuous fire watch and thus the welding non-suppression curve for transient fires in fire areas FC41 and the roof of Room 18 in fire area FC32 is acceptable.

The licensee incorporated these methods in the integrated analysis reported in the response to PRA RAI 24.01 dated January 24, 2014 (Reference 21). The licensee agreed to use these, or alternative, methods acceptable to the NRC in the post-transition FPRA by completing LAR Attachment S, Implementation Item REC-154 and prior to use of the FPRA for post-transition PCEs by completing LAR Attachment S, Implementation Item REC-159 (Reference 23). The NRC staff concludes that this issue is resolved because the reported estimates for transition change in risk include the accepted methods described above that were provided in PRA RAI 07 response, and the FPRA will use these or other acceptable methods for post-transition self-approval risk evaluations.

In PRA RAI 07.01.c dated February 22, 2013 (Reference 25), the NRC staff noted the risk results in fire areas FC41 and FC32 did not address the additional risk from combustible control violations where the allowed transient combustible quantities are exceeded and no fire watch is present. The staff identified this issue since the credit taken by a continuous watch would not be available under those circumstances. In response to the RAI dated May 21, 2013 (Reference 14), the licensee provided a sensitivity analysis by first estimating the likelihood of unapproved combustible storage in FC41 and on the roof of Room 18 in FC32 based on a review of combustible control violations in these fire areas over a recent 5-year period. The licensee then assumed failure of all targets in these fire areas and conservatively did not credit a severity factor or NSP due to uncertainty in the maximum fire size. The results of the sensitivity analysis showed an increase in total CDF and LERF of about 7 percent and 5 percent, respectively, while ΔCDF and ΔLERF showed an increase of less than 1 percent. The NRC staff concludes that the final reported risk results are sufficient for use to support transition because the results of the sensitivity study indicate no substantive effect of using this deviation on the transition risk. However, because the self-approval acceptance guidelines are much smaller than the transition acceptance guidelines, the licensee stated it would account for combustible control violations in FC41 and on the roof of Room 18 in FC32 in the post-transition FPRA by completing LAR Attachment S, Implementation Item REC-158 and in post-transition PCEs prior to use of the FPRA by completing LAR Attachment S, Implementation Item REC-159 (Reference 23).

In the response to PRA RAI 07.a dated September 27, 2012 (Reference 12), the licensee stated that for CFWC fires five minutes was assumed to be available for fire suppression prior to any significant damage occurring to the tray in which the fire initiates, which is not an NRC-endorsed method. In PRA RAI 01.c.01 dated February 22, 2013 (Reference 25), the NRC staff requested the licensee assess the impact on risk from using this method. In response to the RAI dated May 12, 2013 (Reference 14), the licensee provided a sensitivity analysis in which 1) for each fire compartment, the CFWC fire frequency was multiplied by the CCDP and CLERP that were determined by conservatively assuming failure of all FPRA targets in the compartment and 2) for compartments in which the previous approach was too conservative, one CFWC fire

scenario for each cable tray was defined, the fire frequency for each individual cable tray was calculated as the total CFWC frequency for the compartment divided by the number of cable trays in the compartment, and the CCDP and CLERP for each scenario was calculated with target damage limited to the tray of origin. No credit for suppression was assumed in this revised analysis of CFWC fire scenarios. The results of the sensitivity analysis showed a decrease in total CDF and LERF and an increase in ΔCDF and ΔLERF of less than 2 percent. The NRC staff concludes this alternative method to NUREG/CR-6850 for CFWC to be acceptable because assuming failure of all targets in the fire compartment is conservative and limiting target damage to the tray of origin is consistent with fire experience at U.S. nuclear power plants. However, because the self-approval acceptance guidelines are much smaller than the transition acceptance guidelines, in response to RAI 25 dated October 11, 2013 (Reference 17), the licensee stated it would update the FPRA to use this method for evaluating CFWC fires in the post-transition FPRA by completing LAR Attachment S, Implementation Item REC-158 and, in post-transition PCEs prior to use of the FPRA by completing LAR Attachment S, Implementation Item REC-159 (Reference 23).

The NRC staff noted discrepancies between the severity factors for main feedwater pump oil fires used in the FPRA and those defined in NUREG/CR-6850 Supplement 1 (Reference 37). In response to the PRA RAI 02 dated July 24, 2012 (Reference 10), the licensee explained that the severity factors used in the FPRA were from a draft version of FAQ 08-0044 and provided a sensitivity analysis applying the NUREG/CR-6850 Supplement 1 severity factors. The results of the analysis showed an increase in total CDF and LERF of less than 0.1 percent and no change in ΔCDF and ΔLERF. The NRC staff concludes that the final reported risk results are sufficient for use to support transition because the results of the sensitivity study indicate no substantive effect of using this deviation on the transition risk. However, because the self-approval acceptance guidelines are much smaller than the transition acceptance guidelines, the licensee stated it would update the FPRA to use the NUREG/CR-6850 Supplement 1 main feedwater pump severity factors for oil fires in the post-transition FPRA by completing LAR Attachment S, Implementation Item REC-158 and, in post-transition PCEs prior to use of the FPRA, by completing LAR Attachment S, Implementation Item REC-159 (Reference 23).

In PRA RAI 22 dated February 22, 2013 (Reference 25), the NRC staff noted that a Bayesian update of the fire ignition frequencies was not performed, identified three fire events at FCS between 1997 and 2011 that are classified as "potentially challenging" fires, and requested the license provide an assessment of the impact on the risk results of a Bayesian update of the fire ignition frequencies considering these plant-specific fire events. In response to the PRA RAI 27 dated October 11, 2013 (Reference 17), the licensee provided a sensitivity analysis that incorporated a Bayesian update of the generic fire ignition frequencies from NUREG/CR-6850 Supplement 1. Furthermore, the licensee also incorporated Bayesian update of generic fire ignition frequencies in the integrated analysis reported in the response to PRA RAI 24.01 (Reference 21). The licensee agreed to these, or alternative, methods acceptable to the NRC staff in post-transition PCEs prior to use of the FPRA by completing LAR Attachment S, Implementation Item REC-159 (Reference 23). The NRC staff concludes that this issue is resolved because the reported estimates for transition change in risk include the updated frequencies, and the FPRA will use these or other acceptable frequencies for post-transition self-approval risk evaluations.

In PRA RAI 03 dated April 26, 2012 (Reference 24), the NRC staff requested the licensee provide justification for why several SRs were identified as not applicable to the FPRA. In response to the RAI dated July 24, 2012 (Reference 10), the licensee provided the additional justification except for SR FSS-C8. The licensee determined SR FSS-C8 was incorrectly assessed by the peer review to be inapplicable based on the erroneous basis that the FPRA did not credit raceway fire barriers. The licensee provided an assessment of each raceway fire barrier credited in the FPRA establishing a technical basis for the assigned fire resistance rating and the likelihood and extent of mechanical damage to the barrier thereby satisfying the requirements of SR FSS-C8.

In PRA RAI 03.01 dated February 22, 2013 (Reference 25), the NRC staff noted that the response to PRA RAI 03 identified the pyrocrete enclosure in fire area FC36C as a fire compartment, which is specifically precluded by SR PP-B4, and requested the licensee assess the impact of this incorrect model construct. In response to the RAI (Reference 14), the licensee recharacterized this pyrocrete enclosure from its own compartment to a credited ERFBS system within fire area FC36B. These changes were determined by the licensee to have no impact on the risk results because the barrier design has been determined to be adequate for the hazards within FC36B. The NRC staff concludes the licensee's explanations that the FPRA results are unchanged is reasonable due to the protection afforded by the enclosure and therefore concludes the issue is resolved.

In response to PRA RAI 07.c (Reference 12), the licensee stated that, other than the PRA methods identified and discussed above in response to PRA RAI 07, there are no other methods that deviate from NUREG/CR 6850 or other NRC-endorsed guidance. In response to PRA RAI 12 dated July 24, 2012 (Reference 10), the licensee stated that all FPRA methods and plant modifications supporting the LAR were included in the FCS FPRA peer review. Also, in response to PRA RAI 24.01 (Reference 21), the license summarized how it updated the FPRA to use methods acceptable to the NRC staff and provided the final, plant wide risk results including the final fire CDF and LERF, and final estimates for the changes in CDF and LERF associated with the transition to NFPA 805 as requested. In response to RAI 25 (Reference 18), the licensee summarized FPRA methods that were not acceptable to the NRC staff, but that had an insignificant impact on the change in risk associated with transition. The licensee stated that it will update the FPRA model and incorporate acceptable methods before using the PRA to support self-approval in LAR Attachment S, Table S-3, Implementation Items REC-154, REC-158, and REC-159 (Reference 23). The NRC staff concludes that this approach is acceptable because the specific FPRA methods that will be changed to acceptable methods are identified in the responses to RAI 24.01 and RAI 25; and, LAR Attachment S, Table S-3, Implementation Items REC-154, REC-158, and REC-159 are encompassed by the license condition which requires acceptable methods to be incorporated into the PRA before implementing the self-approval process.

The licensee also agreed to upgrade the FPRA HRA to NUREG-1921, to conduct a focused-scope peer review of the upgrade prior to full implementation of the self-approval process, and inform the NRC if the RG 1.174 risk acceptance guidelines are not met following the upgrade of the fire HRA by completing LAR Attachment S, Implementation Items REC-145 and REC-159 (Reference 23). The upgrade and focused-scope peer review process is an acceptable method to evaluate the adequacy of a PRA as described in RG 1.200.

As a result of its review of the LAR, as supplemented, the NRC staff concludes that the FCS FPRA is technically adequate in that its quantitative results, considered together with the results of 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. 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. In addition, the NRC staff has reviewed FPRA modeling aspects and determined that the licensee's resolution to the identified issues also supports the determination that the quantitative results are adequate. Accordingly, the NRC staff concludes that the licensee has demonstrated that the FPRA meets the guidance in RG 1.200, Revision 2, and that it is technically adequate to support the fire risk evaluations and other risk calculations required for the NFPA 805 application.

3.4.2.3 Fire Modeling in Support of the Development of a Fire Risk Evaluation

The NRC staff performed detailed reviews of the fire modeling 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 (Reference 1) were technically adequate. NFPA 805 has the following requirements that pertain to fire modeling used in support of the development of an FRE:

NFPA 805, Section 2.4.3.3: On Acceptability

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

NFPA 805, Section 2.7.3.2, Verification and Validation

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

NFPA 805, Section 2.7.3.3, Limitations of Use

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

NFPA 805, Section 2.7.3.4, Qualification of Users

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

NFPA 805, Section 2.7.3.5, Uncertainty Analysis

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

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

3.4.2.3.1 Overview of Fire Models Used to Support the FCS FPRA

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

- Plume Centerline Temperature, Method of Heskestad (Reference 41, Chapter 9)
- Radiant Heat Flux, Point Source Method (Reference 41, Chapter 5)
- Ceiling Jet Temperature, Method of Alpert (Reference 70)

The first two 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 41). Alpert's ceiling jet temperature correlation is described in FIVE, "EPRI Fire Induced Vulnerability Evaluation Methodology," Revision 1 (Reference 71), and serves as the basis for FDT^s that are used to estimate sprinkler, smoke detector and heat detector response times as documented in NUREG-1805, Chapters 10, 11, and 12, respectively. 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," Volumes 3 and 4, respectively (Reference 42).

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

- Method of McCaffrey, Quintiere and Harkleroad (for naturally ventilated compartments)

This HGL correlation is described in NUREG-1805 (Reference 41, Chapter 2).

The licensee did not directly use the NUREG-1805 and FIVE, Revision 1, spreadsheets, but developed a proprietary set of spreadsheets to perform the ZOI calculations.

The licensee's ZOI approach was used as a screening tool to distinguish between fire scenarios that required further evaluation and those that did not require further evaluation. Qualified personnel performed a plant walk-down to identify ignition sources and surrounding targets or SSCs in compartments and applied the empirical correlation screening tool to assess whether

the SSCs were within the ZOI of the ignition source. Based on the fire hazard present, these generalized ZOIs were used to screen from further consideration those FCS-specific ignition sources that did not adversely affect the operation of credited SSCs, or targets, following a fire. The licensee's screening was based on the 98th percentile fire HRR from Volume 2 of NUREG/CR-6850, Section 8, "Scoping Fire Modeling (Task 8)" (Reference 36) methodology.

Finally, FDS Version 5 was used to assess the MCR abandonment analysis and to model an air compressor oil fire scenario in fire area 32/Room 19. V&V of FDS is documented in NUREG-1824, Volume 7 (Reference 42).

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

3.4.2.3.2 RAIs Pertaining to Fire Modeling in Support of the FCS FPRA

By letter dated April 26, 2012 (Reference 24), the NRC staff sought RAIs concerning the fire modeling conducted to support the FPRA. By letters dated July 24, 2012 (Reference 10), August 24, 2012 (Reference 11), and September 27, 2012 (Reference 12), the licensee provided responses to the first round fire modeling RAIs. By e-mail dated February 22, 2013 (Reference 25), the NRC sent a second set of fire modeling RAIs to the licensee. By letters dated April 23, 2013 (Reference 13), and July 29, 2013 (Reference 15), the licensee provided a response to the second round RAIs. By e-mail dated June 27, 2013 (Reference 26), the NRC sent a third set of fire modeling RAIs to the licensee. By letter dated July 29, 2013, the licensee provided a response to the third round RAIs. The following paragraphs describe selected RAI responses related to the acceptability of the fire models used.

- The NRC staff issued FM RAI 01(a) (Reference 24) asking the licensee to justify why fire location effects were only accounted for in the ZOI calculations for ignition sources that are within 6-inches from a wall or corner.

  In its response (Reference 11), the licensee performed a sensitivity analysis to consider wall/corner effects for scenarios modeled by the FCS FPRA, where the fire is expected to be within 2 feet of a wall or corner. Based on information gathered during a plant walk-down, the licensee identified five scenarios that involve ignition sources within 2 feet (24-inches) of a wall/corner and that are not already bounded by the FCS FPRA. The FRE model was re-quantified for each of the five scenarios, accounting for wall/corner effects.

  The licensee also stated in response to PRA 24.c (Reference 18) that the post-transition FCS NFPA 805 program will use the FPRA supporting the integrated analysis unless or until other methods acceptable to the NRC are used instead. The NRC staff concludes that this issue is resolved because the reported estimates for transition change in risk include the revised wall/corner effects, and the FPRA will use these or other acceptable methods to account for wall/corner effects as needed for post-transition self-approval risk evaluations.

- During the on-site audit walk-down the NRC staff observed a large pipe with combustible insulation in fire area FC32, and noted that the ZOI calculations and fire modeling for this compartment did not include the pipe insulation. This led the NRC staff to question whether non-cable intervening combustibles were considered in the fire scenarios that were modeled at FCS. The NRC staff issued FM RAI 01 (b) (Reference 24), asking the licensee to explain how non-cable intervening combustibles were accounted for in the fire modeling analyses.

  In its response (Reference 10), the licensee explained that plant walk-downs were conducted to identify non-cable intervening combustibles in fire compartments in which detailed fire modeling was performed. Based on the information obtained during these walk-downs, the licensee eliminated scenarios where ignition of intervening combustibles was judged to not be capable of failing targets beyond the modeled ZOI, or where intervening combustibles are assumed to not ignite because they are not directly over the ignition source and outside the horizontal ZOI. A bounding sensitivity analysis was then performed assuming full compartment burnout for the remaining scenarios, except those for which the licensee demonstrated through calculation that an HGL would not develop.

  After reviewing the licensee's response, the NRC staff issued FM RAI 01.02 (Reference 25), asking the licensee to provide the criteria that were used to determine the scenarios in which ignition of intervening combustibles was judged not to expand the ZOI of the ignition source. In this RAI, the NRC staff also requested that the licensee provide justification for the revised CDF and LERF calculations for pump fire scenario FC20-1-IS8. These revised calculations are based on the assumption that the 98th percentile HRR is needed to ignite pipe insulation 2 m above the pump fire. However, in the example in Figure F-1 of NUREG/CR-6850 (Volume 2), a lower HRR is capable of igniting an intervening combustible target at 2 m above the pump fire.

  In its response to FM RAI 01.02 (Reference 14), the licensee provided a discussion of the screening bases for the intervening combustibles scenarios that were identified during the plant walk-downs performed in response to FM RAI 01 (b). The licensee also demonstrated through calculations that the HRR required to ignite the pipe insulation in pump fire scenario FC20-1-IS8 exceed the 98th percentile, and therefore, the use of a severity factor of 0.02 is conservative.

  The licensee also stated in response to PRA 24.c (Reference 18) that the post-transition FCS NFPA 805 program will use the FPRA supporting the integrated analysis unless or until other methods acceptable to the NRC are used instead. The NRC staff concludes that this issue is resolved because the reported estimates for transition change in risk include the potential contribution of non-cable intervening combustibles, and the FPRA will use these or other acceptable methods to account for non-cable intervening combustibles as needed for post-transition self-approval risk evaluations.

- The NRC staff issued FM RAI 01 (c) (Reference 24), asking the licensee to explain how the HRR of cable tray fires was calculated, to justify the use of a "characteristic length" of one foot instead of the cabinet length as specified in Volume 2 of NUREG/CR-6850, Section R.4.2, to perform a sensitivity analysis to quantify the effect of this discrepancy on the ZOI and HGL calculations and target damage assessment, and to justify why the effect of the added HRR from the cable tray fire on the radius of the ZOI was not considered.

  In its response (Reference 11), the licensee indicated that fire is propagated vertically from the ignition source to the overhead cables according to the model described in Appendix R, Section R.3, Volume 2 of NUREG/CR-6850 and that the fire growth profile of the ignition source and ignited cable tray configuration are summed to obtain the overall fire growth profile.

  The FCS FPRA generically used a default fire area of 1 ft^2, and the first tray was therefore assumed to ignite over a length of 1 foot. The licensee presented the following arguments to justify this assumption: (1) using the entire cabinet length as the characteristic length would not be realistic, in particular for large cabinets such as switchgears, load centers, and motor control centers (MCCs); (2) using the entire cabinet length would lead to a longer time to ignition of the first tray, which is non-conservative; and (3) the conservative assumptions in the Volume 2 of NUREG/CR-6850 cable tray fire propagation model are likely to offset the potential non-conservatism due to the use of a characteristic length of 1 foot. To address the last part of the RAI, the licensee performed a plant walk-down to determine whether FPRA targets exist outside the modeled ZOI, but within the 35-degree upward fire propagation through a cable tray stack. The walk-down did not identify any such targets.

  Since the licensee's response did not address how the combined HRR impacts the ZOI, the NRC staff issued FM RAI 06(a) (Reference 24), asking the licensee to explain how the effect of the increased HRR due to vertical propagation to cable trays on the ZOI, and the resulting targets selected for damage in the FPRA, were determined. In addition, regarding the assumption of a characteristic length of one foot, the NRC staff issued FM RAI 06(b) (Reference 24). This RAI asked the licensee to quantify the effect on the ZOI, HGL development and risk of using (a) the width of the vertical section of origin for fires in cabinets that have vertical barriers (switchgear, MCCs, control panels in relay rooms, auxiliary control rooms, etc.) or, (b) the width of the cabinet if it is a single cabinet with no vertical barriers, as the characteristic length for calculating fire propagation in and HRR of horizontal cable trays.

  In its response to FM RAI 06(a) (Reference 14), the licensee explained that the fire growth profile of the ignition source and ignited cable tray configuration are summed to obtain the overall fire scenario HRR profile. Based on this profile, if the HGL temperature at any point exceeds the damage threshold, all targets within the compartment are assumed to have failed. If the HGL temperature never exceeds the target damage threshold, then only the targets within the ZOI of the ignition source are modeled to fail. The ZOI is a cylinder, with a radius of

the distance at which the radiant heat flux or the ceiling jet temperature exceeds the target damage threshold, whichever is greater. The cylinder extends from floor to ceiling, even if the plume temperature is not sufficient to damage targets all the way to the ceiling.

In its response to FM RAI 06(b) (Reference 14), the licensee explained that additional walk-downs were performed to measure the characteristic length of all electrical cabinets. For cabinets with vertical dividers between each section, the characteristic length was taken as the width of the vertical section of origin. For cabinets without vertical partitions between each section, the characteristic length was taken as the entire cabinet width. The field-measured values were incorporated in the FPRA in place of the previously assumed 1 foot. Implementation of the new characteristic lengths reduced the total CDF and LERF.

Since the licensee's response to FM RAI 06(a) did not specifically address horizontal fire propagation to adjacent cable trays, the NRC staff issued FM RAI 06.01 (Reference 26), to ask the licensee to clarify if the guidance provided in NUREG-CR/6850 Appendix-R was used to determine ignition of and propagation through an adjacent cable tray stack, and to re-quantify the risk to account for damage to additional targets resulting from horizontal fire propagation to adjacent cable tray stacks that currently are not included in the FCS FPRA.

In its response to FM RAI 06.01 (Reference 15), the licensee confirmed that the guidelines in NUREG/CR-6850, Section R.4.2 were used to model vertical fire propagation through cable tray stacks. As far as fire propagation to and in adjacent trays is concerned, the licensee explained that the guidelines in NUREG/CR-6850, Section R.4.2.2 were not used. Instead, the first tray in an adjacent stack that is within the ZOI of the ignition source was assumed to ignite at the same time as the first tray in the original stack (as opposed to 7 minutes later based on the NUREG guidance). Vertical fire propagation in the adjacent stack was then assumed to mimic that in the original stack.

Based on the additional information provided, the NRC staff concludes there is reasonable assurance that the licensee's approach to model fire propagation in cable trays, more specifically the assumption of a characteristic length of 1 foot and the method used for calculating fire propagation to and in adjacent stacks, leads to conservative estimates of FPRA target damage.

The NRC staff issued FM RAI 5(c)(i) (Reference 24), to ask the licensee to explain why soot yield in the FDS analysis for MCR habitability study was assumed to be 0.06 while higher values are reported in the fire protection literature for the same type of cables.

In its response (Reference 11), the licensee indicated that when the soot yield is conservatively increased to a value of 0.08, the plant total CDF, and total LERF remain within the RG 1.174, Revision 1, Region II acceptance criteria.

The licensee also stated in response to PRA 24.c (Reference 18) that the post-transition FCS NFPA 805 program will use the FPRA supporting the integrated analysis unless or until other methods acceptable to the NRC are used instead. The NRC staff concludes that this issue is resolved because the reported estimates for transition change in risk include the higher values of soot yield, and the FPRA will use these or other acceptable methods to account for soot yield as needed for post-transition self-approval risk evaluations

- FCS used the McCaffrey, Quintiere and Harkleroad (MQH) correlation to identify the ignition sources that have the potential to generate an HGL. A vent opening of 1 m x 1 m was used in every compartment where HGL calculations were performed. The NRC staff issued FM RAI 01 (d) (Reference 24), requesting that the licensee (i) provide justification for the use of the MQH correlation with a vent of 1 m^2 in size, (ii) explain the effect of the vent opening area and height on the HGL temperature results, (iii) compare the results with the HGL temperature results for closed compartments based on Beyler's correlation in NUREG-1805, and (iv) justify why Beyler's correlation for closed compartments was not used.

  In its response to part (i) (Reference 10), the licensee explained that the use of a ventilation opening area of 1 m^2 is generally conservative as smaller ventilation opening areas yield higher predicted HGL temperatures. The licensee also stated that the reduction of the HRR in ventilation limited scenarios, which are more likely when the ventilation opening is small, was not credited.

  In its response to part (ii) (Reference 10), the licensee stated that plant walk-downs were performed to identify the dimensions of the opening area(s) and ceiling height for each compartment where the MQH model was used. A sensitivity analysis was then performed using the compartment-specific values for these parameters rather than the generically assumed 1 m^2 opening area, m^2 opening height, and 3 m ceiling height. The sensitivity analysis identified small increases in ΔCDF and ΔLERF.

  The NRC staff concludes that the final reported risk results in the response to FM RAI 01 (d) ii are sufficient for use to support transition because the results of the sensitivity study indicate no substantive effect on the transition risk. However, because the self-approval acceptance guidelines are for opening areas much smaller than those in the transition acceptance guidelines, the licensee stated it would include the effects of compartment-specific vent opening areas and heights on HGL temperature in the FPRA prior to use of the FPRA for post-transition PCEs by completing LAR Attachment S, Implementation Items REC-158 and REC-159 (Reference 23).

  From the information gathered during the aforementioned plant walk-downs, the licensee identified two compartments with vent areas significantly smaller than 1 m^2. In response to part (iii) (Reference 10), the licensee re-calculated the CDF and LERF with the assumption that all fire scenarios in these two compartments will result in an HGL. The PRA re-quantification shows that applying Beyler's

method in compartments with very small ventilation openings may result in an increase of the plant CDF and LERF.

The licensee also stated in response to PRA RAI 24.c (Reference 18) that the post-transition FCS NFPA 805 program will use the FPRA supporting the integrated analysis unless or until other methods acceptable to the NRC are used instead. The NRC staff concludes that this issue is resolved because the reported estimates for transition change in risk include the effects of very small ventilation openings on HGL temperature, and the FPRA will use these or other acceptable methods to account for the effects of very small ventilation openings on HGL temperature as needed for post-transition self-approval risk evaluations

Finally, in its response to part (iv) (Reference 10), the licensee stated that Beyler's method was not used because FCS fire compartments are generally not closed, and referred to the response to part (iii) for a discussion of the impact on plant risk from HGL development in compartments with very small ventilation openings.

As a follow-up to FM RAI 01 (d), the NRC staff issued FM RAI 01.03 (Reference 25), asking the licensee to provide technical justification for the use of the MQH correlation in naturally ventilated compartments that have vents in the upper part of the room.

In its response (Reference 14), the licensee explained that heating, ventilation, and air conditioning (HVAC) vents are generally not located at the ceiling, but often in the upper portion of the compartment and close to the ceiling. Since the MQH correlation may not be valid in these compartments, the FPRA was re-quantified using the method of Foote, Pagni, and Alvares to calculate upper layer temperature in mechanically ventilated compartments. When this method is implemented, the total CDF, total LERF, ΔCDF, and ΔLERF are unchanged.

The NRC staff concludes that the final reported risk results are sufficient for use to support transition because the results of the sensitivity study indicate no substantive effect on the transition risk. However, because the self-approval acceptance guidelines are much smaller than the transition acceptance guidelines, the licensee stated it would incorporate these effects in the MCR abandonment analysis in the FPRA prior to use of the FPRA for post-transition PCEs by completing LAR Attachment S Implementation Items REC-158 and REC-159 (Reference 23).

Based on the additional information provided, the NRC staff concludes that the licensee's approach to perform the HGL calculations is acceptable.

- Although some cabinets may contain non-qualified cable, the licensee assumed that all cabinets contain only qualified cable. This was justified on the basis that the 98th percentile HRR of cabinets with qualified cable in Volume 2 of NUREG/CR-6850, is higher than that of cabinets with non-qualified cable and closed doors. However, since the 98th percentile HRR is higher for cabinets with

non-qualified cable and open doors, the NRC staff issued FM RAI 01 (e) (Reference 10), to ask the licensee to provide justification for not considering cabinets with open doors.

In its response (Reference 10), the licensee indicated that no electrical cabinets with open doors were found during walk-downs in areas outside the MCR envelope. In the computer room adjacent to the MCR the licensee identified four instrumentation racks that might behave as open door cabinets in a fire. A sensitivity analysis was performed to quantify the effect on MCR abandonment CDF and LERF of treating these racks as open-door cabinets with multiple bundles of unqualified cable. The effect was found to be negligible.

The NRC staff concludes that the final reported risk results are sufficient for use to support transition because the results of the sensitivity study indicate no substantive effect on the transition risk. However, because the self-approval acceptance guidelines are much smaller than the transition acceptance guidelines the licensee stated they would incorporate these effects in the MCR abandonment analysis in the FPRA prior to use of the FPRA for post-transition PCEs by completing LAR Attachment S, Implementation Items REC-158 and REC-159 (Reference 23).

- The NRC staff issued FM RAI 01 (f).iii (Reference 24), to ask the licensee to justify why a time to peak HRR of 5 minutes was used for transient fires in the MCR abandonment analysis, in light of the fact that FAQ 08-0052 (Reference 51) specifies 2 minutes and 8 minutes for trash bags and trash cans, respectively.

  In its response (Reference 10), the licensee explained that unconfined trash bags are generally not expected at FCS, and that, therefore, a growth time of 5 minutes is considered to be conservative.

  Based on the additional information provided, the NRC staff concludes that the time to transient fire peak HRR of 5 minutes assumed in the MCR abandonment analysis is acceptable.

- The NRC staff issued FM RAI 01 (f).iv (Reference 24), to ask the licensee to justify why scenarios with an ignition source in the kitchen, computer room and other areas connected to the MCR were not considered in the MCR abandonment analysis.

  In its response (Reference 10), the licensee stated that ignition sources in all areas inside the MCR envelope, with exception of the kitchen, are included in the ignition frequency calculation and modeled by the MCR abandonment analysis. The licensee stated that measures will be taken to minimize the risk contribution of ignition sources in the kitchen area. In a letter dated April 10, 2014 (Reference 23), the licensee stated that the method utilized to minimize the risk contribution of ignition sources in the kitchen area will be the development of enhanced administrative controls while equipment is in use. The action to

develop the enhanced administrative controls is included in LAR Attachment S, Implementation Item REC-141 (Reference 23).

In light of the licensee's proposed measures to minimize the risk contribution from ignition sources in the kitchen area, the NRC staff concludes that the fact that the MCR abandonment analysis did not consider fire scenarios in this area is acceptable.

- Regarding the FDS simulation of an air compressor oil fire scenario in fire area FC32, the NRC staff issued FM RAI 01 (f).v (Reference 24), asking the licensee to (a) justify why the potential contribution from raw water pipe insulation to the HRR in this scenario was not considered, (b) explain why the heat flux threshold for cables was not considered and only the temperature threshold was evaluated, and (c) demonstrate how a turbine-driven AFW pump oil fire, including the potential contribution of the raw water pipe insulation in the vicinity of the pump, would not result in further propagation or damage to additional targets.

  - In its response to part (a) (Reference 11), the licensee explained that it re-ran the FDS simulation of the instrument air compressor oil fire scenario with the raw water pipe insulation included in the model. The FDS simulation indicated that the average maximum adiabatic surface temperature of the raw water pipe insulation (120 degrees Celsius (°C)) is well below the ignition temperature of the insulation reported by the manufacturer (>360 °C). However, given the uncertainties in the properties of the insulation, the possibility of melting and dripping, and in consideration of DID, margin enhancement, and the potentially significant consequences if the overhead cables were to fail, the licensee stated that they intend to implement a plant modification to minimize the potential for the foam insulation to threaten overhead cables. Alternatively, the licensee may perform additional analysis to reduce the uncertainty in the FDS simulations. This proposed modification or additional analysis is included in LAR Attachment S, Implementation Item REC-143 (Reference 23).

    Based on the results of the FDS simulation and the licensee's proposed modifications, the NRC staff concludes that the licensee has provided information to assure that the raw water pipe insulation will not contribute to the HRR in the compressor oil fire scenario in fire area FC32.

  - In its response to part (b) (Reference 10), the licensee stated that temperature was judged to be the primary and most likely failure mechanism based on the significant distance between the flaming region and the targets, and the target location in the plume and HGL regions.

    The NRC staff concludes that the licensee's justification for not considering the heat flux damage criteria is acceptable.

- In its response to part (c) (Reference 10), the licensee explained that, according to Volume 2 of NUREG/CR-6850, pump fires are divided into two scenarios, one scenario that involves 10 percent of the lubricating oil and a second scenario with a much lower frequency that involves 100 percent of the oil inventory. Due to the small amount of oil in the 10 percent case (0.55 gallon), the pump is the only target that is damaged and the fire is not expected to ignite the pipe insulation, which is at a considerable distance from the pump. The 100 percent oil fire, if unsuppressed, was assumed to cause an HGL. In this scenario, the potential HRR contribution from the pipe insulation is therefore not relevant.

  The NRC staff concludes that information provided by the licensee assures that turbine-driven AFW pump oil fires will not lead to additional target damage in fire area FC32.

- All cable targets in compartments modeled in the FCS FPRA were assumed to be "thermoset" with regard to critical damage temperature and heat flux thresholds. The NRC staff issued FM RAI 02 (Reference 24), asking the licensee to characterize the cabling in the power block, and to determine how the presence of thermoplastic cabling affects plant risk.

  In its response (Reference 10), the licensee indicated that FCS primarily uses cables having thermoset insulation, but that a limited number of thermoplastic cables are used for fire detection and suppression applications and in the MCR. None of the thermoplastic cables are therefore considered targets in the FPRA, and, consequently, the thermoset damage criteria specified by Volume 2 of NUREG/CR-6850 were used for the purpose of identifying cable targets in the ZOI calculations. The limited use of thermoplastic cable insulation outside the MCR did not necessitate identifying additional targets beyond those identified on the basis of the thermoset damage criteria. Inside the MCR, thermoplastic cable insulation is used inside electrical cabinets, and the MCR abandonment analysis conservatively applied the HRR distribution for electrical cabinets containing qualified cable, despite the presence of thermoplastic cable.

  Based on the additional information provided, the NRC staff concludes that the assumption in the FCS FPRA that all cable targets are "thermoset" is acceptable.

The licensee performed sensitivity analyses to address NRC staff concerns in FM RAIs 01 (a), 01 (b), 01 (d).iii and 05(c).i dated April 26, 2012 (Reference 24), and presented the same conclusion in its response to these RAIs (References 10 and 12). In addition, the licensee performed sensitivity analyses in response to several PRA RAIs. The NRC staff issued PRA RAI 24 (Reference 25), asking the licensee to provide the results of a composite sensitivity analysis that shows the integrated impact on the fire risk (CDF, LERF, ΔCDF, ΔLERF). The results of the composite sensitivity analysis (Reference 15) and the NRC staff's evaluation are discussed in SE Section 3.4.2.2.

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 FCS process for performing fire modeling in support of the FPRA, the NRC staff concludes the licensee's approach for meeting the requirements of NFPA 805, Section 2.4.3.3 is acceptable.

3.4.2.4 Conclusions Regarding FPRA Quality

Based on NUREG-0800, Section 19.2, Section III.2.2.4.1, summarizing the NRC staff's review of PRA Quality required for an application, the NRC staff concludes that the licensee's PRA satisfies the guidance in RG 1.174, Section 2.3, and RG 1.205, Section 4.3 regarding the technical adequacy of the PRA used to support risk assessment to support transition to NFPA 805.

The NRC staff concludes that the PRA approach, methods, and data are acceptable and therefore that Section 2.4.3.3 of NFPA 805 is satisfied for the request to transition to NFPA 805. The NRC staff based this conclusion on the findings that: (1) the PRA model for FCS meets the criteria 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 models conform sufficiently to the applicable industry PRA standards for internal events and fires at an appropriate Capability Category, considering the acceptable disposition of the peer review and NRC staff review findings; and (3) the fire modeling used to support the development of the FCS FPRA has been confirmed as appropriate and acceptable.

Prior to using the FPRA results to support RI self-approval of changes to the FPP, the NRC staff concludes that the following must be completed since the self-approval acceptance guidelines are much smaller than the transition acceptance guidelines:

- The NRC staff concludes that a number of changes identified in the response to PRA RAI 25 (Reference 11) should be revised to replace unacceptable methods with acceptable methods. This is described in Implementation Items REC-158 and REC-159 of LAR Attachment S (Reference 23).

- The NRC staff concludes the Fire PRA HRA, including the HRA of the alternate shutdown process, should be upgraded to NUREG-1921, that a focused-scope peer review of the upgrade should be performed, and that the NRC should be informed if the RG 1.174 risk acceptance guidelines are not met following the upgrade of the fire HRA. This is described in LAR Attachment S, Implementation Items REC-145 and REC-159 (Reference 23).

In addition, implementation item REC-142 (Reference 23) states that as the plant modifications are planned and implemented, the licensee will verify that the risk reducing benefits remain consistent with, or bounded by, the estimates provided in the LAR. Should any non-conservative inconsistencies be discovered, the licensee will submit a summary of the issue and its proposed resolution to the NRC. The NRC staff concludes that this implementation item supports the determination that the PRA is of sufficient quality to support the application even when some of the models and results are based on proposed and not as-built, as-operated plant procedures and configurations as specified in RG 1.174.

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 FCS 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 (Reference 23).

3.4.3 Fire Risk Evaluation

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

Plant configurations that did not meet the deterministic requirements of NFPA 805, Section 4.2.3.1 were considered VFDRs. VFDRs that will be brought into deterministic compliance through plant modifications need no risk evaluation. The licensee identified 264 VFDRs in LAR Attachment C, Table B-3, 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 the VFDRs are acceptable.

All of the VFDRs identified by the licensee were categorized as separation issues. The VFDRs can generally be categorized into the following three types of plant configurations: (1) inadequate separation resulting in fire-induced damage of process equipment or associated cables required for the identified success path; (2) inadequate separation resulting in fire-induced spurious operation of equipment that may defeat the identified success path; (3) inadequate separation resulting in fire-induced failure of process monitoring instrumentation or associated cables required for the identified success path; (4) combinations of the above configurations. In response to PRA RAI 11 (Reference 10), the licensee explained how the change in risk from retained VFDRs was calculated.

Some VFDRs were determined to have no risk implications. For example, the Nuclear Safety Capability Assessment (NSCA) identified pressurizer heaters as a means to help control reactor coolant system pressure. However, the PRA does not model functional failure of the pressurizer heaters and does not credit these heaters to mitigate fire events, hence VFDRs for fire-induced failure of the credited pressurizer heaters were assessed to have negligible risk impact. If all VFDRs in a fire area were assessed to have no risk implications, then the fire area was assessed to have no delta fire risk.

All VFDR failures determined to be risk-relevant to the PRA were included in the FRE. For each of these risk-relevant VFDR failures, where possible, existing basic events were identified in the PRA that represented the component failures associated with the VFDR. Where existing

basic events did not represent the component failures, modeling the VFDR component failures required adding new logic to the FPRA model. The fire scenarios that could induce the VFDR component failures were then identified. In some cases no credible fire scenarios were identified that affected VFDR components (e.g., the components were too far apart given the potential fire size) and no further evaluation of the VFDR was required. If all VFDRs in a fire area were determined to not be failed by any fire scenario, then the fire area was assessed to have no delta fire risk. In a few cases, scenarios which might have involved a VFDR component were identified but were not considered risk relevant because of the combination of unlikely scenario and the associated failure of the component having little impact on the scenario.

All remaining VFDRs were determined to be risk-relevant (i.e., they were not previously determined to have no risk implications or they were not previously determined to not be failed by any fire scenario). The change in risk associated with these remaining VFDRs in each fire area is obtained by subtracting the CDF and LERF for a compliant plant configuration from the corresponding CDF and LERF results for the post-transition plant configuration. The total delta fire risk for FCS was obtained by summing the delta risk for each fire area and comparing the total for each unit to the acceptance guidelines contained in RG 1.174.

The post-transition plant risk for each fire scenario was quantified as the sum of the risk for all basic events that represented all component failures induced by the fire scenario, including basic events that modeled risk-relevant VFDR failures. The compliant plant risk for each fire scenario was similarly quantified with the exception that basic events that modeled risk-relevant fire-induced VFDR failures were removed from the quantification to represent a deterministically-compliant condition. The base or random failure probabilities of the risk-relevant VFDR basic events apply for the compliant case. The NRC staff concludes that this is a reasonable approach since the compliant plant, while having no fire-induced failures of VFDRs, still has the potential to fail VFDRs from random non-fire failures.

This method of calculating the delta risk was used for all fire areas except for FC32, "Compressor Area," FC41, "Cable Spreading Room," FC42, "Control Room Complex," and FC43, "Emergency Feedwater Tank Area." In these cases the licensee used a bounding approach to estimate the delta risk. For FC32, FC41, and FC43, the licensee set the delta risk for each fire area to the total fire risk for each respective fire area (essentially setting the risk of the compliant plant to zero). The NRC staff concludes this approach is conservative because it assumes the fire risk at a compliant plant is zero. For FC42, the licensee set the delta risk to the total fire risk associated with MCR abandonment and subsequent use of the alternate shutdown process. The NRC staff concludes this approach is conservative because there are no VFDRs associated with non-abandonment fire scenarios in the MCR and it assumes the fire risk at a compliant plant of MCR abandonment scenarios is zero. A conservative estimate of the change in risk associated with a RI change is acceptable as described in RG 1.174.

For some VFDRs, the licensee determined the failure not to be risk-relevant (i.e., the delta risk to be effectively zero). In PRA RAI 11.01 (Reference 25), the NRC staff asked the licensee to assess the impact of not including these failures in the calculated delta risk. In response to the RAI (Reference 14), the licensee reviewed the FREs for cases in which the FPRA conservatively did not credit VFDR components, but whose proper operation could mitigate fire-induced events and could thus result in underestimating the calculated delta risk. The licensee

identified no instances where modeling assumptions caused underestimation of delta risk and therefore the NRC staff considers this issue closed.

RG 1.205, Section 2.2.4.1, and FAQ 08-0054 contain guidance that directs that the change in risk between the post-transition and the compliant plant properly reflect both the post-transition and the compliant plant as-built and as-operated risks. To ensure that the risk accurately reflects the as-built and as-operated risk of both the post-transition and the compliant plant risk, the licensee modeled random failures of functions and systems (e.g., offsite power, turbine-driven auxiliary feedwater (TDAFW) pump, emergency core cooling, feed and bleed) that are not failed as a result of the fire in both the post-transition and the compliant models. Therefore, the NRC staff concludes that the change in risk evaluations for VFDRs as described above appropriately reflects the change in risk associated with retaining a VFDR instead of bringing the plant into compliance with the deterministic requirements.

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 52). The NRC staff further concludes that the results of these calculations for each fire area, which are summarized in Table 3.4.6-2 below, demonstrate that the difference between the risk associated with implementation of the deterministic requirements and that of the VFDRs meets the risk acceptance criteria described in NFPA 805, Section 2.4.4.1.

3.4.4 Additional Risk Presented by Recovery Actions

The NRC staff reviewed LAR Attachment C, "NEI 04-02 Table B-3 – Fire Area Transition," LAR Attachment G, "Recovery Actions Transition," and LAR Attachment W, "Fire PRA Insights," during its evaluation of the additional risk presented by the NFPA 805 RAs at FCS. Section 3.2.5 of this SE describes the identification and evaluation of RAs.

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

The licensee identified the RAs in LAR Attachment G, Table G-1. With the exception of fire area FC42, "Control Room Complex," the licensee did not credit RAs for risk reduction. However, the licensee did identify RAs in the resolutions to 115 VFDRs, in four fire areas, to maintain adequate DID. These DID RAs were not credited in the FPRA fire area risk estimates.

For FC42, the licensee identified an alternate shutdown strategy that included RAs associated with alternative shutdown in the resolutions to 103 VFDRs. These alternate shutdown strategy RAs for MCR abandonment scenarios were credited in the FPRA and FC42 FRE. However, the licensee did not provide the additional risk of crediting these RAs as required by NFPA 805. Per FAQ 07-0030 (Reference 45), one acceptable method to estimate the additional risk of RAs is to conservatively assign the total change in risk from transition for a VFDR with one or more RAs to be the additional risk of RAs in that area. Since no risk reduction modifications were

credited in FC42 in either the transition plant or the compliant plant, the total change in risk for fire area FC42 can be conservatively assigned as the additional risk of RAs. This estimated risk is less than the risk acceptance guidelines in RG 1.174 for FC42 and therefore acceptable. The sensitivity analysis provided by the licensee in response to PRA RAI 01.j.01 (Reference 14), regarding the licensee's re-evaluation of the CCDP and CLERP for MCR abandonment due to fires in the MCR, re-confirmed that the delta risk for FC42 remains significantly below the risk acceptance guidelines in RG 1.174.

The licensee reviewed all of the RAs for adverse impact and dispositioned each action as stated in LAR Attachment G. None of the RAs listed in LAR Table G-1 were found to have an adverse impact on the FPRA and all were determined to be feasible based on a documentation review only. A confirmatory field verification walk-through of the feasibility for the credited NFPA 805 RAs will be performed and documented as part of the NFPA 805 RI/PB FPP implementation, identified as LAR Attachment S, Implementation Item REC-106 (Reference 23).

The NRC staff concludes that the licensee's approach for calculating the additional risk of RAs for all fire areas except FC42 is acceptable because it is consistent with RG 1.205, Section 2.2.4.1, FAQ 07-0030 (Reference 45), and FAQ 08-0054 (Reference 52). For fire area FC42, the NRC staff concludes that the licensee did not appropriately calculate the additional risk of RAs. However, the NRC staff used the licensee's calculated delta risk for FC42 as the additional risk of RAs for this fire area because the licensee did not credit risk reduction modifications for this fire area (which is an acceptable method per FAQ 07-0030). The staff concludes that the additional risk of RAs in this fire area is acceptable because it is less than the risk acceptance guidelines in RG 1.174.

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

The licensee did not use any RI or PB alternatives to compliance with NFPA 805.

3.4.6 Cumulative Risk and Combined Changes

In LAR Attachment S, Table S-2, the licensee identified four modifications (REC-111, REC-116, REC-119, and REC-120) (Reference 23) being implemented to reduce plant risk (all other plant modifications identified in LAR Attachment S, Table S-2 are being implemented to bring FCS into compliance with the deterministic requirements of either Chapter 3 or Chapter 4 of NFPA 805). The licensee's FREs included these four plant modifications in both the post-transition plant and in the compliant plant; therefore, these modifications are not combined changes as discussed in Section 2.1.1 of RG 1.174, Revision 1, and the risk reduction from these changes need not be separately estimated.

The total CDF and total LERF are estimated by adding the risk assessment results for internal, fire, and seismic hazard events as indicated in Table 3.4.6-1. The licensee provided final risk estimates in the response to PRA RAI 24.01 dated January 24, 2014. In a response to PRA RAI 24 dated November 4, 2013 (Reference 18), the licensee made a number of modifications to the PRA and the PRA methods as a result of the RAIs discussed above in this SE. After these modifications, the licensee estimated a total internal events CDF of 9.99E-5/year. When the estimate of seismic CDF of 1.30E-5/year was added to this estimate, the total CDF became about 1.13E-4/year, which exceeds 1E-4/year and RG 1.174 guidelines. Consequently, in response to the RAI 24.01 dated January 24, 2014 (Reference 21), the licensee identified several FPRA models and methods that it believed produced conservative results and modified these models and methods. As described in this RAI response, the licensee revised station battery depletions times in the models, eliminated erroneous failure mapping for three fire scenarios models, and credited suppression (in accordance with NUREG/CR-6850) in some models where it was not originally credited. The licensee also switched to a more accurate method to combine cut set probabilities into a single value, and expanded the Bayesian update of generic fire frequency bins from only plant-specific bins where fire events determined to be "challenging" were reported to all generic fire frequency bins including those where no challenging fires were reported at FCS. After incorporating these modifications in the PRA, the licensee reported in the response to PRA RAI 24.01 that the internal, fire, and seismic CDF decreased from 1.13E-4/year to 9.21E-5/year. Thus, the total CDF decreased below 1E-4/year and is slightly below the RG 1.174 guideline for Region II as noted in Table 3.4.6-1. Although a total LERF was not reported, the licensee observed in the RAI response that meeting the CDF guidelines means that the LERF guideline are also met unless the conditional large early release probability for seismic is as high as 0.35, a generally conservative estimate. The NRC staff concludes that modeling and method changes the licensee reported in response to PRA RAI 24.01 are acceptable because they correct errors and otherwise implement acceptable methods. The final CDF and LERF results are summarized in Table 3.4.6-1. The estimated total CDF for FCS is slightly below the RG 1.174 risk guidelines for Region II (small change) of 1E-04/year. The estimated total LERF for FCS is well below the RG 1.174 risk guidelines for Region II (small change) of 1E-05/year.

Table 3.4.6-1: CDF and LERF for FCS after Transition to NFPA 805[(1)]

Hazard Group	CDF (/year)	LERF (/year)
Internal + Internal Flood Events + Fire Events + Seismic Events	9.21E-05	5.34E-06

(1) Risk results provided in the response to PRA RAI 24.01 (Reference 21). The seismic CDF contribution is 1.3E-05/yr, which is for the weakest link model from Memorandum from Patrick Hiland (NRC) to Brian W. Sheron (NRC), "Safety/Risk Assessment Results for Generic Issue 199, 'Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plant,'" dated September 2, 2010 (Reference 72). The LERF does not include a seismic contribution.

The licensee also provided in the LAR the ΔCDF and ΔLERF estimated for each fire area at FCS that is not deterministically compliant, in accordance with NFPA 805, Section 4.2.3, "Deterministic Approach." The risk estimates for these fire areas result from the planned modifications and administrative controls that will be implemented as part of the transition to NFPA 805 at FCS, as well as RAs, to reduce VFDR risk. The ΔCDF and ΔLERF results by fire

area, as reported in the LAR, are summarized in Table 3.4.6-2. Each of the fire area risk increases are less than the RG 1.174 risk acceptance guidelines for Region II (small change) of 1E-05/year for ΔCDF and 1E-06/year for ΔLERF.

While the licensee did not provide a new table of changes in risk for each fire area in the integrated analysis provided in the responses to PRA RAI 24 (Reference 18) and PRA RAI 24.01 (Reference 21), the licensee did report in the RAI responses that the changed PRA methods resulted in a slight decrease in the total ΔCDF and ΔLERF compared to the total ΔCDF and ΔLERF results derived from Table 3.4.6-2. The NRC staff notes that if any single fire area in the integrated analysis exceeded the RG 1.174 risk acceptance guidelines, this risk increase would have to be offset by a risk decrease in a different fire area in order for the total net increase for the plant to be less than the RG 1.174 risk acceptance guidelines. Since the licensee did not credit any new risk reduction modifications in the integrated analysis that might result in any individual fire area changing to a risk decrease, the NRC staff concludes that it is unlikely that the risk increases reported in the LAR for each fire area would have become risk decreases with the model refinements described by the licensee in the response to PRA RAI 24.01. Thus, the NRC staff concludes that it is unlikely that any given fire area would exceed the acceptance guidelines and, if any area did exceed the guidelines, the total risk increase is less than the acceptance guidelines and is, therefore, acceptable.

Table 3.4.6-2: Fire ΔCDF and ΔLERF Associated with Transition to NFPA 805[1]

Fire Area	Description	ΔCDF (/year)	ΔLERF (/year)
FC20-1	Personnel Complex Area (Rooms 26, 31, and 58)	4.8E-08	2.68E-09
FC28	Ventilation Equipment Area	N/A(1)	N/A(1)
FC31	Intake Structure	7.81E-08	6.31E-10
FC32	Compressor Area	5.69E-08	3.68E-09
FC34A	Electrical Penetration Area - Basement	N/A(2)	N/A(2)
FC34B-1	Electrical Penetration Area Ground and Intermediate Levels	4.34E-08	2.02E-10
FC36A	East Switchgear Area	1.47E-07	9.22E-10
FC36B	West Switchgear Area	4.02E-07	1.91E-08
FC41	Cable Spreading Room	3.44E-07	1.81E-07
FC42	Control Room Complex	4.59E-06	4.59E-07
FC43	Emergency Feedwater Tank Area	5.32E-08	4.49E-10

(1) All VFDRs in the fire area were assessed to have no risk implications; therefore, the fire area was assessed to have no delta fire risk.

(2) All VFDRs in the fire area were determined to not be failed by any fire scenario; therefore, the fire area was assessed to have no delta fire risk.

[1] The reported change in risk values in Table 3.4.6-2 are the values from the original LAR.

In the response to PRA RAI 24.01 (Reference 21), the licensee reported final total change in risk estimates based on the FPRA after implementing several FPRA model and method refinements to use NRC-accepted methods. This response indicated that implementing a PB NFPA 805 FPP at FCS is characterized by a CDF increase of 4.93E-6/yr. and a LERF increase of 6.27E-7/year. Based on the licensee's total risk and FREs results, the NRC staff finds that the risk increase for each fire area associated with transition to NFPA 805 at FCS is within the RG 1.174, Region II risk acceptance guidelines of 1E-5/year for ΔCDF and 1E-6/year for ΔLERF.

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

3.4.7 Uncertainty and Sensitivity Analyses

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

In response to PRA RAI 26.01 (Reference 21), the licensee provided the results of a sensitivity analysis, using the updated FPRA, using the fire ignition frequency values in NUREG/CR-6850 (References 35, 36, and 37) for those ignition frequency bins having an alpha factor less than or equal to one as suggested by FAQ 08-0048 (Reference 49). The licensee reported that the risk acceptance guidelines for RG 1.174, Revision 1 Region II are exceeded when the NUREG/CR-6850 fire ignition frequencies are utilized. To address this, the licensee described some modeling methods that result in conservative results for fire scenarios that are the dominant contributors to the risk increase which, if removed, are expected to offset the increases. The conservative modeling methods described by the licensee include failing all targets in the respective compartments for Bin 13 dryer fires and not crediting the alternate shutdown process in loss-of-control scenarios for Bin 4 main control board (MCB) fires and for CFWC fires in fire area FC41. The licensee also identified that CFWC fires in fire areas FC32, FC36A, and FC36B, and Bin 15.1 electrical cabinet fires in fire areas FC36A, FC36B, FC34C, and FC34B-1 are dominant contributors to fire risk because fires in these fire areas can lead to station blackout. To compensate for the uncertainty in the Bin 15.1 and CFWC fire frequencies, the licensee identified additional DID measures to station a self-contained breathing apparatus (SCBA), flashlight, relevant procedure(s), and tools in the vicinity of these areas, which will increase the reliability of station blackout mitigating actions. The licensee also stated that it may pursue crediting an alternate steam generator level monitoring system to provide a redundant source of steam generator level indication if crediting this system is determined to be viable. If determined to be viable, this system may be implemented as an additional DID measure either in lieu of or in addition to stationing the SCBA and associated equipment. The licensee added Implementation Item REC-147 of LAR Attachment S (Reference 23) to implement and maintain these DID measures. The NRC staff concludes that further improvements to the FPRA would reduce the change in risk estimates but that further reduction of the quantitative estimates from additional analytical efforts is not necessary. Based on the quantitative and qualitative evaluation performed by the licensee in the response to PRA RAI 26.01, and the additional DID measures to be implemented at FCS, the NRC staff

concludes that the risk increase associated with the transition to NFPA 805 is acceptable and meets the guidelines described in RG 1.174.

In response to PRA RAI 19 (Reference 13), the licensee stated that transient fires and TFWC were located at pinch points (defined as areas where the highest concentrations of cable trays or conduits exist within a given fire area and where the 98th percentile HRR of a potential transient fire could damage those cable trays). In PRA RAI 19.01 (Reference 18), the NRC staff noted that the licensee's method of locating potential transient fire scenarios near the highest concentrations of cables is not necessarily correlated with the locations of highest CCDP and requested further justification that the licensee's method for postulating the location of transient fires ensures that pinch points are identified. In response to the RAI (Reference 18), the licensee provided the results of a sensitivity analysis in which the entire floor area was divided into a grid and a transient scenario was postulated for each location in the grid, which replaced the original pinch-point method for postulating transient fire locations. The licensee explained that with the grid method all potential transient fire locations within a compartment are considered. The results of the analysis showed a decrease in the total CDF and LERF contribution from transient fires of more than 30 percent and a decrease in the ΔCDF and ΔLERF contribution from transient fires of more than 50 percent. Based on the results of the sensitivity analysis, the NRC staff concludes that the licensee's pinch-point method for locating transient fires is conservative and therefore concludes this issue is resolved.

3.4.8 Conclusion for Section 3.4

Based on the information provided by the licensee in the LAR, as supplemented, regarding the fire risk assessment methods, tools, and assumptions used to support transition to NFPA 805 at FCS, 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 (PCEs) and Section 4.2.4.2 (FREs), is of sufficient quality to support the application to transition the FCS FPP to NFPA 805. The NRC staff concludes the PRA approach, methods, tools, and data are acceptable and are in accordance with NFPA 805 Section 2.4.3.3.

- The PRA maintenance process is adequate to support self-approval of future RI changes to the FPP following completion of the PRA related implementation items. These implementation items are as follows:

  - Replace remaining unacceptable methods with acceptable methods.

  - Upgrade the FPRA HRA, including the HRA of the alternate shutdown process, to NUREG-1921, perform a focused-scope peer review of the upgrade and resolve resulting peer review findings, and inform the NRC if the RG 1.174 risk acceptance guidelines are not met following the upgrade of the fire HRA.

  - Submit to the NRC a summary of any issues and proposed resolutions should any nonconservative inconsistencies with the credit taken for plant modifications in the LAR be discovered.

- The transition process included a detailed review of fire protection DID and safety margin as required by NFPA 805. The NRC staff concludes the licensee's 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 for the purposes of this application, and the licensee has satisfied the guidance contained in RG 1.205, Revision 1, RG 1.174, Section 2.4, and NUREG-0800, Section 19.2, regarding acceptable changes in risk. By meeting the guidance contained in these approved regulatory documents, the changes in risk have been concluded to be acceptable to the NRC staff, and therefore meet the requirements of NFPA 805.

- The risk presented by the use of RAs was determined to be in accordance with the guidance in RG 1.205, Revision 1, and NFPA 805, Section 4.2.4. The NRC staff concluded that the additional risk associated with the NFPA 805 RAs is acceptable because the risk for each fire area that relies on a RA 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 or PB alternatives to compliance to NFPA 805 which fall under the requirements of 10 CFR 50.48(c)(4).

3.5 Nuclear Safety Capability Assessment Results

NFPA 805 (Reference 4), Section 2.2.3, "Evaluating Performance Criteria," states the following:

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

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

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

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

> When applying a deterministic approach, the user shall be permitted to demonstrate compliance with specific deterministic fire protection design requirements in Chapter 4 for existing configurations with an engineering

equivalency evaluation. These existing engineering evaluations shall clearly demonstrate an equivalent level of fire protection compared to the deterministic requirements.

3.5.1 Nuclear Safety Capability Assessment Results by Fire Area

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

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

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

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

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

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

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

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

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

The NRC staff reviewed the LAR Section 4.2.4 (Reference 6), "Fire Area Transition," Section 4.8.1, "Results of the Fire Area Review," Table 4-3, "Summary of NFPA 805 Compliance Basis and Required Fire Protection Systems And Features," Attachment C, "NEI 04-02 (Reference 5) Table B-3 – Fire Area Transition," Attachment G, "Recovery Actions Transition," Attachment K, "Existing Licensing Action Transition," Attachment S, "Plant Modifications and Items to be Completed During Implementation," and Attachment T, "Clarification of Prior NRC Approvals," during its evaluation of the ability of each fire area to meet the NSPC of NFPA 805.

FCS is a single-unit PWR with 54 individual fire areas including the yard, and each fire area is comprised of one or more fire zones. Based on the information provided in the LAR, as supplemented, the licensee performed the NSCA on a fire area basis. LAR Attachment C provides the results of these analyses on a fire area basis and also identifies the individual fire zones within the fire areas. The licensee documented the following:

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

Table 3.5-1 Fire Areas and Compliance Strategy

Fire Area	Area Description	NFPA 805 Compliance Basis
01	Safety Injection and Containment Spray Pump Area I	Deterministic
02	Safety Injection and Containment Spray Pump Area II	Deterministic
03	Spent Regenerant Tank & Pump Area	Deterministic
06-1	Gas Decay Tank Area	Deterministic
06-2	Gas Compressor Area	Deterministic
06-3	Basement & Personnel Corridor Area / Purifier/Waste Filter Room	Deterministic
06-4	Radwaste Monitor Tank Area	Deterministic
06-5	Shutdown Heat Exchanger Area I	Deterministic
06-6	Shutdown Heat Exchanger Area II	Deterministic
06-7	Letdown Heat Exchanger Area III	Deterministic
06-8	Heat Exchanger and Pump Area	Deterministic
06-9	Safety Injection and Refueling Water (SIRW) Storage Tank Area	Deterministic
09	Valve Area I	Deterministic
10	Charging Pump Area	Deterministic
13	Mechanical Penetration Area	Deterministic
16	Valve Area II	Deterministic
19	Personnel Complex Area	Deterministic

Fire Area	Area Description	NFPA 805 Compliance Basis
20-1	Personnel Corridor Area (Rooms 26, 31, 58)	Performance-Based
20-2	Waste Evaporator Area	Deterministic
20-3	Volume Control Tank Area	Deterministic
20-4	Valve Area III	Deterministic
20-5	Ion Exchange Area	Deterministic
20-6	Waste Disposal and Hot Tool Storage and Issue Area / Spent Resin Pump and Tank Room	Deterministic
20-7	New Fuel Storage and Uncrating / Waste Holdup Tank Area / Transfer Canal Pump / Ventilation Room	Deterministic
20-7 Roof	VA-46A and VA-46B Condenser Area	Performance-Based
23	Pipe Penetration Area	Deterministic
24	Sampling Area	Deterministic
28	Ventilation Equipment Area	Performance-Based
30	Containment	Deterministic
31	Intake Structure	Performance-Based
32	Compressor Area	Performance-Based
33	Component Cooling Heat Exchanger Area	Deterministic
34A	Electrical Penetration Area - Basement	Performance-Based
34B-1	Electrical Penetration Area - Ground and Intermediate Levels/QA Vault	Performance-Based
34C	Group 1 MCC Area	Deterministic
35A	Diesel Generator Room 1	Deterministic
35B	Diesel Generator Room 2	Deterministic
36A	East Switchgear Area	Performance-Based
36B	West Switchgear Area	Performance-Based
36C	West Switchgear Area (36C) note(1)	Deterministic
37	Battery Room 1	Deterministic
38	Battery Room 2	Deterministic
40	Equipment Hatch Enclosure Area	Deterministic
41	Cable Spreading Room	Performance-Based
42	Control Room Complex	Performance-Based
43	Service and EFWST Area (Room 81)	Performance-Based
45	Service Building	Deterministic
46	Turbine Building / South Air Lock Control Room to Turbine Building	Deterministic
47	Transformer Yard Area	Deterministic
50	Outdoor Gas Storage	Deterministic

Fire Area	Area Description	NFPA 805 Compliance Basis
C/RP	Chemistry and Radiation Protection Facility	Deterministic
RW	Radwaste Processing Building	Deterministic
TSC	Technical Support Center	Deterministic
YD	Yard Areas, Condensate Storage Tank, General	Deterministic

Note 1: Fire Area 36C combined with Fire Area 36B in Safe shutdown analysis (SSA) RAI 04-02 response dated July 24, 2012 (Reference 10).

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

- The approach used in accordance with NFPA 805 (i.e., the deterministic approach in accordance with NFPA 805, Section 4.2.3, or the PB approach in accordance with NFPA 805, Section 4.2.4).
- The SSCs required to meet the NSPC.
- Fire detection and suppression systems required to meet the NSPC.
- An evaluation of the effects of fire suppression activities on the ability to achieve the NSPC.
- The disposition of each variance from deterministic requirements (VFDR) using either modifications, RAs, or the performance of an FRE in accordance with NFPA 805, Section 4.2.4.2.

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

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

The licensee performed a detailed analysis of fire protection features and identified the fire suppression and detection systems required to meet the NSPC for each fire area. LAR 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 protection systems and features installed in these areas are required to meet criteria for separation, DID, risk, licensing actions, or EEEEs.

The NRC staff reviewed LAR Attachment C for each fire area, to ensure fire protection features systems 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 FCS treatment of the issue is acceptable because the licensee has adequately identified the fire protection features and 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. In SSA RAI 06, the staff requested the licensee clarify a discrepancy related to fire area 34B not containing redundant safe shutdown equipment or cables when LAR Table B-3, indicates that both trains of equipment might be affected by fire. In response to SSA RAI 06 (Reference 10), the licensee stated that this discrepancy arises from the methodology utilized in the preparation of an engineering analysis prepared in support of the 10 CFR 50 Appendix R licensing basis and was utilized as a direct input to the discussions for "Fire Suppression Effects on Nuclear Safety Performance Criteria" in LAR Table B-3. The licensee also stated that the engineering analysis identifies fire areas as being "not considered to contain redundant safe shutdown equipment or cables" where safe shutdown capability can be demonstrated with credit taken for OMAs. The licensee further stated that it has reviewed the discussion of fire suppression effects on NSPC for each fire area identified in LAR Table B-3 which resulted in revision to the LAR Table B-3 discussions for fire suppression effects to eliminate the discrepancy and to improve consistency and enhance the level of technical and basis information regarding fire suppression effects. The staff concludes that the licensee response to SSA RAI 06 is acceptable because the licensee eliminated the discrepancy, and as a result, the staff concludes that fire suppression activities will not adversely affect the ability of the licensee to meet the NSPC.

Based on the information provided by the licensee in LAR Attachment C, as supplemented, the licensee has evaluated fire suppression effects on meeting the NSPC and determined that fire suppression activities will not adversely affect the ability of FCS to meet the NSPC. The NRC staff concludes, based on review of information provided by the licensee, that the licensee's evaluation of the suppression effects on the NSPC is acceptable.

3.5.1.3 Licensing Actions

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

proposed clarifications to some of the previously approved licensing actions and documented these clarifications in LAR Attachment T, "Clarification of Prior NRC Approvals."

As described in LAR Section 4.2.3, the licensee used the endorsed guidance provided in NEI 04-02 (Reference 5), which requires a determination of the basis of acceptability and a determination that the basis of the acceptability was still valid, except as clarified, for the licensing actions that will be transitioned. The licensing actions being transitioned, including the clarifications, are summarized in Table 3.5-2. Clarifications are reviewed separately in Section 3.5.2 of this SE.

The licensee responded to Fire Protection Engineering (FPE) RAI 20 dated July 24, 2012 (Reference 10), in clarification of the need to rely on the exemption regarding no automatic suppression within the MCR. The licensee decided to withdraw this transition request in Attachment K and Attachment T for lack of full area suppression in the MCR (fire area 42). The RI/PB assessment of fire area 42 has established the fire risk as being within the acceptance criteria of RG 1.174, and that adequate DID and safety margin are maintained without full area suppression.

Table 3.5-2 FCS Previously Approved Licensing Actions Being Transitioned

Licensing Action Description	Clarification(s) LAR Attachment T	Applicable Fire Areas	NRC Staff Evaluation
Containment, Lack of 20 feet separation free of intervening combustibles The original exemption was for certain cables that could not be separated by more than 20 feet and other cables may be separated by more than 20 feet but with intervening combustibles present, contrary to the requirements of Section III.G.2 of Appendix R. The transitioned compliance basis for the applicable fire area is NFPA 805, Section 4.2.3.4(a), which is similar to the original Appendix R requirement.	Request 1. Separation of steam generator level and pressure, reactor coolant system (RCS) temperature, and source range neutron flux monitoring instrumentation inside containment: • Provide a corrected list of instruments, cables, penetrations, and raceway required for separating instrumentation located inside containment. • Clarify the separation compliance • To better discriminate compliance routing for RCS hot and cold leg temperature instrumentation as differentiated from other instrumentation separation in containment • Addition of instrument sensing lines to the redundant cable separation compliance in the original exemption	30	Discussed in Section 3.5.2

Licensing Action Description	Clarification(s) LAR Attachment T	Applicable Fire Areas	NRC Staff Evaluation
Containment, Lack of 20 feet separation free of intervening combustibles (see above for additional information regarding original exemption)	Request 2. Separation of RCS loop charging valves inside containment to: • Reflect that the RCS loop charging valves can spuriously close only due to fire damage in the vicinity of the associated electrical penetrations • Clarification of separation compliance to include the control cables for each valve, which are routed from the associated electrical penetration to the valve solenoid, with the cables for each valve contained within their own conduit.	30	Discussed in Section 3.5.2
Containment, Lack of 20 feet separation free of intervening combustibles (see above for additional information regarding original exemption)	Request 3. Separation of pressurizer auxiliary spray valves inside containment to: • Explicitly identify the pressurizer auxiliary spray valves (HCV-240 and HCV-249), cables, and routes that form the basis of valve availability • To additionally reflect that a pressurizer auxiliary spray valve can spuriously open due to fire damage or fail closed due to fire damage in the vicinity of control cables routed in conduit. • Clarification of the separation compliance to include a radiant energy shield installed between HCV-240 / JB-103C, and HCV-249 / JB-252C to provide separation between the redundant valves for a fire occurring in the pressurizer bay.	30	Discussed in Section 3.5.2
Containment, Lack of 20 feet separation free of intervening combustibles (see above for additional information regarding original exemption)	Request 4. Separation of pressurizer level instrumentation inside containment to: • Explicitly identify the pressurizer level instruments (LT-101X, LT-101Y, and LT-106) and the correct containment electrical penetrations for each • Clarification of the separation compliance to include sensing lines for both steam generators and pressurizer. • Clarification of the separation compliance to include radiant energy shield installed in the containment at the electrical penetrations to provide separation between the associate level transmitters.	30	Discussed in Section 3.5.2

Licensing Action Description	Clarification(s) LAR Attachment T	Applicable Fire Areas	NRC Staff Evaluation
Containment, Lack of 20 feet separation free of intervening combustibles (see above for additional information regarding original exemption)	Request 5. Separation of pressurizer pressure instrumentation inside containment to: • Explicitly identify the pressurizer pressure instruments (PT-105 and PT-115) and the correct containment electrical penetrations for each • Clarification of the separation compliance to include sensing lines for both steam generators and pressurizer. • Clarification of the separation compliance to include a radiant energy shield installed in the containment at the electrical penetrations to provide separation between the associated level transmitters.	30	Discussed in Section 3.5.2
Containment, Lack of 20 feet separation free of intervening combustibles (see above for additional information regarding original exemption)	Request 6. Separation of backup pressurizer heater groups inside containment to: • Explicitly identify the pressurizer heaters (RC4-1, RC4-2, RC4-3, and RC4-4) and the correct cabling, raceway, and containment electrical penetrations for each Clarification of the separation compliance to include a radiant energy shield installed between the associated electrical penetrations to provide separation between the associated electrical penetrations.	30	Discussed in Section 3.5.2

Licensing Action Description	Clarification(s) LAR Attachment T	Applicable Fire Areas	NRC Staff Evaluation
Intake Structure and Pull Boxes, Lack of a 1-hour fire barrier, Lack of area wide suppression, Lack of detection in pull box area The original exemption was for certain cables having lack of a 1-hour fire barrier, lack of area wide suppression, and lack of detection in pull box area (Appendix R III.G.2 criteria). The transitioned compliance basis for the applicable fire area is NFPA 805, Section 4.2.3.3(c), which is similar to the original Appendix R requirement.	Request 7. Separation of raw water pumps, discharge valves, and strainers inside the intake structure to: • Explicitly identify components and cables for power and/or control associated with all four raw water (RW) pumps, their associated discharge valves, and their associated strainers • To specify that a three-hour rated fire barrier enclosure has been provided for the power and/or control cables associated with all four RW pumps and their associated discharge valves. • Clarification of the separation compliance.	31	Discussed in Section 3.5.2
Air Compressor Room, Lack of a 1-hour fire barrier The original exemption was for certain cables having lack of a 1-hour fire barrier (Appendix R III.G.2 criteria). The transitioned compliance basis for the applicable fire area is NFPA 805, Section 4.2.3.3(c), which is similar to the original Appendix R requirement.	Request 8. Separation of redundant trains inside the compressor room to: • Include Room 53 (not originally identified) adjacent to the air compressor room in the exemption • Include fire barriers installed between redundant train cable tray sections not originally identified • Add additional tray sections that are not protected with fire barriers, although not containing credited cables, but providing fire propagation exposure • Include area-wide detection and suppression for fire area 32 (room 19) • Remove credit for the motor and turbine driven auxiliary feedwater (AFW) pumps for a fire event in this area using the diesel driven AFW pump.	32	Discussed in Section 3.5.2

Licensing Action Description	Clarification(s) LAR Attachment T	Applicable Fire Areas	NRC Staff Evaluation
Electrical Penetration, Lack of area wide suppression The original exemption was for lack of automatic suppression in the fire area as required by Paragraph III.G.2 and II.G.3 of Appendix R to 10 CFR 50. The transitioned compliance basis for the applicable fire area is NFPA 805, Section 4.2.3.3(c), which is similar to the original Appendix R requirement.	Request 9. Protection of redundant 480V MCCs inside the lower electrical penetration area (Fire Area 34A) to: • Editorially correct a cable number for MCC-3B1	34A, 34B-1	Discussed in Section 3.5.2
Switchgear Room, Lack of 3-hour rated barrier between redundant shutdown divisions The original exemption was for lack of 3-hour rated barrier between redundant shutdown divisions (III.G.2 criteria). The transitioned compliance basis for the applicable fire area is NFPA 805, Section 4.2.3.3(a), which is similar to the original Appendix R requirement.	Request 10. Protection of cable tray sections inside the switchgear rooms to: • Explicitly identify the specific components, cables, and raceways. • IDs for the associated train of pressurizer heater backup groups. • Crediting additional groups of pressurizer heater backup groups similar to original group. • Add credit for Fire Area 36C (pyrocrete enclosure) containing Train A only	36A, 36B, 36C	Discussed in Section 3.5.2

Licensing Action Description	Clarification(s) LAR Attachment T	Applicable Fire Areas	NRC Staff Evaluation
RCP Oil Collection, Lube Oil Holdup Tank Capacity The original exemption was for reactor coolant pump (RCP) oil collection capacity that did not meet Paragraph III.O of Appendix R to 10 CFR 50. The transitioned compliance basis for the applicable fire areas is NFPA 805, Section 3.3.12(2), which is similar to the original Appendix R requirement.	None	30	Based on the previous staff approval of the engineering justification for this exemption and the statement by the licensee that the basis remains valid, the NRC staff concludes that the underlying condition allowed by this licensing action is acceptable as a PB qualitative engineering analysis.

Licensing Action Description	Clarification(s) LAR Attachment T	Applicable Fire Areas	NRC Staff Evaluation
RCP Oil Collection, unprotected oil leakage sites. The original exemption was for reactor coolant pump (RCP) oil collection for unprotected leakage sites that did not meet Paragraph III.O of Appendix R to 10 CFR 50. The transitioned compliance basis for the applicable fire areas is NFPA 805, Section 3.3.12(1), which is similar to the original Appendix R requirement.	None	30	Based on the previous staff approval of the engineering justification for this exemption and the statement by the licensee that the basis remains valid, the NRC staff concludes that the underlying condition allowed by this licensing action is acceptable as a PB qualitative engineering analysis.

Licensing Action Description	Clarification(s) LAR Attachment T	Applicable Fire Areas	NRC Staff Evaluation
Relief from the 72-hour requirement to provide repair procedures and materials for cold shutdown capability for redundant cold shutdown components The original exemption was relief from the 72-hour requirement to provide repair procedures and materials for cold shutdown capability for redundant cold shutdown components (III.G.1.b criteria). The transitioned compliance basis for the applicable fire areas is NFPA 805, Section 4.2.1 to provide one success path necessary to achieve and maintain NSPC. This includes the clarification in Attachment T for raw water credit as hot shutdown and duct bank / manhole NSPC compliance.	Request 11. Separation of raw water pumps, discharge valves, and strainers in pull boxes, underground cable duct bank and manhole vaults to: • Explicitly identify the specific cables and components for the associated trains of RW system • Identify that the NFPA 805 NSPC compliance strategy requires the RW system to support refill capability of the emergency feedwater storage tank (EFWST) within 8 hours	47	Discussed in Section 3.5.2
Control Room, Lack of area wide suppression in alternate shutdown area Exemption requested per FCS to the NRC requests approval for the lack of an area wide automatic fire suppression system in an area for which alternate shutdown is provided, contrary to the requirements of Section III.G.3 of Appendix R.	Request 12. Lack of full suppression in the control room was rescinded by the licensee in RAI Response FPE RAI 20 (Reference 10).	42	Discussed in Section 3.5.2

Licensing Action Description	Clarification(s) LAR Attachment T	Applicable Fire Areas	NRC Staff Evaluation
None	Request 13. Deluge system in Containment Air Cooling and Filter System not in FP Program (FPE RAI 27) (Reference 13), NRC clarification of the approval of fire protection in containment is requested in Attachment T, with respect to the presence of a deluge system protecting the heating, ventilation, and air conditioning (HVAC) charcoal filters. • Clarification that the deluge system supplied by the containment spray system to protect the containment HVAC charcoal filters is not a fire protection system	30	Discussed in Section 3.5.2

The NRC staff reviewed the exemptions from the pre-NFPA 805 licensing basis identified in Table 3.5-2, including the description of the previously approved exemption from the deterministic requirements, the basis for and continuing validity of the exemption, and the NRC staff's original evaluation or basis for approval of the exemption. The licensee stated in LAR Section 4.2.3 and Attachment K for each transitioned exemption that the review of these existing licensing actions included a determination that the bases for previous acceptance remain valid and have been maintained, except as identified in LAR Attachment T which are further described in SE Section 3.5.2. The licensee identified seven of the ten prior exemptions where approval was obtained that needed additional clarification provided in LAR Attachment T, as supplemented.

Based on its review of the licensing actions identified and described in LAR Section 4.2.3, Attachments C and K, the NRC staff concludes that the licensing actions are identified by applicable fire area and remain valid to support the proposed license amendment because the licensee used the process described in NEI 04-02 (Reference 5) as endorsed by RG 1.205 (Reference 2), which requires a determination of the basis of acceptability and a determination that the basis is still valid.

Based on the previous NRC staff approval of the exemptions and the licensee's statement that the bases remain valid, as described with respect to each appropriate fire area, the NRC staff concludes that the engineering evaluations being carried forward supporting the NFPA 805 transition, as identified in Table 3.5-2, are acceptable. See Section 2.5 of this SE 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 (Reference 5). 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 (Reference 2), Regulatory Position 2.3.2, as clarified by FAQ 08-0054 (Reference 52) was followed. EEEEs that demonstrate that a fire protection system or feature is "adequate for the hazard" are to be addressed in the LAR as follows:

- If not requesting specific approval for "adequate for the hazard" EEEEs, then the EEEE is referenced where required and a brief description of the evaluated condition is provided.
- If requesting specific NRC approval for "adequate for the hazard" EEEEs, then the EEEE is referenced where required to demonstrate compliance and is included in LAR Attachment L for NRC review and approval.

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

Based on its review of the licensee's methodology for review of EEEEs and identification of the applicable EEEEs in LAR Attachment C, the NRC staff concludes that the use of EEEEs meets the requirements of NFPA 805 (Reference 4), the guidance of RG 1.205 (Reference 2) and FAQ 08-0054 (Reference 52), and is acceptable.

3.5.1.5 Variances from Deterministic Requirements

For those fire areas where deterministic criteria were not met, VFDRs were identified and evaluated using PB methods. VFDR identification, characterization, and resolutions were identified and summarized in LAR Attachment C for each fire area. Documented variances

were all represented as separation issues. The following strategies were used by the licensee in resolving the VFDRs:

- An FRE determined that applicable risk, DID, and safety margin criteria were satisfied without further action.
- An FRE determined that applicable risk, DID, and safety margin criteria were satisfied with a credited recovery action.
- An FRE determined that applicable risk, DID, and safety margin criteria were satisfied with a DID recovery action.
- An FRE determined that applicable risk, DID, and safety margin criteria were satisfied with a plant modification(s), as identified in LAR Attachment C and Table S-2 "Plant Modifications Committed," as supplemented.

During the NRC staff's review of fire areas 36A, 36B, 41 and 42, the staff had questions related to modification REC-117 (Reference 23). SSA RAI 17 (Reference 16) was written for LAR Attachment S, Table S-2, "Plant Modifications Committed," REC-117 (Reference 23).

The proposed modification was to change the normal operating alignment for 480 V load center tie breakers BT-1B4A, BT-1B3B, and BT-1B4C from normally open and racked-in, to normally racked-out (or otherwise disabled from spuriously closing due to fire damage to the direct current (DC) breaker control circuits in the opposite Train 4 kV switchgear room, MCR, or cable spreading room. This modification addresses the issue associated with electrical failure resulting from a spurious connection of out-of-synch power sources (offsite power to diesel generator, diesel generator to diesel generator). The planned modification in LAR Attachment S, Modification Item REC-117 (Reference 23), was not specified in sufficient detail for the NRC staff to determine its acceptability due to the open-ended parenthetical.

During an inspection conducted from July 22-24, 2013, the NRC Staff questioned the licensee's technical staff about the potential negative impact of performing the design change (modification) to rack out the normally open cross-tie breakers on the 480 V alternating current (AC) switchgear. Discussions with the licensee's technical staff indicated that a contingency plan existed to modify the control circuit to preclude spurious closure should the modification to rack out the breaker be deemed impractical.

The design for LAR Attachment S, Modification Item REC-117 (Reference 23), circuit modification to prevent spurious closure of normally open bus tie breaker resulting from hot shorts provided in response to SSA RAI 17 and 17.01 (References 16 and 19) proposed a new set of switch contacts that were to provide isolation of the close circuit in breakers BT-1B4A, BT-1B3B and BT-1B4C. The NRC staff's understanding of the proposed design indicated that the switch that provided this isolation function will be located on the MCB in the MCR. The NRC staff questions related to the proposed circuit design are stated below.

- Since the protection provided by the proposed design is only functional as long as the switch remains intact, the NRC staff asked the licensee to provide justification that the control switch open contacts will maintain this configuration

given fire damage to the switch (the open contacts are only as good as the switch integrity under fire conditions; state if the open contact configuration will be assured given a loss of switch integrity) expected as postulated in the PB FREs in accordance with NFPA 805.

- The NRC staff also asked the licensee to state if the circuit design is a "stand alone" design or if the licensee plans to implement this design in concert with recovery actions to prevent breaker closure (local actions to remove fuses, rack out the circuit breaker, etc.).

In its response to SSA RAI 17.02 (Reference 19), the licensee stated OPPD proposes to implement a design option that includes a shorting contact to bypass the breaker close coil in addition to the double-break contacts to de-energize the breaker close coil, all on the same switch. OPPD's position is that a loss of switch integrity in a fire event will likely result in a short-circuit condition (directly conductor-to-conductor, or through the ground plane) within the switch/panel, or will result in an open-circuit condition within the switch. These circuit conditions will effectively maintain the shorting switch bypass around the breaker close coil or will maintain the double break design for the breaker close coil. In either case, this will preclude spurious energization of the breaker close coil. To address the very unlikely event that the postulated fire damage causes a loss of switch integrity, OPPD is taking credit for other existing NFPA 805 RAs as a DID measure in response to an MCR fire event to also address the concern for out-of-synch parallel connection between Trains A and B through one or more spuriously closed 480 V tie breaker (with the MCR 480 V tie breaker control switches/control circuits modified as described above).

Based on its review of the proposed design for LAR Attachment S, Modification Item REC-117 (Reference 23), the NRC staff concludes that the information and methods described by the licensee are sufficient to prevent spurious closure of the normally open bus tie breaker resulting from a hot short.

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 review of the VFDRs and associated resolutions as described in LAR Attachment C, as supplemented, the NRC staff concludes that the licensee's identification and resolution of the VFDRs is acceptable.

3.5.1.6 Recovery Actions

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

The licensee identified in LAR Attachment G, in part, that "For Fire Area 42 MCR, the recovery actions that implement the alternate shutdown strategy (Reference LAR Attachment G, Table G-1) have been credited for reduction in risk, and have been credited in the Fire PRA quantification for this fire area."

The NRC staff reviewed LAR Section 4.2.1.3, "Establishing Recovery Actions," Attachment G, "Recovery Actions Transition," and LAR Attachment S, Implementation Items REC-096, 97, and 106 (Reference 23), "revision of fire emergency procedure," to evaluate whether the licensee meets the associated requirements for the use of RAs per NFPA 805. The details of the NRC staff review of the methodology for establishing RAs are described in SE Section 3.2.5 "Establishing Recovery Actions."

3.5.1.7 Recovery Actions Credited for Defense-in-Depth

The licensee stated in the LAR that RAs required for DID are not credited in the fire hazards analysis and/or change evaluation as a part of the risk determination for any fire area. The licensee identified in Attachment G for fire areas 41 (cable spread room), 32 (compressor area), 34B-1 (electrical penetration area), and 36B (west switchgear room), that RAs (reference LAR Attachment G, Table G-1) have been credited for DID only, and have not been credited in the FPRA quantifications for these fire areas.

The nuclear safety and radioactive release performance goals, objectives, and criteria of NFPA 805 are met without these actions. These RAs are required for DID and are part of the RI/PB FPP, which necessitates that these actions would be subject to a PCE if subsequently modified or removed.

The NRC staff reviewed LAR Section 4.2.1.3, "Establishing Recovery Actions," and Attachment G, "Recovery Actions Transition," to evaluate whether the licensee meets the associated requirements for the use of RAs per NFPA 805. The NRC staff's evaluation of the licensee's process for identifying RAs and assessing their feasibility is provided in SE Section 3.2.5, "Establishing Recovery Actions."

3.5.1.8 Plant Fire Barriers and Separations

With the exception of ERFBS, passive fire protection features include the fire barriers used to form fire area boundaries (and barriers separating safe shutdown trains) that were established in accordance with 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 SE Section 3.1.

In addition to those established fire barriers and separations that define the plant fire areas, passive fire protection features may include such design elements or features as radiant energy shields, flame impingement shields, high-energy arcing fault (HEAF) shields, and ERFBS that are credited with protecting cables, electrical components, and equipment within a fire area from the effects of fire or high-energy arcing faults.

The licensee has proposed to build lightweight shielding to limit the extent of damage from a HEAF and bus duct explosion in the switchgear rooms (fire areas 36A and 36B). In LAR Attachment S, Modification Item REC-111 (Reference 23), the licensee stated that HEAF barriers in between the top of each 4 kV and 480 V switchgear and the lowest elevation cable tray above the switchgear would be installed. The licensee also stated that shielding will also be installed between the high voltage bus ducts as well. The licensee's responses to SSA RAI 12 and 12.01 (Reference 10 and 14) indicated that while the detailed design and construction specifications would be developed during the NFPA 805 implementation period, the proposed HEAF barriers are expected to have certain design attributes. In the response to PRA RAI 03 dated July 24, 2012 (Reference 10), the licensee stated that the design of the proposed HEAF shields will consider that the enclosure may be subject to mechanical damage due to HEAFs in the switchgear room.

For switchgear and load center HEAFs, the objective is to minimize damage to risk-significant targets beyond the faulted switchgear or load center and to prevent damage and ignition of the first overhead cable tray(s):

- The HEAF barriers will be of non-flammable construction.
- The HEAF barriers consist of a steel plate mounted between the HEAF source and target(s) requiring protection (aluminum will not be used).
- Any conduits penetrating the plate and originating from the faulted switchgear or load center will contain elastomer plugs.
- Any gaps between the steel plate and conduits will be fitted snugly with a fire barrier material, such as HEMYC®.
- The HEAF barriers will primarily be mounted to existing supports and structural members associated with the cable trays requiring protection.
- The HEAF barriers will meet applicable seismic design requirements.
- The HEAF barriers will be, at a minimum, of similar gauge to an electrical cabinet enclosure.

For bus duct HEAF barriers, the objective is to minimize damage to risk-significant targets beyond the faulted bus duct and components electrically dependent on the faulted bus. To prevent damage to risk-significant targets within the ZOI, a barrier of similar attributes to the switchgear/load center HEAF barrier is proposed but, it is not envisioned that conduits would penetrate this steel plate.

The licensee stated that while the referenced guidance in NUREG/CR-6850 Supplement 1 (Reference 37), Section 7.2.1.5 was written for bus duct HEAFs, the licensee is extending this guidance to switchgear and load center HEAFs, which are expected to be of similar (or lower) energy release. For each postulated switchgear/load center HEAF, there is an ensuing fire that follows the growth characteristics of an electrical cabinet fire. For cases where minimizing damage to overhead cable trays is required, the width of the barrier will extend beyond the edge

of the cable tray stack, such that the secondary fire plume is deflected sufficiently away from the stack to preclude damage and/or ignition. The National Institute of Standards and Technology (NIST) Fire Dynamics Simulator fire modeling program will be used to verify the barrier width and plume deflection are sufficient to prevent cable temperature and incident heat flux from causing damage and/or ignition.

LAR Table 4-3, "Summary of NFPA 805 Compliance Basis and Required Fire Protection Systems and Features," identifies equipment or passive fire protection features that are required to meet NFPA 805 separation criteria, but not barriers relied upon for area boundaries. With the exception of ERFBS, which is addressed in Section 3.5.1.9 below, the equipment or cable-specific passive fire protection features identified in Table 4-3 include barriers installed in fire areas 30 (Containment), 31 (Intake Structure), 32 (Compressor Area), 36A (East Switchgear Room), and 47 (Transformer Yard Area).

Section 3.1 of this SE provides the results of the NRC staff's evaluation of the acceptability of the licensee's fire barriers and separations against the NFPA 805, Chapter 3 Section 3.11 minimum design requirements for these fire protection features.

3.5.1.9 Electrical Raceway Fire Barrier Systems

The licensee stated that the ERFBS used at FCS met the deterministic requirements of NFPA 805, Chapter 3. Each fire area using ERFBS is identified in LAR Attachment C. In fire areas with deterministic compliance, the ERFBS met the requirements of NFPA 805, Section 4.2.3. In fire areas with PB compliance, the ERFBS were analyzed using the PB approach in accordance with NFPA 805 Section 4.2.4. 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.

In both deterministic and PB fire areas, the installed ERFBS configurations met the testing requirements from NFPA 805, Section 3.11.5. This compliance is described in LAR Attachment A.

3.5.1.10 Issue Resolution

There are no RAIs that are not already addressed in the individual subsections of this SE.

3.5.1.11 Conclusion for Section 3.5.1

As documented in LAR Attachment C, for those fire areas that used a deterministic approach in accordance with NFPA 805, Section 4.2.3, the NRC staff concludes that each of the fire areas analyzed using the deterministic approach meet the associated criteria of NFPA 805, Section 4.2.3. This conclusion is based on:

- The licensee's documented compliance with NFPA 805, Section 4.2.3;
- The licensee's assertion that the success path will be free of fire damage without reliance on RAs;

- An assessment that the suppression systems in the fire area will have no adverse impact on the ability to meet the NSPC; and

- The licensee's appropriate determination of the fire protection features and detection systems required to meet the NSPC.

For those fire areas that used the PB approach in accordance with NFPA 805, Section 4.2.4, the NRC staff concludes that each fire area has been properly analyzed and that compliance with the NFPA 805 requirements has been 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 margin, or modifications or RAs were identified and actions planned or implemented to address the issue.

- RAs used to demonstrate the availability of a success path to achieve the 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 have been appropriately identified.

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

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

3.5.2 Clarification of Prior NRC Approvals

LAR Attachment T includes 12 clarifications to exemptions from Appendix R that were previously approved by the NRC and are being transitioned to the NFPA 805 FPP, which meets the requirements of 10 CFR 50.48(c). In addition to the 12 clarifications, by letter dated April 26, 2012, the NRC staff issued RAIs (Reference 24) to clarify certain elements of the Attachment T Clarifications. The licensee's RAI responses (Reference 13 and 14) created supplemental changes to the LAR Attachment T clarifications and added a new clarification (13). The NRC staff's approval of these clarifications was requested in accordance with the guidance in RG 1.205 (Reference 2), Regulatory Position 2.2.1.

The licensee's 13 requests for clarifications within the previously granted exemptions provided in Attachment T, as supplemented, are summarized in the following list.

1. Separation of steam generator level and pressure, RCS temperature, and source range neutron flux monitoring instrumentation inside containment

2. Separation of RCS loop charging valves inside containment

3. Separation of pressurizer auxiliary spray valves inside containment

4. Separation of pressurizer level instrumentation inside containment

5. Separation of pressurizer pressure instrumentation inside containment

6. Separation of backup pressurizer heater groups inside containment

7. Separation of raw water pumps, discharge valves, and strainers inside the intake structure

8. Separation of redundant trains inside the compressor room

9. Protection of redundant 480 V MCCs inside the lower electrical penetration area

10. Protection of cable tray sections inside the switchgear rooms

11. Separation of raw water pumps, discharge valves, and strainers in pull boxes, underground cable duct bank and manhole vaults

12. Lack of full suppression in the control room (Deleted by Licensee)

13. Deluge system in the Containment HVAC Charcoal Filters not in the FPP identified in FPE RAI 27 response (Reference 13)

Approval Clarification Request 1 – Instrument Separation in Containment

Approval clarification request 1 as described in LAR Attachment T, as supplemented by the licensee's SSA RAI 04 and SSA RAI 14 response (References 10 and 14), is associated with previous NRC approval of a 10 CFR 50, Appendix R, Section III.G.2 exemption for lack of 20 feet of separation free of intervening combustibles in the containment. The proposed transitioned exemption addresses steam generator level and pressure instrumentation, RCS temperature instrumentation, and source range neutron flux monitoring instrumentation is located inside containment. The Attachment T clarifications and RAI responses address the following proposed clarifications:

- Provide a corrected list of instruments, cables, penetrations, and raceways required for separating instrumentation located inside containment.

- Clarify the separation compliance.

- To better discriminate compliance routing for RCS hot- and cold-leg temperature instrumentation.

- The addition of instrument sensing lines to the redundant cable separation compliance in the original approved exemption.

The licensee stated in Attachment T, as supplemented by SSA RAI 14 (Reference 14), that steam generator level and pressure instrumentation, RCS temperature instrumentation, and source range neutron flux monitoring instrumentation are located inside containment. Each process monitoring variable has four redundant channels. The cables for these instruments are routed such that at least one redundant channel is routed over 20 feet from any other redundant channel. The revised list of instruments, cabling, penetrations, and raceway required for separation consideration is provided in LAR Attachment T.

The licensee specifically modified the description of routing for RCS hot- and cold-leg temperature instrumentation to "a minimum of channels A and D of RCS hot leg and cold leg temperature instrumentation associated with steam generator (SG) RC-2A or channels B and C of RCS hot leg and cold leg temperature instrumentation associated with SG RC-2B can be credited to remain free of fire damage for a containment fire. Furthermore, for any containment fire, auxiliary feedwater flow can be established to both SGs; and steam rejection to atmosphere can be established from both SGs."

Although the original NRC-approved exemption addressed only redundant cabling and instrumentation, the licensee has also provided clarification to identify that instrument sensing lines should have been included in the original exemption request for lack of 20 feet of separation in containment. Additionally, in response to SSA RAI 04 dated July 24, 2012 (Reference 10), the licensee identified the need for further Attachment T clarification "to specifically include SG pressure and level instrumentation and pressurizer pressure and level instrumentation in the paragraphs discussing the requested clarification for instrument sensing lines," in LAR Attachment T.

The licensee identified in Attachment K the bases for original approval as:

- At the pressurizer bay, there is no significant in-situ combustible material, fire hazard, or ignition source.

- Because of the inaccessibility of this area, the licensee staff has reasonable assurance that no transient combustibles will be present during non-outage periods.

- Because the combustibles are widely dispersed and sources of ignition are limited, the licensee does not expect a fire of significant magnitude or duration to occur.

- Smoke and hot gases from a postulated fire would be dissipated and cooled through the large open areas of containment.

- A fire would, at most, cause damage to systems from one shutdown division, but would not be able to propagate horizontally and damage the redundant division before self-extinguishing or being suppressed by the plant fire brigade.

The clarifications are consistent with the original bases for the approved exemption and those bases remain valid because the routing configuration, instrument locations, and raceway separation, are still as originally approved, as stated above. Based on the information provided by the licensee in Attachment K, Attachment C (Table B-3), Attachment T, and RAI responses, the NRC staff accepts the clarifications made for the originally approved exemption configurations.

Approval Clarification Request 2 – RCS Loop Charging Valve Failure Mode and Separation

Approval clarification request 2 as described in LAR Attachment T is associated with previous NRC approval of a 10 CFR 50, Appendix R, Section III.G.2 exemption for lack of 20-foot separation free of intervening combustibles in the Containment (fire area 30). The Attachment T clarifications and RAI responses (References 10 and 14) address the following proposed clarifications:

- Reflect that the RCS loop charging valves can spuriously close only due to fire damage in the vicinity of the associated electrical penetrations.

- Clarification of the separation compliance to include the control cables for each valve are routed from the associated electrical penetration to the valve solenoid, with the cables for each valve contained within their own conduit run.

The licensee indicated that the RCS loop charging valves (to RCS loop 1A through valve HCV-247; or to RCS loop 2A through valves HCV-239 and HCV-248) are located inside the containment. These valves are designed to fail open on loss of control power, and are required open to provide a flowpath for RCS inventory makeup from the CVCS for hot shutdown. The control cables for each valve are routed from the associated electrical penetration to the valve solenoid, with the cables for each valve being contained within their own conduit run. The applicable portion of the containment exemption for these valves is the portion for separation with limited intervening combustibles, in the area of the electrical penetrations, where the valve cables are assumed to be exposed and subject to external hot shorts. One flowpath for RCS inventory makeup through these valves will remain available for a fire anywhere in containment.

The clarifications are consistent with the original bases for the approved exemption and those bases remain valid because the raceway separation and the routing configuration are still as originally approved. Based on the information provided by the licensee in Attachment K, Attachment C (Table B-3), Attachment T, and RAI responses, the NRC staff accepts the clarifications made for the originally approved exemption configurations.

Approval Clarification Request 3 – Pressurizer Auxiliary Spray Valve Separation

Approval clarification request 3 as described in LAR Attachment T as supplemented by RAI response is associated with previous NRC approval of a 10 CFR 50, Appendix R, Section III.G.2 exemption for lack of 20 feet of separation free of intervening combustibles in the Containment. The Attachment T clarifications and RAI responses (References 10 and 14) address the following proposed clarifications:

- Explicitly identify the pressurizer auxiliary spray valves (HCV-240 and HCV-249), cables, and routes that form the basis of valve availability.

- To additionally reflect that a pressurizer auxiliary spray valve can spuriously open due to fire damage in the vicinity of exposed cable trays, the associated electrical penetration or the pressurizer bay, or fail closed due to fire damage in the vicinity of control cables routed in conduit.

- Clarification of the separation compliance to include a radiant energy shield installed between HCV-240/JB-103C, and HCV-249/JB-252C to provide separation between the redundant valves for a fire occurring in the pressurizer bay.

The licensee indicated that based on the cable routing in containment, the associated electrical penetrations for HCV-240 and HCV-249 are not horizontally separated, and are separated by less than 20 feet vertically. A radiant energy shield exists between the associated electrical penetrations, at elevation 1022' feet, to provide separation between the associated electrical penetrations. Furthermore, valves HCV-240 and HCV-249 and their respective junction boxes are located adjacent to one another in the pressurizer bay. A radiant energy shield exists between HCV-240/JB-103C, and HCV-249/JB-252C to provide separation between the redundant valves for a fire occurring in the pressurizer bay. With the exception of the associated electrical penetrations and the pressurizer bay, the valve control cables are routed in containment with at least 20 foot of separation such that either HCV-240 or HCV-249 will remain operable to open.

The licensee stated that the pressurizer auxiliary spray valves (HCV-240 and HCV-249) are both located inside the containment. These valves are designed to fail closed on loss of control power. The valves are required closed to ensure RCS pressure control during hot shutdown, and are required operable/open as a means to depressurize the RCS for the transition from hot shutdown to cold shutdown. In the LAR Attachment T, as supplemented, the exemption was clarified to reflect that a pressurizer auxiliary spray valve can spuriously open due to fire damage in the vicinity of exposed cable trays, the associated electrical penetration or the pressurizer bay, or fail closed due to fire damage in the vicinity of control cables routed in conduit. The associated electrical penetrations and pressurizer bay are provided with radiant energy shields such that either HCV-240 or HCV-249 will remain operable for cold shutdown, and such that fire damage anywhere else inside containment can only affect one of the two pressurizer auxiliary spray valves due to cable separation.

The clarifications are consistent with the original bases of the approved exemption and those bases remain valid because the raceway separation and routing configuration are as originally approved. NRC staff performed a containment walkdown to verify the radiant energy shield installation. Based on the information provided by the licensee in Attachment K, Attachment C (Table B-3), Attachment T, RAI responses, and NRC staff observations during the audit, the NRC staff accepts the clarifications made for the originally approved exemption configurations.

Approval Clarification Request 4 - Pressurizer Level Instrument Separation in Containment

Approval clarification request 4 as described in LAR Attachment T as supplemented by RAI response is associated with previous NRC approval of a 10 CFR 50, Appendix R, Section III.G.2 exemption for lack of 20 feet of separation free of intervening combustibles in the Containment. The Attachment T clarifications and RAI responses (References 10 and 14) address the following proposed clarifications:

- Explicitly identify the pressurizer level instruments (LT-101X and LT-106) and the correct containment electrical penetrations for each.

- Clarification of the separation compliance to include sensing lines for both SGs and pressurizer.

- Clarification of the separation compliance to include a radiant energy shield installed in the containment at the electrical penetrations to provide separation between the associated level transmitters.

Based on the cable routing in containment, the electrical penetrations are separated by less than 20 feet horizontally, and are separated by less than 20 feet vertically. The existing exemption incorrectly identifies the electrical penetrations associated with the level transmitters, and the exemption was clarified in LAR Attachment T, as supplemented, to provide the correct electrical penetrations associated with each instrument. A radiant energy shield was installed between the associated electrical penetrations to provide separation between the associated level transmitters.

The licensee stated that within the containment, the redundant instrument channels and sensing lines have a minimum of 20 feet of horizontal separation with minimal intervening combustibles. The intervening combustibles consist of lightly loaded cable trays. The sensing lines have common points of origin (i.e., SGs and pressurizer). At the points of origin it is not possible to achieve physical separation. From the point of origin the lines are routed in different directions to the transmitters which have a minimum of 20 feet of horizontal separation.

The licensee indicated that this separation is consistent with the separation discussed and credited in the previous approval. Exemption 1 in Attachment K credits less than 20 feet of separation with no intervening combustibles for certain areas within containment. The previous approval specifically addresses the pressurizer bays and areas where the intervening combustibles are made up of IEEE-383 qualified cables. The instrument sensing line routings meet these criteria and therefore are considered to be covered under this exemption. The licensee stated that the instrument sensing lines have adequate separation to support

NFPA 805 safe shutdown requirements for providing at least one channel of reliable indication for process monitoring of pressurizer level and pressure, and steam generator level and pressure.

The clarifications are consistent with the original bases for the approved exemption and those bases remain valid because the raceway separation and the routing configuration are as originally approved. Although, at the points of origin it is not possible to achieve physical separation, exemption 1 in Attachment K credits less than 20 feet of separation with no intervening combustibles for certain areas within containment. The low level of intervening combustibles forms the basis for acceptability of the lack of physical separation at the point of origin. The NRC staff performed a containment walkdown to verify the radiant energy shield installation. Based on the information provided by the licensee in Attachment K, Attachment C (Table B-3), Attachment T, NRC staff observations made during the audit, and RAI responses, the NRC staff accepts the clarifications made for the originally approved exemption configurations.

Approval Clarification Request 5 – Pressurizer Pressure Instrument Separation in Containment

Approval clarification request 5 as described in LAR Attachment T as supplemented by RAI response is associated with previous NRC approval of a 10 CFR 50, Appendix R, Section III.G.2 exemption for lack of 20 feet of separation free of intervening combustibles in the Containment. The Attachment T clarifications and RAI responses (References 10 and 14) address the following proposed clarifications:

- Explicitly identify the pressurizer pressure instruments (PT-105 and PT-115) and the correct containment electrical penetrations for each.

- Clarify the separation compliance to include sensing lines for both SGs and pressurizer.

- Clarification of the separation compliance to include a radiant energy shield installed between the associated electrical penetrations, at elevation 1013' to provide separation between the instrument cables and their associated electrical penetrations, and a radiant energy shield installed on the existing platform at elevation 1013'-0" beneath PT-115 to provide separation between the redundant transmitters.

The licensee stated that based on the cable routing in containment, the electrical penetrations for PT-105 (A-4) and PT-115 (D-5) are separated by less than 20 feet horizontally, and are separated by less than 20 feet vertically. A radiant energy shield exists between the associated electrical penetrations, at elevation 1013' to provide separation between the redundant instrument cables and their associated electrical penetrations. A radiant energy shield exists at elevation 1013'-0" beneath PT-115 to provide separation between the redundant transmitters. These radiant energy shields limit fire damage such that either pressurizer pressure instrument PT-105 or PT-115 will remain available for safe shutdown.

As described by the licensee, within the containment, the redundant instrument channels and sensing lines have a minimum of 20 feet of horizontal separation with minimal intervening combustibles. The intervening combustibles consist of lightly loaded cable trays. The sensing lines have common point of origin (i.e., steam generators and pressurizer). At the points of origin it is not possible to achieve physical separation. From the point of origin the lines are routed in different directions to the transmitters which have a minimum of 20 feet of horizontal separation. This separation is consistent with the separation discussed and credited in the exemption discussed in LAR Attachment K regarding the lack of 20' separation free of intervening combustibles in containment. The related SER described by the Licensee in the LAR, grants an exemption from less than 20 feet of separation with no intervening combustibles for certain areas within containment. The exemption in Attachment K specifically addresses the pressurizer bays and areas where the intervening combustibles are made up of IEEE-383 qualified cables. Although not originally addressed in the exemption, the instrument sensing line routings meet these criteria and therefore are considered to be covered under this exemption. The licensee stated that the instrument sensing lines have adequate separation to support NFPA 805 safe shutdown requirements for providing at least one channel of reliable indication for process monitoring of pressurizer level and pressure, and steam generator level and pressure.

The clarifications are consistent with the original bases for the approved exemption and those bases remain valid because the raceway separation and routing configuration are as originally approved. Although, at the points of origin it is not possible to achieve physical separation, radiant energy shields were installed on the existing platform at elevation 1013'-0" beneath PT-115 to provide separation between the redundant transmitters, and to provide separation between the associated electrical penetrations. With respect to the sensing lines, the low level of intervening combustibles forms the basis for acceptability of the lack of physical separation at the point of origin. The NRC staff performed a containment walkdown to verify the radiant energy shield installation. Based on the information provided by the licensee in Attachment K, Attachment C (Table B-3), Attachment T, NRC staff observations made during the audit, and RAI responses, the NRC staff accepts the clarifications made for the originally approved exemption configurations.

Approval Clarification Request 6 – Pressurizer Heater Separation in Containment

Approval clarification request 6, as described in LAR Attachment T, as supplemented by RAI response, is associated with previous NRC approval of a 10 CFR 50, Appendix R, Section III, G.2 Exemption for lack of 20 feet of separation free of intervening combustibles in the Containment. The Attachment T and RAI responses (References 10 and 14) address the following proposed clarifications:

- Explicitly identify the pressurizer heater groups (RC4-1, RC4-2, RC4-3, and RC4-4) and the correct cabling, raceway, and containment electrical penetrations for each.

- Clarification of the separation compliance to include a radiant energy shield installed between the associated electrical penetrations at elevation 1013' to provide separation between the associated electrical penetrations.

Based on the cable routing in containment, the associated electrical penetrations for RC4-1 (D-2) and RC4-2 (D-1) are not horizontally or vertically separated from the associated electrical penetrations for RC4-3 (A-2) and RC4-4 (A-1). A radiant energy shield exists between the associated electrical penetrations, at elevation 1013' to provide separation between the associated electrical penetrations. The originally approved NRC exemption also credits one train of heaters remaining free of fire damage based on the lack of in-situ combustible material, fire hazards, and ignition sources in the pressurizer bay, where the cables converge at the pressurizer heaters, which are located in the bay, with less than 20 feet of separation. However, the exemption does not address the lack of horizontal separation of the cable routes between the electrical penetration area and the pressurizer bay. For the redundant pressurizer heater power cables not in the immediate vicinity of the pressurizer cubicle or the electrical penetrations (penetrations A-1, A-2, D-1, D-2), the vertical separation between the cable trays for the redundant pressurizer heater power cables is greater than 24 feet, and the cable trays for the redundant pressurizer heater power cables are separated by a combination of floor slab and grated steel platform, which the licensee stated effectively function as a radiant energy shield.

The clarifications are consistent with the original bases for the approved exemption and those bases remain valid because the raceway separation, penetration separation, and routing configuration are as originally approved. NRC staff members performed a containment walkdown to verify the radiant energy shield installation. Based on the information provided by the licensee in Attachment K, Attachment C (Table B-3), Attachment T, NRC staff observations made during the audit, and RAI responses, the NRC staff accepts the clarifications made for the originally approved exemption configurations.

Approval Clarification Request 7 – Lack of 1-hour Rated Intake Structure Separation

Approval clarification request 7 as described in LAR Attachment T is associated with previous NRC approval of a 10 CFR 50 Appendix R Section III.G.2 exemption for the Intake Structure and Pull Boxes, because of lack of a 1-hour fire barrier, lack of an area wide suppression system, and lack of detection in pull box area. The Attachment T clarifications and RAI responses address the following proposed clarifications:

- Explicitly identify components and cables for power and/or control associated with all four raw water (RW) pumps, their associated discharge valves, and their associated strainers.

- Specify that a three-hour rated fire barrier enclosure has been provided for the power and/or control cables associated with all four RW pumps and their associated discharge valves.

- Clarify the separation compliance.

The licensee stated that for a fire at intake structure elevation 985' (at the intake structure stairwell), a 3-hour rated fire barrier enclosure has been provided for the power and/or control cables associated with all four RW pumps and their associated discharge valves. This

enclosure is identified as fire area 31A in the NSPC analysis. The NRC-approved exemption is being clarified accordingly to explicitly define the safe shutdown compliance strategy for the intake structure, and to specify that a 3-hour rated fire barrier enclosure has been provided for the power and control cables associated with all four RW pumps and their associated discharge valves at intake structure stairwell.

The licensee stated that for a fire at pull boxes 128T and 129T elevation 998' (south wall of auxiliary building), the NRC-approved exemption was granted on the basis that the limited fire loading and widely dispersed combustible materials in the vicinity of the pull boxes will ensure that fire propagation is limited and will ensure that at least one train of the RW system will remain free of fire damage prior to fire brigade intervention, and that no other safe shutdown systems will be fire damaged. Pull boxes 128T and 129T are located outside at grade elevation 998' on the south wall of the auxiliary building. The pull boxes are separated by approximately 3 ½ feet. The licensee has determined that train A pump or train B pump can be credited for safe shutdown within the bases of the NRC-approved exemption, whereby one train of the RW system is assumed to have sustained fire damage prior to successful manual suppression by the fire brigade, with the other train of the RW system having remained unaffected by the fire (for a fire located in the vicinity of the pull boxes). Train A cables are routed together in the duct banks through pull box 129T; similarly, train B cables are routed together in the duct banks through pull box 128T. The NRC-approved exemption is being clarified accordingly to explicitly define the safe shutdown compliance strategy for the intake structure, and to specify that either train A or Train B raw water pump is credited in conjunction with its associated discharge valve and strainer, based on the similar cable routes to the RW pump 4KV power cables.

The licensee stated that for a fire at intake structure elevation 985', the 4kV power cable for RW pump AC-10B power cable and cables for the three required discharge valves is protected by a 3-hour rated fire barrier enclosure. The licensee has determined that the RW system will remain available with pump AC-10B on the basis of the low and widely dispersed and limited combustibles, fire detection, manual suppression, and the fire barrier enclosure and that the AC-10B pump discharge valves, HCV-2851, HCV-2874A, and HCV-2874B will also remain available and unaffected by fire damage. These three valves are protected from the CW pump elevation fire (at the 985' elevation) and the valve control cables are contained within the same three-hour rated fire barrier enclosure as the 4KV power cable for RW pump AC-10B. The NRC-approved exemption is being clarified accordingly to explicitly define the safe shutdown compliance strategy for the intake structure, and to specific that a 3-hour rated fire barrier enclosure has been provided for the power and control cables associated with RW pump AC-10B, and associated discharge valves HCV-2851, HCV-2874A, and HCV-874B at intake structure elevation 985'.

The licensee stated that for a fire at intake structure elevation 993', the physical separation between RW pumps AC-10A and AC-10D and their respective 4kV power cables is adequate to ensure that at least one pump will remain available and free of fire damage. The licensee has determined that the associated pump discharge flowpath valves (HCV-2850 for AC-10A, or HCV-2853 for AC-10D) will also remain available and unaffected by fire damage on the basis of widely dispersed and limited combustibles, fire detection, manual suppression, and the concrete barriers separating the three RW pump rooms. HCV-2850 and HCV-2853, and their associated control cables are contained only within the associated pump room, and therefore have similar physical separation as the associated pumps and their 4kV power cables. The NRC-approved

exemption is being clarified accordingly to explicitly define the safe shutdown compliance strategy for the intake structure, and to specify that either pump AC-10A or AC-10D is credited in conjunction with its associated discharge valve, HCV-2850 or HCV- 2853, respectively (including the associated valve control cables), based on their similar physical separation to the RW pumps and their 4kV power cables at intake structure elevation 993'.

The original bases for the approved exemptions were clarified by the licensee as follows:

- Power cables and valve cables for AC-10A and AC-10B are both protected at the intake structure stairwell (i.e., the pyrocrete enclosure previously identified as fire area 31A).

- The power cable and valve cables for pump AC-10B are both protected for fire based at 985' elevation in the CW pump area. The power cable and valve cables for pump AC-10A is not fully protected for fire based at 985' elevation in the CW pump area; consequently, pump AC-10A is not credited for a fire at the 985' elevation.

The clarifications are consistent with the original bases for the approved exemption and those bases remain valid because the combustible loading remains low, the plant fire brigade remains available to manually extinguish a fire should one occur, the pull boxes and intake structure are located away from and outside of the main plant structure, and a as a result of physical separation and installed raceway fire barrier enclosures, at least one RW pump and its associated discharge valve(s) will remain available. Based on the information provided by the licensee in Attachment K, Attachment C (Table B-3), Attachment T, RAI responses and a letter dated October 8, 2013 (Reference 90), the NRC staff concludes that the clarifications made for the originally approved exemption configurations are acceptable.

Approval Clarification Request 8 – Lack of 1-Hour Separation for the Compressor Room

Approval clarification request 8 as described in LAR Attachment T is associated with previous NRC approval of a 10 CFR 50 Appendix R Section III.G.2 exemption (Reference 73) for the air compressor room because of the lack of a complete 1-hour fire barrier. The Attachment T clarifications and RAI responses address the following proposed clarifications:

- Include Room 53 adjacent to the air compressor room in the exemption.

- Include fire barriers installed between redundant train cable tray sections not originally identified.

- Add three additional tray sections that are not protected with fire barriers, although not containing credited cables, but providing fire propagation exposure.

- Include an area-wide detection and suppression for fire area 32 (room 19).

- Remove credit for the motor and turbine driven AFW pumps for a fire event in this area using the diesel driven AFW pump.

Fire area 32 consists of the compressor room (room 19) and a small corridor (room 53). Room 19 contains cable trays which contain cables supporting redundant safe shutdown trains, including all 480 V MCC power feeder cables. The room also contains AFW pumps FW-6 and FW-10 and associated support cables. The cable trays containing "train A" cables are horizontally separated from cable trays containing redundant "train B" cables by a minimum of 10 feet, and are otherwise protected by partial fire barriers separating "train A" cables routed in trays crossing cable trays containing "train B" cables. On the basis of the approved exemption, at least one train of safe shutdown equipment was credited to remain free of fire damage for a fire occurring in room 19.

The licensee stated that three tray sections have been added to this discussion for clarity as these tray sections are continuous with tray sections originally addressed in the approved exemption. Train A Section 3S is not protected with a fire barrier from a postulated fire occurring in the train B tray sections 17S/19S below. The SSA does not take credit for the survival of any cables in train A tray Section 3S. Fire propagation from the train A tray Section 3S to the other train A tray sections is assumed to be mitigated by the installed fire detection and suppression systems in the area and with backup from manual suppression.

As stated by the licensee, fire area 32, room 19 is provided with an area-wide fire detection system and an area-wide pre-action fire suppression system including spray nozzles installed specifically to prevent fire propagation along exposed cables in trays. The detection and fire suppression systems are designed to detect and suppress any fires in the area to prevent development of a hot gas layer resulting from floor based fire hazards in the area. These include motor- and turbine-driven AFW pumps, air compressors, and air compressor MCCs. The licensee stated that it should be noted that self-ignited cable fires are not postulated in NUREG/CR-6850 for qualified cables, and all cables at FCS were procured as qualified for fire and smoke propagation. The licensee documented previous NRC staff approval of the electrical cable qualification for flame propagation in the original August 23, 1978 FPP SE, which included cable flame propagation limits (see Section 3.1.1.4 of this SE).

The NFPA 805 SSA credits the diesel-driven AFW pump (FW-54), which is independent of fire area 32. Consequently, the 1-hour fire rated barrier that is credited to protect the motor- and turbine-driven AFW pumps from the effects of a fire is no longer being maintained as part of the exemption.

An updated list of components, cables, and raceway is provided in LAR Attachment T Approval request 8 to explicitly define the safe shutdown compliance strategy with regard to train separation.

The clarifications are consistent with the original bases for the approved exemptions and those bases remain valid because the provided separation between redundant trains and the fire detection and suppression system are as originally approved; and, also because the motor and turbine driven AFW pumps are no longer credited for safe shutdown and the combustible loading remains low. Based on the information provided by the licensee in Attachment K, Attachment C (Table B-3), Attachment T, and RAI responses, the NRC staff accepts the clarifications made for the originally approved exemption configurations.

Approval Clarification Request 9 – Lack of Area-Wide Suppression in Lower Penetration Room

Approval clarification request 9 as described in LAR Attachment T is associated with previous NRC approval of the lack of an area-wide automatic fire suppression system in the Lower Penetration Room for which a 1-hour fire barrier and detection is provided as required by 10 CFR 50 Appendix R Section III.G.2, and for the lack of an area-wide automatic fire suppression system in an area (Upper Penetration Room) for which alternate shutdown is provided as required by Section III.G.3 of Appendix R. The Attachment T clarifications and RAI responses (References 10 and 14) address the following proposed clarification:

> The licensee stated that the current compliance strategy and the NRC-approved exemption are adequate with one minor exception. There is a typographical error in the description regarding the cable identifications (IDs) that are credited as being protected with a 1-hour rated fire wrap. The fire-wrapped cable IDs are EA124, EA140, EA154, and EA155; however, the supporting cables for MCC-3B1 are incorrectly identified as EA134 and EA135. These cable IDs are consistent with the cable IDs identified in the 10 CFR 50 Appendix R analysis and the NFPA 805 NSPC analysis and should be identified with components MCC-3A1 (EA124), MCC-3B1 (EA154, EA155), and MCC-3C1 (EA140).

The clarifications are consistent with the original bases for the approved exemptions and those bases remain valid due to the cables being protected with a 1-hour rated fire wrap. Based on the information provided by the licensee in Attachment K, Attachment C (Table B-3), Attachment T, and RAI responses, the NRC staff accepts the clarifications made for the originally approved exemption configurations.

Approval Clarification Request 10 - Cable Tray Protection in Switchgear Rooms

Approval clarification request 10 as described in LAR Attachment T is associated with previous NRC approval of a 10 CFR 50 Appendix R Section III.G.2 exemption for lack of 3-hour rated barriers between redundant shutdown divisions in the switchgear rooms (fire areas 36A and 36B). The Attachment T clarifications and RAI responses (References 10 and 14) address the following proposed clarifications:

- Explicitly identify the specific cables (including associated equipment and tray sections) for the associated train of pressurizer heater backup groups.
- Credit additional backup groups of pressurizer heaters similar to the original group.
- Add credit for fire area 36C (pyrocrete enclosure) containing Train A only.

The licensee stated that the originally approved exemption accepted unrated bus duct penetrations in the 3-hour fire rated wall separating the east and west switchgear rooms. The exemption also accepted, as an unrated heat shield, a pyrocrete barrier enclosure for cable tray sections 1 and 2 in the west switchgear room (fire area 36B). These cable tray sections contain

control cables for the train A backup groups of pressurizer heaters. This cable tray barrier enclosure is identified as fire area 36C in the current 10 CFR 50 Appendix R program documentation and in the NFPA 805 program documentation.

The bases for the approved exemption considered the area-wide automatic fire detection and fixed Halon fire suppression system, the fire rated construction of the walls, and the limited combustibles contained within fire areas 36A and 36B. The bases for the approved exemption were also supported by a qualitative assessment of the realistic fire event(s) in fire area 36B, including fire growth and products of combustion and the fire brigade response.

The licensee has added cables and associated safe shutdown components contained within the pyrocrete enclosure for cable tray sections 1 and 2, and are being credited as having similar protection on the basis of the existing NRC-approved exemption.

Additionally, the licensee added clarification to this approval request in the response to SSA RAI 04 (Reference 10). The licensee stated that fire area 36C is a pyrocrete enclosure located within fire area 36B and that fire area 36C contains only Train A cable trays and conduits. The licensee further stated that fire area 36C is not enclosed by 3-hour rated fire boundaries and is not a fire area per the rule; however, the designation fire area 36C is used in NFPA 805 NSCA to identify the set of cables contained within the pyrocrete enclosure and thereby facilitate the performance of NSCA and NPOs separation analyses for the set of cables contained within the pyrocrete enclosure.

The clarifications are consistent with the original bases for the approved exemption and those bases remain valid due to the cables being credited as having similar protection. Based on the information provided by the licensee in Attachment K, Attachment C (Table B-3), Attachment T, and RAI responses, the NRC staff accepts the clarifications made for the originally approved exemption configurations.

Approval Clarification Request 11 - Raw Water Pump and Valve Separation

Approval clarification request 11 is associated with the previously approved 10 CFR 50 Appendix R, Section III.G.2 exemption in the intake structure and pull box area because of the lack of a 1-hour fire barrier, lack of area wide suppression, and lack of detection in the pull box area. The Attachment T clarifications and RAI responses (Reference 10) address the following:

- Explicitly identify the specific cables and components for the associated trains of raw water system.

- Required for the raw water system to support refill capability of the EFWST within 8 hours.

The current 10 CFR 50 Appendix R compliance strategy as documented in the NRC-approved exemption (Reference 74) only describes the applicability of the raw water system in support of cold shutdown. The NFPA 805 NSPC compliance strategy requires the availability of the raw water system to support refill capability of the EFWST within 8 hours in order to maintain hot shutdown, safe and stable plant conditions. The licensee has provided a clarification to the

approved exemption with respect to the requirement for the raw water system to support maintenance of hot shutdown, safe and stable plant conditions.

The licensee has provided a clarification to this exemption to explicitly identify the raw water components, all of which are contained within the same train specific pull boxes, duct bank, and manholes as the associated train raw water pump 4 kV power cable.

Train A cables are routed together in the duct banks through pull box 129T; similarly, Train B cables are routed together in the duct banks through pull box 128T. The approved exemption is being clarified accordingly to specify that either Train A or Train B pumps (AC-10A or AC-10D) is credited in conjunction with its associated discharge valve and the strainer, based on the similar cable routes.

The licensee stated that the pull boxes 128T and 129T are located outside at grade elevation 998' on the southeast wall of the auxiliary building. The pull boxes are separated by approximately 3 ½ feet. The 4 kV power cable for pump AC-10A is routed through pull box 129T, and the 4 kV power cable for pump AC-10D is routed through pull box 128T. The 480 V power cable for MCC-3B3/1B3B-6 (which provides power for raw water strainer AC-12A) and the control cable for the pump AC-10A discharge valve, HCV-2850, are routed through pull box 129T. The 480 V power cable for MCC-4C4/1B4C-7 (which provides power for raw water strainer AC-12B) and the control cable for the pump AC-10D discharge valve, HCV-2853, are routed through pull box 128T.

The basis for the originally approved exemption included the following two elements:

- The fire loading within these areas is limited and combustible materials are widely dispersed. Consequently, any potential fire would be within the capabilities of the plant fire brigade to extinguish with manual firefighting equipment before significant levels of damage occurred.

- Because the intake structure and pull boxes are located away from and outside of the main plant structure, the staff has reasonable assurance that a fire would not spread to other areas containing safety related equipment.

Additionally the bases included that:

- Entry into manhole vaults is administratively controlled and that appropriate site procedures are in place to limit access to the manhole vaults,

- Appropriate site procedures are in place to govern hot-work and minimize the potential for hot-work fires in the manhole vaults,

- Fixed combustibles in the manhole vaults are limited only to cable and cable insulation, and

- That there are no in-situ ignition sources in the manhole vaults.

The clarifications are consistent with the original bases for the approved exemption and those bases remain valid as described above. Based on the information provided by the licensee in Attachment K, Attachment C (Table B-3), Attachment T, and RAI responses, the NRC staff accepts the clarifications made for the originally approved exemption configurations.

Approval Clarification Request 12 – MCR Suppression System

Approval clarification request 12 was subsequently withdrawn by the licensee in response to FPE RAI 20 (Reference 10). The licensee stated that the Attachment K transition and Attachment T clarification for this prior approval is not required on the basis that the MCR (fire area 42) is transitioned to NFPA 805 as a PB fire area, and is not subject to the NFPA 805 deterministic requirement for full area suppression. The RI/PB assessment for fire area 42 has established the fire risk as being within the acceptance criteria of RG 1.174, and that adequate DID and safety margin are maintained without full area suppression. Based on the information provided by the licensee, no further action is required.

Approval Clarification Request 13 – Containment HVAC Charcoal Filters Deluge System

Approval clarification request 13 as described in the licensee's response to FPE RAI 27 (Reference 13) is associated with a proposed revision to LAR Table B-1 Section 3.6.1 to add "Prior Approval Clarification Request 13." This prior approval is needed to clarify the deluge system to protect the containment HVAC charcoal filters.

The licensee describes this prior approval as clarification that the deluge system supplied by the containment spray system to protect the containment HVAC charcoal filters is not a fire protection system meeting the requirements of NFPA 13. It was installed to suppress a fire only after a loss-of-coolant accident that could be ignited due to high temperatures caused by decay heat from radionuclides accumulating in the charcoal filters, which is why the system is fed from the containment spray system and not the fire protection system. Its presence was never intended to be considered a part of the FPP and is therefore not identified as a fire protection system in LAR Table 4-3 or Attachment C. The system remains in place as approved in the 1978 SE; therefore, the bases for acceptability of fire protection in containment as listed in the SE remain valid and unchanged.

The justification proposed by the licensee stated that because there are separate redundant charcoal filters, the fire in a single charcoal unit would be limited to half the total filters. No safety-related cable trays are at this elevation of the containment and thereby a postulated fire would not interfere with safe shutdown or cause a radioactivity release outside the containment. The filter would not expose any safety-related equipment because of the confining housing of the filter unit and the long ductwork at the discharge of the filters. A deluge system which receives containment spray water is installed in these filters. The deluge system is manually initiated but effective only with containment spray operating. These features can be expected to contain the charcoal fire in the filter assembly.

The bases for the clarification are considered acceptable because the HVAC charcoal filter deluge system is not a fire protection system needing to meet the requirements of NFPA 13. Based on the information provided by the licensee in the RAI response, the NRC staff accepts

the clarifications made for the deluge system as part of the containment spray system to protect the containment HVAC charcoal filters in the event of a loss-of-coolant accident.

3.5.2.1 Increase in the Reported Amount and Configuration of Combustibles in LAR Attachment T Clarifications

For clarifications 1 through 11, the licensee stated that primarily as a result of conservative re-quantification and additional assumed transient combustible material, the reported amount and configuration of combustibles have increased in each respective fire area over time. The licensee indicated in response to SSA RAI 14 (Reference 14) that this disparity is attributed to a more rigorous accounting of combustibles in the calculation, including estimates of transient and token loading. The licensee has defined token loading as a quantity to account for miscellaneous items that are not typically figured into the combustible loading such as gauges, face plates, identification tags, room nameplates, etc. Additionally, an expected transient combustible loading has also been added to each fire zone to support work activities that use combustible material that does not require a permit. The licensee stated that although the reported amount and configuration of combustibles have increased in fire areas over time, the total combustible loading still remains low and the exemption bases remain valid. As part of the transition to NFPA 805, the licensee requested approval of the changes in combustible loading and confirm, in the exemption, the validity of the exemption as long as the combustible loading in the area remains low. During the audit, the NRC staff performed walkdowns for validation of the transient combustible loading. The result of the walkdowns indicated general compliance with the administrative procedure for transient combustible loading.

3.5.2.2 Conclusion for Section 3.5.2

The elements of the pre-transition FPP licensing basis for which previous NRC approval needs clarification are included in NFPA 805 LAR Attachment T. Approval clarification request 12 was subsequently withdrawn by the licensee in response to FPE RAI 20 (Reference 10). Based on the information that the licensee has provided including the documents reviewed, and the discussions held with the licensee's technical staff during the on-site NFPA 805 audit, the NRC staff concludes that the process and the licensee's conclusions regarding the specific requests are in sufficient detail to demonstrate that the elements of the pre-transition FPP licensing basis meet the requirements of 10 CFR 50.48(c) (RG 1.205, Revision 1, Regulatory Position 2.2.1).

3.5.3 Fire Protection during Non-Power Operational Modes

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

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

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

> The nuclear safety goal is to provide reasonable assurance that a fire during any operational mode and plant configuration will not prevent the plant from achieving and maintaining the fuel in a safe and stable condition.

The NRC staff reviewed LAR Section 4.3, "Non-Power Operational Modes," and Attachment D, "NEI 04-02, Table F-1, Non-Power Operational Modes Transition," to evaluate the licensee's treatment of potential fire impacts during NPOs. The licensee used the process described in NEI 04-02, as modified by FAQ 07-0040 (Reference 48), for demonstrating that the NSPC are met for higher risk evolutions (HREs) during NPO modes.

3.5.3.1 NPO Strategy and Plant Operating States

In LAR Section 4.3 and Attachment D, the licensee stated that the process used to demonstrate that the NSPC are met during NPO modes is consistent with the guidance contained in FAQ 07-0040. As described in LAR Attachment D, the licensee stated that the goal is to ensure that contingency plans are established when the plant is in an NPO mode where the risk is intrinsically high. The licensee's strategy for control and protection of equipment during NPO modes follows the process flow in LAR Figure 4-6, which considers the following: (1) the availability of key safety function (KSF) equipment; (2) if the plant is in a higher risk evolution (HRE); (3) if the KSF may be lost due to fire; and (4) contingency plans to mitigate the risks. During low risk periods, normal risk management controls and fire prevention/protection processes and procedures are used by the licensee.

As described in LAR Attachment D, the licensee's procedure defines HRE but it is lacking the detail suggested by the endorsed guidance in NEI 04-02 and the guidance in FAQ 07-0040. The HRE does not address Time-to-Boil as specific criteria to be considered.
LAR Attachment S, Implementation Item REC-095 (Reference 23), has been developed to upgrade this definition in implementation. The LAR further describes the outage management process as providing the plant staff with the necessary information such as time to boil, HRE, and KSF status for consideration in planning work activities. The considerations are consistent with guidance in FAQ 07-0040.

Consistent with the guidance in FAQ 07-0040, the process to demonstrate that the NSPC are met during NPO involved the following steps as described in LAR Sections 4.3.1 and 4.3.2, and depicted in LAR Figures 4-5 and 4-6:

- Review the existing Outage Management Processes
- Identify Equipment/Cables:
  - Review plant systems to determine success paths that support each of the DID KSFs, and
  - Identify cables required for the selected components and determined their routing
- Perform Fire Area Assessments (identify "pinch points," - plant locations where a single fire may damage all success paths of a KSF).
- Manage pinch-points associated with fire-induced vulnerabilities during the outage.

The NRC staff concludes that the NPO process described and documented by the licensee in LAR Section 4.3 and Attachment D 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 an NPO mode where the risk is intrinsically high. LAR Section 4.3 discusses these additional controls and measures. However, during low-risk periods, normal risk management controls, as well as fire prevention/protection processes and procedures will be used.

To identify components and cables associated with KSFs, the licensee considered the Plant Operating States: Hot Shutdown, Cold Shutdown and Refueling. The KSFs review included the plant systems and equipment selected to provide Inventory Control, Decay Heat Removal Capability, Reactivity Control, Containment Closure, and support functions (Process Cooling, and Electrical Power). The selected equipment was logically associated with the supported KSF(s). Power supplies, interlocks, and supporting equipment were logically associated with their parent component, as needed. These data relationships are stored electronically for use with an analytical software tool. As part of the NPO fire area assessments, the licensee has credited the completion of plant modifications from the at-power NFPA 805 NSPC analysis that will be completed as part of LAR implementation described in Attachment S.

In the LAR, the licensee identified equipment and cables necessary to support the KSF success paths. Additional cable selection was performed for those components evaluated for at-power but whose functional requirements may have been different for the non-power analysis. For components which had not been previously cable selected for other NFPA 805 tasks, cable selection was performed per the Nuclear Safety Methodology. The cables necessary to support the selected function of a component were selected and analyzed for fire impact. The operational modes and functional requirements for the systems and components were reviewed, the equipment and cables were logically tied and related to the applicable KSF success path(s), and power supplies and other supporting components such as interlocks were also identified, listed, and tied with their component and KSF success paths in the analysis database.

The licensee stated that in lieu of an explicitly defined set of plant operating states as an HRE period, an evaluation was performed of the evolutions that FCS performs during an outage. This evaluation determined that the evolutions performed, and the plant conditions experienced by FCS during an outage are consistent with the plant operating state guidance discussed in FAQ 07-0040.

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

3.5.3.3 NPO Key Safety Functions and SSCs Used to Achieve Performance

LAR Attachment D defines the KSFs, the success paths to achieve the KSFs, and the components required for the success paths. The licensee stated in the LAR that the guidance in FAQ 07-0040 was followed to perform fire area assessments to identify areas where fires may cause damage to the credited equipment or where KSFs are achieved solely by crediting recovery actions. The LAR Attachment D states that a fire separation analysis was performed to determine the existence of pinch points at FCS. The fire separation analysis is documented in FCS engineering analysis. Fire modeling was not used to eliminate any fire area from being a pinch point.

Pinch points refer to a particular location if a single fire can cause a loss of all success paths for a KSF, assuming the entire content of the fire area are lost. Typically, this involves close vertical proximity of cables which support redundant components or trains of a system such that all such cables can be damaged by just one fire scenario.

In SSA RAI 18a (Reference 26), the NRC requested that the licensee identify and describe the changes to outage management procedures, shutdown risk management tools, work control, and any other document resulting from incorporation of KSF identified as part of NFPA 805 transition. The licensee indicated in the SSA RAI 18a response (Reference 15) that the following changes will be implemented to incorporate the NPO assessment results:

- The Station Fire Plan Standing Order G-28 and the Shutdown Operations Protection Plan SO-O-21 will be revised via LAR Attachment S, Implementation Item REC-094 (Reference 23), to include defined entry and exit conditions for NPO fire risk management controls.

- SO-G-28 will be revised via LAR Attachment S, Implementation Item REC-094 (Reference 23), to include NPO fire risk management controls for plant fire areas where one or more NPO KSF could be lost due to a deterministic fire event (identified as "NPO pinch point fire areas") and that are considered to be NPO pinch point fire areas when a redundant SSC that is required for one or more KSFs is placed out of service. The NPO fire risk management controls for the NPO pinch point fire areas are based on the results of the NPO Assessment (FCS Engineering Analysis (EA) 10-042, Non-Power Operation Modes Transition Review).

- The procedure governing temporary modification control (SO-O-25) will be revised via LAR Attachment S, Implementation Item REC-136 (Reference 23), to consider temporary modifications resulting in changes to plant configuration. Temporary changes to plant configuration may necessitate additional NPO fire risk management controls be identified and implemented during the highest risk time periods as associated with NPO

In SSA RAI 18b (Reference 26), the NRC requested the licensee to provide a description of any actions, including pre-fire staging actions, being credited to minimize the impact of fire-induced spurious actuations on power-operated valves (e.g., air-operated valves (AOVs) and motor-operated valves (MOVs)) during NPO (e.g., pre-fire rack-out, "pinning" valves, or isolation of air

supply). The licensee indicated in the SSA RAI 18b response (Reference 15) that the Station Fire Plan (SO-G-28) identifies pre-fire plans for each plant fire area, and is being revised to include a station plan during NPO for NPO pinch point fire areas (LAR Attachment 3, Implementation Item REC-094) (Reference 23). There are 23 NPO pinch point fire areas, and six areas that are considered to be NPO pinch point areas when a redundant SSC that is required for one or more NPO KSFs is placed out of service. The associated NPO fire risk management controls for these 29 areas are limited to the following options:

- Verification that installed detection and/or suppression systems are in service, and the areas are under an hourly fire watch.
- Verification that the areas are under continuous fire watch.
- Manage transient combustible storage and maintenance activities in the areas.

Other pre-fire actions, including pre-fire rack-out, pre-positioning of valves, or isolation of air supply, are not credited to minimize the impact of fire-induced spurious actuations on power operated valves.

In SSA RAI 18c (Reference 26), the NRC staff requested that the licensee identify those RAs relied upon in NPO by physical analysis unit (PAU) and describe how RA feasibility is evaluated. The NRC staff also requested that the licensee state in the description whether these have been or will be factored into operator procedures supporting these actions. The licensee indicated in the SSA RAI 18c response (Reference 15) that Engineering Analysis EA10-042 identifies "proposed" RAs as one of the allowable means to address specific NPO component failures (NPO pinch points); however, consistent with other NFPA 805 sites, administrative controls will be relied upon for management of fire risk during NPO at FCS as described in the responses to SSA RAI 18.a and SSA RAI 18.b. Administrative controls are another one of the allowable means to address specific NPO component failures (NPO pinch points).

Pinch points were resolved using engineering justifications including the recommended use of RAs or fire prevention and protection controls consistent with the risk management strategies described in the guidance in FAQ 07-0040 (Reference 48).

LAR Attachment S, Implementation item REC-094 (Reference 23), will incorporate the NPO analysis in plant technical and administrative procedures. On the basis of the NPO analysis as described in the LAR, and the response to SSA RAI 18 (Reference 15), the NRC staff concludes that the licensee's NPO fire area assessments method is acceptable.

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

3.5.3.4 NPO Pinch Point Resolutions and Program Implementation

In LAR Attachment D, a fire separation analysis was performed to determine the existence of pinch points at FCS. LAR Attachment D, Table D-1 indicates that 23 areas contain one or more pinch points. The fire separation analysis is documented in an FCS engineering analysis. Pinch points are determined to exist in an area where there is a loss of any single KSF and/or both trains of power distribution. Fire modeling was not used to eliminate any fire area from being a pinch point.

The licensee's approach to managing NPO risks is described in LAR Attachment D and follows the guidance of FAQ 07-0040 to protect KSFs. Normal DID strategies for control of ignition sources, combustible materials, compensatory measures, and housekeeping are employed during outage activities involving lower risk evolutions and enhanced protection involving specific management of risk in fire areas containing pinch points, including the use of RAs, is employed during HREs. Additional fire protection DID measures will be taken during HREs by:

- Managing risk in fire areas that contain known pinch points.
- Managing risk in fire areas where pinch points may arise because of equipment taken out of service.

In LAR Section 4.3.2, the licensee stated that for fire areas where a single fire may damage all the credited paths for a KSF, the following options to reduce fire risk depending upon the significance of the potential damage are considered.

The licensee stated, in part, that

> The list of credited actions specified considers the following guidance from FAQ 07-0040:
>
> - Prohibition or limitation of hot-work in fire areas during periods of increased vulnerability
> - Verification of operable detection and/or suppression in the vulnerable areas
> - Prohibition or limitation of combustible materials in fire areas during periods of increased vulnerability
> - Plant configuration changes (e.g., removing power from equipment once it is placed in its desired position)
> - Provision of additional fire patrols at periodic intervals or other appropriate compensatory measures (such as surveillance cameras) during increased vulnerability
> - Use of recovery actions to mitigate potential losses of KSFs

- Identification and monitoring in-situ ignition sources for "fire precursors" (e.g., equipment temperatures)

- Reschedule the work to a period with lower risk or higher DID

For fire areas where the credited KSF system or equipment has been taken out of service during NPO modes, the LAR describes the licensee's process to evaluate, based on KSF Equipment status, and the NPO Fire Area Assessment to develop needed contingency plans/actions.

LAR Attachment S, Implementation Items REC-094 and REC-095 (Reference 23), address the revision of the plant procedures to contain guidance for management of fire risk during NPO and to contain the definition of HRE to be consistent with industry guidance specifying time-to-boil criteria with respect to the recommendations for management of fire risk during NPO.

On the basis that the licensee has implemented outage management strategies consistent with the guidance in FAQ 07-0040 as described in LAR Section 4.3 and Attachment D and will complete LAR Attachment S, Implementation Items REC-094 and REC-095 (Reference 23), the NRC staff concludes that the licensee's methods to manage outage risks and specifically, pinch-points for KSFs, are acceptable.

3.5.3.5 Conclusion for Section 3.5.3

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 provided in FAQ 07-0040, Revision 4 and RG 1.205, Revision 1, to identify the equipment required to achieve and maintain the fuel in a safe and stable condition during NPO modes. The licensee has a process in place to ensure that fire protection DID measures will be implemented to achieve the KSFs during plant outages.

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

- Identified the KSFs required to support the NSPC during NPOs.

- Identified the plant operating states where further analysis is necessary during NPOs.

- Identified the SSCs required to meet the KSFs during the plant operating states analyzed.

- Identified the location of these SSCs and their associated cables.

- Performed analyses on a fire area basis to identify pinch points where one or more KSFs could be lost as a direct result of fire-induced damage.

- Planned/implemented modifications to appropriate station procedures in order to employ one or more fire protection strategy for reducing risk at these pinch points during HREs.

Accordingly, based on the information provided in the LAR, as supplemented, and upon completion of LAR Attachment S, Implementation Items REC-094 and 095 (Reference 23), the NRC staff concludes that the licensee has provided information to assure that the NSPC is met during NPO modes and HREs at FCS.

3.5.4 Conclusion for Section 3.5

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

For those fire areas that used a deterministic approach, the NRC staff reviewed the licensee's statements regarding the following:

- The engineering evaluation for exemptions from the existing FPP were 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.

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

Accordingly, the NRC staff concludes that the licensee has provided sufficient information to assure that each fire area using the deterministic approach does so in accordance with NFPA 805, Section 4.2.3.

For those fire areas that used a PB approach, the NRC staff confirmed the following:

- The engineering evaluations for exemptions from the existing FPP were 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 FREs PB method (in accordance with NFPA 805, Section 4.2.4.2) to address risk impact, DID, and safety margin, and found to be acceptable.

- All RAs necessary to demonstrate the availability of a success path were evaluated with respect to the additional risk presented by their use and found to

be acceptable in accordance with NFPA 805, Section 4.2.4 (See Section 3.4.4 of this SE).

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

Based on its review of the licensee's analysis and outage management process during NPO modes, the NRC staff concludes that the licensee provided information to assure 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. Based on its review, the NRC staff also concludes that the normal FPP DID actions are credited for addressing the risk impact of those fires which potentially affect one or more trains of equipment that provide a KSF required during NPO modes, but would not be expected to cause the total loss of that KSF. The NRC staff concludes that this overall approach for fire protection during NPO modes is acceptable.

3.6 Radioactive Release Performance Criteria

NFPA 805, 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 in any plant operational mode.

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

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

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

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

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

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

The NRC staff has endorsed (with certain exceptions) the methodology given in NEI 04-02 as providing methods acceptable to the staff for establishing an FPP consistent with NFPA 805 and 10 CFR 50.48(c) in RG 1.205. Using these methods, the licensee has assessed the capability of the current FPP to meet the NFPA 805 performance criteria as contained in NEI 04-02 and FAQ 09-0056 (Reference 53). The results of the licensee's assessment are documented in the LAR.

In order to assess whether the FPP to be implemented under NFPA 805 meets the above requirements, the licensee reviewed the current FPP using the methodology contained in NEI 04-02 and subsequent guidance provided in NFPA 805 Task Force FAQ 09-0056. Each fire area was first screened to determine the potential for generating radioactive effluents during firefighting operations. The screening process considered input from FCS radiation protection personnel and evaluated the fire area's potential for radioactive effluent release during all modes of operation. 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 areas, engineering controls afforded by plant design features, fire pre-plans, and fire brigade training materials were reviewed to ascertain whether the existing FCS FPP is 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.

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. With the exception of those fire areas discussed below, the licensee's review determined that FCS buildings and structures provide sufficient capacity to contain the liquid and gaseous firefighting effluents such that there are no offsite releases.

The licensee's review did not identify any plant design features (such as roll-up doors, windows, or drains) that would divert the liquid or gaseous effluents from being collected and processed as credited. The fire preplans will be revised, per LAR Attachment S (Reference 23), to assure that manual actions are taken to prevent offsite releases in those fire areas where there is a potential for such effluent diversions. Additionally, the pre-fire plans will be revised to include provisions for containment and monitoring of smoke and fire-suppression agent runoff from potentially contaminated areas should the effectiveness of the installed engineering controls be challenged or impacted by fire suppression activities.

In general, the reactor containment and auxiliary building ventilation systems are credited for the capture and monitoring of airborne products of firefighting. In those areas where no monitored ventilation is provided, or where normal ventilation is not available, gaseous effluents will either be manually ventilated to the outside (after Radiation protection personnel have verified the radioactive concentrations are within TS limits) or will be directed to an area that has operating normal ventilation.

Floor drains in contaminated areas are directed to the radioactive waste disposal system tanks. The liquid waste tanks are processed, analyzed, and released under controlled conditions in accordance with the FCS Offsite Dose Collection Manual and TS. The licensee indicated that engineering controls for both smoke and fire suppression agent runoff, and the use of revised pre-fire plans and training manuals (to be completed as identified in Attachment S of the NFPA 805 Transition Report) will be acceptable to meet the NFPA 805 radioactive release performance criteria. Consistent with the guidance in RG 1.205, as discussed in Regulatory Issue Summary (RIS) 2007-19, "Process for Communicating Clarifications of Staff Positions Provided in Regulatory Guide 1.205 Concerning Issues Identified During the Pilot Application of National Fire Protection Association Standard 805," dated August 20, 2007 (Reference 105), and FAQ 09-0056, the licensee provided information to provide assurance that the annual dose limits of 10 CFR Part 20 are met if the concentrations of radioactive materials in airborne and liquid releases are maintained below the limits in FCS TSs. Accordingly, the NRC staff concludes that this approach is acceptable.

Attachment E of the FCS LAR identifies several fire areas, outside of contaminated areas, where radioactive materials are stored, but where neither a monitored liquid drain, nor monitored ventilation are provided. These identified fire areas included the steam generator storage facility, sea-land containers storage areas, the "maintenance shop expansion," the "old warehouse," and the training center. In response to the NRC staff's RAI on these fire areas, the licensee provided additional details that included engineering calculations, procedures, training, and pre-fire plans to demonstrate that firefighting effluents in these areas will meet the radiological release performance criteria. The calculations and procedures are listed below:

- Calculation FC07083, "Doses Due to Component Cover Plate Damage,"
- Calculation FC07084, "Original Steam Generator Storage Facility Flooding Concentrations,"
- FCS procedure PE-RR-AE-1001, "Flood Barrier and Sandbag Staging and Installation," and
- Calculation FC07865, "National Fire Protection Association (NFPA) Standard 805 Airborne and Liquid Effluents Offsite Dose, Revision 0"

For releases from the original steam generator storage facility (OSGSF), the licensee evaluated the consequences of the collapse of the OSGSF (calculation FC07083) and the subsequent incineration of the combustible material. The possible exposure at the exclusion area boundary and the low population zone resulting from that scenario was estimated to not exceed the 10 CFR Part 20 annual dose limit. The licensee then applied a flooding analysis (Calculation FC07084), which assumes a 7-foot flood height, to demonstrate that the resulting radionuclide concentrations from runoff of liquid fire-fighting agents would be less than the 10 CFR Part 20, Appendix B, Table 2, Column 2 concentration limits. This bounding analysis provided by the licensee provides assurance that the radioactive releases from fire-fighting activities at the OSGSF will be within the limits of 10 CFR Part 20, consistent with the radiological release requirements.

For releases from sea-land containers (at the Maintenance Shop Expansion and the old warehouse), the licensee's analysis indicated the fire brigade uses standard industry methods (e.g., sandbags, berms, and tarps), in accordance with FCS procedure PE-RR-AE-1001, to prevent runoff into the river. Additionally, OPPD stated that would revise the FCS Offsite Dose Calculation Manual and pre-fire plan SO-G-28 to ensure Radiation Protection personnel monitor contaminated liquid effluents prior to safe removal from the station's protected area. If these methods of containment are not able to prevent the release of radioactive materials, the licensee also limits the contact dose rate of sea-land containers (per calculation FC07865) such that the effects of complete combustion of the largest source, together with the effects of fire suppression activities, would not exceed the dose limits of 10 CFR Part 20. This bounding analysis provided by the licensee assures that the radioactive releases from fire-fighting activities associated with sea-land containers will be within the limits of 10 CFR Part 20, consistent with the radiological release objectives.

For sources located at the training facility, the location of the source (in a locked safe) and the activity of the source are controlled to ensure there is no radiological release from this source. These administrative controls, as described by the licensee, provide assurance that the maximum offsite dose resulting from fire suppression activities will be within the limits of 10 CFR Part 20, consistent with the radiological release objectives.

The licensee also reviewed the fire brigade training materials to ensure they are consistent with the pre-fire plans in terms of containment and monitoring of potentially contaminated smoke and fire suppression water. The licensee's review of the fire brigade training materials determined that the existing fire brigade training materials need revision. For example, LAR Attachment S, Table S-3, "Implementation Items," indicates fire brigade members will need sufficient training and knowledge of nuclear safety systems to understand the effects of fire suppressants on NSPC. Additionally, LAR Attachment E identifies several fire areas where the fire pre-plan and associated training materials will identify potentially contaminated areas, provide instruction for communication with Radiation Protection personnel, and describe precautions to be undertaken for safe removal of contaminated smoke and water runoff in these potentially contaminated areas. As indicated in LAR Attachment S, Table S-3, "Implementation Items," revisions of the pre-fire plans and the fire brigade training materials will be completed prior to the implementation of the new NFPA 805 FPP, in 12 months of NRC approval of the LAR.

NFPA 805 requires the licensee to address the nuclear safety and radioactive release goals, objectives, and performance criteria in any operational mode. As noted above, the licensee's radioactive release review considered all plant operating modes (including power and non-power operations), since fire suppression activities, as defined in the pre-fire plans and fire brigade firefighting instruction operating guidelines, are written for any plant operating mode.

Based on (1) the information provided in the LAR, as supplemented, (2) the licensee's use of pre-fire 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 RI/PB FPP is acceptable to assure that radiation releases to any unrestricted area resulting from the direct effects of fire suppression activities at FCS Unit 1 are as low as reasonably achievable (ALARA) and are not expected to exceed the radiological dose limits in 10 CFR Part 20. In conclusion, the NRC staff finds that the licensee's RI/PB FPP complies with

the requirements specified in NFPA 805 Sections 1.3.2, 1.4.2, and 1.5.2. Accordingly, the NRC staff concludes that this approach is acceptable.

3.7 NFPA 805 Monitoring Program

For this section of the SE, the following requirements from NFPA 805 (Reference 4), Section 2.6, are applicable to the NRC staff's review of the LAR:

NFPA 805 Section 2.6, "Monitoring":

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

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

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

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

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

NFPA 805 Section 2.6.3, "Corrective Action":

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

The NRC staff reviewed LAR Section 4.6, "Monitoring Program," that the licensee developed to monitor availability, reliability, and performance of the FCS FPP systems and features after the transition to NFPA 805. The focus of the NRC staff 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 concluded was acceptable.

The licensee stated that the FCS technical staff will develop an NFPA 805 monitoring program consistent with FAQ 10-0059 (Reference 54). Development of the licensee's 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.

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, which is consistent with FAQ 10-0059, is acceptable to demonstrate that FCS will implement an effective program for monitoring risk-significant fire SSCs because the NFPA 805 monitoring program development and implementation process ensures that the NFPA 805 monitoring program does the following:

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

However, since the final values for availability and reliability, as well as the performance criteria for the SSCs being monitored, have not been established for the NFPA 805 monitoring program as of the date of this SE, completion of the FCS NFPA 805 Monitoring Program is an implementation item, as noted previously (LAR Attachment S, Implementation Item REC-101) (Reference 23).

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

3.7.1 Conclusion for Section 3.7

The NRC staff reviewed the licensee's RI/PB FPP and RAI responses for Section 3.7 of this SE. The NRC staff concludes that, upon closure of the implementation item in this area, as included in the proposed fire protection license condition, the licensee's monitoring program is acceptable to assure that it meets the requirements specified in Sections 2.6.1, 2.6.2, and 2.6.3 of NFPA 805.

3.8 Program Documentation, Configuration Control, and Quality Assurance

For this section of the SE, the requirements from NFPA 805 (Reference 4), Section 2.7, "Program Documentation, Configuration Control and Quality," are applicable to the NRC staff's review of the LAR in regard to the appropriate content, configuration control, and quality of the documentation used to support the FCS 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 appropriateness of the content of the FCS FPP design basis document and supporting documentation.

The FCS 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 4-8, "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 FCS 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 FCS document control system. Being analyses, they are also subject to review and revision consistent with the other plant calculations and analyses, as required by the plant design change process.

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

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

3.8.2 Configuration Control

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

To support the many other technical, engineering, and licensing programs at FCS, the licensee has existing configuration control processes and procedures for establishing, revising, or using

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 FCS licensing programs, including the FPP.

The LAR stated that the configuration control process includes provisions for appropriate design and engineering reviews and approvals, and that approved analyses are considered controlled documents available through the FCS document control system. The LAR also stated that analyses based on the PRA program, which includes the FREs, are issued as formal analyses subject to these same configuration control processes, and are additionally subjected to the PRA peer review process specified in the ASME/ANS PRA standard RA-Sa-2009 (Reference 34).

Configuration control of the FPP during the transition period is maintained by the licensee's change evaluation process, as defined in existing FCS configuration management and configuration control procedures. The licensee will revise these existing procedures as necessary for application to the NFPA 805 FPP.

The NRC staff reviewed the Implementation Items for updating the FCS FPRA, which are noted in Section 3.4 of this SE.

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

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

3.8.3.1 Review

NFPA 805 requires that each analysis, calculation, or evaluation performed be independently reviewed. The licensee stated that its procedures require independent review of analyses, calculations, and evaluations, including those performed in support of compliance with 10 CFR 50.48(c). The LAR also stated that the transition to NFPA 805 was independently reviewed, and that analyses, calculations, and evaluations to be performed post-transition will be independently reviewed as required by the existing FCS procedures.

Based on the licensee's description of the process for performing independent reviews of analyses, calculations, and evaluations, the NRC staff concludes the licensee's approach for meeting the Quality requirements of NFPA 805, Section 2.7.3.1, is acceptable.

3.8.3.2 Verification and Validation

NFPA 805 requires that each calculational model or numerical method used be verified and validated (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 the V&V of fire models used to support the development of the FCS FPRA. 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 42), documents the V&V of five selected fire models commonly used to support applications of RI/PB fire protection at nuclear power plants. The seven volumes of this NUREG-series report provide technical documentation concerning the predictive capabilities of a specific set of fire dynamics calculation tools and fire phenomenological models that may be used for the analysis of fire hazards in postulated nuclear power plant scenarios. When used within the limitations of the fire models and considering the identified uncertainties, these models may be employed to demonstrate compliance with the requirements of 10 CFR 50.48(c).

Accordingly, for those fire modeling elements performed by the licensee using the V&V applications contained in NUREG-1824 to support the transition to NFPA 805 at FCS, 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.

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

The NRC staff concluded that the theoretical bases of the models and empirical correlations used in the fire modeling calculations that were not addressed in NUREG-1824 were identified and described in authoritative publications, such as The Society of Fire Protection Engineers' *SFPE Handbook of Fire Protection Engineering* (Reference 75).

As reflected in Tables 3.8-1 and 3.8-2, of Attachments A and B to this SE, the fire modeling employed by the licensee in the development of the FCS FPRA used either: (1) empirical correlations that provide bounding solutions for the ZOI, or (2) conservative input parameters in the application of the other models, which produced conservative results for the fire modeling analysis.

Based on the above, the NRC staff concludes that this approach is acceptable to provide assurance that the fire modeling used in the development of the fire scenarios for the FCS FPRA is appropriate, and thus acceptable for use in application (i.e., transition to NFPA 805)

3.8.3.2.2 Discussion of Selected RAI Responses

By letters dated April 26, 2012 (Reference 24), February 22, 2012 (Reference 25), June 27, 2013 (Reference 26), August 14, 2013 (Reference 27), September 27, 2013 (Reference 28), November 15, 2013 (Reference 29), and December 23, 2013 (Reference 30), the NRC staff sought additional information (through RAIs) concerning the fire modeling conducted to support the FPRA. By letters dated July 24, 2012 (Reference 10), August 24, 2012 (Reference 11), September 27, 2012 (Reference 12), April 23, 2013 (Reference 13), May 21, 2013 (Reference 14), July 29, 2013 (Reference 15), September 12, 2013 (Reference 16), October 11, 2013 (Reference 17), November 4, 2013 (Reference 18), November 11, 2013 (Reference 19), December 18, 2013 (Reference 20), and January 24, 2014 (Reference 21), the licensee provided responses to these RAIs. The following paragraphs describe selected RAI responses related to the V&V of the fire models used.

The NRC staff noted that new spreadsheets were developed to automate the ZOI and hot gas layer (HGL) calculations based on Fire Dynamics Tools (FDT^s) in NUREG-1805 (Reference 41) and the evaluation methodology in Fire Induced Vulnerability Evaluation (FIVE), Revision 1 (Reference 71). The NRC staff issued fire modeling (FM) RAI 03(a) (Reference 24), asking the licensee to explain how these spreadsheets were verified (i.e., how did the licensee ensure that the equations in the spreadsheets were coded correctly and that the spreadsheet solutions are identical to those that would be obtained with the FDT^s or FIVE Revision 1?).

In its response (Reference 10), the licensee explained that fire modeling calculations supporting the FCS FPRA were subject to full independent verification per the fire modeling contractor's (Westinghouse Electric Company) quality management system (QMS). In response to follow-up RAI 03.01 (Reference 13), the licensee described the QMS procedure for verifying calculations in some detail.

Based on the additional information provided, the NRC staff concludes that the approach used by the licensee to verify the fire modeling spreadsheets provides is acceptable to demonstrate that the fire modeling calculations were implemented correctly.

The NRC staff issued FM RAI 03(b) (Reference 10), asking the licensee to provide technical details to demonstrate that the algebraic models have been applied within the validated range of input parameters, or to justify the application of the equations outside the validated range reported in NUREG-1824.

In its response (Reference 10), the licensee provided a table that shows the range of values of the input parameters for the algebraic models used in support of the FCS FPRA. Based on these values, the licensee calculated the applicable dimensionless parameters in Table 2-5 of NUREG-1824, and either showed that they are within the validated range specified in the NUREG or justified the application of the algebraic fire model outside the validated input parameter range.

Based on the additional information provided, the NRC staff concludes that the algebraic fire models and correlations used in the FCS transition were applied within their range of applicability and are acceptable.

The NRC staff issued FM RAI 03(c).ii (Reference 24), asking the licensee to provide technical details to demonstrate that, in the evaluation of MCR abandonment, FDS has been applied within the validated range of input parameters, or to justify the application of the model outside the validated range reported in NUREG-1824 and the V&V reports for FDS Version 5 (Reference 76).

In its response (Reference 10), the licensee provided a table with the FDS input parameters for the MCR abandonment analysis. Based on these values, the licensee calculated the applicable dimensionless parameters in Table 2-5 of NUREG-1824, and either showed that they are within the validated range specified in the NUREG-1824 or justified the application of FDS outside the validated input parameter range.

Based on the additional information provided, the NRC staff concludes that FDS, as used in the MCR abandonment analysis, was applied within its range of applicability and is acceptable.

FDS was also used to model an instrument air compressor oil fire scenario in fire area FC32. The NRC staff issued FM RAI 03(d) (Reference 24), asking the licensee to provide technical details for this scenario to demonstrate that FDS has been applied within the validated range of input parameters, or to justify the application of the model outside the validated range reported in NUREG-1824.

In its response (Reference 10), the licensee provided a table with the input parameters for the FDS model of the air compressor oil fire scenario in fire area FC32. Based on these values, the licensee calculated the applicable dimensionless parameters in Table 2-5 of NUREG-1824 and showed that they are within the validated range specified in the NUREG-1824.

Based on the additional information provided, the NRC staff concludes that FDS, as used to model an air compressor oil fire scenario in fire area FC32, was applied within its range of applicability and is acceptable.

The NRC staff issued FM RAI 01 (f).ii (Reference 10), asking the licensee to justify the grid spacing that was used in the FDS simulations of fire scenarios in the MCR and fire area FC32. In addition, the NRC staff asked the licensee to explain how the ventilation of the compartment was specified in the FDS model of the air compressor oil fire scenario in fire area FC32.

In its response (Reference 10), the licensee calculated $D^*/\delta x$ for every scenario that was modeled with FDS and determined that this non-dimensional ratio is within the validated range specified in Volume 7 of NUREG-1824, except for the simulations of fires in the MCR with a HRR of 100, 200, and 300 kW. For these three scenarios, the licensee justified using FDS with the selected grid spacing on the basis that the modeling results that affect MCR abandonment (global HGL temperature, heat flux, and smoke density) are not sensitive to grid size.

Based on the additional information provided, the NRC staff concludes that the grid spacing used in the FDS simulations of fire scenarios in the MCR and fire area FC32 is acceptable.

In its response to FM RAI 01.f.ii (Reference 10), the licensee stated that an error was found in the FDS input file concerning the ventilation in the air compressor oil fire scenario. The licensee

subsequently re-ran the simulation with appropriate ventilation and determined that the conclusions of the analysis were not affected.

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 implementation items (see LAR Attachment S, Implementation Items REC-101 through REC-105) (Reference 23).

3.8.3.2.4 Summary of Staff Position

Based on the licensee's description of the FCS process for V&V of calculational models and numerical methods and its continued use post-transition, the NRC staff concludes the licensee's approach to meeting the requirements of NFPA 805 Section 2.7.3.2 is acceptable.

3.8.3.3 Limitations of Use

NFPA 805 requires that only acceptable engineering methods and numerical models be used for transition to the extent that these methods have been subject to V&V; and that they are applied within the scope, limitations, and assumptions prescribed for that method. The LAR stated that the engineering methods and numerical models used in support of the transition to NFPA 805 were used 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 at FCS fall within their V&V limitations.

3.8.3.3.1 General

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

3.8.3.3.2 Post-Transition

The licensee also stated that it will revise the appropriate processes and procedures to include the NFPA 805 quality requirements for use during the performance of post-transition FPP changes, including those for limitations of use. Revision of the applicable post-transition processes and procedures to include NFPA 805 requirements for limitations of use are implementation items (see LAR Attachment S, Implementation Items REC-101 through REC-105) (Reference 23).

3.8.3.3.3 Conclusion for Section 3.8.3.3

Based on the licensee's statements that the fire models used to support development of the FPRA were used within their limitations, and the description of the FCS process for placing limitations on the use of engineering methods and numerical models, the NRC staff concludes the licensee's approach to meeting the requirements of NFPA 805, Section 2.7.3.3 is acceptable.

3.8.3.4 Qualification of Users

3.8.3.4.1 General

NFPA 805 requires that personnel performing engineering analyses and applying numerical methods (e.g., fire modeling) 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. 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).

Specifically, these requirements are being addressed through the implementation of an engineering qualification process at FCS. 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. FCS has developed qualification or training requirements for personnel performing engineering analyses and numerical methods.

The NRC staff issued several RAIs pertaining to the qualification of personnel who support FCS FRE fire modeling. Relevant RAIs and responses are summarized below:

3.8.3.4.2 Discussion of Selected RAI Responses

By letters dated April 26, 2012 (Reference 24), February 22, 2012 (Reference 25), June 27, 2013 (Reference 26), August 14, 2013 (Reference 27), September 27, 2013 (Reference 28), November 15, 2013 (Reference 29), and December 23, 2013 (Reference 30), the NRC staff sought additional information (through RAIs) concerning the fire modeling conducted to support the FPRA. By letters dated July 24, 2012 (Reference 10), August 24, 2012 (Reference 11), September 27, 2012 (Reference 12), April 23, 2013 (Reference 13), May 21, 2013 (Reference 14), July 29, 2013 (Reference 15), September 12, 2013 (Reference 16), October 11, 2013 (Reference 17), November 4, 2013 (Reference 18), November 11, 2013 (Reference 19), December 18, 2013 (Reference 20), and January 24, 2014 (Reference 21), the licensee provided responses to these RAIs. The following paragraphs describe selected RAI responses related to the qualifications of fire model users.

The NRC staff issued FM RAIs 04(a) (Reference 24), asking the licensee to describe what constitutes the appropriate qualifications for the OPPD staff and consulting engineers to use and apply the fire modeling tools included in the engineering analyses.

In its response (Reference 10), the licensee explained that attributes of a qualified fire model user include one or several of the following: an engineering degree, formal training or experience in fire behavior and fire modeling techniques, and experience performing or supporting nuclear power plant fire modeling applications.

The NRC staff issued FM RAIs 04(b) (Reference 24), and FM RAI 04.01 (Reference 25), asking the licensee to describe the processes and procedures in place to ensure that personnel and contractors who perform fire modeling during and after the transition have the necessary qualifications.

In its response to the initial RAI (Reference 10), the licensee explained that the FRE was performed by contract personnel under the Westinghouse Electric Company QMS and will be maintained under the OPPD Quality Assurance (QA) Program, both of which provide specific requirements for ensuring that work is performed by qualified personnel. In its response to the follow-up RAI (Reference 13), the licensee described the process in more detail.

The NRC staff issued FM RAI 04(c) (Reference 24), asking the licensee to explain how the necessary communication and exchange of information between fire modeling analysts and FPRA personnel was accomplished.

In its response (Reference 10), the licensee explained that the FCS FPRA was developed by PRA analysts who were also qualified fire modeling users. Since the FPRA analysts performed the fire modeling, there was no need for a formal process for exchanging information.

3.8.3.4.3 Post-Transition

The post-transition qualification training program will be implemented to include NFPA 805 requirements for Qualification of Users as identified in LAR Attachment S, Implementation Item REC-105 (Reference 23).

3.8.3.4.4 Summary of Staff Position

Based on its review and above explanation, the NRC staff concludes that appropriately competent and experienced personnel developed the FCS FRE, including the supporting fire modeling calculations and including the additional documentation for models and empirical correlations not identified in previous NRC-approved V&V documents.

In addition, based on the licensee's description of the FCS procedures for ensuring personnel who use and apply engineering analyses and numerical methods are competent and experienced, the NRC staff concludes 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 RA-SA-2009 standard (Reference 34)) includes requirements to address uncertainty. Accordingly, the licensee addressed uncertainty as a part of the development of the FCS 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 77) there are three types of uncertainty associated with fire modeling 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 fire modeling 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 Application Guide (NPP FIRE MAG)" (Reference 78).

3. Completeness Uncertainty: This refers to the fact that a model is not a complete description of the phenomena it is designed to simulate. Some consider this a form of model uncertainty because most fire models neglect certain physical phenomena that are not considered important for a given application. Completeness uncertainty is addressed by the description of the algorithms found in the model documentation. It is addressed, indirectly, by the same process used to address the Model Uncertainty

3.8.3.5.2 Discussion of Fire Modeling RAIs

By letters dated April 26, 2012 (Reference 24), February 22, 2012 (Reference 25), June 27, 2013 (Reference 26), August 14, 2013 (Reference 27), September 27, 2013 (Reference 28), November 15, 2013 (Reference 29), and December 23, 2013 (Reference 30), the NRC staff sought additional information (through RAIs) concerning the fire modeling conducted to support the FPRA. By letters dated July 24, 2012 (Reference 10), August 24, 2012 (Reference 11),

September 27, 2012 (Reference 12), April 23, 2013 (Reference 13), May 21, 2013 (Reference 14), July 29, 2013 (Reference 15), September 12, 2013 (Reference 16), October 11, 2013 (Reference 17), November 4, 2013 (Reference 18), November 11, 2013 (Reference 19), December 18, 2013 (Reference 20), and January 24, 2014 (Reference 21), the licensee provided responses to these RAIs. The following paragraphs describe RAI responses related to the acceptability of the fire models used. The following paragraphs describe selected RAI responses related to uncertainty.

The NRC staff issued FM RAI 05(a) (Reference 24), asking the licensee to describe the uncertainty analyses for the fire modeling that was performed, and to explain how the uncertainties of the input parameters were determined.

In its response (Reference 10), the licensee stated that each source of uncertainty was either qualitatively or quantitatively dispositioned. The fire modeling sources of uncertainty were identified based on a review of each FPRA calculation and on guidelines in Volume 2 of NUREG/CR-6850 (Reference 36). The response concludes with a brief discussion of the sources of uncertainty relevant to fire scenario development.

Based on the additional information provided, as described above, the NRC staff concludes the licensee's approach to account for parameter uncertainty in the fire modeling analyses is acceptable.

The NRC staff issued FM RAI 05(b) (Reference 24), asking the licensee to provide a quantitative assessment of the impact of the uncertainties in the thermo-physical properties of cables on the FRE results.

In its response (Reference 10), the licensee identified five thermo-physical cable properties that affect the FPRA: damage temperature, damage radiative heat flux, heat release rate per unit area (HRRPUA), heat of combustion and cable mass per unit length. The uncertainties of the temperature and heat flux thresholds were addressed by using the conservative values specified in Volume 2 of NUREG/CR-6850. Based on sensitivity analyses, the licensee determined that the effect on CDF and LERF of variations in the heat of combustion and the cable mass per unit length is negligible. Finally, the licensee performed a sensitivity analysis to evaluate the effect of variations in the HRRPUA on plant risk. The HRRPUA used in the FCS FPRA was 328 kW/m^2, which is the average value for thermoset cables reported in Volume 2 of NUREG/CR-6850. The sensitivity analysis shows that using a HRRPUA of 475 kW/m^2 (the highest value in Volume 2 of NUREG/CR-6850) results in an increase of plant CDF from 6.01E-05/year to 6.03E-05/year (0.3-percent) and an increase of plant LERF from 4.82E-06/year to 4.83E-06/year (0.2-percent). The licensee concluded that the net change in risk is within the Region II acceptance criteria of RG 1.174 for the range of Cable HRRs per unit area.

The NRC staff concludes that the licensee's quantitative assessment of the impact on the FPRA results of the uncertainties associated with the thermo-physical properties of cables is acceptable.

The NRC staff issued FM RAI 05(c) (Reference 24), asking the licensee to (i) quantify the impact of the uncertainty of the soot yield on the MCR abandonment times and FPRA results,

and (ii) quantify the impact of the uncertainty of the combustible cable tray loading on the FPRA results.

In its response to part (i) (Reference 12), the licensee performed a sensitivity analysis to evaluate the effect of variations in the soot yield on MCR abandonment times. The soot yield used in the FCS FRE was 0.06 kg/kg. The sensitivity analysis shows that using a soot yield of 0.08 kg/kg (chosen based on soot yield for different types of cables in NUREG-1805) results in an increase of plant CDF from 6.01E-05/year to 6.31E-05/year (5.0-percent) and an increase of plant LERF from 4.82E-06/year to 5.12E-06/year (6.2-percent). The licensee concluded that the net change in risk is within the Capability Category II requirements of the ASME/ANS RA-SA-2009 standard.

The NRC staff concludes that the licensee's quantitative assessment of the impact on the MCR abandonment time calculations and FPRA results of the uncertainties associated with the assumed soot yield is acceptable.

In the response to part (ii) (Reference 10), the licensee explained that the combustible cable loading is a function of the HRRPUA, the cable mass per unit length and the number of cables per tray. The effects of the HRRPUA and the cable mass per unit length are discussed in the response to FM RAI 05(b). To determine the effect of the third parameter, the licensee reviewed the FCS cable database and established a probability distribution for the number of cables per tray. The CDF and LERF were recalculated assuming 96 cables per tray (98^{th} percentile) instead of 50 cables per tray used in the FCS FPRA. The CDF and LERF remained unchanged.

The NRC staff concludes that the licensee's quantitative assessment of the impact on the FPRA results of the uncertainties associated with the combustible cable tray loading is acceptable.

The NRC staff issued FM RAI 05(d) (Reference 24), asking the licensee to provide justification for the assumption that in fire area FC32 (only) 10-percent of the compressor oil fires result in failure of the overhead cable trays, while the overhead cable trays in 90-percent of the fires are not damaged.

In its response (Reference 10), the licensee explained that, although the FDS analysis showed that the overhead cables will not reach their damage threshold in the air compressor oil fire scenario, it was conservatively assumed that they will be damaged in 10 percent of the oil fires. This assumption was made to account for the model and parameter uncertainties, since the CDF is very sensitive to the failure of the overhead cables.

Based on the additional information provided, the NRC staff concludes that the licensee's justification for the assumption that overhead cable trays will not fail in 90 percent of the compressor oil fires postulated in fire area FC32 is acceptable.

The NRC staff issued FM RAI 05(e) (Reference 24), asking the licensee to justify the assumption that cable tray obstructions were not considered in the FDS fire modeling analysis for fire area FC32.

In its response (Reference 11), the licensee explained that excluding obstructions in this case is conservative since they are non-combustible and do not focus the plume energy toward specific targets.

Based on the additional information provided, the NRC staff concludes that excluding obstructions in the FDS fire modeling analysis of compressor oil fires in Fire Area FC32 is acceptable.

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 implementation items (see LAR Attachment S, Implementation Items REC-101 through REC-105) (Reference 23).

3.8.3.5.4 Conclusion for Section 3.8.3.5

Based on the licensee's description of the FCS 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, the NRC staff concludes that the FCS RI/PB fire protection QA program adequately addresses each of the requirements of NFPA 805, Section 2.7.3, which include conducting independent reviews, performing V&V, limiting the application of acceptable methods and models to within prescribed boundaries, ensuring that personnel applying acceptable methods and models are qualified, and performing uncertainty analyses.

3.8.4 Fire Protection Quality Assurance Program

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

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

The licensee established its fire protection quality assurance (QA) program in accordance with the guidelines of NUREG-0800, Section 9.5.1 Position C.4, "Quality Assurance Program," (Reference 62). In addition, the guidance in Appendix C to NEI 04-02 (Reference 5) suggests that the LAR include a description of how the existing fire protection QA program will be transitioned to the new NFPA 805 RI/PB FPP, as discussed below.

The LAR stated that the fire protection QA program is included within and implemented by the FCS nuclear QA program, although certain aspects of that program are not applicable to the FPP. The QA program will be updated in accordance with the requirements of Section 2.7.3 of

NFPA 805 in accordance with LAR Attachment S, Implementation Items REC-101 through REC-105 (Reference 23).

Based on its review and the above explanation, the NRC staff concludes that the licensee's changes to the fire protection QA program are acceptable because they 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 QA program that are required by NFPA 805 for transition and post-transition, as identified in LAR Attachment S, Implementation Items REC-101 through REC-105 (Reference 23).

3.8.5 Conclusion for Section 3.8

The NRC staff reviewed the licensee's RI/PB FPP and RAI responses for Section 3.8 of this SE. The NRC staff concludes that, upon completion of the implementation items, the licensee's approach for meeting the requirements specified in Section 2.7 of NFPA 805 is acceptable.

4.0 FIRE PROTECTION LICENSE CONDITION

The licensee proposed an FPP license condition regarding transition to an RI/PB FPP under NFPA 805, in accordance with 10 CFR 50.48(c)(3)(i). The new license condition adopts the guidelines of the standard fire protection license condition promulgated in RG 1.205, Revision 1, Regulatory Position C.3.1, as issued on December 18, 2009 (74 FR 67253). Plant-specific changes were made to the sample license condition; however, the proposed plant-specific FPP license condition is consistent with the standard fire protection license condition, incorporates all of the relevant features of the transition to NFPA 805 at Fort Calhoun Station and is, therefore, acceptable.

The following license condition is included in the revised license for the Fort Calhoun Station, and will replace Operating License No. DPR-40 Condition 3.D:

D. Fire Protection Program

Omaha Public Power District shall implement and maintain in effect all provisions of the approved fire protection program that comply with 10 CFR 50.48(a) and 10 CFR 50.48(c), as specified in the licensee amendment request dated September 28, 2011 (and supplements dated December 19, 2011, December 22, 2011, March 20, 2012, July 24, 2012, August 24, 2012, September 27, 2012, April 23, 2013, May 21, 2013, July 29, 2013, September 12, 2013, October 11, 2013, November 4, 2013, November 11, 2013, December 18, 2013, January 24, 2014, February 28, 2014, April 10, and June 11, 2014), and as approved in the safety evaluation dated June 16, 2014. Except where NRC approval for changes or deviations is required by 10 CFR 50.48(c), and provided no other regulation, technical specification, license condition or requirement would require prior NRC approval, the licensee may make changes to the fire protection program without prior approval of the Commission if those changes satisfy the provisions set forth in

10 CFR 50.48(a) and 10 CFR 50.48(c), the change does not require a change to a technical specification or a license condition, and the criteria listed below are satisfied.

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

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

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

(b) Prior NRC review and approval is not required for individual changes that result in a risk increase less than 1×10^{-7}/year (yr) for core damage frequency (CDF) and less than 1×10^{-8}/yr for large early release frequency (LERF). The proposed change must also be consistent with the defense-in-depth philosophy and must maintain sufficient safety margins. The change may be implemented following completion of the plant change evaluation.

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

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

Prior NRC review and approval 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.

(b) 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 June 16, 2014, to determine that certain fire protection program changes meet the minimal criterion. The licensee shall ensure that fire protection defense-in-depth and safety margins are maintained when changes are made to the fire protection program.

(3) Transition License Conditions

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

(b) The licensee shall implement the modifications to its facility, as described in Enclosure 1, Attachment S, Table S-2, "Plant Modifications Committed," of OPPD letter LIC-14-0042, dated April 10, 2014, to complete the transition to full compliance with 10 CFR 50.48(c) by the end of the second refueling outage following issuance of the license amendment. The licensee shall maintain appropriate compensatory measures in place until completion of these modifications.

(c) The licensee shall implement the items listed in Enclosure 1, Attachment S, Table S-3, "Implementation Items," of OPPD letter LIC-14-0042, dated April 10, 2014, no later than 12 months after issuance of the license amendment.

5.0 SUMMARY

The NRC staff reviewed the licensee's application, as supplemented by various letters, to transition to an RI/PB FPP in accordance with the requirements established by NFPA 805. The NRC staff concludes that the applicant's approach, methods, and data are acceptable to establish, implement and maintain an RI/PB FPP in accordance with 10 CFR 50.48(c).

Implementation of the RI/PB FPP in accordance with 10 CFR 50.48(c) will include the application of a new fire protection license condition. The new license condition includes a list of implementation items that must be completed in order to support the conclusions made in this SE, as well as an established date by which full compliance with 10 CFR 50.48(c) will be achieved.

6.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Nebraska State official was notified on February 21, 2014, of the proposed issuance of the amendment. The state official had no comments.

7.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to the installation or use of facility components located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts and no significant change in the types of any effluents that may be released offsite and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding published in the *Federal Register* on April 10, 2012 (77 FR 21595). 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: June 16, 2014

Attachments:

A. Table 3.8-1 – V&V Basis for Fire Modeling Correlations Used at FCS
B. Table 3.8-2 – V&V Basis for Fire Model Calculations of Other Models Used at FCS
C. Abbreviations and Acronyms

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at FCS

Correlation	**Application at FCS**	**V&V Basis**	**NRC Staff Evaluation of Acceptability**
Plume Centerline Temperature (Method of Heskestad)	The Plume Centerline Temperature correlation was implemented in the generic calculation procedure of FCS and was used to determine the vertical extent of the ZOI	NUREG-1805, Chapter 9, 2004 (Reference 41) NUREG-1824, Volume 3, 2007 (Reference 42) Society of Fire Protection Engineers (SFPE) Handbook, 4th Edition, Chapter 2-1, Heskestad, 2008 (Reference 79)	• Licensee used Westinghouse quality management system (QMS) to verify the implementation of the correlation in spreadsheets. Licensee stated that the Westinghouse QMS ensures commitments to the QA requirements of ISO 9001 (Reference 80), ISO 9003 (Reference 81), 10 CFR 50 Appendix B, ASME NQA-1 (Reference 82), and other national and international regulatory requirements. (Response to FM RAI 03(a), Reference 10) • The correlation is validated in NUREG-1824 and an authoritative publication of the SFPE Handbook. • Licensee stated that in most cases, the correlation has been applied within the validated range reported in NUREG-1824. (Response to FM RAI 03(b), Reference 10) Based on these observations, the NRC staff concludes that the use of this correlation in the FCS application is acceptable.

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at FCS

Correlation	**Application at FCS**	**V&V Basis**	**NRC Staff Evaluation of Acceptability**
Radiant Heat Flux (Point Source Method)	The Radiant Heat Flux (Point Source Method) correlation was implemented in the generic calculation procedure of FCS and was used to determine the horizontal separation distance, based on heat flux, to a target in order to determine the horizontal extent of the ZOI	NUREG-1805, Chapter 5, 2004 (Reference 41) NUREG-1824, Volume 3, 2007 (Reference 42) SFPE Handbook, 4th Edition, Chapter 3-10, Beyler, C., 2008 (Reference 83)	• Licensee used Westinghouse QMS to verify the implementation of the correlation in spreadsheets. Licensee stated that the Westinghouse QMS ensures commitments to the QA requirements of ISO 9001 (Reference 80), ISO 9003 (Reference 81), 10 CFR 50 Appendix B, ASME NQA-1 (Reference 82), and other national and international regulatory requirements. (Response to FM RAI 03(a), Reference 10) • The correlation is validated in NUREG-1824 and an authoritative publication of the SFPE Handbook. • Licensee stated that in most cases, the correlation has been applied within the validated range reported in NUREG-1824. (Response to FM RAI 03(b), Reference 10). Based on these observations, the NRC staff concludes that the use of this correlation in the FCS application is acceptable.

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at FCS

Correlation	**Application at FCS**	**V&V Basis**	**NRC Staff Evaluation of Acceptability**
Hot Gas Layer (Method of McCaffrey, Quintiere, and Harkleroad)	The Hot Gas Layer (Method of McCaffrey, Quintiere, and Harkleroad) correlation was implemented in the generic calculation procedure of FCS and was used to calculate the HGL temperature for a room with natural ventilation	NUREG-1805, Chapter 2, 2004. (Reference 41) NUREG-1824, Volume 3, 2007. (Reference 42) SFPE Handbook, 4th Edition, Chapter 3-6, Walton W. and Thomas, P., 2008 (Reference 84)	• Licensee used Westinghouse QMS to verify the implementation of the correlation in spreadsheets. Licensee stated that the Westinghouse QMS ensures commitments to the QA requirements of ISO 9001 (Reference 80), ISO 9003 (Reference 81), 10 CFR 50 Appendix B, ASME NQA-1 (Reference 82), and other national and international regulatory requirements. (Response to FM RAI 03(a), Reference 10) • The correlation is validated in NUREG-1824 and an authoritative publication of the SFPE Handbook. • Licensee stated that in most cases, the correlation has been applied within the validated range reported in NUREG-1824. (Response to FM RAI 01 (c), Reference 11). Based on these observations, the NRC staff concludes that the use of this correlation in the FCS application is acceptable.

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at FCS

Correlation	**Application at FCS**	**V&V Basis**	**NRC Staff Evaluation of Acceptability**
Ceiling Jet Temperature (Method of Alpert)	The Ceiling Jet Temperature (Method of Alpert) correlation was implemented in the generic calculation document of FCS and was used to calculate horizontal separation distance, based on temperature at the ceiling of a room, to a target in order to determine the horizontal extent of the ZOI.	NUREG-1824, Volume 4, 2007 (Reference 42) SFPE Handbook, 4th Edition, Chapter 2-2, Alpert, R., 2008 (Reference 70)	• Licensee used Westinghouse QMS to verify the implementation of the correlation in spreadsheets. Licensee stated that the Westinghouse QMS ensures commitments to the QA requirements of ISO 9001 (Reference 80), ISO 9003 (Reference 81), 10 CFR 50 Appendix B, ASME NQA-1 (Reference 82), and other national and international regulatory requirements. (Response to FM RAI 03(a), Reference 10) • The correlation is validated in NUREG-1824 and an authoritative publication of the SFPE Handbook. • Licensee stated that in most cases, the correlation has been applied within the validated range reported in NUREG-1824. (Response to FM RAI 01 (c), Reference 11). Based on these observations, the NRC staff concludes that the use of this correlation in the FCS application is acceptable.

Attachment B: Table 3.8-2, V&V Basis for Other Fire Models and Related Calculations Used at FCS

Calculation	Application at FCS	V&V Basis	NRC Staff Evaluation of Acceptability
Fire Dynamics Simulator (Version 5)	Fire Dynamics Simulator (Version 5) was used to calculate HGL height, visibility and temperatures in the MCR to determine abandonment time	NUREG-1824, Volume 7, 2007 (Reference 42) NIST SP 1018-5, Volume 2, 2010 (Reference 85) NIST SP 1018-5, Volume 3, 2010 (Reference 76)	• The modeling technique is validated in NUREG-1824 (Reference 42) and an authoritative publications of National Institute of Standards and Technology (NIST) (References 85 and 76). • Licensee stated that in most cases, the correlation has been applied within the validated range reported in NUREG-1824. Licensee provided justification for cases where the correlation was used outside the NUREG-1824 validated range. (Response to FM RAI 03(c).ii, Reference 10) Based these observations, the NRC staff concludes that the use of FDS in the FCS application for the MCR abandonment time calculations is acceptable.
Fire Dynamics Simulator (Version 5)	Fire Dynamics Simulator (Version 5) was used to calculate gas and target temperatures in an instrument air compressor oil fire scenario	NUREG-1824, Volume 7, 2007 (Reference 42) NIST SP 1018-5, Volume 2, 2010 (Reference 85) NIST SP 1018-5, Volume 3, 2010 (Reference 76)	• The modeling technique is validated in NUREG-1824 (Reference 42) and authoritative publications of NIST (References 76 and 85). • Licensee stated that the correlation has been applied within the validated range reported in NUREG-1824. (Response to FM RAI 03(d), Reference 10) Based these observations, the NRC staff concludes that the use of FDS in the FCS application for the MCR abandonment time calculations is acceptable.

Attachment C: Abbreviations and Acronyms

AC	alternating current
ADAMS	Agencywide Documents Access and Management System
AFW	auxiliary feedwater
AHJ	authority having jurisdiction
ALARA	as low as reasonably achievable
ANS	American Nuclear Society
AOV	air-operated valve
ASME	American Society of Mechanical Engineers
BAST	boric acid storage tank
BWR	boiling-water reactor
CAROLFIRE	Cable Response to Live Fire
CCDP	conditional core damage probability
CDF	core damage frequency
CEOG	Combustion Engineering Owners Group
CFAST	consolidated model of fire and smoke transport
CFR	Code of Federal Regulations
CFWC	cable fires caused by welding and cutting
CLERP	conditional large early release probability
CO_2	carbon dioxide
CPT	control power transformer
CST	condensate storage tank
CVCS	chemical and volume control system
CW	circulating water
DC	direct current
DESIREE-Fire	Direct Current Electrical Shorting in Response to Exposure Fire
DG	diesel generator
DID RA	defense-in-depth recovery action
DID	defense-in-depth
EdF	Electricite de France
EEEE	existing engineering equivalency evaluation
EFWST	emergency feedwater storage tank
EPRI	Electric Power Research Institute
Epsilon (ε)	Non-zero but below truncation limit
ERFBS	electrical raceway fire barrier system
ERO	emergency response organization
F&O	facts and observations
FAQ	frequently asked question
FCS	Fort Calhoun Station
FDS	fire dynamics simulator
FDT^s	fire dynamics tool
FIVE	Fire Induced Vulnerability Evaluation Methodology
FM	fire modeling
FPE	fire protection engineering
FPEE	fire protection engineering evaluation
FPP	fire protection program
FPRA	fire probabilistic risk assessment
FR	*Federal Register*

FRE	fire risk evaluation
FSAR	final safety analysis report
GDC	general design criteria
GL	generic letter
HEAF	high-energy arching fault
HEP	human error probability
HFE	human failure event
HGL	hot gas layer
HPSI	high-pressure safety injection
HRA	human reliability analysis
HRE	high(er) risk evolution
HRR	heat release rate
HRRPUA	heat release rate per unit area
HVAC	heating, ventilation, and air conditioning
IEEE	Institute of Electrical and Electronics Engineers
KSF	key safety function
kV	kiloVolt
kW	kiloWatt
LAR	license amendment request
LERF	large early release frequency
MCA	Multi-compartment analysis
MCB	main control board
MCC	motor control center
MCR	main control room
MOV	motor-operated valve
MQH	McCaffrey, Quintiere, and Harkleroad
MSO	multiple spurious operation
NEI	Nuclear Energy Institute
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
No.	number
NPO	non-power operation
NPP FIRE MAG	Nuclear Power Plant Fire Modeling Analysis Guidelines
NRC	U.S. Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
NSCA	nuclear safety capability assessment
NSPC	nuclear safety performance criteria
OMA	operator manual action
OPPD	Omaha Public Power District
OSGSF	original steam generator storage facility
P&ID	piping and instrumentation drawing
PAU	physical analysis unit
PB	performance-based
PCE	plant change evaluation
PCS	primary control station
PRA	probabilistic risk assessment
PSA	probabilistic safety assessment
psi	pounds per square inch
PWR	pressurized-water reactor

PWROG	Pressurized Water Reactor Owners Group
PWROG	Pressurized Water Reactor Owners Group
QA	quality assurance
QMS	quality management system
RA	recovery action
RAI	request for additional information
RCP	reactor coolant pump
RCS	reactor coolant system
RES	Office of Nuclear Regulatory Research
RG	Regulatory Guide
RI	risk-informed
RI/PB	risk-informed, performance-based
RPV	reactor pressure vessel
RTI	response time index
SCBA	self-contained breathing apparatus
SE	safety evaluation
SER	safety evaluation report
SFPE	Society of Fire Protection Engineers
SG	steam generator
SIRWT	safety injection refueling water tank
SOKC	state of knowledge correlations
SR	supporting requirement
SRV	safety relief valve
SSA	safe shutdown analysis
SSC	structures, systems, and components
SSD	safe shutdown
SSEL	safe shutdown equipment list
TFWC	transient fires caused by welding and cutting
TR	technical/topical report
TS	technical specification
USAR	Updated Safety Analysis Report
V	Volt
V&V	verification and validation
VFDR	variance from deterministic requirements
YD	yard
yr	year
ZOI	zone of influence

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

Sincerely,

/RA/

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

Docket No. 50-285

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