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

August 30, 2016

Mr. Bryan C. Hanson
President and Chief Nuclear Officer
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NOS. 1 AND 2 - ISSUANCE OF AMENDMENTS REGARDING TRANSITION TO A RISK-INFORMED, PERFORMANCE-BASED FIRE PROTECTION PROGRAM IN ACCORDANCE WITH 10 CFR 50.48(c) (CAC NOS. MF2993 AND MF2994)

Dear Mr. Hanson:

The Nuclear Regulatory Commission (NRC or the Commission) has issued the enclosed Amendment No. 318 to Renewed Facility Operating License (RFOL) No. DPR-53, and Amendment No. 296 to RFOL No. DPR-69, for the Calvert Cliffs Nuclear Power Plant, Units 1 and 2, respectively. These amendments consist of changes to the operating licenses and technical specifications (TSs) in response to your application dated September 24, 2013, as supplemented by letters dated February 9, 2015, March 11, 2015, April 13, 2015, July 6, 2015, August 13, 2015, February 24, 2016, and April 22, 2016.

The amendments modify the operating licenses and TSs to incorporate a new fire protection licensing basis in accordance with Title 10 of the *Code of Federal Regulations* Section 50.48(c). The amendments authorize the transition of the fire protection program to a risk-informed, performance-based program based on the 2001 Edition of National Fire Protection Association Standard 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants." This standard describes how to use performance-based methods, such as fire modeling, and risk-informed methods, such as fire probabilistic risk assessment, to demonstrate compliance with nuclear safety performance criteria.

The NRC staff's safety evaluation (SE) of the amendments is enclosed. We have previously sent the SE in draft form to your staff to ascertain that it contains no proprietary information. Your staff confirmed that the SE contains no proprietary information.

A Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

Richard V. Guzman, Senior Project Manager
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-317 and 50-318

Enclosures:
1. Amendment No. 318 to DPR-53
2. Amendment No. 296 to DPR-69
3. Safety Evaluation

cc w/enclosures: Distribution via Listserv

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

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT 1

CALVERT CLIFFS NUCLEAR POWER PLANT, LLC

EXELON GENERATION COMPANY, LLC

DOCKET NO. 50-317

Amendment No. 318
Renewed License No. DPR-53

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

   A. The application for amendment by Exelon Generation Company, LLC (Exelon, the licensee), dated September 24, 2013, as supplemented by letters dated February 9, 2015, March 11, 2015, April 13, 2015, July 6, 2015, August 13, 2015, February 24, 2016, and April 22, 2016, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

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

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

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

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

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Renewed Facility Operating License No. DPR-53 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 318, are hereby incorporated into this license. Exelon Generation shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of the date of its issuance and shall be implemented according to the schedule contained in the revised Paragraph 2.E. and page 12 of Appendix C, Additional Conditions to the Renewed Facility Operating License No. DPR-69.

FOR THE NUCLEAR REGULATORY COMMISSION

Travis L. Tate, Chief
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Facility Operating
License and Technical Specifications

Date of Issuance: August 30, 2016

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

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT 2

CALVERT CLIFFS NUCLEAR POWER PLANT, LLC

EXELON GENERATION COMPANY, LLC

DOCKET NO. 50-318

Amendment No. 296
Renewed License No. DPR-69

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

   A. The application for amendment by Exelon Generation Company, LLC (Exelon, the licensee), dated September 24, 2013, as supplemented by letters dated February 9, 2015, March 11, 2015, April 13, 2015, July 6, 2015, August 13, 2015, February 24, 2016, and April 22, 2016, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

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

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

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

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

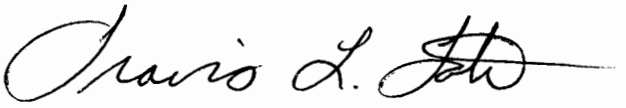
2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Renewed Facility Operating License No. DPR-69 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 296, are hereby incorporated into this license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of the date of its issuance and shall be implemented according to the schedule contained in the revised Paragraph 2.E. and page 12 of Appendix C, Additional Conditions to the Renewed Facility Operating License No. DPR-69.

FOR THE NUCLEAR REGULATORY COMMISSION



Travis L. Tate, Chief
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Facility Operating
License and Technical Specifications

Date of Issuance: August 30, 2016

ATTACHMENT TO LICENSE AMENDMENTS

CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT 1

AMENDMENT NO. 318 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-53

DOCKET NO. 50-317

Replace the following pages of Renewed Facility Operating License No. DPR-53 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	3
5	5
6	6

Replace the following page of Appendix C, Additional Conditions to Renewed Facility Operating License No. DPR-53 with the attached revised page. The revised page is identified by amendment number and contains marginal lines indicating the areas of change.

REMOVE	INSERT
	12

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

REMOVE	INSERT
5.4-1	5.4-1

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

(5) Exelon Generation 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 the operation of the facility.

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

(1) Maximum Power Level

Exelon Generation is authorized to operate the facility at steady-state reactor core power levels not in excess of 2737 megawatts-thermal in accordance with the conditions specified herein.

(2) Technical Specifications

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 318, are hereby incorporated into this license. Exelon Generation shall operate the facility in accordance with the Technical Specifications.

(a) For Surveillance Requirements (SRs) that are new, in Amendment 227 to Facility Operating License No. DPR-53, the first performance is due at the end of the first surveillance interval that begins at implementation of Amendment 227. For SRs that existed prior to Amendment 227, including SRs with modified acceptance criteria and SRs whose frequency of performance is being extended, the first performance is due at the end of the first surveillance interval that begins on the date the Surveillance was last performed prior to implementation of Amendment 227.

(3) Additional Conditions

The Additional Conditions contained in Appendix C as revised through Amendment No. 318 are hereby incorporated into this license. Exelon Generation shall operate the facility in accordance with the Additional Conditions.

(4) Secondary Water Chemistry Monitoring Program

Exelon Generation shall implement a secondary water chemistry monitoring program to inhibit steam generator tube degradation. This program shall include:

10 CFR 50.90 and 10 CFR 50.54(p). The combined set of plans, which contain Safeguards Information protected under 10 CFR 73.21, is entitled: "Calvert Cliffs Nuclear Power Plant Security Plan, Training and Qualification Plan, and Safeguards Contingency Plan, Revision 1" submitted May 19, 2006.

Exelon Generation shall fully implement and maintain in effect all provisions of the Commission-approved cyber security plan (CSP), including changes made pursuant to the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The licensee's CSP was approved by License Amendment No. 298 and modified by License Amendment No. 312.

E. Exelon Generation shall implement and maintain in effect all provisions of the approved fire protection program that comply with 10 CFR 50.48(a) and 10 CFR 50.48(c), as specified in the license amendment request dated September 24, 2013; as supplemented by letters dated February 9, 2015, March 11, 2015, April 13, 2015, July 6, 2015, August 13, 2015, February 24, 2016, and April 22, 2016, and as approved in the NRC safety evaluation dated August 30, 2016. 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), 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, 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}/yr for CDF and less than 1×10^{-8}/yr for LERF. The proposed change must also be consistent with the defense-in-depth philosophy and must maintain sufficient safety margins. The change may be implemented following completion of the plant change evaluation.

(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. 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 August 30, 2016, 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.

Appendix C (Cont'd.)

Additional Conditions

Facility Operating License No. DPR-53

Amendment No.	Additional Conditions	Implementation Date
318	(1) Before achieving full compliance with 10 CFR 50.48(c), 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 License Condition 2.E.(2)(b). (2) The licensee shall complete the modifications to its facility as described in Table S-2, "Plant Modifications Committed," of licensee letter dated April 22, 2016, to complete the transition to full compliance with 10 CFR 50.48(c) by April 30, 2018. The licensee shall maintain appropriate compensatory measures in place until completion of these modifications. (3) The licensee shall implement the items listed in Enclosure 1, Attachment S, Table S-3, "Implementation Items," from licensee letter dated April 22, 2016 within 12 months after NRC approval unless that implementation date falls within a scheduled refueling outage. Then, implementation will occur 60 days after startup from that scheduled refueling outage. It should be noted that implementation item IMP-12 is associated with incorporation of the NFPA 805 modification and the completion of this implementation item is an on-going action initiated within the 180 day timeframe for completion of implementation items but only complete after completion of modification implementation per Table S-2.	April 30, 2018

5.0 ADMINISTRATIVE CONTROLS

5.4 Procedures

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

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

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

c. Quality assurance for effluent and environmental monitoring; and

d. Deleted

e. All programs specified in Specification 5.5.

ATTACHMENT TO LICENSE AMENDMENTS

CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT 2

AMENDMENT NO. 296 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-69

DOCKET NO. 50-318

Replace the following pages of Renewed Facility Operating License No. DPR-53 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	3
4	4
5	5
6	6
7	7

Replace the following page of Appendix C, Additional Conditions to Renewed Facility Operating License No. DPR-69 with the attached revised page. The revised page is identified by amendment number and contains marginal lines indicating the areas of change.

REMOVE	INSERT
	12

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

REMOVE	INSERT
5.4-1	5.4-1

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

(5) Exelon Generation 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 the operation of the facility.

C. This license is deemed to contain and is subject to the conditions set forth in 10 CFR Chapter I and is subject to all applicable provisions of the Act, and the rules, regulations, and orders of the Commission, now and hereafter applicable; and is subject to the additional conditions specified and incorporated below:

(1) Maximum Power Level

Exelon Generation is authorized to operate the facility at reactor steady-state core power levels not in excess of 2737 megawatts-thermal in accordance with the conditions specified herein.

(2) Technical Specifications

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 296 are hereby incorporated into this license. The licensee shall operate the facility in accordance with the Technical Specifications.

(a) For Surveillance Requirements (SRs) that are new, in Amendment 201 to Facility Operating License No. DPR-69, the first performance is due at the end of the first surveillance interval that begins at implementation of Amendment 201. For SRs that existed prior to Amendment 201, including SRs with modified acceptance criteria and SRs whose frequency of performance is being extended, the first performance is due at the end of the first surveillance interval that begins on the date the Surveillance was last performed prior to implementation of Amendment 201.

(3) Less Than Four Pump Operation

The licensee shall not operate the reactor at power levels in excess of five (5) percent of rated thermal power with less than four (4) reactor coolant pumps in operation. This condition shall remain in effect until the licensee has submitted safety analyses for less than four pump operation, and approval for such operation has been granted by the Commission by amendment of this license.

(4) Environmental Monitoring Program

If harmful effects or evidence of irreversible damage are detected by the biological monitoring program, hydrological monitoring program, and the

radiological monitoring program specified in the Appendix B Technical Specifications, Exelon Generation (the licensee) will provide to the staff a detailed analysis of the problem and a program of remedial action to be taken to eliminate or significantly reduce the detrimental effects or damage.

(5) Additional Conditions

The Additional Conditions contained in Appendix C as revised through Amendment No. 296 are hereby incorporated into this license. Exelon Generation shall operate the facility in accordance with the Additional Conditions.

(6) Secondary Water Chemistry Monitoring Program

Exelon Generation shall implement a secondary water chemistry monitoring program to inhibit steam generator tube degradation. This program shall include:

a. Identification of a sampling schedule for the critical parameters and control points for these parameters;

b. Identification of the procedures used to quantify parameters that are critical to control points;

c. Identification of process sampling points;

d. Procedure for recording and management of data;

e. Procedures defining corrective actions for off control point chemistry conditions; and

f. A procedure identifying the authority responsible for the interpretation of the data and the sequence and timing of administrative events required to initiate corrective action.

(7) Mitigation Strategy

Exelon Generation shall develop and maintain strategies for addressing large fires and explosions 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

D. Exelon Generation shall fully implement and maintain in effect all provisions of the Commission-approved physical security, training and qualification, and safeguards contingency plans, including amendments made pursuant to provisions of the Miscellaneous Amendments and Search Requirements revisions to 10 CFR 73.55 (51 FR 27817 and 27822) and the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The combined set of plans, which contain Safeguards Information protected under 10 CFR 73.21, is entitled: "Calvert Cliffs Nuclear Power Plant Security Plan, Training and Qualification Plan, and Safeguards Contingency Plan, Revision 1" submitted dated May 19, 2006.

Exelon Generation shall fully implement and maintain in effect all provisions of the Commission-approved cyber security plan (CSP), including changes made pursuant to the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The licensee's CSP was approved by License Amendment No. 275 and modified by License Amendment No. 290.

E. Exelon Generation shall implement and maintain in effect all provisions of the approved fire protection program that comply with 10 CFR 50.48(a) and 10 CFR 50.48(c), as specified in the license amendment request dated September 24, 2013; as supplemented by letters dated February 9, 2015, March 11, 2015, April 13, 2015, July 6, 2015, August 13, 2015, February 24, 2016, and April 22, 2016, and as approved in the NRC safety evaluation dated August 30, 2016. 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), 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, 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 $1x10^{-7}$/yr for CDF and less than $1x10^{-8}$/yr for LERF. The proposed change must also be consistent with the defense-in-depth philosophy and must maintain sufficient safety margins. The change may be implemented following completion of the plant change evaluation.

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

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

Prior NRC review and approval 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. 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 August 30, 2016, 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.

F. At the time of the next scheduled update to the FSAR required pursuant to 10 CFR 50.71(e)(4) following the issuance of this renewed license, Exelon Generation shall update the FSAR to include the FSAR supplement submitted pursuant to 10 CFR 54.21(d), as amended and supplemented by the program descriptions in Appendix E to the Safety Evaluation Report, NUREG-1705. Until that FSAR update is complete, Exelon Generation may make changes to the programs described in Appendix E without prior Commission approval, provided that the licensee evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59 and otherwise complies with the requirements in that section.

G. Any future actions listed in Appendix E to the Safety Evaluation Report, NUREG-1705, shall be included in the FSAR. Exelon Generation shall complete these actions by August 13, 2016.

H. This renewed license is effective as of the date of issuance and shall expire at midnight on August 13, 2036.

FOR THE NUCLEAR REGULATORY COMMISSION

Samuel J. Collins, Director
Office of Nuclear Reactor Regulation

Attachments:

Appendix A – Technical Specifications
Appendix B – Environmental Protection Plan (non-radiological) Technical Specifications
Appendix C – Additional Conditions

Date of Issuance: March 23, 2000

Appendix C (Cont'd.)

Additional Conditions

Facility Operating License No. DPR-69

Amendment No.	Additional Conditions	Implementation Date
296	(1) Before achieving full compliance with 10 CFR 50.48(c), 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 License Condition 2.E.(2)(b). (2) The licensee shall complete the modifications to its facility as described in Table S-2, "Plant Modifications Committed," of licensee letter dated April 22, 2016, to complete the transition to full compliance with 10 CFR 50.48(c) by April 30, 2018. The licensee shall maintain appropriate compensatory measures in place until completion of these modifications. (3) The licensee shall implement the items listed in Enclosure 1, Attachment S, Table S-3, "Implementation Items," from licensee letter dated April 22, 2016 within 12 months after NRC approval unless that implementation date falls within a scheduled refueling outage. Then, implementation will occur 60 days after startup from that scheduled refueling outage. It should be noted that implementation item IMP-12 is associated with incorporation of the NFPA 805 modification and the completion of this implementation item is an on-going action initiated within the 180 day timeframe for completion of implementation items but only complete after completion of modification implementation per Table S-2.	April 30, 2018

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

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. 318 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-53

AMENDMENT NO. 296 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-69

CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NOS. 1 AND 2

EXELON GENERATION COMPANY, LLC

DOCKET NOS. 50-317 AND 50-318

Enclosure 3

TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 Background 1
1.2 Requested Licensing Action 4
2.0 REGULATORY EVALUATION 5
2.1 Applicable Regulations 7
2.2 Applicable Staff Guidance 8
2.3 NFPA 805 Frequently Asked Questions 14
2.4 Orders, License Conditions, and Technical Specifications 17
2.4.1 Orders 18
2.4.2 License Conditions 18
2.4.3 Technical Specifications 19
2.4.4 Updated Final Safety Analysis Report 20
2.5 Rescission of Exemptions 20
2.6 Self-Approval Process for FPP Changes (Post-Transition) 22
2.6.1 Post-Implementation Plant Change Evaluation Process 22
2.6.2 Requirements for the Self-Approval Process Regarding Plant Changes 25
2.7 Modification and Implementation Items 28
2.7.1 Modifications 28
2.7.2 Implementation Items 29
2.7.3 Schedule 29
3.0 TECHNICAL EVALUATION 30
3.1 NFPA 805 Fundamental FPP and Design Elements 31
3.1.1 Compliance with NFPA 805 Chapter 3 Requirements 32
3.1.1.1 Compliance Strategy – Complies 33
3.1.1.2 Compliance Strategy – Complies with Clarification 34
3.1.1.3 Compliance Strategy – Complies with Use of EEEEs 36
3.1.1.4 Compliance Strategy – Complies with Previous NRC Approval 36
3.1.1.5 Compliance Strategy – Submit for NRC Approval 37
3.1.1.6 Compliance Strategy – Complies with Required Action 39
3.1.1.7 Compliance Strategy -- Multiple Strategies 42
3.1.1.8 Chapter 3 Sections Not Reviewed 42

3.1.1.9 Compliance with Chapter 3 Requirements Conclusion 43
3.1.2 Identification of the Power Block 44
3.1.3 Closure of Generic Letter 2006-03, "Potentially Nonconforming Hemyc™ and MT™ Fire Barrier Configurations," Issues 46
3.1.4 Performance-Based Methods for NFPA 805, Chapter 3, Elements 46
3.1.4.1 NFPA 805, Section 3.2.3(1) Procedures for Inspection, Testing and Maintenance 48
3.1.4.2 NFPA 805, Section 3.3.5.1 Electrical Wiring above Suspended Ceiling 50
3.1.4.3 NFPA 805, Section 3.3.1.3.1 Control of Ignition Sources 55
3.1.4.4 NFPA 805, Section 3.6.1 Standpipe and Hose Stations 57
3.1.4.5 NFPA 805, Section 3.3.7.2 High Pressure Flammable Gas Storage 59
3.1.4.6 NFPA 805, Section 3.3.8 Bulk Storage of Flammable and Combustible Liquids 62
3.1.4.7 NFPA 805, Section 3.3.1.2(1), Control of Combustible Materials 65
3.1.4.8 NFPA 805, Section 3.3.5.2, Electrical Raceways 71
3.1.4.9 NFPA 805, Section 3.3.4, Insulation Materials 74
3.2 Nuclear Safety Capability Assessment (NSCA) Methods 78
3.2.1 Compliance with NFPA 805 Nuclear Safety Capability Assessment 80
Methods 80
3.2.1.1 Attribute Alignment – Aligns 82
3.2.1.2 Attribute Alignment – Aligns with Intent 84
3.2.1.3 NFPA 805 Nuclear Safety Capability Assessment Methods Conclusion 86
3.2.2 Maintaining Fuel in a Safe and Stable Condition 86
3.2.3 Applicability of Feed-and-Bleed 90
3.2.4 Assessment of Multiple Spurious Operations 91
3.2.5 Establishing Recovery Actions 94
3.2.6 Conclusion for Section 3.2 98
3.3 Fire Modeling Performance-Based Approach 99
3.4 Fire Risk Assessments 100
3.4.1 Maintaining Defense in Depth and Safety Margins 100
3.4.1.1 Defense-in-Depth (DID) 100
3.4.1.2 Safety Margins 102
3.4.2 Quality of the Fire Probabilistic Risk Assessment 103
3.4.2.1 Internal Events PRA Model 104

3.4.2.2 Fire PRA Model 105
3.4.2.3 Fire Modeling in Support of the Development of the Fire Risk Evaluations 110
3.4.2.3.1 Overview of Fire Models Used to Support the Fire Risk Evaluations 111
3.4.2.3.2 RAIs Pertaining to Fire Modeling in Support of the CCNPP Fire PRA 113
3.4.2.3.3 Conclusion for Section 3.4.2.3 130
3.4.2.4 Conclusions Regarding Fire PRA Quality 131
3.4.3 Fire Risk Evaluations 131
3.4.4 Additional Risk Presented by Recovery Actions 133
3.4.5 Risk-Informed or Performance-Based Alternatives to Compliance with NFPA 805 134
3.4.6 Cumulative Risk and Combined Changes 134
3.4.7 Uncertainty and Sensitivity Analyses 136
3.4.8 Conclusion for Section 3.4 136
3.5 Nuclear Safety Capability Assessment Results 137
3.5.1 Nuclear Safety Capability Assessment Results by Fire Area 138
3.5.1.1 Fire Detection & Suppression Systems Required to Meet the Nuclear Safety Performance Criteria 143
3.5.1.2 Evaluation of Fire Suppression Effects on Nuclear Safety Performance Criteria 146
3.5.1.3 Licensing Actions 148
3.5.1.4 Existing Engineering Equivalency Evaluations (EEEEs) 153
3.5.1.5 Variances from Deterministic Requirements 154
3.5.1.6 Recovery Actions 157
3.5.1.7 Recovery Actions Credited for Defense-in-Depth 160
3.5.1.8 Plant Fire Barriers and Separations 161
3.5.1.9 Electrical Raceway Fire Barrier Systems (ERFBS) 162
3.5.1.10 Conclusion for Section 3.5.1 162
3.5.2 Clarification of Prior NRC Approvals 163
3.5.3 Fire Protection during Non-Power Operational Modes 163
3.5.3.1 NPO Strategy and Plant Operating States 164
3.5.3.2 NPO Analysis Process 165
3.5.3.3 NPO Key Safety Functions (KSF) and SSCs Used to Achieve Performance 166
3.5.3.4 NPO Pinch Point Resolutions and Program Implementation 168
3.5.4 Conclusion for Section 3.5 170
3.6 Radioactive Release Performance Criteria 172

3.6.1 Method of Review 172
3.6.2 Scope of Review 173
3.6.3 Identification of Plant Areas Containing Radioactive Materials and Providing Containment during Fire Fighting Operations 173
3.6.4 Pre-Fire Plans 174
3.6.5 Gaseous Effluent Controls 175
3.6.6 Liquid Effluent Controls 176
3.6.7 Fire Brigade Training Materials 177
3.6.8 Actions to Be Taken 177
3.6.9 Conclusions 177
3.7 NFPA 805 Monitoring Program 178
3.7.1 Conclusion for Section 3.7 180
3.8 Program Documentation, Configuration Control, and Quality Assurance 180
3.8.1 Documentation 181
3.8.2 Configuration Control 182
3.8.3 Quality 183
3.8.3.1 Review 183
3.8.3.2 Verification and Validation (V&V) 184
3.8.3.2.1 General 184
3.8.3.2.2 Discussion of RAIs 185
3.8.3.2.3 Post-Transition 185
3.8.3.2.4 Conclusion for Section 3.8.3.2 186
3.8.3.3 Limitations of Use 186
3.8.3.3.1 General 186
3.8.3.3.2 Discussion of RAIs 186
3.8.3.3.3 Post-Transition 187
3.8.3.3.4 Conclusion for Section 3.8.3.3 187
3.8.3.4 Qualification of Users 187
3.8.3.4.1 General 187
3.8.3.4.2 Discussion of RAIs 188
3.8.3.4.3 Post-Transition 189
3.8.3.4.4 Conclusion for Section 3.8.3.4 190
3.8.3.5 Uncertainty Analysis 190

3.8.3.5.1 General 190
3.8.3.5.2 Discussion of RAIs 191
3.8.3.5.3 Post-Transition 193
3.8.3.5.4 Conclusion for Section 3.8.3.5 194
3.8.3.6 Conclusion for Section 3.8.3 194
3.8.4 Fire Protection Quality Assurance Program 194
3.8.5 Conclusion for Section 3.8 195
4.0 FIRE PROTECTION LICENSE CONDITION 195
5.0 SUMMARY 198
6.0 STATE CONSULTATION 198
7.0 ENVIRONMENTAL CONSIDERATION 198
8.0 CONCLUSION 199
9.0 REFERENCES 200

ATTACHMENTS

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at CCNPP ..... - A1 -

Attachment B: Table 3.8-2, V&V Basis for Other Fire Models and Related Correlations Used at CCNPP ..... - B1 -

Attachment C: Abbreviations and Acronyms ..... - C1 -

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

SAFETY EVALUATION BY THE

OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO TRANSITION TO A RISK-INFORMED, PERFORMANCE-BASED

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

AMENDMENT NOS. 318 AND 296 TO RENEWED FACILITY OPERATING

LICENSE NOS. DPR-53 AND DPR-69

EXELON GENERATION COMPANY, LLC

CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2

DOCKET NOS. 50-317 AND 50-318

1.0 INTRODUCTION

1.1 Background

The U.S. Nuclear Regulatory Commission (NRC or the Commission) started developing fire protection requirements in the 1970s. In 1976, the NRC published comprehensive fire protection guidelines in the form of Branch Technical Position (BTP) Auxiliary and Power Conversion Systems Branch (APCSB) 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants" (Reference 1), and Appendix A to BTP APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants Docketed Prior to July 1, 1976" (Reference 2). Subsequently, the NRC performed fire protection reviews for the operating reactors, and documented the results in safety 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 (NPPs) and published its Final Rule, Fire Protection Program for Operating Nuclear Power Plants, in the *Federal Register* (FR) on November 19, 1980 (45 FR 76602), adding Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.48, "Fire Protection," and Appendix R to 10 CFR Part 50, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979," to 10 CFR Part 50. Section 50.48(a)(1) of 10 CFR requires each holder of an operating license, and holders of a combined operating license issued under Part 52 to have a fire protection plan that satisfies General Design Criterion (GDC) 3 of Appendix A to 10 CFR Part 50 and states that the fire protection plan must describe the overall fire protection program (FPP); identify the positions responsible for the program and the authority delegated to those positions; and outline the

plans for fire protection, fire detection and suppression capability, and limitation of fire damage. Section 50.48(a)(2) states that the fire protection plan must describe the specific features necessary to implement the program described in section (a)(1), including administrative controls and personnel requirements; automatic and manual fire detection and suppression systems; and the means to limit fire damage to structures, systems, and components (SSCs) to ensure the capability to safely shut down the plant. Section 50.48(a)(3) requires that the licensee retain the fire protection plan and each change to the plan as a record until the Commission terminates the license, and that the licensee retain each superseded revision of the procedures for 3 years.

In the 1990s, the NRC worked with the National Fire Protection Association (NFPA) and industry to develop a risk-informed (RI), performance-based (PB) consensus standard for fire protection. In 2001, the NFPA Standards Council issued NFPA 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants" (Reference 3), which describes a methodology for establishing fundamental FPP design requirements and elements, determining required fire protection systems and features, applying PB requirements, and administering fire protection for existing light-water reactors during operation, decommissioning, and permanent shutdown. It provides for the establishment of a minimum set of fire protection requirements, but allows PB or deterministic approaches to be used to meet performance criteria.

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

> On March 26, 1998, the staff sent to the Commission SECY-98-058, "Development of a Risk-Informed, Performance-Based Regulation for Fire Protection at Nuclear Power Plants" (Reference 5), in which it proposed to work with NFPA and the industry to develop a risk-informed, performance-based consensus standard for nuclear power plant fire protection. This consensus standard could be endorsed in a future rulemaking as an alternative set of fire protection requirements to the existing regulations in 10 CFR 50.48. In SECY-00-0009, "Rulemaking Plan, Reactor Fire Protection Risk-Informed, Performance-Based Rulemaking," dated January 13, 2000 (Reference 6), the NRC staff requested and received Commission approval to proceed with a rulemaking to permit reactor licensees to adopt NFPA 805 as an alternative to existing fire protection requirements. On February 9, 2001, the NFPA Standards Council approved the 2001 Edition of NFPA 805 as an American National Standard for performance-based fire protection for light-water nuclear power plants.

A licensee that elects to adopt NFPA 805 must meet the performance goals, objectives, and criteria that are itemized in Chapter 1 of NFPA 805 through the implementation of PB or deterministic approaches. The goals include ensuring that reactivity control, inventory and pressure control, decay heat removal, vital auxiliaries, and process monitoring are achieved and maintained. The licensee then must establish plant fire protection requirements using the methodology in Chapter 2 of NFPA 805, such that the minimum FPP elements and design

criteria contained in Chapter 3 of NFPA 805 are satisfied. Next, a licensee identifies fire areas and fire hazards through a plant-wide analysis, and then applies either a PB or a deterministic approach to meet the performance criteria. As part of a PB approach, the licensee will use engineering evaluations, probabilistic safety assessments (PSAs), and fire modeling (FM) calculations to show that the criteria are met. Chapter 4 of NFPA 805 establishes the methodology to determine the fire protection systems and features required to achieve the performance criteria. It also specifies that at least one success path to achieve the nuclear safety performance criteria (NSPC) shall be maintained free of fire damage by a single fire.

RG 1.205 also states, in part, that:

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

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

RG 1.205 also states, in part, that:

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

RG 1.205 provides the NRC staff's position on NEI 04-02, Revision 2 (Reference 7), and offers additional information and guidance to supplement the NEI document and assist licensees in meeting the NRC's regulations in 10 CFR 50.48(c) related to adopting an 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, Exelon Generation Company, LLC (Exelon, the licensee), requested license amendments to revise the Calvert Cliffs Nuclear Power Plant, Units 1 and 2, (CCNPP) FPP in accordance with 10 CFR 50.48(c) and change the renewed facility operating licenses and technical specifications (TSs) accordingly.

1.2 Requested Licensing Action

By application to the NRC dated September 24, 2013 (Reference 8), as supplemented by letters dated February 9, 2015 (Reference 9), March 11, 2015 (Reference 10), April 13, 2015 (Reference 11), July 6, 2015 (Reference 12), August 13, 2015 (Reference 13), February 24, 2016 (Reference 14), and April 22, 2016 (Reference 15), the licensee submitted license amendments to transition the CCNPP FPP from 10 CFR 50.48(b) to 10 CFR 50.48(c), NFPA 805, "Performance-Based Standard for Fire Protection For Light Water Reactor Electric Generating Plants," 2001 Edition. The supplemental letters were in response to the NRC staff's requests for additional information (RAIs) dated January 12, 2015 (Reference 16), June 3, 2015 (Reference 17), and July 15, 2015 (Reference 18). The above listed supplemental letters 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 FR on August 5, 2014 (79 FR 45488).

The licensee requested amendments to the CCNPP Renewed Facility Operating Licenses 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 final safety analysis report (UFSAR) as approved in the SER dated September 14, 1979 (Reference 19), and supplements dated October 2, 1980 (Reference 20), March 18, 1982 (Reference 21), and September 27, 1982 (Reference 22), and exemptions dated August 16, 1982 (Reference 23), April 21, 1983 (Reference 24), March 15, 1984 (Reference 25), August 22, 1990 (Reference 26), and April 7, 1999 (Reference 27), 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 CCNPP 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's application has identified any orders and license conditions that must be revised or superseded, and contains any necessary revisions to the plant's TSs and the bases thereof, as required by 10 CFR 50.48(c)(3)(i);

(2) The licensee has completed its implementation of the methodology in Chapter 2, "Methodology," of NFPA 805 (including all required evaluations and analyses), and the NRC staff has approved the licensee's modified FPP, which

reflects the decision to comply with NFPA 805, as required by 10 CFR 50.48(a); and

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

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

2.0 REGULATORY EVALUATION

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

> 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, in part, that:

> This paragraph requires licensees to complete all of the Chapter 2 methodology (including evaluations and analyses) and to modify their fire protection plan before making changes to the fire protection program or to the

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

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

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

> The Director of the Office of Nuclear Reactor Regulation, or a designee of the Director, may approve the application if the Director or designee determines that the performance-based approach;
>
> (A) Satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release;
>
> (B) Maintains safety margins; and
>
> (C) Maintains fire protection defense-in-depth (DID) (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown [SSD] capability).

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

> The Director of the Office of Nuclear Reactor Regulation, or designee of the Director, may approve the application if the Director or designee determines that the proposed alternatives:
>
> (i) Satisfy the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release;
>
> (ii) Maintain safety margins; and

(iii) Maintain fire protection defense-in-depth (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown capability).

In addition to the conditions outlined by the rule that require licensees to submit an LAR for NRC review and approval in order to adopt an RI/PB FPP, a licensee may submit additional elements of its FPP for which it wishes to receive specific NRC review and approval, as set forth in Regulatory Position (RP) C.2.2.1 of RG 1.205 (Reference 4). Inclusion of these elements in the NFPA 805 LAR is meant to alleviate uncertainty in portions of the current FPP licensing bases as a result of the lack of specific NRC approval of these elements. Regulatory guides are not substitutes for regulations, and compliance with them is not required. Methods and solutions that differ from those set forth in RGs will be deemed acceptable if they provide a basis for the findings required for the issuance or continuance of a permit or license by the Commission. Accordingly, any submittal addressing these additional FPP elements needs to include sufficient detail to allow the NRC staff to assess whether the licensee's treatment of these elements meets 10 CFR 50.48(c) requirements.

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

> Protecting the safety of the public, the environment, and plant personnel from a plant fire and its potential effect on safe reactor operations is paramount to this standard. The fire protection standard shall be based on the concept of defense-in-depth. Defense-in-depth shall be achieved when an adequate balance of each of the following elements is provided:
>
> (1) Preventing fires from starting;
>
> (2) Rapidly detecting fires and controlling and extinguishing promptly those fires that do occur, thereby limiting fire damage; and
> (3) Providing an adequate level of fire protection for 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.

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.

- GDC 5, "Sharing of structures, systems, and components," to 10 CFR Part 50, Appendix A:

  Structures, systems, and components important to safety shall not be shared among nuclear power units unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions, including, in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units.

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

- 10 CFR 50.48(c) incorporates NFPA 805 (2001 Edition) (Reference 3) by reference, with certain exceptions, modifications and supplementation. This regulation establishes the requirements for using an RI/PB FPP in conformance with NFPA 805 as a voluntary alternative to the requirements in 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, RGs, and standards:

- RG 1.205, Revision 1, issued December 2009 (Reference 4), which provides guidance for use in complying with the requirements that the NRC has promulgated for RI/PB FPPs that comply with 10 CFR 50.48 and the referenced 2001 Edition of the NFPA standard. It endorses portions of NEI 04-02, Revision 2 (Reference 7), where it has been found to provide methods acceptable to the NRC for implementing NFPA 805 and complying with 10 CFR 50.48(c). The regulatory positions in Section C of RG 1.205 include clarification of the guidance provided in NEI 04-02, as well as NRC exceptions to the guidance. RG 1.205 sets forth regulatory positions, emphasizes certain issues, clarifies the requirements of 10 CFR 50.48(c) and NFPA 805, clarifies

the guidance in NEI 04-02, and modifies the NEI 04-02 guidance where required. Should a conflict occur between NEI 04-02 and this RG, the regulatory positions in RG 1.205 govern. This RG also indicates that Chapter 3 of NEI 00-01, "Guidance for Post-Fire Safe Shutdown Circuit Analysis," Revision 2, issued May 2009 (Reference 28), when used in conjunction with NFPA 805 and the RG, provides one acceptable approach to circuit analysis for a plant implementing an FPP under 10 CFR 50.48(c).

- The 2001 Edition of NFPA 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants" (Reference 3), which specifies the minimum fire protection requirements for existing light water NPPs during all phases of plant operations, including shutdown, degraded conditions, and decommissioning. NFPA 805 was developed to provide a comprehensive RI/PB standard for fire protection. The NFPA 805 Technical Committee on Nuclear Facilities is composed of nuclear plant licensees, the NRC, insurers, equipment manufacturers, and subject matter experts. The standard was developed in accordance with NFPA processes, and consisted of a number of technical meetings and reviews of draft documents by committee and industry representatives. The scope of NFPA 805 includes goals related to nuclear safety, radioactive release, life safety, and plant damage/business interruption. The standard addresses fire protection requirements for nuclear plants during all plant operating modes and conditions, including shutdown and decommissioning, which had not been explicitly addressed by previous requirements and guidelines. NFPA 805 became effective on February 9, 2001.

- NEI 04-02, "Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c)," Revision 2 (Reference 7), provides guidance for implementing the requirements of 10 CFR 50.48(c), and represents methods for implementing in whole or in part an RI/PB FPP. This implementing guidance for NFPA 805 has two primary purposes: (1) to provide direction and clarification for adopting NFPA 805 as an acceptable approach to fire protection, consistent with 10 CFR 50.48(c); and (2) to provide additional supplemental technical guidance and methods for using NFPA 805 and its appendices to demonstrate compliance with fire protection requirements. Although there is a significant amount of detail in NFPA 805 and its appendices, clarification and additional guidance for select issues help ensure consistency and effective utilization of the standard. The NEI 04-02 guidance focuses attention on the RI/PB fire protection goals, objectives, and performance criteria contained in NFPA 805 and the RI/PB tools considered acceptable for demonstrating compliance. Revision 2 of NEI 04-02 incorporates guidance from RG 1.205 and approved Frequently Asked Questions (FAQs).

- NEI 00-01, "Guidance for Post Fire Safe Shutdown Circuit Analysis," Revision 2 (Reference 28), provides a deterministic methodology for performing post-fire safe shutdown analysis (SSDA). In addition, NEI 00-01 includes information on RI methods (when allowed within a plant's licensing basis) that may be used in conjunction with the deterministic methods for resolving circuit failure issues related to multiple spurious operations (MSOs). The RI method is intended for application by licensees to determine the risk significance of identified circuit failure issues related to MSOs.

RG 1.205 indicates that Chapter 3 of NEI 00-01, Revision 2, when used in conjunction with NFPA 805 and RG 1.205, provides one acceptable approach to circuit analysis for a plant implementing an FPP under 10 CFR 50.48(c).

- 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 29), provides the NRC staff's recommendations for using risk information in support of licensee-initiated licensing basis changes to a NPP that require such review and approval. The guidance provided does not preclude other approaches for requesting licensing basis changes. Rather, RG 1.174 is intended to improve consistency in regulatory decisions in areas in which the results of risk analyses are used to help justify regulatory action. As such, the RG provides general guidance concerning one approach that the NRC has determined to be acceptable for analyzing issues associated with proposed changes to a plant's licensing basis and for assessing the impact of such proposed changes on the risk associated with plant design and operation.

- RG 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," Revision 2, issued March 2009 (Reference 30), provides guidance to licensees for use in determining the technical adequacy of the base probabilistic risk assessment (PRA) used in an RI regulatory activity, and endorses standards and industry peer review guidance. The RG provides guidance in four areas:

  (1) a definition of a technically acceptable PRA;

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

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

  (4) documentation needed to support a regulatory submittal.

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

- American Society of Mechanical Engineers (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 31), provides guidance for PRAs used to support RI decisions for commercial light water reactor NPPs and prescribes a method for applying these requirements for specific applications. The standard gives guidance for a Level 1 PRA of internal and external hazards for all plant operating modes. In

addition, the standard provides guidance for a limited Level 2 PRA sufficient to evaluate large early release frequency (LERF). The only hazards explicitly excluded from the scope are accidents resulting from purposeful human-induced security threats (e.g., sabotage). The standard applies to PRAs used to support applications of RI decision-making related to design, licensing, procurement, construction, operation, and maintenance.

- RG 1.189, "Fire Protection for Nuclear Power Plants," Revision 2, issued October 2009 (Reference 32), provides guidance to licensees on the proper content and quality of engineering equivalency evaluations used to support the FPP. The NRC staff developed the RG to provide a comprehensive fire protection guidance document and to identify the scope and depth of fire protection that the staff would consider acceptable for NPPs.

- NUREG-0800, Section 9.5.1.2, "Risk-Informed, Performance-Based Fire Protection Program," Revision 0, issued December 2009 (Reference 33), 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 34), 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 35), provides the NRC staff with guidance for evaluating the risk information used by a licensee to support permanent RI changes to the licensing basis.

- NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities," Volumes 1 and 2 and Supplement 1 (Reference 36), (Reference 37), (Reference 38), 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, FM, electrical engineering, human reliability analysis, and systems engineering for methods development. A formal technical issue resolution process was developed to direct the deliberative process between RES and EPRI. The process ensures that divergent technical views are fully considered, yet encourages consensus at many points during the deliberation. Significantly, the process provides that each party maintain its own point of view if consensus is not reached. Consensus was reached on all technical issues documented in NUREG/CR-6850. The methodology documented in this report reflects the current

state-of-the-art in FPRA. These methods are expected to form a basis for RI analyses related to the plant FPP. Volume 1, the Executive Summary, provides general background and overview information, project insights and conclusions. Volume 2 provides the detailed discussion of the recommended approach, methods, data, and tools for conduct of an FPRA. Supplement 1 provides certain FPRA method enhancements.

- Memorandum from Richard P. Correia, RES, to Joseph G. Giitter, NRR, titled, "Interim Technical Guidance on Fire-Induced Circuit Failure Mode Likelihood Analysis," dated June 14, 2013 (Reference 39), notes that, based on new experimental information documented in NUREG/CR-6931, "Cable Response to Live Fire (CAROLFIRE)," issued April 2008 (Reference 40), and NUREG/CR- 7100, "Direct Current Electrical Shorting in Response to Exposure Fire (DESIREE-Fire): Test Results," issued April 2012 (Reference 41), the reduction in hot short probabilities for circuits provided with control power transformers (CPTs) identified in NUREG/ CR-6850 cannot be repeated in experiments, and therefore, may be too high and should be reduced.

- NUREG-1805, "Fire Dynamics Tools (FDT^s): Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program" (Reference 42), provides quantitative methods, known as FDT^s, to assist regional fire protection inspectors in performing fire hazard analysis. The FDT^s are intended to assist fire protection inspectors in performing RI evaluations of credible fires that may cause critical damage to essential safe shutdown equipment.

- NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," Volumes 1 through 7 (Reference 43), provides 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 EPRI and the National Institute of Standards and Technology (NIST). The selected models are:

    (1) FDTs developed by NRC (Volume 3);

    (2) Fire-Induced Vulnerability Evaluation Methodology-Rev. 1 developed by EPRI (Volume 4);

    (3) The zone model Consolidated Model of Fire and Smoke Transport (CFAST) developed by NIST (Volume 5);

    (4) The zone model MAGIC developed by Électricité de France (Volume 6); and

    (5) The computational fluid dynamics model fire dynamics simulator developed by NIST (Volume 7).

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

- NUREG/CR-7010, "Cable Heat Release, Ignition, and Spread in Tray Installations during Fire (CHRISTIFIRE), Phase 1: Horizontal Trays," Volume 1 (Reference 44), describes Phase 1 of the CHRISTIFIRE testing program conducted by NIST. The overall goal of this multiyear program is to quantify the burning characteristics of grouped electrical cables installed in cable trays. This first phase of the program focuses on horizontal tray configurations. CHRISTIFIRE addresses the burning behavior of a cable in a fire beyond the point of electrical failure. The data obtained from this project can be used for the development of fire models to calculate the heat release rate (HRR) and flame spread of a cable fire.

- NUREG-1855, Volume 1, "Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decision Making" (Reference 45), provides guidance on how to treat uncertainties associated with PRA in RI decision-making. The objectives of this guidance include fostering an understanding of the uncertainties associated with PRA and their impact on the results of PRA and providing a pragmatic approach to addressing these uncertainties in the context of the decision-making. To meet the objective of the NUREG, it is necessary to understand the role that PRA results play in the context of the decision-making process. To define this context, NUREG-1855 provides an overview of the RI decision-making process itself.

- NUREG-1921, "EPRI/NRC-RES Fire Human Reliability Analysis Guidelines, Final Report" (Reference 46), 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 following the fire-induced initiating events of an FPRA. The report builds on existing HRA methods, and is intended primarily for practitioners conducting a fire HRA to support an FPRA.

- NUREG-1934, "Nuclear Power Plant Fire Modeling Analysis Guidelines (NPP FIRE MAG)" (Reference 47), describes the implications of the verification and validation (V&V) results from NUREG-1824 for fire model users. The features and limitations of the fire models documented in NUREG-1824 are discussed relative to their use to support nuclear power plant fire hazard analyses. The report also provides information to assist fire model users in applying this technology in the nuclear power plant environment.

- Generic Letter (GL) 2006-03, "Potentially Nonconforming Hemyc and MT Fire Barrier Configurations" (Reference 48), requested that licensees evaluate their facilities to confirm compliance with the existing applicable regulatory requirements in light of the information provided in this GL and, if appropriate, take additional actions. Specifically, NRC testing revealed that, for the configurations tested, Hemyc and MT

fire barriers failed to provide the protective function intended for compliance with existing regulations.

- NFPA 101, "Life Safety Code" (Reference 49), provides the minimum requirements for egress, features of fire protection, sprinkler systems, alarms, emergency lighting, smoke barriers, and special hazard protection.

- NFPA 20, "Standard for the Installation of Stationary Pumps for Fire Protection" (Reference 50), provides requirements for the selection and installation of pumps to ensure that systems will work as intended to deliver adequate and reliable water supplies in a fire emergency.

- NFPA 14, "Standard for the Installation of Standpipe and Hose Systems" (Reference 51), provides the minimum requirements for the installation of standpipes and hose systems to ensure that systems will work as intended to deliver adequate and reliable water supplies in a fire emergency. NFPA 14 covers all system components and hardware, including piping, fittings, valves, and pressure-regulation devices, as well as system requirements; installation requirements; design; plans and calculations; water supply; and system acceptance.

- NFPA 10, "Standard for Portable Fire Extinguishers" (Reference 52), provides requirements to ensure that portable fire extinguishers will work as intended to provide a first line of defense against fires of limited size.

2.3 NFPA 805 Frequently Asked Questions

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

Table 2.3-1: NFPA 805 Frequently Asked Questions

FAQ #	FAQ Title and Summary	Reference	SE Section
07-0030	"Establishing Recovery Actions" • This FAQ provides an acceptable process for determining the recovery actions (RAs) for NFPA 805 Chapter 4 compliance. The process includes: ▪ Differentiation between RAs and activities in the main control room or at primary control station(s). ▪ Determination of which RAs are required by the NFPA 805 FPP. ▪ Evaluate the additional risk presented by the use of RAs. ▪ Evaluate the feasibility of the identified RAs. ▪ Evaluate the reliability of the identified RAs.	(Reference 53)	3.2.5 3.4.4 3.5.1.6 3.5.3.4
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.	(Reference 54)	3.2.4 3.2.6
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 55). 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.	(Reference 56)	3.2.1

FAQ #	FAQ Title and Summary	Reference	SE Section
07-0040	"Non-Power Operations (NPOs) Clarifications" • This FAQ clarifies an acceptable NFPA 805 NPO program. The process includes: ▪ Selecting NPOs equipment and cabling. ▪ Evaluation of NPOs Higher Risk Evolutions (HRE). ▪ Analyzing NPO Key Safety Functions (KSFs). ▪ Identifying plant areas to protect or "pinch points" during NPOs HREs and actions to be taken if KSFs are lost.	(Reference 57)	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.	(Reference 58)	3.4.7
08-0049	"Cable Tray Fire Propagation" • This FAQ provides clarification regarding guidance on cable fire propagation for use in developing fire PRAs.	(Reference 59)	3.4.2.3.2
08-0054	"Compliance with Chapter 4 of NFPA 805" • This FAQ provides an acceptable process to demonstrate Chapter 4 compliance for transition: ▪ Step 1 – Assemble documentation ▪ Step 2 – Document Fulfillment of NSPC ▪ Step 3 – Variance From Deterministic Requirements (VFDR) Identification, Characterization, and Resolution Considerations ▪ Step 4 – PB Evaluations ▪ Step 5 – Final VFDR Evaluation ▪ Step 6 – Document Required Fire Protection Systems and Features	(Reference 60)	3.4.3 3.5.1.4
09-0056	"Radioactive Release Transition" • This FAQ provides an acceptable level of detail and content for the radioactive release section of the LAR. It includes: ▪ Justification of the compartmentation, if the radioactive release review is not performed on a fire area basis. ▪ Pre-fire plan and fire brigade training review results. ▪ Results from the review of engineering controls for gaseous and liquid effluents.	(Reference 61)	3.6.1

FAQ #	FAQ Title and Summary	Reference	SE Section
10-0059	"Monitoring Program" • This FAQ provides clarification regarding the implementation of an NFPA 805 monitoring program for transition. It includes: ▪ Monitoring program analysis units; ▪ Screening of low safety SSCs; ▪ Action level thresholds; and ▪ The use of existing monitoring programs.	(Reference 62)	3.7
12-0062	"Updated Final Safety Analysis Report (UFSAR) Content" • This FAQ provides the necessary level of detail for the transition of the fire protection sections within the UFSAR.	(Reference 63)	2.4.4
13-0004	"Clarifications on Treatment of Sensitive Electronics" • This FAQ provides supplemental guidance for application of the damage criteria provided in Sections 8.5.1.2 and H.2 of NUREG/CR-6850 for solid-state components.	(Reference 64)	3.4.2.2 3.4.2.3.2
13-0005	"Cable Fires Special Cases: Self-Ignited and Caused by Welding and Cutting" • This FAQ outlines a proposed approach for addressing self-ignited or hot work fires.	(Reference 65)	3.4.2.2
13-0006	"Modeling Junction Box Scenarios in a Fire PRA" • This FAQ provides a definition for junction boxes that allow the characterization and quantification of junction box fire scenarios in plant physical access units (PAUs) requiring detailed FPRA/FM analysis and also describes a process for quantifying the risk associated with junction box fire scenarios in such plant locations.	(Reference 66)	3.4.2.2
14-0009	"Treatment of Well Sealed MCC Electrical Panels Greater Than 440V" • This FAQ provides clarification for the treatment of fire propagation from well-sealed MCC electrical cabinets with voltage levels at 440V or greater.	(Reference 67)	3.4.2.2

2.4 Orders, License Conditions, and Technical Specifications

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

2.4.1 Orders

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

The licensee determined that no orders need to be superseded or revised to implement an FPP at CCNPP that complies with 10 CFR 50.48(c).

The review conducted by the licensee included an assessment of docketed correspondence files and electronic searches, including the NRC's Agencywide Documents Access and Management System (ADAMS). The review was performed to ensure that compliance with the physical protection requirements, security orders, and adherence to commitments applicable to CCNPP are maintained. The NRC staff accepts the licensee's determination that 5 exemptions are rescinded as listed in LAR Attachment K, "Existing Licensing Action Transition," and that no Orders need to be superseded or revised to implement NFPA 805 at CCNPP.

The licensee also performed a specific review of the license amendments 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 Calvert Cliffs. The licensee's review of this regulation and the related license amendments 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). 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.

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

2.4.2 License Conditions

The NRC staff reviewed LAR Section 5.2.1, "License Condition Changes," and LAR Attachment M, "License Condition Changes," regarding changes the licensee seeks to make to the CCNPP 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 CCNPP fire protection license condition, for consistency with the format and content guidance in RP C.3.1 of RG 1.205, Revision 1, and with the proposed plant modifications identified in the LAR.

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

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

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

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

2.4.3 Technical Specifications

The NRC staff reviewed LAR Section 5.2.2, "Technical Specifications," and LAR Attachment N, "Technical Specification Changes," with regard to proposed changes to the CCNPP TSs that are being revised or superseded during the NFPA 805 transition process. According to the LAR, the licensee conducted a review of the CCNPP TSs to determine which, if any, TS sections will be impacted by the transition to an RI/PB FPP based on 10 CFR 50.48(c). The licensee identified changes to the TSs needed for CCNPP adoption of the new fire protection licensing basis and provided applicable justification listed in LAR Attachment N. The licensee identified one change to the TS that involved deleting TS 5.4.1.d,

which requires that procedures be established, implemented, and maintained for FPP implementation. The licensee stated that the change to the TSs is 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 regulations (10 CFR 50.48(a); 10 CFR 50.48(c); and NFPA 805, Chapter 3).

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

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

2.4.4 Updated Final Safety Analysis Report

The NRC staff reviewed LAR Section 5.4 "Revision to the UFSAR," which states:

> After the approval of the LAR, in accordance with 10 CFR 50.71(e), the CCNPP UFSAR will be revised. The format and content will be consistent with NEI 04-02 FAQ 12-0062.

The licensee included the action to update the UFSAR in LAR Attachment S, Table S-3, Implementation Item IMP-9, and the NRC staff concludes that this action is acceptable because it would be required by the proposed license condition.

The NRC staff concludes that the licensee's method to update the UFSAR is acceptable because the licensee will update the UFSAR after approval of the LAR in accordance with 10 CFR 50.71(e) and the proposed license condition, and the content will be consistent with the guidance contained in NEI 04-02 and FAQ 12-0062 (Reference 63).

2.5 Rescission of Exemptions

Since CCNPP was licensed to operate on July 31, 1974, for Unit 1, and on August 13, 1976, for Unit 2, the CCNPP FPP is based on compliance with 10 CFR 50.48(a), 10 CFR 50.48(b), and the CCNPP fire protection license condition.

The NRC staff reviewed LAR Section 5.2.3, "Orders and Exemptions," LAR Attachment O, "Orders and Exemptions," LAR Section 4.2.3, "Licensing Action Transition," and LAR Attachment K, "Existing Licensing Action Transition," with regard to previously approved exemptions to Appendix R to 10 CFR Part 50, which will be superseded by the transition to an FPP licensing basis in conformance with NFPA 805. These exemptions will no longer be required since upon approval of the RI/PB FPP in accordance with NFPA 805, Appendix R will not be part of the licensing basis for CCNPP.

The licensee previously requested and received NRC approval for exemptions from 10 CFR Part 50 Appendix R. These exemptions were discussed in detail in LAR Attachment K. The licensee stated that the exemptions are either compliant with 10 CFR 50.48(c) or no longer necessary, in accordance with the requirements of 10 CFR 50.48(c)(3)(i). The licensee requested, in accordance with the requirements of 10 CFR 50.48(c)(3)(i), that all the exemptions be rescinded.

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

- The exemption was found to be unnecessary because the underlying condition has been evaluated using RI/PB methods (FM and/or FRE) and found to be acceptable and no further actions are necessary by the licensee.

- The exemption was found to be appropriate as a qualitative engineering evaluation that meets the deterministic requirements of NFPA 805 and is carried forward as part of the engineering analyses supporting NFPA 805 transition.

The following exemptions, originally issued by the NRC on April 21, 1983 (Reference 24), March 15, 1984 (Reference 25), August 22, 1990 (Reference 26), and April 7, 1999 (Reference 27), are rescinded as requested by the LAR because the underlying condition has been evaluated using RI/PB methods and found to be acceptable with no further actions since DID and sufficient safety margin is maintained, or because there is no similar requirement under NFPA 805:

- April 21, 1983 - An exemption from the requirements of Section III.G.3 of Appendix R for the control room complex and the intake structure related to the installation of fixed fire suppression systems.

- March 15, 1984 - An exemption from the requirements of Section IIL.G for Fire Areas 10 and 11 related to the installation of fixed fire suppression systems.

- August 22, 1990 - An exemption from the requirements of Section III.J to allow the use of portable hand lights as an alternative to permanently installed 8-hour emergency lights in the Unit 1 and Unit 2 containment buildings.

- April 7, 1999 - An exemption from the requirements for Section III.J to allow the use of security lighting in exterior areas, the use of portable lights in high radiation areas and the use of helmet mounted lights inside of switchgear cabinets as alternatives to permanently installed 8-hour emergency lights.

The following exemptions originally issued by the NRC on August 16, 1982 (Reference 23), and March 15, 1984 (Reference 25), are rescinded as requested by the LAR, but the engineering evaluation of the underlying condition will be used as a qualitative engineering evaluation for transition to NFPA 805:

- August 16, 1982 - An exemption from the requirements of Section III.G.2 of Appendix R to allow alternatives to the 3-hour fire rated barriers for areas listed in the exemption.

- March 15, 1984 - An exemption from the requirements of Section III.G to allow alternatives to the 3-hour rated fire barriers for areas listed in the exemption.

- March 15, 1984 - An exemption from the requirements of Section III.O regarding the capacity of the oil collection systems for the reactor coolant pumps.

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

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

NFPA 805, Section 2.2.9, "Plant Change Evaluation," states that:

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

NFPA 805, Section 2.4.4, "Plant Change Evaluation," states, 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 Sections 2.7.2 and 2.2.9 of NFPA 805," for compliance with the NFPA 805 plant change evaluation (PCE) process requirements to address potential changes to the NFPA 805 RI/PB FPP after implementation is completed. The licensee indicated that it 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, RPs 2.2.4, 3.1, 3.2, and 4.3.

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

1. Defining the change;

2. Performing the preliminary risk screening;

3. Performing the risk evaluation; and

4. Evaluating the acceptance criteria.

In the LAR, the licensee stated that the PCE process begins by defining the change or altered condition 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 is then performed to identify and resolve minor changes to the FPP and the screening is consistent with fire protection regulatory review processes currently in place at nuclear plants under traditional licensing bases. The licensee stated that the screening process is modeled after NEI 02-03, "Guidance for Performing a Regulatory Review of Proposed Changes to the Approved Fire Protection Program," (Reference 68), 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 NFPA 805, Section 2.4.4, are not met, then the licensee will proceed to the risk evaluation step of the PCE process.

The licensee stated that the screening will be followed by engineering evaluations that may include 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 license condition (see Attachment M

to the LAR) can be implemented within the framework provided by NFPA 805. Changes that do not satisfy the acceptance criteria, cannot be implemented within this framework. The licensee further stated that the acceptance criteria require that the resultant change in core damage frequency (CDF) and LERF be consistent with the license condition, and 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 margins were maintained.

The licensee stated its 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 utilized to maintain configuration control of the FPP documents. The licensee further stated the configuration control procedures which govern the various CCNPP documents and databases, which currently exist, will be revised to reflect the new NFPA 805 licensing bases requirements. This action is included in LAR Attachment S, Table S-3, Implementation Item IMP-8, and the NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

The licensee stated that several NFPA 805 document types, such as nuclear safety capability assessment (NSCA) supporting information and non-power operations (NPO) mode treatment, generally require existing procedures and processes to be developed since they are new documents and databases created as a result of the transition to NFPA 805. The licensee further stated the new procedures will be modeled after the existing processes for similar types of documents and databases, and system level design basis documents will be revised to reflect the NFPA 805 role that the system components now play. This action is included in LAR Attachment S, Table S-3, Implementation Item IMP-7, and the NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

The 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 reviews that identify potential FPP impacts will be sent to qualified

individuals (Fire Protection, SSD/NSCA, PRA) to ascertain the program impacts, if any, and that if FPP impacts are determined to exist as a result of the proposed change, the issue would be resolved by one of the following:

- Deterministic Approach: Comply with NFPA 805, Chapter 3 and Section 4.2.3 requirements; or

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

The licensee stated that this process follows the requirements in NFPA 805 and the guidance outlined in RG 1.174 (Reference 29). NFPA 805 requires the use of qualified individuals, procedures that require independent review and verification of calculations, record retention, peer review, and a corrective action program that ensures appropriate actions are taken when discrepancies 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 CCNPP NFPA 805 fire protection license condition to assess the acceptability of the proposed change. This process will be used to determine if prior NRC approval of the proposed change is required.

Based on the information provided by the licensee, the NRC staff concludes that the licensee's PCE process is considered acceptable because it meets the guidance in NEI 04-02, Revision 2 (Reference 7), as well as RG 1.205, Revision 1 (Reference 4), and addresses attributes for using FREs in accordance with NFPA 805. Section 2.4.4 of NFPA 805 requires that PCEs consist of an integrated assessment of risk, DID and safety margin. NFPA 805, Section 2.4.3.1 requires that the PSA use CDF and LERF as measures for risk. NFPA 805, Section 2.4.3.3 requires that the risk assessment approach, methods, and data shall be acceptable to the Authority Having Jurisdiction (AHJ), which is the NRC. NFPA 805, Section 2.4.3.3 also requires that the PSA be appropriate for the nature and scope of the change being evaluated, be based on the as-built and as-operated and maintained plant, and reflect the operating experience at the plant.

The licensee's PCE process includes the required delta risk calculations, uses risk assessment methods acceptable to the NRC, uses appropriate risk acceptance criteria in determining acceptability, involves the use of an FPRA of acceptable quality, and includes an integrated assessment of risk, DID, and safety 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 (1) used in developing the peer-reviewed FPRA model, (2) approved by the NRC via a plant-specific license amendment or through NRC approval of generic methods specifically for use in NFPA 805 risk assessments, or (3) demonstrated to bound the risk impact.

Based on the information provided by the licensee in the LAR, the process established to evaluate post-transition plant changes meets the guidance in NEI 04-02, Revision 2 (Reference 7) as well as RG 1.205, Revision 1 (Reference 4). The NRC staff concludes that the proposed PCE process at CCNPP, 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 completing the plant modifications and implementation items discussed in Section 2.7 of this SE (i.e., during full implementation of the transition to NFPA 805), the proposed license condition provides that RI changes to the licensee's FPP may not be made without prior NRC review and approval unless the changes have been demonstrated to have no more than a minimal risk impact using the screening process discussed above. The risk analysis is not consistent with the as-built, as-operated, and maintained plant since the items have not been completed. In addition, the proposed license condition requires 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 RP C.3.1 of RG 1.205, Revision 1 (Reference 4), with respect to the requirements for FPP changes during transition, and therefore demonstrate compliance with 10 CFR 50.48(c).

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

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

Alternatively, the licensee may use an engineering evaluation to demonstrate that changes to certain NFPA 805, Chapter 3 elements are acceptable because the changes are "adequate for the hazard." Prior NRC review and approval would not be required for alternatives to four specific sections of NFPA 805, Chapter 3 listed below, for which an engineering evaluation demonstrates that the alternative to the Chapter 3 element is adequate for the hazard. A qualified fire protection engineer shall perform the engineering evaluation and conclude that the change has not affected the functionality of the component, system, procedure, or physical arrangement (with respect to the ability to meet the nuclear safety and radioactive release performance criteria), using a relevant technical requirement or standard. NFPA 805, Section 2.4, states 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 are sufficient to support self-approval of future RI changes to the FPP under the proposed license condition. Therefore, the NRC staff concludes that the licensee's process for self-approving future FPP changes is acceptable.

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

2.7 Modification and Implementation Items

As stated in RP C.3.1 of RG 1.205, Revision 1, 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 22, 2016 (Reference 15).

2.7.1 Modifications

The NRC staff reviewed LAR Attachment S, "Modifications and Implementation Items," Table S-2, "Plant Modifications Committed," which describes the plant modifications necessary to implement the NFPA 805 licensing basis, as proposed. These modifications are identified in the LAR as necessary to bring CCNPP into compliance with either the deterministic or PB requirements of NFPA 805. As described below, LAR Attachment S, Table S-1, provides a description of each of the proposed plant modifications, presents the

problem statement explaining why the modification is needed and whether compensatory actions are required to be in place pending completion and implementation of the modification.

The NRC staff confirmed that the modifications identified in LAR Table S-1 are the same as those identified in LAR Attachment C, 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 LAR Table S-2 modifications and the associated completion schedule are the same as those provided in the proposed NFPA 805 license condition.

As depicted in LAR Attachment S, Table S-1, "Plant Modifications Completed," the licensee has completed several 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 CCNPP to be in full accordance with NFPA 805, implement many of the attributes upon which this SE is based, and thereby meet the requirements of 10 CFR 50.48(c). The modifications will be completed in accordance with the schedule provided in the proposed NFPA 805 license condition, which states that the modifications will be completed by April 30, 2018, and that appropriate compensatory measures will be maintained until the modifications are complete.

2.7.2 Implementation Items

Implementation items are items that the licensee has not fully completed or implemented as of the issuance date of the license amendments, but which will be completed during implementation of the license amendments to transition to NFPA 805 (e.g., procedure changes that are still in process, or NFPA 805 programs that have not been fully implemented). The licensee identified the implementation items in LAR Attachment S, Table S-3. For each implementation item, the NRC staff has resolved with the licensee regarding the level of detail and main attributes that each remaining change will incorporate upon completion. Completion of these items in accordance with the schedule discussed in Section 2.7.3 of this SE, does not change or impact the bases for the safety conclusions made by the NRC staff in this SE.

Each implementation item will be completed prior to the deadline for implementation of the RI/PB FPP based on NFPA 805, as specified in the license condition and the letter transmitting the amended license (i.e., implementation period) which indicates that completion of the implementation items listed in LAR Attachment S, Table S-3, will occur 12 months following issuance of the amendment unless that date falls within a scheduled refueling outage, then, implementation will occur 60 days after startup from that scheduled refueling outage. The licensee also stated that Implementation Item IMP-12 and IMP-15 will be completed in conjunction with the modifications described in LAR Attachment S, Table S-2.

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 resolved appropriately under the licensee's corrective action program. Any discrepancies noted during onsite audits or fire protection

inspections examining resolution of the implementation items could be subject to appropriate NRC enforcement action, as completion of the implementation items is required by the proposed license conditions.

2.7.3 Schedule

LAR (Reference 8) Section 5.5, provides the overall schedule for completing the NFPA 805 transition at CCNPP. The licensee indicated that implementation of the new NFPA 805 FPP to include procedure changes, process updates, and training to affected plant personnel will occur 12 months following the issuance of the amendment (except for Implementation Item IMP-12 which is associated with modifications) unless that date falls within a scheduled refueling outage. Then, implementation will occur 60 days after startup from that scheduled refueling outage.

The licensee stated that the reason it requested 12 months to complete the implementation items, is due to additional implementation items and the response to the RAIs result in a change to the FPRA model, the main control room (MCR) RAs, LAR Attachment G, and abnormal operating procedures, all of which require more time to implement. Based on the information provided by the licensee, the NRC staff finds the licensee's request acceptable.

LAR Section 5.5 also states that modifications will be completed by April 30, 2018, and that appropriate compensatory measures will be maintained until modifications are complete.

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

3.0 TECHNICAL EVALUATION

The following sections evaluate the technical aspects of the requested license amendment to transition the FPP at CCNPP to one based on NFPA 805 (Reference 3) in accordance with 10 CFR 50.48(c). While performing the technical evaluation of the licensee's submittal, the NRC staff utilized the guidance provided in NUREG-0800, Section 9.5.1.2, "Risk-Informed, Performance-Based Fire Protection" (Reference 33), 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 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 (QA).

Attachments A and B to this SE provide additional information regarding the FM that the licensee used and was evaluated 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 sections of this SE.

3.1 NFPA 805 Fundamental FPP and Design Elements

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

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

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

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

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

3.1.1 Compliance with NFPA 805 Chapter 3 Requirements

The licensee used the systematic approach described in NEI 04-02, Revision 2 (Reference 7), as endorsed by the NRC in Regulatory Guide 1.205, Revision 1 (Reference 4), to assess the proposed CCNPP 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 CCNPP FPP and provided specific compliance statements for each NFPA 805, Chapter 3 attribute that contained applicable requirements. As discussed below, some subsections of NFPA 805, Chapter 3 do not contain requirements, or are otherwise not applicable to CCNPP, and others are provided with multiple compliance statements to fully document compliance with the element.

The methods used by CCNPP for achieving compliance with the fundamental FPP elements and minimum design requirements are as follows:

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

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

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

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

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 the B-1 Table as "Complies with Required Action." These outstanding actions are identified as implementation items in LAR Attachment S.

Compliance approach 6, "Complies with Required Action," is a change 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.

In LAR Section 4.2.2, "Existing Engineering Equivalency Evaluation Transition," the licensee stated that it evaluated the EEEEs used to demonstrate compliance with the NFPA 805, Chapter 3 requirements in order to ensure continued appropriateness, quality, and applicability to the current CCNPP plant configuration. The licensee determined that no EEEE used to support compliance with NFPA 805 required NRC approval.

EEEEs (previously known as GL 86-10 evaluations) were performed for fire protection design variances such as fire protection system designs and fire barrier component deviations from the specific fire protection deterministic requirements. Once a licensee transitions to NFPA 805, future equivalency evaluations are to be conducted in accordance with the fire protection license condition. The evaluation should demonstrate that the specific plant configuration meets the performance criteria in the standard.

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

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

3.1.1.1 Compliance Strategy – Complies

For the majority of the NFPA 805, Chapter 3 requirements, as modified by 10 CFR 50.48(c)(2), the licensee determined that the RI/PB FPP complies directly with the fundamental FPP element using the existing FPP element. In these instances, based on the validity of the licensee's statements, the NRC staff concludes that the licensee's statements of compliance are acceptable.

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

- 3.4.1(c)

NFPA 805 Section 3.4.1(c) requires that during every shift, 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. In fire protection engineering (FPE) RAI 02 (Reference 16), the NRC staff requested that the licensee provide additional detail regarding the training that is provided to the fire brigade leader and members to assess the effects of fire and fire suppressants on NSPC. In its response to FPE RAI 02 (Reference 9), the licensee stated that the compliance basis of Section 3.4.1(c) has been changed from "Complies" to "Complies with Clarification," and that it is utilizing the exception to 3.4.1(c), which requires that sufficient training and knowledge shall be permitted to be provided by an operations advisor dedicated to industrial fire brigade support. The licensee further stated that administrative procedures and the UFSAR ensure that an operations technical advisor, a licensed operator position, is dedicated to respond with the industrial fire brigade. The NRC staff concludes that the licensee's response is acceptable because it complies with the exception to the NFPA 805, Section 3.4.1(c) requirement that allows an operations advisor dedicated to support the fire brigade leader and members in understanding the effects of fire and fire suppressants on the NSPC.

3.1.1.2 Compliance Strategy – Complies with Clarification

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

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

- 3.3.4
- 3.4.1(a)

NFPA 805 Section 3.3.4 requires that thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials shall be noncombustible or limited combustible. The licensee stated that its procedures, specifications and combustible loading database account for the use of thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials. In FPE RAI 01 (Reference 16), the NRC staff requested that the licensee (a) clarify that its procedure(s), specifications, and database specify that thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials are noncombustible or limited combustible materials, (b) clarify whether the insulation materials are noncombustible or limited combustible and, (c) if the materials are not noncombustible or limited combustible, describe how the materials are accounted for and managed in the FPP.

In its response to FPE RAI 01 (Reference 10), the licensee stated that fleet administrative procedures and specifications specify that thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials are noncombustible, limited combustible, or shall have a flame spread rating of less than 25 when tested in accordance with ASTM E84. The licensee further stated that its administrative procedures identify that the fire protection engineer approves thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials, and that materials which cannot be classified as noncombustible or limited combustible are treated the same as any other combustible material located within the plant. The licensee stated that thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials that are either permanently or temporarily installed in the plant are noncombustible or limited combustible, with some exceptions. The licensee further stated that materials that are not noncombustible or limited combustible are administratively tracked by the site combustible loading database and evaluated and approved by the site fire protection engineer to ensure that the installed materials will not impact the ability of the plant to achieve and maintain the nuclear safety and radioactive release performance criteria of NFPA 805 in LAR Attachment E.

In FPE RAI 01.01 (Reference 17), the NRC staff stated "Complies with Clarification" are items that meet the requirements in NFPA 805 with clarifications of an administrative or editorial nature, and based on the licensee's response to FPE RAI 01, the NRC staff did not agree that the licensee's current plant configuration meets the criteria for classifying "Complies with Clarification" to Section 3.3.4 of NFPA 805. The NRC staff requested that the licensee (1) revise its compliance statement using one or more of the compliance strategies described in NEI 04-02 Appendix B, such as evaluating the condition in an existing engineering equivalency evaluation (EEEE) or submitting a PB evaluation approval request in accordance with 10 CFR 50.48(c)(2)(vii), (2) provide additional information characterizing the installed conditions that do not meet the NFPA 805 Section 3.3.4 requirements (i.e., types, quantity, permanent or temporary installation, locations, installation details, etc.), and (3) describe the administrative controls and the criteria for evaluating the acceptability of future uses of materials that do not meet the requirements of NFPA 805 Section 3.3.4. In its response to FPE RAI 01.01 (Reference 12), the licensee stated that it revised LAR Attachment A to include the following compliance statements: "Complies," "Complies by Previous NRC Approval," "Submit for NRC Approval." The licensee further stated that all materials that meet

the requirements of NFPA 805, Section 3.3.4, are included in the "Complies" statement, and that materials that do not meet the requirements of Section 3.3.4, but are the subject of a previous NRC approval are included in the "Complies by Previous NRC Approval." The licensee further stated that LAR Attachment L is supplemented by Approval Request 9, which was developed for all materials that do not meet the requirements of Section 3.3.4 and are not part of a previous approval, and that these materials are discussed in the "Submit for NRC Approval" compliance statement. The licensee also stated that administrative procedures ensure that the future use of materials subject to the requirements of NFPA 805, Section 3.3.4 will either comply, or, in the case of radiation shielding materials, will meet the criteria for acceptability requested in Part A of LAR Attachment L, Approval Request 9 (see Section 3.1.4 of this SE). The NRC staff concludes that the licensee's response to FPE RAI 01.01 is acceptable because it describes appropriate compliance methods for materials that do not meet the requirements of NFPA 805 Section 3.3.4, in accordance with the guidance in RG 1.205 and NEI 04-02.

NFPA 805 Section 3.4.1(a) requires that a fully staffed, trained, and equipped fire-fighting force be available at all times to control and extinguish all fires on site. In FPE RAI 09 (Reference 16), the NRC staff requested additional detail on the compliance bases for conditions when there are less than five (5) fire brigade members onsite. In its response to FPE RAI 09 (Reference 11), the licensee stated that the compliance basis has been revised to "Complies by Previous NRC approval" because Section 5.2.2 of its TSs allows for the shift crew composition, of which Fire Brigade members are, to be less than the minimum for a period of time not to exceed two hours in order to accommodate unexpected absence of on-duty shift crew members provided immediate action is taken to restore the shift crew composition to within the minimum requirements. The NRC staff concludes that the change of compliance basis is acceptable because the licensee revised the LAR to include an additional compliance statement and bases and reference its TSs, which provides the controls for maintaining the minimum shift crew composition to meet the NFPA 805 requirement and that plant modifications and changes have not affected the controls for the minimum shift crew composition in the TSs.

3.1.1.3 Compliance Strategy – Complies with Use of EEEEs

For certain NFPA 805, Chapter 3 requirements, the licensee demonstrated compliance with the fundamental FPP element through the use of EEEEs. The NRC staff reviewed the licensee's statement of continued validity for the EEEEs, and the statement on the quality and appropriateness of the evaluations, and concludes that the licensee's statements of compliance in these instances are acceptable.

3.1.1.4 Compliance Strategy – Complies with Previous NRC Approval

Certain NFPA 805, Chapter 3 requirements were supplanted by an alternative that was previously approved by the NRC. The approval was documented in the following documents:

(1) Letter from Reid (NRC) to Lundvall, Jr. (BG&E), dated September 14, 1979, Safety Evaluation Report (Reference 19);

(2) Letter from Clark (NRC) to Lundvall, Jr (BG&E) dated October 02, 1980, Supplement 1 to Safety Evaluation Report (Reference 20);

(3) Letter from Clark (NRC) to Lundvall, Jr. (BG&E), dated March 18, 1982, Supplement 2 to Safety Evaluation Report (Reference 21);

(4) Letter from Clark (NRC) to Lundvall (BG&E) dated August 16, 1982, 10 CFR 50 Appendix R Exemption (Reference 23);

(5) Letter from Miller (NRC) to Lundvall (BG&E) dated March 15, 1984, 10 CFR 50 Appendix R Exemption (Reference 25); and

(6) Letter from Clark (NRC) to C. H. Cruse (BG&E), dated June 08, 2001, Safety Evaluation Report, Calvert Cliffs Nuclear Plant Unit Nos 1 and 2 – Review of the Individual Plant Examination of External Events (IPEEE) (Reference 69).

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 concluded 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.

3.1.1.5 Compliance Strategy – Submit for NRC Approval

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

- 3.2.3(1), which concerns establishing procedures for inspection, testing and maintenance for fire protection systems and features credited by the FPP. The licensee requested approval to use PB methods described in EPRI Technical Report 1006756, "Fire Protection Surveillance Optimization and Maintenance Guide for Fire Protection Systems and Features" (Reference 70), to establish appropriate inspection, testing, and maintenance frequencies of fire protection systems and features required by the FPP. See Section 3.1.4.1 of this SE for the NRC staff's evaluation of this request.

- 3.3.5.1, which concerns the requirement that wiring above suspended ceilings be kept to a minimum, and where installed the wiring shall be listed for plenum use, routed in armored cable, routed in metallic conduit or routed in cable trays with solid metal top and bottom covers. The licensee requested NRC staff approval to use a PB method to

demonstrate an equivalent level of fire protection for having unlisted and exposed wiring above the suspended ceiling for certain fire areas. See Section 3.1.4.2 of this SE for the NRC staff's evaluation of this request.

- 3.3.1.3.1, which concerns the requirement that hot work safety procedures be developed, implemented and periodically updated in accordance with NFPA 51B. The licensee requested NRC staff approval to use a PB method to demonstrate an equivalent level of fire protection for performing welding, cutting and other hot work in sprinklered areas while the suppression system is impaired. See Section 3.1.4.3 of this SE for the NRC staff's evaluation of this request.

- 3.6.1, which concerns installation of Class III standpipe and hose systems for all power block buildings in accordance with NFPA 14. The licensee requested NRC staff approval to use a PB method to demonstrate an equivalent level of fire protection for having a Class I standpipe and hose system, in lieu of a Class III standpipe and hose system. See Section 3.1.4.4 of this SE for the NRC staff's evaluation of this request.

- 3.3.7.2, which concerns locating outdoor high-pressure flammable gas storage containers so that the long axis is not pointed at buildings. The licensee requested NRC staff approval to use a PB method to demonstrate an equivalent level of fire protection for having hydrogen storage tanks located in the outdoor yard area north of the Turbine Building with the long axes pointed at the Turbine Building (to the south), Condensate Storage Tank No. 11 (to the north) and pretreated Water Storage Tank No. 11 (to the north). See Section 3.1.4.5 of this SE for the NRC staff's evaluation of this request.

- 3.3.8, which concerns the requirement that bulk storage of flammable and combustible liquids shall not be permitted inside structures containing systems, equipment or components important to safety. The licensee requested NRC staff approval to use a PB method to demonstrate an equivalent level of fire protection for bulk storage of fuel oil in the Fuel Oil Storage Tank (FOST 1A) to be maintained within a structure containing components important to nuclear safety. See Section 3.1.4.6 of this SE for the NRC staff's evaluation of this request.

- 3.11.3(2), which concerns the installation of air-conditioning and ventilating systems in accordance with NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems" (Reference 71). Although not specifically listed in LAR Section 4.1.2.3 or LAR Attachment L, Approval Request 1, the licensee requested approval in LAR Attachment A for the use of PB surveillance frequencies as described in EPRI Technical Report TR-1006756. In FPE RAI 04 (Reference 16), the NRC staff requested a clarification to determine if LAR Attachment L, Approval Request 1, which involved a similar approval request for NFPA 805 Section 3.2.3(1), was also applicable to NFPA 805 Section 3.11.3(2). In its reply to FPE RAI 04 (Reference 9), the licensee stated that the intent of Approval Request 1 is for the option to utilize the PB methodology described in EPRI TR-1006756 for all fire protection inspection, testing and maintenance at CCNPP; and is therefore, applicable to NFPA 805

Section 3.2.3(1). The licensee further stated that the approval request for NFPA 805 Section 3.11.3(2) has been revised to remove the "Submit for NRC Approval" compliance statement and that the existing "Complies with Required Action" compliance statement will remain in LAR Attachment A and is discussed further in Section 3.1.1.6 of this SE. The NRC staff concludes that the licensee's response to FPE RAI 04 is acceptable because it clarified that an approval request is no longer necessary for NFPA 805 Section 3.11.3(2), and that its compliance statement of "Complies, with Required Action" remains valid.

In letter dated April 13, 2015 (Reference 11), the licensee requested additional approvals for the use of PB methods to demonstrate compliance with fundamental FPP elements in NFPA 805 Section 3.3.1.2(1) and 3.3.5.2. In its letter, the licensee provided revised sections of LAR Attachment A for NFPA 805 Sections 3.3.1.2(1) and 3.3.5.2 and new Approval Requests 7 and 8 in LAR Attachment L. These additional approval requests are as follows:

- 3.3.1.2(1), which concerns the requirement that wood used within the power block be listed pressure-impregnated or coated with a listed fire-retardant application. In the revised pages of LAR Attachment A, the licensee modified its compliance statement for NFPA 805 Section 3.3.1.2(1) from "Complies" to "Complies with Clarification" and "Submit for Approval. The licensee clarified that except for the storage of wood in designated storage areas of the North Service Building, it complies with NFPA 805, Section 3.3.1.2(1). The licensee requested NRC staff approval to use a PB method to demonstrate an equivalent level of fire protection for the use and storage of wood that is not listed pressure-impregnated or coated with a listed fire-retardant application. See Section 3.1.4.7 of this SE for the NRC staff's evaluation of this request.

- 3.3.5.2, which concerns the requirement that only metal tray and metal conduits be used for electrical raceways and thin wall metallic tubing not be used for power, instrumentation, or control cables. In the revised pages of LAR Attachment A, the licensee added a new compliance statement "Submit for NRC Approval" and bases for the current configuration and future use of thin wall metallic tubing and non-metallic raceways. The licensee requested NRC staff approval to use a PB method to demonstrate an equivalent level of fire protection for the use of non-metallic raceways (conduit) in concrete-embedded and underground applications and the use of exposed electrical metallic tubing to route cables in various locations throughout the plant. See Section 3.1.4.8 of this SE for the NRC staff's evaluation of this request.

In its response to FPE RAI 01.01 (Reference 12), as discussed in Section 3.1.1.2 of this SE, the licensee requested approval for the use of PB methods to demonstrate compliance with the fundamental FPP elements in NFPA 805, Section 3.3.4. In its letter, the licensee provided revised sections of LAR Attachment A for NFPA 805 Section 3.3.4 and new Approval Request 9 in LAR Attachment L, which involves the following:

- 3.3.4, which concerns the requirement that thermal insulation materials, radiation shielding materials, ventilation duct materials and soundproofing materials be noncombustible or limited combustible. The licensee requested NRC staff approval to

use a PB method to demonstrate an equivalent level of fire protection for (A) the use radiation shielding materials that have not been specifically tested to the standards for classification as "noncombustible" or "limited combustible," and (B) the use of high density polyethylene neutron shielding installed in the north and west portion of the spent fuel pool cask wash pit on the 69-ft elevation of the Auxiliary Building. See Section 3.1.4.9 of this SE for the NRC staff's evaluation of this request.

As discussed in 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, the licensee determined that the RI/PB FPP will comply with the fundamental FPP element after completion of a required action. The following NFPA 805 sections, identified in LAR Attachment A, as complying via this method, and the applicable NFPA 805, Chapter 3 modifications and implementation items in LAR Attachment S, required additional review by the NRC staff:

- 3.2.3(1)
- 3.3.1.3.1
- 3.3.7.1
- 3.4.2.1
- 3.5.2
- 3.10.1(2)
- 3.10.3
- 3.11.3(2)

NFPA 805 Section 3.2.3(1) requires that inspection, testing, and maintenance procedures be established for fire protection systems and features credited by the FPP. In LAR Attachment A, the licensee stated that CCNPP complies with the NFPA 805 requirement with an action to utilize PB methodology to review and update surveillance frequencies using the guidance of Electric Power Research Institute (EPRI) Technical Report TR-1006756 (Reference 70). The action to revise plant documentation to incorporate the EPRI methodology is addressed in LAR Attachment S, Table S-3, Implementation Item IMP-2. The licensee also requested approval for the use of this PB methodology in LAR Attachment L in accordance with 10 CFR 50.48(a)(2)(c)(vii). The NRC staff's review of this PB methodology is addressed in Sections 3.1.1.5 and 3.1.4.1 of this SE. On the basis that the action as described by the licensee will implement the use of the PB approach to meet the requirements of NFPA 805, Chapter 3, and the action is included as an implementation item which would be required by the proposed license condition, the NRC staff concludes that the licensee's statement of compliance is acceptable.

NFPA 805 Section 3.3.1.3.1 requires that a hot work safety procedure shall be developed, implemented, and periodically updated as necessary in accordance with NFPA 51B, "Standard for Fire Prevention During Welding, Cutting, and Other Hot Work" (Reference 72) and NFPA 241, "Standard for Safeguarding Construction, Alteration, and Demolition Operations" (Reference 73). In LAR Attachment A, the licensee stated that CCNPP complies with NFPA 51B with a required action to revise site procedures to prohibit hot work in areas with partitions, walls, ceilings, or roofs that have a combustible covering or insulation, or partitions of combustible sandwich-type panel construction. The action to revise the site procedures is included in LAR Attachment S, Table S-3, Implementation Item IMP-1. On the basis that the action as described by the licensee will incorporate the provisions of NFPA 805,

Chapter 3 in the FPP, and the action is included as an implementation item, which would be required by the proposed license condition, the NRC staff concludes that the licensee's statement of compliance is acceptable.

NFPA 805 Section 3.3.7.1 requires that storage of flammable gas shall be located outdoors, or in separate detached buildings, so that a fire or explosion will not adversely impact systems, equipment, or components important to nuclear safety. The requirement further states that NFPA 50A, Standard for Gaseous Hydrogen Systems at Consumer Sites (Reference78), shall be followed for hydrogen storage. In LAR Attachment A, the licensee stated that hydrogen storage at CCNPP complies with NFPA 50A, 1973 Edition, with a required action to add ventilation louvers to the bulk hydrogen system pressure reducing station cabinet. This modification is addressed in LAR Attachment S, Table S-2, Item 10. On the basis that the action as described by the licensee will incorporate the provisions of NFPA 805, Chapter 3 in the FPP, and the action is included as a modification, which would be required by the proposed license condition, the NRC staff concludes that the licensee's statement of compliance is acceptable.

NFPA 805 Section 3.4.2.1 requires that pre-fire plans shall detail the fire area configuration and fire hazards to be encountered in the fire area, along with any nuclear safety components and fire protection systems and features that are present. In LAR Attachment A, the licensee stated that the pre-fire plans at CCNPP comply with NFPA 805 with a required action to address radioactive release requirements. This action to revise plant documentation is addressed in LAR Attachment S, Table S-3, Implementation Item IMP-3. On the basis that the action as described by the licensee will incorporate the provisions of NFPA 805, Chapter 3 in the FPP, and the action is included as an implementation item, which would be required by the proposed license condition, the NRC staff concludes that the licensee's statement of compliance is acceptable.

NFPA 805 Section 3.5.2 requires that water tanks that provide a water source to the fire protection system shall be designed in accordance with NFPA 22, Standard Water Tanks for Private Fire Protection (Reference 74). In LAR Attachment A, the licensee stated that the pretreated water storage tanks at CCNPP comply with NFPA 22 with a required action to provide sufficient venting. This modification is addressed in LAR Attachment S, Table S-2, Item 4. On the basis that the required action, as described by the licensee, will incorporate the provisions of NFPA 805, Chapter 3 and the action is included as modification in LAR Attachment S, which is required by the proposed license condition, the NRC staff concludes that the licensee's statement of compliance is acceptable.

NFPA 805 Section 3.10.1(2) requires that an automatic total flooding and local application gaseous fire suppression system that is required to meet the performance or deterministic requirements of Chapter 4 shall be designed and installed in accordance with NFPA 12A, "Standard on Halon 1301 Fire Extinguishing Systems" (Reference 75). NFPA 805 Section 3.10.3 requires that ventilation system designs shall take into account prevention from over-pressurization during agent injection, adequate sealing to prevent loss of agent, and confinement of radioactive contaminants. In LAR Attachment A, the licensee stated that CCNPP has a Halon gaseous fire suppression system that complies with NFPA 12A and

NFPA 805, Section 3.10.3, and identified a required action in LAR Attachment S, Table S-2, Item 18; however, there was no Item 18 listed in LAR Attachment S. In FPE RAI 03 (Reference 16), the NRC staff requested that the licensee confirm that LAR Attachment S, Tables-2 Item 17 is the correct item or provide the correct item for the Halon system actions identified in the LAR. In its response to FPE RAI 03 (Reference 9), the licensee confirmed that the modification is addressed in LAR Attachment S, Table S-2, Item 17. The licensee revised LAR Attachment A and Attachment S to incorporate the information described in FPE RAI 03 (Reference 9). On the basis that the required action as described by the licensee in its response to FPE RAI 03 will incorporate the provisions of NFPA 805, Chapter 3 and the action is included as a modification in LAR Attachment S, which would be required by the proposed license condition, the NRC staff concludes that the licensee's statement of compliance is acceptable.

NFPA 805 Section 3.11.3(2) requires that passive fire protection devices such as dampers conform with NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems" (Reference 71). In LAR Attachment A, the licensee stated that it complies with NFPA 90A with a required action to utilize PB surveillance frequencies using the guidance of EPRI Technical Report TR-1006756 (Reference 70) to review the surveillance frequencies for fire dampers and update, as necessary. This action to revise plant documentation is included in LAR Attachment S, Table S-3, Implementation Item IMP-2. The NRC staff's review of the licensee's proposal to use the EPRI PB methods is discussed in Sections 3.1.1.5 and 3.1.4.1 of this SE. On the basis that the action as described by the licensee will implement the PB approach as discussed in this SE, and the action is included as an implementation item, which would be required by the proposed license condition, the NRC staff concludes that the licensee's statement of compliance is acceptable

Based on the licensee's statement of compliance and the associated modification and 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 modifications and implementation items will be completed as discussed in the LAR; the NRC staff concludes the licensee's statements of compliance are acceptable because completion of the implementation items and modifications will bring these attributes into compliance with the requirements of NFPA 805.

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 described in Section 3.1.1 of this SE, to demonstrate compliance with aspects of the fundamental element.

In each of these cases, the NRC staff concludes that the individual compliance statements are acceptable, that the combination of compliance strategies is acceptable, and that holistic compliance with the fundamental FPP element is assured because the licensee demonstrated that the compliance strategy meets the requirements of NFPA 805.

3.1.1.8 Chapter 3 Sections Not Reviewed

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

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

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

  — The licensee stated that CCNPP does not have systems of this type installed (e.g., Section 3.9.1(3) as applicable to NFPA 750 for Water Mist Fire Protection Systems; Section 3.9.1(4) as applicable to NFPA 16 for Foam-Water Sprinkler or Spray Systems; Section 3.10.1(1) as applicable to NFPA 12 for Carbon Dioxide Extinguishing Systems; Section 3.10.1(2) as applicable to NFPA 2001 for Clean Agent Fire Extinguishing Systems; and Sections 3.10.6, 3.10.7, and 3.10.8 as applicable to total flooding CO_2 systems).

  — The type of system, while installed at CCNPP, is not required under the RI/PB FPP (e.g., Section 3.11.5 which applies to ERFBS [electrical raceway fire barrier systems] credited for compliance with NFPA 805 Chapter 4). In FPE RAI 10 (Reference 16), the NRC staff requested that the licensee clarify if there were any cable resolutions that credit an ERFBS to protect the affected cables to meet NFPA 805, Chapter 4 because the methodology in LAR Attachment B for NEI 00-01 Attributes 3.4.1.3, 3.4.1.5, 3.4.2.2 and 3.4.2.3 states that one of the means of addressing cable impacts of fire damage is to protect the cables by an ERFBS. In its response to FPE RAI 10 (Reference 9), the licensee stated that LAR Attachment B documents the NSCA review and Sections 3.4.1.3, 3.4.1.5, 3.4.2.2 and 3.4.2.3 identify that ERFBS may be utilized as an acceptable method to protect cables from fire damage and be credited within the analysis. The licensee further stated that the NSCA has not credited any ERFBS. The NRC staff concludes that the licensee's response to FPE RAI 10 is acceptable because the licensee determined that no ERFBS is credited for compliance with NFPA 805 Chapter 4.

  — The requirements are structured with an applicability statement (e.g., Section 3.3.12, which applies to reactor coolant pumps in non-inerted containments; Sections 3.4.1(a)(2) and 3.4.1(a)(3), which apply to the fire brigade standard used since they depend on the type of brigade specified in the FPP; or Section 3.10.4, which applies to areas required to be protected by both primary and backup gaseous fire suppression systems).

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 CCNPP 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 one or more of 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, and/or,

- Provided appropriate documentation of CCNPP's state of compliance with the NFPA 805, Chapter 3 requirements, which adequately demonstrated compliance in that the licensee was able to substantiate that it complied:

    — With the requirement directly, or with the requirement directly after the completion of a modification or an implementation item;

    — With the intent of the requirement (or element) given adequate justification/clarification;

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

    — Through the use of an engineering equivalency evaluation;

    — Through the use of a combination of the above methods; or,

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

3.1.2 Identification of the Power Block

The NRC staff reviewed the CCNPP structures identified in LAR Table I-1 "Power Block Definition" as comprising the "power block." The plant structures listed are established as part of the power block for the purpose of denoting the structures and equipment included in the CCNPP RI/PB FPP that have additional requirements in accordance with 10 CFR 50.48(c) and NFPA 805. As stated in the LAR, Section 4.1.3, the power block includes structures that contain equipment that could affect plant operation for power generation; equipment important to safety; equipment that could affect the ability to maintain NSCA in the event of a fire; or structures containing radioactive materials that could potentially be released in the event of a fire. In FPE RAI 07 (Reference 16), the NRC staff requested the basis for excluding the

following structures from the power block, based on the criteria stated in Section 4.1.3 of the LAR, which states that "Structures in the CCNPP owner-controlled area were reviewed to determine those that contain equipment required to meet the nuclear safety and radioactive release criteria described in Section 1.5 of NFPA 805":

- Interim Resin Storage Facility (Lake Davies)
- Material Processing Facility (MPF)
- Office and Training Facility (OTF)
- Original Steam Generator Storage Facility
- Pre-Assembly Facility (PAF) Upper
- Sewage Treatment Plant
- Unit 1 Butler Building
- Unit 2 Butler Building
- Warehouse No. 3
- West Road Cage

In its response to FPE RAI 07 (Reference 10), the licensee stated that the facilities listed do not contain NSCA or Fire PRA-credited components. For the Material Processing Facility, Unit 1 Butler Building and Unit 2 Butler Building, the licensee stated that a release of the involved radioactive materials due to fire will not challenge the applicable 10 CFR Part 20 limits, as discussed in LAR Attachment E, and that no fixed equipment contained in these areas is required in order to meet the radioactive release criteria of NFPA 805. For the Interim Resin Storage Facility (Lake Davies), Original Steam Generator Storage Facility, Pre-Assembly Facility Upper Laydown Area, Sewage Treatment Plant, Warehouse No. 3, and West Road Cage, the licensee stated that a calculation demonstrates that instantaneous radioactive releases are below applicable 10 CFR Part 20 limits without relying on equipment within the compartments to meet the radioactive release criteria of NFPA 805. For the Office and Training Facility, the licensee stated that the acceptability of the radioactive sources credited in part, the sprinkler system in the building. The licensee further stated that these radioactive source(s) will be removed, as necessary, to ensure that the radioactive release performance criteria of NFPA 805 can be met without relying on fixed fire suppression in non-power block buildings, and the activity is identified in Implementation Item IMP-17 in LAR Attachment S. The NRC staff concludes that the licensee's response to FPE RAI 07 is acceptable because it determined that the Interim Resin Storage Facility (Lake Davies), Material Processing Facility, Original Steam Generator Storage Facility, Pre-Assembly Facility

Upper Laydown Area, Sewage Treatment Plant, Unit 1 Butler Building, Unit 2 Butler Building, Warehouse No. 3, and West Road Cage are not within the definition of the power block, and Implementation Item IMP-17 is included in LAR Attachment S, which is required by the proposed license condition, to remove radioactive sources in the Office and Training Facility.

In FPE RAI 08 (Reference 16), the NRC requested that the licensee provide the bases for excluding the 45'-0" elevation of the North Servicer Building from the power block. In its response to FPE RAI 08 (Reference 9), the licensee stated that an engineering equivalency evaluation was performed to demonstrate that the 45' elevation is excluded from Fire Area TB / NSB / ACA and the power block on the basis that there are no cables or equipment required to achieve the NSPC in the 45' elevation of the North Service Building and in the Yard within 50 feet of the 45' elevation of the North Service Building. The licensee further stated that a fire originating in the 45' elevation of the North Service Building will not impact cables or equipment required to achieve NSPC in adjacent fire area TB / NSB / ACA. The licensee revised pages to LAR Attachment I to incorporate the information described in FPE RAI 08 (Reference 9). The NRC staff concludes that the licensee's response is acceptable because excluding the 45-ft elevation of Fire Area TB / NSB / ACA was evaluated in an engineering equivalency evaluation which determined that the a fire in the 45-ft elevation of the North Service Building will not impact cables or equipment required to achieve the NSPC.

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

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

GL 2006-03 requested that licensees evaluate its facilities to confirm compliance with existing applicable regulatory requirements in light of the results of NRC testing that determined that both Hemyc™ and MT™ fire barriers failed to provide the protective function intended for compliance with existing regulations, for the configurations tested using the NRC's thermal acceptance criteria. In a letter dated June 9, 2006 (Reference 76), the licensee stated that CCNPP does not rely on either the Hemyc or MT fire barrier system or any other 1 or 3-hour fire barrier that separates redundant safe shutdown trains located within the same fire area. Therefore, the NRC staff concludes that the generic issue (GL 2006-03), (Reference 48), related to the use of these ERFBS is not applicable to CCNPP.

3.1.4 Performance-Based Methods for NFPA 805, Chapter 3, Elements

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

(A) Satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release;

(B) Maintains safety margins; and

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

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

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

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

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

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

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

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

> Either of the following objectives shall be met during all operational modes and plant configurations.
>
> (1) Containment integrity is capable of being maintained.
>
> (2) The source term is capable of being limited.

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

> Fire protection features shall be capable of providing reasonable assurance that, in the event of a fire, the plant is not placed in an unrecoverable condition. To demonstrate this, the following performance criteria shall be met:
>
> (a) *Reactivity Control.* Reactivity control shall be capable of inserting negative reactivity to achieve and maintain subcritical conditions. Negative reactivity inserting shall occur rapidly enough such that fuel design limits are not exceeded.
>
> (b) *Inventory and Pressure Control.* With fuel in the reactor vessel, head on and tensioned, inventory and pressure control shall be capable of controlling coolant level such that subcooling is maintained for a PWR [pressurized-water reactor] and shall be capable of maintaining or rapidly restoring reactor water level above top of active fuel for a BWR [boiling-water reactor] such that fuel clad damage as a result of a fire is prevented.
>
> (c) *Decay Heat Removal.* Decay heat removal shall be capable of removing sufficient heat from the reactor core or spent fuel such that fuel is maintained in a safe and stable condition.
>
> (d) *Vital Auxiliaries.* Vital auxiliaries shall be capable of providing the necessary auxiliary support equipment and systems to assure that the systems required under (a), (b), (c), and (e) are capable of performing their required nuclear safety function.
>
> (e) *Process Monitoring.* Process monitoring shall be capable of providing the necessary indication to assure the criteria addressed in (a) through (d) have been achieved and are being maintained.

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

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

In LAR Attachment L, "NFPA 805, Chapter 3 Requirements for Approval (10 CFR 50.48(c)(2)(vii)," the licensee requested NRC staff review and approval of PB methods to demonstrate an equivalent level of fire protection for the requirement of the elements identified in section 3.1.1.6 of this SE. The NRC staff evaluation of these proposed methods is provided below.

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

In LAR Attachment L, Approval Request 1, the licensee requested NRC staff approval of a PB method to demonstrate an equivalent level of fire protection for the NFPA 805, Section 3.2.3(1) requirement to establish procedures for inspection, testing, and maintenance of fire protection systems and features credited by the FPP. Specifically, the licensee requested approval to utilize PB methods to establish appropriate inspection, testing, and maintenance frequencies for fire protection systems and features required by NFPA 805 using the methods described in EPRI Technical Report 1006756 (Reference 70).

The licensee stated that NFPA 805, Section 2.6, "Monitoring," requires that "A monitoring program shall be established to ensure that the availability and reliability of the fire protection systems and features are maintained and to assess the performance of the FPP in meeting the performance criteria, and that monitoring shall ensure that the assumptions in the engineering analysis remain valid."

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

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

The licensee stated that the scope and frequency of the inspection, testing, and maintenance activities for fire protection systems and features required in the FPP have been established based on the previously approved TSs / licensee controlled documents and appropriate NFPA codes, and that the approval request does not involve the use of the EPRI Technical Report TR-1006756 to establish the scope of those activities as determined by the required systems review identified in LAR Attachment C, Table C-2.

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

The licensee stated that the target tests, inspections and maintenance will be those activities for the NFPA 805 required fire protection systems and features and that the reliability and frequency goals will be established to ensure the assumptions in the NFPA 805 engineering

analysis remain valid. The licensee further stated that the failure criterion will be established based on the required fire protection systems and features credited functions and will ensure those functions are maintained. The licensee further stated that the data collection and analysis will also follow EPRI Technical Report TR-1006756 document guidance and that the failure probability will be determined based on EPRI Technical Report TR-1006756 guidance and a 95% confidence level will be utilized. The licensee stated that the performance monitoring will be performed in conjunction with the monitoring program required by NFPA 805 Section 2.6 and will ensure site specific operating experience is considered in the monitoring process.

The licensee stated that the use of PB test frequencies established in accordance with EPRI Technical Report TR-1006756 methods combined with NFPA 805 Section 2.6, "Monitoring Program", will ensure that the availability and reliability of the fire protection systems and features are maintained to the levels assumed in the NFPA 805 engineering analysis; and therefore, there is no adverse impact to NSPC.

The licensee stated that the radiological release performance criteria are satisfied based on the determination of limiting radioactive release in LAR Attachment E, and that fire protection systems and features are credited as part of that evaluation. The licensee further stated that the use of PB test frequencies established per EPRI Technical Report TR-1006756 methods, combined with NFPA 805 Section 2.6, "Monitoring Program", will ensure that the availability and reliability of the systems and features are maintained to the levels assumed in the NFPA 805 engineering analysis, which includes those assumptions credited to meet the radioactive release performance criteria; and therefore, there is no adverse impact on meeting these criteria.

The licensee stated that the use of PB test frequencies established per EPRI Technical Report TR-1006756 methods, combined with NFPA 805 Section 2.6, "Monitoring Program", will ensure that the availability and reliability of the fire protection systems and features are maintained to the levels assumed in the NFPA 805 engineering analysis, which includes those assumptions credited in the risk evaluation safety margin discussions. The licensee further stated that the use of these methods in no way invalidates the inherent safety margins contained in the codes used for design and maintenance of fire protection systems and features and therefore, the safety margin inherent and credited in the analysis has been preserved.

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

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

3.1.4.2 NFPA 805, Section 3.3.5.1 Electrical Wiring above Suspended Ceiling

In LAR Attachment L, Approval Request 2, the licensee requested NRC staff approval of a PB method to demonstrate an equivalent level of fire protection for the NFPA 805, Section 3.3.5.1 requirement that electrical wiring above suspended ceilings be listed for plenum use, routed in armored cable, routed in metallic conduit, or routed in cable trays with solid metal top and bottom covers. Specifically, the licensee requested approval of a PB method to justify the acceptability of having wiring above suspended ceilings in the following areas:

- Access Control Area (including Chemistry Lab Area) in the Turbine Building
- Fire Area 24 in the Auxiliary Building
- Fire Area 11 (ACA) in the Auxiliary Building

The licensee stated that it has been verified from plant walk downs and above-ceiling surveys that the majority of the cables above the ceilings are either enclosed in metal raceways or listed for plenum use in compliance with NFPA 805, Section 3.3.5.1; however, it is not confirmed with certainty that all of the cables that are not enclosed in metal raceway (exposed), are listed for plenum use. The licensee stated that this request is therefore based on the assumption that some small population of the cables that are exposed is also not listed for plenum use, and that these cables are referred to as "unverified" cables in the request. The licensee stated that it is undetermined whether these unverified cables meet IEEE-383 (Reference 77) or other qualification standards and that these cables are therefore also assumed to be "unqualified" in terms of combustibility, for the purposes of the approval request. The licensee stated there is no automatic fire suppression or detection above the ceilings in these areas.

The licensee stated that NSCA- credited cables that are routed through these above-ceiling areas are protected by metal conduit. In FPE RAI 05c.i (Reference 16), the NRC staff requested clarification if the NSCA-credited cables that are routed in metal conduit above the suspended ceiling need to be free from fire damage in order to support a nuclear safety function or risk evaluation for a fire in the fire areas described in the request. In its response to FPE RAI 05c.i (Reference 9), the licensee stated that the NSCA credited cables that are routed above suspended ceilings were evaluated on a fire area basis to determine if its failure would result in a variance from deterministic requirements (VFDR) and that cables routed in

metal conduit were not screened out of the analysis or considered to be free from the effects of fire in the area. The licensee stated that those cables above the suspended ceiling were evaluated as failed in the NSCA. The licensee further stated that there are some conduits routed above suspended ceilings that contain NSCA-credited cables, and that a few conduits contained NSCA cables that resulted in VFDRs. The licensee stated that those VFDRs were evaluated in accordance with NFPA 805, Section 4.2.4.2, using a PB approach FRE with simplifying deterministic assumptions. The licensee stated that the risk assessment concluded for each of these VFDRs that the risk, safety margin, and defense-in- depth meet the acceptance criteria of NFPA 805 Section 4.2.4, therefore, no further action is required. The NRC staff concludes that the licensee's response to FPE RAI 05.c.i is acceptable because it clarified that fire damage to the NSCA-credited cables located above the suspended ceiling were evaluated in the NSCA in accordance with the NFPA 805 requirements.

In FPE RAI 05.c.ii (Reference 16), the NRC staff stated that cables in metal conduit or in metal covered trays are not generally sufficient to protect cables from exposure fire damage and requested that the licensee provide additional discussion and/or details that provide assurance that NSCA credited cables are not susceptible to damage from extension cords or other potential fire hazards in the area above the ceiling. In its response to FPE RAI 05.c.ii (Reference 9), the licensee stated that the NSCA did not credit the metallic conduit as a means to prevent fire induced failure of NSCA-credited cables routed above suspended ceilings, and that the NSCA-credited cables that are routed above suspended ceilings were evaluated on a fire area basis to determine if its failure would result in a VFDR and evaluated in accordance with NFPA 805, Section 4.2.4.2. The licensee further stated that NSCA-credited cables are susceptible to damage from extension cords and other potential fire hazards in the area above a ceiling and no assurance is given that metal conduit will protect those cables. The NRC staff concludes that the licensee's response to FPE RAI 05.c.ii is acceptable because the licensee does not credit the metal conduit or metal trays to protect cables and instead considers fire damage to the NSCA-credited cables and evaluates the effects of fire damage using PB methods in NFPA 805 Section 4.2.4.2 if fire damage to the NSCA cables would result in a VFDR.

In the approval request, as supplemented, the licensee stated that it is expected that the fire will be manually detected and the Control Room operators will dispatch the CCNPP fire brigade to commence manual fire suppression activities. The licensee further stated that there are limited combustibles above the ceiling; therefore, even if detection is delayed due to the presence of the suspended ceiling, a challenging fire is not expected.

The licensee stated that based on walkdowns and above-ceiling surveys in these areas, no ignition sources were observed above the suspended ceilings except for extension cords which are potentially susceptible to self-ignition. The licensee stated that exposed wiring above these ceilings was observed to be low-voltage communication and data type network cables, which are not prone to heat-generating overload faults. The licensee stated that no other fixed ignition sources (i.e., fans, fan motors, etc.) were observed above the suspended ceilings.

The licensee stated that industry experience has shown that in the unlikely event of a self-ignited cable tray fire, the fire is not expected to spread beyond the cable tray of fire origin. The licensee further stated that the industry fire events related to self-ignitable tray fires have only led to localized failures in a small number of cables within a single raceway. The licensee further stated that no event has led to sustained open flaming fires, or damage to cables beyond the initially impacted raceway.

The licensee stated that the extension cords above the ceiling are not bundled with cables or other combustible materials, nor are they routed in cable trays. The licensee further stated that there is even less likelihood that a self-ignited extension cord fire will lead to a sustained open flaming fire, due to lack of combustible material in the vicinity of the extension cords. In FPE RAI 05a (Reference 16), the NRC staff requested the licensee provide further details that describe the extent of the use of extension cords that are located above the suspended ceiling, such as number, length, size, use (e.g. type of the electrical cords), and if the extension cords are permanent or temporary use. In its response to FPE RAI 05a (Reference 11), the licensee stated that extension cords are no longer located above the suspended ceiling, and that administrative procedures prohibit the use of extension cords above the suspended ceiling. The licensee revised pages of LAR Attachment A and Attachment L to incorporate the response to FPE RAI 05a. The NRC staff concludes that the licensee's response to FPE RAI 05a is acceptable because removing the extension cords that were located above the suspended ceiling and implementing administrative controls to prohibit the use of extension cords above the ceiling complies with NFPA 805 Section 3.3.5.1, and the licensee revised the LAR to delete extension cords from the description in Approval Request 2.

The licensee stated that the only other significant combustible material observed above the ceilings was ventilation duct wrap insulation and that documentation of this material identifies that the duct wrap insulation has a flame spread rating of less than 25. The licensee further stated that the duct wrap insulation will therefore not support sustained combustion or fire growth. In the unlikely event of fire originating in the exposed non-plenum cable, fire will not spread to the duct wrap insulation.

The licensee stated that its administrative control procedure states, "Minimize wiring above suspended ceilings. Where installed, electrical wiring shall be listed for plenum use, routed in armored cable, routed in metallic conduit, or routed in cable trays with solid metal top and bottom covers," and is in place to ensure that future compliance with NFPA 805 will be achieved. In FPE RAI 05b (Reference 16), the NRC staff requested the licensee to describe the administrative controls that are (or will be) in place to maintain the technical bases for the request (e.g. prevent /limit future placement of ignition sources and combustible materials, periodic surveillance above the ceiling, etc.). In its response to FPE RAI 05b (Reference 10), the licensee stated that fleet administrative configuration control procedures limit future installation of additional cabling above suspended ceilings and require that all future installations comply with the requirements of NFPA 805 Section 3.3.5.1, and that fleet administrative configuration control procedures require that any new combustible materials and/or ignition sources are reviewed to ensure that the bases of an approved deviation from the requirements of NFPA 805 are not compromised. The NRC staff concludes that the

licensee's response to FPE RAI 05b is acceptable because administrative configuration control procedures are in place to maintain the technical bases for this approval request and to provide assurance that compliance with NFPA 805, Section 3.3.5.1, as modified by this approval request will be maintained.

The licensee stated that the Access Control Area (ACA) ventilation system is served by one supply unit (RTU-1) and two independent exhaust units (access control exhaust fans 11 and 12). The licensee further stated that in the Fire Area 11 portion of the ACA, supply and exhaust registers in the ceiling are ducted to and from these units, and the above-ceiling space is therefore not used as an air plenum. The licensee stated that on the Turbine Building side of the ACA, supply registers in the ceiling are ducted to the supply unit, but some exhaust registers in the ceiling are not ducted. The licensee further stated that exhaust air is pulled from the ceiling plenum into ducts that lead to the Unit 2 Main Exhaust Plenum where it is exhausted by the main plant exhaust fan 21 or 22. The licensee stated that the ACA exhaust fans are interlocked with the Main Plant Exhaust Fans as well as the ACA supply unit RTU-1, and the exhaust air discharges outside and is not recycled and returned to the ACA or any other part of the building. The licensee stated that for the Auxiliary Building ventilation system, including Fire Area 24, supply and exhaust registers in the ceiling are ducted to and from air handling units, and that the above-ceiling space is therefore not used as an air plenum.

The licensee stated that there are limited ignition sources above the suspended ceilings in these areas; however, per industry findings, the postulated fires should not grow beyond the cable tray (or cable, or extension cord) of origin. The licensee further stated that the combustibles above the ceilings are insufficient to support a sustained fire or fire growth. The licensee stated that there is no impact on the NSPC.

The licensee stated that the cables above the suspended ceilings have no impact on the radiological release performance criteria and that the radiological release performance criteria are satisfied based on the determination of limiting radioactive release in LAR Attachment E, which is not affected by the cables above the suspended ceilings.

The licensee stated that exposed, non-plenum-rated electrical wiring located above suspended ceilings is minimal, and is sufficiently dispersed, and that industry experience has shown that cable fires are limited to the cable tray of origin. The licensee further stated that a self-ignited cable fire will not grow to a size that could cause damage to components necessary for nuclear safety capability, and therefore, the safety margin inherent in the analysis for the fire event has been preserved.

The licensee stated that the three echelons of DID are (1) to prevent fires from starting (2) rapidly detect, control and extinguish fires that do occur thereby limiting damage, and (3) provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed. The licensee stated that per NFPA 805 Section 1.2, DID is achieved when an adequate balance of each of these elements is provided. The licensee stated that exposed, non-plenum rated electrical wiring and extension cords located above suspended ceilings do not significantly affect Echelon 1 of the

DID concept of preventing fires from occurring. The licensee further stated that the limited quantity of this wiring above suspended ceilings will not result in open, sustained flaming and is therefore not capable of causing fire damage to components necessary for nuclear safety capability; and therefore, Echelons 2 and 3 of the DID concept are also maintained. In FPE RAI 05d (Reference 16), the NRC staff noted that DID is based on a balance of the three echelons and requested the licensee to provide additional details related to how Echelons 2 (fire detection and suppression) and 3 (safe shutdown) of the DID concept are maintained. In its response to FPE RAI 05d (Reference 11), the licensee stated that an adequate balance of each of these elements is provided:

- Echelon 1: Hot work controls and the lack of fixed ignition sources in the areas above the suspended ceilings will limit possibility of fires in the area.

- Echelon 2: Manual detection and CCNPP fire brigade manual suppression capability for a fire in the above-ceiling space will limit fire damage in the area.

- Echelon 3: Fire rated barriers between fire areas limit fire spread above the suspended ceiling and the VFDRs located above the suspended ceiling areas were evaluated and found acceptable in accordance with NFPA 805, Section 4.2.4.2, "Use of Fire Risk Evaluation," with simplifying deterministic assumptions.

The NRC staff concludes that the licensee's response to FPE RAI 05d is acceptable because the licensee adequately described how each element of DID is achieved.

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

3.1.4.3 NFPA 805, Section 3.3.1.3.1 Control of Ignition Sources

In LAR Attachment L, Approval Request 3, the licensee requested NRC staff approval of a PB method to demonstrate an equivalent level of fire protection for the NFPA 805, Section 3.3.1.3.1 requirement that hot work safety procedures shall be developed, implemented, and periodically updated as necessary in accordance with NFPA 51B, "Standard for Fire Prevention During Welding, Cutting and Other Hot Work" (Reference 72), and NFPA 241, "Standard for Safeguarding Construction, Alternation, and Demolition Operations" (Reference 73). Specifically, the licensee requested approval to perform welding, cutting and other hot work in sprinklered buildings while the suppression system is impaired.

The licensee stated that while expected to be a very uncommon occurrence, it anticipates that there may be occasions where hot work is necessary in sprinklered plant areas while such

systems are temporarily impaired. The licensee further stated that any fire area containing a sprinkler system identified in LAR Attachment C, Table C-2, is subject to the provisions of the request. In FPE RAI 06a and 06b (Reference 16), the NRC requested the licensee to discuss the bases for limiting the hot work procedure request to only fire areas that contain required sprinkler systems identified in LAR Attachment C, Table C-2. In its response to FPE RAI 06a and 06b (Reference 9), the licensee stated that the request is applicable to any fire area containing a sprinkler system and is not limited to only fire areas that contain required fire sprinkler systems. The licensee further stated that LAR Attachment C, Table C-2 lists all sprinkler systems in plant fire areas, regardless of whether the system is required, and revised LAR Attachment L Approval Request 3 to include this information. The NRC staff concludes that the licensee's response to FPE RAI 06a and FPE RAI 06b is acceptable because it clarified that the scope of the hot work procedure request applied to all sprinkler systems in plant areas and the LAR was revised accordingly.

The licensee stated that the procedures that are in place to limit combustibles and control hot work are administratively controlled by plant procedures, and with the exception of Section 3-2(b) of NFPA 51B, the procedure employed for hot work is a rigorous one and is in compliance with the applicable requirements of NFPA 51B and NFPA 241. The licensee stated that a summary of the key elements of the procedure include:

- A permit application for hot work is submitted to the fire marshal.
- The fire marshal assigns a number to the permit, reviews the permit and conducts [sic an] inspection of the area prior to commencing work.
- A hot work permit hazard analysis checklist is successfully completed before starting work.
- The Operations group is notified prior to all hot work, and the notification is once per shift.
- A hot work fire watch, with the appropriate fire extinguisher for the type and size for the hazard, is required to be present during the hot work activity and must remain in the immediate work area for a minimum of 30 minutes following completion of the hot work activity.
- Back-up fire suppression equipment is available in areas where the fire suppression system is inactive.
- Combustibles located within 35 feet of the work area are removed prior to hot work operations, and that for permanent combustibles located within 35 feet of the work area that cannot be removed must be covered with the appropriate style of blanket.

- Equipment is checked prior to the activity to ensure it is in good working condition.

- If hot work is required in an area in which nuclear safety compensatory actions are in place, completion of a form approved by the system manager, shift manager/operations maintenance coordinator, fire marshal, and responsible maintenance group supervisor is required.

- Hot work procedures are in compliance with all other applicable NFPA 51B and NFPA 241 requirements, including those related to management, permit-authorizing individual, hot work operator training, fire watch (and training) alarm activation, hot work areas, hot work permits, hot tapping, and fire prevention (precautions regarding combustibles, inadvertent sprinkler discharge, etc.).

In FPE RAI 06c (Reference 16), the NRC staff requested the licensee to clarify if the "appropriate style of blanket" is a listed or approved welding curtain, welding blanket, welding pad or equivalent as required by NFPA 51B. In its response to FPE RAI 06c (Reference 9), the licensee stated that permanent combustibles located within 35 feet of the work area that cannot be removed must be covered with an NFPA 51B compliant blanket. The NRC staff concludes that the licensee's response to FPE RAI 06c is acceptable because it identified that an NFPA 51B compliant blanket will be used to cover permanent combustibles located within 35 feet of the work area and meets NFPA 51B.

In FPE RAI 06d (Reference 16), the NRC staff requested the licensee to describe any additional actions/controls to be used when hot work is performed in fire areas/zones where one or more sprinkler systems are impaired, that are above and beyond those taken for any other hot work activity conducted when sprinklers are in service. In its response to FPE RAI 06d (Reference 9), the licensee stated that plant procedures ensure that appropriate contingency measures are in place when the sprinkler systems are not in service and that these contingency measures, which are above and beyond those taken for any hot work activity conducted when sprinklers are in service, may include, but are not limited to, ensuring backup suppression is available (i.e., laying hose from an operable hose station in an adjacent fire area). The NRC staff concludes that the licensee's response to FPE RAI 06d is acceptable because the licensee has established contingency measures to provide backup suppression in the areas where automatic systems are impaired.

The licensee stated that the procedures demonstrate the highest standard of care in fire prevention measures for hot work activities, and that the rigorous approval, documentation, training, hazard analysis, precautions, lack of combustibles, manual suppression, and vigilance ensure that the occurrence of a fire during hot work operations is very unlikely. The licensee further stated that the risk of a fire growing uncontrolled beyond the incipient stage due to hot work is therefore not considered a credible scenario.

The licensee stated that although the hot work requirements in its plant procedures do not comply with Section 3.2(b) of NFPA 51B, strict procedures are in place to limit the combustibles, control the hot work within the area, and provide a fire watch to promptly extinguish any fires that do occur; and therefore, there is no impact on the NSPC.

The licensee further stated that the use of the procedure to perform hot work activities has no impact on the radiological release criteria. The licensee stated that the radiological release performance criteria are satisfied based on the determination of limiting radioactive release in LAR Attachment E, which is not affected by the hot work control procedure.

The licensee stated that there are procedures in place to limit the combustibles and control the hot work within the area and that since fire prevention and manual suppression is maintained by its plant procedure, the safety margin inherent in the analysis for the fire event has been preserved.

The licensee stated that the three echelons of DID are (1) to prevent fires from starting, (2) rapidly detect, control and extinguish fires that do occur thereby limiting damage, and (3) provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed. The licensee stated that per NFPA 805 Section 1.2, DID is achieved when an adequate balance of each of these elements is provided. The licensee stated that Echelons 1, 2, and 3 are met through the limiting of combustibles, control of hot work, and availability of a fire watch (i.e., manual suppression), and that the hot work procedures, therefore, do not compromise fire suppression functions or post-fire nuclear safety capability. The licensee stated that since a balance of the elements is provided, DID is achieved.

Based on its review of the information submitted by the licensee, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the proposed PB method is an acceptable alternative to the corresponding NFPA 805, Section 3.3.1.3.1 requirement because it satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown capability).

3.1.4.4 NFPA 805, Section 3.6.1 Standpipe and Hose Stations

In LAR Attachment L, Approval Request 4, the licensee requested NRC staff approval of a PB method to demonstrate an equivalent level of fire protection for the NFPA 805, Section 3.6.1 requirement that Class III standpipe and hose systems to be installed in all power block buildings and in accordance with NFPA 14, "Standard for the Installation of Standpipe, Private Hydrant, and Hose Systems" (Reference 51). Specifically, the licensee requested approval to use Class I standpipe systems, in lieu of a Class III systems.

The licensee stated that the standpipe and hose system at CCNPP is a Class I standpipe system (2½-inch hose outlets provided for use by the trained fire brigade) in accordance with the 1970, 1973, and 1990 editions of NFPA 14, and is not a Class III system (2½-inch hose outlets provided for use by the trained fire brigade and small occupant-use hose outlet and hose provided for use by building occupants).

The licensee stated that the design and construction of the fire protection system at CCNPP includes standpipes and hose stations for manual fire-fighting purposes, and that per procedure, building occupants are instructed to notify the control room to report a fire and to utilize extinguishers or actuate an installed fire suppression system only if appropriately trained to do so. The licensee further stated that occupants are not instructed to utilize standpipe and hose systems.

The licensee stated that the use of small-diameter hose by building occupants is not sufficient for the purposes of fighting any fire other than an incipient fire when compared with larger-diameter hose, which is utilized by the trained fire brigade. The licensee further stated that since the original design of the plant, the equipment and tactics to fight interior fires have evolved and improved, and that the fire brigade conducts simulated and live fire training with 1¾-inch fire-fighting hose, not the 1½-inch hose that is typically used as occupant-use hose in a Class III system. The licensee further stated that the fire brigade carries its own high-rise pack that contains a minimum of 100 feet of 1¾-inch fire-fighting hose, as well as the 2½-inch-to-1½-inch adapter required to attach the hose to the standpipe. The licensee stated that each standpipe location is equipped with a universal spanner wrench per procedure to facilitate connecting this hose to the standpipe. The licensee further stated that the fire brigade is trained to connect the 2½-inch-to-1½-inch adapter to the standpipe to support the use of the 1¾-inch interior attack hose, and this practice is in accordance with the Class I requirements of NFPA 14; however, it is not in compliance with Section 3.6.1 of NFPA 805, which requires a Class III system.

The licensee stated that currently there are 64 standpipe/hose stations installed in the power block that are equipped with 2½-inch hose connections. The licensee further stated that the water volume and pressure requirements for Class I and Class III standpipe systems are common among both classes; therefore, there is no deviation for these requirements.

The licensee stated that Class I standpipes and Class III standpipes are both acceptable per NFPA 14.

The licensee stated that the fire brigade is trained to respond expeditiously to fire incidents and to connect its 1¾-inch interior attack hose to the standpipe system's 2½-inch outlets for fire suppression activities with the use of adapters. The licensee further stated that because the fire brigade will respond rapidly to suppress the fire as trained, the existence of a Class I standpipe system in lieu of a Class III standpipe system has no impact on the NSPC.

The licensee stated that the use of Class I standpipes in lieu of Class III standpipes has no impact on the radiological release performance criteria, and that the radiological release performance criteria are satisfied based on the determination of limiting radioactive release in LAR Attachment E, which is not affected by the presence of fire hose and adapters at hose station locations.

The licensee stated that the fire brigade is trained to extinguish fires using Class I standpipes and the use of occupant hoses is not permitted by plant personnel, and that this does not result in compromising manual fire suppression functions, or the nuclear safety capability

assessment. The licensee further stated that since the manual fire suppression functions are maintained through performance evaluations according to plant procedures, the safety margin inherent in the analysis for the fire event has been preserved.

The licensee stated that the three echelons of DID are (1) to prevent fires from starting, (2) rapidly detect, control and extinguish fires that do occur thereby limiting damage, and (3) provide adequate level of fire protection for systems and structures, so that a fire will not prevent essential safety functions from being performed. The licensee further stated that per NFPA 805, Section 1.2, DID is achieved when an adequate balance of each of these elements is provided. The licensee stated that Echelon 1 is met through plant fire prevention procedures and is not affected by this configuration, and that Echelons 2 and 3 are met by performance evaluations through fire prevention procedures, which maintain automatic and manual fire suppression functions. The licensee further stated that the fire brigade is trained to rapidly respond to and extinguish fires with the tools provided to them, which include a Class I standpipe and hose system, and that the use of a Class I standpipe system do not result in compromising automatic fire suppression functions, manual fire suppression functions, or post-fire safe shutdown capability. The licensee stated that since a balance of the elements is provided, DID is achieved.

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

3.1.4.5 NFPA 805, Section 3.3.7.2 High Pressure Flammable Gas Storage

In LAR Attachment L, Approval Request 5, the licensee requested NRC staff approval of a PB method to demonstrate an equivalent level of fire protection for the NFPA 805, Section 3.3.7.2 requirement that outdoor high-pressure flammable gas storage containers be located so that the long axis is not pointed at buildings. Specifically, the licensee requested approval of a PB method to allow hydrogen storage tanks located at CCNPP in the outdoor yard area north of the Turbine Building to be arranged such that the long axes are pointed at the Turbine Building (to the south), Condensate Storage Tank No 11 (to the north) and pretreated Water Storage Tank No 11 (to the north).

The licensee stated that there is currently an array of nine (9) hydrogen storage tanks located on a concrete pad adjacent to the road located "plant north" of the Unit 1 Turbine Building, and stated that the hydrogen storage foundation is constructed of substantial concrete supports which are embedded three feet underground and span the width of the hydrogen storage bank at each end. The licensee further stated that the capacity of the hydrogen system is 62,357 standard cubic feet (scf) and that the hydrogen tanks are supported on each end with 10-inch wide concrete foundations and are supported within a large bolted steel rack.

The licensee stated that the existing hydrogen tanks at CCNPP are in compliance with the applicable requirements of the 1973 edition of NFPA 50A, "Standard for Gaseous Hydrogen Systems at Consumer Sites" (Reference 78), and a summary of compliance with the key provisions of NFPA 50A is documented below:

- Design of containers - The storage bank is composed of nine (9) ASME coded gas storage tubes.

- Safety relief devices - Each tube is equipped with an approved shutoff valve and a bursting disc assembly with a vent stack which discharges above the highest vessel in the modular assembly.

- Piping, tubing and fittings - The piping, tubing and fittings are suitable for hydrogen service and for the pressures and temperatures involved, and cast iron pipe fittings are not used.

- Equipment assembly - Valves, gauges, regulators, and other accessories are suitable for hydrogen service, and the tanks are protected against vehicular and other physical damage by concrete modular barriers. The tube trailer stanchion has equipment to electrically ground mobile hydrogen supply units, and truck grounding capability is provided at the loading area.

- Marking – The hydrogen storage location is permanently placarded as follows:
  - No Smoking
  - No Open-Flame
  - No Ignition Source within 25 feet of Storage Tank

- Location - The tanks and connections are readily accessible to delivery equipment and to authorized personnel, not located beneath electric power lines, and not located near any other flammable liquid or gas sources.

- Outdoor Location – The hydrogen storage area is in compliance with exterior fire exposure requirements.

- Maintenance – The system is inspected and maintained quarterly.

- Fire Protection - A fire hydrant is located within 15 feet of the hydrogen system.

The licensee stated that compliance with all of these requirements ensures that the likelihood of fire or other damage to the hydrogen tanks is minimized. The licensee further stated that a fire exposure that is prolonged and severe enough to result in a rocketing tank is very unlikely, particularly with the safety relief devices, lack of ignition sources, lack of combustible loading, and physical protection afforded to the tanks.

The licensee stated that, as indicated above, the hydrogen tanks are pointed at condensate storage tank (CST) 11 and pretreated water storage tank (PWST) 11, and in the very unlikely event that a rocketing tank was to damage CST 11, nuclear safety capability would not be impacted due to the presence of a redundant CST 12, which is not located in the line of sight of the long axis of the hydrogen tanks and would be available in the event of a hydrogen fire. The licensee further stated that similarly, PWST 11 is located behind CST 11 and there is a redundant PWST 12 that is not located in the line of sight of the long axis of the hydrogen tanks and would be available in the event of a hydrogen fire.

The licensee stated that the Turbine Building is located 75 feet away from the hydrogen storage tanks, and that the north-facing exterior wall is constructed of 12-inch thick reinforced concrete up to a height of 8 feet above grade. The licensee further stated that above this height, the exterior wall is constructed of non-insulated metal panels. The licensee stated that a PB NSCA has been performed per Chapter 4 of NFPA 805, and the findings of the NSCA indicate that even in the very unlikely event that the Turbine Building is lost from damage due to a hydrogen fire, a nuclear safety success path can be achieved and maintained.

The licensee stated that the FPRA has evaluated the potential risk associated with the hydrogen tanks and concluded that the fire scenario is not risk significant. The licensee further stated that the guidance in NUREG/CR-6850 (Reference 37), Attachment N, for hydrogen tanks, does not require analysis of a fire scenario beyond 10-15 feet, and that, however, for the purposes of this request for approval, an estimate of the risk associated with the hydrogen tanks damaging the Unit 1 Turbine Building was performed used the ignition frequency of the hydrogen tanks and the CCDP for the loss of the Unit 1 Turbine Building, and the estimated CDF was not risk significant.

The licensee stated that the hydrogen storage tanks meet the design input requirements of NFPA 50A, and that the redundancy for CSTs and PWSTs provides a method to maintain nuclear safety capability. The licensee further stated that the probability of hydrogen storage tank penetrating the north wall of the Unit 1 Turbine Building is unlikely, and that a success path for nuclear safety performance would remain available in this scenario; and that, therefore, there is no impact on the NSPC.

The licensee stated that the configuration of the hydrogen storage tanks was reviewed for NFPA 805 Chapter 3 acceptance and has no impact on the radiological release performance criteria. The licensee further stated that the radiological release performance criteria are satisfied based on the determination of limiting radioactive release in LAR Attachment E, which is not affected by impacts of the hydrogen storage tank configuration.

The licensee stated that the hydrogen storage tanks meet the design requirements of NFPA 50A, and the approval request does not compromise the nuclear safety capability assessment; and therefore, the safety margin inherent in the analysis for the fire event has been preserved.

The licensee stated that the three echelons of DID are (1) to prevent fires from starting, (2) rapidly detect, control and extinguish fires that do occur thereby limiting damage, and (3)

provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed. The licensee further stated that per NFPA 805 1.2, DID is achieved when an adequate balance of each of these elements is provided. The licensee stated that Echelon 1 is maintained by NFPA 50A compliance, and that Echelon 3 is maintained by the nuclear safety redundancies provided for the condensate storage tank (CST) and the pretreated water storage tank (PWST). The licensee further stated that the probability of a hydrogen storage tank damaging the Unit 1 Turbine Building is low and a nuclear safety success path can be achieved if the Turbine Building is damaged. The licensee stated that automatic fire protection systems are not required for protection of these tanks, and there are fire hydrants in the vicinity of these tanks, such that DID Echelon 2 is also met. The licensee stated that the approval request does not compromise automatic fire suppression functions, manual fire suppression functions, or post-fire nuclear safety capability. The licensee stated that since a balance of the elements is provided, DID is achieved.

Based on its review of the information submitted by the licensee, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the proposed PB method is an acceptable alternative to the corresponding NFPA 805, Section 3.3.7.2 requirement because it satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown capability).

3.1.4.6 NFPA 805, Section 3.3.8 Bulk Storage of Flammable and Combustible Liquids

In LAR Attachment L, Approval Request 6, the licensee requested NRC staff approval of a PB method to demonstrate an equivalent level of fire protection for the NFPA 805, Section 3.3.8 requirement that bulk storage of flammable and combustible liquids not be permitted inside structures containing systems, equipment, or components important to nuclear safety, and as a minimum, the storage and use shall comply with NFPA 30, "Flammable and Combustible Liquids Code" (Reference 79).

The licensee noted that NFPA 30 (1990 Edition) Section 2-3.5.1 states "Except as provided in 2-3.5.2, every aboveground storage tank shall have some form of construction or device that will relieve excessive internal pressure caused by exposure fires." The licensee also noted that the exception in Section 2-3.5.2 does not apply.

The licensee stated that Fuel Oil Storage Tank (FOST) 1A is located in a structure containing components important to nuclear safety, and that the NFPA 30 code compliance evaluation identified conditions that deviate from the requirements listed above for the FOST 1A in the emergency diesel generator (EDG) 1A Building. The licensee requested approval to allow the current configuration of the Fuel Oil Storage Tank (FOST 1A), which is located in a structure containing components important to nuclear safety.

- NFPA 805, Section 3.3.8:

  The licensee stated that the FOST 1A is located in the tank room of the EDG 1A Building and EDG 1A serves as the dedicated emergency diesel for Bus 11. The licensee further stated that the room is protected by 3-hour rated construction, fire doors and automatic detection and suppression, and that in the unlikely event of a tank failure and subsequent fuel oil fire, the damage will be limited to the [sic EDG] 1A Building and could possibly affect the adjacent EDG 0C Building. The licensee further stated that the EDG 0C Building contains the Station Blackout (SBO) diesel generator (DG) 0C, and that DG 0C can be manually aligned to any of the four safety buses. The licensee further stated that all other plant buildings are physically separated from the EDG 1A and DG 0C Buildings by a distance exceeding 50 feet.

  The licensee stated that the plant is also provided with three other dedicated emergency diesel generators (EDG 1B, 2A and 2B) for the other three safety buses, and that in the event of failure of EDG 1A and DG 0C, the three other diesels and offsite power remain available. The licensee further stated that since the total loss of EDG 1A does not prevent the plant from achieving and maintaining nuclear safety performance goals, the hazards associated with bulk storage of combustible liquids inside these structures is considered acceptable.

- NFPA 30 Section 2-3.5.1:

  The licensee stated that the intent of the requirement for emergency venting in NFPA 30, as defined in the NFPA 30 Handbook, 2012 Edition, is to protect tanks from failure in the event of an exposure fire. The licensee stated that when exposed to a fire, the liquid contents of a tank are heated and can be expected to boil, generating vapor at a rate greater than can be handled by normal vent. The licensee stated that EDG 1A FOST is not equipped with a pressure relieving device, and that the following discussions establish bases to demonstrate that the EDG 1A FOST is acceptable without meeting this requirement as the tank is unlikely to be impacted by an exposure fire and the consequences of tank failure do not compromise the NSPC.

  The licensee stated that EDG 1A FOST is located in the FOST Room at the 66'-6" elevation in the EDG 1A building, and that the base of the EDG 1A FOST is located at the 45'-6" elevation and extends up through the grated floor in the room. The licensee further stated that the basis for acceptability of the EDG 1A FOST configuration is as follows:

  - Tank is shielded from exposure fire
    - The tank is located in a room, which is an isolated compartment in a building of robust exterior wall construction (1'-8" thick poured concrete).

- Transient exposure fires are unlikely
  - There are no other secondary combustibles that could create a fire exposure hazard to the tank.
  - Personnel access is limited and the plant enforces strict controls and procedures on the storage and use of combustible materials.

- Fixed ignition sources are limited
  - There are no ignition sources located at the 66'-6" location.
  - The only ignition sources in the room are three relatively small (5hp and 10hp) pumps located at the 45'-6" location.

- Detection and suppression of fire is expected
  - The room is protected by a pre-action sprinkler system and that in the event of an exposure fire, the pre-action system is expected to activate and control the fire.
  - The sprinkler system and detection system alarms are monitored in the Control Room, which will initiate fire brigade response.

- Consequences of fire are limited
  - The floor of the 66'-6" elevation is grated, allowing oil to drain to the area below, which is designed to contain the full tank contents and confine the spill.
  - Structural steel within the room is protected by spray-applied fireproofing materials.
  - In the event that an exposure fire occurs, is not suppressed by the automatic system or fire brigade, and the tank fails, the damage will be limited to the EDG 1A and DG 0C Buildings, which are physically separated from the other plant buildings by a distance exceeding 50 feet.
  - In the event that all components in the EDG 1A and DG 0C Building are damaged, EDG 1B, 2A and 2B and offsite power remain available; therefore nuclear safety performance capability can be achieved and maintained.

The licensee stated that deviations from NFPA 805 and NFPA 30 regarding flammable and combustible liquid storage in FOST 1A do not affect nuclear safety as there are redundant power supplies available to power safety buses should EDG 1A and DG 0C be lost. The licensee further stated that in the event of loss of EDG 1A and DG 0C, redundant equipment EDG 1B, 2A and 2B and offsite power capabilities remain available to power the four safety buses, and therefore, the nuclear safety performance capability can be achieved and maintained.

In LAR Attachment E, the licensee identified the diesel generator buildings as rooms/areas that screened-out from the radioactive release review. Therefore, the NRC staff concludes

that this approval request regarding flammable and combustible liquid storage in FOST 1A does not affect the results of the radioactive release performance criteria as evaluated in LAR Attachment E.

The licensee stated that the three echelons of DID are (1) to prevent fires from starting, (2) rapidly detect, control and extinguish fires that do occur thereby limiting damage, and (3) provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed. The licensee further stated that per NFPA 805 Section 1.2, DID is achieved when an adequate balance of each of these elements is provided. The licensee stated that Echelon 1 is not significantly affected by FOST 1A and there is no effect on Echelon 2. The licensee further stated that in the unlikely event of tank failure due to fire, Echelon 3 is maintained by availability of the other diesel generators and offsite power, which have the capacity to provide the required power supply for plant equipment and systems. The licensee stated that since a balance of the elements is provided, DID is achieved.

Based on its review of the information submitted by the licensee, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the proposed PB method is an acceptable alternative to the corresponding NFPA 805, Section 3.3.8 requirement because it satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown capability).

3.1.4.7 NFPA 805, Section 3.3.1.2(1), Control of Combustible Materials

In LAR Attachment L, Approval Request 7, the licensee requested NRC staff approval of a PB method to demonstrate an equivalent level of fire protection for the NFPA 805, Section 3.3.1.2(1) requirement that wood used within the power block be listed pressure-impregnated or coated with a listed fire-retardant application. Specifically, the licensee requested approval to store/use wood that is not pressure-impregnated or coated with a listed fire-retardant application in designated fenced-in storage areas in Fire Area TB/NSB/ACA Room 1101 (12' North Storage Area) and Room 1109 (Warehouse).

The licensee stated that the areas listed below contain some quantity of wood that is not pressure-impregnated or coated with a listed fire-retardant application:

- Fire Area TB/NSB/ACA, Room 1101 (12' North Storage Area)
  - Fenced-in storage area between column DD/102.4 and GG/105.5 (approximately 5,500 ft^2).

- Fire Area TB/NSB/ACA, Room 1109 (Warehouse)
  - Fenced-in storage area between column DD/207.5 and GG/208.5 (approximately 1,900 ft^2).
  - Fenced-in storage area west of the freight elevator to column AA/207.5 (approximately 1,300 ft^2).

The licensee stated that Room 1101 and Room 1109 are miscellaneous storage areas, and that these rooms are part of the fire area TB/NSB/ACA which encompasses the 12' and 27/31' elevations of the North Service Building and all elevations of the Turbine Building. The licensee stated that the storage areas contain various types and quantities of combustible storage, including but not limited to rack storage (stored height does not exceed 12'), and that the limits on quantities of combustibles in these storage areas are administratively established by the fire protection engineer through its combustible control program. In FPE RAI 11.a (Reference 18), the NRC staff requested that the licensee (i) characterize the type, quantifies and use of wood and other combustible storage in Rooms 1101 and 1109 and its relative contribution to the combustible loading, and (ii) describe the specific limits and associated administrative controls on the amount of non-treated wood that can be stored in the storage areas.

In its response to FPE RAI 11.a.i (Reference 13), the licensee clarified that the storage in Rooms 1101 and 1109 consists of solid metal shelving (less than 12 feet high), metal single row open storage single and double row racks with less than 12 feet of storage located on the racks, and materials stored on the floor. The licensee further stated that the metal open storage racks are separated from each other by a minimum distance of 8 feet, and the areas contain ordinary combustibles and can be classified as Ordinary Hazard (Group 2) occupancies with Type II storage, as defined by NFPA 13, 1971 edition (code of record) (Reference 80). The licensee stated that the areas are not used as storage areas for wood; instead, wood is incidental to the storage areas. The wood in the areas consists of pallets, cable reels, shipment containers, and small hand tools, and that storage in the areas consists of plant supplies including both metal and plastic tools, equipment and supplies. The licensee stated that the commodities stored on the single and double row open storage racks and solid metal shelving can be primarily classified as Class I through Class IV commodities, and that there are minor amounts (10 or fewer distributed, non-adjacent pallets, as allowed by NFPA 13, 2013 edition) (Reference 80) of higher hazard commodities (Group A plastics). The licensee further stated that stacks of idle wood pallets are not stored in the area, and it is estimated that untreated wood does not exceed 20% of total fire loading of the storage.

In its response to FPE RAI 11.a.ii (Reference 13), the licensee described that administrative controls in these areas include procedural controls on transient combustibles and inspections of the area to ensure that the storage in the requested areas (including the wood in these areas) does not exceed the design capabilities of the sprinkler system protecting Rooms 1101 and 1109. The licensee further stated that LAR Attachment S, Table S-3, Implementation Item IMP-21 was created to ensure proceduralized inspections of the area will verify that the storage configurations will not exceed the design capability of the sprinkler system protecting Rooms 1101 and 1109 and that non-treated wood will not exceed 20% of the total fire loading of the storage. The NRC staff concludes that this action is acceptable because the action will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

The NRC staff concludes that the combustible loading in the storage areas in Rooms 1101 and 1109 is acceptable because the storage of wood that is not pressure-impregnated or

coated with a listed fire-retardant application in the storage areas does not exceed 20% of the total fire loading of the storage areas, is within the design capability of the automatic sprinkler system, and administrative controls will be developed through Implementation Item IMP-21 which would be required by the proposed license condition.

The licensee stated that the likelihood of a fire in these areas (described in LAR Attachment L, Approval Request 7) is expected to be minimal due to the limited number of fixed ignition sources in the rooms and the procedural controls on hot work and transient combustible material. In FPE RAI 11.b (Reference 18), the NRC staff requested a description of the types of fixed ignition sources in, or near the fenced-in storage areas, and the exposure fire hazards that could propagate to the fenced-in storage. In its response to FPE RAI 11b (Reference 13), the licensee stated that fixed ignition sources in, or near, the fenced-in storage areas consist of small wall-mounted transformers, forklift battery chargers, small wall-mounted panels, junction boxes, and electrical cables. The licensee further stated that the ignition sources are located such that there is no continuous path of fixed intervening combustibles present that could be expected to facilitate fire propagation from a fixed ignition source to potentially ignite the stored materials. The licensee stated that administrative controls ensure that adequate clearance, free of combustible material, is maintained around energized electrical equipment, and that existing processes ensure that administrative controls are being followed in these areas, and that this provides reasonable assurance that transient combustibles will not provide a pathway for potential fire spread from a fixed ignition source to the stored materials.

The licensee stated that in the event of a fire in the storage areas, wet pipe suppression is provided in the areas above the storage which has been reviewed for compliance with NFPA 13, "Standard for the Installation of Sprinkler Systems" (Reference 80). In FPE RAI 11.c (Reference 18), the NRC staff requested that the licensee provide a summary of the technical basis for concluding acceptability of the sprinkler design for the hazard expected in the storage areas. In its response to FPE RAI 11.c (Reference 13), the licensee described the design of the sprinkler system based on the code-of-record (i.e., NFPA 13, 1971). The licensee stated that as the code-of-record does not contain detailed commodity classification requirements or guidelines and due to the increased prevalence of plastic in modern products compared to 1971, the area/density requirements for the storage configuration were reviewed against the current (2013) edition of NFPA 13. The licensee stated that it was determined that the existing storage configuration resembles Class IV commodities and the sprinkler protection requirements are similar to those met by the installed sprinkler system. The licensee stated that the design of the sprinkler system is adequate for the hazards present as long as the following bases for acceptability are maintained:

i. The height of storage (measured from floor to top of commodity) does not exceed 12 feet.

ii. Commodities stored on racks and shelves can be classified as Class I, Class II, Class III, or Class IV commodities as defined in Section 5.6 of NFPA 13, 2013, with the exception that minor quantities of more severe commodities (e.g., Group A plastics) will be allowed as permitted by Section 5.3.1.2.3 of NFPA 13, 2013 (limited to 10 distributed and non-adjacent pallets).

iii. Current rack spacing is maintained (i.e., minimum of 8 foot spacing between storage racks).

iv. There are no stacks of idle wood pallets present.

The licensee further stated that the proceduralized inspections of the area will ensure that the aforementioned bases for the acceptability of storage in Rooms 1101 and 1109 are maintained and included the action to develop those administrative controls in LAR Attachment S, Table S-3, Implementation Item IMP-21. The licensee further stated that the bases for acceptability, listed above (storage height, acceptable commodities, rack spacing) may be revised consistent with the hazards/storage configuration allowed by NFPA 13 in the code-of-record in force at the time the upgraded system is designed/installed. The licensee stated that additionally, the procedural inspections of the area will ensure that the following conditions are maintained:

- Non-treated wood does not exceed 20% of the total fire loading of the areas.
- Adequate clearance, free of combustible material, is maintained around energized electrical equipment.
- There are neither fixed ignition sources in, or near, the fenced-in storage areas, nor exposure fire hazards that could propagate to the fenced-in storage and potentially ignite the stored materials.

The licensee stated that based on the administrative controls and storage practices in the subject areas, the sprinkler design is acceptable for the associated hazard and reasonable assurance is provided that a fire in the areas will not challenge the wet pipe sprinkler system. The licensee stated that additionally, the fire brigade will respond to a fire in this area and supplement the automatic suppression system with manual hose streams. Based on its response to FPE RAI 11.c, the NRC staff concludes that the licensee's response is acceptable because it provides the basis for ensuring that the sprinkler system installed in Rooms 1101 and 1109 are adequate for the hazards, and because LAR Attachment S, Table S-3, Implementation Item IMP-21 will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

The licensee stated that actuation of a water flow switch results in a fire alarm signal being transmitted to the continually-manned Control Room, and the Control Room operators will dispatch the onsite fire brigade to extinguish the fire. In FPE RAI 11.d (Reference 18), the NRC staff requested that the licensee provide information on the bases for not needing the installation of an automatic smoke detection system to provide early warning of a fire in the fenced-in storage areas, assuming the storage areas contain the maximum allowed quantity of non-treated wood and other combustibles and to describe the additional fire protection available to support DID. In its response to FPE RAI 11.d (Reference 13), the licensee stated that an automatic smoke detection system is not necessary in these areas because the automatic wet-pipe suppression system is equipped with a flow switch that alarms in the

continually –manned control room and that operators will dispatch the onsite fire brigade to commence manual firefighting operations. The licensee further stated that additional fire protection in the areas includes fixed hose stations and portable fire extinguishers and that these additional fire protection features support DID for Echelon 2. The licensee stated that additionally, although a full room burn of either Room 1101 or Room 1109 is not expected, a deterministic analysis for each of these rooms was completed and demonstrated that for a fire in Room 1101 or 1109 damaging all NSCA targets, the plant would be able to achieve a safe and stable condition with a NSCA success path free of fire damage, without recovery actions (RAs). Based on its response to FPE RAI 11.d, the NRC staff concludes that the licensee's basis for not providing an automatic detection system to protect the storage areas in Rooms 1101 and 1109 is acceptable because actuation of the flow switch alarm for the existing fire suppression system will also provide indication of a fire to the operators in the control room.

The licensee stated that there are cable trays located near the ceiling of each room, approximately 24 feet above the floor and 13 feet above the maximum height of storage, and that there is also a series of cable risers at column FF/102.4 in Room 1101. The licensee further stated that although a full room burn of either Room 1101 or Room 1109 is not expected, a deterministic analysis for each of these rooms was completed. The licensee stated that Room 1109 does not contain any NSCA targets, and that the deterministic analysis of Room 1101 concluded the following:

- Backup Control Room/Cable Spreading Room Ventilation and Cooling System is impacted; however, CR/CSR HVAC remains available from redundant systems.

- Offsite power is impacted; however, power remains available to credited 4kV buses from EDGs.

- Non-safety buses are impacted; however, power remains available to credited 4kV buses.

- Steam isolations downstream of the main steam isolation valves (MSIVs) are impacted for both units; however, the MSIVs remain available for both units to provide SG isolation.

The licensee stated that based on the above discussion, the deterministic analysis demonstrated that for a fire in Room 1101 or 1109 damaging all NSCA targets, the plant would be able to achieve a safe and stable condition with a NSCA success path free of fire damage. The licensee stated that due to the presence of automatic suppression and the CCNPP onsite fire brigade, the fire is not expected to spread to adjacent rooms. The licensee further stated that Fire Area TB/NSB/ACA is separated from other Fire Areas by fire barriers, and that administrative procedures prohibit wood within all other portions of power block structures at CCNPP. The licensee also stated that the storage of wood in the subject fenced-in areas of Room 1101 and 1109 will not result in a fire that will compromise the NSPC of NFPA 805.

The licensee stated that the storage of wood in the subject fenced-in portion of Room 1101 and 1109 has no impact on the radiological release performance criteria. The licensee further stated that the radiological release performance criteria are satisfied based on the determination of limiting radioactive release in LAR Attachment E, which is not affected by the storage of wood within the subject areas.

The licensee stated that the storage of wood to a height less than 12 feet in the subject fenced-in portions of Room 1101 and 1109 is within the design capabilities of the NFPA 13 wet pipe sprinkler system and a fire will not impact nuclear safety or radioactive release performance criteria; therefore, the safety margin inherent in the analysis for the fire event has been preserved.

The licensee stated that the three echelons of DID are: (1) to prevent fires from starting; (2) rapidly detect, control and extinguish fires that do occur, thereby limiting damage; and (3) provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed. The licensee stated that per NFPA 805 Section 1.2, DID is achieved when an adequate balance of each of these elements are provided.

In FPE RAI 11.e (Reference 18), the NRC staff requested that the licensee provide information on how the storage and use of untreated wood in Rooms 1101 and 1109 meets or has compensated for Element 1 of DID in NFPA 805 Section 1.2 relative to control of combustibles. In its response to FPE RAI 11.e (Reference 13), the licensee stated that Echelon 1 is met by the presence of hot work controls, the limited number of fixed ignition sources in or near the fenced-in areas, and administrative controls that ensure that the types and quantities of storage in the subject areas do not exceed the design capabilities of the installed suppression system.

The licensee stated that Echelon 2 is met by the installed automatic wet pipe sprinkler system and the on-site fire brigade. The licensee further stated as part of its response to FPE RAI 11.d, as described above, the flow switch alarms for the wet pipe sprinkler system will alarm in the continually manned control room and that control room operators will dispatch the onsite fire brigade to commence manual firefighting operations. The licensee further stated that additional fire protection features in the storage areas include fixed hose stations and portable fire extinguishers. Based on information provided by the licensee in its response to FPE RAI 11, the NRC staff concludes that the licensee's discussion of Echelon 1 and 2 of DID is acceptable because it described the additional administrative controls for the combustible materials in the storage areas, it has automatic fire suppression that is adequate for the hazard, and it identified the additional fire protection features for manual firefighting operations.

The licensee stated that Echelon 3 is met through the fire barriers separating Fire Area TB/NSB/ACA from adjacent fire areas as well as a success path remaining free of fire damage even if all cables located within each room are failed due to fire. The licensee stated that since a balance of the elements is provided, DID is achieved.

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

3.1.4.8 NFPA 805, Section 3.3.5.2, Electrical Raceways

In LAR Attachment L, Approval Request 8, the licensee requested NRC staff approval of a PB method to demonstrate an equivalent level of fire protection for the NFPA 805, Section 3.3.5.2 requirement that requires the use of only metal tray and metal conduits for electrical raceways, and prohibits the use of thin wall metallic tubing for power, instrumentation, or control cables. Specifically, the licensee requested approval to use non-metallic raceways (conduit) in concrete-embedded and underground applications and to use exposed electrical metallic tubing (EMT) to route cables in various locations throughout the plant.

Regarding approval of non-metallic Raceways (Conduit):

The licensee stated that the use of non-metallic conduit is required by plant drawings and specification for concrete-embedded and underground installations where metal raceways do not meet design requirements, and that these design applications are required where:

- corrosive conditions exist (water, chemicals, etc.) and metal conduits are subject to failure; and
- non-metallic conduit is not relied upon for grounding

The licensee stated that non-metallic conduits are required to be suitable for its intended use and that the new applications of non-metallic conduit are approved and evaluated in accordance with design procedures which include a review of FPP design requirements. The licensee further stated that non-metallic conduit designs rely on the concrete in which they are embedded and/or the ground in which they are buried to prevent:

- the failure of credited internal circuits due to an external fire; or
- the failure of credited external circuits due to an internal fire

The licensee stated that non-metallic conduits are not credited to be fire resistant in the NFPA 805 analysis, and that non-metallic conduits are combustible; however, due to the installed locations (underground, concrete-embedded) the combustible material associated with these conduits will not contribute to fire loading. In FPE RAI 12a (Reference 18), the NRC staff requested that the licensee provide a description of the acceptance criteria that allow the installation of non-metallic conduit and if design procedures include criteria that involve satisfying the nuclear safety and radiological release performance goals and maintaining safety margins and DID. In its response to FPE RAI 12a (Reference 13), the licensee provided the criteria for embedding non-metallic conduits in concrete or burying

non-metallic conduits underground. The licensee revised Approval Request 8 to remove the use of non-metallic raceways (conduits) in applications that are neither embedded in concrete nor buried underground.

Regarding approval of thin wall metallic tubing (EMT):

The licensee stated that Article 358.10(A) of NFPA 70, National Electric Code (NEC), 2014 Edition (Reference 81), permits the use of EMT for both exposed and concealed work, and that the Section 3.3.5.2 of NFPA 805 was revised for consistency with NFPA 70 to remove the sentence regarding thin wall metallic tubing. The licensee stated that this change has been retained by the current edition of NFPA 805 (2015) (Reference 82), with the revised section now being section 5.3.8.2 in the 2015 edition. In FPE RAI 12b (Reference 18), the NRC staff requested that the licensee provide justification for the use of an unendorsed edition of NFPA 805 (i.e., the 2015 edition) or any other unendorsed NFPA code (e.g., NFPA 70). The NRC staff also requested that the licensee describe installation details of EMT including protection from physical damage as required by NFPA 805, and also requested the licensee confirm that the fire damage and circuit failure assumptions for the circuits installed within EMT and non-EMT metallic conduit are the same or different. In its response to FPE RAI 12b (Reference 13), the licensee stated that EMT is made from steel and is therefore impact resistant (tough) due to high yield and tensile strengths, and that EMT provides a method of routing and supporting cables. The licensee further stated that EMT is non-combustible and is not installed in locations subject to severe physical damage, such as locations where routine load handlings with forklifts are allowed. The licensee stated that EMT, as well as rigid conduit, is used to route NSCA cables for power, control and instrumentation circuits, and that fire damage and circuit failure assumptions for non-EMT and EMT conduits are the same as other raceway types. The licensee stated that EMT is metallic and will provide an electrical ground path for circuit failures (e.g., an energized conduit could spuriously energize an NSCA circuit), and therefore, no credit is given for the EMT to prevent or delay fire damage and circuit failures. The NRC staff concludes that the licensee's response to FPE RAI 12b is acceptable because it conservatively does not credit the EMT to prevent or delay fire damage and circuit failures.

The licensee stated in its response to FPE RAI 12b, that the basis for this approval request is:

- EMT is non-combustible.
- EMT has been installed at CCNPP since its original construction, in accordance with plant specifications/drawings, which allow for the use of EMT.
- EMT has been installed at CCNPP under design and FPP procedures such that technical requirements are properly met for the intended use.

For non-metallic raceways, the licensee stated that the use of non-metallic conduit does not adversely affect nuclear safety since the materials in which the conduits are run (concrete and earth) effectively render the non-metallic conduit non-combustible, and that the new installations of non-metallic conduit are evaluated in accordance with design and FPP procedures. The licensee further stated that the use of non-metallic conduit in concrete-embedded and underground locations has no impact on the radioactive release

performance criteria in LAR Attachment E, and that the radioactive release review was performed based on the potential location of radiological concerns and is not dependent on the type of conduit material. The licensee stated that the use of non-metallic conduit in concrete-embedded and underground locations does not add additional radiological materials or challenge the integrity of plant boundaries.

For thin wall metallic tubing, the license stated that the use of EMT in the plant does not have an adverse effect on nuclear safety, and that EMT is noncombustible and will not contribute to fire load. The licensee further stated that neither non-EMT nor EMT metallic conduits are credited in NFPA 805 analyses to prevent or delay damage due to fire, and therefore, the use of EMT does not impact the NSPC. The licensee further stated that the use of EMT has no impact on the radioactive release performance criteria in LAR Attachment E, and that the radioactive release review was performed based on the potential location of radiological concerns and is not dependent on the construction of metallic conduits. The licensee further stated that the use of EMT does not add additional radiological materials or challenge the integrity of plant boundaries.

For non-metallic raceways (conduits), the licensee stated that the use of non-metallic conduit will not adversely impact the ability to meet the NFPA 805 nuclear safety or radioactive release performance criteria. The licensee further stated that while non-metallic conduit is combustible, it is embedded or buried in non-combustible materials. The licensee stated that the use of these materials has been defined by the limitations of the analytical methods used in the development of the Fire PRA; and therefore, the inherent safety margin and conservatisms in these methods remain unchanged.

For the thin wall metallic tubing, the licensee stated that the use of EMT will not adversely impact the ability to meet the NFPA 805 nuclear safety or radioactive release performance criteria. The licensee further stated that EMT is noncombustible due to its metallic construction and its use is allowed by the NEC; and therefore, the safety margin inherent in the analysis for the fire event has been preserved.

The licensee stated that the three echelons of DID are: (1) to prevent fires from starting; (2) to rapidly detect, control, and extinguish fires that do occur, thereby limiting damage, and; (3) to provide an adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed. The licensee further stated that per NFPA 805 (2001) Section 1.2, DID is achieved when an adequate balance of each of these elements is provided.

For non-metallic raceways, the licensee stated that Echelon 1 is met because the non-metallic conduit is installed in concrete-embedded and underground locations, and that a fire occurring in one of the cables will not spread to impact adjacent fire areas due to combustible non-metallic conduit because the conduits are embedded in, or buried under, noncombustible materials. The licensee stated that Echelon 2 is met because the areas adjacent to those containing non-metallic conduit are protected by manual fire suppression functions, such as portable extinguishers and hose reel stations that are available for manual firefighting activities by the site fire brigade, to assure that if a fire was to occur that damage from the fire

would be limited. The licensee stated that Echelon 3 is met because the use of non-metallic conduit does not result in compromising automatic fire suppression functions, manual fire suppression functions, or the ability to maintain a success path free of fire damage. The licensee stated that the use of non-metallic conduit in concrete-embedded or underground installations does not affect the balance of Echelons 1, 2, or 3 and fire protection DID is maintained.

For thin wall metallic tubing, the licensee stated that Echelon 1 is met by administrative hot work controls and transient combustible controls that are present in the areas where EMT is routed, and that the use of EMT is permitted by the NEC when installed in areas not subject to severe physical damage. The licensee further stated that the use of EMT will not result in additional cables being considered ignition sources. The licensee further stated that Echelon 2 is met in areas where EMT is used due to being protected by manual fire suppression functions, such as portable extinguishers and hose reel stations that are available for manual firefighting activities by the site fire brigade, to assure that if a fire was to occur that damage from the fire would be limited. The licensee further stated that Echelon 3 is met because the use of EMT does not result in compromising automatic fire suppression functions, manual fire suppression function, or the ability to maintain a success path free of fire damage. The licensee stated that, therefore, the use of EMT does not affect the balance of Echelons, 1, 2, or 3 and fire protection DID is maintained.

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

3.1.4.9 NFPA 805, Section 3.3.4, Insulation Materials

In LAR Attachment L, Approval Request 9, the licensee requested NRC staff approval of a PB method to demonstrate an equivalent level of fire protection for the NFPA 805, Section 3.3.4 requirement for use of radiation shielding materials that do not meet or have not been specifically tested to the standards for classification as "noncombustible" or "limited combustible."

Specifically, the licensee requested the following:

- Approval to allow the use of radiation shielding materials that have been classified as Class A materials in accordance with NFPA 101, "Life Safety Code" (Reference 49), and/or have passed NFPA 701, "Standard Methods of Fire Tests for Flame Propagation of Textiles and Films" (Reference 83).

- Approval to allow the use of a 32 foot long, 4 foot high, 1 inch thick, 5-percent borated high density polyethylene (HDPE) neutron shield along the north and west

railings of the spent fuel cask wash pit located in Room 530, "Spent Fuel Pool/Cask Handling Area."

The licensee stated that some radiation shielding materials in use in the plant, primarily for temporary purposes, have successfully passed fire tests using methods that measure flame spread or propagation of flame and the ability to self-extinguish when removed from flames. The licensee further stated that these test methods do not specifically confirm whether the material qualifies as a "noncombustible" or "limited combustible" material, as required by Section 3.3.4 of NFPA 805. The licensee stated that these materials are hypalon-coated Kevlar, fiberglass fabric impregnated with specially formulated silicone rubber, lead shielding covered with proprietary fire retardant heavy duty fabric, and a shield that contains a mix of silicone and proprietary radiation shielding materials. The licensee further stated that the materials are used, as necessary, for temporary radiation shielding in the Auxiliary Building, Turbine Building, and Containment Buildings.

The licensee stated that the limited combustible materials will contribute a minor amount to the fire (i.e. up to 3500 BTU/lb); however, the materials have low flame propagation properties or do not exhibit self-sustained combustion and are not expected to be significant contributors to fire growth. The licensee further stated that the materials either meet NFPA 101, Class A, and/or have passed the NFPA 701 test, and that these materials meet the testing standards that are required by NFPA 805 for interior finish and/or plastic sheeting [i.e., NFPA 805 Sections 3.3.1.2(2) and 3.3.3]. The licensee further stated that in many instances, the combustible portion of the radiation shielding is similar to plastic sheeting (e.g., heavy duty fabric with lead core), and that radiation shielding is no more prevalent in the plant than plastic sheeting. The licensee stated that this request is to allow use of radiation shielding materials that are classified as Class A per NFPA 101, and/or have passed the NFPA 701 test standard, and that administrative procedures ensure that the future use of radiation shielding materials will either comply with the requirements of NFPA 805 Section 3.3.4 or will meet the criteria for acceptability described in this approval request.

The licensee stated that high density polyethylene (HDPE) radiation shielding is utilized at CCNPP to attenuate neutrons during independent spent fuel storage installation (ISFSI) activities, and that due to as low as reasonably achievable (ALARA) concerns, the shielding remains in place as a permanent installation. The licensee further stated that use of water for neutron attenuation is a noncombustible alternative to the borated HDPE shielding; however, to obtain similar boron attenuation properties, extremely large quantities of water would be required. The licensee further stated that future installation and use of radiation shielding is governed by administrative procedures to ensure compliance with the requirements of Section 3.3.4 of NFPA 805, except as requested in this approval request. The licensee stated that Room 530, "Spent Fuel Pool/Cask Handling Area," is part of Fire Area 11, "Auxiliary Building (All Elevations) General and Miscellaneous Areas," and is located on the 69 foot elevation of the Auxiliary Building, and that this room is a large open area surrounding the upper level of the spent fuel pools with a ceiling height of approximately 50 feet.

The licensee stated that although HDPE insulation is expected to contribute to a fire if subjected to an unmitigated exposure fire, this scenario is unlikely to occur based on several factors:

- The likelihood of a fire involving the HDPE is minimal as there are no fixed ignition sources located within 20 feet of the material, except for the Unit 1 new fuel elevator drive assemblies, which are located approximately 7 feet from the shielding; however, this is not considered a credible fixed ignition source because the equipment is infrequently operated and is continually-manned when in operation.

- The likelihood of a fire involving transient combustible/ignition sources is minimized due to administrative controls on ignition sources, hot work, and transient combustibles throughout the plant.

- The 1-inch thick, high density boards are expected to behave as a thermally-thick material and a significant exposure fire is therefore necessary to ignite the material.

- There are no fixed intervening combustibles located adjacent to the HDPE shielding.

- There are smoke and flame detectors located directly above the HDPE shielding that will provide early warning of an exposure fire in the vicinity of the HDPE. The fire is expected to be detected prior to significant involvement of the HDPE board materials.

- The smoke and flame detectors will initiate an alarm signal in the continually-manned control room. CCNPP maintains an on-site fire brigade which will be dispatched to quickly extinguish any fire that could occur. There is significant open floor space around the HDPE and spent fuel cask wash pit that provide excellent fire brigade access. Fire hose stations and extinguishers are provided in the vicinity of the cask washing pit.

The licensee stated that in the unlikely event of an uncontrolled fire involving the radiation shielding materials, the fire is not expected to spread to adjacent rooms due to the lack of intervening combustibles in the vicinity of the radiation shielding materials. The licensee further stated that a hot gas layer is not expected to form due to the very large volume of the room, which has a ceiling height of approximately 50 feet and that the control room will be notified of flame and/or smoke detector activation in this area which will facilitate a rapid emergency response.

NFPA 805 Section 3.3.1.2(2) requires that plastic sheeting materials used in the power block be fire-retardant types that have passed NFPA 701, large-scale tests or equivalent, and NFPA 805 Section 3.3.3 requires that interior wall or ceiling finish classification be in accordance with NFPA 101 for Class A materials. The licensee stated that the limited use of

radiation shielding materials that meet the above described standards meet the level of fire safety intended by NFPA 805, and therefore, there is no adverse impact to the NSPC.

The licensee stated that the presence of radiation shielding, which is not noncombustible or limited combustible, but has passed NFPA 701 or is classified as Class A, has no impact on the radiological release performance criteria. The licensee further stated that the radiological release performance criteria are satisfied based on the determination of limiting radioactive release in LAR Attachment E, which is not affected by the shielding that does not comply with the requirements specified in Section 3.3.4 of NFPA 805.

The licensee stated that there are no credible fixed ignition sources located in the area of the HDPE shielding and transient ignition sources are controlled by administrative procedures. The licensee further stated that in the unlikely event of a fire involving the thermally-thick HDPE, the fire will not spread to adjacent rooms due to the lack of intervening combustibles and the presence of automatic flame and smoke detection in the area of the shielding. The licensee stated that Room 530, which is the room that contains the HDPE shielding, is part of Fire Area 11. The licensee stated that Fire Area 11 was evaluated in accordance with NFPA 805, Section 4.2.4, PB approach FRE with simplifying deterministic assumptions, and the risk was determined to be acceptable. The licensee clarified that fire modeling was not performed in the room and the NSCA assumed whole room damage, which bounds all potential fire scenarios involving the HDPE shielding, and that therefore, there is no impact on the NSPC.

The licensee stated that the HDPE shielding has no impact on the radiological release performance criteria, and that the radiological performance criteria are satisfied based on the determination of limiting radioactive release in LAR Attachment E, which is not affected by the HDPE shielding.

The licensee stated that the three echelons of DID are: (1) to prevent fires from starting; (2) to rapidly detect, control, and extinguish fires that do occur, thereby limiting damage, and; (3) to provide an adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed. The licensee further stated that per NFPA 805 Section 1.2, DID is achieved when an adequate balance of each of these elements is provided.

The licensee stated that radioactive shielding materials that are Class A per NFPA 101 and/or pass NFPA 701 are not considered ignition sources, and that Echelon 1 is achieved by controls on ignition sources, hot work and combustibles throughout the plant. The licensee further clarified that because the radiation shielding meets the fire tests required by NFPA 101 and NFPA 701, it provides reasonable assurance that the materials will neither be easily ignited, nor facilitate significant flame spread when subjected to an exposure fire. The licensee stated that Echelon 2 is achieved by the presence of automatic detection and suppression systems located in areas of the plant where fire risk, fire hazards, or regulatory commitments require their installations. The licensee further stated that the materials have low flame propagation properties or do not exhibit self-sustaining combustion and are within the design capabilities of the fire protection systems in the plant. The licensee stated that

these detection systems alarm in the continually-manned control room and will ensure rapid detection of a fire, should one occur, and that the manual fire brigade will respond to a fire in all plant areas. The licensee further stated that the presence of radiation shielding materials does not impact Echelon 2. The licensee stated that Echelon 3 is achieved by the presence of fire rated barriers between fire areas throughout the plants, and that administrative procedures ensure that fire area separation be maintained. The licensee further stated that the NSCA and Fire PRA are not impacted by the presence of radiation shielding materials as described in this request, and that since a balance of the elements is provided, DID is achieved.

The licensee stated that the HDPE shielding is not an ignition source, and it is thermally-thick and will not easily ignite unless subjected to a significant exposure fire, and therefore, the presence of the HDPE shielding has minimal impact on Echelon 1. The licensee further stated that Echelon 1 is achieved through the lack of fixed ignition sources in the vicinity of the HDPE shielding and administrative controls on ignition sources, hot work, and combustibles. The licensee stated that Echelon 2 is achieved by the presence of automatic smoke and flame detection systems in the area of the HDPE shielding, and that these detection systems alarm in the continually-manned control room and will ensure rapid detection of a fire, should one occur, and rapid response by the fire brigade, who will initiate suppression activities. The licensee stated that Echelon 3 is achieved by the presence of fire rated barriers between fire areas and the risk of VFDRs in Fire Area 11 determined acceptable in accordance with NFPA 805, Section 4.2.4.2. The licensee stated that since a balance of the elements is provided, DID is achieved.

Based on the NRC staff's review of the information submitted by the licensee in its response to FPE RAI 01.01, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the proposed PB method is an acceptable alternative to the corresponding NFPA 805, Section 3.3.5.2 requirement because it satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown capability).

3.2 Nuclear Safety Capability Assessment (NSCA) Methods

NFPA 805 (Reference 3) is a RI/PB standard that allows engineering analyses to be used to show that FPP features and systems provide sufficient capability to meet the requirements of 10 CFR 50.48(c).

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

> Engineering analysis is an acceptable means of evaluating a fire protection program against performance criteria. Engineering analyses shall be permitted to be qualitative or quantitative... The effectiveness of the fire protection features shall be evaluated in relation to their ability to detect, control, suppress, and extinguish a fire and provide passive protection to achieve the

performance criteria and not exceed the damage threshold defined in Section [2.5] for the plant area being analyzed.

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

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

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

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

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

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

> Fire protection features shall be capable of providing reasonable assurance that, in the event of a fire, the plant is not placed in an unrecoverable condition. To demonstrate this, the following performance criteria shall be met.
>
> (a) *Reactivity Control.* Reactivity control shall be capable of inserting negative reactivity to achieve and maintain subcritical conditions. Negative reactivity inserting shall occur rapidly enough such that fuel design limits are not exceeded.
>
> (b) *Inventory and Pressure Control.* With fuel in the reactor vessel, head on and tensioned, inventory and pressure control shall be capable of controlling coolant level such that subcooling is maintained for a PWR [pressurized water reactor] and shall be capable of maintaining or rapidly restoring reactor water level above top of active fuel for a BWR [boiling water reactor] such that fuel clad damage as a result of a fire is prevented.

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

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

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

3.2.1 Compliance with NFPA 805 Nuclear Safety Capability Assessment Methods

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

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

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

Regulatory Guide 1.205, Revision 1 (Reference 4), endorses NEI 04-02, Revision 2 (Reference 7), and Chapter 3 of NEI 00-01, Revision 2, (Reference 28), and promulgates the method outlined in NEI 04-02 for conducting a nuclear safety capability assessment. This NRC-endorsed guidance (i.e., NEI 04-02 Table B-2, "NFPA 805 Chapter 2 – Nuclear Safety Transition – Methodology Review" and NEI 00-01, Chapter 3) has been determined to address the related requirements of NFPA 805, Section 2.4.2. The NRC staff reviewed LAR Section 4.2.1, "Nuclear Safety Capability Assessment Methodology," and Attachment B, "NEI 04-02 Table B-2 Nuclear Safety Capability Assessment Methodology Review," against these guidelines.

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

- Selecting systems and components required to meet the NSPC
- Selecting the cables necessary to achieve the NSPC
- Identifying the location of nuclear safety equipment and cables
- Appropriately conservative assumptions to be used in the performance of the nuclear safety capability assessment

The licensee developed the LAR based on the three guidance documents cited above. Based on the information provided in the licensee's submittal, as supplemented, the NRC staff concludes that a systematic process to evaluate the post-fire safe shutdown analysis against the requirements of NFPA 805, Section 2.4.2, Subsections (1), (2), and (3), was used, which meets the methodology outlined in the latest NRC-endorsed industry guidance.

FAQ 07-0039 (Reference 56), provides one acceptable method for documenting the comparison of the safe shutdown analysis against the NFPA 805 requirements. This method first maps the existing safe shutdown analysis to the NEI 00-01, Chapter 3 methodology, which in turn, is mapped to the NFPA 805 Section 2.4.2 requirements.

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

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

1. The safe shutdown analysis directly aligns with the attribute: noted in LAR Table B-2 as "Aligns."
2. The safe shutdown analysis aligns with the intent of the attribute: noted in LAR Table B-2 as "Aligns with Intent."

Finally, some attributes may not be applicable to the safe shutdown analysis (for example, the attribute may be applicable only to BWRs or PWRs). These are noted in the B-2 Table as "Not Required."

The NRC staff has determined that, taken together, these methods compose an acceptable approach for documenting compliance with the NFPA 805, Section 2.4.2 "Nuclear Safety Capability Assessment," requirements, because the licensee has followed the alignment

strategies identified in the endorsed NEI 04-02 guidance document. The process defined in the endorsed guidance provides an organized structure to document each attribute in NEI 00-01, Chapter 3, allowing the licensee to provide significant detail as to how the program meets the requirements. In addition to the basic strategy of "Aligns," which itself makes the attribute both auditable and inspectable, additional strategies have been provided allowing for amplification of information, when necessary, regarding how or why the attribute is acceptable.

3.2.1.1 Attribute Alignment – Aligns

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

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

- 3.2.1.2
- 3.3.1.1.4
- 3.5.1.3

Attribute 3.2.1.2 includes the assumption that exposure fire damage to manual valves and piping does not adversely impact their ability to perform their pressure boundary or safe shutdown function. The guidance continues to state that any post-fire operation of a rising stem valve should be well justified using an engineering evaluation. In LAR Attachment B, the licensee stated in the alignment basis that manual valves that are repositioned for credited NFPA 805 RAs are included in the NFPA 805 NSPC equipment list, and are subject to assessment of feasibility. In SSA RAI 01 (Reference 16), the NRC staff requested the licensee to clarify if any rising stem valves involved in a recovery action (RA) are subject to fire damage, and to clarify if an engineering evaluation was performed to evaluate the exposure fire damage to manual valves and piping to determine if the exposure to fire would adversely impact their ability to perform their pressure boundary or safe shutdown functions. In its response to SSA RAI 01 (Reference 9), the licensee stated that all RAs as documented in LAR Attachment G were reviewed, and that there are no RAs that credit the manipulation of rising stem valves that have been exposed to the effects of fire. The licensee further stated that an engineering evaluation is not required as there are no RAs that require the manipulation of a rising stem valve that has been exposed to fire. Based on the licensee's response to SSA RAI 01, the NRC staff concludes that the methods, as described by the licensee, are acceptable because the licensee has determined there are no actions required to operate rising stem valves exposed to fire damage.

In the alignment basis for Attribute 3.2.1.2, the licensee stated that instrument air tubing includes copper tubing with soldered joints which are susceptible to separation during a fire and could cause the loss of instrument air to components, and that these effects were evaluated on an area basis to determine if the instrument air system pressure could be

maintained. The licensee further stated that its calculation demonstrates that the instrument air system can maintain system pressure with a 1-inch line pipe rupture. In SSA RAI 15a and SSA RAI 15b (Reference 16), the NRC requested justification, based on review of the licensee's calculations, that maintaining a system pressure of 50 psig with a maximum 1-inch line pipe rupture will prevent instrument air operated valves from changing position. In addition, the NRC staff requested the licensee to provide justification for limiting the size of the soldered joints that could separate during a fire to 1-inch, and to describe how soldered joints larger that 1-inch were treated in the NSCA and fire PRA.

In its response to SSA RAI 15a and SSA RAI 15b (Reference 11), the licensee stated that its design calculation concluded that a system pressure as low as 50 psig is acceptable to maintain system operability in support of fire safe shutdown and that valves may change position at this pressure, but all credited valves can only change to the desired NSCA position. The licensee further stated that credit is not taken for the loss of instrument air pressure to place credited valves in the required NSCA position. The licensee stated that soldered joints are only used at endpoint/load connections within the instrument air system and that there are no soldered joints equal to or larger than 1-inch in the system. The licensee further stated that any joints in the system of this size are pipe fittings, and that the parts of the system that could fail are the "soft" components connecting the instrument air distribution system to their loads. The licensee stated that each load that could be fire affected for a given fire area was reviewed and that the cumulative impact of these failures was evaluated to determine if the system would blowdown due to the rupture being greater than the makeup capacity of the operable air compressors. The licensee further stated that this analysis was done on a deterministic basis and in each case where system blowdown could occur, it was identified with a variance from deterministic requirements (VFDR). The NRC staff concludes that the licensee's response to SSA RAI 15a and SSA RAI 15b is acceptable because the methods used to evaluate exposure fire damage to the instrument air lines and soldered joints aligns with the NEI 00-01 attribute.

Attribute 3.3.1.1.4 includes criteria/assumptions for identifying cables supplying power to each safe shutdown and/or required interlock component as required for safe shutdown, including power cables for breaker coordination concerns and non-safe shutdown cables off of the safe shutdown buses. In LAR Attachment B, the licensee stated in the alignment bases that the NSCA circuit identification and analysis should utilize a "building block" approach and that the boundary for NSCA circuit identification and analysis (for each NSCA component) includes only, as applicable, the power cable from the NSCA component to the upstream electrical power source. The licensee also stated that plant modifications identified to achieve selective coordination of breakers/fuses have been identified in LAR Attachment S. In SSA RAI 02 (Reference 16), the NRC staff requested that the licensee clarify if cables that supply loads not required to meet the NSPC off of the nuclear safety buses are classified as "required" cables, and if non-nuclear safety cables are not included, then to provide the justification for not considering the failure of the non-nuclear safety cables in meeting the breaker coordination criteria for protection. The NRC staff also requested that the licensee identify the specific modifications that are required to achieve the selective coordination of breakers/fuses.

In its response to SSA RAI 02 (Reference 10), the licensee stated that in LAR Attachment B, Table B-2, Attribute 3.3.1.1.4, the term "building block" has been removed and explained using logic relations between components and cables in its NSCA database. The licensee further stated that cables that supply loads that are not required to meet NSPC, are required to meet breaker coordination criteria protection, and that power cables and their associated power supplies were analyzed for common power and common enclosure requirements. The licensee stated that common power requirements were considered for power supplies supplying loads required to meet NSPC. The licensee further stated that common enclosure requirements were considered for all electrical power supplies supplying loads in the power block by evaluating the adequacy of overcurrent protection for power cables. The licensee stated that the modifications required to achieve coordination and protection, specifically common enclosure requirements for protection of power cables or transformers, are listed in LAR Attachment S, Table S-2, Modification Items 14, 15, and 18. In its letter dated April 22, 2016 (Reference 15), the licensee indicated that Modification Item 18 is complete. The licensee provided revised pages to LAR Attachment B and LAR Attachment S, to incorporate its response to SSA RAI 02. Based on the licensee's response to SSA RAI 02, the NRC staff concludes that the methods and modifications, as described by the licensee and provided in the revised pages to the LAR, are acceptable because the methods identify power cables (safe shutdown and non-safe shutdown) for breaker coordination concerns and plant modifications, which meets the endorsed guidance of NEI 00-01 Revision 2.

Attribute 3.5.1.3 includes an assumption that circuit contacts are initially positioned (i.e., open or closed) consistent with the normal mode/position of the safe shutdown equipment, and that the analyst must consider the position of the safe shutdown equipment for each specific shutdown scenario when determining the impact that fire damage to a particular circuit may have on the operation of the equipment. In LAR Attachment B, the licensee stated in the alignment basis that the circuit analysis may discount spurious operation based on a fire affected cable being routed in a dedicated conduit, and therefore being protected from external sources of voltage (also taking into consideration the potential impact from ground equivalent hot shorts). In SSA RAI 03 (Reference 16), the NRC staff requested that for multi-conductor cables routed in dedicated conduit, the licensee describe if intra-cable hot shorts (wire-to-wire shorts) are considered as a potential impact of fire damage on required position of the NSCA equipment (i.e., the function of the initial position of circuit contacts are not affected by intra-cable hot shorts). In its response to SSA RAI 03 (Reference 10), the licensee stated that intra-cable hot shorts (wire-to-wire shorts) were considered as potential fire impacts for circuits without regard to a cable's pathway (whether through a conduit, raceway, wireway, or tray). Based on the licensee's response to SSA RAI 03, the NRC staff concludes that the methods as described by the licensee are acceptable because intra-cable hot shorts are considered as potential fire impacts on the initial position of required NSCA equipment, which meets the endorsed guidance of NEI 00-01 Revision 2.

3.2.1.2 Attribute Alignment – Aligns with Intent

In three (3) of the NEI 00-01, Chapter 3, attributes, the licensee determined that the safe shutdown analysis aligns with the intent of the attribute, and provided additional clarification

when describing its means of alignment. The attributes identified in LAR Attachment B, Table B-2 as having this condition are as follows:

- 3.2.2.1
- 3.4.1.4
- 3.4.1.6

Attribute 3.2.2.1 – Identify the System Flow Path for Each Shutdown Path: This attribute provides guidance for identifying and documenting the credited safe shutdown path and developing an equipment list that can readily be related to required post-fire safe shutdown systems and functions for that safe shutdown path. The licensee stated that the overall process utilized to identify the combinations of plant components for each plant system as being required to satisfy each of the NSPC described in Section 1.5.1 of NFPA 805 involved a review of the piping and instrumentation drawings (P&IDs), electrical drawings, instrument loop diagrams, etc. to identify the NSCA systems, and to identify and develop the NSCA system-to-equipment logic relationships (i.e., Boolean logic/success paths) and the NSCA component-to-component logic success path relationships (i.e., success paths). The NRC staff concludes that the methods, as described by the licensee, are acceptable and meet the intent of the guidance in NEI 00-01 because combinations of shutdown components and systems were evaluated using safe shutdown logics to identify the safe shutdown success path(s) for each fire area.

Attribute 3.4.1.4 – Criteria/Assumption: The guidance in this attribute addresses the classification of each impacted cable/component as either a required or important to safe shutdown cable/component. The licensee stated that the NFPA 805 NSPC equipment list identifies the required hot shutdown / hot standby position for each component and any component on the equipment list that has a listed position for hot shutdown / hot standby is defined to be “Required for Hot Shutdown.” The licensee further stated that cables that are required for the proper operation of such components are also understood to be "Required for Hot Shutdown." The licensee further stated that it conservatively treated all plant equipment required to achieve and maintain safe and stable plant conditions as "Required for Hot Shutdown." The NRC staff concludes that the methods, as described by the licensee are acceptable and meet the intent of the guidance because the licensee treats all plant equipment required to achieve and maintain safe and stable plant conditions as "Required for Hot Shutdown," which is sufficiently similar to the specific methods in NEI 00-01.

Attribute 3.4.1.6 – Criteria/Assumption: The guidance in this attribute is to use repairs to equipment, where appropriate, to achieve and maintain cold shutdown within 72 hours. The licensee stated that the NFPA 805 NSPC requires the licensee to demonstrate that the plant can achieve and maintain “safe and stable” conditions, but it does not explicitly require the licensee to demonstrate that cold shutdown can be achieved within 72 hours and maintained indefinitely thereafter. The licensee further stated that NFPA 805 NSPC analysis defined “safe and stable” condition as being able to achieve and maintain Hot Standby until such time as the plant can either transition to Cold Shutdown, or can safely return to power operation. The licensee stated that the nuclear safety goals, objectives and performance criteria of NFPA 805 are different than the previous deterministic regulations and guidance documented in 10 CFR 50 Appendix R; NUREG-0800, Section 9.5-1; and NEI 00-01, Revision 2. NFPA 805 requires the licensee to maintain the reactor fuel in a “safe and stable” condition rather than to

achieve and maintain cold shutdown. The NRC staff concludes that the methods, as described by the licensee, are acceptable and meet the intent of the guidance because the licensee evaluates the ability to achieve and maintain safe and stable conditions as required by the NSPC described in NFPA 805 Section 1.5.

3.2.1.3 NFPA 805 Nuclear Safety Capability Assessment Methods Conclusion

The NRC staff reviewed the documentation provided by the licensee describing the process used to perform the nuclear safety capability assessment required by NFPA 805, Section 2.4.2. The licensee performed this evaluation by comparing the safe shutdown analysis against the NFPA 805 nuclear safety capability assessment requirements using the NRC endorsed process in Chapter 3 of NEI 00-01, Revision 2. The results of the review are documented in LAR Attachment B, Table B-2, in accordance with NEI 04-02, Revision 2.

Based on the information provided in the licensee's submittal, as supplemented, the NRC staff accepts the method the licensee used to perform the nuclear safety capability assessment 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 with adequate justification.

3.2.2 Maintaining Fuel in a Safe and Stable Condition

The nuclear safety goals, objectives and performance criteria of NFPA 805 allow more flexibility than the previous deterministic FPPs based on Appendix R to 10 CFR 50 and NUREG-0800, Section 9.5.1.1 (Reference 84), since NFPA 805 only requires the licensee to maintain the fuel in a safe and stable condition rather than achieve and maintain cold shutdown in 72 hours. In LAR Section 4.2.1.2, the licensee stated that the NFPA 805 licensing basis is that the plant can achieve and maintain the reactor fuel in a safe and stable condition assuming that a fire event occurs during Mode 1 (Power Operation), Mode 2 (Startup), Mode 3 (Hot Standby), and Mode 4 (Hot Shutdown), when the motor control center breakers for the shutdown cooling header return isolation valves are open. The licensee further stated that the systems and components credited with supporting "safe and stable" plant conditions by compartment (fire area) are included in LAR Attachment C.

The licensee stated that the NSCA will demonstrate that it can achieve and maintain safe and stable conditions for at least 12 hours with the minimum shift operating staff before having to take action to align backup makeup water to the auxiliary feedwater (AFW) system, and that this initial 12 hours provides sufficient time for the emergency response organization (ERO) to respond and be available to support "safe and stable" actions to extend hot standby conditions.

The licensee stated that the minimum 12 hour coping duration is supported by the TSs required inventory in CST 12 assuming the necessary flow rate to provide reactor coolant system (RCS) decay heat removal for both Unit 1 and Unit 2. The licensee further stated that CST 12 is required per TS to contain a minimum volume of 150,000 gallons per Unit. The licensee stated that actions required to sustain Mode 3 (Hot Standby) beyond 12 hours include actions to align CST 11 for Unit 1 and CST 21 for Unit 2, and that aligning CST 11 and CST 21 requires an operator to open manual valves located in the Tank Farm. The licensee further stated that, if available, the demineralized water transfer pumps can be used to provide additional makeup volume to CST 12 from Demineralized Water Storage Tank 11, thereby extending the minimum time until CST 11 and CST 21 are required.

The licensee stated the following are methods to maintain the "safe and stable" condition and related support actions and extend hot standby conditions:

1. CCNPP has design features and procedures to ensure that an adequate source of inventory is provided for decay heat removal in sustained Mode 3 (Hot Standby) conditions. If the CST 12 inventory is depleted, the AFW system for each unit can be aligned to appropriate backup tank, CST 11 or CST 21. Transfer to the backup tanks requires local manual action. If available the demineralized water transfer pumps can be used to provide additional makeup volume to CST 12.

2. RCS pressure control is maintained by a combination of SG safety valves (RCS contraction) and securing of unnecessary pressurizer heaters.

3. Core decay heat in Mode 3 (Hot Standby) will be rejected to the secondary plant through one or both of the SGs, and then to atmosphere through the SG (steam generator) safety valves.

4. The CCNPP reactor core design ensures that k_{eff} is maintained <0.99 while the plant is in sustained Mode 3 (Hot Standby). Gravity insertion of the control rods into the reactor core will ensure reactivity control is achieved for Mode 3 (Hot Standby). The addition of borated water to the RCS is not necessary to maintain adequate shutdown margin for the duration of NFPA 805 safe and stable plant conditions.

5. Inventory makeup to the RCS may only be required to account for expected RCS leakage and minimal RCS shrinkage. CCNPP has design features and procedures to ensure that an adequate source of borated inventory is provided for RCS inventory control in sustained Mode 3 (Hot Standby). Inventory makeup is provided to maintain pressurizer level by the charging system. Makeup to the RCS is provided from either the refueling water tank or boric acid storage tanks via the RCS cold legs.

6. CCNPP has design features and procedures to ensure that adequate RCS pressure control is maintained in sustained Mode 3 (Hot Standby). Pressurizer

heater operation is not required, but may be utilized as desired by operator, when available. At least one bank of backup pressurizer heaters are capable of being energized from emergency diesel generator (EDG) power, but may require local manual operator action to re-shut the supply breaker in the event of a load shed or safety injection actuation signal.

7. Each of the EDGs is provided with a fuel oil day tank and a fuel oil transfer pump. The level in the fuel oil day tanks is controlled by level switches which automatically operate the respective fuel oil transfer pump to maintain level in the fuel oil day tanks. The fuel oil day tanks' capacities are capable of providing 1 hour of EDG operation if the transfer pump was inoperable. EDG 1A is provided with a dedicated FOST. The EDG 1A FOST has a Technical Specification quantity of 49,500 gallons of fuel oil that allows for 7 days of continuous operation at accident loading. EDG 1B and EDG 2B are normally aligned to FOST 21. EDG 2A will be normally aligned to FOST 21 pending the completion of LAR Attachment S, Table S-3, Implementation Item IMP-16. In its letter dated April 22, 2016 (Reference 15), the licensee indicated that it completed IMP-16. FOST 21 has a Technical Specification quantity of 85,000 gallons of fuel oil for the EDGs. The fuel oil volume in FOST 21 was established based on 7 days of EDG operation with one EDG at accident loading and one EDG at non-accident loading. The onsite fuel oil capacity is sufficient to operate the EDGs for longer than the time to replenish the onsite supply from outside sources.

8. Battery chargers are credited with maintaining DC (direct-current) station batteries at rated voltage. Should AC (alternating-current) charging sources be lost, local manual operator action may be required. Station batteries are capable of providing a minimum of 4 hours of 125 VDC (volt direct-current) power to their respective loads during a station blackout without AC charging sources. This time allowance credits securing 1INV1T11 in the cable spreading room within 45 minutes. In SSA RAI 04a (Reference 16), the NRC staff requested that the licensee clarify if this local manual action is credited as a RA in any fire area. In its response to SSA RAI 04a (Reference 10), the licensee stated that securing 1INV1T11 to load shed the battery has not been credited as a RA in any fire area, and that the alternating current (AC) power is required to support other functions to achieve safe and stable conditions and is restored to the charger before the battery is discharged. The NRC staff concludes that the licensee's response to SSA RAI 04a is acceptable because it clarified that this local action is not a RA required in the NSCA to maintain safe and stable conditions and the risk of the RA does not need to be evaluated as required by NFPA 805 Section 4.2.4.

9. Instrument air supports safety related equipment required to achieve a safe and stable condition. On loss of instrument air, AFW air accumulators provide a redundant source of safety related air to the AFW system for a minimum of 2 hours. The AFW air can also be supplied with manual alignment to either the

nitrogen system or salt water air compressors (SWAC). The SWACs also provide a backup source of motive air to designated safety related components outside of the AFW system. The NSCA and LAR Attachment B provide a discussion of the assessment for the post-fire pressure boundary integrity of the instrument air system with respect to loss of pressure boundary integrity resulting from fire damage to fire sensitive instrument air end loads.

10. The saltwater strainers flush automatically at regular intervals or on a high differential pressure without disruption to the straining process. A local control station is provided for strainer control, indication and annunciation. The saltwater system provides cooling for the service water and component cooling water systems.

In LAR Section 4.2.1.2, the licensee stated that operations personnel and/or the fire brigade will respond to fire events within the protected area boundary in accordance with the guidance of CCNPP procedures and stated that if the fire meets the criteria of the emergency response plan, then an emergency would be declared and classified based on the severity. The licensee further stated that in the event of an "Alert" declaration or higher, the CCNPP ERO will be initiated and the first line of control of any emergency at CCNPP lies with the normal shift personnel on duty at such time as an emergency situation should occur. The licensee further stated that assistance is available within one hour from other plant staff and operating personnel to assist with implementation of the longer term actions necessary to maintain the fuel in a "safe and stable" configuration. The licensee further stated that following stabilization at Mode 3 (Hot Standby), assessment and repair activities would commence to restore plant equipment needed to support RCS cool down in a safe and controlled manner, and that ERO resources will be available to assist operations in fire damage assessment and restoration of multiple success paths:

- The actions required to maintain "safe and stable" conditions are limited.
- Procedures are in place for the "safe and stable" actions identified above.
- The 12 hour coping period provides reasonable assurance that adequate time is provided for the ERO to be available to augment the minimum plant staffing to support the longer term "safe and stable" actions.

The licensee stated that for the most limiting fire scenarios, the anticipated end state is an RCS temperature maintained within the Mode 3 (Hot Standby) band, with a long term strategy for reactivity, decay heat removal, and inventory control. The licensee further stated that long term subcooled natural circulation decay heat removal is provided by supplying AFW flow from CST 12 to the SGs and steaming to atmosphere. The licensee stated that the extended coping period at these conditions is based on the significant volume of water available for decay heat removal and reduced need for primary make up to match the RCS system losses.

The licensee stated that the ERO provides sufficient resources for assessment of fire damage and completion of repairs to equipment necessary to maintain hot standby for an extended

period, transition to cold shutdown, or return to power operations as dictated by the plant fire event, and that the risk impact of the failure of actions to sustain safe and stable plant conditions beyond 12 hours is deemed to be very low since the requisite inventory and manpower for maintaining systems operable is not time critical. In SSA RAI 04b (Reference 16), the NRC staff requested the licensee to describe, if any, repair activities that are necessary to maintain hot standby for an extended period (safe and stable conditions), including a detailed description of the specific repairs that would be needed, the success path(s) being restored and the time frame required to complete the repair. In its response to SSA RAI 04b (Reference 10), the licensee stated that no repair activities are necessary to maintain hot standby for an extended period (safe and stable conditions), and that LAR Section 4.2.1.2 subsection "Methods to Maintain 'Safe and Stable' and Extend Hot Standby Conditions" identifies those systems which are required to maintain hot standby for an extended period. The licensee further stated that post fire assessments would include evaluation of impacted equipment and compensatory measures to restore needed plant equipment to support RCS cool down in a safe and controlled manner. The NRC staff concludes that the licensee's response to SSA RAI 04b is acceptable because it stated that no repairs to equipment are necessary to maintain hot standby for an extended period.

On the basis of the licensee's analysis as described in the LAR, as supplemented, and successful completion of the implementation item, the NRC staff concludes that the licensee has provided reasonable assurance that the fuel can be maintained in a safe and stable condition, post-fire, for an extended period of time.

3.2.3 Applicability of Feed-and-Bleed

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

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

The NRC staff reviewed LAR Table 5-3, "10 CFR 50.48(c) – Applicability/Compliance References," and Attachment C, "NEI 04-02 Table B-3 Fire Area Transition," to evaluate whether CCNPP 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 path at CCNPP for any scenario. The NRC staff confirmed this by reviewing the designated safe shutdown path 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, defense-in-depth, and safety margins for the fire area was acceptable.

Therefore, the NRC staff concludes that, based on the information provided in LAR Table 5-3 as well as the fire area analyses documented in LAR Attachment C, 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 CCNPP.

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

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

As part of the NFPA 805 transition project, the licensee stated that it reviewed and evaluated the susceptibility of fire-induced MSOs in accordance with NEI 04-02 and RG 1.205, as supplemented by FAQ 07-0038 Revision 3 (Reference 54).

In LAR Attachment F, the licensee stated that the review method used insights from the FPRA developed in support of transition to NFPA 805 and consists of the following:

- Step 1 - Identify potential MSOs of concern.
- Step 2 - Conduct an expert panel to assess plant specific vulnerabilities (e.g., per NEI 00-01, Rev. 1 Section F.4.2).
- Step 3 - Update the FPRA model and NSCA to include the MSOs of concern.
- Step 4 - Evaluate for NFPA 805 compliance.

- Step 5 - Document the results.

For Step 1, the licensee stated it used the following sources as input to the overall assessment of MSOs: NEI 00-01, WCAP-16933-NP (Reference 85), piping and instrumentation diagrams, electrical schematics, operating experience (e.g., licensee event reports, NRC inspection findings, etc.), PRA risk model, UFSAR, safe shutdown logic diagrams, system description and training modules, and Fire PRA NUREG/CR-6850 Task 2 Equipment Selection Report.

For Step 2, the licensee stated that an MSO expert panel meeting was conducted at CCNPP in May 2010, using the guidance in NEI 00-01, Revision 2. The licensee stated that the MSO expert panel included representatives from CCNPP fire protection, CCNPP Electrical/ Mechanical Engineering, CCNPP Operations, CCNPP PRA Engineering, and supporting staff, and that the panel conducted document reviews and held discussions on potential fire-induced spurious operations that could potentially impact plant safety. The licensee stated that training for the 2010 expert panel consisted of procedures and training material which included purpose and scope, overview training on the MSO issues, including the background on fire-induced MSOs, types of circuit failures that can occur and result in spurious operations and role of the MSO resolution in the NFPA 805 transition. The licensee stated that the key points of the training included:

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

- The focus should not be on individual fire area locations, but rather on a system / component approach, in order to allow the analysis following the expert panel (e.g., PRA model and scenario development) to determine the vulnerability of the proposed interactions to credible fires.

The licensee stated that the MSO list includes scenarios related to the following functions:

- RCS inventory control/RCS integrity
- RCS pressure control
- Heat removal
- Reactivity control decay
- Support functions
- Other scenarios

The licensee further stated that these reviews considered system flow paths and addressed items such as deadheading of pumps, pump run out, and flow diversion, and that by using the PWR generic MSO list as guidance, a step-by-step discussion was held, typically by reviewing P&IDs, postulating scenarios, discussing the potential consequences and likelihood, discussing operator response, and recommending additional courses of action. Key considerations, in addition to consequences, were:

- Whether the scenario of concern was currently modeled in the CCNPP SSA
- Whether the scenario of concern was currently modeled in the CCNPP internal events PRA
- Whether procedures addressed the potential scenarios of concern
- Additional analyses or justification that may be necessary to document exclusion of a particular scenario

The licensee stated that consensus was achieved in the expert panel process by discussing individual scenarios, reaching a conclusion, and asking for any dissenting opinions, and that the expert panel identified several potential MSOs during the May 2010 meeting for which they had insufficient information available to determine applicability to CCNPP. The licensee further stated that the original expert panel report identified several open/action items for members of the panel, and that closure of the action items occurred during 2010 and 2011 as the required information was collected.

The licensee stated that the findings of the expert panel were documented in a report issued in 2011, and that the report includes the training session materials, the qualifications (i.e., education, experience, and areas of expertise) for each of the MSO expert panel participants, a list of the MSOs that were reviewed, and the source of the MSOs that were reviewed (i.e., industry list, plant-specific, "what if" review, etc.).

For Step 3, the licensee stated that the results of the expert panel were included in the equipment identification task of the CCNPP FPRA, and that this task addressed spurious operations, including MSOs, identified in the post-fire safe shutdown analysis, including those that resulted from the expert panel review. The licensee further stated that the results of the FPRA model were documented in a report and included a listing of MSOs considered with documentation of their disposition and logic changes made to the FPRA model to account for MSO scenarios relevant to fire, but not already captured by the internal events PRA. The licensee stated that the MSO combination components of concern were then evaluated for inclusion into the CCNPP NSCA, and, as necessary, components were added to the NSCA equipment list and logics, and circuit analysis and cable routing was performed. The licensee stated that instances existed where conditions associated with MSOs did not require an update of the FPRA and NSCA analysis because of the following conditions, for example:

- FPRA analysis determined that the particular interaction would not lead to core damage
- Pre-existing equipment and cable routing information determined that the particular MSO interaction was not physically possible
- The FPRA model bounds the MSO issue (e.g., spurious actuation of a motor operated valve renders it inoperable for local operation, but local operation is not credited in the model; or multiple spurious operation of valves is identified, but the PRA model has the applicable function failed by a single spurious actuation, so the second spurious actuation is moot).

The licensee stated that the rationale for exclusion of identified MSOs from the FPRA and NSCA was documented in calculations and that these calculations are the configuration control mechanisms that provide reasonable confidence that the exclusion bases for future MSO concerns remain valid.

For Step 4, the licensee stated that the MSO combination components of concern were evaluated as part of the NSCA, and that for fire areas 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.

Finally for Step 5, the licensee stated that the MSO scenarios that were identified from the expert panel were documented in a technical report, and the results of reviewing the impact on the FPRA and NSCA were documented in the respective documents. The licensee further stated that the fire-induced MSOs are included in the FPRA model, and its associated risk is included in the quantification of each fire scenario, the total plant fire risk and evaluation of each VFDR. The licensee further stated that the VFDRs were identified in LAR Attachment C, and a summary of the FPRA results were provided in LAR Attachment W.

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

3.2.5 Establishing Recovery Actions

NFPA 805, Section 1.6.52, "Recovery Action," defines a RA as follows:

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

NFPA 805, Section 4.2.3.1, states that:

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

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

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

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

The licensee stated that in accordance with the guidance provided in NEI 04-02, FAQ 07-0030, Revision 5 (Reference 53), and RG 1.205, the following methodology was used to determine RAs required for compliance (i.e., determining the population of post-transition RAs), and the methodology consisted of the following steps:

- Step 1: Define the primary control station(s) and determine which pre-transition OMAs (operator manual action) are taken at primary control station(s) (Activities that occur in the main Control Room are not considered pre-transition OMAs). Activities that take place at primary control station(s) or in the main Control Room are not RAs, by definition.

- Step 2: Determine the population of RAs that are required to resolve VFDRs (to meet the risk acceptance criteria or maintain a sufficient level of DID).

- Step 3: Evaluate the additional risk presented by the use of RAs required to demonstrate the availability of a success path

- Step 4: Evaluate the feasibility of the RAs

- Step 5: Evaluate the reliability of the RAs

Based on the definition provided in RG 1.205, and the additional guidance provided in FAQ 07-0030 Revision 5, the licensee stated that the following stations are considered to be the primary control stations:

- 1C43, Alternate Shutdown Panel, Unit 1

- 2C43 Alternate Shutdown Panel, Unit 2.

The licensee stated that 1C43 (Unit 1) and 2C43 (Unit 2) are the primary control stations in the event of a fire that requires the evacuation of the MCR and that NRC approval for the design was provided in SER supplement No. 3 dated September 27, 1982 (Reference 22). The licensee stated that enabling of the Alternate Shutdown Panel involves transfer of control from the MCR to 1C43 (Unit 1) and 2C43 (Unit 2) through an operator action to manually position eight hand-switches (HS), and eight hand controllers (HC) which are located on 1C43 (2C43). The licensee stated that enabling each hand controller also requires a local RA to

reposition one or more hand valves from the normal instrument air control loop to the alternate shutdown control loop. The licensee further stated that following activation of the Alternate Shutdown Panel, the plant operator is provided with the capability to control and monitor secondary side decay heat removal capability utilizing the AFW system, the capability to control RCS pressure, and the capability to monitor critical RCS process parameters which are necessary to verify that natural circulation has been established in the RCS and that it is being successfully maintained thereafter.

In a letter dated February 24, 2016 (Reference 14), the licensee provided an updated LAR Attachment G, Table G-1, and removed the RAs to reposition the hand valves associated with the steam generator atmospheric dump valves (ADVs), but maintained the actions to operate the respective HCs at the PCS. However, the description of the PCS actions in the results of Step 1 in LAR Attachment G still stated that the hand valves associated with the ADV hand controller on panels 1C43 and 2C43, respectively, are required to be repositioned in order to enable operation of the ADVs from panels 1C43 and 2C43. In a letter dated April 22, 2016 (Reference 15), the licensee clarified that the description of the local actions on pages G-4 and G-7 that are required to enable the 1C43 and 2C43 hand controllers is accurate. The licensee further clarified that these actions are not a (NFPA 805) RA, since the actions are not required to reduce risk or for DID in fire area 16 or 17. The NRC staff concludes that the licensee's clarification is acceptable because the actions to operate the ADVs from PCS panels 1C43 and 2C43 are described correctly in LAR Attachment G, and are not credited to meet the NSPC.

The licensee stated that the final set of RAs are provided in LAR Attachment G, Table G-1 – Recovery Actions and Activities Occurring at the Primary Control Station(s). The licensee further stated that the set of RAs that are necessary to demonstrate the availability of a success path for the nuclear safety performance were evaluated for additional risk using the process described in NEI 04-02 (Reference 7), FAQ 07-0030, Revision 5 (Reference 53), and RG 1.205, and compared against the guidelines of RG 1.174 (Reference 29) and RG 1.205. The licensee stated that none of the RAs were found to have an adverse impact on the fire PRA, and the additional risk of RAs is provided in LAR Attachment W and documented in the FPRA support documents.

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

The licensee stated that it has evaluated the feasibility of RAs modeled in the FPRA and used to resolve the VFDRs identified in LAR Attachment C. The licensee further stated that the feasibility of these RAs was evaluated against the criteria outlined in NEI 04-02, FAQ 07-0030 Revision 5, and RG 1.205 and made extensive use of the human error probability (HEP)

quantifications for the RAs credited in the human reliability analysis (HRA). The licensee stated that RAs that are required by the FRE, but not addressed in the HRA were evaluated for feasibility using the NEI 04-02, FAQ 07-0030 Revision 5 and RG 1.205 criteria and that the results of the feasibility assessments demonstrate that all credited NFPA 805 RAs are feasible. The FAQ 07-0030 attributes used to assess feasibility are:

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

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

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

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

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

- Procedures - Written procedures should be provided.

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

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

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

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

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

In LAR Attachment G, the licensee stated that implementation items resulting from the feasibility evaluation include modifying, as needed, the abnormal operating procedures for the RAs evaluated. In LAR Attachment S, Table S-3, Implementation Item IMP-15 the licensee included an action to revise post-fire safe shutdown procedures and training as necessary to incorporate updated nuclear safety capability assessment strategies. The NRC staff concludes that this action is acceptable because the action will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

Based on the above considerations, the NRC staff concludes that the licensee has followed the endorsed guidance of NEI 04-02 and RG 1.205 to identify and evaluate RAs in accordance with NFPA 805, and therefore, there is reasonable assurance of meeting the regulatory requirements of 10 CFR 50.48(c). The NRC staff concludes that the feasibility criteria applied to RAs are acceptable based on conformance with the endorsed guidance contained in NEI 04-02 and successful completion of implementation item IMP-15.

3.2.6 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 nuclear safety capability assessment. The NRC staff concludes that the declared safe and stable condition proposed was acceptable and that the licensee's process was adequate to appropriately identify and locate the systems, equipment, and cables, required to provide reasonable assurance of achieving and maintaining the fuel in a safe and stable condition, as well as to meet the NFPA 805 nuclear safety performance criteria.

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

The following implementation items described in LAR Attachment S, Table S-3 were identified as a result of the review of RAs:

- Item IMP-15 involves modifying, as needed, the AOP 9 series procedures (Abnormal Operating Procedures - Fire) for the RAs evaluated and that required training will be completed in accordance with CNG-PR-1.01-1011.

- Item IMP-16 includes changing the normal alignment of EDG 2A to FOST 21.

The completion of these implementation items is necessary for compliance.

As discussed above, in its letter dated April 22, 2016 (Reference 15), the licensee indicated that it completed Implementation Item IMP-16. Accordingly, subject to completion of Implementation Item IMP-15 as described in LAR Attachment S, Table S-3, the NRC staff concludes that the process used by the licensee to review, categorize, and address RAs during the transition is consistent with RG 1.205 and the NRC-endorsed guidance contained in NEI 04-02. Therefore, the information provided by the licensee provides reasonable assurance that the regulatory requirements of 10 CFR 50.48(c) and NFPA 805 for nuclear safety capability assessment methods are met.

3.3 Fire Modeling Performance-Based Approach

The approach in NFPA 805 (Reference 3) allows both fire modeling (FM) and FREs as PB alternatives to the deterministic approach outlined in the standard. These two PB approaches are described in NFPA 805, Sections 4.2.4.1 and 4.2.4.2, respectively. Although FM and FREs are presented as two different approaches for PB compliance, the FRE generally involves some degree of FM to support engineering analyses and fire scenario development. NFPA 805, Section 1.6.18, defines a fire model as a "mathematical prediction of fire growth, environmental conditions, and potential effects on SSCs based on the conservation equations or empirical data."

The NRC staff reviewed the LAR (Reference 8) Section 4.5.2, "Performance-Based Approaches," which describes how the licensee used FM as part of the transition to NFPA 805, and LAR Section 4.7.3, "Compliance with Quality Requirements in Section 2.7.3 of NFPA 805," which describes how the licensee performed FM calculations in compliance with the NFPA 805 PB evaluation quality requirements for fire protection systems and features, to determine whether the FM used to support transition to NFPA 805 is acceptable.

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

The licensee did not propose any FM methods to support PB evaluations in accordance with NFPA 805, Section 4.2.4.1, as the sole means for demonstrating compliance with the NSPC.

3.4 Fire Risk Assessments

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

NFPA 805, Section 4.2.4.2 states that:

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

3.4.1 Maintaining Defense in Depth and Safety Margins

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

3.4.1.1 Defense-in-Depth (DID)

NFPA 805, Section 1.2, states that:

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

The NRC staff reviewed LAR (Reference 8), Section 4.5.2.2, "Fire Risk Approach," LAR Section 4.8.1, "Results of the Fire Area Review," and LAR Attachment C, "NEI 04-02 Table B-3 – Fire Area Transition," as well as the associated supplemental information, in order to determine whether the principles of DID were maintained in regard to the planned transition to NFPA 805.

When implementing the PB approach, the licensee followed the guidance contained in Section 5.3, "Plant Change Process," of NEI 04-02 (Reference 7), which includes a detailed consideration of DID and safety margins as part of the change process. The results of the licensee's DID assessment are provided in LAR Attachment C, Table C-1. LAR Attachment C, Table C-2 documents the results of the licensee's review of the required fire suppression and fire detection systems.

The licensee's methodology for evaluating DID refers to each of the three DID elements identified in NFPA 805, Section 1.2. In its response to PRA RAI 24 (Reference 9), the licensee provided a discussion in which, for each of the three elements, several examples of fire protection features that addressed that element are identified, along with a discussion of the considerations used in assessing those features. The assessment determined whether changes would be needed to assure that each element has been satisfactorily achieved or whether reliance on features in other elements were needed and should be developed. Many of the identified fire protection features are required to be in place in order to demonstrate compliance with the fundamental FPP and design elements of NFPA 805 Chapter 3 (e.g., combustible control program, hot work control program, etc.). However, the capabilities for some of the fire protection features for DID were evaluated and improved as needed based on the results of the PB analyses.

As described in its response to PRA RAI 24, the licensee implemented this method for addressing DID in the FREs performed on each PB fire area. Per LAR Attachment C, the FRE (1) documents the fire protection systems/features required to either meet the deterministic criteria of NFPA 805, Section 4.2.3, "Deterministic Approach," or to support the fire probabilistic risk assessment (FPRA), (2) notes whether changes or improvements are necessary for each fire protection system/feature to maintain a balance among the DID elements, and (3) provides a justification or basis for why the required fire protection systems/features are adequate for DID. As such, the FRE is the licensee's internal record of the systems required to meet the nuclear safety performance criteria (NSPC) and DID requirements of NFPA 805.

Based on its review of the LAR, the response to PRA RAI 24, and the FREs, the NRC staff concludes that the licensee has systematically and comprehensively evaluated fire hazards, area configuration, detection and suppression features, and administrative controls in each fire area and concludes that the methodology as proposed in its LAR adequately evaluates DID against fires as required by NFPA 805, and, therefore, the proposed RI/PB FPP adequately maintains DID.

3.4.1.2 Safety Margins

NFPA 805, Section 2.4.4.3, "Safety Margins," states that:

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

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

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

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

LAR Section 4.5.2.2 discusses how safety margins are addressed as part of the FRE process and states that this process is based on the requirements of NFPA 805, industry guidance in NEI 04-02, and RG 1.205 (Reference 4). The licensee performed a FRE for each fire area containing a variance from deterministic requirements (VFDR). The FREs contain the details of the licensee's review of safety margins for each PB fire area.

As discussed in LAR Section 4.5.1.2, "Fire PRA," and the licensee's response to PRA RAI 24 (Reference 9), the FPRA, including FM performed to support the FPRA, applies methodologies consistent with the guidance in NUREG/CR-6850 (Reference 36), (Reference 37), (Reference 38), and NRC-approved FAQs according to LAR Attachment H, "NFPA 805 Frequently Asked Question Summary Table." LAR Attachment J, "Fire Modeling Verification and Validation (V&V)," and the licensee's response to PRA RAI 24, explain that FM, including verification and validation (V&V), performed in support of the FPRA utilized accepted codes and standards including NUREG/CR-6850, NUREG-1805 (Reference 42), and NUREG-1824 (Reference 43). In its response to PRA RAI 24, the licensee described the methodology used to evaluate safety margins in the FREs to include the following evaluations and determinations:

- Fire Modeling: The conservatisms in the fire modeling methods, inputs, tools, and results used in support of the FREs (i.e., as part of the FPRA) were reviewed to ensure safety margins are maintained.

- Plant System Performance: Plant system performance was evaluated using the safety analysis acceptance criteria in the licensing basis (e.g., FSAR, supporting analyses, etc.).

- PRA Logic Model: In Section 4.5.1 of the LAR (September 24,2013), the licensee stated that the FPRA model was developed in compliance with the ASME/ANS RA-

Sa-2009 PRA standard (Reference 31), and peer reviewed in accordance with RG 1.200, Revision 2 (Reference 30).

The results of the licensee's safety margin assessment by fire area are provided in LAR Attachment C, Table C-1, as supplemented.

Based on the information provided by the licensee, the NRC staff concludes that the safety margin criteria described in NEI 04-02, Section 5.3.5.3 and the LAR, as supplemented, are consistent with the criteria as described in RG 1.174 (Reference 29), and are therefore acceptable. The licensee used appropriate codes and standards (or NRC guidance), and met the safety analyses acceptance criteria in the licensing basis. Based on its review of the LAR and a sample of the FREs during the audit, the NRC staff concludes that the licensee's approach has adequately addressed the issue of safety margins in the implementation of the FRE process.

3.4.2 Quality of the Fire Probabilistic Risk Assessment

The objective of the PRA quality review is to determine whether the plant-specific PRA used in evaluating the proposed LAR is of sufficient scope, level of detail, and technical adequacy for the application. The NRC staff evaluated the PRA quality information provided by the licensee in its 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, "Fire PRA Development and Assessment," LAR Section 4.7, "Program Documentation, Configuration Control, and Quality Assurance," LAR Attachment C, "NEI 04-02 Table B-3-Fire-Area Transition," Attachment U, "Internal Events PRA Quality," LAR Attachment V, "Fire PRA Quality," and LAR Attachment W, "Fire PRA Insights," as well as associated supplemental information.

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

In LAR Section 4.8.2, "Plant Modifications and Items to be Completed During the Implementation Phase," the licensee stated that no significant plant changes (beyond those identified and scheduled to be implemented as part of the transition to a FPP based on NFPA 805) are outstanding with respect to their inclusion in the FPRA model. Based on this information, the NRC staff concludes that the FPRA model represents the current as-built, as-operated configuration, and is, therefore, capable of being adapted to model both the post-transition and compliant plant configuration, 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 Section 3.8.3 of this SE, the licensee has a program for ensuring that developers and users of these models are appropriately trained and qualified. Therefore, the NRC staff concludes that the PRA should be capable of supporting post-transition FREs to support, for example, the self-approval process, after any changes required during implementation are completed.

3.4.2.1 Internal Events PRA Model

As discussed in LAR Attachment U and clarified by the licensee's response to PRA RAI 21 (Reference 9), the licensee's evaluation of the technical adequacy of the portions of its IEPRA model used to support development of the FPRA model consisted of a full scope peer review that was performed in June 2010 using the NEI 05-04 process (Reference 86), and the combined ASME/ANS PRA standard (Reference 31), as clarified by RG 1.200, Revision 2 (Reference 30). The IEPRA model that was reviewed for the full scope peer review serves as the basis of the FPRA used in performing PRA evaluations for the LAR. In its response to PRA RAI 22 (Reference 9), the licensee stated that since the full-scope peer review, no changes have been made to the IEPRA that are consistent with the definition of a "PRA upgrade" as defined by the ASME/ANS PRA Standard.

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

In general, facts and observations (F&Os) are written for any SR that is judged not to be met or does not fully satisfy CC-II of the ASME standard, consistent with RG 1.200, Revision 2. LAR Attachment U, Table U-1 provides the licensee's resolutions to all 39 F&Os characterized as findings per peer review guidelines (Reference 86). In LAR Attachment U, the licensee resolved 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 resolution in LAR Attachment U to determine whether the F&O had any significant impact for the application. The NRC staff's review and conclusion for the licensee's resolution of each F&O is summarized in the NRC's Record of Review dated May 31, 2016 (Reference 87).

In PRA RAI 02.a the NRC staff requested that the licensee provide additional information with respect to the alignment strategy assumed by the PRA for the 0C diesel generator (Reference 16). In its response to the RAI (Reference 9), the licensee explained that the alignment of the 0C diesel generator is flexible and based on operational needs. The licensee further clarified that although a fixed alignment strategy is modeled in the PRA, the resulting modeling logic is conservative relative to the proceduralized alignment strategy. In its response to PRA RAI 03 (Reference 14) and (Reference 15), the licensee added that the modeling logic is supported by operator interviews and simulator observations and confirmed that it incorporated this modeling logic into the integrated analysis provided in its response to

PRA RAI 03. The NRC staff concludes the licensee's response to the RAI is acceptable because the licensee demonstrated that the FPRA conservatively models the proceduralized alignment strategy of the 0C diesel generator as confirmed by operator interviews and simulator observations.

Based on its review of the LAR and the licensee responses to RAIs, the NRC staff concludes that the IEPRA has sufficient technical adequacy and that its quantitative results, considered together with sensitivity study results, can be used to demonstrate that the change in risk due to the transition to NFPA 805 meets the acceptance guidelines of RG 1.174 (Reference 29). To reach this conclusion, the NRC staff reviewed all F&Os provided by the peer reviewers and determined that the resolution of every F&O supports the determination that the quantitative results are adequate or have no significant impact on the FPRA. Accordingly, the NRC staff concludes that the licensee has demonstrated that the IEPRA meets the guidance in RG 1.200, Revision 2, that it is reviewed against the applicable SRs in ASME/ANS-RA-Sa 2009, and that it is technically adequate to support the FREs and other risk calculations required for the LAR.

3.4.2.2 Fire PRA Model

The licensee evaluated the technical adequacy of the FPRA model by conducting a full-scope peer review in January 2012 using the NEI 07-12 (Reference 88), process, and the FPRA part (Part 4) of ASME/ANS-RA-Sa-2009, as clarified by RG 1.200, Revision 2. LAR Attachment V, Table V-1 provides the licensee's resolutions to the F&Os written against SRs of Part 4 of ASME/ANS RA-Sa-2009, as clarified by RG 1.200, Revision 2, and classified as findings per NEI 07-12. LAR Attachment V, Table V-2 identifies all SRs determined by the peer review to be not met or only met at CC-I and provides an evaluation of those SRs. An F&O was written against each SR determined to be not met or only met at CC-I. In its response to PRA RAI 22 (Reference 9), the licensee stated that since the last full-scope peer review, no changes have been made to the FPRA that are consistent with the definition of a "PRA upgrade" as defined by the ASME/ANS PRA Standard.

As described in LAR Attachment V, the licensee resolved each F&O by assessing the impact of the F&O on the FPRA and on the results for the LAR. The NRC staff evaluated each F&O and the licensee's respective resolution in LAR Attachment V to determine whether the issue had any significant impact for the LAR. The NRC staff's review and conclusions for the resolution of each F&O is summarized in the NRC's Record of Review dated May 31, 2016 (Reference 87).

In PRA RAI 01.b (Reference 16), associated with F&O FSS-A5-01, the NRC staff requested that the licensee provide clarification on the process it used to divide physical analysis units (PAUs) into "sub-PAUs" and the methods employed for evaluating the fire spread across sub-PAU boundaries, which, as noted by F&O FSS-A5-01, are not defined by physical barriers. In its response to PRA RAI 01.b (Reference 11), and PRA RAI 03 (Reference 14), and (Reference 15), the licensee indicated that it updated the FPRA to address fire effects, including fire spread, consistent with guidance in NUREG/CR-6850 and independent of assigned sub-PAU boundaries. The licensee also confirmed in its response to PRA RAI 03

that it incorporated this revised treatment of fire effects into its integrated analysis. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the FPRA models fire effects, including fire spread, are consistent with the guidance in NUREG/CR-6850.

In PRA RAI 01.c (Reference 16), associated with F&O FSS-G4-01, the NRC staff indicated that the multi-compartment analysis (MCA) did not postulate propagation scenarios if doing so would require failure of certain barrier types, such as penetration seals. In its response to PRA RAI 01.c (Reference 11), the licensee updated the FPRA MCA to include propagating scenarios for all barrier types consistent with guidance in Section 11.5.4 of NUREG/CR-6850. The licensee further clarified that it applied the sum of applicable generic barrier failure probabilities from Table 11-3 of NUREG/CR-6850. In its response to PRA RAI 03 (Reference 14), and (Reference 15), the licensee confirmed that it incorporated the revised treatment of propagating MCA scenarios into the integrated analysis. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the FPRA MCA is consistent with guidance in NUREG/CR-6850.

In PRA RAI 02.b (Reference 16), associated with F&O 6-23, the NRC staff requested clarification of whether the FPRA human reliability analysis (HRA) dependency analysis considered the sequential timing of actions that appear within the same accident sequence or cutset. In its response to PRA RAI 02.b (Reference 9), the licensee clarified that it performed operator interviews to confirm the appropriateness of human failure event (HFE) timelines and subsequently led to the identification of some human error probabilities (HEPs) that may have inappropriately applied a time delay of zero. In its response to PRA RAI 02.b.i.01 (Reference 12) and PRA RAI 03 (Reference 14), and (Reference 15), the licensee confirmed that it performed a review of all HEPs with a time delay of zero. The licensee further stated that it documented the justification for a time delay of zero or updated the FPRA to apply appropriate timing. The licensee also confirmed that it incorporated the revised HEP timing into its integrated analysis. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the FPRA HRA dependency analysis considered the sequential timing of actions and applied appropriate time delays to all HEPs.

In PRA RAI 02.b (Reference 16), associated with F&O 6-23, the NRC staff requested that the licensee provide justification with respect to the establishment of acceptable minimum (or "floor") values for HEP combinations (i.e., joint HEPs). In its response to PRA RAI 02.b.ii.01 (Reference 12) and (Reference 15) and PRA RAI 03 (Reference 14) and (Reference 15), the licensee indicated that it updated the FPRA to use no joint HEP value below 1.0E-05. The licensee also confirmed that it incorporated this treatment of joint HEPs into its integrated analysis. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the FPRA includes the use of floor values consistent with guidance in NUREG-1921 (Reference 46).

In PRA RAI 04 (Reference 16), the NRC staff requested that the licensee provide further clarification on transient fire placement within PAUs. In its response to PRA RAI 04 (Reference 11), the licensee stated that the FPRA considered general transient fires and transient fires caused by welding and cutting in each PAU. For PAUs where detailed FM was

performed, such fires were postulated in all accessible floor areas except where precluded by design and/or operation. For PAUs where scoping FM was performed, all unscreened fire scenarios, as discussed in its response to FM RAI 02.a (Reference 11), were mapped to whole PAU damage. The NRC staff concludes the licensee's response to the RAI is acceptable because the licensee demonstrated that its method for locating transient fires appropriately identifies and addresses pinch points for all PAUs, consistent with the guidance in NUREG/CR-6850.

In PRA RAI 05 (Reference 16), the NRC staff requested that the licensee provide further justification on the ranking values assigned to transient influence factors. In its response to PRA RAI 05 (Reference 11) and PRA RAI 03 (Reference 14) and (Reference 15), the licensee stated that it updated the FPRA to treat transient influencing factors consistent with the guidance in NUREG/CR-6850. The licensee also confirmed that it incorporated the revised treatment of transient influence factors in its integrated analysis. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the FPRA applies transient influence factors consistent with the guidance in NUREG/CR-6850.

In PRA RAI 06 (Reference 16), the NRC staff requested that the licensee provide clarification on its use of a heat release rate (HRR) of 142 kilowatt (kW) instead of 317 kW for modeling transient fires in PAUs 311, 317, 407 and 430. In its response to PRA RAI 06 (Reference 11), and PRA RAI 06.01 (Reference 13), the licensee clarified that strict controls on combustible material will be implemented to significantly reduce the amount of combustible material in these PAUs, which will be designated transient combustible exclusion zones as part of LAR Attachment S, Table S-3, Implementation Item 22. The licensee applied guidance from the NRC letter to NEI dated June 21, 2012 (Reference 89), that accepted use of a HRR lower than 317 kW based on specific attributes and considerations applied to that location. The licensee also indicated that it performed a review of past transient fire experience and identified no violations of existing transient combustible controls for these PAUs over a five-year period. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that its use of a reduced transient HRR is consistent with NRC guidance.

In PRA RAI 07 (Reference 16), the NRC staff requested that the licensee provide clarification regarding the FPRA's treatment of self-ignited cable fires and cable fires due to welding and cutting. In its response to PRA RAI 07 (Reference 10), PRA RAI 07.01 (Reference 12), and PRA RAI 03 (Reference 14) and (Reference 15), the licensee indicated that it updated the FPRA to be consistent with the guidance in FAQ 13-0005 (Reference 65). The licensee also confirmed that it included the revised treatment in the integrated analysis. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the FPRA's treatment of self-ignited cable fires and cable fires due to welding and cutting is consistent with NRC guidance.

In PRA RAI 08 (Reference 16), the NRC staff requested that the licensee provide clarification regarding the FPRA's treatment of junction box fires. In its response to PRA RAI 08 (Reference 10), PRA RAI 08.01 (Reference 12), and PRA RAI 03 (Reference 14) and

(Reference 15), the licensee indicated that it updated the FPRA to be consistent with the guidance in FAQ 13-0006 (Reference 66). The licensee also confirmed that the revised treatment is included in the integrated analysis. The NRC staff concludes that the licensee's response to the RAI is acceptable because the license demonstrated that the FPRA's treatment of junction box fires is consistent with NRC guidance.

In PRA RAI 09 (Reference 16), the NRC staff requested that the licensee provide clarification on its treatment of sensitive electronics. In its response to PRA RAI 09 (Reference 11), and PRA RAI 03 (Reference 14) and (Reference 15), the licensee indicated that it updated the FPRA to be consistent with guidance in NUREG/CR-6850 and FAQ 13-0004 (Reference 64). The licensee further clarified that it adhered to the caveats in FAQ 13-0004 regarding the applicability of the FAQ, and that it applied the guidance in NUREG/CR-6850 to those configurations where the FAQ was not applicable. The licensee also confirmed that the revised treatment is included in the integrated analysis. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the FPRA's treatment of sensitive electronics is consistent with NRC guidance.

In PRA RAI 10 (Reference 16), the NRC staff requested that the licensee provide an assessment of its method for assigning conditional probabilities of spurious operations for control circuits relative to the guidance in NUREG/CR-7150, Volume 2 (Reference 90). In its response to PRA RAI 10 (Reference 11), and PRA RAI 03 (Reference 14) and (Reference 15), the licensee indicated that it updated the circuit failure probabilities and hot short duration probabilities in the FPRA to be consistent with guidance in NUREG/CR-7150, Volume 2. The licensee also confirmed that the revised treatment is included in the integrated analysis. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the FPRA's treatment of circuit failure probabilities and hot short duration probabilities is consistent with NRC guidance.

In PRA RAI 11 (Reference 16), the NRC staff requested that the licensee justify the FPRA's counting and treatment of Bin 15 electrical cabinets. In its response to PRA RAI 11 (Reference 10) and (Reference 11), the licensee clarified that all electrical cabinets that house circuits of 440V or greater have been counted for the purposes of Bin 15 frequency apportionment based on the guidance in Section 6.5.6 of NUREG/CR-6850. Additionally, the licensee indicated that it applied guidance in Chapter 8 of Supplement 1 to NUREG/CR-6850 to determine whether electrical cabinets were robustly secured and well-sealed and indicated that it updated the FPRA to exclude those cabinets below 440V from the Bin 15 count, consistent with NUREG/CR-6850. In its response to PRA RAI 11.d.01 (Reference 12), the licensee further clarified that it addressed propagation of fire outside of electrical cabinets that house circuits above 440V consistent with guidance in NUREG/CR-6850 with the exception of well-sealed and robustly secured MCCs, which were addressed consistent with guidance in FAQ 14-0009 (Reference 67). In its response to PRA RAI 03 (Reference 14) and (Reference 15), the licensee stated that this revised treatment is included in the integrated analysis. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the FPRA's counting and treatment of Bin 15 electrical cabinets is consistent with NRC guidance.

In PRA RAI 12 (Reference 16), NRC staff requested that the licensee justify the FPRA's treatment of high energy arcing fault (HEAF) events. In its response to PRA RAI 12 (Reference 11), and PRA RAI 03 (Reference 14) and (Reference 15), the licensee indicated that it updated the FPRA to treat HEAF scenarios, including associated non-suppression probabilities where applicable, consistent with guidance in Appendix M of NUREG/CR-6850. The licensee also confirmed that this revised treatment is included in the integrated analysis. The NRC staff concludes the licensee's response to the RAI is acceptable because the licensee demonstrated that the FPRA's treatment of HEAF events is consistent with NRC guidance.

In PRA RAI 13 (Reference 16), NRC staff requested that the licensee justify the assumption that all wiring within the main control board (MCB) is qualified when unqualified wiring is also known to be present. In its response to PRA RAI 13.01 (Reference 13), and PRA RAI 03 (Reference 14) and (Reference 15), the licensee indicated that it updated the FPRA to treat all wiring within the MCB as unqualified. The licensee also confirmed that this revised treatment is included in the integrated analysis. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the FPRA conservatively treats all wiring within the MCB as unqualified.

In PRA RAI 14 and PRA RAI 15 (Reference 16), the NRC staff requested that the licensee provide justification for the modeling of fire scenarios in which abandonment of the MCR is credited. In its response to PRA RAI 14 and PRA RAI 15 (Reference 11), the licensee clarified that MCR abandonment is assessed for loss of function for fires in the MCR and cable spreading room (CSR) as well as for loss of MCR habitability for fires in the MCR. Abandonment conditional core damage probabilities (CCDPs) and conditional large early release probabilities (CLERPs) are evaluated in the FPRA using detailed fire scenario analyses for each fixed and transient ignition source in the same manner as other fire scenarios. The licensee stated that "abandonment cases assume a complete relocation of the primary control station (PCS) to the Auxiliary Safe Shutdown Panel (ASSDP)." The licensee further clarified that loss of function is defined as the "immediate or impending loss of vital auxiliaries, degraded steam generator level indication and/or degraded flow control instruments [that] will lead to MCR abandonment." The licensee added that loss of the whole CSR meets these conditions and, for lesser fires, fault tree logic is applied. In its response to PRA RAI 15.01 (Reference 13), the licensee further explained that not all CSR fires lead to use of the ASSDP, and only a small percentage of over 200 fixed and transient scenarios modeled in the fault trees are assessed and modeled as leading to abandonment. The NRC staff concludes that the licensee's responses to the RAIs are acceptable because the licensee demonstrated that the effects of individual fires in the MCR and CSR are evaluated, and should loss of function or MCR habitability occur, the FPRA models the shutdown of the plant from the ASSDP using detailed fire scenario analysis consistent with accepted methods.

LAR Section 4.5.1.2 states that that no unreviewed methods or deviations from NUREG/CR-6850 were utilized in the FPRA model development. In PRA RAI 23 (Reference 16), the NRC staff requested that the licensee identify and justify any fire PRA methods that deviate from other NRC-accepted guidance. In its response to PRA RAI 23 (Reference 9), the licensee identified no deviations. The NRC staff concludes that the licensee's response to the

RAI is acceptable because the licensee demonstrated that there are no deviations from accepted methods and approaches.

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

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

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

NFPA 805, Section 2.4.3.3, states, in part, that:

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

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

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

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

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

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

> Cognizant personnel who use and apply engineering analysis and numerical models (e.g., fire modeling techniques) shall be competent in that field and experienced in the

application of these methods as they relate to nuclear power plants, nuclear power plant fire protection, and power plant operations.

NFPA 805, Section 2.7.3.5, "Uncertainty Analysis," states that:

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

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

3.4.2.3.1 Overview of Fire Models Used to Support the Fire Risk Evaluations

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

- Flame Height, Method of Heskestad (Reference 91)
- Plume Centerline Temperature, Method of Heskestad (Reference 91)
- Radiant Heat Flux, Point Source Method (Reference 92)
- Ceiling Jet Temperature, Method of Alpert (Reference 93)

The first three algebraic models are described in NUREG-1805, "Fire Dynamics Tools (FDT^s): Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program" (Reference 42). Alpert's ceiling jet temperature correlation is described in FIVE, "EPRI Fire Induced Vulnerability Evaluation Methodology", Revision 1 (Reference 94), 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. V&V of these algebraic models is documented in NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," Volumes 1-7 (Reference 43). The algebraic fire models and empirical correlations were implemented in a database and workbook referred to as the Fire Modeling Workbook (FMWB).

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 CCNPP FPRA used these HGL screening approaches to further screen ignition sources, scenarios, and compartments that would not be expected to generate an HGL, and to identify the ignition sources that have the potential to

generate an HGL for further analysis. The following correlations were used to determine the potential for the development of an HGL:

- Method of McCaffrey, Quintiere and Harkleroad (MQH), for naturally ventilated compartments (Reference 42)
- Method of Beyler, for closed compartments (Reference 42)
- Method of Foote, Pagni, and Alvares (FPA), for mechanically ventilated compartments (Reference 42)

These HGL correlations are also implemented in the FMWB.

In LAR (Reference 8) Attachment J, the licensee also identified the use of the following empirical correlations that are not addressed in NUREG-1824 Volumes 3 and 4 (Reference 43).

- Plume Radius, Method of Heskestad (Reference 91)
- Sprinkler Activation Correlation (Reference 42)
- Smoke Detection Actuation Correlation, Method of Heskestad and Delichatsios (Reference 42)
- Correlation for Heat Release Rates of Cables (Reference 42)
- Correlation for Flame Spread over Horizontal Cable Trays, FLASH-CAT, described in NUREG/CR-7010, "Cable Heat Release, Ignition, and Spread in Tray Installations During Fire (CHRISTIFIRE), Volume 1: Horizontal Trays" (Reference 95)

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 CCNPP-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 heat release rate (HRR) from the NUREG/CR-6850 methodology (Reference 36), (Reference 37), and (Reference 38).

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

- Temperature sensitive equipment HGL study

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

- Control room abandonment calculations
- Estimating flame height, heat fluxes, and smoke detector actuation in the cable spreading and switchgear rooms.
- Plume/HGL interaction study
- Temperature sensitive equipment ZOI study

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

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

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

By letters dated January 12, 2015 (Reference 16), and June 3, 2015 (Reference 17), the NRC staff requested additional information concerning the FM conducted to support the FREs. By letters dated February 9, 2015 (Reference 9), March 11, 2015 (Reference 10), April 13, 2015 (Reference 11), and July 6, 2015 (Reference 12), the licensee responded to these RAIs.

- In FM RAI 01.a (Reference 16), the NRC staff requested that the licensee explain whether any fire modeling tools and methods were used in the development of the LAR that are not discussed in LAR Attachment J, and identify any fire modeling tools and methods that are discussed in LAR Attachment J that were not used in the fire modeling analyses performed at CCNPP.

  In its response to FM RAI 01.a (Reference 11), the licensee explained that the following tools and methods that were not discussed in Attachment J of the LAR were used to support the RAI responses:

  - Plume Radius (Method of Heskestad);
  - Ceiling Jet Temperature (Method of Alpert);
  - Method for determining the heat release rate adjustment in determining the ZOI of wall and corner fires;

- Sprinkler Activation Correlation;
- Plume/Hot Gas Layer Interaction Study using Fire Dynamics Simulator (FDS);
- Temperature Sensitive Equipment Hot Gas Layer Study using Consolidated Model of Fire and Smoke Transport (CFAST);
- Correlation for Flame Spread over Horizontal Cable Trays (FLASH-CAT);
- PyroSim software package for generating FDS input files; and,
- Engineering Planning and Management (EPM) Fire Modeling Workbook (FMWB).

The licensee further explained that the following tools and methods were removed from Attachment J because they were not used in the development of the LAR:

- Cable Response to Live Fire (CAROLFIRE);
- Thermally Induced Electrical Failure (THIEF) Model;
- Corner Flame Height (Method of Hesemi and Tokunaga);
- Wall Flame Height (Method of Delichatsios); and,
- Time to Ignition of Combustible Materials (Method of Tewarson).

The licensee further discussed some changes that were made to Attachment J to make it clearer where each method and tool is used in the CCNPP Fire PRA.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee identified the fire model applications that were not mentioned in the LAR and added a discussion of their V&V basis to LAR Attachment J, and deleted fire modeling tools and methods from LAR Attachment J that were not used in the development of the LAR.

- In FM RAI 01.c (Reference 16), the NRC staff requested that the licensee provide justification for ignoring the effect of flame spread and fire propagation in secondary combustibles (cable trays) and the corresponding HRR on the calculated ZOI and HGL temperature.

  In its response to FM RAI 01.c (Reference 11), the licensee explained that CCNPP reviewed and updated the fire modeling analysis to include fire propagation and spread to secondary combustibles, as appropriate, in the fire scenarios for all

PAUs. The licensee further stated that the results of the revised fire modeling analysis are reflected in the updated FPRA results that were provided to the NRC in the CCNPP response to PRA RAI 03.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee updated the fire modeling analysis and the FPRA to incorporate the HRR contribution of secondary combustibles (cable trays), and the licensee's approach to determine this contribution is consistent with the guidance in NUREG/CR-6850, Appendix R and NUREG/CR-7010, Chapter 9.

- In FM RAI 01.d (Reference 16), the NRC staff requested that the licensee provide information on how non-cable intervening combustibles were identified and accounted for in the fire modeling analyses.

  In its response to FM RAI 01.d (Reference 11), the licensee stated that additional walkdowns were performed of all fire compartments where detailed fire modeling was performed, and that for any PAUs with significant quantities of non-cable secondary combustibles the additional combustibles were incorporated into the fire modeling analysis. The licensee further stated that the results of the revised fire modeling analysis are reflected in the updated FPRA results that were provided to the NRC in the CCNPP response to PRA RAI 03.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee updated the fire modeling analysis and the FPRA to incorporate the HRR contribution of non-cable secondary combustibles.

- In FM RAI 01.e (Reference 16), the NRC staff requested that the licensee explain what administrative controls are in place to minimize the likelihood of fires involving a cabinet with temporarily open doors, and describe how such cabinets were treated in the fire modeling analyses.

  In its response to FM RAI 01.e (Reference 11), the licensee stated that, based on walkdowns confirmed by plant procedures and personnel practices, the fire modeling analysis assumed that electrical cabinets with normally closed doors are maintained closed. The licensee further explained that electrical equipment is generally de-energized prior to performing work, and that a de-energized electrical cabinet is not considered to be a credible ignition source. The licensee further stated that plant administrative procedures require that periodic inspections be performed to ensure electrical component doors and hardware are intact and that enclosure covers are not open, missing, or not secure.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because plant administrative procedures ensure that the likelihood of fires involving a cabinet with temporary open doors is minimal, and the assumptions in the fire modeling analysis concerning the HRR of electrical cabinets and the status of cabinet doors are consistent with plant conditions.

- In FM RAI 01.f (Reference 16), the NRC staff requested that the licensee describe the criteria that were used to decide whether a cable tray in the vicinity of an electrical cabinet will ignite following a HEAF event in the cabinet, to explain how the subsequent fire propagation was calculated, and to describe if and how the effect of tray covers and fire-resistant wraps on HEAF-induced cable tray fires was accounted for.

  In its response to FM RAI 01.f (Reference 11), the licensee stated that the ZOI of HEAFs in a cabinet was assumed to be five feet vertically and three feet horizontally, that FPRA targets and secondary combustibles within the ZOI of the HEAF were assumed to ignite at time zero, and that cable tray enclosures and electrical raceway fire barrier systems within the ZOI of the HEAF were not credited in the analysis. The licensee further explained that the HRR of a cabinet following a HEAF was assumed to instantaneously reach the 98th percentile HRR given for the cabinet in Table G-1 of NUREG/CR-6850, and to remain at that level for a period of 40 minutes following the HEAF. The licensee further stated that the first overhead cable tray was assumed to ignite at time zero and that the methods described in NUREG/CR-6850, Appendix R and NUREG/CR-7010, Chapter 9 were used to calculate subsequent fire propagation in a stack of horizontal cable trays. The licensee also stated that fire propagation to adjacent cabinet sections was not assumed to occur. The licensee further stated that the results of the fire modeling of HEAF scenarios are reflected in the updated FPRA results that were provided to the NRC in the CCNPP response to PRA RAI 03.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee's approach to calculate fire propagation in cable trays in HEAF-initiated fires is consistent with and generally more conservative than the guidance in NUREG/CR-6850 and NUREG/CR-7010, and the licensee updated the FPRA to incorporate the HHR contribution of secondary combustibles (cable trays) in HEAF scenarios.

- In FM RAI 01.g (Reference 16), the NRC staff requested that the licensee provide justification for the assumed fire areas and elevations that were used in the transient ZOI calculations, and explain how the model assumptions in terms of location and HRR of transient combustibles in a fire area or zone will not be violated during and post-transition.

  In its response to FM RAI 01.g (Reference 11), the licensee explained that class A transient fire areas were modeled to be 4 ft2 (2 x 2 ft), and that the corresponding Froude number for a 317 kW transient fire is 0.71, which is within the validated range (0.2-9.1). The licensee further stated that the assumed height of transient fire sources was 2 ft above the floor for most PAUs, and that in some PAUs the height of transient fire sources was selected to be at floor level with a large bounding ZOI that extends to the ceiling. The licensee further explained that transient fires were evaluated based on the 98th percentile HRR of 317 kW, except

in PAUs 311, 317, 407 and 430 which the licensee designated as transient combustible exclusion zones (see response to PRA RAI 06.01 (Reference 13)). The licensee further explained that the model assumptions pertaining to the locations and HRRs of transient combustibles in safety-related areas were based on transient combustible control procedures for these areas, and provided a detailed discussion of transient combustible controls in safety-related areas as well as non-safety related areas of critical buildings. The licensee also stated that walkdowns were performed to verify that the HRRs used for the transient scenarios modeled in the FPRA would be an appropriate representation of any potential transient fire in the PAU.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the transient areas and elevations assumed in the fire modeling analysis are either consistent with plant conditions or lead to more conservative ZOI estimates, and that the HRRs and locations of transient fires are justified based on the strict transient combustible controls in safety-related areas and critical buildings.

- In FM RAI 01.h (Reference 16), the NRC staff requested that the licensee explain how wall and corner effects were accounted for in the fire modeling calculations.

  In its response to FM RAI 01.h (Reference 11), the licensee explained that a location factor (HRR multiplier) of 2 was applied for fires that are in contact with a wall, and that a location factor 4 was used for fires within 2 ft of a corner. The licensee further stated that these location factors were applied in the flame height, plume temperature, plume radius and ceiling jet correlations. The licensee also provided a detailed discussion to justify its approach to account for location effects.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee's approach to account for wall fire location effects is consistent with experimental data reported in the literature, and the approach used for corner fires is the same as described in the Fire Protection Significance Determination Process (IMC 0609, Appendix F).

- In FM RAI 01.i(i) (Reference 16), the NRC staff requested that the licensee provide justification for ignoring the false ceiling above the operator and back panel areas in the control room abandonment calculations, and explain how the MCR dimensions specified in the FDS input files were established.

  In its response to FM RAI 01.i(i) (Reference 11), the licensee explained that the FDS input files were taken from plant drawings and confirmed during walkdowns of the MCR, and that varying ceiling heights, including a false ceiling, were modeled. The licensee further stated that the suspended acoustic tiles comprising the false ceiling were modeled to not allow smoke or hot gases to enter the interstitial space above (the false ceiling) unless the ventilation smoke purge mode is activated.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the geometry of the FDS model is consistent with that of the MCR, and excluding the interstitial space provides more conservative HGL and optical density results.

- In FM RAI 01.i(ii) (Reference 16), the NRC staff requested that the licensee explain if the doors of the MCR were assumed closed or open at all times in the control room abandonment calculations or were assumed to open at a specified time; and to identify the additional natural ventilation leakage paths that were specified in the FDS input files.

  In its response to FM RAI 01.i(ii) (Reference 11), the licensee stated that the doors of the MCR were assumed to be closed for the entirety of the analysis, and explained that a 0.2 m gap was assumed under the doors of the MCR (total leakage area of 1.16 m2) to prevent excessive pressure buildup in the compartment and to ensure the fire does not become under-ventilated..

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the assumed door position and leakage path lead to the conservative MCR abandonment time estimates while avoiding under-ventilated fire conditions.

- In FM RAI 01.i(iii) (Reference 16), the NRC staff requested that the licensee explain why the normal HVAC mode was not considered in the control room abandonment calculations.

  In its response to FM RAI 01.i(iii) (Reference 11), the licensee explained that the normal HVAC mode is conservatively bound by scenarios where the ventilation system is inoperable due to equipment failure or operator error, and was therefore not included in the analysis.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee considered the two ventilation modes, HVAC turned off and HVAC in purge mode, required in NUREG-CR/6850, Section 11.5.2.11.

- In FM RAI 01.i(iv) (Reference 16), the NRC staff requested that the licensee explain why only 10 HRR bins were used for each ignition source in the control room abandonment calculations.

  In its response to FM RAI 01.i(iv) (Reference 11), the licensee explained that the MCR abandonment calculations were updated to use the 15-bin HRR discretization in Appendix E of NUREG/CR-6850 for both electrical cabinets and transient fires. The licensee further stated that the results of the revised MCR abandonment calculations are reflected in the updated fire risk results that were provided to the NRC in the response to PRA RAI 03.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee updated the MCR abandonment calculations and considered the 15 HRR bins for electrical cabinet and transient fires in NUREG/CR-6850.

- In FM RAI 01.i(v) (Reference 16), the NRC staff requested that the licensee describe the technical basis for choosing the location of the ignition source in the electrical cabinet and transient fire control room abandonment scenarios, and provide technical justification for not considering fire scenarios with the ignition source against a wall or in a corner.

  In its response to FM RAI 01.i(v) (Reference 11), the licensee stated that the MCR abandonment calculations were updated to include two electrical cabinet scenarios and four transient scenarios. The licensee further stated that electrical and transient fires were modeled in the operator area, the back panel area, and in the shift supervisor's office; that the electrical cabinet fire scenario location were conservatively selected such that the fire would spread to two additional cabinets; and that the locations for the transient fires were selected based on walkdowns which identified areas where transient combustibles were present or likely to accumulate. The licensee further explained that one transient fire placed in the back panel area was modeled against the wall, and stated that transient scenarios placed farther away from the MCBs would have delayed effects on the operators, and single electrical cabinet fires against a wall generate less heat and smoke than multi-cabinet fires away from a wall. The licensee further stated that the results of the revised MCR abandonment calculations are reflected in the updated fire risk results that were provided to the NRC in the response to PRA RAI 03.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee updated the MCR abandonment calculations assuming fire locations that bound fires at any location within the control room where electrical cabinets and transient combustibles are or can be located.

- In FM RAI 01.i(vi) (Reference 16), the NRC staff requested that the licensee explain how the area and elevation of electrical cabinet and transient fires were determined in the control room abandonment calculations.

  In its response to FM RAI 01.i(vi) (Reference 11), the licensee explained that the area and elevation of electrical cabinet fires in the MCR were updated based on walkdown information. The licensee further explained that the area and elevation of transient fires was also determined by plant walkdowns and represents the dimensions of a large trash can located in the MCR. The licensee further explained that an additional transient scenario involving a photocopier, and that the area and elevation of this scenario were determined by plant walkdowns and represent the dimensions of a typical photocopier. The licensee further stated that the results of the revised MCR abandonment calculations are reflected in the updated fire risk results that were provided to the NRC in the response to PRA RAI 03.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the fire areas and elevations assumed in the MCR abandonment calculations are consistent with plant conditions.

- In FM RAI 01.i(vii) (Reference 16), the NRC staff requested that the licensee provide justification for not considering scenarios that involve secondary combustibles in the control room abandonment calculations.

  In its response to FM RAI 01.i(vii) (Reference 11), the licensee explained that walkdowns were performed to determine if any significant secondary combustibles could impact the MCR abandonment calculations, and stated that the MCR abandonment calculations were updated to include electrical cabinet fires that propagate to adjacent vertical cabinet sections and that additional transient scenarios were created in FDS for transient fires that may involve secondary combustibles. The licensee further stated that the transient scenarios were modeled by using an increased HRR of 1000 kW, which was determined to be bounding for the types of combustibles in the area and accounts for any potential impact due to secondary combustibles. The licensee further stated that the results of the revised MCR abandonment calculations are reflected in the updated fire risk results that were provided to the NRC in the response to PRA RAI 03.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee updated the MCR abandonment calculations to incorporate scenarios that bound secondary combustible impacts.

- In FM RAI 01.i(viii) (Reference 16), the NRC staff requested that the licensee explain how the HRRs for electrical cabinets were determined in the control room abandonment calculations.

  In its response to FM RAI 01.i(viii) (Reference 11), the licensee explained that the MCR abandonment calculations were updated to use the Case 5 discretized HRR distribution from Table E-6 in NUREG/CR-6850 for vertical cabinets with unqualified cable, fire in more than one cable bundle and open doors. The licensee further stated that the results of the revised MCR abandonment calculations are reflected in the updated fire risk results that were provided to the NRC in the response to PRA RAI 03.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee updated the MCR abandonment calculations using HRRs for electrical cabinet fire scenarios that are consistent with the types of cabinets that are present in the MCR.

- In FM RAI 01.i(ix) (Reference 16), the NRC staff requested that the licensee provide technical justification for not considering electrical cabinet fires that propagate to adjacent cabinets in the control room abandonment calculations.

In its response to FM RAI 01.i(ix) (Reference 11), the licensee explained that the MCR abandonment calculations were updated to include electrical cabinet fires that propagate to adjacent vertical cabinet sections in 10 minutes. The licensee further stated that the results of the revised MCR abandonment calculations are reflected in the updated that fire risk results were provided to the NRC in the response to PRA RAI 03.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee updated the MCR abandonment calculations to include electrical cabinet fires that spread to adjacent vertical cabinet sections, and followed the guidance in NUREG/CR-6850 to determine the propagation time.

- In FM RAI 01.i(x) (Reference 16), the NRC staff requested that the licensee provide the technical basis for the cable properties that were used in the control room abandonment calculations.

  In its response to FM RAI 01.i(x) (Reference 11), the licensee explained that the material properties specified in the MCR FDS model for cables inside of the cabinets was based on XLPE cable, and that the property values were obtained from the SFPE Handbook. The licensee further stated that XLPE cable is representative of the primary combustible in scenarios involving fire with qualified cables, and that, based on the SFPE Handbook, the XLPE soot yield and heat of combustion values are also representative of the safety-related internal wiring in the MCBs, which is assumed to be comprised of thermoplastic material.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the XLPE soot yield and heat of combustion values specified for the MCR electrical cabinets are conservative.

- In FM RAI 01.i(xi) (Reference 16), the NRC staff requested that the licensee describe the technical basis for the transient fire growth rates that were assumed in the control room abandonment calculations.

  In its response to FM RAI 01.i(xi) (Reference 11), the licensee explained that the MCR abandonment calculations were updated to incorporate a t2 growth rate with a time to peak HRR of 8 minutes, which the NRC staff found is representative of common trash can fires as described in FAQ 08-0052. The licensee further stated that scenarios involving fires outside a trash can or involving solvents are considered to be of sufficiently low probability that they can be ignored in the determination of the time to HRR growth. The licensee further stated that the results of the revised MCR abandonment calculations are reflected in the updated fire risk results that were provided to the NRC in the response to PRA RAI 03.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee updated the MCR abandonment calculations to include

transient fire growth rates that are representative of the primary transient combustibles that are present in the MCR.

- In FM RAI 01.i(xii) (Reference 16), the NRC staff requested that the licensee provide the technical basis for the material properties of the transient combustibles that were used in the control room abandonment calculations.

  In its response to FM RAI 01.i(xii) (Reference 11), the licensee explained that the MCR abandonment calculations were updated to include conservative soot yield and heat of combustion values, and that these properties will be based on a combination of the values for red oak and polyethylene reported in the SFPE Handbook. The licensee further stated that the results of the revised MCR abandonment calculations are reflected in the updated fire risk results that were provided to the NRC in the response to PRA RAI 03.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee updated the MCR abandonment calculations to include material properties for transient combustibles that are representative of the primary transient combustibles that are present in the MCR.

- In FM RAI 01.i(xiii) (Reference 16), the NRC staff requested that the licensee describe the limiting habitability conditions that were used to determine the time to control room abandonment, and to provide the basis for the locations where the temperature and optical density sensors were placed in FDS.

  In its response to FM RAI 01.i(xiii) (Reference 11), the licensee stated that the following habitability criteria were used in the MCR abandonment calculations:

  - The heat flux at 6 feet above the floor exceeds 1 kW/m2,
  - An upper layer temperature greater than 95°C, and
  - The smoke layer descends below 6 feet from the floor and the optical density of smoke is less than 3.0 m-1.

  The licensee further explained that the analysis was updated to include additional devices to measure the habitability conditions at a height of 6 feet throughout the MCR in over 25 different locations, and that these devices were located:

  - To ensure complete coverage of the MCR,
  - In areas representing the most likely fire scenario points of origin,
  - In proximity to the expected locations of the operators, and
  - In locations where smoke is expected to accumulate.

  The licensee further stated that the results of the revised MCR abandonment calculations are reflected in the updated fire risk results that were provided to the NRC in the response to PRA RAI 03.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the habitability criteria used for the MCR abandonment calculations are consistent with the guidance in NUREG/CR-6850, and the licensee updated the MCR abandonment calculations to include devices that were placed in locations that are likely to result in the shortest abandonment times.

- In FM RAI 01.i(xiv) (Reference 16), the NRC staff requested that the licensee demonstrate that the abandonment times for a given scenario are not sensitive to variations within the uncertainty of the FDS input parameters.

  In its response to FM RAI 01.i(xiv) (Reference 11), the licensee explained that the MCR abandonment calculations were updated to ensure the fire model inputs provide conservative or bounding results. The licensee further described the conservatisms that were used for the input parameters in the MCR analysis. The licensee further stated that the results of the revised MCR abandonment calculations are reflected in the updated fire risk results that were provided to the NRC in the response to PRA RAI 03.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee updated the MCR abandonment calculations to include conservative input parameters that bound the uncertainty present in the model.

- In FM RAI 01.i(xv) (Reference 16), the NRC staff requested that the licensee explain how the results of the control room abandonment calculations were used in the FPRA.

  In its response to FM RAI 01.i(xv) (Reference 11), the licensee explained that the abandonment times calculated in the MCR analysis were used to calculate the abandonment probability for each scenario, and that the abandonment probabilities for all scenarios were added together to obtain the total probability of control room abandonment. The licensee further stated that total probability of abandonment was multiplied by the ignition frequency, and that the resulting overall abandonment frequency was then used in the quantification task for establishing the CDF and LERF of abandonment scenarios.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee's use of the calculated MCR abandonment times in determining CDF and LERF of abandonment scenarios is consistent with the guidance in NUREG/CR-6850.

- In FM RAI 01.j(i) (Reference 16), the NRC staff requested that the licensee describe the criteria that were used in the MCA to screen multi-compartment scenarios based on the size of the exposing or exposed compartment.

In its response to FM RAI 01.j(i) (Reference 11), the licensee explained that the MCA was updated to include the effects of fire propagation to secondary combustibles and only potentially exclude scenarios from further analysis based on the size of the exposing compartment. The licensee further stated that only compartments for which the highest HRR is below the HRR required to create a damaging HGL will be screened from further consideration. The licensee further stated that the results of the revised MCA calculations are reflected in the updated fire risk results that were provided to the NRC in the response to PRA RAI 03.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee's approach to screen multi-compartment scenarios based on the size of the exposing compartment is consistent with the guidance in NUREG/CR-6850.

- In FM RAI 01.j(ii) (Reference 16), the NRC staff requested that the licensee clarify which FDTs were used for the HGL temperature calculations in the MCA to screen an ignition source based on insufficient HRR to generate an HGL condition in the exposing compartment.

  In its response to FM RAI 01.j(ii) (Reference 11), the licensee explained that FDS was used in the updated MCA to determine the potential of forming a damaging HGL in the exposing compartments where detailed fire modeling was performed, and that the method of McCaffrey, Quintiere, and Harkleroad (MQH) was used to calculate the HGL temperatures for the remainder of the exposing compartments. The licensee further stated that the results of the revised MCA calculations are reflected in the updated fire risk results that were provided to the NRC in the response to PRA RAI 03.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee used fire models that were verified and validated to calculate HGL temperatures in the MCA.

- In FM RAI 01.j(iii) (Reference 16), the NRC staff requested that the licensee explain the technical basis of modeling the ZOI as a vertical cylinder with the radius equal to 0.2 times the ceiling height in multi-compartment scenarios in which the fire is near the opening between the two compartments and the ZOI extends into the exposed compartment.

  In its response to FM RAI 01.j(iii) (Reference 11), the licensee explained that the MCA was updated to eliminate the inclusion step for fires occurring near openings between two adjacent compartments. The licensee further stated that the results of the revised MCA calculations are reflected in the updated fire risk results that were provided to the NRC in the response to PRA RAI 03.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the inclusion step for fires occurring near openings between two adjacent compartments is not required in NUREG/CR-6850.

- In FM RAI 01.j(iv) (Reference 16), the NRC staff requested that the licensee provide technical justification for the assumption in selected multi-compartment FDT calculations that the forced air flow rate is distributed among the interconnected compartments based on the volume of the compartments.

  In its response to FM RAI 01.j(iv) (Reference 11), the licensee explained that the MCA was updated and no longer uses this assumption, and that a compartment will only be screened out of the analysis if both the forced ventilation and natural ventilation will not form a damaging hot gas layer (HGL) in the exposing compartment. The licensee further stated that the results of the revised MCA calculations are reflected in the updated fire risk results that were provided to the NRC in the response to PRA RAI 03.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the referenced assumption is no longer used in the updated MCA.

- In FM RAI 01.j(v) (Reference 16), the NRC staff requested that the licensee describe the additional analysis in the MCA that was performed when there are cable trays, conduits or targets within the ZOI on the exposed side of the barrier that may not be the same as those in the exposing compartment.

  In its response to FM RAI 01.j(v) (Reference 11), the licensee explained that the MCA was updated to eliminate the inclusion step for fires occurring near openings between two adjacent compartments. The licensee further stated that the results of the revised MCA calculations are reflected in the updated fire risk results that were provided to the NRC in the response to PRA RAI 03.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the screening based on the ZOI at the boundaries between the exposing and exposed compartments was removed from the MCA.

- In FM RAI 01.k(i) (Reference 16), the NRC staff requested that the licensee provide technical justification for the assumed delay in smoke detector actuation associated with cross-train logic in the Cable Spreading Room (CSR) FDS analysis.

  In its response to FM RAI 01.k(i) (Reference 11), the licensee explained that the CSR FDS fire modeling analysis was updated to assume that the automatic suppression sequence will begin after the actuation of the second cross-train detector. The licensee further stated that the results of the revised CSR analysis are reflected in the updated fire risk results that were provided to the NRC in the response to PRA RAI 03.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the updated analysis correctly models cross-train detector actuation and automatic suppression timing in the CSR.

- In FM RAI 01.k(ii) (Reference 16), the NRC staff requested that the licensee describe the basis for choosing the FDS temperature and heat flux "devices" in the CSR analysis.

  In its response to FM RAI 01.k(ii) (Reference 11), the licensee explained that the CSR FDS fire modeling analysis was updated to include additional devices in the CSR, and that these devices were located:

  - To ensure complete coverage of the CSR,
  - In larger quantity and spaced closer in areas in the vicinity of the fire,
  - In actual locations within the plant for smoke detectors,
  - Above electrical components throughout the room,

  The licensee further stated that the results of the revised CSR analysis are reflected in the updated fire risk results that were provided to the NRC in the response to PRA RAI 03.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the locations of the additional FDS devices will provide a detailed picture of the actual fire conditions throughout the CSR.

- In FM RAI 01.k(iii) (Reference 16), the NRC staff requested that the licensee provide technical justification for the location of electrical cabinet fires that were considered in the CSR FDS calculations.

  In its response to FM RAI 01.k(iii) (Reference 11), the licensee explained that the CSR FDS fire modeling analysis was updated to analyze electrical cabinet fire scenarios in bounding locations, and described the details that were taken into consideration for creating the bounding scenarios. The licensee further stated that the results of the FDS calculations for the bounding scenarios, such as the ZOI or time to detection and suppression, were used to determine the target damage and non-suppression probability for each ignition source. The licensee further stated that the results of the revised CSR analysis are reflected in the updated fire risk results that were provided to the NRC in the response to PRA RAI 03.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee's updated approach ensures conservative estimates of target damage and non-suppression probability for the electrical cabinet scenarios in the CSR.

- In FM RAI 01.k(iv) (Reference 16), the NRC staff requested that the licensee provide justification for the transient fires that were postulated in the CSR FDS calculations.

  In its response to FM RAI 01.k(iv) (Reference 11), the licensee explained that, although the transient combustible walkdowns of the CSR did not identify any permanent storage locations of transient combustibles or locations where transient combustibles are likely to accumulate, 317 kW transient scenarios were still analyzed in any possible location in the CSR fire areas. The licensee further stated that these scenarios conservatively bound any potential procedural non-compliances of the administrative controls for transient combustibles in these areas, and therefore, the transient fires analyzed in the CSR are only dependent on the administrative controls of transient combustibles already present in the CSR.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the transient fire scenarios that were modeled conservatively bound any potential administrative control non-compliances for transient fire combustibles in the CSR.

- In FM RAI 01.k(v) (Reference 16), the NRC staff requested that the licensee provide justification for the HRR used for the cabinet fires in the CSR FDS calculations.

  In its response to FM RAI 01.k(v) (Reference 11), the licensee explained that the HRR of electrical cabinets in the CSR was that for Case 3 in NUREG/CR-6850, Table E-1 (unqualified cable, fire limited to one bundle, 98th percentile HRR of 211 kW). The licensee further stated that, based on current plant procedures and requirements, it was assumed that there are no open cabinet doors in the CSR.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the assumed HRR of electrical cabinets in the CSR is consistent with plant conditions.

- In FM RAI 01.k(vi) (Reference 16), the NRC staff requested that the licensee explain how secondary combustibles were considered in the Unit 1 and Unit 2 cable spreading room FDS calculations.

  In its response to FM RAI 01.k(vi) (Reference 11), the licensee explained that the lowest tray in a stack was assumed to ignite when the HRR of the electrical cabinet reaches the minimum HRR needed to damage the cables in the tray, and that FDT 09 was used to calculate this minimum HRR. The licensee further stated that the model in NUREG/CR-6850, Section R.4.2 was used to determine the ignited area and to calculate subsequent fire propagation in the stack. The licensee further stated that fire propagation to stacks immediately adjacent to the source was modeled in accordance with FAQ 08-0049. The licensee further explained that it

was assumed some cables are in direct contact with the separating wall between electrical cabinets, and that cabinet fires were therefore assumed to propagate to adjacent cabinets in 10 minutes. The licensee further stated that the results of the revised CSR analysis are reflected in the updated fire risk results that were provided to the NRC in the response to PRA RAI 03.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee's approach to calculate fire propagation in cable trays and between electrical cabinets follows the guidance in NUREG/CR-6850 Appendix R and S, respectively, and there are no significant non-cable secondary combustibles in the CSR.

- During the audit walkdown of the MCR, the NRC staff noted that the main horseshoe and back panel cabinet configurations consist of open cabinets with a steel mesh open top with the open sides facing each other across a narrow aisle. In FM RAI 01.I(i) (Reference 16), the NRC staff requested that the licensee provide technical justification for not using an HRR case applicable to open cabinets, or update the analysis with the appropriate HRR.

  In its response to FM RAI 01.I(i) (Reference 10), the licensee explained that, although the main horseshoe and back panel cabinets contain predominately qualified cable, the licensee updated the MCR abandonment calculations to use the HRR probability distribution from NUREG/CR-6850 Table G-1 for an open cabinet with unqualified cable, fire in more than one cable bundle. The licensee further stated that the results of the revised MCR abandonment calculations are reflected in the updated fire risk results that were provided to the NRC in the response to PRA RAI 03.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the HRR for electrical cabinets assumed in the updated MCR abandonment calculations is conservative and based on NUREG/CR-6850 guidance.

- During the audit walkdown of the MCR, the NRC staff expressed concern about the potential for fire spread across the aisle within the horseshoe. In FM RAI 01.I(ii) (Reference 16), the NRC staff requested that the licensee provide technical justification for not considering this spread in the MCR abandonment calculations.

  In its response to FM RAI 01.I(ii) (Reference 11), the licensee explained that the MCR abandonment calculations were updated to include heat flux gauge devices placed against the cabinets directly across the horseshoe aisle from the initial fire location and the adjacent cabinet sections, and that the FDS device output files were reviewed to confirm that fire spread across the aisle would not occur prior to control room abandonment.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the potential for fire spread across the aisle within the horseshoe was considered in the updated fire modeling analysis consistent with the guidance in NUREG/CR-6850.

- During the audit walkdown of the MCR, the NRC staff observed several combustibles that could potentially have a HRR greater than 317 kW (e.g., kitchen area upholstered furniture in the shift manager's office, and photocopiers). In FM RAI 01.l(iii) (Reference 16), the NRC staff requested that the licensee provide evidence that fires involving these combustibles are bounded by the transient fire scenarios that were considered in the abandonment time calculations.

  In its response to FM RAI 01.l(iii) (Reference 11), the licensee explained that the updated MCR abandonment calculations include an increased transient fire HRR (1000 kW) in locations where greater quantities of transient combustibles are located, and that the FDS results for these scenarios were included in the probability for control room abandonment calculations. The licensee further stated that the results of the revised MCR abandonment calculations are reflected in the updated fire risk results that were provided to the NRC in the response to PRA RAI 03.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee updated the MCR abandonment calculations and included transient fire scenarios that bound fire scenarios involving the combustibles that were observed by NRC staff during the walkdowns.

- In FM RAI 02.a (Reference 16), the NRC staff requested that the licensee describe how the installed cabling in the power block was characterized, and explain how raceways with a mixture of thermoset and thermoplastic cables were treated in terms of damage thresholds.

  In its response to FM RAI 02.a (Reference 11), the licensee explained that a review of all plant cables was performed using the cable database and specifications to determine the type (thermoset or thermoplastic) of cables installed, and that, for PAUs where detailed fire modeling was performed, the damage criteria of NUREG/CR-6850 Appendix H, Table H-1 for these two cable types was used. The licensee further stated that the scoping fire modeling task in areas with thermoset cables only used an alternative target damage threshold of 380°C based on the review of all plant cables, which indicated that the majority of the plant cables are composed of silicon rubber with an asbestos braided jacket and that the second most common cable type has thermoset XLPE insulation with thermoset jacketing material. The licensee further stated that a small amount of cables was found to have thermoset XLPE insulation with thermoplastic PVC jacket, and that a failure temperature of 350°C was selected for use in areas containing thermoplastic jacket cables. The licensee further discussed the

conservatisms in the scoping fire modeling to justify the use of plant-specific target damage thresholds.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the cable target damage thresholds used in the fire modeling analysis are representative of the cables installed in the plant.

- In FM RAI 02.b (Reference 16), the NRC staff requested that the licensee explain how the damage thresholds for non-cable components were determined.

  In its response to FM RAI 02.b (Reference 10), the licensee explained that active, non-combustible components were characterized based on the damage thresholds for the supporting power, control or instrument cables or wiring for the component, and that passive, non-combustible components were considered invulnerable to fire.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the damage threshold for non-cable components was determined using the guidance of NUREG/CR-6850, Appendix H.

- In FM RAI 02.c (Reference 16), the NRC staff requested that the licensee describe the damage criteria that were used for exposed temperature-sensitive equipment, and explain how temperature-sensitive equipment inside an enclosure was treated.

  In its response to FM RAI 02.c (Reference 11), the licensee explained that a damage threshold of 65°C was assumed for sensitive electronics immersed in a HGL, and that the analyses considering damage by radiant heat were consistent with the guidance provided in FAQ 13-0004 (Reference 64). The licensee further stated that field inspections were performed of all cabinets containing sensitive electronics to verify that the limitations in FAQ 13-0004 were not violated.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee followed the guidance in NUREG/CR-6850 and in FAQ 13-004 to establish damage thresholds for temperature-sensitive equipment.

3.4.2.3.3 Conclusion for Section 3.4.2.3

Based on the licensee's description in the LAR, as supplemented, of the process for performing FM in support of the FREs, the NRC staff concludes that the licensee's approach for meeting the requirements of NFPA 805, Section 2.4.3.3 is acceptable because the licensee demonstrated that its approach, methods, and data are appropriate for the nature and scope of the changes being evaluated, are based on the as-built and as-operated and maintained plant, and reflect the operating experience at the plant.

3.4.2.4 Conclusions Regarding Fire PRA Quality

Based on NUREG-0800, Section 19.2 (Reference 35) , Section III.2.2.4.1, summarizing the NRC staff's review of PRA Quality required for a LAR, the NRC staff concludes that the licensee's PRA satisfies the guidance in RG 1.174, Section 2.3, and RG 1.205, Section 4.3 regarding the technical adequacy of the PRA used to support risk assessment to support transition to NFPA 805.

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

The FPRA used to support RI self-approval of changes to the FPP must use an acceptable PRA approach and acceptable methods and data. The NRC staff concludes that the changes already made to the baseline FPRA model to incorporate acceptable methods, as detailed in the response to PRA RAI 03 (Reference 14) and (Reference 15), and discussed above and following completion of all implementation items described in LAR Attachment S, Table S-3, as supplemented, demonstrate that NFPA 805 criteria are satisfied and the PRA is acceptable for use to support self-approval changes to the FPP.

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 Section 3.8.3 of this SE), the NRC staff concludes that the PRA maintenance process is adequate to maintain the quality of the PRA to support self-approval of future RI changes to the FPP under the NFPA 805 license condition.

3.4.3 Fire Risk Evaluations

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

Plant configurations that did not meet the deterministic requirements of NFPA 805, Section 4.2.3.1 were considered VFDRs. VFDRs that will be brought into deterministic compliance

through plant modifications do not require a risk evaluation. The licensee identified the VFDRs that it does not intend to bring into deterministic compliance in LAR Attachment C. For these VFDRs that will be retained and become part of the licensing basis, the licensee used the risk-informed approach, in accordance with NFPA 805, Section 4.2.4.2, to demonstrate that the increased risk from the retained VFDRs is acceptable.

All of the VFDRs identified by the licensee were categorized as separation issues or degraded fire protection systems or features. The VFDRs categorized as separation issues can generally be categorized into the following four types of plant configurations: (1) inadequate separation resulting in fire-induced damage of process equipment or associated cables required for the identified success path; (2) inadequate separation resulting in fire-induced spurious operation of equipment that may defeat the identified success path; (3) inadequate separation resulting in fire-induced failure of process monitoring instrumentation or associated cables required for the identified success path; (4) combinations of the above configurations. More detailed discussion about how VFDRs are identified is provided in Section 3.5 of this SE.

In its response to PRA RAI 18 (Reference 9) and (Reference 11), the licensee described how an FRE is performed for VFDRs. The licensee explained that the change in risk associated with each fire area is obtained by calculating the difference between the CDF and LERF of a compliant plant configuration and the post-transition plant configuration. The licensee further explained that some risk reduction modifications (i.e., non-VFDR modifications) are planned that do not resolve a VFDR but, instead, reduce risk. Non-VFDR modifications are included in both the compliant and post-transition plant configurations. The total change in risk was obtained by summing the change in risk for each fire area and comparing the total for each unit to the RG 1.174 acceptance guidelines.

The post-transition plant is modeled with fire-induced component failures included for retained VFDRs, with all RAs at their nominal values. For cases in which the FPRA did not model equipment associated with a VFDR, as identified in the NSCA, the change in risk is not estimated with the FPRA, but rather designated as having no risk impact based on qualitative evaluation. In its response to PRA RAI 18.a (Reference 9), the licensee stated that VFDRs were removed from the FPRA compliant plant model by setting the VFDR-related cables or basic events to false in all areas. In its response to PRA RAI 18.b (Reference 11), the licensee further clarified that for scenarios that lead to MCR abandonment, RAs that effectively mitigate the failures associated with a VFDR were either adjusted to reflect an equivalent action at the PCS or assumed to be successful in the compliant plant model. While the licensee's method does not eliminate the risk of all credited MCR abandonment RAs in the compliant plant, the NRC staff concludes that the licensee's method for resolving these VFDRs by converting the RAs to PCS actions is acceptable, because actions taken at the PCS, model an acceptable compliant plant, and, therefore, the resulting risk estimate is the difference between a compliant plant configuration and the post-transition plant configuration.

The NRC staff concludes that the licensee's methods for calculating the change in risk associated with VFDRs are acceptable because they are consistent with RG 1.205, Section 2.2.4.1, "Fire Risk Evaluations (Including Recovery Actions) by Fire Area," and FAQ 08-0054 (Reference 60). The NRC staff further concludes that the results of these

calculations for each fire area, which are summarized in LAR Attachment W, Tables W-6 and W-7, as supplemented, demonstrate that the difference between the risk associated with implementation of the deterministic requirements and that of the VFDRs meets the risk acceptance criteria described in NFPA 805, Section 2.4.4.1.

3.4.4 Additional Risk Presented by Recovery Actions

The NRC staff reviewed LAR Attachment C, "NEI 04-02 Table B-3 – Fire Area Transition," LAR Attachment G, "Recovery Actions Transition," and LAR Attachment W, "Fire PRA Insights," during its evaluation of the additional risk presented by the NFPA 805 RAs. 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, and FAQ 07-0030 (Reference 53) for addressing RAs, which included the definition of PCS and RA. Accordingly, any actions required to transfer control to the PCS, or operate equipment from the PCS, 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. Any OPAs required to be performed outside the control room to resolve a VFDR to meet risk criteria, although not performed at the PCS, were considered RAs.

The licensee identified the RAs in LAR Attachment G, Table G-1 and indicated those that are credited for risk reduction as well as those that are required for DID only. In its response to PRA RAI 18 (Reference 9) and (Reference 11), the licensee clarified that DID-RAs are not credited in the FPRA fire area risk estimates. Operator actions that are performed at the PCS following MCR abandonment are also identified in LAR Attachment G, Table G-1, but as explained above, they are not considered RAs.

The additional risk of RAs for each fire area is presented in LAR Attachment W, as supplemented. In LAR Attachment W, Section W.2.1, "Methods Used to Determine Changes in Risk," the licensee stated that the additional risk of RAs for a given fire area was estimated as the sum of the delta risks of the VFDRs that are resolved by crediting a RA. This calculation is consistent with setting the risk of RAs to zero and, therefore, is acceptable. The total additional risk of RAs was obtained by summing the additional risk for each fire area.

According to the supplemented LAR Attachment W (Reference 14) and (Reference 15), the additional risk of RAs is a CDF of 3.44E-06/year and a LERF of 4.10E-07/year for Unit 1, and a CDF of 2.67E-06/year and a LERF of 3.68E-07/year for Unit 2. RG 1.205, Position 2.2.4.1 indicates that the RG 1.174 guidelines are also applicable to the additional risk of RAs and the reported values are below the change in risk acceptance guidelines and, therefore, the NRC staff concludes that they are acceptable. Additionally, the licensee confirmed that the additional risk of RAs in each area is also below the RG 1.174 acceptance guidelines.

Per LAR Attachment G, the licensee reviewed all of the RAs for adverse impact on plant risk per FAQ 07-0030 and stated that no RAs listed in LAR Attachment G, Table G-1 were found to have an adverse impact. Furthermore, all RAs listed in LAR Attachment G were evaluated against the feasibility criteria provided in NEI 04-02 (Reference 7), FAQ 07-0030, and RG

1.205 (Reference 4). The action described in LAR Attachment S, Implementation Item IMP-15, would require the licensee to complete revisions to the post-fire shutdown procedures and associated operator training to incorporate updated NSCA strategies. The NRC staff concludes that this action is acceptable because it will incorporate the provisions of NPFA 805 in the FPP and would be required by the proposed license condition

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

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

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

3.4.6 Cumulative Risk and Combined Changes

In LAR Attachment S, Table S-2, the licensee identified planned NFPA 805 transition modifications that decrease risk rather than bring the plant into compliance with the deterministic requirements of NFPA 805 (i.e., non-VFDR modifications). LAR Attachment W, Section W.2.1 explains that non-VFDR modifications are credited in both the compliant and post-transition plant PRA models used to calculate the fire area change-in-risk estimates presented in LAR Attachment W, Tables W-6 and W-7. The licensee's application to transition to a RI/PB FPP is, therefore, not a combined change request per Section 1.1, "Combined Change Requests," of RG 1.174, Revision 2, and separate estimates of the risk increase and risk decrease are not needed.

As outlined in LAR Attachment W, Table W-1, the total CDF and total LERF are estimated by adding the risk assessment results for internal events (including internal flooding), fire, seismic, and other external hazard events (i.e., tornadoes/high winds). In its response to PRA RAI 03 (Reference 14) and (Reference 15), the licensee identified a number of modifications made to the PRA and its methods, as discussed above in this SE, and provided revised estimates of total fire CDF and LERF for each unit. Total CDF and LERF results for Units 1 and 2, including the revised estimates for total fire CDF and LERF, are summarized in Table 3.4 of this SE. The estimated total CDF and LERF for both units are below the RG 1.174 risk guidelines of 1E-04/year and 1E-05/year, respectively, indicating an increase in CDF of up to 10-5/year and LERF of 10-6/year would normally be acceptable.

The NRC staff found that the reported seismic CDF values are lower than the "weakest link" seismic CDF values of 1.0E-05/year and 1.2E-05/year estimated for Units 1 and 2, in an NRC memorandum on Generic Issue 199 (Reference 96). However, even if these higher values are applied, the total CDF for both units would still remain below 1E-04/year and 1E-05/year respectively. In LAR Attachment W, Section W.2.4, "Total CDF and LERF," the licensee stated that the risk estimates reported in LAR Attachment W, Table W-1 for tornadoes and

high winds are based on the IPEEE values, which bound those obtained from the current high winds PRA model.

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

Hazard Group	Unit 1		Unit 2	
	CDF (/year)	LERF (/year)	CDF (/year)	LERF (/year)
Fire	4.20E-05	3.20E-06	3.99E-05	3.42E-06
Internal Events (including Internal Flooding)	9.50E-06	1.20E-06	9.60E-06	1.20E-06
Seismic	1.10E-06	1.10E-07	1.10E-06	1.10E-07
Tornadoes/High Winds	3.30E-07	1.60E-08	5.40E-07	2.90E-08
TOTAL	5.30E-05	4.52E-06	5.11E-05	4.76E-06

In LAR Attachment W, Tables W-6 and W-7, the licensee provided the delta (Δ) CDF and ΔLERF estimated for each Unit 1 and Unit 2 fire area, respectively, that is not deterministically compliant, in accordance with NFPA 805, Section 4.2.3, "Deterministic Approach." The risk estimates for these fire areas result from planned modifications and administrative controls that will be implemented as part of the transition to NFPA 805, as well as RAs, to reduce the VFDR risk. In letters dated February 24, 2016 (Reference 14) and (Reference 15), the licensee submitted a revised LAR Attachment W that reports change-in-risk estimates after implementing a number of FPRA model and method refinements to use NRC-accepted methods. A total CDF increase of 3.83E-06/year and a LERF increase of 4.74E-07/year were reported for Unit 1; a total CDF increase of 2.81E-06/year and a LERF increase of 4.13E-07/year for Unit 2. The total estimated ΔCDF and ΔLERF for both units are below the RG 1.174 risk acceptance guidelines for Region II of 1E-05/year and 1E-06/year, respectively.

With regard to individual fire areas, the largest fire area risk increases are: 2.40E-06/reactor-year and 3.32E-07/reactor-year for Unit 1 CDF and LERF, respectively, and 1.91E-06/reactor-year and 2.87E-07/reactor-year for Unit 2 CDF and LERF, respectively. These estimates are well below the RG 1.174 risk acceptance guidelines. Based on the results of the licensee's fire risk assessments, the cumulative change-in-risk estimates for all fire areas subject to PB approaches are within the RG 1.174 risk acceptance guidelines.

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

3.4.7 Uncertainty and Sensitivity Analyses

The licensee evaluated key sources of uncertainty and sensitivity in response to NRC RAIs. The licensee used updated fire bin frequencies provided in NUREG/CR-6850, Supplement 1

(i.e., FAQ-08-0048). The guidance in FAQ 08-0048 (Reference 58), states that a sensitivity study should be performed using the mean of the fire frequency bins contained in Section 6 of NUREG/CR-6850 for those bins with an alpha value less than or equal to one. In its response to PRA RAI 17 (Reference 11), and PRA RAI 03 (Reference 14) and (Reference 15), and as discussed in LAR Attachment W, Section W.2.6, "Ignition Frequency Sensitivity Analysis," the licensee performed the sensitivity study consistent with FAQ 08-0048 and confirmed that the total risk and delta risk results remain below the risk acceptance guidelines in RG 1.174, and, therefore, no additional DID measure need be considered. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the results of the sensitivity analysis continue to meet the risk acceptance guidelines in RG 1.174.

In PRA RAI 16 (Reference 16), the NRC staff requested that the licensee clarify whether statistical propagation of parametric uncertainty was performed and if so, whether it addressed the correlation between fire-specific parameters. Although the licensee indicated in its response to PRA RAI 16 (Reference 9) and PRA RAI 03 (Reference 14) and (Reference 15), that risk results provided for the integrated analysis and the supplement to LAR Attachment W represent point estimates, the licensee stated that it performed an uncertainty evaluation to confirm that the corresponding mean values, which reflect propagation of parametric uncertainty (including state-of-knowledge correlation), do not deviate significantly from the point estimates provided. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the point estimates are not significantly different from the corresponding mean values, and also because the licensee demonstrated the ability to perform such calculations as needed to support post transition FREs.

3.4.8 Conclusion for Section 3.4

Based on the information provided by the licensee regarding the fire risk assessment methods, tools, and assumptions used to support transition to NFPA 805, the NRC staff concludes that:

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

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

- LAR Attachment S, Table S-3, Implementation Item IMP-12 states that the licensee will re-evaluate the risk and the net total change-in-risk results after completing implementation of the transition to NFPA 805 and will inform the NRC if risk metrics exceed RG 1.174 risk acceptance guidelines. If these guidelines are exceeded, the licensee will perform additional analytical efforts, procedure changes, and/or plant modifications to assure the risk acceptance guidelines are met.

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

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

- The changes in risk (i.e., ΔCDF and ΔLERF) associated with the proposed alternatives to compliance with the deterministic criteria of NFPA 805 (FREs) are acceptable 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 risk. By meeting the guidance contained in these approved documents, the NRC staff has concluded that the changes in risk are acceptable and therefore meet the requirements of NFPA 805.

- The risk presented by the use of RAs was determined to be in accordance with NFPA 805 Section 4.2.4, and the guidance in RG 1.205, Revision 1. 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 risk acceptance guidelines in RG 1.174, and, therefore, meets the acceptance criteria in RG 1.205, Revision 1.

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

3.5 Nuclear Safety Capability Assessment Results

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

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

NFPA 805, Section 2.2.4, "Performance Criteria" states that:

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

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

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

3.5.1 Nuclear Safety Capability Assessment Results by Fire Area

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

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

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

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

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

In accordance with the above, the process defined in NFPA 805, Chapter 4, provides a framework to select either a deterministic or a PB approach to meet the NSPC. Within each

of these approaches, additional requirements and guidance provide the information necessary for the licensee to perform the engineering analyses necessary to determine which fire protection systems and features are required to meet the NSPC of NFPA 805.

NFPA 805, Section 4.2.2, "Selection of Approach," states that:

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

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

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

CCNPP is a dual unit PWR with sixty-seven (67) individual fire areas including the outside Yard area and buildings, and each fire area is composed of one or more fire zones. Based on the information provided by the licensee in the LAR, 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 identified the fire zones within the fire areas.

Table 3.5-1 of this SE identifies those fire areas that were analyzed using either the deterministic or PB approach in accordance with NFPA 805 Chapter 4 based on the information provided in LAR Attachment C, "NEI 04-02 Table B-3 - Fire Area Transition."

Table 3.5-1 Fire Area and Compliance Strategy Summary

Fire Area	Area Description	NFPA 805 Compliance Basis
Unit 1		
1	Unit 2 No. 21 ECCS Pump Room	Deterministic
2	Unit 2 No. 22 ECCS Pump Room	Deterministic
3	Unit 1 No. 12 ECCS Pump Room	Performance-Based
4	Unit 1 No. 11 ECCS Pump Room	Performance-Based
5	No. 11 Charging Pump Room	Deterministic
6	No. 12 Charging Pump Room	Performance-Based
7	No. 13 Charging Pump Room	Deterministic
8	No. 22 Charging Pump Room	Deterministic
9	No. 23 Charging Pump Room	Deterministic

Fire Area	Area Description	NFPA 805 Compliance Basis
10	(-)10'/(-)15' Hallways and General Areas/No. 21 Charging Pump	Performance-Based
11	Auxiliary Building (All Elevations) General and Miscellaneous Areas	Performance-Based
12	Unit 2 Component Cooling Room	Performance-Based
13	Unit 2 5' Fan Room	Deterministic
14	Unit 1 5' Fan Room	Performance-Based
15	Unit 1 Component Cooling Room	Performance-Based
16	Unit 1 Cable Spreading Room and 1C Cable Chase	Performance-Based
16A	Unit 1 Battery Room No. 11	Performance-Based
16B	Hallway Outside Unit 1 CSR and Battery Rooms	Performance-Based
16C	Unit 1 Battery Room No. 12	Deterministic
17	Unit 2 Cable Spreading Room and 2C Cable Chase	Performance-Based
17A	Unit 2 Battery Room No. 21	Performance-Based
17B	Hallway Outside Unit 2 CSR and Battery Rooms	Performance-Based
17C	Unit 2 Battery Room No. 22	Deterministic
18	Unit 2 27' Switchgear Room	Deterministic
18A	Unit 2 Purge Air Supply Room	Deterministic
19	Unit 1 27' Switchgear Room	Performance-Based
19A	Unit 1 Purge Air Supply Room	Performance-Based
20	Cable Chase 1A	Performance-Based
21	Cable Chase 1B	Performance-Based
22	Cable Chase 2A	Deterministic
23	Cable Chase 2B	Deterministic
24	Control Room Complex	Performance-Based
25	Unit 2 45' Switchgear Room	Deterministic
26	Unit 2 45' East Electrical Penetration Room	Deterministic
27	Unit 2 45' West Electrical Penetration Room	Deterministic
28	2B Diesel Generator Room	Deterministic
29	Unit 2 RWT Room	Deterministic
30	1B Diesel Generator Room and RC Waste Room	Performance-Based
31	2A Diesel Generator Room	Deterministic
32	Unit 1 45' West Electrical Penetration Room	Performance-Based
33	Unit 1 45' East Electrical Penetration Room	Performance-Based
34	Unit 1 45' Switchgear Room	Performance-Based
35	Unit 2 Horizontal Cable Chase	Performance-Based
36	Unit 1 Horizontal Cable Chase	Performance-Based
37	Unit 1 69' West Electrical Penetration Room	Performance-Based
38	Unit 2 69' West Electrical Penetration Room	Deterministic
39	Unit 1 Service Water Pump Room	Performance-Based

Fire Area	Area Description	NFPA 805 Compliance Basis
40	Unit 2 Service Water Pump Room	Deterministic
41	Misc. Waste Evap Room on 69'	Deterministic
42	Unit 1 AFW Pump Room	Deterministic
43	Unit 2 AFW Pump Room	Deterministic
44	Unit 1 RWT Pump Room	Deterministic
AB-1	Aux. Bldg. Stairtower 1	Deterministic
AB-2	Aux. Bldg. Stairtower 2	Deterministic
AB-3	Aux. Bldg. Stairtower 3	Deterministic
AB-4	Aux. Bldg. Stairtower 4	Deterministic
AB-5	Aux. Bldg. Stairtower 5	Deterministic
ABFL	Aux Bldg Slab Containing NFPA 805 Embedded Conduits 69'	Deterministic
1CNMT	Unit 1 Containment	Performance-Based
2CNMT	Unit 2 Containment	Deterministic
DGB1	1A Diesel Generator Building	Deterministic
DGB2	0C Diesel Generator Building	Deterministic
IS	Intake Structure	Performance-Based
KWAL	Vertical K-Line Wall Containing NFPA 805 Embedded Conduits	Deterministic
TBFL	Turb Bldg Slab Containing NFPA 805 Embedded Conduits	Deterministic
TB/NSB/ ACA	Unit 1 and Unit 2 Turbine Building/North Service Building/Access Control Area	Performance-Based
Yard	Outside Yard Area and Buildings	Performance-Based
Unit 2		
1	Unit 2 No. 21 ECCS Pump Room	Deterministic
2	Unit 2 No. 22 ECCS Pump Room	Performance-Based
3	Unit 1 No. 12 ECCS Pump Room	Deterministic
4	Unit 1 No. 11 ECCS Pump Room	Deterministic
5	No. 11 Charging Pump Room	Deterministic
6	No. 12 Charging Pump Room	Deterministic
7	No. 13 Charging Pump Room	Deterministic
8	No. 22 Charging Pump Room	Performance-Based
9	No. 23 Charging Pump Room	Deterministic
10	(-)10'/(-)15' Hallways and General Areas/No. 21 Charging Pump	Performance-Based
11	Auxiliary Building (All Elevations) General and Miscellaneous Areas	Performance-Based
12	Unit 2 Component Cooling Room	Performance-Based
13	Unit 2 5' Fan Room	Performance-Based
14	Unit 1 5' Fan Room	Deterministic
15	Unit 1 Component Cooling Room	Deterministic

Fire Area	Area Description	NFPA 805 Compliance Basis
16	Unit 1 Cable Spreading Room and 1C Cable Chase	Performance-Based
16A	Unit 1 Battery Room No. 11	Performance-Based
16B	Hallway Outside Unit 1 CSR and Battery Rooms	Performance-Based
16C	Unit 1 Battery Room No. 12	Deterministic
17	Unit 2 Cable Spreading Room and 2C Cable Chase	Performance-Based
17A	Unit 2 Battery Room No. 21	Performance-Based
17B	Hallway Outside Unit 2 CSR and Battery Rooms	Performance-Based
17C	Unit 2 Battery Room No. 22	Deterministic
18	Unit 2 27' Switchgear Room	Performance-Based
18A	Unit 2 Purge Air Supply Room	Performance-Based
19	Unit 1 27' Switchgear Room	Deterministic
19A	Unit 1 Purge Air Supply Room	Deterministic
20	Cable Chase 1A	Performance-Based
21	Cable Chase 1B	Deterministic
22	Cable Chase 2A	Performance-Based
23	Cable Chase 2B	Performance-Based
24	Control Room Complex	Performance-Based
25	Unit 2 45' Switchgear Room	Performance-Based
26	Unit 2 45' East Electrical Penetration Room	Performance-Based
27	Unit 2 45' West Electrical Penetration Room	Performance-Based
28	2B Diesel Generator Room	Performance-Based
29	Unit 2 RWT Room	Deterministic
30	1B Diesel Generator Room and RC Waste Room	Deterministic
31	2A Diesel Generator Room	Performance-Based
32	Unit 1 45' West Electrical Penetration Room	Performance-Based
33	Unit 1 45' East Electrical Penetration Room	Deterministic
34	Unit 1 45' Switchgear Room	Deterministic
35	Unit 2 Horizontal Cable Chase	Performance-Based
36	Unit 1 Horizontal Cable Chase	Performance-Based
37	Unit 1 69' West Electrical Penetration Room	Performance-Based
38	Unit 2 69' West Electrical Penetration Room	Performance-Based
39	Unit 1 Service Water Pump Room	Deterministic
40	Unit 2 Service Water Pump Room	Performance-Based
41	Misc. Waste Evap Room on 69'	Deterministic
42	Unit 1 AFW Pump Room	Deterministic
43	Unit 2 AFW Pump Room	Deterministic
44	Unit 1 RWT Pump Room	Deterministic
AB-1	Aux. Bldg. Stairtower 1	Deterministic
AB-2	Aux. Bldg. Stairtower 2	Deterministic
AB-3	Aux. Bldg. Stairtower 3	Deterministic

Fire Area	Area Description	NFPA 805 Compliance Basis
AB-4	Aux. Bldg. Stairtower 4	Deterministic
AB-5	Aux. Bldg. Stairtower 5	Deterministic
ABFL	Aux Bldg Slab Containing NFPA 805 Embedded Conduits 69'	Deterministic
1CNMT	Unit 1 Containment	Deterministic
2CNMT	Unit 2 Containment	Performance-Based
DGB1	1A Diesel Generator Building	Deterministic
DGB2	0C Diesel Generator Building	Deterministic
IS	Intake Structure	Performance-Based
KWAL	Vertical K-Line Wall Containing NFPA 805 Embedded Conduits	Deterministic
TBFL	Turb Bldg Slab Containing NFPA 805 Embedded Conduits	Deterministic
TB/NSB/ ACA	Unit 1 and Unit 2 Turbine Building/North Service Building/Access Control Area	Performance-Based
Yard	Outside Yard Area and Buildings	Performance-Based

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 safe shutdown components required in order to meet the nuclear safety performance criteria.
- Fire detection and suppression systems required to meet the nuclear safety performance criteria.
- An evaluation of the effects of fire suppression activities on the ability to achieve the nuclear safety performance criteria.
- The resolution of each VFDR using either modifications (completed or committed) or the performance of a FRE in accordance with NFPA 805, Section 4.2.4.2.

3.5.1.1 Fire Detection & 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 nuclear safety performance criteria. 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 nuclear safety performance criteria.

The licensee performed a detailed analysis of fire protection features and identified the fire suppression and detection systems required to meet the nuclear safety performance criteria for each fire area. LAR Attachment C, Table C-2, "Summary of NFPA 805 Compliance Basis and Required Fire Protection Systems and Features," lists the fire areas, and identifies if the fire suppression, fire detection systems and fire protection features installed in these areas are required to meet criteria for separation, DID, risk, licensing actions, or EEEEs.

In SSA RAI 08 (Reference 16), the NRC staff requested the licensee to clarify if the fire zone numbers listed in LAR Attachment C, Table C-2, are the same as the room numbers listed in the fire area summary in LAR Attachment C, Table C-1, and if the room numbers in LAR Attachment C correspond with the room numbers cited in the previous licensing actions in LAR Attachment K. The NRC staff also requested the licensee to provide a description of the water curtain(s) that are discussed in LAR Attachment K, Licensing Action 5 to clarify the arrangement of water curtains and the associated sprinkler systems. In its response to SSA RAI 08 (Reference 9), the licensee stated that the "fire zone" numbers listed in Attachment C, Table C-2, are the same as the "room numbers" listed in the fire area summary in LAR Attachment C, Table C-1, and that the "room numbers" in LAR Attachment C also correspond with the "room numbers" cited in the previous licensing actions in LAR Attachment K. The licensee stated that the Room 216A water curtain is supplied by the Room 216A sprinkler system, and that the Room 110 water curtain is supplied by the Room 106 sprinkler system. The NRC staff concludes that the licensee's response to SSA RAI 08 is acceptable because it clarified that the room numbers described in LAR Attachment C Table C-1 are the same as the fire zone numbers in LAR Attachment C Table C-2, and that the sprinkler system in Room 106 is the correct fire suppression system that supplies the water curtain on the corridor Room 110 side of the hatch.

In SSA RAI 11 (Reference 16), the NRC staff noted that in LAR Attachment C, Table C-1, the licensee identified Marinite® boards as fire protection features that are required to protect cables for a fire in Fire AREA 1CNMT (Unit 1 Containment) and 2CNMT (Unit 2 Containment). The NRC staff requested the licensee to describe the extent that Marinite® boards are credited to meet NFPA 805, Chapter 4 requirements, as well as the design and plant configuration of the Marinite® boards and the nuclear safety functions that these passive fire protection features are protecting. The NRC staff also requested that the licensee identify any previous NRC approval for the use of Marinite® boards in containment, which can be credited to meet the separation requirements of NFPA 805 Section 4.2.3.4, or to evaluate acceptability using a PB analysis approach in accordance with NFPA 805 Section 4.2.4. In its response to SSA RAI 11 (Reference 11), the licensee stated that the Marinite® boards will no longer be credited to provide 20 foot separation in Unit 1 and Unit 2 Containments, and stated that the Marinite® boards are credited in the Fire PRA as a "fire break" to prevent spread across the east and west portions of Unit 1 and Unit 2 Containments. The licensee further stated that the

Marinite® boards are not credited to protect the cables inside the trays from fire damage. The licensee stated that there are 4 trays covered in Unit 1, and 3 trays covered in Unit 2, and that the design of the Marinite® boards is as follows:

- A minimum of 25 feet of each cable tray (that traverses between containment east to west) is covered (top to bottom) with ½-inch Marinite® XL.

- The Marinite® board is banded to the trays with 3/8-inch stainless steel banding, minimum of 12 gauge steel.

The licensee stated that site procedures ensure that the Marinite® boards are inspected, in place and free from damage prior to start-up.

The licensee provided revised pages to LAR Attachment C, Table C-1, and removed the credit for the Marinite® boards for Chapter 4 separation criteria in Fire Area 1CNMT and 2CNMT. The licensee further stated that additional VFDRs will be evaluated for acceptability in accordance with NFPA 805, Section 4.2.4 as part of the response to PRA RAI 03. In SSA RAI 11.01 (Reference 18), the NRC staff noted that NFPA 805 Section 4.1 states that once a determination has been made that a fire protection system or feature is required to achieve the performance criteria of Section 1.5, its design and qualification shall meet the applicable requirement of Chapter 3 and requested the licensee to describe the applicable NFPA 805 Chapter 3 requirements that are met for the Marinate® board installations and how the identified Chapter 3 requirements are met, including any qualification fire tests. The NRC staff further requested that the licensee describe the attributes of the Marinite® board installation, as well as performance assumptions, as credited in the PB analysis performed to meet the Chapter 4 criteria and that demonstrate the ability of the Marinite® board to perform its designated "fire break" function. In its response to SSA RAI 11.01 (Reference 13), the licensee stated that the Marinite® boards have been installed and are being credited in a similar manner to metal cable tray top and bottom covers, and that the Marinite® boards are not credited to prevent fire damage to the cables routed in the cable trays. The licensee further stated that the Marinite® boards are credited in the FPRA to prevent fire spread and propagation, and to allow the covered sections of the cable trays to be excluded as a secondary combustible. The licensee stated that this credit is consistent with the cable tray barrier test findings reported in NUREG/CR-6850, Appendix Q, and the testing results reported in NUREG-0381. The NRC concludes that the licensee's response to SSA RAIs 11 and 11.01 are acceptable because the licensee evaluated the Marinite® boards using PB methods as allowed by NFPA 805 to demonstrate that the Marinite® boards will perform as credited in the FPRA.

In SSA RAI 12 (Reference 16), the NRC staff noted that in LAR Attachment C, Table C-2, the licensee makes reference to "Unit 1 Containment (App-R Purposes Only)" and "Unit 2 Containment (App-R Purposes Only)" for fire protection systems and features that appear to be required in NFPA 805, Chapter 4, for separation, risk significance, or DID. The NRC staff requested the licensee to clarify the meaning of "App-R Purposes Only" and if these fire protection system and features are credited with respect to compliance with NFPA 805, Chapter 4. In its response to SSA RAI 12 (Reference 9), the licensee stated that the containment areas were divided into rooms under the Appendix R program and that the descriptions for these rooms contain "(App-R Purposes Only)" within its name. The licensee further stated that the phrase "(App-R Purposes Only)" will be removed from plant documentation upon implementation of NFPA 805 and revised LAR Attachment C and LAR Attachment E. The licensee stated that the fire protection systems and features are credited with respect to compliance with NFPA 805, Chapter 4, and that the containment fire areas will remain subdivided as described in plant documents. Based on its response to SSA RAI 12, the NRC staff concludes that the licensee's response is acceptable because it clarified that the reference to "Appendix-R Purposes Only" was due to the name of the rooms in Unit 1 and Unit 2 Containment and not associated with technical basis for meeting the NSPC, and the licensee revised the LAR accordingly.

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

Based on the statements provided in LAR Attachment C, the NRC staff concludes that the licensee's treatment of this issue is acceptable because it has adequately identified the fire detection and suppression systems required to meet the NFPA 805 nuclear safety performance criteria 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 nuclear safety performance criteria.

The licensee stated that damage to plant areas and equipment from the accumulation of water discharged from manual and automatic fire protection systems and the discharge of manual suppression water to adjacent compartments is controlled. The licensee stated that the effects of an inadvertent actuation of a suppression system in the fire area was evaluated for impact on equipment credited for the NSCA, and that redundant equipment would remain available outside the fire area. The licensee further stated that a CCNPP flooding analysis, which incorporates high energy line breaks and moderate energy line breaks (e.g., fire protection piping), has determined that safe shutdown can be achieved for design bases flooding events postulated. The licensee stated that its fire brigade is trained to discharge water in a judicious manner and instructed to direct hose streams and fire extinguishers in such a way as to limit the amount of overspray beyond the immediate area of the fire. The licensee further stated that consideration is given to the type of fire suppression method used

(fire extinguisher, water, direct, indirect attack, etc.), and that the extinguishment method is based on the type of fire, extent, intensity and the need to limit the quantity of water in areas containing energized electrical and safety-related equipment. The licensee stated that fire brigade members are trained in protecting safety-related equipment from fire and water damage; and, therefore, fire suppression activities will not adversely affect achievement of the nuclear safety performance criteria.

In LAR Attachment C, the licensee stated for a majority of fire areas that "Fire suppression in this fire area will not impact the ability to achieve the NSPC in accordance with NFPA 805, Section 4.2.1 and 4.2.4.1.5." The NRC staff noted that NFPA 805 Section 4.2.4.1.5 is associated with the fire-modeling PB approach, which the licensee stated it did not use in LAR Section 4.5.2.1. In SSA RAI 09a (Reference 16), the NRC staff requested that the licensee clarify the basis for discussing the fire suppression effects for a fire modeling PB approach when the fire areas used a risk evaluation PB approach. In its response to SSA RAI 09a (Reference 10), the licensee stated that the fire modeling PB approach (NFPA 805 Section 4.2.4.1.5) was not used at Calvert Cliffs, and that NFPA 805 Section 4.2.4.1.5 was inadvertently listed in Attachment C, Table C-1 of the LAR. The licensee revised LAR Attachment C and removed the reference to NFPA 805 Section 4.2.4.1.5. The NRC staff concludes that the licensee's response to SSA RAI 09a is acceptable because FM PB analysis was not credited to meet the NSPC and the licensee revised the LAR accordingly.

In LAR Attachment C, the licensee stated that in several fire areas (e.g., Fire Area 18A, 20, 21, 22, 23, 35 and 36) there are no suppression effect concerns for those fire areas, as the fire areas do not contain NSCA equipment. However, the NRC staff noted that there were VFDRs identified in these fire areas. In SSA RAI 09b (Reference 16), the NRC staff requested that the licensee provide additional discussion on fire suppression effects for those fire areas where VFDRs are identified, but the licensee stated that there is no NSCA equipment in the fire area. In its response to SSA RAI 09b (Reference 10), the licensee stated that Fire Areas 18A, 20, 22, 21, 23, 35 and 36 do not contain any NSCA equipment and that the VFDRs are the result of cable failures within the fire areas. The licensee revised LAR Attachment C, Table C-1 to include this information. The NRC staff concludes that the licensee's response to SSA RAI 09b is acceptable because the effects on fire suppression activities on NSCA cables were evaluated and it determined that there were no concerns on the ability to achieve the NSPC, and the licensee revised the LAR accordingly.

In SSA RAI 15d (Reference 16), the NRC staff noted that the licensee's discussion on suppression effects on the nuclear safety performance criteria for fire areas 39 and 40 addressed the impact of suppression damage to redundant instrument air compressors and the saltwater air system, and stated that the AFW air accumulators can be charged from the nitrogen system via a RA; however, no RA was identified in the disposition of the associated VFDRs, or described in LAR Attachment G. In its response to SSA RAI 15d (Reference 11), the licensee stated that the Unit 1 instrument air and saltwater air compressors (SWAC) could both be lost due to the effects of fire and/or suppression in Fire Area 39 and that the Unit 2 instrument air and SWAC compressors could both be lost due to the effects of fire and/or suppression in Fire Area 40. The licensee further stated that the NSCA analysis identified these potential failures as documented in VFDRs 39-01-1 and 40-01-2. The licensee stated

that these VFDRs were evaluated in accordance with NFPA 805, Section 4.2.4.2 and it was determined that the risk, safety margin and DID meet the acceptance criteria of NFPA 805 Section 4.2.4 with no further action, and that RAs are not required for these VFDRs. The licensee revised LAR Attachment C to change the suppression effects section for Fire Areas 39 and 40 to identify that the opposite plant's air system can be aligned to the affected unit's instrument air system from the MCR. The NRC staff reviewed the licensee's response to SSA RAI 15d and concludes that its response is acceptable because the fire suppression effects on the NSPC were evaluated and the VFDRs were resolved using PB analysis in accordance with NFPA 805, Section 4.2.4. On the basis of this analysis, as described by the licensee, no RAs are necessary to mitigate the loss of instrument air. In addition, the licensee revised the LAR to remove discussion of RAs in the fire suppression effects evaluation for Fire Areas 39 and 40.

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

3.5.1.3 Licensing Actions

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

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

Table 3.5-2 Previously Approved Licensing Actions Being Transitioned

Licensing Action Description	**Applicable Fire Areas**	**NRC Staff Evaluation**
Licensing Action No. 1 – Exemption from 10 CFR 50, Appendix R, Section III.G. 2, "Watertight Doors, Bullet Proof Doors, and Water Curtains"	1, 2, 3, 4, 7, 10, 11, 12, 13, 14, 15, 24, 25, 30, 34, 39 and 40	The licensee stated in LAR Attachment K that the basis for the exemption to utilize non-rated watertight doors, bullet proof doors, and water curtains to maintain the 3-hour fire rating of barriers in which they are installed is as follows: • Test report showed that watertight doors, bullet proof doors, and water curtains of the type

Licensing Action Description	Applicable Fire Areas	NRC Staff Evaluation
		proposed, successfully passed a 3 hour fire test in accordance with test method ASTM E-119. • Hydraulic analyses verify the minimum water pressure at the most remote doorway water curtain, under maximum flow conditions, is equal to or greater than that maintained during the ASTM E-119 fire test. The licensee stated that the exemption request that credits a water curtain between the Tendon Gallery (Rooms 121 and 123) from the Piping Area (Rooms 203 and 224) is actually located between the Piping Area (Rooms 203 and 224) and the Recirculation Piping Tunnel (Room 120 and 122). The licensee also notes that room numbers cited in the exemption request that credits a water curtain between the Charging Pump Room (Room 115) and the corridor (Room 100) have changed, and the correct room numbers are now Room 115C and Room 104, respectively. Based on the previous staff approval of this exemption in Safety Evaluation Report dated August 16, 1982 (Reference 23), and the statement by the licensee that the bases remain valid (including the clarification of the location of the water curtains), the NRC staff concludes that the transition of this licensing action is acceptable.
Licensing Action No. 5 – Exemption from 10 CFR 50, Appendix R, Section III.G. 2, "Watertight Doors, Bullet Proof Doors, and Water Curtains"	10, 11, 39 and 40	The licensee stated in LAR Attachment K that the basis for the exemption to utilize non-rated watertight doors and dedicated water curtains to maintain the 3-hour fire rating of barriers in which they are

Licensing Action Description	Applicable Fire Areas	NRC Staff Evaluation
		installed, is as follows: • Test report showed that watertight doors, bullet proof doors, and water curtains of the type proposed, successfully passed a 3 hour fire test in accordance with test method ASTM E-119 • Installation of a dedicated sprinkler head to provide three-hour protection for an unrated metal emergency hatch (Room 110 and Room 216A) • Hydraulic analyses verify the minimum water pressure at the most remote doorway water curtain, under maximum flow conditions, is equal to or greater than that maintained during the ASTM E-119 fire tests. Based on the previous staff approval of this exemption in Safety Evaluation Report dated March 15, 1984 (Reference 25), and the statement by the licensee that the bases remain valid, the NRC staff concludes that the transition of this licensing action is acceptable.
Licensing Action No. 7 – Exemption from 10 CFR 50, Appendix R, Section III.O, "RCP Oil Collection System"	1CNMT and 2CNMT	The licensee stated in LAR Attachment K that the basis for the exemption to utilize two lube oil collection tanks in each containment sized to accommodate the largest possible oil leak for two reactor coolant pump motors, is as follows: • Each of the oil collection tanks has the capacity of 275 gallons, compared to 225 gallons of oil in the lube oil system for each pump.

Licensing Action Description	Applicable Fire Areas	NRC Staff Evaluation
		• The components, except for the collection tanks, have been designed to withstand a safe shutdown earthquake. • If a failure of more than one RCP motor lube system occurred, the oil collection tank would overflow onto the lower containment floor where there are no ignition sources. The NRC staff reviewed the original evaluation and basis for the NRC approval, which included the following additional conditions as described in LAR Attachment K: • An oil spillage protection system has been provided for each reactor coolant pump motor and the system consists of encapsulating devices installed around all potential leakage points. Drain lines are sized and arranged to accommodate the maximum leak. • The oil collection tanks, located on the containment floor, are not ASME Code qualified and are not seismically qualified. They are, however, supported and restrained to prevent movement during the Design Bases Earthquake, thus providing assurance that they will perform their function during and following a Safe Shutdown Earthquake. • All lube oil collection tank vents are equipped with U/L-approved flame arrestors.

Licensing Action Description	Applicable Fire Areas	NRC Staff Evaluation
		• A surveillance procedure has been established to demonstrate that the oil collection systems remain functional, as follows: - At each refueling outage, a visual examination of the encapsulation devices, drain piping, and oil collection tanks is performed prior to startup. - Prior to startup, the oil collection tank level is checked routinely in accordance with the procedure. • The lube oil collection tanks are U/L-approved and the RCPs are separated by a horizontal distance of 25 feet and are seismically supported. • If the oil collection tank were to overflow, the oil would merely flow from the tank vent line down to the floor, an area free of ignition sources, and eventually flow to the containment sump. • The lubricating oil used in the RCP motors has a flash point greater than 400°F. Based on the previous staff approval of this exemption in Safety Evaluation Report dated March 15, 1984 (Reference 25), and the statement by the licensee that the bases remain valid, the NRC staff concludes that the transition of this licensing action is acceptable.

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 exemptions from the deterministic requirements, the basis for and continuing validity of the exemptions, and the

NRC staff's original evaluation or basis for approval of the exemptions. The licensee stated in LAR Section 4.2.3, that its review of these existing licensing actions included a determination of the basis of acceptability and a determination that the basis of acceptability was still valid.

Based on the NRC staff's review of the licensing actions identified and described in LAR 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 utilized the process described in NEI 04-02 (Reference 7) as endorsed by RG 1.205 (Reference 4), 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 statement by the licensee that the basis remains valid, as presented in 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 (EEEEs)

The EEEEs that support compliance with NFPA 805 Chapter 4 were reviewed by the licensee using the methodology contained in NEI 04-02. The methodology for performing the EEEE review included the following determinations:

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

In LAR section 4.2.2, the licensee stated that the guidance in RG 1.205, Regulatory Position 2.3.2, and FAQ 07-0054 [*sic*: 08-0054] was followed. EEEEs that demonstrate that a fire protection system or feature is "adequate for the hazard" are addressed in the LAR as follows:

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

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

The licensee identified and summarized the EEEEs for each fire area in LAR Attachment C, as applicable. The EEEE's used to demonstrate compliance with Chapters 3 and 4 of NFPA

805 are referenced in LAR Attachments A and C, as appropriate. The licensee stated in LAR Section 4.2.2 that none of the transitioning EEEEs require NRC approval.

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

3.5.1.5 Variances from Deterministic Requirements

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

- A FRE determined that applicable risk, DID, and safety margin criteria were satisfied without further action.
- A FRE determined that applicable risk, DID, and safety margin criteria were satisfied with a credited RA.
- A FRE determined that applicable risk, DID, and safety margin criteria were satisfied with a DID RA.
- A FRE determined that applicable risk, DID, and safety margin criteria were satisfied with a plant modification(s).

In SSA RAI 07 (Reference 16), the NRC staff noted that modifications were identified in LAR Attachment S, Table S-2, that appear to resolve certain VFDR issues; however, the disposition of the VFDRs as summarized in LAR Attachment C, Table C-1, does not describe whether the modification was credited or not. The NRC requested that the licensee clarify how the modifications items described below were addressed in the disposition of the VFDRs listed:

- LAR Attachment S, Table S-2, Item 7, which involves modifying control circuits for the pressurizer power operated relief valves (PORVs) 1(2)ERV402 and 1 (2)ERV404, to prevent the PORVs from spuriously opening as it relates to VFDRs 16-46-1, 24-26-1, 16-47-1, 24-27-1,17-41-2, 24-63-2, 17-42-2, and 24-64-2, which involve fire damage to cables which could result in spurious opening of the Pressurizer PORV.
- LAR Attachment S, Table S-2, Item 8, which involves modifying the control circuits for the AFW steam admission valves 1(2)CV4070 and 1(2)CV4071 to ensure adequate separation such that one set of valves will be available during a fire in either the CSR or switchgear rooms, as it relates to VFDRs (16-22-1, 17-16-2, 16-

26-1, and 17-26-2), which involve fire damage to cables that could cause the loss of control and/or spurious operation of 1(2)CV4070 and 1(2)CV4071.

- LAR Attachment S, Table S-2, Item 11, which involves modifying control circuits for the MSIVs 1(2)CV4043OP and 1(2)CV4048OP, to ensure at least one solenoid dump valve can be energized to close the MSIVs, as it relates to VFDRs 16-31-1, 16-32-1, 17-23-2, and 17-24-2, which involve fire damage to cables that could cause a loss of control and/or spurious operation of the associated MSIV.

In its response to SSA RAI 07 (Reference 11), the licensee stated the modification identified in LAR Attachment S, Table S-2, Item 7 will not prevent the possible spurious operation of the PORVs due to a fire in Fire Areas 16, 17 or 24, and that NSCA credits a RA for DID to ensure the PORVs are closed. The licensee stated that the modification identified in LAR Attachment S, Table S-2, Item 8 will prevent the potential for a loss of control and/or spurious operation of the AFW Steam Admission valves as identified in VFDRs 16-22-1 and 17-16-2, and that the modification will not prevent the potential for a loss of control and/or spurious operation of the AFW Steam Admission Valves as identified in VFDRs 16-26-1 and 17-26-2. The licensee stated that a RA is required for DID for these failures in Fire Areas 16 and 17. The licensee stated that the modification identified in LAR Attachment S, Table S-2, Item 11 will prevent the potential for a loss of control and/or spurious operation of the MSIVs as identified in VFDRs 16-31-1, 16-32-1, 17-23-2 and 17-24-2, and revised the LAR accordingly. The NRC staff concludes that the licensee's response to SSA RAI 07 is acceptable because it provided the clarification necessary for the NRC staff to complete its evaluation of the disposition of the subject VFDRs relative to the modifications identified in LAR Attachment S. In a letter dated April 22, 2016 (Reference 15), the licensee indicated that LAR Attachment S, Table S-2, Item 7 is no longer required in the FPRA.

In SSA RAI 15c (Reference 16), the NRC staff noted that for several fire areas in LAR Attachment C (e.g., Fire Areas 18, 19, 20, 21, and 22), the method of accomplishing the vital auxiliaries performance goal indicated that instrument air may be recoverable from the opposite unit plant air system; however, the VFDRs associated with the fire areas (e.g., VFDRs 18-16-2, 19-01-1, 20-02-1, 21-02-1, and 22-05-2) state that plant air from the opposite unit cannot be used because of failure of 1CV2061 or 2CV2061, and the VFDR disposition credits an RA that involves aligning backup nitrogen to the affected unit control valves. The NRC staff requested clarification on discrepancies in the use and recovery of the instrument air system in Fire Areas 18, 19, 20, 21 and 22 as described in LAR Attachment C. In its response to SSA RAI 15c (Reference 11), the licensee stated that the VFDRs associated with the loss of instrument air in Fire Areas 18, 19, 20, 21 and 22 will be mitigated by a RA to align the opposite unit's plant air system and that the RA to align nitrogen will not be used for these VFDRs. The licensee clarified the compliance strategies for specific VFDRs associated with the instrument air system in Fire Areas 18, 19, 20, 21 and 22, as follows:

- Fire Area 18 - The licensee stated that the compliance statement in LAR Attachment C, which states that Unit 2 instrument air is recoverable from Unit 1 plant air, is correct and that VFDR 18-16-2 is misleading in stating that Unit 1 plant

air cannot be used to mitigate the loss of the Unit 2 instrument air system because plant air can be aligned to the instrument air system with a RA to open 2CV2061.

- Fire Area 19 - The licensee stated that the compliance statement in LAR Attachment C, which states that Unit 1 instrument air is recoverable from Unit 2 plant air, is correct and that VFDR 19-01-1 is misleading by stating that Unit 2 plant air cannot be used to mitigate the loss of the Unit 1 instrument air system because plant air can be aligned to the instrument air system with a RA to open 1CV2061.

- Fire Area 20 - The licensee stated that the compliance statement in LAR Attachment C, which states that Unit 1 instrument air is recoverable from Unit 2 plant air, is correct and that VFDR 20-02-1 is misleading by stating that Unit 2 plant air cannot be used to mitigate the loss of Unit 1 instrument air system because plant air can be aligned to the instrument air system with a RA to open 1 CV2061.

- Fire Area 21 - The licensee stated that the compliance statement in LAR Attachment C, which states that Unit 1 instrument air is recoverable from Unit 2 plant air, is correct and that VFDR 21-02-1 is misleading by stating that Unit 2 plant air cannot be used to mitigate the loss of Unit 1 instrument air system because plant air can be aligned to the instrument air system with a RA to open 1 CV2061 credited for DID.

- Fire Area 22 - The licensee stated that the compliance statement in LAR Attachment C, which states that Unit 2 instrument air is recoverable from Unit 1 plant air, is correct and that VFDR 22-05-2 is misleading by stating that Unit 1 plant air cannot be used to mitigate the loss of Unit 2 instrument air system because plant air can be aligned to the instrument air system with a RA to open 2CV2061.

For each of the areas discussed above, the licensee revised LAR Attachment C, which corrected the compliance strategy for the associated VFDR, and revised LAR Attachment G, which corrected the RA description. In an E-Mail dated August 2, 2016 (Reference 97), the licensee stated that the RAs for VFDRs 18-16-2, 19-01-1, 20-02-1, 21-02-1, and 22-05-2 associated with the loss of instrument air were not required and indicated that updated LAR Attachments C and G were provided in its April 22, 2016 (Reference 15), letter. The NRC staff concludes that the licensee's resolution of this issue is acceptable because the licensee clarified the compliance strategies for meeting the NSPC for the instrument air system in Fire Areas 18, 29, 20, 21 as no longer requiring RAs, and revised the LAR accordingly.

In SSA RAI 16 (Reference 16), the NRC staff noted that in LAR Attachment C, the NSCA summary of vital auxiliaries in Fire Area 17B identifies that control room and cable spreading room heating, ventilating and air condition (HVAC) is not available without a RA and referenced VFDR 17B-01-0; however, in the disposition for the VFDR, the licensee stated that no RAs were required based on the PB analysis. In its response to SSA RAI 16 (Reference 9), the licensee stated that the results of the FRE determined that risk, safety margin, and DID met the acceptance criteria of NFPA 805 Section 4.2.4 with no further action required and revised the LAR accordingly. The NRC concludes that the licensee's response to SSA RAI 16

is acceptable because it clarified the results of the PB analysis and revised the LAR to describe the results of the resolution to VFDR 17B-01-0.

For all fire areas where the licensee used the PB approach to meet the nuclear safety performance criteria, each VFDR and the associated disposition has been described in LAR Attachment C. Based on the NRC staff review of the VFDRs and associated resolutions as described in LAR Attachment C, as supplemented, the NRC staff concludes that the licensee's identification and resolution of the VFDRs is acceptable.

3.5.1.6 Recovery Actions

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

The guidance of RG 1.205, Section 2.4, states that operation of alternative or dedicated shutdown controls at the PCS while the MCR remains the command and control location would be considered a RA because, for such scenarios, the dedicated or alternative controls are not considered primary. In SSA RAI 05a (Reference 16), the NRC staff requested the licensee to clarify if the control room remains the command and control location for a fire in Fire Areas 16 and 17, and discuss how the RAs at the PCS are evaluated for compliance with NFPA 805 Section 4.2.4. In SSA RAI 05b-d (Reference 16), the NRC staff requested the licensee to clarify the basis for performing the following RAs:

- RAs performed at the PCS that are not associated with VFDRs: 16ICHECKRXSD1, 16ICONSERVE1, 16ISECHTR11_13, 16IADV1C43; 16I1C43CONTROL, 16IRCSTEMP, 17ICHECKRXSD2, 17ICONSERVE2, 17ISECHTR21_23, 17IADV2C43; 17I2C43CONTROL and 17IRCSTEMP2

- RAs in Fire Area 16 associated with energizing and securing pressurizer backup heater banks 11 and 13 at the PCS that appear to conflict.

- RAs associated with controlling atmospheric dump valves are associated with VFDRs 16-27-1 and 17-25-2 when its respective hand valve is locally operated, and not associated with a VFDR when the dump valves are controlled at the PCS.

In its response to SSA RAI 05a (Reference 10), the licensee stated that for a fire in Fire Area 16, the Unit 1 Alternate Shutdown Panel is the PCS for Unit 1 and the Control Room is the command and control location for Unit 2, and for a fire in Fire Area 17, the Unit 2 Alternate Shutdown Panel is the PCS for Unit 2 and the Control Room is the command and control location for Unit 1. The licensee further stated that all actions not taken at the specified command and control station (MCR or PCS) for the fire area/unit combination are documented with a VFDR and evaluated in accordance with NFPA 805, Section 4.2.4.2. In its response to SSA RAI 05b-d, the licensee clarified that actions identified to be performed at the PCS are not considered to be RAs because they are performed at the PCS and that a VFDR does not

need to be documented and evaluated in accordance with NFPA 805 Section 4.2.4.2. The NRC staff concludes that the licensee's responses to SSA RAI 05a-d are acceptable because its treatment of RAs is consistent with NFPA 805 requirements and the method of identifying VFDRs is consistent with guidance in RG 1.205, NEI 04-02 and FAQ 07-0030.

In a letter dated February 24, 2016 (Reference 14), the licensee indicated that the risk, DID, and safety margin criteria were met with no further action related to VFDR 16-27-1, (ADVs 1CV-3938 and 1CV-3939), and VFDRs 16-61-2, and 17-25-2 (ADVs 2CV-3938 and 2CV-3939), citing the use of the safety relief valves for controlling steam generator pressure. The NRC staff found that the licensee's revisions to LAR Attachment G, Table G-1 created inconsistencies with the approach to disposition the VFDR in that the licensee removed the RAs to reposition steam generator ADV hand valves, but maintained the PCS action to initialize the ADV hand controllers at the PCS panel 1C43 and 2C43 to control RCS temperature and verify natural circulation. In the summary of results for Step 1 in LAR Attachment G, the licensee stated that the hand valves associated with the ADV hand controller on panels 1C43 and 2C43, respectively, are required to be repositioned in order to enable operation of the ADVs from panels 1C43 and 2C43. In a letter dated April 22, 2016 (Reference 15), the licensee clarified that the hand controllers at the PCS panels 1C43 and 2C43 for the steam generator ADVs for both units are not credited to meet the NSPC for a fire in fire area 16 or 17. The licensee further stated that the description of the local actions required to enable the 1C43 and 2C43 hand controllers in LAR Attachment G is accurate, but these actions are not a NFPA 805 RA, since they are not required to reduce risk or for DID in fire areas 16 or 17. The NRC staff concludes that the licensee's clarification of actions associated with the hand valves and respective hand controllers for the steam generator ADVs are acceptable because these actions are not required for risk reduction or DID in the disposition of VFDRs 16-27-1, 16-61-2, and 17-25-2.

In SSA RAI 06 (Reference 16), the NRC staff noted there appeared to be conflicting information between the results of the NSCA in LAR Attachment C and the summary of the results in LAR Attachment W for a number of fire areas, which included discrepancies such as the applicable nuclear safety compliance approach (deterministic or PB), the identification of VFDRs, and RAs that were credited in the FREs. In its response to SSA RAI 06 (Reference 11), the licensee stated that the NSCA described in LAR Attachment C correctly describes the nuclear safety compliance strategy for the fire areas identified in SSA RAI 06. The licensee provided the corrections in revised pages to LAR Attachment W. The NRC staff concludes that the licensee's response to SSA RAI 06 is acceptable because the licensee confirmed the nuclear safety compliance strategies in LAR Attachment C are correct and revised LAR Attachment W accordingly.

In SSA RAI 14 (Reference 16), the NRC staff requested the licensee to provide a description of any RAs that require the cross-connecting of Unit 1 and Unit 2 systems to achieve the nuclear safety performance criteria, including a description of how the feasibility analysis reflects the Unit 1 and Unit 2 staffing, communication, and operational interface. The NRC staff also requested a description of any operational impacts (by fire), if any, on the unaffected unit created by cross-tying these systems and to describe whether TS 3.0.3 is entered once the cross-tie with the opposite unit has been completed for fire safe shutdown. In its response

to SSA RAI 14 (Reference 9), the licensee stated that the only RAs that credit a cross-tie between Unit 1 and Unit 2 systems to achieve the NSPC are cross-connecting air systems and that the RAs are credited in Fire Areas 18, 19, 20, 22, 25 and 34 for the VFDR to reduce the risk due to fire in that area. The licensee further stated that the RA to cross-tie plant air systems requires staff from both units, and that the fire impacted unit staff will direct/request the supporting unit to perform the required alignment and operate the necessary equipment under their cognizance and report back to the fire impacted unit operators. The licensee further stated that the feasibility analysis identifies RAs, including sub-steps, by unit and operator to ensure adequate staffing and that communications between the units is specifically directed and maintained by plant procedures. The licensee stated that there are no RAs which credit unit cross-tie which require entry into TS Limiting Condition of Operation (LCO) 3.0.3. In an E-Mail dated August 2, 2016 (Reference 97) the licensee stated that the RAs that cross-tie Unit 1 and Unit 2 systems for Fire Areas 18, 19, 20, 22, 25 and 34 were not required and indicated that updated LAR Attachments C and G were provided in its April 22, 2016 (Reference 15), letter to indicate this. The NRC staff concludes that the licensee's resolution to this issue is acceptable because the licensee clarified that the RAs to cross-tie the Unit 1 and Unit 2 air systems are not required and updated the LAR accordingly.

In SSA RAI 17 (Reference 16), the NRC staff noted that there are RAs credited in Unit 1 Fire Areas 11, 16, 17, 18 and 20 and Unit 2 Fire Areas 22, 25, 34 and yard that involve providing portable fans for temporary cooling of switchgear rooms, and that plant procedures indicate the use of portable generators to power the fans if normal power is not available. The NRC staff requested the licensee to:

- Describe the location of the portable generators and the location of NSCA structures, systems, and components (SSCs), if any, in the vicinity of these location(s);

- A summary of the procedure guidance for the use of portable gas generators and how the RA aligns with each of the feasibility criteria of FAQ 07-0030 (i.e., training, procedures, drills, etc.).

- Describe the type of fuel and quantity associated with the portable generators and the availability and the location(s) of sufficient fuel sources to support maintaining safe and stable conditions for the time period required.

- Provide justification that refueling the generators does not present a fire exposure hazard to NSCA SSCs.

- Describe the installation of temporary power cables, connections to distribution panels, and any disruptions to fire area boundaries.

- Describe the method (e.g., the analyzed ventilation path configuration) of providing temporary cooling when portable fans are used for these RAs.

In its response to SSA RAI 17 (Reference 11), the licensee stated that should the use of portable generators be required to supply power to the fans used to provide cooling to switchgear rooms, the generator will be placed outside of the turbine building in the yard. The licensee stated that the U4000 transformers, which are relied upon in the NSCA analysis, are located in the yard approximately 50-ft from the area where the generator will be located and that the operation of the generator or refueling the generator will not impact the function or operability of the U4000 transformers based on it having a minimal fire severity/load for the yard fire area, and the U4000 transformers located a sufficient distance away from the portable generators to not represent a fire risk. The licensee further stated that the portable generators are fueled by gasoline and have a 7.2 gallon capacity onboard tank. The licensee stated that each generator will run for 10 hours at 50% load, and that the load demand from the cooling fans is below 50% capacity of the generators; therefore, with two generators available per unit, a scenario that requires two rooms to be cooled via the fans will have 20 hours of run time prior to requiring refuel. The licensee further stated that additional fuel can readily be obtained from outside sources within a 20 hour time frame, thereby maintaining the ability to provide cooling for any duration that is required. The licensee stated that the use of the portable generators to supply power to the fans, via an extension cord, does not require connections to distribution panels or disrupt any fire area boundary. The licensee stated that the analyzed ventilation path configuration is air from the turbine building directed into the switchgear rooms via the portable fans at the switchgear room roll up door, which is lowered down to rest on top of the fans, and that the personnel access door to the switchgear room is opened for the ventilation path exhaust. The NRC staff concludes that the response to SSA RAI 17 is acceptable because the RAs to use portable fuel-fired generators, as described by the licensee, do not present a fire exposure hazard to NSCA SSCs because the portable generators have a minimal fire severity/load and are located approximately 50-feet away from the location of the NSCA SSCs. In addition, the generators are provided with sufficient fuel to support maintaining safe and stable conditions for an extended period and the actions to use the generators are proceduralized and have been subjected to a feasibility evaluation in accordance with RG 1.205, NEI 04-02 and FAQ 07-0030 as described in LAR Attachment G.

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 RAs per NFPA 805. The details of the NRC staff review for RAs are described in Section 3.2.5, "Establishing Recovery Actions" of this SE. The NRC staff's evaluation of the additional risk of RAs credited to meet the risk acceptance guidelines is provided in Section 3.4.4 of this SE.

3.5.1.7 Recovery Actions Credited for Defense-in-Depth

The licensee stated in the LAR that RAs may also be credited based on an evaluation of the VFDR's impact to DID features within a compartment/fire area.

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

necessitates that these actions would be subject to a plant change evaluation 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 Section 3.2.5, "Establishing Recovery Actions" of this SE.

3.5.1.8 Plant Fire Barriers and Separations

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

In SSA RAI 10 (Reference 16), the NRC staff noted that LAR Section 4.5.2.2 states there are no VFDRs that involve PB evaluations related to wrapped or embedded cables; however, Fire Areas 18, 19, 35, 36, and TB/NSB/ACA are performance-based fire areas and an EEEE was performed to evaluate the acceptability of cables in embedded conduits in the Turbine Building floor slab (elevation 27-ft); the floor/ceiling slab between stairwells AB-4 and AB-5; and the horizontal cable chases (Room 517 and 518). The NRC staff requested the licensee to clarify if the disposition of the VFDRs in Fire Areas 18, 19, 35, 36 and TB/NSB/ACA credit the embedment as evaluated in the EEEE. In its response to SSA RAI 10, the licensee stated that the EEEE includes an evaluation of the acceptability of the embedment depth of the conduits routed in the barriers of Fire Areas 18, 19 and TB/NSB/ACA to ensure cable damage will not occur due to fire because the depth of the embedment of these conduits does not meet the required depth of 6.2 inches to achieve a 3 hour fire rating in siliceous concrete. The licensee further stated that the evaluation concludes that the embedded configuration of these conduits will provide sufficient fire resistance capability to withstand the hazards in the areas and therefore not adversely impact the ability to achieve and maintain the nuclear safety performance goals. The licensee stated that the EEEE was credited and referenced in Attachment C for Fire Areas 18, 19 and TB/NSB/ACA, and that the cables routed in these conduits were excluded from the analysis for Fire Areas 18, 19 and TB/NSB/ACA unless they specifically exited the barrier into the area. The licensee further stated that the cables within these conduits will therefore not contribute to a VFDR and embedment is not utilized in the disposition of a VFDR. The licensee stated that the EEEE is referenced in Attachment C for Fire Areas 35 and 36 due to fire area barriers analyzed within the evaluation, and that there are no embedded conduits analyzed in these areas and no embedded conduits are utilized in the disposition of a VFDR. The NRC staff concludes that the licensee's response to SSA RAI 10 is acceptable because one success path of required cables is protected by fire barriers that were evaluated in an EEEE that determined the embedded configuration is adequate for the hazard and provides an acceptable fire area boundary between the room and the embedded cables.

Fire area boundaries are established for those areas described in LAR Attachment C, as modified by applicable Licensing Actions 1 and 5, and EEEEs that determine the barriers are adequate for the hazard or otherwise disposition differences in barrier design and performance from applicable criteria. The acceptability of fire barriers and separations is also evaluated as part of the NRC staff's review of LAR Attachment A, Table B-1 process and as such are addressed in Section 3.1 of this SE.

3.5.1.9 Electrical Raceway Fire Barrier Systems (ERFBS)

The licensee stated in LAR Attachment A, Table B-1, Section 3.11.5 that there were no ERFBS credited for compliance with NFPA 805 Chapter 4, and there were no VFDRs associated with ERFBS.

3.5.1.10 Conclusion for Section 3.5.1

As documented in LAR Attachment C, for those fire areas that used a deterministic approach in accordance with NFPA 805, Section 4.2.3, the NRC staff concludes that each of the fire areas analyzed using the deterministic approach meet the associated criteria of NFPA 805, Section 4.2.3. This conclusion is based on:

- The licensee's documented compliance with NFPA 805, Section 4.2.3;
- The licensee's assertion that the success path will be free of fire damage without reliance on RAs;
- The licensee's assessment that the suppression systems in the fire area will have no impact on the ability to meet the nuclear safety performance criteria; and
- The licensee's appropriate determination of the automatic fire suppression and detection systems required to meet the nuclear safety performance criteria.

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:

- Exemptions from the pre-NFPA 805 fire protection licensing basis that were transitioned to the NFPA 805 licensing basis were reviewed for applicability, as well as continued validity, and found acceptable.
- VFDRs were evaluated and either found to be acceptable based on an integrated assessment of risk, DID, and safety margins, or modifications or RAs were identified and actions planned or implemented to address the issue.

- RAs used to demonstrate the availability of a success path to achieve the nuclear safety performance criteria were evaluated and the additional risk of their use determined, reported, and found to be acceptable.

- The licensee's analysis appropriately identified the fire protection SSCs required to meet the nuclear safety performance criteria, including fire suppression and detection systems.

- Fire area boundaries (ceilings, walls, and floors), such as fire barriers, fire barrier penetrations, and through penetration fire stops were established for the fire areas described in LAR Attachment C.

Accordingly, the NRC staff concludes that each fire area utilizing the PB approach meets the applicable requirements of NFPA 805 Section 4.2.

3.5.2 Clarification of Prior NRC Approvals

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

3.5.3 Fire Protection during Non-Power Operational Modes

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

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

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

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

The NRC staff reviewed LAR Section 4.3, "Non-Power Operational Modes" and Attachment D, "NEI 04-02 Non-Power Operational Modes Transition," to evaluate the licensee's treatment of potential fire impacts during non-power operational modes (NPOs). The licensee used the process described in NEI 04-02, Revision 2, as modified by FAQ 07-0040 (Reference 57), for demonstrating that the nuclear safety performance criteria 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 LAR Attachment D, the licensee stated that the process used to demonstrate that the nuclear safety performance criteria are met during NPO modes is consistent with the guidance contained in FAQ 07-0040. In LAR Attachment D, the licensee

stated that procedures define "Higher Risk Evolution"; however, the licensee stated that the conditions affecting time to boil, inventory, and decay heat removal capability were not specifically considered HREs. The licensee stated that it utilized a qualitative analysis of plant conditions during NPO evolutions which determined that the reduced inventory/mid-loop operation condition was the highest risk period. The licensee further stated that the NPO analysis determined that the evolutions performed, and the plant conditions experienced by CCNPP during an outage are consistent with the plant operational states (POS) discussed in FAQ 07-0040. The licensee stated that in the absence of an explicit list of plant conditions which are to be considered as higher risk evolutions, the generic plant conditions known as POS were analyzed, and that this is consistent with the approach provided in FAQ 07-0040. The licensee identified an action in LAR Attachment S, Table S-3, Implementation Item IMP-4 to revise plant outage risk management procedures to include an explicit list of plant conditions to be considered a HRE that will include time to boil, reactor coolant system inventory, and decay heat removal. The NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

In LAR Attachment D, the licensee stated that the following POS and key safety functions (KSF) were considered in the NPO analysis:

- POS 1 conditions (shutdown, on SDC, RCS closed such that SG (steam generation) could be used for DHR (decay heat removal) if the secondary side is filled) were analyzed for the NPO review and were further described as two conditions with separate dispositions:
    - POS 1 (SG available for DHR) is previously analyzed as part of the at-power NSCA and has not been reanalyzed under this NPO review.
    - POS 1 (SG not available due to secondary inventory) is included in the NPO review and that inventory makeup and RCS isolation capability is also included in the NPO analysis.
- POS 2 conditions (RCS vented, SDC in service) were analyzed as part of the NPO analysis and include the reduced inventory and mid-loop condition. The licensee stated that this POS was qualitatively considered to be the period of highest risk for CCNPP.
- POS 3 conditions (RCS not intact, refueling cavity filled to at least refueling height) were analyzed as part of the NPO analysis and include the ability to isolate the RCS and prevent fire induced draindown from lowering RCS inventory margin.

As described in LAR Section 4.3 and LAR Attachment D, the licensee identified equipment and cables necessary to support the key safety functions (KSFs) success paths and performed analysis on a fire area basis to identify areas where redundant equipment and cables credited for a given KSF might fail due to fire damage (i.e., pinch-points). The licensee used a deterministic approach to identify these pinch-points and mitigated these pinch-points

by identifying resolutions that included engineering justification for condition acceptability as well as strategies per FAQ-0040 guidance. As stated in LAR Section 4.3.2, fire modeling was not used to eliminate any fire area from having a pinch-point.

3.5.3.2 NPO Analysis Process

In LAR Section 4.3.1, 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, and that during low risk periods, normal risk management controls and fire prevention/protection processes and procedures will be used.

The licensee stated in LAR Section 4.3.1 that the process to demonstrate that the nuclear safety performance criteria are met during NPO modes involved the following:

- Reviewing the existing outage management processes;
- Identifying equipment and cables, including review of plant systems to determine success paths that support each of the DID KSF, and identifying cables required for the selected components and determining their routing;
- Performing fire area assessments to identify "pinch points; and
- Managing pinch-points associated with fire-induced vulnerabilities during the outage.

In LAR Section 4.3.2, the licensee stated that plant operational states were reviewed and the systems and equipment selected. The licensee stated that components were identified to provide the NPO KSF of core cooling, inventory control, reactivity control, and support functions (process monitoring for inventory, and electrical power), and power supplies, interlocks, and supporting equipment were logically tied to their parent component. The licensee further stated that these data relationships were stored electronically for use with an analytical software tool.

The licensee also stated that for those components which required cables to perform the NPO function, where the same function had not been identified for other NFPA 805 tasks, additional cable selection was performed per the NSCA methodology. The licensee stated in LAR Attachment D that fifty-seven (57) additional components were selected for the NPO model which had not previously been analyzed in the NSCA.

In SSA RAI 13b (Reference 16), the NRC staff requested a list of those components that had not previously been analyzed in support of the at-power analysis or whose functional requirements may have been different for the non-power analysis. The NRC staff also requested information on the description of the difference between the at-power safe shutdown function and the NPO function, including a general description by system indicating why components would be selected for NPO and not be included in the at-power analysis. In its response to SSA RAI 13b (Reference 9), the licensee stated that in its NPO analysis, functional differences can be identified by comparing the required NSCA and NPO positions and generated cable selection packages for components credited in the NPO evaluation that have a different function from the function required by the NSCA for all credited functions.

The licensee further stated that the differences in equipment and functions are typically attributable to the difference in plant operating state, and that some examples of systems where a change in state or different equipment selection may occur include the following:

- Process monitoring – different instruments are required due to differences in plant operating state and differences in credited systems (e.g. shutdown cooling).
- Shutdown cooling (low pressure safety injection) – credited for the decay heat removal (DHR) KSF in NPO, not credited in NSCA.
- Shutdown cooling isolation valves – required closed high low pressure interface for the NSCA, required open for the DHR KSF in NPO.
- High pressure safety injection – credited for the Inventory KSF in NPO, not credited in NSCA.
- Auxiliary feedwater system – required operable for DHR in NSCA, not credited in NPO.

The NRC staff concludes that the licensee's response to SSA RAI 13b is acceptable because it identifies the differences between the at-power and NPO conditions, which would require equipment to be added or a new function to be considered in the NPO analysis.

3.5.3.3 NPO Key Safety Functions and SSCs Used to Achieve Performance

In LAR Attachment D, the licensee stated that the NPO KSFs were explicitly analyzed as part of the NPO review for the following functions: decay heat removal, inventory control, reactivity control, and support equipment/systems to provide electrical power (power availability), process cooling, and HVAC support.

The licensee stated in LAR Section 4.3.2 that the cables necessary to support the selected function of a component were selected and analyzed for fire impact and any area experiencing fire damage which eliminates all success paths for an NPO KSF was considered a 'pinch point.' In LAR Attachment D, the licensee stated that pinch-points were conservatively assigned in fire areas where FAQ 07-0040 strategies were required to resolve cable or equipment failure due to fire damage. The licensee further stated that for Unit 1, 51 areas containing pinch points were identified, and for Unit 2, 46 areas containing pinch points were identified. The licensee further stated that 35 of the areas identified are pinch points for Units 1 and 2.

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

In SSA RAI 13d (Reference 16), the NRC staff noted that during NPO modes, spurious actuation of valves can have a significant impact on the ability to maintain decay heat removal and inventory control. The NRC staff requested that the licensee provide a description of any actions being credited to minimize the impact of fire-induced spurious actuations on power-operated valves (e.g., air-operated valves and motor-operated valves) during NPO (e.g., pre-fire rack-out, actuation of or pinning of valves, and isolation of air supplies). In its response to SSA RAI 13d (Reference 10), the licensee stated that the NPO analysis does not specifically credit any actions to prevent spurious actuations during NPO; however, the licensee stated that pre-positioning has not been excluded as a method of mitigating fire impact to KSFs. The licensee further stated that the NPO analysis identifies plant configuration changes (e.g., removing power from valves) as an option to reduce fire risk, and the analysis will be used as a reference document in support of site procedure updates that will be completed as described in LAR Attachment S, Table S-3, Implementation Item IMP-4. The NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition. The NRC staff concludes that the licensee's response to SSA RAI 13d is acceptable because the NPO analysis has taken into consideration spurious operation of equipment during non-power modes, which is consistent with the guidance provide in FAQ 07-0040, and because the licensee included an action to incorporate the NPO analysis results in plant procedures in an Implementation Item.

In SSA RAI 13c (Reference 16), the NRC staff requested the licensee to provide a list of KSF pinch points by fire area that were identified in the NPO fire area reviews using FAQ 07-0040, including a summary level identification of unavailable paths in each fire area and to describe how these locations will be identified to the plant staff for implementation. In its response to SSA RAI 13c (Reference 9), the licensee stated that the NPO analysis documents the results of the pinch point analysis, and identifies the KSFs that are evaluated and the status of each path that could be used to accomplish the KSF for each fire area. The licensee stated that the NPO analysis will be used as a reference document in support of site procedure updates and will be available during outage planning and HRE fire risk mitigation reviews. The NRC staff concludes that the licensee's response to SSA RAI 13c is acceptable because the NPO analysis used identifies the pinch points for each fire area and that the NPO analysis will be utilized as a reference during outage planning, which meets the NFPA 805 requirements and is consistent with the guidance in FAQ 07-0040.

Based on its review of the information provided in the LAR, the NRC staff concludes that the licensee used acceptable methods consistent with the guidance provided in RG 1.205 and FAQ 07-0040 to identify the equipment required to achieve and maintain the fuel in a safe and stable condition during NPO modes. Furthermore, the NRC staff concludes that the licensee has a process in place to ensure that fire protection DID measures will be implemented to achieve the KSFs during plant outages and that any required actions will be completed through implementation items identified in LAR Attachment S, Table S-2, which are required by the proposed license condition.

3.5.3.4 NPO Pinch Point Resolutions and Program Implementation

The licensee stated that the NPO analysis identified which areas require resolutions to restore NPO KSF functions, and that the resolutions used engineering justifications, administrative controls and heightened fire prevention strategies to address fire impact. The licensee further stated that fire areas that contain pinch points were evaluated for plant controls that increase fire prevention surveillance (fire rounds), ignition controls, combustible controls, and fire barrier compensatory measures.

In SSA RAI 13e (Reference 16), the NRC staff requested the licensee to describe the types of compensatory actions that will be used during equipment down-time when certain NPO credited equipment will have to be removed from service during normal outage evolutions. In its response to SSA RAI 13e (Reference 10), the licensee stated that updates to procedures will ensure that NPO credited equipment is not removed from service during HRE without adequate compensatory measures, and that the plant procedures provide guidelines and identify compensatory actions that can be taken when fire safe shutdown components are out of service. The licensee further stated that these procedures will be evaluated for updates during NFPA 805 implementation, and that the following types of compensatory measures are expected to be maintained for fire risk mitigation: hot work restrictions, transient combustible controls, access limitations, automatic detection and suppression systems, and fire watch patrols. The licensee further stated that the NPO analysis identifies locations where only one success path may remain available to support a KSF in the event of a fire, and that when NPO credited equipment is removed from service, the NPO analysis can be used as a reference to develop adequate compensatory measures. The NRC staff concludes that the licensee's response to SSA RAI 13e is acceptable because the licensee's analysis will be used to update procedural controls that are provided to ensure the NPO credited equipment is not removed from service during the HRE or if the equipment is the sole credited KSF success path, without implementing adequate compensatory measures, which is consistent with the guidance provided in NEI 04-02 and FAQ 07-0040. The licensee included an action in LAR Attachment S, Table S-3, Implementation Item IMP-4, to update NPO procedures. The NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

In SSA RAI 13f (Reference 16), the NRC staff requested the licensee to identify those RAs credited to achieve the KSF and associated instrumentation, including how the RA feasibility is evaluated and whether these variables have been or will be factored into operator procedures supporting these actions. In its response to SSA RAI 13f (Reference 10), the licensee stated that RAs have not been credited as the sole means of mitigating KSF pinch points, but that RAs have not been excluded as a method of mitigating fire impact to KSFs. The licensee further stated that RAs have been evaluated for several failure modes including loss of HVAC systems, loss of Instrument Air, and loss of control room indicators (where local or backup indication is available). The licensee stated that these RAs were evaluated using existing plant procedural guidance which will be reviewed and updated as necessary during NFPA 805 implementation. Any RAs that will be implemented during an HRE will be evaluated for feasibility in a manner consistent with NSCA credited RAs. The NRC staff concludes that the licensee's response is acceptable because it clarifies that RAs are not

credited as a sole means to mitigate the KSF pinch points, and that RAs were evaluated for feasibility using the guidance provided in RG 1.205, NEI 04-02 and FAQ 07-0030, which applies to the NSCA credited RAs for its at-power analysis.

The licensee stated that plant procedures will be revised to provide guidance to use insight from the NFPA 805 transition review to ensure that the NPO KSFs can be maintained, and that as part of the outage planning, evaluations will be performed to determine appropriate measures that need to be in place to minimize fire risk given the plant work and evolutions scheduled. The licensee identified an action to revise the plant procedures in LAR Attachment S, Table S-3, Implementation Item IMP-4. The NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

In SSA RAI 13a (Reference 16), the NRC staff requested the licensee to identify and describe the changes to outage management procedures, risk management tools and any other document resulting from incorporation of KSFs identified as part of the NFPA 805 transition, and to include changes to any administrative procedures, such as "Control of Combustibles." In its response to SSA RAI 13a (Reference 9), the licensee stated that plant procedures will be updated during NFPA 805 implementation, which will incorporate the KSF pinch point analysis, to include the following:

- Limiting/prohibiting hot work in select Fire Zones.
- Detection/Suppression Systems should be verified to be functional, (not tagged out etc.).
- Limiting/Prohibiting the hazard of combustible materials.
- Using alternate equipment and/or the equipment's position whenever removing power.
- Appropriate compensatory measures required during periods of increased vulnerability.
- Activities that may impact KSFs should be limited and strictly controlled to mitigate losses.
- Consider the hazards from the introductions of combustible materials and sources of fire precursors.
- Limiting work during periods of HRE conditions.
- Ensure HREs are identified in a manner consistent with NUMARC 91-06 (Reference 57) and FAQ 07-0040.

The NRC staff concludes that the licensee's response to SSA RAI 13a is acceptable because it states that the changes to plant procedures will incorporate NPO mitigating strategies that are consistent with the guidance in NEI 04-02 and FAQ 07-0040.

NFPA 805 requires that the nuclear safety performance criteria be met during any operational mode or condition, including NPOs. 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 nuclear safety performance criteria during NPOs.
- Identified the plant operating states where further analysis is necessary during NPOs.
- Identified the SSCs required to meet the KSFs during the plant operating states analyzed.
- Identified the location of these SSCs and their associated cables.
- Performed analyses on a fire area basis to identify pinch points where one or more KSF could be lost as a direct result of fire-induced damage.
- Planned/implemented modifications to appropriate procedures in order to employ a fire protection strategy for reducing risk at these pinch points during HREs.

Accordingly, based on the information provided in the LAR, the NRC staff concludes that the licensee has provided reasonable assurance that the nuclear safety performance criteria are met during NPO modes and HREs at CCNPP.

3.5.4 Conclusion for Section 3.5

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

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

- 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 nuclear safety performance criteria for each fire area.

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

Accordingly, the NRC staff concludes that there is reasonable assurance that each fire area utilizing the deterministic approach does so in accordance with NFPA 805, Section 4.2.3.

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

- The engineering 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 nuclear safety performance criteria for each fire area.

- All VFDRs were evaluated using the FRE PB approach (in accordance with NFPA 805, Section 4.2.4.2) to address risk impact, defense-in-depth, and safety margin, and found to be acceptable.

- All RAs necessary to demonstrate the availability of a success path were evaluated with respect to the additional risk presented by their use and found to be acceptable in accordance with NFPA 805, Section 4.2.4.

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

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

Accordingly, the NRC staff concludes that each fire area utilizing the PB approach, in accordance with NFPA 805, Section 4.2.4, is able to achieve and maintain the nuclear safety performance criteria.

The NRC staff concludes that the licensee's analysis and outage management process during NPO modes provides reasonable assurance that the nuclear safety performance criteria will be met during NPO modes and HREs, and that the licensee used methods consistent with the guidance provided in RG 1.205 and FAQ 07-0040. The NRC staff also concludes that RAs have not been credited as the sole means of mitigating KSF pinch points, but that RAs have not been excluded as a method of mitigating fire impact to KSFs, and that the normal FPP defense-in-depth 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 the licensee's overall approach for fire protection during NPO modes is acceptable.

3.6 Radioactive Release Performance Criteria

3.6.1 Method of Review

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

> Radioactive Release Goal
>
> The radioactive release goal is to provide reasonable assurance that a fire will not result in a radiological release that adversely affects the public, plant personnel, or the environment.
>
> Radioactive Release Objective
>
> Either of the following objectives shall be met during all operational modes and plant configurations.
>
> (1) Containment integrity is capable of being maintained.
>
> (2) The source term is capable of being limited.
>
> Radioactive Release Performance Criteria
>
> Radiation release to any unrestricted area due to the direct effects of fire suppression activities (but not involving fuel damage) shall be as low as reasonably achievable and shall not exceed applicable 10 CFR Part 20 limits.

The NRC staff endorsed (with certain exceptions) the guidance in NEI 04-02 (Reference 7), as providing methods acceptable to the staff for adopting a FPP consistent with NFPA 805 and 10 CFR 50.48(c) in RG 1.205 (Reference 4). As described in the LAR, the licensee assessed its current FPP using the methodology contained in NEI 04-02 and FAQ 09-0056 (Reference 61).

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

3.6.2 Scope of Review

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

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

The licensee performed a screening of plant fire area subdivisions (rooms) to determine where there was a potential for generating radioactive effluents during firefighting operations. The rooms where there were no radioactive materials present were identified and eliminated from further review.

Each room that had the potential for generation of radioactive effluents created by firefighting activities was identified (screened in) for further evaluation. The licensee's review identified the plant areas where radioactive materials were present as the Unit 1 and Unit 2 reactor enclosures and associated butler buildings; portions of the auxiliary, turbine, and north service buildings; West Road Cage area, Warehouse #3, Pre-Assembly Facility (Upper Laydown Area), Interim Resin Storage Facility (Lake Davies), Material Processing Facility, Original Steam Generator Storage Facility, the Sewage Treatment Plant, and portions of the Office and Training Facility. The results of the review are documented in the LAR, Attachment E, "NEI 04-02 Radioactive Release Transition."

For each screened-in room, the licensee's review identified the existing engineering controls that were sufficient to contain and filter gaseous and liquid effluent. The plant's engineering controls for these areas are identified and documented in the LAR, Attachment E. The NRC staff's review determined that areas with adequate engineering controls would contain radioactive effluent because the gaseous and liquid firefighting effluents were contained and filtered and monitored prior to release to ensure compliance with regulatory limits in accordance with the Offsite Dose Calculation Manual (ODCM).

The licensee's review also identified other plant areas without sufficient engineering controls to adequately contain radioactive effluent. These areas were further evaluated in a quantitative analysis and demonstrated to meet the 10 CFR Part 20 limits during firefighting activities. These areas include the Interim Storage Facility (Lake Davies), Pre-Assembly Facility (Upper Laydown Area), Warehouse #3, and the West Road Cage Road area. Other areas with smaller or insignificant amounts of radioactive materials were bounded by the analyses for areas with higher levels of radioactive materials.

Based on the NRC staff's review, the NRC staff concludes that the licensee's identification of potentially affected areas was an adequate assessment because the licensee's review included all plant areas, and identified potentially affected areas with and without engineering controls, in accordance with the guidance in NEI 04-02 as endorsed by RG 1.205.

3.6.4 Pre-Fire Plans

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

- Identification of applicable documentation; including firefighting strategy manuals, procedures, and support drawings.

- Review of engineering controls for gaseous effluents to determine whether gaseous effluents are contained (for example containment, filtering, and monitoring of contaminated smoke).

- Review of engineering controls for liquid effluents to determine whether liquid effluents are contained, filtered, and monitored prior to release (e.g., collection in drains and storage in holdup tanks).

- Review of current documentation to identify whether the current procedures and training documents discuss the containment and monitoring of potential contamination involving fire suppression activities.

- An identification of those documents needing revision such as to provide for monitoring and containment of fire suppression agents as needed to support radioactive release requirements.

The licensee identified the following plant documents in support of the firefighting activities and radioactive material containment, monitoring and releasing of effluents:

- SA-1-101, "Fire Fighting"
- SA-1-105, "Fire Brigade Training"
- Fire Fighting Strategy Manuals
- ODCM – Offsite Dose Calculation Manual
- Radiation Safety Manual
- CNG-TR-1.1025, "Radiation Protection Training Program"
- RP-2-100 "Radioactive Materials Management"
- RP-1-101 "Radioactive Waste Management"
- Hazardous Material Oil (spill) Plan
- Emergency Response Plan Implementation Procedures

The NRC staff concludes that the licensee's evaluation of the plant documents in support of firefighting activities was adequate because the licensee's review was comprehensive and was performed in accordance with the guidance in NEI 04-02, Appendix G, as endorsed by RG 1.205.

3.6.5 Gaseous Effluent Controls

In areas where engineering controls exist for containment, filtering, and monitoring of gaseous effluent, the licensee determined that the engineering controls provided adequate containment because the effluent was either contained, or filtered to remove radioactive materials and subsequently monitored prior to discharge. For plant areas where the installed engineering controls were adequate to contain the gaseous effluent, the NRC staff concludes that NFPA 805 radioactive release goals, objectives, and performance criteria will be met because the radioactive release will be contained to within acceptable limits.

For other areas without adequate engineering controls, the licensee minimizes potential gaseous releases using manual or administrative controls (e.g. using portable smoke eductors, closing of doors, and directing effluents into filtered ventilation to the extent feasible). The licensee will establish communication protocols between the Fire Brigade and Radiation Protection personnel to manually establish containment as needed and to perform monitoring of potential radioactive effluent and included that action in LAR Attachment S, Table S-3, Implementation Item IMP-3. The NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition. The Fire Brigade and Health Physics staff will be trained to communicate the need for monitoring and containment of contaminated gaseous effluent to the extent possible.

The licensee also performed a quantitative assessment for areas without adequate engineered controls to verify that the potential gaseous effluent from areas would not exceed the acceptance criteria of NFPA 805. The licensee identified the inventory of radioactive material that was present that could potentially be discharged during firefighting activities. The licensee's analysis assumed that those radioactive materials not in fire-proof containers would be immediately released into the atmosphere during a fire. The licensee assumed that the radioactive material was dispersed based on the plant's design basis accident atmospheric dispersion coefficient. The licensee's dose assessment to members of the public was based on calculational methods and models provided by federal agencies such as the EPA Federal Guidance Report No. 11, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion" and Federal Guidance Report No. 12, "External Exposure to Radionuclides in Air, Water, and Soil." The results of the analyses concluded that the maximum offsite dose at the Exclusion Area Boundary did not exceed the radiological release performance criteria of NFPA 805 and the public dose limits of 10 CFR Part 20.

The NRC staff reviewed the licensee's analysis and determined that appropriate assumptions and calculational bases were adequate based on the licensee's use of conservative

assumptions, and the use of analytical models and assumptions recognized by the NRC as acceptable methods. The NRC staff concludes that the licensee has adequately quantified and limited the maximum amount of radioactive material that can be released as a gaseous effluent. Based on its review, the NRC staff concludes that the public dose from radioactive material released as a gaseous effluent during a fire would not exceed the radiological release performance criteria of NFPA 805 and the public dose limits of 10 CFR Part 20.

3.6.6 Liquid Effluent Controls

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

The licensee's review also identified those areas where there were minimal or no engineered controls for a potential radioactive liquid effluent release during firefighting activities. To mitigate this potential release, the licensee has included an action to revise firefighting strategy manuals in LAR Attachment S, Table S-3, Implementation Item IMP-3 to ensure the fire brigade communicates with the Radiation Protection staff as needed to install flood barriers to control a potential liquid effluent release. The NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition. The licensee will perform radiological monitoring as needed to determine whether containment of contaminated fire suppression agents (e.g., fire hose water runoff) is needed in order to limit the radioactive release to within acceptable levels.

In areas where there were minimal or no engineered controls for liquid effluent, the licensee also performed a quantitative assessment of the impact of the liquid effluent discharge during firefighting activities. Radioactive materials (not in fire-proof containers) were assumed to be immediately released during a fire (e.g., no credit was given in the assessment for Fire Brigade or Health Physics staff mitigation actions). The liquid effluent analysis assumed that the radioactive material was released onto the ground and discharged into storm drains and into the Chesapeake Bay. Dose calculations to a potential member of the public were performed based in part on the licensee's ODCM (a document required by the plant's TSs and prepared in accordance with NRC regulatory guidance), and in part on the effluent concentration limits provided in 10 CFR Part 20, Appendix B, Table 2, Column 2.

The NRC staff reviewed the licensee's calculational methods and concludes that the licensee's assumptions and calculational bases were adequate to determine the radiological impact of potential liquid effluent releases during firefighting activities because the licensee used conservative assumptions and approved dose calculational methodologies. The NRC staff therefore concludes that the potential liquid effluent releases during firefighting activities will not exceed the radiological release performance criteria of NFPA 805 and the public dose limits of 10 CFR Part 20.

3.6.7 Fire Brigade Training Materials

The licensee reviewed the Fire Brigade training materials to determine if the training materials provide for containment and monitoring of potentially contaminated smoke and fire suppression water. In the review, the licensee identified the need to revise some training materials to identify potentially contaminated areas, and provide further instruction for communication between the Fire Brigade and Health Physics staff. Training materials and firefighting strategy manuals will be revised to describe the potential need to monitor ventilation and drainage systems in firefighting activities. The licensee's review is documented in LAR Attachment E.

The NRC staff reviewed the licensee's evaluation of training materials and concludes that the training material revisions will be adequate to instruct the Calvert Cliffs Fire Brigade staff to implement the FPP because plant staff will be informed and trained to take mitigating actions to minimize the potential public dose to within the radiological release performance criteria of NFPA 805.

3.6.8 Actions to Be Taken

In LAR Attachment S, Table S-3, Implementation Item IMP-3 the licensee included an action to revise firefighting strategy manuals to address radioactive release requirements of NFPA 805. These changes will occur 12 months following the issuance of the amendment (except for Implementation Item IMP-12 which is associated with modifications) unless that date falls within a scheduled refueling outage. Then, implementation will occur 60 days after startup from that scheduled refueling outage. The NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

3.6.9 Conclusions

The NRC staff's evaluation is based on:

(1) information and analyses provided in the LAR, as supplemented,
(2) use of installed and manual engineered controls to contain potential releases,
(3) use of fire pre-plans,
(4) use of revised fire brigade response procedures and training procedures, and
(5) Fire Brigade and Health Physics staff actions to utilize temporary containment devices when manual containment of radioactive release is needed.

Based on these factors, the NRC staff concludes that the licensee's RI/PB FPP provides reasonable assurance that radiation releases to any unrestricted area resulting from the direct effects of fire suppression activities are as low as reasonably achievable and are not likely to exceed the radiological release performance criteria of NFPA 805 and the radiological dose limits in 10 CFR Part 20. The NRC staff therefore concludes that the licensee's FPP complies

with the requirements specified in NFPA 805, Sections 1.3.2, 1.4.2, and 1.5.2 and that this approach is acceptable.

3.7 NFPA 805 Monitoring Program

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

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

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

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

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

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

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

NFPA 805 Section 2.6.3, "Corrective Action," states that:

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

The NRC staff reviewed LAR (Reference 8) Section 4.6, "Monitoring Program," that the licensee developed to monitor availability, reliability, and performance of its FPP systems and features after the transition to NFPA 805. The focus of the NRC staff review was on the critical elements related to the monitoring program, including the selection of FPP systems and features to be included in the program, the attributes of those systems and features that will be monitored, and the methods for monitoring those attributes. Implementation of the monitoring program will occur on the same schedule as the NFPA 805 RI/PB FPP implementation, which the NRC staff concludes is acceptable.

The licensee stated that it will develop an NFPA 805 monitoring program consistent with FAQ 10-0059 (Reference 62). Development of the monitoring program will include a review of existing surveillance, inspection, testing, compensatory measures, and oversight processes for adequacy. The review will examine adequacy of the scope of SSCs within the existing plant programs, performance criteria for availability and reliability of SSCs, and the adequacy of the plant corrective action program. The monitoring program will incorporate phases for

scoping, screening using risk criteria, risk target value determination, and monitoring implementation. The scope of the program will include fire protection systems and features, NSCA equipment, SSCs relied upon to meet radioactive release criteria, and fire protection programmatic elements. The licensee identified an action in LAR Attachment S, Table S-3, Implementation Item IMP-6 to develop and implement the NFPA 805 Monitoring Program per Section 2.6 of NFPA and the NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

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

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

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

However, since the final values for availability and reliability, as well as the performance criteria for the SSCs being monitored, have not been established for the monitoring program as of the date of this SE, completion of the licensee's NFPA 805 Monitoring Program is an implementation item, as described in LAR, Attachment S, Table S-3, Implementation Item IMP-6, and the NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

The NRC staff concludes that completion of the monitoring program on the same schedule as the implementation of NFPA 805 is acceptable because the monitoring program will be completed with the other implementation items as described in LAR Attachment S, Table S-3, within 12 months following the issuance of the amendment, unless that date falls within a scheduled refueling outage, then implementation will occur within 60 days after plant startup from that scheduled refueling outage, which is prior to completion of the modifications to

achieve full compliance with 10 CFR 50.48(c) (which is prior to startup from the second refueling outage greater than 12 months after issuance of the SE).

3.7.1 Conclusion for Section 3.7

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

3.8 Program Documentation, Configuration Control, and Quality Assurance

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

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

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

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

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

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

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

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

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

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

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

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

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

Section 2.7.3.2 of NFPA 805, "Verification and Validations" states that:

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

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

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

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

> Cognizant personnel who use and apply engineering analysis and numerical models (e.g., FM 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.

Section 2.7.3.5 of NFPA 805, "Uncertainty Analysis" states that:

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

3.8.1 Documentation

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

The CCNPP FPP design basis is a compilation of multiple documents (i.e., fire safety analyses, calculations, engineering evaluations, nuclear safety capability assessments, etc.), databases, and drawings which are identified in LAR Figure 4-9, "NFPA 805 Planned Post-Transition Documentation Relationships." The licensee stated that the analyses conducted to support the NFPA 805 transition were performed in accordance with CCNPP processes which meet or exceed the requirements for documentation outlined in NFPA 805, Section 2.7.1.

Specifically, the licensee stated that 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 NRC staff found that 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 CCNPP's document control system. The NRC staff also found that 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.

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

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 CCNPP configuration control process for the new NFPA 805 FPP.

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

be reviewed for potential impact on the various CCNPP licensing programs, including the FPP.

The LAR stated that the configuration control process includes provisions for appropriate design, engineering reviews and approvals, and that approved analyses are considered controlled documents available through the CCNPP document control system. The LAR also stated that analyses based on the PRA program, which includes the FRE, are issued as formal analyses subject to these same configuration control processes, and are additionally subjected to the PRA peer review process specified in the ASME/ANS PRA standard (Reference 31).

Configuration control of the existing FPP during the transition period is maintained by the change evaluation process, as defined in existing configuration management and configuration control procedures. LAR Attachment S, Table S-3 includes Implementation Items IMP-8 to ensure that plant configurations are appropriately reflected and evaluated in the NFPA 805 documentation prior to full implementation of NFPA 805. The NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

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

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

3.8.3 Quality

The NRC staff reviewed LAR Section 4.7.3, "Compliance with Quality Requirements in Section 2.7.3 of NFPA 805," to evaluate the quality of the engineering analyses used to support transition of the FPP to NFPA 805 based on the requirements outlined above. The individual sections of this SE provide the NRC staff's evaluation of the application of the NFPA 805 quality requirements to the licensee's FPP, as appropriate.

3.8.3.1 Review

NFPA 805, Section 2.7.3.1, requires that each analysis, calculation, or evaluation performed be independently reviewed. The licensee stated that its procedures require independent review of analyses, calculations, and evaluations, including those performed in support of compliance with 10 CFR 50.48(c). The licensee further stated that the transition to NFPA 805 was independently reviewed, and that analyses, calculations, and evaluations to be performed post-transition will be independently reviewed, as required by the existing procedures.

Based on the licensee's description of the process for performing independent reviews of analyses, calculations, and evaluations, the NRC staff concludes that the licensee's approach for meeting the Quality requirements of NFPA 805, Section 2.7.3.1, is acceptable.

3.8.3.2 Verification and Validation (V&V)

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

3.8.3.2.1 General

NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications", Volumes 1-7 (Reference 43), documents the V&V of five selected fire models commonly used to support applications of RI/PB fire protection at NPPs. The seven volumes of this NUREG-series report provide technical documentation concerning the predictive capabilities of a specific set of fire dynamics calculation tools and fire phenomenological models that may be used for the analysis of fire hazards in postulated NPP scenarios. When used within the limitations of the fire models and considering the identified uncertainties, these models may be employed to demonstrate compliance with the requirements of 10 CFR 50.48(c) as part of an approved PB approach in accordance with NFPA 805, Chapter 4.

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

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

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

The NRC staff concludes that the theoretical bases of the models and empirical correlations used in the FM calculations that were not addressed in NUREG-1824 were identified and described in authoritative publications, peer reviewed journal articles, or national research laboratory reports (Reference 42), (Reference 91), (Reference 92), (Reference 93),

(Reference 94), (Reference 97), (Reference 47), (Reference 98), (Reference 99), (Reference 100), (Reference 101), (Reference 102), (Reference 103), (Reference 104), and (Reference 105). Tables 3.8-1 and 3.8-2 of this SE, summarize the additional fire models, and the NRC staff's evaluation of the acceptability of each.

The NRC staff further concludes that the FM employed by the licensee in the development of the FRE 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. See Section 3.4.2.3 of this SE for further discussion of the licensee's FM method.

3.8.3.2.2 Discussion of RAIs

By letters dated January 12, 2015 (Reference 16), and June 3, 2015 (Reference 17), the NRC staff requested additional information concerning the FM conducted to support the FREs. By letters dated February 9, 2015 (Reference 9), March 11, 2015 (Reference 10), April 13, 2015 (Reference 11), and July 6, 2015 (Reference 12), the licensee responded to these RAIs.

- In FM RAI 03 (Reference 16), the NRC staff requested that the licensee provide the V&V basis for any tool or method identified in the response to FM RAI 01.a, and provide technical details to demonstrate that these models were applied within the validated range of input parameters.

  In its response to FM RAI 03 (Reference 10), the licensee provided an extensive discussion of the V&V of the new fire modeling tools or methods identified in the response to FM RAI 01.a, stated that the models and methods were applied within the NUREG-1824 validated range, that their applications were justified as acceptable, and provided an updated version of LAR Attachment J.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee identified the fire model applications that were used in support of the transition but not mentioned in the LAR and added a discussion of its V&V basis to LAR Attachment J.

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. Post transition, the licensee will revise the quality assurance topical report (QATR) to incorporate the NFPA 805 licensing basis as described in LAR Attachment S, Table S-3, Implementation item IMP-9, and the NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

3.8.3.2.4 Conclusion for Section 3.8.3.2

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

3.8.3.3 Limitations of Use

NFPA 805 requires that only acceptable engineering methods and numerical models be used for transition to the extent that these methods have been subject to V&V and that they are applied within the scope, limitations, and assumptions prescribed for that method. The LAR stated that the engineering methods and numerical models used in support of the transition to NFPA 805 were subject to the limitations of use outlined in NFPA 805, Section 2.7.3.3, and that the engineering methods and numerical models used post-transition will be subject to these same limitations of use.

3.8.3.3.1 General

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

3.8.3.3.2 Discussion of RAIs

By letters dated January 12, 2015 (Reference 16), and June 3, 2015 (Reference 17), the NRC staff requested additional information concerning the FM conducted to support the FREs. By letters dated February 9, 2015 (Reference 9), March 11, 2015 (Reference 10), April 13, 2015 (Reference 11), and July 6, 2015 (Reference 12), the licensee responded to these RAIs.

- In FM RAI 04 (Reference 16), the NRC staff requested that the licensee identify uses of FDS and the FDTs outside the limits of applicability of the model and explain how the use of FDS and the FDT was justified.

  In its response to FM RAI 04 (Reference 11), the licensee stated that the fire modeling input parameters were analyzed to determine if they are within the normalized parameter ranges summarized in NUREG-1934 and NUREG-1824 (including Supplement 1), and that the normalized parameters that were found to be outside of the validated range were assessed to determine if their use can be quantitatively or qualitatively justified. The licensee further stated that input parameters that could not

be justified were either conservatively modified to bring the parameters within the range, or were justified by other appropriate means.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee used the process described in NUREG-1934 to determine whether a fire model was applied within its limits of applicability, and justified the use of the model in cases where it was applied outside these limits.

3.8.3.3.3 Post-Transition

The licensee also stated that it will revise the appropriate processes and procedures to include NFPA 805 quality requirements for use during the performance of post-transition FPP changes. Post transition, the licensee will revise the QATR to incorporate the NFPA 805 licensing basis as described in LAR Attachment S, Table S-3, Implementation item IMP-9, and the NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

3.8.3.3.4 Conclusion for Section 3.8.3.3

Based on the licensee's statements that the fire models used to support development of the FRE were used within their limitations, and the description of the CCNPP process for placing limitations on the use of engineering methods and numerical models, the NRC staff concludes that the licensee's approach to meeting the requirements of NFPA 805 Section 2.7.3.3, is acceptable because the models are consistent with approved uses in NRC guidance or other authoritative publications and the licensee has identified actions that will incorporate the provisions of NFPA 805 in the FPP and those actions would be required by the proposed license condition.

3.8.3.4 Qualification of Users

NFPA 805, Section 2.7.3.4, requires that personnel performing engineering analyses and applying numerical methods (e.g. FM) shall be competent in that field and experienced in the application of these methods as they relate to NPPs, NPP fire protection, and power plant operations. The licensee's procedures require that cognizant personnel who use and apply engineering analyses and numerical models be competent in the field of application and experienced in the application of the methods, including those personnel performing analyses in support of compliance with 10 CFR 50.48(c).

3.8.3.4.1 General

Specifically, these requirements are being addressed through the implementation of an engineering qualification process at CCNPP. 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. CCNPP has developed qualification or training requirements for personnel performing engineering analyses and numerical methods.

3.8.3.4.2 Discussion of RAIs

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

- In FM RAI 05a (Reference 16), the NRC staff requested that the licensee describe the requirements to qualify personnel for performing fire modeling calculations in the NFPA 805 transition.

  In its response to FM RAI 05.a (Reference 9), the licensee explained that fire modeling calculations were performed by engineers who meet the qualification requirements of Section 2.7.3.4 of NFPA 805. The licensee further stated that in the case of the initial fire modeling, the vendor provided the credentials of the fire modelers, which were reviewed and approved by Risk Management Supervision, and that during and following transition, the existing engineering staff will continue to be knowledgeable in fire modeling techniques, including interpreting and maintaining the fire modeling database. The licensee also stated that the Risk Management organization has transitioned to Exelon qualification processes, and that if new fire modeling personnel are needed in the future, their credentials will also be reviewed and approved by Exelon supervision.

  In FM RAI 05.01 (Reference 17), the NRC staff requested that the licensee describe how the qualifications of personnel performing fire modeling calculations met or will meet the requirements of NFPA 805, Section 2.7.3.4, during the development of the application, before transition, during the transition period, and after transition.

  In its response to FM RAI 05.01 (Reference 12), the licensee explained that the initial fire modeling calculations in support of the LAR were performed by engineers who were determined to have met the requirements of NFPA 805, Section 2.7.3.4 based on a formal review of their qualifications per Constellation Energy Nuclear Group (CENG) procedures, and that during and following the transition to Exelon, procedures the fire modeling personnel supporting the Calvert Cliffs Fire PRA continued to meet the NFPA 805 requirements. The licensee further stated that three new Exelon qualification guides specific to fire modeling have been implemented, and that all personnel assigned to tasks involving fire modeling are required to be evaluated against the requirements of the three new guides.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because personnel initially involved in the fire modeling were qualified per CENG procedures, and the implementation of the three new Exelon fire modeling qualification guides ensures that the requirements of NFPA 805, Section 2.7.3.4 are presently met, and will continue to be met during and following transition.

- In FM RAI 05b (Reference 16), the NRC staff requested that the licensee describe the process for ensuring that fire modeling personnel have the appropriate qualifications, not only before the transition but also during and following the transition.

  In its response to FM RAI 05b (Reference 10), the licensee explained that the credentials of the personnel who performed the initial fire modeling were reviewed and approved per CENG procedures. The licensee further stated that during and following the transition to Exelon procedures, the Exelon engineering staff will continue to be knowledgeable in fire modeling techniques, and that the credentials will also be reviewed and approved by Exelon PRA Engineering Management in accordance with Exelon procedures.

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

- In FM RAI 05c (Reference 16), the NRC staff requested that the licensee describe how proper communication between the fire modeling and FPRA personnel is ensured when fire modeling is performed in support of the FPRA.

  In its response to FM RAI 05c (Reference 10), the licensee stated that periodic meetings with the FPRA and fire modeling personnel were held as necessary to ensure proper communication, that fire modeling personnel and PRA engineers participated in the cutset reviews, and that the FPRA was developed and will continue to be maintained with oversight from the Fire PRA Exelon manager who is responsible for the fire modeling personnel and the PRA engineers.

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

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

3.8.3.4.3 Post-Transition

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

> Post-transition, for personnel performing fire modeling for FPRA development and evaluation, CCNPP develops and maintains qualification for individuals assigned various tasks. Position specific guides were developed to identify and document required training and mentoring to ensure individuals are

appropriately qualified per the requirements of NFPA 805 Section 2.7.3.4 to perform assigned work.

The post-transition qualification training program will be implemented to include NFPA 805 requirements for qualification of users as described in LAR Attachment S, Table S-3, Implementation Item IMP-10. In a letter dated April 22, 2016 (Reference 15), the licensee indicated that it completed Implementation Item IMP-10. The NRC staff concludes that this is acceptable because the licensee incorporated the provisions of NFPA 805 in the FPP.

3.8.3.4.4 Conclusion for Section 3.8.3.4

Based on the licensee's description of the procedures for ensuring personnel who use and apply engineering analyses and numerical methods are competent and experienced, the NRC staff concludes that the licensee's approach for meeting the requirements of NFPA 805, Section 2.7.3.4, is acceptable.

3.8.3.5 Uncertainty Analysis

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

3.8.3.5.1 General

The industry consensus standard for PRA development, (i.e., the ASME/ANS PRA standard (Reference 31)), includes requirements to address uncertainty. Accordingly, the licensee addressed uncertainty as a part of the development of the CCNPP FRE. The NRC staff's evaluation of the licensee's treatment of these uncertainties is discussed in Section 3.4.7 of this SE.

According to NUREG-1855, Volume 1, "Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decision Making," (Reference 45), there are three types of uncertainty associated with FM calculations:

(1) Parameter Uncertainty: Input parameters are often chosen from statistical distributions or estimated from generic reference data. In either case, the uncertainty of these input parameters affects the uncertainty of the results of the FM analysis.

(2) Model Uncertainty: Idealizations of physical phenomena lead to simplifying assumptions in the formulation of the model equations. In addition, the numerical solution of equations that have no analytical solution can lead to

inexact results. Model uncertainty is estimated via the processes of V&V. An extensive discussion of quantifying model uncertainty can be found in NUREG-1934, "Nuclear Power Plant Fire Modeling Analysis Guide (NPP FIRE MAG)" (Reference 47).

(3) Completeness Uncertainty: This refers to the fact that a model is not a complete description of the phenomena it is designed to simulate. Some consider this a form of model uncertainty because most fire models neglect certain physical phenomena that are not considered important for a given application. Completeness uncertainty is addressed by the description of the algorithms found in the model documentation. It is addressed, indirectly by the same process used to address the Model Uncertainty.

3.8.3.5.2 Discussion of RAIs

By letters dated January 12, 2015 (Reference 16), and June 3, 2015 (Reference 17), the NRC staff requested additional information concerning the FM conducted to support the FREs. By letters dated February 9, 2015 (Reference 9), March 11, 2015 (Reference 10), April 13, 2015 (Reference 11), and July 6, 2015 (Reference 12), the licensee responded to these RAIs.

- In FM RAI 06.a (Reference 16), the NRC staff requested that the licensee describe how the uncertainty associated with the fire model input parameters was accounted for in the fire modeling analyses.

  In its response to FM RAI 06a (Reference 11), the licensee explained that conservative model input parameters were used in the FM calculations to provide a safety margin that bounds the uncertainty. The licensee gave the following examples of conservative modeling assumptions that provide safety margin:

  - The majority of fire scenarios involving electrical cabinets utilize the 98th percentile HRR to determine the severity factor.
  - The fire elevation in most cases is at the top of the cabinet or pump body.
  - The radiant fraction is 0.4, while the convective fraction is maintained at 0.7.
  - For most transient fire impacts, a large bounding transient zone assumes all targets within its ZOI are affected by a fire and time to damage is usually calculated based on the closest target.
  - For HGL calculations, no equipment or structural steel is credited as a heat sink.
  - For most scenarios target damage is assumed to occur when the exposure environment meets or exceeds the damage threshold.

- In some PAUs, transient fires will be assumed to damage everything from the floor to the ceiling.
- The fire elevation for transient fires is 2 feet in most cases.
- For many scenarios, automatic or manual detection and suppression were not credited.
- Scenarios that identify the time to automatic detection and suppression did not account for the HGL effect on the ceiling jet temperature.
- All fires modeled using FDS assumed that the fire does not experience the effects of oxygen deprivation.
- The FDTs generally over-predict hot gas layer temperatures.
- For the non-FDS analyses, as the fire propagates to secondary combustibles, the fire was conservatively modeled as one single fire using the fire modeling closed-form correlations.
- For some scenarios fire propagation to the first cable tray was estimated to be one minute. In most cases, propagation to the first cable tray would be greater than one minute; therefore, this is considered conservative.
- Not every cable tray in the plant is filled to capacity. In many cases, fire modeling will assume cable trays were filled to capacity, which provided a conservative estimate of surface area and the corresponding fire severity.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee has demonstrated that the uncertainty associated with the model input parameters was adequately accounted for by the safety margin created through the use of conservative model input parameter values.

- In FM RAI 06b (Reference 16), the NRC staff requested that the licensee describe how the "model" and "completeness" uncertainties were accounted for in the fire modeling analyses.

  In its response to FM RAI 06b (Reference 11), the licensee explained that "model" uncertainties can be estimated using the processes of V&V, and provided a detailed discussion of model uncertainty for the following calculations:

  - HGL Temperature using FDTs.
  - HGL Depth and Temperature using FDS.
  - HGL Depth and Temperature using CFAST.

- Ceiling Jet Temperature using Alpert's Correlation.
- Plume Temperature using the FDTs.
- Plume Temperature using FDS.
- Flame Height using FDTs.
- Smoke Concentration using FDS.
- Radiant Heat Flux using FDTs.
- Radiant Heat Flux using FDS.

The licensee further stated that completeness uncertainty is addressed in the FPRA within the overall quantification process by conservatively failing targets in the fire scenarios so that the risk contribution is bounding. The license also listed the conservative assumptions that were made to offset the impact of ignoring the contents of a compartment in the HGL calculations.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee has demonstrated that the model and completeness uncertainties are offset by the conservatisms in the fire modeling analyses and FPRA quantification process.

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. Post transition, the licensee will revise the QATR to incorporate the NFPA 805 licensing basis as described in LAR Attachment S, Table S-3, Implementation item IMP-9, and the NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

3.8.3.5.4 Conclusion for Section 3.8.3.5

Based on the licensee's description of the CCNPP process for performing an uncertainty analysis, the NRC staff concludes that the licensee's approach for meeting the requirements of NFPA 805 Section 2.7.3.5 is acceptable.

3.8.3.6 Conclusion for Section 3.8.3

Based on the above discussions, the NRC staff concludes that upon completion of the implementation items, the CCNPP RI/PB Fire Protection Quality Assurance (QA) Program will meet each of the requirements of NFPA 805, Section 2.7.3, which includes conducting

independent reviews, performing V&V, limiting the application of acceptable methods and models to within prescribed boundaries, ensuring that personnel applying acceptable methods and models are qualified, and performing uncertainty analyses.

3.8.4 Fire Protection Quality Assurance Program

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

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

The guidance in Appendix C to NEI 04-02 (Reference 7), suggests that the LAR include a description of how the existing fire protection quality assurance program will be transitioned to the new NFPA 805 RI/PB FPP, as discussed below.

In LAR Section 4.7.3, the licensee stated that the quality assurance topical report addresses the CCNPP FPP. The licensee also provided a listing of the aspects of NFPA Section 2.7.3 along with a description of the controls currently in place to ensure that NFPA 805 related activities are performed correctly and in conformance with applicable requirements. The licensee included an action in LAR Attachment S, Table S-3, Implementation Item IMP-10, to provide training to engineering support personnel in order to incorporate the provisions of NFPA 805, Section 2.7.3.4 in the FPP. In a letter dated April 22, 2016 (Reference 15), the licensee indicated that it completed Implementation Item IMP-10. The NRC staff concludes that this is acceptable because the licensee incorporated the provisions of NFPA 805 in the FPP.

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 the licensee updated its QA program to reflect NFPA 805 Quality Assurance requirements.

3.8.5 Conclusion for Section 3.8

The NRC staff reviewed the licensee's RI/PB FPP as described in the LAR, as supplemented, to evaluate the NFPA 805 program documentation content, the associated configuration control process, and the appropriate QA requirements. Based on its review, the NRC staff concludes that, upon completion of the implementation items in LAR Attachment S, Table S-3 related to the QA program, the licensee's approach for meeting the requirements specified in NFPA 805 Section 2.7, is acceptable.

4.0 FIRE PROTECTION LICENSE CONDITION

The licensee proposed 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, RP 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 CCNPP and is, therefore, acceptable.

The following license condition is included in the revised license for CCNPP, and will replace Renewed Facility Operating License No. DPR-53, Paragraph 2E and Renewed Facility Operating License No. DPR-69, Paragraph 2E.

Fire Protection

E. Exelon Generation shall implement and maintain in effect all provisions of the approved fire protection program that comply with 10 CFR 50.48(a) and 10 CFR 50.48(c), as specified in the license amendment request dated September 24, 2013; as supplemented by letters dated February 9, 2015, March 11, 2015, April 13, 2015, July 6, 2015, August 13, 2015, February 24, 2016, and April 22, 2016, and as approved in the NRC safety evaluation dated August 30, 2016. 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), 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, 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 $1x10^{-7}$/yr for CDF and less than $1x10^{-8}$/yr for LERF. The proposed change must also be consistent with the defense-in-depth philosophy and must maintain sufficient safety margins. The change may be implemented following completion of the plant change evaluation.

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

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

Prior NRC review and approval 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. 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 August 30, 2016, to determine that certain fire protection program changes meet the minimal criterion. The licensee shall ensure that fire protection defense-in-depth and safety margins are maintained when changes are made to the fire protection program.

Transition License Conditions

(1) Before achieving full compliance with 10 CFR 50.48(c), 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 License Condition 2.E.(2)(b).

(2) The licensee shall complete the modifications to its facility as described in Table S-2, "Plant Modifications Committed," of licensee letter dated April 22, 2016, to complete the transition to full compliance with 10 CFR 50.48(c) by April 30, 2018. The licensee shall maintain appropriate compensatory measures in place until completion of these modifications.

(3) The licensee shall implement the items listed in Enclosure 1, Attachment S, Table S-3, "Implementation Items," from licensee letter dated April 22, 2016 within 12 months after NRC approval unless that implementation date falls within a scheduled refueling outage. Then, implementation will occur 60 days after startup from that scheduled refueling outage. It should be noted that implementation item IMP-12 is associated with incorporation of the NFPA 805 modification and the completion of this implementation item is an on-going action initiated within the 180 day timeframe for completion of implementation items but only complete after completion of modification implementation per Table S-2.

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 fire protection program 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. Before the licensee is able to fully implement the transition to an FPP based on NFPA 805 and apply the new fire protection license condition, to its full extent, the implementation items must be completed within the timeframe specified.

6.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Maryland official, Ms. Susan Gray, was notified on July 22, 2016, of the proposed issuance of the amendments. The State official had no comments.

7.0 ENVIRONMENTAL CONSIDERATION

The amendments change requirements 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 amendments involve 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 amendments involve no significant hazards consideration, published in the FR on August 5, 2014 (79 FR 45488), and there has been no public comment on such finding. Accordingly, the amendments meet 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 amendments.

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 amendments will not be inimical to the common defense and security or to the health and safety of the public.

9.0 REFERENCES

1 Branch Technical Position (BTP) APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants" (ADAMS Accession No. ML070660461).

2 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).

3 National Fire Protection Association Standard 805 (NFPA 805), "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," 2001 Edition, Quincy, Massachusetts.

4 U.S. Nuclear Regulatory Commission, Regulatory Guide 1.205, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants," Revision 1, December 2009 (ADAMS Accession No. ML092730314).

5 U.S. Nuclear Regulatory Commission, SECY-98-058, "Development of a Risk-Informed, Performance-Based Regulation for Fire Protection at Nuclear Power Plants," March 1998 (ADAMS Accession No. ML992910106).

6 U.S. Nuclear Regulatory Commission, SECY-00-0009, "Rulemaking Plan, Reactor Fire Protection Risk-Informed, Performance-Based Rulemaking," January 2000 (ADAMS Accession No. ML003671923).

7 Nuclear Energy Institute, NEI 04-02, "Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c)," Washington, DC, Revision 2, April 2008 (ADAMS Accession No. ML081130188).

8 Gellrich, George, H. Calvert Cliffs Nuclear Power Plant, LLC, letter to U.S. Nuclear Regulatory Commission, "Calvert Cliffs Nuclear Power Plant Unit Nos. 1 & 2, Docket Nos. 50-317 & 50-318, License Amendment Request re: Transition to 10 CFR 50.48(c) - NFPA 805 Performance Based Standard for Fire Protection," September 24, 2013 (ADAMS Accession No. ML13301A673).

9 Gellrich, George, H., Exelon Generation, letter to U.S. Nuclear Regulatory Commission, "Calvert Cliffs Nuclear Power Plant Unit Nos. 1 & 2, Renewed Facility Operating License Nos. DPR-53 and DPR-69, NRC Docket Nos. 50-317 and 50-318, Request for Additional Information Regarding the NFPA Standard 805 License Amendment Request," February 09, 2015 (ADAMS Accession No. ML15229A143).

10 Gellrich, George, H., Exelon Generation, letter to U.S. Nuclear Regulatory Commission, "Calvert Cliffs Nuclear Power Plant Unit Nos. 1 & 2, Renewed Facility Operating License Nos. DPR-53 and DPR-69, NRC Docket Nos. 50-317 and 50-318, Request for Additional Information Regarding the NFPA Standard 805 License Amendment Request," March 11, 2015 (ADAMS Accession No. ML15075A104).

11 Flaherty, Mark, D., Exelon Generation, letter to U.S. Nuclear Regulatory Commission, "Calvert Cliffs Nuclear Power Plant Unit Nos. 1 & 2, Renewed Facility Operating License Nos. DPR-53 and DPR-69, NRC Docket Nos. 50-317 and 50-318, Request for Additional Information Regarding the NFPA Standard 805 License Amendment Request," April 13, 2015 (ADAMS Accession No. ML15107A029).

12 Gellrich, George, H., Exelon Generation, letter to U.S. Nuclear Regulatory Commission, "Calvert Cliffs Nuclear Power Plant Unit Nos. 1 & 2, Renewed Facility Operating License

Nos. DPR-53 and DPR-69, Docket Nos. 50-317 & 50-318, Request for Additional Information Regarding the NFPA Standard 805 License Amendment Request," July 6, 2015 (ADAMS Accession No. ML15190A111).

13 Gellrich, George, H., Exelon Generation, letter to U.S. Nuclear Regulatory Commission, "Calvert Cliffs Nuclear Power Plant Unit Nos. 1 & 2, Renewed Facility Operating License Nos. DPR-53 and DPR-69, Docket Nos. 50-317 & 50-318, Request for Additional Information Regarding the NFPA Standard 805 License Amendment Request," August 13, 2015 (ADAMS Accession No. ML15230A032).

14 Gellrich, George, H., Exelon Generation, letter to U.S. Nuclear Regulatory Commission, "Calvert Cliffs Nuclear Power Plant Unit Nos. 1 & 2, Renewed Facility Operating License Nos. DPR-53 and DPR-69, Docket Nos. 50-317 & 50-318, Request for Additional Information Regarding the NFPA Standard 805 License Amendment Request," February 24, 2016 (ADAMS Accession No. ML16060A361).

15 Gellrich, George, H., Exelon Generation, letter to U.S. Nuclear Regulatory Commission, "Calvert Cliffs Nuclear Power Plant Unit No. 1 & 2, Renewed Facility Operating License Nos. DPR-53 and DPR-69, Docket Nos. 50-317 & 50-318, Response to NRC Clarification Request for NFPA 805 License Amendment Request," April 22, 2016 (ADAMS Accession No. ML16117A499).

16 Morgan, Nadiyah, U.S. Nuclear Regulatory Commission letter to Exelon Generation Company, LLC, "Calvert Cliffs Nuclear Power Plant, Request for Additional Information, LAR to Adopt NFPA 805, TAC Nos. MF2993 and MF2994," January 12, 2015 (ADAMS Accession No. ML14356A019).

17 Chereskin, Alexander, N., U.S. Nuclear Regulatory Commission letter to Exelon Generation Company, LLC, "Calvert Cliffs Nuclear Power Plant, Request for Additional Information, LAR to Adopt NFPA 805, TAC Nos. MF2993 and MF2994," June 3, 2015 (ADAMS Accession No. ML15142A729).

18 Chereskin, Alexander, N., U.S. Nuclear Regulatory Commission, letter to Gellrich, George, H., Exelon Generation Company, LLC, "Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 - Request for Additional Information Regarding the National Fire Protection Association Standard 805 License Amendment Request (TAC Nos. MF2993 and MF2994)," July 15, 2015 (ADAMS Accession No. ML15183A016).

19 U.S. Nuclear Regulatory Commission, "Amendments Nos. 41 and 23 to License Nos. DPR-53 and DPR-69, Adding License Conditions Relating to Completion of Facility Modifications for Fire Protection and Safety Evaluation," September 14, 1979 (ADAMS Accession No. ML010430052).

20 U.S Nuclear Regulatory Commission, "Safety evaluation of acceptable fire protection items, item 3.2.5 re: drain system backflow protection is only partially acceptable," October 2, 1980 (ADAMS Accession No. 8010290364).

21 U.S. Nuclear Regulatory Commission, "Forwards Second Supplement to NRC 740914 Safety Evaluation which Addresses Fire Protection Items Now Acceptable, Status of Unresolved items also Provided," March 18, 1982 (ADAMS Accession No. 8203300243).

22 U.S. Nuclear Regulatory Commission, "Safety Evaluation Concluding that Proposed Fire Protection Design Meets requirements of Appendix R to 10 CFR 50, Items III.G.3 and

III.L re: Safe Shutdown in Event of Fire," September 27, 1982 (ADAMS Accession No. 8210120139).

23 U.S. Nuclear Regulatory Commission, "Calvert Cliffs, Units 1 and 2 - Exemption to 10 CFR Part 50, Section 50.48, and Appendix R to 10 CFR 50 in Response to Letter dated March 19, 1981, Re: Fire Protection," August 16, 1982 (ADAMS Accession No. ML091310062).

24 U.S. Nuclear Regulatory Commission, "Exemption Request of March 4, 1983 - Fire Suppression Requirements of Section III.G.2 of Appendix R to 10 CFR Part 50 - Calvert Cliffs Nuclear Power Plant, Units 1 and 2," April 21, 1983 (ADAMS Accession No. ML010430334).

25 U.S. Nuclear Regulatory Commission, "Calvert Cliffs, Units 1 and 2 - Fire Protection Exemption Request," March 15, 1984 (ADAMS Accession No. ML010430325).

26 U.S. Nuclear Regulatory Commission, "Issuance of a Technical Exemption from the Requirement of 10 CFR Part 50, Appendix R, for the Calvert Cliffs Nuclear Power Plant, Units 1 and 2," August 22, 1990 (ADAMS Accession No. ML010450247).

27 U.S. Nuclear Regulatory Commission, "Exemption from the Requirements of 10 CFR Part 50, Appendix R, Section III.J, Emergency Lighting - Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 (TAC Nos. M99791 and M99792)," April 7, 1999 (ADAMS Accession No. ML010580511).

28 Nuclear Energy Institute, NEI 00-01, "Guidance for Post Fire Safe Shutdown Circuit Analysis, Revision 2," Nuclear Energy Institute (NEI), Washington, DC, May 2009 (ADAMS Accession No. ML091770265).

29 U.S. Nuclear Regulatory Commission, Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," Revision 2, May 2011 (ADAMS Accession No. ML100910006).

30 U.S. Nuclear Regulatory Commission, Regulatory Guide 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk Informed Activities," Revision 2, March 2009 (ADAMS Accession No. ML090410014).

31 American Society of Mechanical Engineers (ASME) and American Nuclear Society (ANS) standard ASME/ANS RA-Sa-2009, "Addenda to ASME/ANS RA-S-2008, Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," Februrary 2, 2009.

32 U.S. Nuclear Regulatory Commission, Regulatory Guide 1.189, "Fire Protection for Nuclear Power Plants," Revision 2, October 2009 (ADAMS Accession No. ML092580550).

33 NUREG-0800 U.S. Nuclear Regulatory Commission, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Chapter 9.5.1.2, "Risk-Informed, Performance-Based Fire Protection Program," Revision 0, December 2009 (ADAMS Accession No. ML092590527).

34 NUREG-0800 U.S. Nuclear Regulatory Commission, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Chapter 19.1, "Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-

Informed License Amendment Requests After Initial Fuel Load"," Revision 3, September 2012 (ADAMS Accession No. ML12193A107).

35 U.S. Nuclear Regulatory Commission, NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Chapter 19.2, "Review of Risk Information Used to Support Permanent Plant-Specific Changes to the Licensing Basis: General Guidance"," Revision 0, June 2007 (ADAMS Accession No. ML071700658).

36 U.S. Nuclear Regulatory Commission, NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities, Volume 1: Summary and Overview," September 2005 (ADAMS Accession No. ML052580075).

37 U.S. Nuclear Regulatory Commission, NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities, Volume 2: Detailed Methodology," September 2005 (ADAMS Accession No. ML052580118).

38 U.S. Nuclear Regulatory Commission, NUREG/CR-6850, Supplement 1, "Fire Probabilistic Risk Assessment Methods Enhancements," September 2010 (ADAMS Accession No. ML103090242).

39 Correia, R. P., memorandum to Joseph G. Giitter, U.S. Nuclear Regulatory Commission, "Interim Technical Guidance on Fire-Induced Circuit Failure Mode Likelihood Analysis," June 14, 2013 (ADAMS Accession No. ML13165A194).

40 U.S. Nuclear Regulatory Commission, NUREG/CR-6931, "Cable Response to Live Fire (CAROLFIRE)," Volumes 1, 2, and 3, April 2008 (ADAMS Accession Nos. ML081190230, ML081190248, and ML081190261).

41 U.S. Nuclear Regulatory Commission, NUREG/CR-7100, "Direct Current Electrical Shorting in Response to Exposure Fire (DESIREE-Fire): Test Results," April 2012 (ADAMS Accession No. ML121600316).

42 U.S. Nuclear Regulatory Commission, NUREG-1805, "Fire Dynamics Tools (FDTs): Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program," December 2004 (ADAMS Accession No. ML043290075).

43 U.S. Nuclear Regulatory Commission, NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," May 2007. Volume 1: Main Report, Volume 2: Experimental Uncertainty, Volume 3: Fire Dynamics Tools (FDTS), Volume 4: Fire-Induced Vulnerability Evaluation (FIVE-Rev1), Volume 5: Consolidated Fire Growth and Smoke Transport Model (CFAST), Volume 6: MAGIC, and Volume 7: Fire Dynamics Simulator (ADAMS Accession Nos. ML071650546, ML071730305, ML071730493, ML071730499, ML071730527, ML071730504, ML071730543, respectively).

44 U.S. Nuclear Regulatory Commission, "Cable Heat Release, Ignition, and Spread in Tray Installations during Fire (CHRISTI FIRE), Phase 1: Horizontal Trays," NUREG/CR-7010, Volume 1, July 2012 (ADAMS Accession No. ML12213A056).

45 U.S. Nuclear Regulatory Commission, NUREG-1855, Volume 1, "Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decision Making," March 2009 (ADAMS Accession No. ML090970525).

46 U.S. Nuclear Regulatory Commission, NUREG-1921, "EPRI/NRC-RES Fire Human Reliability Analysis Guidelines," July 2012 (ADAMS Accession No. ML12216A104).

47 U.S. Nuclear Regulatory Commission, NUREG-1934, "Nuclear Power Plant Fire Modeling Analysis Guidelines (NPP FIRE MAG)," November 2012 (ADAMS Accession No. ML12314A165).

48 U.S. Nuclear Regulatory Commission, Generic Letter 2006-03, "Potentially Nonconforming Hemyc and MT Fire Barrier Configurations," April 10, 2006 (ADAMS Accession No. ML053620142).

49 National Fire Protection Association Standard 101, (NFPA 101), "Life Safety Code," Quincy, Massachusetts.

50 National Fire Protection Association Standard 20, (NFPA 20), "Standard for Installation of Stationary Pumps for Fire Protection," Quincy, Massachusetts.

51 National Fire Protection Association Standard 14, (NFPA 14), "Standard for the Installation of Standpipe and Hose Systems," Quincy, Massachusetts.

52 National Fire Protection Association Standard 10 (NFPA 10), "Portable Fire Extinguishers," Quincy, Massachusetts.

53 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of National Fire Protection Association Frequently Asked 07-0030 on Establishing Recovery Actions," February 4, 2011 (ADAMS Accession No. ML110070485).

54 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of National Fire Protection Association Frequently Asked 07-0038 on Lessons Learned on Multiple Spurious Operations," February 3, 2011 (ADAMS Accession No. ML110140242).

55 Nuclear Energy Institute, NEI 00-01, "Guidance for Post Fire Safe Shutdown Circuit Analysis," Revision 1, Nuclear Energy Institute (NEI), Washington, DC, January 2005 (ADAMS Accession No. ML050310295).

56 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of National Fire Protection Association Standard 805 Frequently Asked Question 07-0039 Incorporation of Pilot Plant Lessons Learned- Table B-2," January 15, 2010 (ADAMS Accession No. ML091320068).

57 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of National Fire Protection Association 805 Frequently Asked Question 07-0040 on Non-Power Operations Clarifications," August 11, 2008 (ADAMS Accession No. ML082200528).

58 Klein, Alexander, R., U.S. Nuclear Regulatory Commission, memo to AFPB file, "Closure of National Fire Protection Association 805 Frequently Asked Question 08-0048 Revised Fire Ignition Frequencies," September 1, 2009 (ADAMS Accession No. ML092190457).

59 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of National Fire Protection Association Standard 805 Frequently Asked Question 08-0049 on Cable Tray Fire Propagation," July 30, 2009 (ADAMS Accession No. ML092100274).

60 Klein, Alexander R., U.S. Nuclear Regulatory Commission, "Close-out of National Fire Protection Association Frequently Asked 08-0054 on Demonstrating Compliance with Chapter 4 of National Fire Protection Association 805," March 20, 2015 (ADAMS Accession No. ML15016A280).

61 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of National Fire Protection Association 805 Frequently Asked Question 09-0056 on Radioactive Release Transition," January 14, 2011 (ADAMS Accession No. ML102920405).

62 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of National Fire Protection Association Standard 805 Frequently Asked Question 10-0059: National Fire Protection 805 Monitoring Program," March 19, 2012 (ADAMS Accession No. ML120750108).

63 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of National Fire Protection Association Standard 805 Frequently Asked Question 12-0062 on Updated Final Safety Analysis Report (UFSAR) Content," September 5, 2012 (ADAMS Accession No. ML121980557).

64 Hamzehee, Hossein, G., U.S. Nuclear Regulatory Commission, memorandum to file, "Close-out of Fire Probabilistic Risk Assessment Frequently Asked Question 13-0004 on Clarifications Regarding Treatment of Sensitive Electronics," December 3, 2013 (ADAMS Accession No. ML13322A085).

65 Hamzehee, Hossein, G., U.S. Nuclear Regulatory Commission, Memorandum to APLA Files, "Close-out of Fire Probabilistic Risk Assessment Frequently Asked Question 13-0005 on Cable Fires Special Cases: Self-Ignited and Caused by Wedling and Cutting," December 3, 2013 (ADAMS Accession No. ML13319B181).

66 Hamzehee, Hossein, G., U.S. Nuclear Regulatory Commission, Memorandum to APLA FilesFile, "Closeout of Fire Probabilistic Risk Assessment Frequently Asked Question 13-0006 on Modeling Junction Box Scenarios in a Fire PRA," December 12, 2013 (ADAMS Accession No. ML13331B213).

67 Hamzehee, Hossein, G., memorandum to APLA Files, "Close-Out of Fire Probabilistic Risk Assessment Frequently Asked Question 14-0009 on Treatment of Well Sealed MCC Electrical Panels Greater Than 440V," April 29, 2015 (ADAMS Package Accession No. ML15119A176).

68 Nuclear Energy Institute, NEI 02-03, "Guidance for Performing a Regulatory Review of Proposed Changes to the Approved Fire Protection Program," June 2003 (ADAMS Accession No. ML031780500).

69 Clark, Robert, L., U.S. Nuclear Regulatory Commission, letter to Cruse, Charles, H., Calvert Cliffs Nuclear Power Plant, Inc., "Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 And 2 - Review Of The Individual Plant Examination Of External Events (IPEEE) Submittal (TAC Nos. M83603 and M83604)," June 8, 2001 (ADAMS Accession No. ML011550238).

70 Electric Power Research Institute (EPRI) Technical Report TR-1006756, "Fire Protection Equipment Surveillance Optimization and Maintenance Guide for Fire Protection Systems and Features," Final Report, Palo Alto, CA, Final Report July 2003.

71 National Fire Protection Association Standard 90A, (NFPA 90A), "Standard for the Installation of Air-Conditioning and Ventilating Systems," Quincy, Massachusetts.

72 National Fire Protection Association Standard 51B (NFPA 51B), "Standard for Fire Prevention During Welding, Cutting, and Other Hotwork," Quincy, Massachusetts.

73 National Fire Protection Association Standard 241 (NFPA 241), "Standard for Safeguarding Construction Alteration, and Demolition Operations," Quincy, Massachusetts.

74 National Fire Protection Association Standard 22 (NFPA 22), "Standard Water Tanks for Private Fire Protection," Quincy, Massachusetts.

75 National Fire Protection Association Standard 12A (NFPA 12A), "Standard on Halon 1301 Fire Extinguishing Systems," Quincy, Massachusetts.

76 Heffley, J.M., Constellation Energy Generation Group, letter to U.S. Nuclear Regulatory Commission, "Response to Generic Letter 2006-03, Potentially Nonconforming Hemyc and MT Fire Barrier Configurations," June 9, 2006 (ADAMS Accession No. ML061650026).

77 IEEE 383, "Standard for Qualifying Class 1E Electric Cables and Field Splices for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, New York, NY.

78 National Fire Protection Association Standard 50A (NFPA 50A), "Standard for Gaseous Hydrogen Systems at Consumer Sites," Quincy, Massachusetts.

79 National Fire Protection Association Standard 30 (NFPA 30), "Flammable and Combustible Liquids Code," Quincy, Massachusetts.

80 National Fire Protection Association Standard 13, (NFPA 13), "Standard for the Installation of Sprinkler Systems," Quincy, Massachusetts.

81 National Fire Protection Association Standard 70 (NFPA - 70), 2014, "National Electric Code," Quincy, Massachusetts,.

82 National Fire Protection Association Standard 805 (NFPA 805), 2015, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants, 2015 Edition," Quincy, Massachusetts,.

83 National Fire Protection Association Standard 701 (NFPA 701), "Standard Methods of Fire Tests for Flame Propagation of Textiles and Films," Quincy, Massachusetts.

84 U.S. Nuclear Regulatory Commission, NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Chapter 9.5.1.1 "Fire Protection Program," Revision 0, February 2009 (ADAMS Accession No. ML090510170).

85 Westinghouse Electric Report WCAP-16933-NP, "PWR Generic List of Fire-Induced Multiple Spurious Operation Scenarios," Revision 0, April 2009.

86 Nuclear Energy Institute, NEI 05-04, "Process for Performing Follow-on PRA Peer Reviews Using the ASME/ANS PRA Standard (Internal Events), Revision 1, draft," Washington, DC, March/November, 2007.

87 U.S. Nuclear Regulatory Commission, "Record of Review for Dispositions to Calvert Cliffs Nuclear Power Plant, Units 1 and 2, Internal Events PRA and Fire PRA Facts and Observations," May 31, 2016 (ADAMS Accession No. ML16152A223).

88 Nuclear Energy Institute, NEI 07-12, "Fire Probabilistic Risk Assessment (FPRA) Peer Review Process Guidelines," Revision 0, Nuclear Energy Institute (NEI), Washington, DC, November 2008.

89 Giitter, Joseph, U.S. Nuclear Regulatory Commission, letter to Bradley, Biff, Nuclear Energy Institute, "Recent Fire PRA Methods Review Panel Decisions and EPRI 1022993, Evaluation of Peak Heat Release Rates in Electrical Cabinet Fires," June 21, 2012 (ADAMS Accession No. ML12172A406).

90 NUREG/CR-7150, Vol. 2 and EPRI 3002001989 and BNL-NUREG-98204-2012, "Joint Assessment of Cable Damage and Quantification of Effects from Fire (JACQUE-FIRE), Volume 2: Expert Elicitation Exercise for Nuclear Power Plant Fire-Induced Electrical Circuit Failure," U. S. Nuclear Regulatory Commission, Washington, DC, May 2014.

91 Heskestad, G., "Fire Plumes, Flame Height, and Air Entrainment," in *The SFPE Handbook of Fire Protection Engineering*, 4th ed. Quincy, Massachusetts: National Fire Protection Association, 2008, ch. 2-1.

92 Beyler, C., "Fire Hazard Calculations for Large, Open Hydrocarbon Fires," in *The SFPE Handbook of Fire Protection Engineering*. Quincy, Massachusetts: National Fire Protection Association, ch. 3-10.

93 Alpert, R. L., "Ceiling Jet Flows," in *The SFPE Handbook of Fire Protection Engineering*. Quincy, Massachusetts: National Fire Protection Association, 2008, ch. 2-2.

94 EPRI 1002981, "Fire Modeling Guide for Nuclear Power Plant Applications," Electric Power Research Institute, Palo Alto, California, August 2002.

95 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to file, "Closure of National Fire Protection Association 805 Frequently Asked Question 08-0052 Transient Fires - Growth Rates and Control Room Non-Suppression," August 4, 2009 (ADAMS Accession No. ML092120501).

96 Hiland, Patrick, U.S. Nuclear Regulatory Commission memo to Sheron, Brian W., U.S. Nuclear Regulatory Commission, "Safety/Risk Assessment Results for Generic Issue 199, Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants," September 2, 2010 (ADAMS Accession No. ML100270582).

97 U.S. Nuclear Regulatory Commission, Inspection Manual Chapter (IMC) 0609, Appendix F, "Fire Protection Significance Determination Process," Washington, DC, 2004.

98 Walton W., and Thomas, P., "Estimating Temperatures in Compartment Fires," in *The SFPE Handbook of Fire Protection Engineering*. Quincy, Massachusetts: National Fire Protection Association, 2008, ch. 3-6.

99 Budnick, E.K., Evans, D.D., and Nelson, H.L., "Simplified Fire Growth Calculations," in *Fire Protection Handbook*, 19th ed. Quincy, Massachusetts: National Fire Protection Association, 2003, ch. 3-9.

100 Custer R.L.P., Meacham B. J., and Schifiliti, R. P., "Design of Detection Systems," in *The SFPE Handbook of Fire Protection Engineering*. Quincy, Massachusetts: National Fire Protection Association, 2008, ch. 4-1.

101 R., Reneke, P. Peacock, "CFAST – Consolidated Model of Fire Growth and Smoke Transport (Version 6) Software Development and Model Evaluation Guide," National Institute of Standards and Technology, Gaithersburg, MD, Special Publication 1086r1, 2012.

102 McDermott, R., McGrattan, K., Hostikka, S., Floyd, J., "Fire Dynamics Simulator (Version 5) Technical Reference Guide Volume 2: Verification," National Institute of Standards and Technology, Gaithersburg, MD, Special Publication 1018-5, 2010.

103 McGrattan, K., Hostikka, S., Floyd, J, McDermott, R., "Fire Dynamics Simulator (Version 5) Technical Reference Guide Volume 3: Validation," National Institute of Standards and Technology, Gaithersburg, MD, Special Publication 1018-5, 2010.

104 Babrauskas, V., "Heat Release Rates," in *The SFPE Handbook of Fire Protection Engineering*. Quincy, Massachusetts: National Fire Protection Association, 2008, ch. 3-1.

105 Lee, B., "Heat Release Rate Characteristics of Some Combustible Fuel Sources in Nuclear Power Plants," National Bureau of Standards, Washington, DC, NBSIR 85-3195, July, 1985.

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Attachments:
A. Table 3.8-1 – V&V Basis for Fire Modeling Correlations Used at CCNPP
B. Table 3.8-2 – V&V Basis for Fire Model Calculations of Other Models Used at CCNPP
C. Abbreviations and Acronyms

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at CCNPP

Correlation	Application at CCNPP	V&V Basis	NRC Staff Evaluation of Acceptability
Flame Height (Method of Heskestad)	The Flame Height Correlation was implemented in the Fire Modeling Workbook (FMWB). The correlation was used to determine the vertical extension of the flame region as part of the Zone of Influence (ZOI) calculations.	NUREG-1805, Chapter 3, 2004 (Reference 42) NUREG-1824, Volume 3, 2007 (Reference 43) SFPE Handbook, 4th Edition, Chapter 2-1, Heskestad, 2008 (Reference 91)	• The licensee provided verification of the FMWB on basis of comparison with NUREG-1805. • The correlation is validated in NUREG-1824 and the SFPE Handbook. • The licensee stated that in most cases, it applied the correlation within the validated range reported in NUREG-1824. The licensee provided justification for cases where it used the correlation outside the validated range reported in NUREG-1824. (see response to FM RAI 04, (Reference 11)) Based on its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at CCNPP

Correlation	Application at CCNPP	V&V Basis	NRC Staff Evaluation of Acceptability
Plume Centerline Temperature (Method of Heskestad)	The Plume Centerline Temperature correlation was implemented in the FMWB. The correlation was used to determine vertical separation distance, based on temperature, to a target in order to determine the vertical extent of the ZOI.	NUREG-1805, Chapter 9, 2004 (Reference 42) NUREG-1824, Volume 3, 2007 (Reference 43) SFPE Handbook, 4th Edition, Chapter 2-1, Heskestad, 2008 (Reference 91)	• The licensee provided verification of the FMWB on basis of comparison with NUREG-1805. • The correlation is validated in NUREG-1824 and the SFPE Handbook. • The licensee stated that in most cases, it applied the correlation within the validated range reported in NUREG-1824. The licensee provided justification for cases where it used the correlation outside the validated range reported in NUREG-1824. (see response to FM RAI 04, (Reference 11)) Based on its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at CCNPP

Correlation	Application at CCNPP	V&V Basis	NRC Staff Evaluation of Acceptability
Radiant Heat Flux (Point Source Method)	The Radiant Heat Flux (Point Source Method) correlation was implemented in the FMWB. The correlation was used to determine the horizontal separation distance, based on heat flux, to a target in order to determine the horizontal extent of the ZOI.	NUREG-1805, Chapter 5, 2004 (Reference 42) NUREG-1824, Volume 3, 2007 (Reference 43) SFPE Handbook, 4th Edition, Chapter 3-10, Beyler, C., 2008 (Reference 92)	• The licensee provided verification of the FMWB on basis of comparison with NUREG-1805. • The correlation is validated in NUREG-1824 and the SFPE Handbook. • The licensee stated that in most cases, it applied the correlation within the validated range reported in NUREG-1824. The licensee provided justification for cases where it used the correlation outside the validated range reported in NUREG-1824. (see response to FM RAI 04, (Reference 11)) Based on its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at CCNPP

Correlation	Application at CCNPP	V&V Basis	NRC Staff Evaluation of Acceptability
Ceiling Jet Temperature (Method of Alpert)	The Ceiling Jet Temperature (Method of Alpert) correlation was implemented in the FMWB. The correlation was used to calculate horizontal separation distance, based on temperature at the ceiling of a room, to a target in order to determine the horizontal extent of the ZOI.	NUREG-1824, Volume 4, 2007 (Reference 43) SFPE Handbook, 4th Edition, Chapter 2-2, Alpert, R., 2008 (Reference 93) FIVE – Rev. 1 (Reference 94)	• The licensee provided verification of the FMWB on basis of comparison with NUREG-1805. • The correlation is validated in NUREG-1824 and the SFPE Handbook. • The licensee stated that in most cases, it applied the correlation within the validated range reported in NUREG-1824. The licensee provided justification for cases where it used the correlation outside the validated range reported in NUREG-1824. (see response to FM RAI 04, (Reference 11)) Based on its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at CCNPP

Correlation	Application at CCNPP	V&V Basis	NRC Staff Evaluation of Acceptability
Hot Gas Layer (Method of McCaffrey, Quintiere, and Harkleroad)	The HGL (Method of McCaffrey, Quintiere, and Harkleroad) correlation was implemented in the FMWB. The correlation was used to calculate the HGL temperature for a room with natural ventilation.	NUREG-1805, Chapter 2, 2004 (Reference 42) NUREG-1824, Volume 3, 2007 (Reference 43) SFPE Handbook, 4th Edition, Chapter 3-6, Walton W. and Thomas, P., 2008 (Reference 98)	• The licensee provided verification of the FMWB on basis of comparison with NUREG-1805. • The correlation is validated in NUREG-1824 and the SFPE Handbook. • The licensee stated that in most cases, it applied the correlation within the validated range reported in NUREG-1824. The licensee provided justification for cases where it used the correlation outside the validated range reported in NUREG-1824. (see response to FM RAI 04, (Reference 11)) Based its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.
Hot Gas Layer (Method of Foote, Pagni, and Alvares)	The HGL correlation (Method of Foote, Pagni, and Alvares) was implemented in the FMWB. The correlation was used to calculate the HGL temperature for a room with mechanical ventilation.	NUREG-1805, Chapter 2, 2004 (Reference 42) NUREG-1824, Volume 3, 2007 (Reference 43) SFPE Handbook, 4th Edition, Chapter 3-6, Walton W. and Thomas, P., 2008 (Reference 98)	• The licensee provided verification of the FMWB on basis of comparison with NUREG-1805. • The correlation is validated in NUREG-1824 and the SFPE Handbook. • The licensee stated that in most cases, it applied the correlation within the validated range reported in NUREG-1824. The licensee provided justification for cases where it used the correlation outside the validated range reported in NUREG-1824. (see response to FM RAI 04, (Reference 11)) Based on its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at CCNPP

Correlation	Application at CCNPP	V&V Basis	NRC Staff Evaluation of Acceptability
Hot Gas Layer (Method of Beyler)	The HGL correlation (Method of Beyler) was implemented in the FMWB. The correlation was used to calculate the HGL temperature for a room with no ventilation.	NUREG-1805, Chapter 2, 2004 (Reference 42) NUREG-1824, Volume 3, 2007 (Reference 43) SFPE Handbook, 4th Edition, Chapter 3-6, Walton W. and Thomas, P., 2008 (Reference 98)	• The licensee provided verification of the FMWB on basis of comparison with NUREG-1805. • The correlation is validated in NUREG-1824 and the SFPE Handbook. • The licensee stated that in most cases, it applied the correlation within the validated range reported in NUREG-1824. The licensee provided justification for cases where it used the correlation outside the validated range reported in NUREG-1824. (see response to FM RAI 04, (Reference 11)) Based on its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.
Plume Radius (Method of Heskestad)	The Plume Radius (Method of Heskestad) correlation was implemented in the FMWB. The correlation was used to calculate the horizontal radius, based on temperature of the plume at a given height.	FIVE – Rev. 1 (Reference 94) NUREG-1824, Volume 4, 2007 (Reference 43) SFPE Handbook, 4th Edition, Chapter 2-1 (Reference 91)	• The licensee stated that it did not use the plume radius as the sole basis for any target failures. • The licensee provided verification of the FMWB on the basis of Heskestad's correlation. • The correlation is validated in the SFPE Handbook. • The plume radius correlation is derived from Heskestad's plume centerline temperature correlation, for which V&V is documented in NUREG-1824. The plume radius correlation is subject to the same validated ranges. (see response to FM RAI 04, (Reference 11)) Based on its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at CCNPP

Correlation	Application at CCNPP	V&V Basis	NRC Staff Evaluation of Acceptability
Sprinkler Activation Correlation	The correlation was used to estimate sprinkler actuation time based on the Alpert ceiling jet temperature, velocity, and thermal response of sprinkler.	NUREG-1805, Chapter 10, 2004 (Reference 42) NFPA Handbook, 19th Edition, Chapter 3-9, Budnick, E., Evans, D., and Nelson, H., 2003. (Reference 99)	• The correlation is validated in the NFPA Handbook. • The sprinkler actuation correlation is used in the NUREG-1805 fire model. • The licensee stated that in most cases, it applied the correlation within the validated range. The licensee provided justification for cases where it used the correlation outside the validated range. (see response to FM RAI 04, (Reference 11)) Based on its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.
Smoke Detection Actuation Correlation (Method of Heskestad and Delichatsios)	The smoke detector actuation correlation was used to estimate smoke detector time based on Alpert's ceiling jet temperature, velocity, and thermal response of the detector.	FIVE – Revision 1 (Reference 94) NUREG-1824, Volume 4, 2007 (Reference 43) NFPA Handbook, 19th Edition, Chapter 3-9, Budnick, E., Evans, D., and Nelson, H., 2003. (Reference 99)	• The licensee provided verification of the FMWB on basis of comparison with NUREG-1805. • The correlation is validated in the NFPA Handbook. (see response to FM RAI 03.a, (Reference 10)) • The licensee stated that in most cases, it applied the correlation within the validated range. The licensee provided justification for cases where it used the correlation outside the validated range. (see response to FM RAI 04, (Reference 11)) Based on its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.

Attachment B: Table 3.8-2, V&V Basis for Other Fire Models and Related Calculations Used at CCNPP

Calculation	Application at CCNPP	V&V Basis	NRC Staff Evaluation of Acceptability
Temperature Sensitive Equipment Hot Gas Layer Study	CFAST (Version 6) was used to calculate the upper and lower gas layer temperatures for various compartments, and the layer height, for use in assessment of damage to temperature sensitive equipment's.	NUREG-1824, Volume 5, 2007 (Reference 43) NIST Special Publication 1086, 2012 (Reference 101)	• The modeling technique is validated in NUREG-1824 and an authoritative publication of NIST. • The licensee stated that in most cases, it applied the model within the validated range reported in NUREG-1824. The licensee provided justification for cases where it used the model outside the validated range reported in NUREG-1824. (see response to FM RAI 04, (Reference 11)) Based on its review and evaluation, the NRC staff concludes that the use of CFAST is acceptable.
Control Room Abandonment Calculations using Fire Dynamics Simulator (Version 5)	Fire Dynamics Simulator (Version 5) was used to find smoke concentration/visibility, temperature impacts, heat flux, and flame height of a fire in the MCR. From these values calculated by FDS, abandonment time was determined.	NUREG-1824, Volume 7, 2007 (Reference 43) NIST Special Publication 1018-5, Volume 2: Verification (Reference 102) NIST Special Publication 1018-5, Volume 3: Validation (Reference 103)	• The modeling technique is validated in NUREG-1824 and authoritative publications of NIST. • The licensee stated that in most cases, it applied FDS within the validated range reported in NUREG-1824. The licensee provided justification for cases where it used FDS outside the validated range reported in NUREG-1824. (see response to FM RAI 04, (Reference 11)) Based on its review and evaluation, the NRC staff concludes that the use of FDS for the MCR abandonment time calculations is acceptable.

Attachment B: Table 3.8-2, V&V Basis for Other Fire Models and Related Calculations Used at CCNPP

Calculation	Application at CCNPP	V&V Basis	NRC Staff Evaluation of Acceptability
Cable Spreading Room Analysis using Fire Dynamics Simulator (Version 5)	Fire Dynamics Simulator (Version 5) was used to estimate flame height, heat fluxes, and smoke detector activation in the CCNPP cable spreading room.	NUREG-1824, Volume 7, 2007 (Reference 43) NIST Special Publication 1018-5, Volume 2: Verification (Reference 102) NIST Special Publication 1018-5, Volume 3: Validation (Reference 103) NUREG-1805, Chapter 11, (Reference 42)	• The modeling technique is validated in NUREG-1824 and authoritative publications of NIST. • The licensee stated that in most cases, it applied FDS within the validated range reported in NUREG-1824. The licensee provided justification for cases where it used FDS outside the validated range reported in NUREG-1824. (see response to FM RAI 04, (Reference 11)) Based on its review and evaluation, the NRC staff concludes that the use of FDS to estimate flame height, heat fluxes, and smoke detector activation in the cable spreading room is acceptable.

Attachment B: Table 3.8-2, V&V Basis for Other Fire Models and Related Calculations Used at CCNPP

Calculation	Application at CCNPP	V&V Basis	NRC Staff Evaluation of Acceptability
Plume/Hot Gas Layer Interaction Study	FDS (Version 5) was used to locate the point where HGL and plume interact and establish limits for plume temperature application.	NUREG-1824, Volume 7, 2007 (Reference 43) NIST Special Publication 1018-5, Volume 2: Verification (Reference 102) NIST Special Publication 1018-5, Volume 3: Validation (Reference 103)	• The modeling technique is validated in NUREG-1824 and authoritative publications of NIST. • The licensee stated that in most cases, it applied FDS within the validated range reported in NUREG-1824. The licensee provided justification for cases where it used FDS outside the validated range reported in NUREG-1824. (see response to FM RAI 04, (Reference 11)) Based on its review and evaluation, the NRC staff concludes that the use of FDS is acceptable
Correlation for Heat Release Rates and Ignition Timing of Cable Fires (Method of Lee)	Method of Lee was used to correlate bench scale data to heat release rates from cable tray fires.	SFPE Handbook, 4th Edition, Chapter 3-1, Babrauskas, 2008 (Reference 104)	• The modeling technique is documented in authoritative publications of NIST and the SFPE Handbook. • The licensee stated that it applied the correlation within the range of its applicability. Based on its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.

Attachment B: Table 3.8-2, V&V Basis for Other Fire Models and Related Calculations Used at CCNPP

Calculation	Application at CCNPP	V&V Basis	NRC Staff Evaluation of Acceptability
Correlation for Flame Spread over Horizontal Cable Trays (FLASH-CAT)	The FLASH-CAT method was used to calculate the growth and spread of a fire within a vertical stack of horizontal cable trays.	NUREG/CR-7010, Section 9, 2012 (Reference 44)	• The modeling technique is validated in an authoritative publication of NIST. • The licensee stated that it applied the correlation within the range of its applicability. Based on its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.

Attachment C: Abbreviations and Acronyms

AC	alternating current
ADAMS	Agencywide Documents Access and Management System
ADV	atmospheric dump valves
AFW	auxiliary feedwater
AHJ	authority having jurisdiction
ANS	American Nuclear Society
ALARA	as low as reasonably achievable
AOG	auxiliary off-gas
AOP	abnormal operating procedures
APCSB	Auxiliary and Power Conversion Systems Branch
ASME	American Society of Mechanical Engineers
ASSDP	Auxiliary Safe Shutdown
BTP	Branch Technical Position
BWR	boiling-water reactor
BWRVIP	Boiling Water Reactor Vessels and Internals Project
CAROLFIRE	Cable Response to Live Fire
CC	capability category
CCDP	conditional core damage probability
CCNPP	Calvert Cliffs Nuclear Power Plant
CDF	core damage frequency
CENG	constellation energy nuclear group
CFAST	consolidated model of fire and smoke transport
CFR	Code of Federal Regulations
CHRISTIFIRE	Cable Heat Release, Ignition, and Spread in Tray Installations During Fire
CLERP	conditional large early release probabilities
CSR	cable spreading room
CST	condensate storage tank
DC	direct current
DESIREE-Fire	Direct Current Electrical Shorting in Response to Exposure Fire
DHR	decay heat removal
DID RA	defense-in-depth recovery action
DID	defense-in-depth
DG	diesel generator
EDG	emergency diesel generator
EEEE	existing engineering equivalency evaluation
EMT	electrical metallic tubing
EPM	Engineering, Planning and Management
EPRI	Electric Power Research Institute
ERFBS	electrical raceway fire barrier system
ERO	Emergency Response Organization
F&O	facts and observations
FAQ	frequently asked question
FDS	fire dynamics simulator
FDT	fire dynamics tool
FIVE	Fire Induced Vulnerability Evaluation Methodology
FLASH-CAT	flame spread over horizontal cable trays
FM	fire modeling
FMWB	Fire Modeling Workbook
FOST	fuel oil storage tank
FPE	fire protection engineering

FPP	fire protection program
FPRA	fire probabilistic risk assessment
FR	Federal Register
FRE	fire risk evaluation
FSAR	final safety analysis report
GDC	general design criteria
GFMT	generic fire modeling treatments
GL	generic letter
HC	hand controllers
HEAF	high energy arcing fault
HDPE	high-density polyethylene
HEP	human error probability
HFE	human failure event
HGL	hot gas layer
HRA	human reliability analysis
HRE	high(er) risk evolution
HRR	heat release rate
HVAC	heating, ventilation, and air conditioning
IEEE	Institute of Electrical and Electronics Engineers
IEPRA	internal events PRA (probabilistic risk assessment)
ISFSI	independent spent fuel storage
KSF	key safety function
kV	kilovolt
kW	kilowatt
LAR	license amendment request
LER	license event report
LERF	large early release frequency
MCA	multi-compartment analysis
MCB	main control board
MCR	main control room
min	minute(s)
MQH	McCaffey, Quintiere and Harkleroad
MSIV	main steam isolation valves
MSO	multiple spurious operation
NEC	National Electric Code
NEI	Nuclear Energy Institute
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NLO	Non-licensed operator
No.	number
NPO	non-power operation
NPP	nuclear power plant
NRC	U.S. Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
NSCA	nuclear safety capability assessment
NSPC	nuclear safety performance criteria
ODCM	Offsite Dose Calculation Manual
OMA	operator manual action
PAU	physical analysis unit
PB	performance-based

PCE	plant change evaluation
PCS	primary control station
P&ID	piping and instrumentation drawings
PORV	power-operated relief valves
POS	plant operational states
PRA	probabilistic risk assessment
PSA	probabilistic safety assessment
PWR	pressurized-water reactor
PWST	pretreated water storage tank
QA	quality assurance
RA	recovery action
RAI	request for additional information
RB	reactor building
RCS	reactor coolant system
RES	Office of Nuclear Regulatory Research
RG	Regulatory Guide
RHR	residual heat removal
RI	risk-informed
RI/PB	risk-informed, performance-based
RP	regulatory position
SBO	station blackout
SCBA	self-contained breathing apparatus
scf	standard cubic feet (foot)
SDC	shutdown cooling
SE	safety evaluation
SER	safety evaluation report
SFPE	Society of Fire Protection Engineers
SG	steam generator
SOKE	state of knowledge correlation
SR	supporting requirement
SSA	safe shutdown analysis
SSC	structures, systems, and components
SSD	safe shutdown
SSDA	safe shutdown analysis
SWAC	saltwater air compressors
THIEF	Thermally Induced Electrical Failure
TS	Technical Specification
UFSAR	updated final safety analysis report
V	volt
VDC	volt direct-current
V&V	verification and validation
VEWFDS	very early warning fire detectors
VFDR	variance from deterministic requirements
yr	year
ZOI	zone of influence

A Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

/RA/

Richard V. Guzman, Senior Project Manager
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-317 and 50-318

Enclosures:
1. Amendment No. 318 to DPR-53
2. Amendment No. 296 to DPR-69
3. Safety Evaluation

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