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

February 8, 2017

Mr. Tom Simril
Site Vice President
Duke Energy Carolinas, LLC
Catawba Nuclear Station
4800 Concord Road
York, SC 29745

SUBJECT: CATAWBA NUCLEAR STATION, UNITS 1 AND 2 – ISSUANCE OF AMENDMENTS REGARDING NATIONAL FIRE PROTECTION ASSOCIATION STANDARD NFPA 805 (CAC NOS. MF2936 AND MF2937)

Dear Mr. Simril:

The U.S. Nuclear Regulatory Commission (NRC) has issued the enclosed Amendment No. 287 to Renewed Facility Operating License No. NPF-35 and Amendment No. 283 to Renewed Facility Operating License No. NPF-52 for the Catawba Nuclear Station (CNS), Units 1 and 2, respectively. These amendments are in response to your application dated September 25, 2013, as supplemented by letters dated January 13, 2015; January 28, 2015; February 27, 2015; March 30, 2015; April 28, 2015; July 15, 2015; August 14, 2015; September 3, 2015; December 11, 2015; January 7, 2016; March 23, 2016; June 15, 2016; August 2, 2016; September 7, 2016; and January 26, 2017.

The amendments transition CNS, Units 1 and 2, to Title 10 of the *Code of Federal Regulations*, Section 50.48(c), "National Fire Protection Association Standard NFPA 805."

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

Sincerely,

Michael Mahoney, Project Manager
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-413 and 50-414

Enclosures:
1. Amendment No. 287 to NPF-35
2. Amendment No. 283 to NPF-52
3. Safety Evaluation

cc w/enclosures: Distribution via Listserv

DUKE ENERGY CAROLINAS, LLC

DOCKET NO. 50-413

CATAWBA NUCLEAR STATION, UNIT 1

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 287
Renewed License No. NPF-35

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

   A. The application for amendment to the Catawba Nuclear Station, Unit 1 (the facility), Renewed Facility Operating License No. NPF-35, filed by Duke Energy Carolinas, LLC (the licensee), dated September 25, 2013, as supplemented by letters dated January 13, 2015; January 28, 2015; February 27, 2015; March 30, 2015; April 28, 2015; July 15, 2015; August 14, 2015; September 3, 2015; December 11, 2015; January 7, 2016; March 23, 2016; June 15, 2016; August 2, 2016; September 7, 2016; and January 26, 2017 complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations as 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 set forth in 10 CFR Chapter I;

   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 hereby amended as indicated in the attachment to this license amendment. Paragraph 2.C.(5) of Renewed Facility Operating License No. NPF-35 is hereby amended to read as follows:

(5) Fire Protection Program

Duke Energy Carolinas, LLC shall implement and maintain in effect all provisions of the approved fire protection program that complies with 10 CFR 50.48(a) and 10 CFR 50.48(c), as specified in the licensee amendment request dated September 25, 2013; as supplemented by letters dated January 13, 2015; January 28, 2015; February 27, 2015; March 30, 2015; April 28, 2015; July 15, 2015; August 14, 2015; September 3, 2015; December 11, 2015; January 7, 2016; March 23, 2016; June 15, 2016; August 2, 2016; September 7, 2016; and, January 26, 2017, as approved in the SE dated February 8, 2017. Except where NRC approval for changes or deviations is required by 10 CFR 50.48(c), and provided no other regulation, technical specification, license condition or requirement would require prior NRC approval, the licensee may make changes to the fire protection program without prior approval of the Commission if those changes satisfy the provisions set forth in 10 CFR 50.48(a) and 10 CFR 50.48(c), the change does not require a change to a technical specification or a license condition, and the criteria listed below are satisfied.

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

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

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

2) Prior NRC review and approval is not required for individual changes that result in a risk increase less than $1X10^{-7}$/year (yr) for CDF and less than $1X10^{-8}$/yr for LERF. The proposed change must also be consistent with the defense-in-depth philosophy and must maintain sufficient safety margins. The change may be implemented following completion of the plant change evaluation.

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

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

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

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

The four specific sections of NFPA 805, Chapter 3, are as follows:

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

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

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

Prior NRC review and approval is not required for changes to the licensee's fire protection program that have been demonstrated to have no more than a minimal risk impact. The licensee may use its screening process as approved in the NRC SE dated February 8, 2017, to determine that certain fire protection program changes meet the minimal criterion. The licensee shall ensure that fire protection defense-in-depth and safety margins are maintained when changes are made to the fire protection program.

(c) Transition License Conditions

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

(2) The licensee shall implement the modifications to its facility, as described in Table S-2, "Plant Modifications Committed," Attachment S, of the Duke Energy Carolinas, LLC letter CNS-17-004, dated January 26, 2017, to complete the transition to full compliance with 10 CFR 50.48(c) by December 31, 2017. The licensee shall maintain appropriate compensatory measures in accordance with its procedures until completion of these modifications.

(3) The licensee shall complete the implementation items as listed in Table S-3, "Implementation Items," Attachment S, of the Duke Energy Carolinas, LLC letter CNS-17-004, dated January 26, 2017, within 180 days after issuance of the Safety Evaluation unless that falls within a scheduled outage window, then the completion of implementation items will occur 60 days after startup from the scheduled outage. Implementation Item 13 is associated with modifications and will be completed 180 days after modifications are complete.

3. This license amendment is effective as of its date of issuance and shall be implemented as stated in paragraph 2.C.(5) above.

FOR THE NUCLEAR REGULATORY COMMISSION

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

Attachment: Changes to Renewed Facility Operating License No. NPF-35

Date of Issuance: February 8, 2017

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

DUKE ENERGY CAROLINAS, LLC

DOCKET NO. 50-414

CATAWBA NUCLEAR STATION, UNIT 2

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 283
Renewed License No. NPF-52

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

   A. The application for amendment to the Catawba Nuclear Station, Unit 2 (the facility), Renewed Facility Operating License No. NPF-52, filed by Duke Energy Carolinas, LLC (the licensee), dated September 25, 2013, as supplemented by letters dated January 13, 2015; January 28, 2015; February 27, 2015; March 30, 2015; April 28, 2015; July 15, 2015; August 14, 2015; September 3, 2015; December 11, 2015; January 7, 2016; March 23, 2016; June 15, 2016; August 2, 2016; September 7, 2016; and, January 26, 2017, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations as 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 set forth in 10 CFR Chapter I;

   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 hereby amended as indicated in the attachment to this license amendment. Paragraph 2.C.(5) of Renewed Facility Operating License NPF-52 is hereby amended to read as follows:

(5) Fire Protection Program

Duke Energy Carolinas, LLC shall implement and maintain in effect all provisions of the approved fire protection program that complies with 10 CFR 50.48(a) and 10 CFR 50.48(c), as specified in the licensee amendment request dated September 25, 2013, as supplemented by letters dated January 13, 2015; January 28, 2015; February 27, 2015; March 30, 2015; April 28, 2015; July 15, 2015; August 14, 2015; September 3, 2015; December 11, 2015; January 7, 2016; March 23, 2016; June 15, 2016; August 2, 2016; September 7, 2016; and, January 26, 2017, as approved in the SE dated February 8, 2017. Except where NRC approval for changes or deviations is required by 10 CFR 50.48(c), and provided no other regulation, technical specification, license condition or requirement would require prior NRC approval, the licensee may make changes to the fire protection program without prior approval of the Commission if those changes satisfy the provisions set forth in 10 CFR 50.48(a) and 10 CFR 50.48(c), the change does not require a change to a technical specification or a license condition, and the criteria listed below are satisfied.

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

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

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

2) Prior NRC review and approval is not required for individual changes that result in a risk increase less than $1X10^{-7}$/year (yr) for CDF and less than $1X10^{-8}$/yr for LERF. The proposed change must also be consistent with the defense-in-depth philosophy and must maintain sufficient safety margins. The change may be implemented following completion of the plant change evaluation.

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

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

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

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

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

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

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

Prior NRC review and approval is not required for changes to the licensee's fire protection program that have been demonstrated to have no more than a minimal risk impact. The licensee may use its screening process as approved in the NRC SE dated February 8, 2017, to determine that certain fire protection program changes meet the minimal criterion. The licensee shall ensure that fire protection defense-in-depth and safety margins are maintained when changes are made to the fire protection program.

(c) Transition License Conditions

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

(2) The licensee shall implement the modifications to its facility, as described in Table S-2, "Plant Modifications Committed," Attachment S, of the Duke Energy Carolinas, LLC letter CNS-17-004, dated January 26, 2017, to complete the transition to full compliance with 10 CFR 50.48(c) by December 31, 2017. The licensee shall maintain appropriate compensatory measures in accordance with its procedures until completion of these modifications.

(3) The licensee shall complete the implementation items as listed in Table S-3, "Implementation Items," Attachment S, of the Duke Energy Carolinas, LLC letter CNS-17-004, dated January 26, 2017, within 180 days after issuance of the Safety Evaluation unless that falls within a scheduled outage window, then the completion of implementation items will occur 60 days after startup from the scheduled outage. Implementation Item 13 is associated with modifications and will be completed 180 days after modifications are complete.

3. This license amendment is effective as of its date of issuance and shall be implemented as stated in paragraph 2.C.(5) above.

FOR THE NUCLEAR REGULATORY COMMISSION

Michael T. Markley

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

Attachment:
Changes to Renewed Facility Operating License No. NPF-52

Date of Issuance: February 8, 2017

ATTACHMENT TO LICENSE AMENDMENT NO. 287

RENEWED FACILITY OPERATING LICENSE NO. NPF-35

DOCKET NO. 50-413

AND

LICENSE AMENDMENT NO. 283

RENEWED FACILITY OPERATING LICENSE NO. NPF-52

DOCKET NO. 50-414

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

Remove	Insert
Licenses	Licenses
NPF-35, page 4	NPF-35, page 4
---	NPF-35, page 4A
---	NPF-35, page 4B
---	NPF-35, page 4C
NPF-52, page 4	NPF-52, page 4
---	NPF-52, page 4A
---	NPF-52, page 4B
---	NPF-52, page 4C

(2) Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 286 which are attached hereto, are hereby incorporated into this renewed operating license. Duke Energy Carolinas, LLC shall operate the facility in accordance with the Technical Specifications.

(3) Updated Final Safety Analysis Report

The Updated Final Safety Analysis Report supplement submitted pursuant to 10 CFR 54.21(d), as revised on December 16, 2002, describes certain future activities to be completed before the period of extended operation. Duke shall complete these activities no later than December 6, 2024, and shall notify the NRC in writing when implementation of these activities is complete and can be verified by NRC inspection.

The Updated Final Safety Analysis Report supplement as revised on December 16, 2002, described above, shall be included in the next scheduled update to the Updated Final Safety Analysis Report required by 10 CFR 50.71 (e)(4), following issuance of this renewed operating license. Until that update is complete, Duke may make changes to the programs described in such supplement without prior Commission approval, provided that Duke evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59 and otherwise complies with the requirements in that section.

(4) Antitrust Conditions

Duke Energy Carolinas, LLC shall comply with the antitrust conditions delineated in Appendix C to this renewed operating license.

(5) Fire Protection Program

Duke Energy Carolinas, LLC shall implement and maintain in effect all provisions of the approved fire protection program that complies with 10 CFR 50.48(a) and 10 CFR 50.48(c), as specified in the licensee amendment request dated September 25, 2013; as supplemented by letters dated January 13, 2015; January 28, 2015; February 27, 2015; March 30, 2015; April 28, 2015; July 15, 2015; August 14, 2015; September 3, 2015; December 11, 2015; January 7, 2016; March 23, 2016; June 15, 2016; August 2, 2016; September 7, 2016; and, January X, 2017, as approved in the SE dated February 8, 2017. Except where NRC approval for changes or deviations is required by 10 CFR 50.48(c), and provided no other regulation, technical specification, license condition or requirement would require prior NRC approval, the licensee may make changes to the fire protection program without prior approval of the Commission if those changes satisfy the provisions set forth in 10 CFR 50.48(a) and 10 CFR 50.48(c), the change does not require a change to a technical specification or a license condition, and the criteria listed below are satisfied.

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

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

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

2) Prior NRC review and approval is not required for individual changes that result in a risk increase less than $1X10^{-7}$/year (yr) for CDF and less than $1X10^{-8}$/yr for LERF. The proposed change must also be consistent with the defense-in-depth philosophy and must maintain sufficient safety margins. The change may be implemented following completion of the plant change evaluation.

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

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

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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),
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- "Passive Fire Protection Features" (Section 3.11).

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

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

Prior NRC review and approval is not required for changes to the licensee's fire protection program that have been demonstrated to have no more than a minimal risk impact. The licensee may use its screening process as approved in the NRC SE dated February 8, 2017, to determine that certain fire protection program changes meet the minimal criterion. The licensee shall ensure that fire protection defense-in-depth and safety margins are maintained when changes are made to the fire protection program.

(c) Transition License Conditions

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

2) The licensee shall implement the modifications to its facility, as described in Table S-2, "Plant Modifications Committed," Attachment S, of the Duke Energy Carolinas, LLC letter CNS-17-004, dated January 26, 2017, to complete the transition to full compliance with 10 CFR 50.48(c) by December 31, 2017. The licensee shall maintain appropriate compensatory measures in accordance with its procedures until completion of these modifications.

3) The licensee shall complete the implementation items as listed in Table S-3, "Implementation Items," Attachment S, of the Duke Energy Carolinas, LLC letter CNS-17-004, dated January 26, 2017, within 180 days after

then the completion of implementation items will occur 60 days after startup from the scheduled outage. Implementation Item 13 is associated with modifications and will be completed 180 days after modifications are complete.

(2) Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 282, which are attached hereto, are hereby incorporated into this renewed operating license. Duke Energy Carolinas, LLC shall operate the facility in accordance with the Technical Specifications.

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The Updated Final Safety Analysis Report supplement submitted pursuant to 10 CFR 54.21(d), as revised on December 16, 2002, describes certain future activities to be completed before the period of extended operation. Duke shall complete these activities no later than December 6, 2024, and shall notify the NRC in writing when implementation of these activities is complete and can be verified by NRC inspection.

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(c) Transition License Conditions

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

2) The licensee shall implement the modifications to its facility, as described in Table S-2, "Plant Modifications Committed," Attachment S, of the Duke Energy Carolinas, LLC letter CNS-17-004, dated January 26, 2017, to complete the transition to full compliance with 10 CFR 50.48(c) by December 31, 2017. The licensee shall maintain appropriate compensatory measures in accordance with its procedures until completion of these modifications.

3) The licensee shall complete the implementation items as listed in Table S-3, "Implementation Items," Attachment S, of the Duke Energy Carolinas, LLC letter CNS-17-004, dated January 26, 2017, within 180 days after issuance of the Safety Evaluation unless that falls within a scheduled outage window,

then the completion of implementation items will occur 60 days after startup from the scheduled outage. Implementation Item 13 is associated with modifications and will be completed 180 days after modifications are complete.

ENCLOSURE 3

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. 287 and 283 TO RENEWED FACILITY OPERATING LICENSE

NOS. NPF-35 AND NPF-52

DUKE ENERGY CAROLINAS, LLC

CATAWBA NUCLEAR STATION, UNITS 1 AND 2

DOCKET NOS. 50-413 AND 50-414

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ATTACHMENTS

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

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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) APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants" (Reference 1), and Appendix A to BTP APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants Docketed Prior to July 1, 1976" (Reference 2). Subsequently, the NRC performed fire protection reviews for the operating reactors and documented the results in safety evaluation reports (SERs), or supplements, to SERs.

In 1980, to resolve issues identified in those reports, the NRC amended its regulations for fire protection in operating nuclear power plants and published its Final Rule, Fire Protection Program for Operating Nuclear Power Plants, in the *Federal Register* on November 19, 1980 (45 FR 76602), adding Section 50.48, "Fire Protection," and Appendix R to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979." Section 50.48(a)(1) of 10 CFR Part 50 requires each holder of an operating license, and holders of a combined operating license issued under Part 52, to have a fire protection plan that satisfies General Design Criterion (GDC) 3 of Appendix A to 10 CFR Part 50 and states that the fire protection plan must describe the overall fire protection program (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) (RI/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, Revision 1, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants" (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 performance criteria 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, 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 meeting the requirements of) NFPA 805, the NRC staff is referring to NFPA 805 with the exceptions, modifications, and supplements described in 10 CFR 50.48(c)(2).

RG 1.205 also states, in part, that:

> In parallel with the Commission's efforts to issue a rule incorporating the risk-informed, performance-based fire protection provisions of NFPA 805, NEI [the Nuclear Energy Institute] published implementing guidance for the specific provisions of NFPA 805 and 10 CFR 50.48(c) in NEI 04-02, ["Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c)." (Reference 7)]

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

Consistent with this guidance, Duke Energy Carolinas, LLC (Duke Energy, the licensee) requested license amendments to allow the licensee to revise the Catawba Nuclear Station, Units 1 and 2 (CNS), FPP in accordance with 10 CFR 50.48(c) and change the license and technical specifications (TSs) accordingly.

1.2 Requested Licensing Action

By letter dated September 25, 2013 (Reference 8), as supplemented by letters dated January 13, 2015 (Reference 9); January 28, 2015 (Reference 10); February 27, 2015 (Reference 11); March 30, 2015 (Reference 12); April 28, 2015 (Reference 13); July 15, 2015 (Reference 14); August 14, 2015 (Reference 15); September 3, 2015 (Reference 16); December 11, 2015 (Reference 17); January 7, 2016 (Reference 18); March 23, 2016 (Reference 19); June 15, 2016 (Reference 20); August 2, 2016 (Reference 21); September 7, 2016 (Reference 22); and, January 26, 2017 (Reference 23), the licensee submitted an application for a license amendment to transition the FPP to 10 CFR 50.48(c), NFPA 805, "Performance-Based Standard for Fire Protection For Light Water Reactor Electric Generating Plants," 2001 Edition. The supplemental letters were in response to the NRC staff's requests for additional information (RAIs) dated November 20, 2014 (Reference 24); April 22,

2015 (Reference 25); May 10, 2015 (Reference 26); June 18, 2015 (Reference 27); June 25, 2015 (Reference 28); July 2, 2015 (Reference 29); July 7, 2016 (Reference 30), and December 29, 2016 (Reference 31). The licensee's supplemental letters dated January 13, January 28, February 27, March 30, April 28, July 15, August 14, September 3, and December 11, 2015; and January 7, March 23, June 15, August 2, September 7, and January 26, 2017, provided additional information that clarified the application, did not expand the overall scope of the application as originally noticed, and did not change the staff's original proposed no significant hazards consideration determination as published in the *Federal Register* on February 4, 2014 (79 FR 6641).

The licensee requested an amendment to the CNS Renewed Facility Operating Licenses and TSs to establish and maintain an RI/PB FPP in accordance with the requirements of 10 CFR 50.48(c).

Specifically, the licensee requested to transition from the existing deterministic fire protection licensing basis - established in accordance with all provisions of the approved FPP as described in the Updated Final Safety Analysis Report (UFSAR) and as approved in the SER dated February 28, 1983 (Reference 32), and supplemented by letters dated June 30, 1984 (Reference 33); July 31, 1984 (Reference 34); December 31, 1984 (Reference 35); and February 28, 1986 (Reference 36), to an RI/PB FPP in accordance with 10 CFR 50.48(c) that uses risk information, in part, to demonstrate compliance with the fire protection and nuclear safety goals, objectives, and performance criteria of NFPA 805. As such, the proposed FPP at CNS is referred to as RI/PB throughout this SE.

In its license amendment request (LAR), the licensee provided a description of the revised FPP that 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 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 is required to 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. SE Sections 2.4.2 and 4.0 discuss in detail the license condition, and SE Section 2.4.3 discusses the TS changes.

2.0 REGULATORY EVALUATION

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

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

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

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

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

> The Director of the Office of Nuclear Reactor Regulation (NRR), or a designee of the Director, may approve the application if the Director or designee determines that the licensee has identified orders, license conditions, and the TSs that must be revised or superseded, and that any necessary revisions are adequate.

The regulations also allow for flexibility that was not included in the NFPA 805 standard. Licensees who choose to adopt 10 CFR 50.48(c), but wish to use the PB methods permitted

elsewhere in the standard to meet the fire protection requirements of NFPA 805, Chapter 3, "Fundamental Fire Protection Program and Design Elements," may do so by submitting an LAR in accordance with 10 CFR 50.48(c)(2)(vii). This regulation further provides that:

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

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

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

In addition to the conditions outlined by the rule that requires licensees to submit an LAR for NRC review and approval in order to adopt an RI/PB FPP, a licensee may also submit additional elements of its FPP for which it wishes to receive specific NRC review and approval, as set forth in Regulatory Position (RP) C.2.2.1 of RG 1.205, Revision 1 (Reference 4). Inclusion of these elements in the NFPA 805 LAR is meant to alleviate uncertainty in portions of the current FPP licensing bases as a result of the lack of specific NRC approval of these elements. RGs are not substitutes for regulations, and compliance with them is not required. Methods and solutions that differ from those set forth in RGs will be deemed acceptable if they provide a basis for the findings required for the issuance or continuance of a permit or license by the Commission. Accordingly, any submittal addressing these additional FPP elements needs to include sufficient detail to allow the NRC staff to assess whether the licensee's treatment of these elements meets the 10 CFR 50.48(c) requirements.

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

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

2.1 Other Applicable Regulations

The following regulations address fire protection:

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

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

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

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

2.2 Applicable Guidance

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

- RG 1.205, Revision 1, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants," issued December 2009 (Reference 4), which provides guidance for use in complying with the requirements that the NRC has promulgated for RI/PB FPPs in accordance with 10 CFR 50.48 and the referenced 2001 Edition of the NFPA standard. It endorses portions of NEI 04-02, Revision 2, 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 RPs in Section C of RG 1.205, Revision 1, include clarification of the guidance provided in NEI 04-02, as well as NRC exceptions to the guidance. RG 1.205 sets forth RPs, emphasizes certain issues, clarifies the requirements of 10 CFR 50.48(c) and NFPA 805, clarifies the guidance in NEI 04-02. Should a conflict occur between NEI 04-02 and this RG, the RPs in RG 1.205 govern. This RG also indicates that Chapter 3 of NEI 00-01, "Guidance for Post-Fire Safe Shutdown Circuit Analysis," Revision 2, issued May 2009, when used in conjunction with NFPA 805 and the RG, provides 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), specifies the minimum fire protection requirements for existing light-water nuclear power plants during all phases of plant operations, including shutdown, degraded conditions, and decommissioning. 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)" (Reference 7), which provides guidance for implementing the requirements of 10 CFR 50.49(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) provide direction and clarification for adopting NFPA 805 as an acceptable approach to fire protection, consistent with 10 CFR 50.48(c); and (2) provide additional supplemental technical guidance and methods for using NFPA 805 and its appendices to demonstrate compliance with fire protection requirements. Although there is a significant amount of detail in NFPA 805 and its appendices, clarification and additional guidance for select issues help ensure consistency and effective utilization of the standard. The NEI 04-02 guidance focuses attention on the RI/PB 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, Revision 2, "Guidance for Post Fire Safe Shutdown Circuit Analysis" (Reference 37), which provides a deterministic methodology for performing post-fire safe shutdown analysis (SSA). In addition, NEI 00-01 includes information on RI methods (when allowed within a plant's licensing basis) that may be used in conjunction with the deterministic methods for resolving circuit failure issues related to multiple spurious operations (MSOs). The RI method is intended for application by licensees to determine the risk significance of identified circuit failure issues related to MSOs. RG 1.205 indicates that Chapter 3 of NEI 00-01, 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, Revision 2, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," issued May 2011 (Reference 38), which provides the NRC staff's recommendations for using risk information in support of licensee-initiated licensing basis changes to a nuclear power plant that require such review and approval. The guidance provided does not preclude other approaches for requesting licensing basis changes. Rather, RG 1.174 is intended to improve consistency in regulatory decisions in areas in which the results of risk analyses are used to help justify regulatory action. As such, the RG provides general guidance concerning one approach that the NRC has determined to be acceptable for analyzing issues associated with proposed changes to a plant's

licensing basis and for assessing the impact of such proposed changes on the risk associated with plant design and operation.

- RG 1.200, Revision 2, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," issued March 2009 (Reference 39), which 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 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 decisionmaking 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 40), which provides guidance PRAs used to support RI decisions for commercial light-water reactor nuclear power plants and prescribes a method for applying these requirements for specific applications. The Standard gives guidance for a Level 1 PRA of internal and external hazards for all plant operating modes. In addition, the standard provides guidance for a limited Level 2 PRA sufficient to evaluate large early release frequency (LERF). The only hazards explicitly excluded from the scope are accidents resulting from purposeful human-induced security threats (e.g., sabotage). The standard applies to PRAs used to support applications of RI decisionmaking related to design, licensing, procurement, construction, operation, and maintenance.

- RG 1.189, Revision 2, "Fire Protection for Operating Nuclear Power Plants," issued October 2009 (Reference 41), which provides guidance to licensees on the proper content and quality of engineering equivalency evaluations used to support the FPP. The NRC staff developed the RG to provide a comprehensive fire protection guidance document and to identify the scope and depth of fire protection that the NRC staff would consider acceptable for nuclear power plants.

- NUREG-0800, Revision 0, Section 9.5.1.2, "Risk-Informed, Performance-Based Fire Protection Program," issued December 2009 (Reference 42), which 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, Revision 3, Section 19.1, "Determining the Technical Adequacy of Probabilistic Risk Assessment for Risk-Informed License Amendment Requests After Initial Fuel Load," issued September 2012 (Reference 43), which 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, Revision 0, Section 19.2, "Review of Risk Information Used to Support Permanent Plant-Specific Changes to the Licensing Basis: General Guidance," issued June 2007 (Reference 44), which provides the NRC staff with guidance for evaluating the risk information used by a licensee to support permanent RI changes to the licensing basis for the plant.

- NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities," Volumes 1 and 2 and Supplement 1 (Reference 45), (Reference 46), and (Reference 47), which presents a compendium of methods, data, and tools to perform a fire PRA (FPRA) and develop associated insights. In order to address the need for improved methods, the NRC Office of Nuclear Regulatory Research (RES) and Electric Power Research Institute (EPRI) embarked upon a program to develop state-of-the-art FPRA methodology. Both RES and EPRI have provided specialists in fire risk analysis, FM, electrical engineering, human reliability analysis (HRA), and systems engineering for methods development. A formal technical issue resolution process was developed to direct the deliberative process between RES and EPRI. The process ensures that divergent technical views are fully considered, yet encourages consensus at many points during the deliberation. Significantly, the process provides that each party maintain its own point of view if consensus is not reached. Consensus was reached on all technical issues documented in NUREG/CR-6850. The methodology documented in this report reflects the current state-of-the-art in FPRA. These methods are expected to form a basis for RI analyses related to the plant FPP. Volume 1, the Executive Summary, provides general background and overview information including both programmatic and technical, and project insights and conclusions. Volume 2 provides the detailed discussion of the recommended approach, methods, data, and tools for conduct of an FPRA. Supplement 1 provides certain FPRA method enhancements.

- NUREG-1805, "Fire Dynamics Tools (FDTs): Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program" (Reference 48), which provides quantitative methods known as "Fire Dynamics Tools" (FDTs) to assist regional fire protection inspectors in performing fire hazard analysis. The FDTs are intended to assist fire protection inspectors in performing RI evaluations of credible fires that may cause critical damage to

essential safe shutdown equipment as provided in the new reactor oversight process defined in the NRC's inspection manual.

- NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," Volumes 1 through 7 (Reference 49), which 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 (FIVE) Methodlogy – Rev. 1 developed by EPRI (Volume 4),
    3. The zone model Consolidated Model of Fire and Smoke Transport (CFAST) developed by NIST (Volume 5),
    4. The zone model MAGIC developed by Electricite de France (Volume 6), and
    5. The computational fluid dynamics model Fire Dynamics Simulator (FDS) developed by NIST (Volume 7).

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

- NUREG/CR-7010, "Cable Heat Release, Ignition, and Spread In Tray Installations during Fire (CHRISTIFIRE), Volume 1: Horizontal Trays" (Reference 50), which 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 51), which provides guidance on how to treat uncertainties associated with PRA in RI decision-making. The objectives of this guidance include fostering an understanding of the uncertainties associated with PRA and their impact on the results of PRA and providing a pragmatic approach to addressing these uncertainties in the context of the decision-making. To meet the objective of the NUREG, it is necessary to understand the role that PRA results play in the

context of the decision-making process. To define this context, NUREG-1855, Volume 1, provides an overview of the RI decisionmaking process itself.

- NUREG-1921, "EPRI/NRC-RES Fire Human Reliability Analysis Guidelines – Final Report" (Reference 52), which presents the state of the art in fire HRA practice. This report was developed jointly between RES and EPRI to develop the methodology and supporting guidelines for estimating human error probabilities 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 53), which describes the implications of the verification and validation results from NUREG-1824 for fire model users. The features and limitations of the fire models documented in NUREG-1824 are discussed relative to their use to support nuclear power plant fire hazard analyses. The report also provides information to assist fire model users in applying this technology in the nuclear power plant environment.

- NUREG/CR-6595, "An Approach for Estimating the Frequencies of Various Containment Failure Modes and Bypass Events" (Reference 54), which provides a simplified approach for using PRA to estimate the frequency of containment failure and bypass events that result in radioactive releases to the environment with the potential for causing early fatalities. The approach uses LERF as a measure of the risk of early fatality, and provides guidance for estimating LERF under low power and shutdown conditions.

- Generic Letter (GL) 2006-03, "Potentially Nonconforming Hemyc and MT Fire Barrier Configurations" (Reference 55), which requested that licensees evaluate their facilities to confirm compliance with the existing applicable regulatory requirements in light of the information provided in this GL and, if appropriate, take additional actions.

- Branch Technical Position (BTP) Chemical Engineering Branch (CMEB) 9.5-1, Revision 2, "Guidelines for Fire Protection for Nuclear Power Plants," July 1981 (Reference 56), which provides the NRC staff with guidance for implementing a deterministic FPP in accordance with 10 CFR 50.48, and 10 CFR Part 50, Appendix R.

- NFPA 13, "Standard for the Installation of Sprinkler Systems" (Reference 57), which is the industry benchmark for design and installation of automatic fire sprinkler systems. NFPA 13 addresses sprinkler system design approaches, system installation, acceptance testing, and component options.

- NFPA 14, "Standard for the Installation of Standpipe and Hose Systems" (Reference 58), which 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.

- Regulatory Issue Summary (RIS) 2004-03, Revision 1, "Risk-Informed Approach for Post-Fire Safe-Shutdown Circuit Inspections," dated December 29, 2004 (Reference 59), which informed the industry that the NRC has risk-informed its inspection procedure for post-fire safe shutdown circuit analysis inspections to concentrate inspections on circuit failures that have a relatively high likelihood of occurrence. The RIS describes three categories, or bins, of circuit failure likelihood and the inspection process used to assess circuit configurations in each of the three bins. This RIS also describes the process the NRC will use to implement the reactor oversight process for post-fire safe shutdown circuit inspection findings.

- Information Notice 84-09, Revision 1, "Lessons Learned from NRC Inspections of Fire Protection Safe Shutdown Systems (10 CFR 50, Appendix R)," dated March 7, 1984 (Reference 60), which provides the industry with supplemental guidance on meeting the fire protection safe shutdown requirements in 10 CFR Part 50, Appendix R. Information Notice 84-09 includes supplemental guidance on establishing fire areas, fire barrier testing and configuration, protection of equipment necessary to achieve hot shutdown, performing reassessments for conformance with Appendix R, identification of safe shutdown systems and components, assessing combustibility of electrical cable insulation, detection and automatic suppression, instrumentation and procedures necessary for alternative shutdown, fire protection features for cold shutdown systems, and configuration of reactor coolant pump (RCP) oil collection systems.

2.3 NFPA 805 Frequently Asked Questions

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

Table 2.3-1: NFPA 805 Frequently Asked Questions

FAQ #	FAQ Title and Summary	Reference	SE Section
06-0019	"Definition of 'Power Block' and 'Plant'" • This FAQ provides guidance on the definitions of "power block" and "plant" as found in NFPA 805.	(Reference 61)	3.1.2
06-0022	"Electrical Cable Flame Propagation Tests" • This FAQ provides a list of acceptable electrical cable flame propagation tests.	(Reference 62)	3.1.3

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) (PCSs). ▪ Determination of which RAs are required by the NFPA 805 FPP. ▪ Evaluate the additional risk presented by the use of RAs. ▪ Evaluate the feasibility of the identified RAs. ▪ Evaluate the reliability of the identified RAs.	(Reference 63)	3.2.2 3.2.5 3.4.4
07-0038	"Lessons Learned on Multiple Spurious Operations (MSOs)" • This FAQ reflects an acceptable process for the treatment of MSOs during transition to NFPA 805: ▪ Step 1 – Identify potential MSO combinations of concern. ▪ Step 2 – Expert panel assesses plant-specific vulnerabilities and reviews MSOs of concern. ▪ Step 3 – Update the FPRA and Nuclear Safety Capability Assessment (NSCA) to include MSOs of concern. ▪ Step 4 – Evaluate for NFPA 805 compliance. ▪ Step 5 – Document the results.	(Reference 64)	3.2.4 3.2.6 3.4.2.2
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, Revision 1, "Guidance for Post-Fire Safe Shutdown Circuit Analysis" (Reference 65). In short, the process has the licensees: ▪ Assemble industry and plant-specific documentation; ▪ Determine which sections of the guidance are applicable; ▪ Compare the existing safe shutdown methodology to the applicable guidance; and ▪ Document any discrepancies.	(Reference 66)	3.2.1
07-0040	"Non-Power Operations (NPO) Clarifications" • This FAQ clarifies an acceptable NFPA 805 NPO program. The process includes: ▪ Selecting NPO equipment and cabling. ▪ Evaluation of NPO higher risk evolutions (HRE). ▪ Analyzing NPO key safety functions (KSF). ▪ Identifying plant areas to protect or "pinch points" during NPO HREs and actions to be taken if KSFs are lost.	(Reference 67)	3.5.3 3.5.4

<table>
<tr><th>FAQ #</th><th>FAQ Title and Summary</th><th>Reference</th><th>SE Section</th></tr>
<tr><td>08-0048</td><td>“Revised Fire Ignition Frequencies”
This FAQ provides an acceptable method for using updated fire ignition frequencies in the licensee’s FPRA. The method involves the use of sensitivity studies when the updated fire ignition frequencies are used.</td><td>(Reference 68)</td><td>3.4.7</td></tr>
<tr><td>08-0052</td><td>“Transient Fires - Growth Rates and Control Room Non-Suppression”
This FAQ clarifies and updates the treatment of transient fires in terms of both manual suppression and time-dependent fire growth modeling.</td><td>(Reference 69)</td><td>3.4.2</td></tr>
<tr><td>08-0054</td><td>“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</td><td>(Reference 70)</td><td>3.4.3
3.4.4
3.5.1</td></tr>
<tr><td>09-0056</td><td>“Radioactive Release Transition”
This FAQ provides an acceptable level of detail and content for the radioactive release section of the LAR. It includes:
Justification of the compartmentation, if the radioactive release review is not performed on a fire area basis.
Pre-fire plan and fire brigade training review results.
Results from the review of engineering controls for gaseous and liquid effluents.</td><td>(Reference 71)</td><td>3.6</td></tr>
<tr><td>10-0059</td><td>“Monitoring Program”
This FAQ provides clarification regarding the implementation of an NFPA 805 monitoring program for transition. It includes:
Monitoring program analysis units;
Screening of low safety significant SSCs;
Action level thresholds; and
The use of existing monitoring programs.</td><td>(Reference 72)</td><td>3.7.1</td></tr>
<tr><td>12-0062</td><td>“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.</td><td>(Reference 73)</td><td>2.4.4</td></tr>
</table>

FAQ #	FAQ Title and Summary	Reference	SE Section
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 74)	3.4.2.2 3.4.2.3.2
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 75)	3.4.2.2
14-0008	"Main Control Board [MCB] Treatment" • This FAQ clarifies the MCB definition and gives guidance on application of the frequencies in Appendix L to NUREG/CR-6850.	(Reference 76)	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 77)	3.4.2.2

2.4 Orders, License Conditions, and Technical Specifications

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

2.4.1 Orders

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

The licensee determined that no orders need to be superseded or revised to implement an FPP at CNS that complies with 10 CFR 50.48(c). The licensee's review included an assessment of docketed correspondence files and electronic searches, including the NRC's Agencywide Documents Access and Management System (ADAMS). The review was performed to ensure that compliance with the physical protection requirements, security orders, and adherence to commitments applicable to CNS are maintained. The NRC staff accepts the licensee's determination that no orders need to be superseded or revised to implement NFPA 805 at CNS.

In addition, the licensee performed a specific review of the license amendments that incorporated the mitigation strategies required by Section B.5.b of Commission Order EA-02-026 (subsequently incorporated into 10 CFR 50.54(hh)(2)) to ensure that any changes being made in order to comply with 10 CFR 50.48(c) do not invalidate existing commitments applicable to CNS. The licensee's review of this order and the related license amendments demonstrated that changes to the FPP during transition to NFPA 805 will not affect the mitigation measures required by Commission Order EA-02-026. The NRC staff concludes that the licensee's determination regarding Commission Order EA-02-026 is 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 CNS fire protection license condition in order to adopt NFPA 805, as required by 10 CFR 50.48(c)(3).

The NRC staff reviewed the revised license conditions, which supersede the current CNS fire protection License Condition 2.C.(5), for consistency with the content guidance outlined by RP C.3.1 of RG 1.205, Revision 1, and with the proposed plant modifications in the LAR.

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

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

Overall, the licensee's proposed revised license conditions allow self-approval for FPP changes that meet the requirements of NFPA 805 with regard to engineering analyses, fire risk evaluations (FREs), and plant change evaluations (PCEs). The NRC staff's evaluation of the self-approval process for FPP changes (post-transition) is contained in SE Section 2.6. The license conditions also references the plant-specific modifications and associated implementation item schedules that must be accomplished at CNS to complete transition to NFPA 805 and comply with 10 CFR 50.48(c). In addition, the license condition includes a requirement that appropriate compensatory measures in accordance with its procedures remain in place until the specified plant modifications are completed. These modifications and implementation schedules are identical to those identified elsewhere in the LAR, as discussed by the NRC staff in SE Sections 2.7.1 and 2.7.2, and reviewed in SE Section 3.0. SE Section 4.0 provides the NRC staff's review of the proposed CNS FPP license condition.

2.4.3 Technical Specifications

The NRC staff reviewed LAR Section 5.2.2, "Technical Specifications," and LAR Attachment N, "Technical Specification Changes," with regard to proposed changes to the CNS TSs that are being revised or superseded during the NFPA 805 transition process. According to the LAR, the licensee conducted a review of the CNS TSs to determine which, if any, TS sections will be impacted by the transition to an RI/PB FPP based on 10 CFR 50.48(c). The licensee identified no changes to the TSs that need to be revised, deleted, or added as a result of the transition to NFPA 805.

2.4.4 Updated Final Safety Analysis Report (UFSAR)

The NRC staff reviewed LAR Section 5.4, "Revision to the Updated Final Safety Aanalysis Report," which states, "After the approval of the LAR, in accordance with 10 CFR 50.71(e), the CNS Updated Final Safety Aanalysis Report (UFSAR) will be revised." The LAR further states that, "The format and content will be consistent with NEI 04-02 FAQ 12-0062."

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

2.5 Rescission of Exemptions

CNS, Unit 1, was licensed to operate on January 17, 1985, and CNS, Unit 2, was licensed to operate on May 15, 1986, therefore, the FPP is based on compliance with 10 CFR 50.48(a) and the CNS fire protection license condition.

The NRC staff reviewed LAR Section 5.2.3, "Orders and Exemptions"; LAR Attachment O, "Orders and Exemptions"; and LAR Attachment K, "Existing Licensing Action Transition," with regard to previously approved exemptions to Appendix R to 10 CFR Part 50, which will be superseded by the transition to an FPP licensing basis in conformance with NFPA 805. Since CNS was licensed to operate after January 1, 1979, licensing actions associated with 10 CFR 50, Appendix R, were not issued as exemptions to the regulation, and, therefore, the NRC staff concludes that no exemptions need to be rescinded.

The licensee previously requested and received NRC approval for many deviations from 10 CFR, Part 50, Appendix R, and BTP CMEB 9.5-1. These deviations were discussed in detail in LAR Attachment K. The licensee stated that the deviations are no longer required because they are either compliant with 10 CFR 50.48(c), because the configuration has been determined to be adequate for the hazard based on existing engineering equivalency evaluation (EEEE), or because a PB evaluation determined that the configuration is in accordance with NFPA 805, Section 4.2.4.

The licensee requested that the underlying engineering evaluations for the following deviations be transitioned into the NFPA 805 FPP, as previously approved (NFPA 805, Section 2.2.7), and that they are considered compliant under 10 CFR 50.48(c) (numbering scheme provided by licensee) (see Table 3.5-2 in SE Section 3.5.1.3):

- 01. Commitment to utilize metallic sheathed MI cable as a radiant energy shield in containment per Section III.G.2 of Appendix R to 10 CFR 50.
- 02. Deviation from Item C.5.a(5) of BTP CMEB 9.5-1 regarding unlabeled fire doors.
- 07. Deviation from Item C.6.c of BTP CMEB 9.5-1 related to standpipe protection in the annulus and pipe tunnel.
- 08. Deviation from Item C.6.c(1) of BTP CMEB 9.5-1 regarding unlisted water supply valves.
- 09. Deviation from Item C.6.c(1) of BTP CMEB 9.5-1 related to seismic design of standpipe systems.
- 12. Deviation from C.5.a of BTP CMEB 9.5-1 regarding protection of HVAC penetrations of fire barriers.
- 13. Deviation from Section C.5.a of BTP CMEB 9.5-1 regarding unprotected structural steel over the turbine driven auxiliary feedwater pump pit.
- 17. Installation of safe shutdown system per NRC SER requirement.
- 18. Protection of penetrations of fire area boundaries in the reactor building.

The licensee stated that the following licensing actions are no longer necessary and will not be transitioned into the NFPA 805 FPP because either NFPA 805, Chapter 3, contains an equivalent requirement, because the configuration was demonstrated adequate for the hazard based on engineering evaluation, or because a PB evaluation determined that the configuration is in accordance with NFPA 805, Section 4.2.4.

- 03. Deviation from C.5.b and C.5.c of SRP 9.5-1 regarding unprotected structural steel supporting protected cables in the auxiliary feedwater pump room.
- 06. Deviation from Item C.6.a of BTP CMEB 9.5-1 related to unsupervised water flow alarms.
- 10. Deviation from Section C.3.b of BTP CMEB 9.5-1 regarding composition of the fire brigade.
- 15. Deviation from Section C.6.a of BTP CMEB 9.5-1 regarding the absence of certain fire rated seals in penetrations of exterior walls and roofs.
- 11. Deviation from Section C.5.a of BTP CMEB 9.5-1 non-fire-rated hatchway covers.
- 04. Deviation from Item C.5.b of BTP CMEB 9.5-1 regarding partial coverage sprinkler system.
- 05. Deviation from Item C.5.b of BTP CMEB 9.5-1 related to fire areas containing safe shutdown related equipment without having automatic suppression.
- 14. Deviation from Section C.6.a of BTP CMEB 9.5-1 regarding absence of certain fire detectors in safety-related areas.
- 16. Deviation from Section C.7.c of BTP CMEB 9.5-1 regarding no fixed fire suppression in the cable spreading room.

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

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

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

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

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

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

2.6.1 Post-Implementation Plant Change Evaluation Process

The NRC staff reviewed LAR Section 4.7.2, "Compliance with Configuration Control Requirements in Section 2.2.9 and 2.7.2 of NFPA 805," for compliance with the NFPA 805 PCE process requirements to address potential changes to the NFPA 805 RI/PB FPP after implementation is completed. The licensee indicated that it 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 will consist 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 will be performed to identify and resolve minor changes to the FPP, and that the screening will be consistent with fire protection regulatory review processes currently in place at CNS. The licensee stated that the screening process is modeled after NEI 02-03, "Guidance for Performing a Regulatory Review of Proposed Changes to the Approved Fire Protection Program" (Reference 78), 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 meet the "assessment of the acceptability of risk" requirement of Section 2.4.4 of NFPA 805 are not met, the licensee will proceed to the risk evaluation step of the PCE process.

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

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

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

The licensee stated that the FPP configuration is defined by the program documentation and that to the greatest extent possible, the existing configuration control processes for modifications, calculations, and analyses, and FPP license basis reviews will be used to maintain configuration control of the FPP documents. The licensee further stated that the configuration control procedures, which govern the various CNS documents and databases that currently exist, will be revised to reflect the new NFPA 805 licensing bases requirements. In LAR Attachment S, Table S-3, Implementation Item 10, the licensee included the action to "ensure the configuration control process follows the requirements in NFPA 805 and the guidance outlined in RG 1.174....", which the NRC considers acceptable because the action will result in compliance with NFPA 805 and because the action 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 mode NSCA treatment, generally require new control procedures and processes to be developed since they are new documents

and databases created as a result of the transition to NFPA 805. The licensee further stated that the new procedures will be modeled after the existing processes for similar types of documents and databases. The licensee further stated that system level design-basis documents will be revised to reflect the NFPA 805 role that the systems and components now play. In LAR Attachment S, Table S-3, Implementation Item 9, the licensee included the action to create "the fire protection design-basis document described in Section 2.7.1.2 of NFPA 805, and necessary supporting documentation described in Section 2.7.1.3 of NFPA 805, as part of the transition to 10 CFR 50.48(c)," which the NRC staff considers acceptable because the action will result in compliance with NFPA 805 and because the action would be required by the proposed license condition.

The licensee stated that the process for capturing the impact of proposed changes to the plant on the FPP will continue to be a multiple step review and that the first step of the review will be an initial screening for process users to determine if there is a potential to impact the FPP as defined under NFPA 805 through a series of screening questions/checklists contained in one or more procedures, depending upon the configuration control process being used. The licensee further stated that reviews that identify potential FPP impacts will be sent to qualified individuals (e.g., fire protection engineer, FPRA engineer, etc.) to ascertain the program impacts, if any, and that if FPP impacts are determined to exist as a result of the proposed change, the issue would be resolved by one of the following:

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

The licensee stated that this process follows the requirements in NFPA 805 and the guidance outlined in RG 1.174 (Reference 38). NFPA 805 requires the use of qualified individuals and procedures that require calculations and evaluations be subject to independent review and verification, record retention, peer review, and a corrective action program that ensures appropriate actions are taken when errors are discovered.

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

Based on the information provided by the licensee, the NRC staff concludes that the licensee's PCE process is acceptable because it meets the guidance in NEI 04-02, Revision 2 (Reference 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. Section 2.4.3.1 of NFPA 805 requires that the probabilistic safety assessment (PSA) use CDF and LERF as measures for risk. Section 2.4.3.3 of NFPA 805 requires that the risk assessment approach, methods, and data shall be acceptable to the authority having jurisdiction (AHJ), which is the NRC. Section 2.4.3.3 of NFPA 805 also requires that the PSA be appropriate for the nature and scope of the change being evaluated, be based on the as-built, as-operated, and maintained plant, and reflect the operating experience at the plant.

The licensee's PCE process includes the required Δ 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 utilize methods that are acceptable to the NRC staff. Acceptable methods to assess the risk of the proposed plant change may include methods that have been used in developing the peer-reviewed FPRA model, methods that have been approved by the NRC by a plant-specific license amendment or through NRC approval of generic methods specifically for use in NFPA 805 risk assessments, or methods that have been demonstrated to bound the risk impact.

Based on the information provided by the licensee in the LAR, the process established to evaluate post-transition plant changes meets the guidance in NEI 04-02, Revision 2 (Reference 7), as well as RG 1.205, Revision 1 (Reference 4). The NRC staff concludes that the proposed PCE process at CNS, which includes defining the change, a preliminary risk screening, a risk evaluation, and an acceptability determination, as described in Section 2.6.1, is acceptable because it addresses the required Δ risk calculations, uses risk assessment methods acceptable to the NRC, uses appropriate risk acceptance criteria in determining acceptability, involves the use of an FPRA of acceptable quality, and includes an integrated assessment of risk, DID, and safety margins.

Before achieving full compliance with 10 CFR 50.48(c) by implementing the plant modifications and implementation items discussed in SE Section 2.7.1 (i.e., during full implementation of the transition to NFPA 805), the proposed license condition provides that RI changes to the licensee's FPP may not be made without prior NRC review and approval unless the changes have been demonstrated to have no more than a minimal risk impact using the screening process discussed above, because the risk analysis is not consistent with the as-built, as-operated, and maintained plant since the modifications have not been completed. In addition, the proposed license condition requires that fire protection DID and safety margins are maintained during the transition process. The "transition license conditions" in the proposed NFPA 805 license condition include the appropriate acceptance criteria and other attributes to form an acceptable method for meeting 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 quantitative, 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:

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

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

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

2.7 Modifications and Implementation Items

RP C.3.1 of RG 1.205, Revision 1 (Reference 4), states that a license condition included in an 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 the modifications are completed.

The list of modifications and implementation items originally submitted in the LAR has been updated by the licensee with the final version of LAR Attachment S, "Plant Modifications and Items to be Completed During Implementation," provided in the licensee's letter dated January X, 2017 (Reference 31).

2.7.1 Modifications

The NRC staff reviewed LAR Attachment S, "Plant Modifications and Items to be Completed During Implementation," which describes the plant modifications necessary to implement the

NFPA 805 licensing basis, as proposed. These modifications are identified in the LAR as necessary to bring CNS into compliance with either the deterministic or PB requirements of NFPA 805. As described below, LAR Attachment S, Table S-2, provides a description of each of the proposed plant modifications, presents the problem statement explaining why the modification is needed, and identifies whether compensatory actions are required to be in place pending completion/implementation of the modification.

The NRC staff confirmed that the modifications identified in LAR Table S-2, are the same as those identified elsewhere in the LAR as the modifications being credited in the proposed NFPA 805 licensing basis. The NRC staff also confirmed that the LAR Attachment S, Table S-2, modifications and the associated completion schedule are the same as those provided in the proposed NFPA 805 license condition.

LAR Attachment S, Table S-2, provides a detailed listing of the plant modifications that must be completed in order for CNS to be in full accordance with NFPA 805, implements many of the attributes upon which this SE is based, and thereby meets 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 December 31, 2017, and that appropriate compensatory measures in accordance with the licensee's procedures will remain in place until the modifications are complete.

2.7.2 Implementation Items

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

Each implementation item will be completed prior to the deadline for implementation of the RI/PB FPP based on NFPA 805, as specified in the license condition and the letter transmitting the license amendment (i.e., implementation period), that states that implementation items described in LAR Attachment S, Table S-3, will be completed within 180 days after NRC approval, unless that date falls within a scheduled outage window. In that case, the completion of implementation items will occur 60 days after startup from the scheduled outage. Implementation Item 13 is associated with modifications and will be completed 180 days after modifications are complete.

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

2.7.3 Schedule

LAR Section 5.5, as supplemented, provides the overall schedule for completing the NFPA 805 transition at CNS. The licensee stated that it will complete the implementation of the new NFPA 805 FPP to include procedure changes, process updates, and training to affected plant personnel within 180 days after NRC approval, unless that date falls within a scheduled outage window. In that case, completion of implementation items will occur 60 days after startup from that scheduled outage. The licensee also stated that Implementation Item 13 is associated with modifications and will be completed 180 days after modifications are complete.

LAR Section 5.5 also states that modifications will be completed in accordance with the date provided in LAR Attachment S, Tables S-2a and S-2b, which is December 31, 2017, and that appropriate compensatory measures in accordance with the licensee's procedures will remain in place until the modifications are complete.

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

3.0 TECHNICAL EVALUATION

The following sections evaluate the technical aspects of the LAR to transition the FPP at CNS 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, Standard Review Plan, Section 9.5.1.2, "Risk-Informed, Performance-Based Fire Protection" (Reference 42), to determine whether the licensee had provided sufficient information in both scope and level of detail to adequately demonstrate compliance with the requirements of NFPA 805, as well as the other associated regulations and guidance documents discussed in SE Section 2.0. Specifically:

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

- Section 3.2 provides the results of the NRC staff's 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's 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's 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's review of the licensee's NSCA results by fire area;

- Section 3.6 provides the results of the NRC staff's 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's review of the NFPA 805 monitoring program developed as a part of the transition to a an RI/PB FPP based on NFPA 805; and

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

SE Attachments A and B provide additional information regarding the FM that was used by the licensee 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 SE sections.

3.1 NFPA 805 Fundamental Fire Protection Program Elements and Minimum Design Requirements

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

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

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

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

Chapter 3, may be subject to the PB methods permitted elsewhere in the standard.

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

3.1.1 Compliance with NFPA 805, Chapter 3, Requirements

The licensee used the systematic approach described in NEI 04-02, Revision 2 (Reference 7), as endorsed by the NRC in RG 1.205, Revision 1 (Reference 4), to assess the proposed FPP against the NFPA 805, Chapter 3, requirements.

As part of this assessment, the licensee reviewed each section and subsection of NFPA 805, Chapter 3, against the existing CNS FPP and provided specific compliance statements for each 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 CNS, and others are provided with multiple compliance statements to fully document compliance with the element.

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

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

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

3. The existing FPP element complies through the use of EEEEs whose bases remain valid and are of sufficient quality: noted in LAR Attachment A, Table B-1, as "Complies with Use of EEEEs."

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

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

The NRC staff has determined that, taken together, these methods compose an acceptable approach for documenting compliance with NFPA 805, Chapter 3, requirements, because the

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

The licensee stated in LAR Section 4.2.2, "Existing Engineering Equivalency Evaluation Transition," that it evaluated the EEEEs used to demonstrate compliance with NFPA 805, Chapter 3, requirements in order to ensure continued appropriateness, quality, and applicability to the current CNS 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 using a PB approach. The evaluation should demonstrate that the specific plant configuration meets the performance criteria in the standard.

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

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

3.1.1.1 Compliance Strategy -- Complies

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

The following NFPA 805 sections identified in LAR Attachment A, Table B-1, as complying via this method, including those sections with applicable NFPA 805, Chapter 3, implementation items in LAR Attachment S, Table S-3, required additional review by the NRC staff:

- 3.2.2.4
- 3.2.3(1)
- 3.2.3(3)
- 3.3.1.2(1)
- 3.3.3
- 3.4.1(c)
- 3.4.2.1
- 3.4.3(b)

NFPA 805, Section 3.2.2.4, requires that the management policy document shall identify the appropriate AHJ for the various areas of the FPP. The licensee stated that the NRC is the AHJ for fire protection changes requiring approval, and that the NRC is notified of changes to the

FPP in accordance with plant procedures that screen changes to the FPP to determine if NRC approval is required. The licensee identified an action to update the FPP policy document to include a statement that the NRC is the AHJ for fire protection changes requiring approval. This action is addressed in LAR Attachment S, Table S-3, Implementation Item 3. The NRC staff concludes that the licensee's statement of compliance is acceptable because the licensee has identified a required action to achieve compliance with NFPA 805, Section 3.2.2.4, and the action is included as an implementation item in LAR Attachment S, which would be required by the proposed license condition.

NFPA 805, Section 3.2.3(1), requires that procedures be established for the inspection, testing, and maintenance of fire protection systems and features credited by the FPP. The licensee identified an action to update appropriate FPP document(s) to provide a requirement that if a plant elects to implement the methodologies in EPRI Report TR-1006756, "Fire Protection Equipment Surveillance Optimization and Maintenance Guide" (Reference 79), the methodologies will be implemented in their entirety as they pertain to the fire protection systems or features being evaluated. This action is addressed in LAR Attachment S, Table S-3, Implementation Item 4. The NRC staff's evaluation of the use of the methodology in EPRI TR-1006756 (Reference 79) is included in SE Section 3.1.4.1. The NRC staff concludes that the licensee's statement of compliance is acceptable because the use of the EPRI methodology is approved by the NRC staff as described in SE Section 3.1.4.1, the licensee has identified a required action to achieve compliance with NFPA 805, Section 3.2.3(1), and the action is included as an implementation item in LAR Attachment S, which would be required by the proposed license condition.

NFPA 805, Section 3.2.3(3), requires that procedures be established to review the FPP for program-related performance and trends. The licensee stated that procedures have been established for the FPP reviews, and that the reviews of the plant FPP are conducted on a regular basis and data is collected for performance monitoring and trending. The licensee identified an action to have a monitoring program required by NFPA 805 that will include a process that reviews fire protection performance and trends in performance. This action is addressed in LAR Attachment S, Table S-3, Implementation Item 5. The NRC staff's review of the monitoring program required by NFPA 805 is included in SE Section 3.7. The NRC staff concludes that the licensee's statement of compliance is acceptable because the licensee has identified a required action to achieve compliance with NFPA 805, Section 3.2.3(3), and the action is included as an implementation item in LAR Attachment S, which would be required by the proposed license condition.

NFPA 805, Section 3.3.1.2(1), requires that wood used within the power block be listed pressure-impregnated or coated with a listed fire-retardant application with an exception that cribbing timbers 6-inch by 6-inch (15.2 centimeter (cm) by 15.2 cm), or larger, shall not be required to be fire-retardant treated. The licensee stated that wood is required to be flame retardant except where allowed by the exception to this section. The licensee identified an action to revise station procedures/directives to comply with NFPA 805, Section 3.3.1.2(1). This action is addressed in LAR Attachment S, Table S-3, Implementation Item 6. The NRC staff concludes that the licensee's statement of compliance is acceptable because the licensee has identified a required action to achieve compliance with NFPA 805, Section 3.3.1.2(1), and the action is included as an implementation item in LAR Attachment S, which would be required by the proposed license condition.

NFPA 805, Section 3.3.3, requires that interior wall or ceiling finish classification be in accordance with NFPA 101, "Life Safety Code" (Reference 80), requirements for Class A materials and that interior floor finishes shall be in accordance with NFPA 101 requirements for Class I interior floor finishes. The licensee stated that interior wall and structural components, thermal insulation materials, radiation shielding materials, and soundproofing materials are non-combustible. The licensee further stated that interior finishes have a flame spread rating of 25 or less and a smoke and fuel contribution of 50 or less in their installed configurations. The licensee further stated that coatings used on interior floors, walls, and ceilings in "power block" buildings are required to meet NFPA 805, Section 3.3.3. The licensee identified an action to update station documentation to indicate requirements for interior floor finishes. This action is addressed in LAR Attachment S, Table S-3, Implementation Item 17. The NRC staff concludes that the licensee's statement of compliance is acceptable because the licensee has identified a required action to achieve compliance with NFPA 805, Section 3.3.3, and the action is included as an implementation item in LAR Attachment S, which would be required by the proposed license condition.

NFPA 805, Section 3.4.1(c), requires that during every shift, the brigade leader and at least two brigade members shall have sufficient training and knowledge of nuclear safety systems to understand the effects of fire and fire suppressants on NSPC. In FPE RAI 01 (Reference 24), the NRC staff requested that the licensee provide additional information regarding the training provided to the fire brigade leader and members that address their ability to assess the effects of fire and fire suppressants on NFPA 805 NSPC and to include the justification for how the training meets NFPA 805, Section 3.4.1. In its response to FPE RAI 01 (Reference 9), the licensee stated that CNS utilizes a fire brigade where during every shift the brigade leader and at least two brigade members shall have sufficient training and knowledge of nuclear safety systems to understand the effects of fire and fire suppressants on nuclear safety performance. The licensee stated that an equivalent knowledge of plant systems is provided in plant procedures and the procedures specify the plant systems for a pressurized-water reactor (PWR) that represent the minimum plant knowledge for a non-licensed operator fire brigade member or leader to understand the effects of fire and fire suppressants on NSPC. The licensee stated that these systems include:

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

Based on the information provided by the licensee in its response to FPE RAI 01, the NRC staff concludes that the licensee's statement of compliance is acceptable, because the fire brigade leader and at least two fire brigade members have knowledge of plant nuclear safety systems

and are trained to understand the effects of fire and fire suppressants on NSPC, and, therefore, meet the requirements of NFPA 805, Section 3.4.1(c).

NFPA 805, Section 3.4.2.1, requires that the pre-fire plans 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. The licensee stated that the detailed pre-fire plans are available in the CNS fire strategies and contain the following information:

- A graphic representation of the various plant areas that depicts the installed fire protection/suppression features;
- Equipment important to safety and other potentially affected equipment;
- A listing of special hazards including radiological, electrical, chemical, physical, and flammable liquids and gases; and
- Notes such as special access, special concerns, ventilation, etc.

The licensee identified an action to review and update the fire strategies to include any changes to equipment important to nuclear safety and other updates pertinent to the NFPA 805 transition. This action is addressed in LAR Attachment S, Table S-3, Implementation Item 8. The NRC staff concludes that the licensee's statement of compliance is acceptable because the licensee has identified a required action to achieve compliance with NFPA 805, Section 3.4.2.1, and the action is included as an implementation item in LAR Attachment S, which would be required by the proposed license condition.

NFPA 805, Section 3.4.3(b), requires that plant personnel who respond with the industrial fire brigade shall be trained as to their responsibilities, potential hazards to be encountered, and interfacing with the industrial fire brigade. The licensee stated that other non-fire brigade personnel who respond to a fire incident are informed of their responsibilities and interfaces with the fire brigade. The licensee identified an action to develop a formal training program for non-fire brigade personnel who respond to a fire incident. This action is addressed in LAR Attachment S, Table S-3, Implementation Item 14. The NRC staff concludes that the licensee's statement of compliance is acceptable because the licensee has identified a required action to achieve compliance with NFPA 805, Section 3.4.3(b), and the action is included as an implementation item in LAR Attachment S, which would be required by the proposed license condition.

Based on the licensee's statement of compliance and the associated implementation items, as described in LAR Attachment A and listed in LAR Attachment S for the individual attributes described above, as well as the statements that these items will be complete prior to implementation; the NRC staff concludes that the licensee's statements of compliance are acceptable because completion of the implementation items will bring these attributes into compliance with NFPA 805 requirements.

3.1.1.2 Compliance Strategy -- Complies with Clarification

For certain NFPA 805, Chapter 3, requirements, the licensee provided additional clarification when describing its means of compliance with the fundamental FPP element. In these

instances, the NRC staff reviewed the additional clarifications and concludes that the licensee will meet the underlying requirement for the FPP element as clarified.

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

- 3.9.2

NFPA 805, Section 3.9.2, requires that each automatic and manual water-based fire suppression system be equipped with a water flow alarm. The licensee stated that automatic water-based suppression systems are provided with a water flow alarm, and that manual water-based suppression systems are not provided with water flow alarm. The licensee further stated that the manual systems will only operate after an operator manually opens an isolation or deluge valve, and that water flow alarms are not necessary for indication of a manual system, as the control room makes the decision to activate the system. In FPE RAI 02 (Reference 24), the NRC staff clarified that NEI 04-02 defines the use of "complies with clarification" as an editorial issue, and compliance should be explained in the compliance basis field. The NRC staff does not consider the lack of water flow alarms as an editorial issue and requested CNS provide a compliance strategy commensurate with the guidance of NEI 04-02, which demonstrates compliance with NFPA 805, or provide a detailed justification for not meeting the requirement of NFPA 805, Section 3.9.2. In its response to FPE RAI 02 (Reference 10), the licensee stated that it will revise LAR Attachment A, Table B-1, Section 3.9.2, compliance statements to include "Comply" and "Submit for NRC Approval." The licensee stated that automatic water-based suppression systems comply with Section 3.9.2, as each system is provided with a water flow alarm, the manual water-based suppression systems do not have water flow alarms, and approval is required for this configuration under 10 CFR 54.48(c)(2)(vii). In its response to FPE RAI 02, the licensee also provided Approval Request 5 to request NRC staff approval for not providing water flow alarms for manual water-based suppression systems. The licensee provided a revision to LAR Section 4.1.2.3, Attachment A and Attachment L, to incorporate the information described in the RAI response (Reference 11). The NRC staff's review of Approval Request 5 is included in SE Section 3.1.4.5.

Based on the licensee's response to FPE RAI 02, including the associated amendments to the LAR, the NRC staff concludes that the change in compliance statements is acceptable because the installation of water flow alarms for automatic water-based suppression systems complies with NFPA 805, Section 3.9.2, and the deviation from NFPA 805, Section 3.9.2, for the lack of water flow alarms for manual water-based suppressions systems was submitted by the licensee in accordance with 10 CFR 50.48(c)(2)(vii) and is approved by the NRC staff as described in SE Section 3.1.4.5.

3.1.1.3 Compliance Strategy -- Complies with Use of EEEEs

In several NFPA 805, Chapter 3, requirements, the licensee demonstrated compliance with the fundamental FPP element through the use of EEEEs. The NRC staff reviewed the licensee's statement of continued validity for the EEEEs and the statement on the quality and appropriateness of the evaluations. The staff concludes that the licensee's statements of compliance in these instances is acceptable because the licensee followed the applicable guidance in RG 1.205 and NEI 04-02 for use of EEEEs.

3.1.1.4 Compliance Strategy -- Complies via Previous NRC Approval

Certain NFPA 805, Chapter 3, requirements were replaced by an alternative that was previously approved by the NRC. The approvals are documented in the following:

(1). NUREG-0954, February 1983, SER related to the operation of CNS, Unit 1 and 2 (Reference 32); and
(2). NUREG-0954, Supplement No. 3, July 1984 (Reference 34).

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

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

- 3.3.4
- 3.5.5
- 3.11.3

NFPA 805, Section 3.3.4 requires that thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials be noncombustible or limited combustible. In the LAR (Reference 8), Attachment A, the licensee indicated that insulation materials comply with NFPA 805. In its letter dated June 15, 2016 the licensee revised its LAR Attachment A, and changed its compliance strategy from "Comply" to "Complies with Previous NRC Approval". The licensee stated that some insulation materials around ventilation ducts and cold pipes does not meet the definition of non-combustible or limited combustible. NUREG-0954, Supplement No. 3, dated July 31, 1984 (Reference 34), stated that the applicant indicated that HVAC duct and pipe insulation to be used have flame spread indexes of 25 or less, and that the NRC staff concludes that the material meets NRC guidelines. Based on its review of the information submitted by the licensee and its review of NUREG-0954, Supplement No. 3, the NRC staff concludes that the basis for prior approval remains valid.

NFPA 805, Section 3.5.5, requires that each fire pump and its driver and controls shall be separated from the remaining fire pumps and from the rest of the plant by rated fire barriers. The licensee identified an excerpt from NUREG-0954 (1983 NRC SER) (Reference 32), which states that, "[t]wo of the three fire pumps are located in the same bay of the Intake Structure and are separated by a three-hour rated barrier." The licensee further stated that there have been no changes that invalidate the bases for this approval. The NRC staff reviewed additional technical bases for the previous approval in NUREG-0954, Supplement No. 3, dated July 31, 1984 (Reference 34), and noted that the approved configuration included the "installation of a 1-hour rated fire wrap on the conduit and supports containing cables for fire pump B." In LAR Attachment A, Table B-1, an engineering evaluation was referenced for the deletion of the Hemyc™ fire barrier wrap on the B Main Fire Pump (MFP) cable. In FPE RAI 08 (Reference 24), the NRC staff requested that CNS provide the basis for acceptability of the removal of this

fire barrier and describe how CNS meets the requirements of NFPA 805, Section 3.5.5. In its response to FPE RAI 08 (Reference 10), the licensee stated that it will revise LAR Attachment A, Table B-1, Section 3.5.5, compliance statements to include "Comply" and "Submit for NRC Approval." The licensee stated that a Hemyc™ fire barrier (cable wrap) was installed to protect the B MFP power cable and that CNS performed an engineering evaluation, which justified the removal of the 1-hour cable wrap, and formal approval is requested for this configuration under 10 CFR 50.48(c)(2)(vii). In its response to FPE RAI 08, the licensee also provided Approval Request 6 to request NRC staff approval for no longer crediting the Hemyc™ fire barrier wrap on the B MFP cable. The licensee provided amendments to LAR Section 4.1.2.3, Attachments A and L, to incorporate the information described in the FPE RAI 08 response (Reference 11). Based on the licensee's response to FPE RAI 08, including the associated amendments to the LAR, the NRC staff concludes that changing the statement of compliance from "Complies with previous NRC Approval" to "Complies" and "Submit for NRC Approval" is acceptable because the licensee revised the LAR to request specific approval for removing credit of the Hemyc™ cable wrap in accordance with 10 CFR 50.48(c)(2)(vii). The NRC staff's review of Approval Request 6 is described in SE Section 3.1.4.6.

NFPA 805, Section 3.11.3, requires that penetrations in fire barriers be provided with listed fire-rated door assemblies having a resistance rating consistent with the designated fire resistance rating of the barriers and that fire doors shall conform to NFPA 80, "Standard for Fire Doors and Fire Windows" (Reference 81). In LAR Attachment A, Table B-1, the licensee stated that some doors at CNS are unlabeled and modified in order to satisfy field requirements. The licensee provided a citation from NUREG-0954 (Reference 32), which documented NRC staff acceptance of pressure doors, as well as bullet- and missile-resistant doors, as providing an equivalent level of protection to labeled fire doors. In FPE RAI 07 (Reference 24), the NRC staff noted that in LAR Attachment K, Licensing Action 02, the licensee discusses the use of hollow metal doors in Fire Area 35 that are not rated and hollow metal doors with louvers in radiological areas, which were not described in LAR Attachment A. In its response to FPE RAI 07 (Reference 9), the licensee stated that the complete excerpt of the SER approval was not included in LAR Attachment A, Table B-1, Section 3.11.3, and was an oversight. The licensee further stated that the SER approval includes the discussion of the hollow metal doors in Fire Area 35, which should have been included in LAR Attachment A. The licensee provided revised pages to LAR Attachment A, Table B-1, to incorporate the information described in the FPE RAI 07 response (Reference 11). Based on the licensee's response to FPE RAI 07, including the associated amendments to the LAR, the NRC staff concludes that the licensee's response is acceptable because the licensee revised the LAR to include the additional hollow metal doors and hollow metal doors with louvered grills for radiological purposes, which were not included in the original submittal, but were included in the NRC staff approval documented in the original SER.

3.1.1.5 Compliance Strategy -- Submit for NRC Approval

The licensee also requested NRC staff 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 CNS. The NFPA 805 sections identified in LAR Attachment A, Table B-1, as complying via this method are as follows:

- Section 3.2.3(1) – concerns procedures that implement the FPP, including inspection, testing, and maintenance procedures for fire protection systems. The licensee requested approval to use PB methods using EPRI Report TR1006756, "Surveillance Frequency Optimization and Maintenance Guide" (Reference 79), to establish inspection, testing, and maintenance frequencies for fire protection systems and features, thereby meeting the requirements of NFPA 805. The NRC staff's review and approval of this request is documented in SE Section 3.1.4.1.

- Section 3.3.5.1 – concerns wiring above suspended ceilings and the requirement that this wiring be listed for plenum use, routed in armored cable and routed in metallic conduit or routed in cable trays with solid metal top and bottom covers. The licensee requested approval to use PB methods to demonstrate an equivalent level of fire protection for the existence of wiring, thereby meeting the requirements of NFPA 805, Section 3.3.5.1. The NRC staff's review and approval of this request is documented in SE Section 3.1.4.2.

- Section 3.3.5.2 – concerns use of only metal tray and metal conduits for electrical raceways. The licensee requested approval to use PB methods to demonstrate an equivalent level of fire protection for the existence of embedded/buried Polyvinyl Chloride (PVC) conduit, thereby meeting the requirements of NFPA 805, Section 3.3.5.2. The NRC staff's review and approval of this request is documented in Section 3.1.4.3.

- Section 3.3.12(1) – concerns the oil collection system for each RCP being capable of collecting lubricating oil from all potential pressurized and non-pressurized leakage sites in each RCP oil system. The licensee has requested approval to use PB methods to demonstrate an equivalent level of fire protection for potential oil misting from the RCPs/motors, thereby meeting the requirements of NFPA 805, Section 3.3.12(1). The NRC staff's review and approval of this request is documented in SE Section 3.1.4.4.

- Section 3.9.2 – concerns the lack of water flow alarms for manual water-based fire suppression systems. In its response to FPE RAI 02 (Reference 10), the licensee requested approval to use PB methods to demonstrate an equivalent level of fire protection for not providing water flow alarms for manual sprinkler systems provided for the RCPs, the lower containment filters (carbon beds), and the reactor building pipe corridor, thereby meeting the requirements of NFPA 805, Section 3.9.2. The NRC staff's review and approval of this request is documented in SE Section 3.1.4.5.

- Section 3.5.5 – concerns the lack of separating each fire pump and its driver and controls from the remaining fire pumps and the rest of the plant by rated fire barriers. In its response to FPE RAI 08 (Reference 10), the licensee requested approval to use a PB method to evaluate the acceptability of the 1-hour Hemyc™ fire wrap that was abandoned in place and is no longer credited in the FPP,

thereby meeting the requirements of NFPA 805, Section 3.5.5. The NRC staff's review and approval of this request is documented in SE Section 3.1.4.6.

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

3.1.1.6 Compliance Strategy -- Multiple Strategies

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

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

3.1.1.7 Chapter 3 Sections Not Reviewed

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

- Sections that do not contain any technical requirements (e.g., NFPA 805, Sections 3.4.5 and 3.11).
- Sections that are not applicable to CNS because of the following:
    - The licensee stated that CNS does not have systems of this type installed (e.g., NFPA 805, Section 3.10.4, "Gaseous Suppression System Single Failure Limits"; Section 3.10.1 (2) NFPA 12A, "Standard on Halon 1301 Fire Extinguishing Systems"; and Section 3.10.1 (3) NFPA 2001, "Standard on Clean Agent Fire Extinguishing Systems").
    - The requirements are structured with an applicability statement (e.g., Sections 3.4.1(a)(2) and 3.4.1(a)(3), in that the code(s) that apply to the fire brigade depend on the type of brigade specified in the FPP at the site).

3.1.1.8 Compliance with Chapter 3 Requirements Conclusion

As discussed above, the NRC staff evaluated the results of the licensee's assessment of the proposed RI/PB FPP against NFPA 805, Chapter 3, fundamental FPP elements and minimum design requirements, as modified by the exceptions, modifications, and supplements 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 CNS's state of compliance with NFPA 805, Chapter 3, requirements, which adequately demonstrated compliance in that the licensee was able to substantiate that it complied:

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

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

  — By 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 Power Block

The NRC staff reviewed the CNS 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 RI/PB FPP that have additional requirements in accordance with 10 CFR 50.48(c) and NFPA 805. In LAR Section 4.1.3, the licensee stated that where used in NFPA 805, Chapter 3, the terms "power block" and "plant" refer to structures that have equipment required for nuclear plant operations such as containment, auxiliary building, service building, control building, fuel building, radioactive waste, water treatment, turbine building, and intake structures, or structures that are identified in the CNS pre-transition licensing basis. The licensee stated that all structures within the CNS owner-controlled area were reviewed to determine the potential impact of fire on the nuclear safety criteria described in Section 1.5 of NFPA 805, and that this was accomplished by identifying the structures containing equipment that could affect any of the following:

- Plant operation for power generation,
- Equipment important to safety, or
- The ability to maintain NSPC in the event of a fire.

The licensee stated that the switchyard is not included in the power block definition, as the NFPA 805 analysis boundary begins at the main and auxiliary transformers. The licensee further stated that structures required to meet the radioactive release criteria described in Section 1.5 of NFPA 805, but not required to meet the nuclear safety criteria, are not defined as

"power block" and that separate screening of structures was performed for the radioactive release review.

In FPE RAI 03 (Reference 24), the NRC staff identified structures described in LAR Attachment E that were not described as part of the power block in LAR Attachment I, Table I-1. The NRC staff requested the licensee to provide clarification whether the radioactive material containers area, radiography vault, radiation materials control building (#7767), tents containing radioactive materials, and mixed waste storage are accounted for as either within or not within the power block. In its response to FPE RAI 03 (Reference 9), the licensee stated that the definition of power block was developed based on the guidance provided in FAQ 06-0019, "Definition of 'Power Block' and 'Plant' " (Reference 61), which was developed with respect to those structures required to meet the NFPA 805 NSPC. The licensee stated that this includes structures with the potential to affect power plant operations, equipment important to safety, and the ability to safely shut down the plant in the event of a fire. The licensee further stated that the structures that the CNS power block include are containment (reactor buildings), auxiliary building (including control complex and fuel buildings), service building, diesel generator building, turbine building, and intake (and discharge) structures, in addition to structures specific to CNS – the dog houses, standby shutdown facility (SSF), and yard areas where equipment required to meet the NSPC goals is located. The licensee further stated that the radiological material/waste areas are not included in the CNS power block definition, and there are a series of structures identified in LAR Attachment E not identified in the CNS power block. The licensee further stated that the CNS radiological release areas are not included because they are not needed to generate electricity or to mitigate accidents. Based on the licensee's response to FPE RAI 03, the NRC staff concludes that not including the radioactive material containers area, radiography vault, radiation materials control building (#7767), tents containing radioactive materials, and mixed waste storage within the definition of the power block is acceptable because the licensee followed the guidance included in FAQ 06-0019, which was endorsed as an acceptable approach to meet the requirements of NFPA 805, Section 1.5.

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

3.1.3 Plant-Specific Treatments or Technologies

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

In LAR Attachment A, Section 3.11.5, the licensee stated that CNS does not utilize electrical raceway fire barrier systems (ERFBS) for Chapter 4 compliance, and hence, CNS does not utilize either the Hemyc™ or MT™ ERFBS. Therefore, the generic issue (GL 2006-03) (Reference 43) related to the use of these ERFBS is not applicable to CNS. GL 2006-03 requested that licensees evaluate their facilities to confirm compliance with existing applicable regulatory requirements in light of the results of NRC testing that determined that both Hemyc™ and MT™ fire barriers failed to provide the protective function intended for compliance with existing regulations for the configurations tested using the NRC's thermal acceptance criteria.

In FPE RAI 04 (Reference 24), the NRC noted that in LAR Attachment C, Table B-3, Hemyc™ is cited in a number of applications used as an ERFBS and that on June 7, 2006, the licensee submitted its response to GL 2006-03 (Reference 55) and committed to bring its Hemyc™ issues into full compliance through the NFPA 805 transition process. The NRC staff requested that the licensee provide a description on how GL 2006-03 was resolved in the NFPA 805 transition process, and in particular, information on how Hemyc™ was credited in the NSCA, the qualification of the credited rating, and if PB methods are used, how the risk, safety margin, and DID were considered in the evaluation. In its reply to FPE RAI 04 (Reference 9), the licensee stated that it originally relied upon Hemyc™ to protect safe shutdown circuits in the Unit 1 and Unit 2 auxiliary feedwater pump rooms (Fire Areas 02 and 03) and that CNS resolved GL 2006-03 by no longer crediting the Hemyc™ wrap in these areas as part of the NFPA 805 analysis. The licensee further stated that no credit is taken for the Hemyc™ wrap on any cables in the FPRA.

The licensee stated that the VFDRs that discuss Hemyc™ are identified in LAR Attachment C, Table C-1 (NEI 04-02 Table B-3), in Fire Areas 02 and 03. The licensee stated that two VFDRs (2-VFDR-08 and 3-VFDR-07) cite Hemyc™ and an accompanying modification. The licensee stated that the non-credit of the Hemyc™ results in potentially non-coordinated loads and that the associated modifications are for resolution of the non-coordinated loads and not specifically related to the resolution of Hemyc™ ERFBS. The licensee further stated that the other VFDRs that involve circuits previously protected by Hemyc™ were demonstrated to satisfy risk, DID, and safety margin with no further action. The licensee further stated that no Hemyc™ is required by NFPA 805 analysis, thereby resolving the GL 2006-03 issue.

Based on the licensee's compliance statement in LAR Attachment A, Section 3.11.5, and its response to FPE RAI 04, the NRC concludes that the licensee's resolution of GL 2006-03 issues is acceptable because the licensee does not credit Hemyc™ ERFBS to meet the requirements of NFPA 805.

3.1.3.2 Use of Armored Cables

LAR Attachment A, Table B-1, Section 3.3.5.3, states that electrical cables comply with Institute of Electrical and Electronics Engineers (IEEE) 383, "IEEE Standard for Type Test of Class 1E Electric Cables Field Splices and Connections for Nuclear Power Generating Stations" (Reference 82). In FPE RAI 05 (Reference 24), the NRC staff found that the licensee explained that the armored cable control circuit test program conducted by the licensee in 2006 included tests on cable qualified for use in Duke Energy nuclear power plants. The licensee explained that the 2006 test program involved comparative tests on cables with and without an outer PVC jacket, and the comparative tests indicated that removing the outer PVC jacket may accelerate the horizontal flame spread over the cable. The NRC staff requested that the licensee describe how the requirements of NFPA 805, Section 3.3.5.3, are met for armored cables. In its response to FPE RAI 05 (Reference 9), the licensee stated that the unjacketed cable used at CNS exhibited flame spread and fire propagation characteristics consistent with cable types considered to be IEEE 383 equivalent. The licensee stated that there were some unanticipated observations made during a series of cable tests performed in 2006, and one of the unexpected observations is the flame propagation concern. The licensee stated that the series of tests was conducted to evaluate fire-induced circuit failure, not flame propagation, and that these tests were performed under conditions that were significantly more severe than testing required to

meet IEEE 383 and IEEE 1202, "IEEE Standard for Flame Propagation Testing of Wire and Cable" (Reference 83). The licensee described its analysis performed to review the performance characteristics of the armored cables under fire exposure. The licensee stated the calculation included the following:

- In the fall of 2007, Duke requested that General Cable Corporation (GCC), the manufacturer of the Duke-specific armored cable that was used in the Duke Armored Cable Control Circuit Tests conducted in 2006, provide IEEE 1202 test results of both jacketed and unjacketed version of the same armored cable type used in some of the Duke Armored Cable Control Circuit Tests.

- ...These standardized test results indicate that both jacketed and unjacketed version of the armored 8-conductor #12 AWG cable passed the IEEE 1202 cable flame propagation test...

- ...The test results also indicate that there is essentially no difference in the flame propagation performance of jacketed and unjacketed application of this armored cable type when tested in accordance with the IEEE 1202 standard.

The licensee stated that based on the information presented in the report [sic – calculation] that reviewed the fire tests, the licensee considers the unjacketed cables non-propagating/equivalent to IEEE 383 qualified cable, and, therefore, they meet the requirements of NFPA 805, Section 3.3.5.3. The NRC staff concludes that IEEE 1202 is considered equivalent to IEEE 383 as described in FAQ 06-0022, "Acceptable Electrical Cable construction Tests" (Reference 62). In addition, the licensee provided a revision to LAR Attachment A to incorporate the information described in its FPE RAI 05 response (Reference 11).

Based on the information provided by the licensee, the NRC staff concludes that the fire tests performed by the licensee on armored cables, and the subsequent review of the performance characteristics based on testing, are acceptable to demonstrate that the armored cables are equivalent to an IEEE 383 qualified cable, because the methodology is consistent with the guidance in FAQ 06-0022, which identifies cable testing standards acceptable to the NRC, and, therefore, meets NFPA 805, Section 3.3.5.3.

3.1.3.3 High Density Polyethylene (HDPE) Piping

The NRC staff found high density polyethylene (HDPE) piping used in various areas of the service, turbine, and auxiliary buildings. In a letter dated December 29, 2016 (Reference 31), the NRC staff requested that the licensee provide a description of how it addressed potential flooding in its analysis. The NRC staff requested that the licensee describe how safe shutdown is assured through either demonstrating that the HDPE installations are bounded by existing analysis, or by performing a RI/PB evaluation that considers the possibility of flooding, and to include all areas containing HDPE piping in its response.

In its letter dated January 26, 2017 (Reference 23), the licensee responded to the RAI and stated that HDPE piping has been installed for safety related and non-safety related uses, and

that the safety related use is in the nuclear service water system as part of the underground buried pipe that delivers cooling water to the emergency diesel generators, and that there is no fire risk to the piping that could lead to a flooding scenario. The licensee further stated that in the auxiliary building, HDPE piping has been installed to support the maintenance activity of draining the nuclear service water system, and that when not in use, this HDPE piping is drained and isolated from the normal nuclear service water system. The licensee further stated that HDPE is also installed in select systems located in the Unit 1 and Unit 2 turbine buildings and the service building and that in these applications, the piping is not isolated and is typically in service.

The licensee stated that its analysis demonstrates that HDPE pipe with flowing water is resistant to thermal failure, and that for postulated fire exposed HDPE scenarios leading to possible failure, it has developed appropriate response procedures.

The licensee stated that a fire impacting the HDPE in the auxiliary building will not contribute to an auxiliary building flood during normal plant operations because the HDPE piping is normally isolated and drained.

The licensee stated that the HDPE piping in the service building and turbine buildings has been installed in minor chemical treatment/water processing systems and the low pressure service water system (LPSW) and that the the minor chemical treatment/water processing systems do not pose a significant flooding concern. The licensee further stated that the (LPSW) system is a large flow, large volume system which provides cooling water to several major, non-safety components.

The licensee stated that the largest analyzed flooding source in either the service building or turbine buildings is a break in both units condenser cooling water system and that this system does not contain any HDPE piping, but that a failure of the system would allow a unit's cooling tower basins content to drain into the unit associated turbine tuilding. The licensee further stated that the auxiliary building is protected from a break in both units condenser cooling water system by an existing flood wall in the service building. The licensee stated that the majority of the station's safe shutdown equipment, located in the adjacent auxiliary building, is protected from either a service or turbine building flood by the existing flood wall in the service building.

The licensee stated that the effects of the flooding scenario induced by the condenser cooling water system in the service building or turbine buildings maintain similarities to a flooding scenario from a (LPSW) system HDPE pipe failure, and that these similarities provide assurance that the (LPSW) system HDPE pipe flood would be identified and mitigated within a reasonable period of time by operator action to isolate or shut down the operating (LPSW) system pumps before the critical flood depth is reached. The licensee further stated that in the event of a flood from an HDPE pipe failure in the service or turbine buildings, its flooding procedure directs plant personnel to investigate the source of the flood, and to perform actions necessary to isolate the source of the flooding, including shutdown of the pumps, as needed and that these actions ensure any flooding is managed with minimal effect to either unit. The

licensee further stated that the worst case condenser cooling water system system flooding scenario is bounding for the (LPSW) system HDPE pipe failure.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that potential flooding from HDPE pipe has been addressed in its analysis and because the licensee also demonstrated that safe shutdown is assured by demonstrating that the HDPE piping installations are bounded by existing analysis. See SE Section 3.4.2.3.2 for additional discussion regarding HDPE piping.

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

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

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

(B) Maintains safety margins; and

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

In Attachment L, "NFPA 805, Chapter 3 Requirements for Approval (10 CFR 50.48(c)(2)(vii)," of the LAR, and in its responses to FPE RAI 02 and FPE RAI 08 (Reference 10) (see SE Sections 3.1.1.2, 3.1.1.4, and 3.1.1.5), the licensee requested NRC staff's review and approval of PB methods to demonstrate an equivalent level of fire protection for the requirement of the elements identified in SE Section 3.1.1.5. The NRC staff's evaluation of these proposed methods is provided below.

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

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 NFPA 805, Section 3.2.3(1), requirement for procedures that implement the FPP, including inspection, testing, and maintenance procedures for fire protection systems. Specifically, the licensee requested approval to use PB methods to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features required by NFPA 805.

The licensee stated that PB inspection, testing, and maintenance frequencies will be established as described in EPRI TR-1006756 (Reference 79).

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. 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, license controlled documents, and appropriate NFPA codes and standards, and that this request does not involve the use of EPRI TR-1006856 to establish the scope of the activities. That is determined by the required systems review identified in Table 4-3, "NFPA 805 Ch 4 Required FP Systems/Features" [sic: LAR Attachment C, Table C-2, "NFPA 805 Required Fire Protection Systems and Features."].

The licensee stated that this request is specific to the use of EPRI TR-1006756 to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features credited by the FPP and that as stated in EPRI 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. The licensee stated that EPRI TR-1006756 provides an accepted method to establish appropriate inspection, testing, and maintenance frequencies, which ensures 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 failure probability will be determined based on EPRI TR-1006756 guidance, and a 95 percent confidence level will be utilized. The licensee further stated that data collection and analysis will also follow EPRI TR-1006756 guidance and 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 it does not intend to revise any fire protection surveillance, test, or inspection frequencies until after transitioning to NFPA 805 and that the existing fire protection surveillance, test, and inspection will remain consistent with applicable selected licensee commitments, insurer, and NFPA code requirements. The licensee stated that its intent of using the EPRI PB method is to provide evidence of equipment performance beyond that achievable

under traditional prescriptive maintenance practices to ensure optimal use of resources while maintaining reliability.

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

The licensee stated that the radiological release performance criteria are satisfied based on the determination of limiting radioactive release and that fire protection systems and features may be credited as part of that evaluation. The licensee further stated that the use of PB test frequencies established per EPRI TR-1006756 methods, combined with NFPA 805, Section 2.6, "Monitoring Program," will ensure that the availability and reliability of fire protection 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 to meeting these criteria.

The licensee stated that the use of PB test frequencies established per EPRI TR-1006756 methods, combined with the NFPA 805, Section 2.6, "Monitoring Program," will ensure that the availability and reliability of the fire protection systems and features are maintained to the levels assumed in the NFPA 805 engineering analysis, which includes those assumptions credited in the FRE 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 and standards 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 to (1) prevent fires from starting; (2) rapidly detect, control, and extinguish fires that do occur (thereby limiting damage); and (3) 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 stated that echelon 1 is not affected by the use of EPRI TR-1006756 methods and that the use of PB test frequencies established per EPRI TR-1006756 methods, combined with NFPA 805, Section 2.6, "Monitoring Program," will ensure that the availability and reliability of the fire protection systems and features credited for DID are maintained to the levels assumed in the NFPA 805 engineering analysis, and, therefore, there is no adverse impact to echelons 2 and 3 for DID.

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

3.1.4.2 NFPA 805, Section 3.3.5.1, "Electrical Wiring Above Suspended Ceilings"

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 for wiring above suspended ceilings. Specifically, the licensee requested approval of a PB method to justify the use of limited quantities of wiring/cabling, which does not meet the criteria of NFPA 805, Section 3.3.5.1.

The licensee stated that wiring exists above suspended ceilings and may not comply with the requirements of this code section and that tray covers are not provided on all trays present. The licensee further stated that the wiring/cable may be small amounts of video/communications cable that are not listed for plenum use as required by this section of the code.

The licensee stated that the areas that have suspended ceilings installed inside the NFPA 805 defined power block are as follows:

- Control room and work control center
- Technical support center
- Service building offices and corridors
- Turbine building OAC computer room
- Auxiliary service building RP/chemistry offices/laboratories

The licensee stated that these areas are not risk-significant, with the exception of the control room. The licensee further stated that cable construction for power, control, and instrumentation cables are IEEE 383 (or equivalent) in steel jackets (armored); therefore, power, control, and instrumentation cables meet the requirements. The licensee further stated that the cables in question are video/communication/data cables, which have been field routed above suspended ceilings, and these cables may not be plenum rated.

The licensee further stated that video/communication/data cables are low voltage and that these low voltage cables are not generally susceptible to shorts, which would result in a fire.

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

- The wiring above ceilings in offices, corridors, etc. does not pose a hazard:
    - Low voltage is not susceptible to shorts causing a fire.
    - Power, control, and instrumentation cables are protected (armored) per this code section.
    - Eliminating cables with the potential for shorts eliminates ignition sources, and, therefore, the jacketing of cable is not relevant.
    - There is no equipment important to nuclear safety in the vicinity of these cables.
    - There are limited/no ignition sources above these ceilings, and the lack of continuity of combustibles make it unlikely a significant fire could develop.

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

The licensee stated that the location of cables above suspended ceilings has no impact on the radiological release performance criteria and that the radiological review was performed based on the potential location of radiological concerns and is not dependent on the type of cables or locations of suspended ceilings. The licensee further stated that the cables do not change the results of the radiological release evaluation performed that concluded that potentially contaminated water is contained and smoke is monitored, and the cables do not add additional radiological materials to the areas or challenge system boundaries.

The licensee stated power, control, and instrumentation cables meet the requirements of this code section and that other wiring, while it may not be in armored cable, in metallic conduit, or plenum rated, is low voltage cable not susceptible to shorts that would result in a fire. The licensee further stated that these areas with video/communication/data cables have been analyzed in their current configuration and that the amount of non-rated and non-enclosed wiring above the ceilings in the power block is minor and does not present a significant fire hazard. Therefore, the safety margin inherent in the analysis for the fire event has been preserved.

The licensee stated that the three echelons of DID are to (1) prevent fires from starting; (2) rapidly detect, control, and extinguish fires that do occur (thereby limiting damage); and (3) 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 stated that prior introduction of non-listed video/communications/data cables routed above suspended ceilings does not impact fire protection DID and that echelon 1 is maintained by the cable installation procedures documenting the requirements of NFPA 805, Section 3.3.5.1. The licensee further stated that the introduction of cables above suspended ceilings does not affect echelons 2 or 3 and that the video/communications/data cables routed above suspended ceilings do not directly result in compromising automatic fire suppression systems, manual fire suppression functions, or post-fire safe shutdown capability. The licensee further stated that there are limited/no ignition sources above the ceilings, and the lack of continuity of combustibles makes it unlikely that a significant fire could develop, and there is no equipment important to nuclear safety in the vicinity of these cables.

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

3.1.4.3 NFPA 805, Section 3.3.5.2, "Metal Tray and Conduits"

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 3.3.5.2, requirement for use of only metal trays and conduits for raceways. Specifically, the licensee requested approval of a PB method to justify the use of PVC conduit when embedded in building walls, floors, or foundations, and in outdoor buried locations with or without concrete encasement. The licensee stated that where embedded/buried/encased, the PVC conduit is within a non-combustible enclosure, which provides protection from mechanical damage and

from damage resulting from either an exposure fire or from a fire within the conduit impacting other targets.

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

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

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

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

The licensee stated that the use of PVC conduits in embedded/buried/encased installations has no impact on the radiological release performance criteria and that the radiological review was performed based on the potential location of radiological concerns and is not dependent on the type or location of conduit. The licensee further stated that the PVC conduits do not change the results of the radiological release evaluation performed, which concluded that potentially contaminated water is contained and smoke is monitored, and that the PVC conduits do not add additional radiological materials to the areas or challenge systems boundaries.

The licensee stated that the PVC conduit material is embedded/buried/encased in a non-combustible configuration; therefore, the safety margin inherent in the analysis for the fire event has been preserved.

The three elements of DID described in NFPA 805, Section 1.2, are to (1) prevent fires from starting; (2) rapidly detect, control, and extinguish fires that do occur (thereby limiting damage); and (3) 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 stated that the use of PVC conduits embedded/buried/encased in a non-combustible configuration does not impact fire protection DID and that the PVC conduits do not directly result in compromising automatic or manual fire suppression functions. The licensee further stated that the PVC conduit, while a combustible material, is not subject to flame/heat impingement from an external source, which would result in structural failure, contribution to fire load, and damage to the circuits contained within where the conduit is embedded in concrete or compacted sand/soil, and failure of circuits within the conduit resulting in a fire would not result in damage to external targets.

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

3.1.4.4 NFPA 805, Section 3.3.12(1),"Reactor Coolant Pump Oil Misting"

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 3.3.12(1) requirement that the oil collection system for each RCP be capable of collecting lubricating oil from all potential pressurized and non-pressurized leakage sites in each RCP oil system. Specifically, the licensee requested approval to use PB methods to demonstrate an equivalent level of fire protection for potential oil misting from the RCPs/motors not being collected in the oil collection system.

The licensee stated that the CNS RCP oil collection system is designed and was reviewed in accordance with 10 CFR 50, Appendix R, Section III.O, to collect leakage from pressurized and non-pressurized leakage sites in the RCP oil system and that this may not include collection of oil mist as a result of pump/motor operation. The licensee stated that oil misting is not leakage due to equipment failure but rather inherent occurrence in the operation of large rotating equipment, and that it is normal for large motors to lose some oil through seals and the oil to potentially become 'atomized' in the ventilation system. The licensee further stated that this atomized oil mist can then collect on surfaces in the vicinity of the RCP, as the pump design is not completely sealed to permit airflow for cooling. The licensee stated that the oil mist resulting from normal operation will not adversely impact the ability of a plant to achieve and maintain safe shutdown even if ignition occurred.

The licensee stated that the GL 86-10 (Reference 84) Response to Industry Question 6.2 discussed oil dripping, and the response concluded that there was no concern with oil consumption (which is an oil misting phenomena), but the concern was with an oil fire started from a pressurized leakage point and/or spilled leakage. The licensee further stated that fires have occurred due to oil leakage from equipment failure such as cracked welds on piping or inadequate collection pan design. The licensee stated that it does not have a history of significant oil loss form the RCPs as a result of oil misting or oil leakage that is not contained by the properly designed and installed oil leakage collection system.

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

- The oil collection system is designed to collect leakage from pressurized and non-pressurized leakage sites in the RCP oil system.

- Oil misted from normal operation is not leakage; it is normal motor oil consumption.

- Oil misted from normal operation does not significantly reduce the oil inventory. The oil historically released as misting does not account for an appreciable HRR or accumulation near potential ignition sources or non-insulated reactor coolant piping.

- The RCPs use a synthetic oil of a high flash point, over 400 degrees Fahrenheit (°F).

The licensee stated that RCPs are not required to achieve or maintain fire safe shutdown, and, therefore, there is no impact on the NSPC. The licensee further stated that the potential for oil mist from the RCPs has no impact on the radiological release performance criteria and that the radiological review was performed based on the potential location of radiological concerns, which encompasses the reactor building in which the RCPs are located.

The licensee stated that the oil mist resulting from normal operation will not adversely impact the ability of a plant to achieve and maintain fire safe shutdown, even if ignition occurred; therefore, the safety margin inherent in the analysis for the fire event has been preserved.

The three elements of DID described in NFPA 805, Section 1.2, are to (1) prevent fires from starting; (2) rapidly detect, control, and extinguish fires that do occur (thereby limiting damage); and (3) 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 stated that the potential for mist from the RCPs does not directly result in compromising automatic fire suppression functions, manual fire suppression functions, or post-fire safe shutdown capability, and, therefore, does not affect DID. The licensee further stated that the oil historically released as misting does not account for an appreciable HRR or accumulation near potential ignition sources or non-insulated reactor coolant piping and that the RCPs use a synthetic oil of a high flash point, over 400 °F.

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 3.3.12(1), requirement, because it satisfies the performance goals, objectives, and criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID.

3.1.4.5 NFPA 805, Section 3.9.2, "Fire Suppression System Flow Alarm"

In FPE RAI 02 (Reference 24), as discussed in SE Section 3.1.1.2, the NRC staff identified that the lack of water flow alarms for manually water-based suppression systems did not meet the requirements of NFPA 805, Section 3.9.2. In its response to FPE RAI 02 (Reference 10), the licensee revised its compliance strategy from "complies with clarification" to "Submit for NRC Approval," and submitted Approval Request 5 (Reference 11). The licensee submitted a revised response to FPE RAI 02 in its letter dated August 2, 2016 (Reference 21).

In LAR Attachment L, as supplemented, 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 3.9.2, requirement for fire suppression system flow alarms. Specifically, the licensee requested approval for certain manual water-based suppression systems that are not provided with water flow alarms. The licensee stated that manual suppression systems without water flow alarms are those that are located in containment and that the manual sprinkler systems are provided for the RCPs, the lower containment filters (carbon beds), and the reactor building pipe corridors. The licensee further stated that these systems require opening of the containment isolation valve in order for water to reach the system and they are considered manual suppression systems.

The licensee stated that the containment isolation valve is opened if there is indication that there may be fire. The licensee further stated that each system is equipped with closed head fusible link sprinklers and that each system also has an independent detection system in the area consisting of either line-type heat, photo-electric smoke, or rate-of-rise devices. The licensee further stated that indication of suppression system actuation would be visual confirmation based on operator response to a detection alarm, personnel in the area observing system operation, or abnormal fire pump/jockey pump operation. The licensee further stated that due to the limited times the containment isolation valve is open, inadvertent actuation without water flow alarm indication is not a concern.

The licensee stated that the bases for the approval requests are:

- The control room authorizes opening of the containment isolation valve.
- The suppression systems will only operate after an operator opens the containment isolation valve.
- Each area protected by the manual water-based suppression systems is also protected by automatic detection systems.
- Multiple alternative means of indication of suppression system operation are available.

The licensee stated that the lack of water flow alarm does not affect nuclear safety and that the manual suppression systems are normally isolated. The licensee further stated that the FPRA and FREs have evaluated the reactor building fire areas and do not credit the manual suppression systems for risk reduction or for DID, and the suppression systems will only operate after the containment isolation valve is opened. The licensee further stated that if a fire were to occur, there are multiple means of indication that the suppression system has actuated, and, therefore, there is no impact on the nuclear safety performance.

The licensee stated that the radiological review was performed based on the potential location of radiological concerns, is not dependent on water flow alarms in fire protection suppression systems, and the lack of water flow alarms does not change the results of the radiological release evaluation performed, which concluded that potentially contaminated water is contained and smoke is monitored. The licensee further stated that the lack of water flow alarms does not add additional radiological materials to the areas or challenge system boundaries.

The licensee stated that the methods, input parameters, and acceptance criteria used in this analysis were reviewed against those used for NFPA 805, Chapter 3, acceptance, and that the methods, input parameters, and acceptance criteria used to determine the adequacy of the fire suppression systems were not altered. The licensee stated that the suppression systems will actuate when water is present, and the lack of a water flow alarm will not impact the ability of the suppression system to perform its design objectives; therefore, the safety margin inherent in the analysis of the fire event has been preserved.

The licensee stated that the three echelons of DID are to (1) prevent fires from starting; (2) rapidly detect, control, and extinguish fires that do occur (thereby limiting damage); and (3) 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 stated that the manual suppression systems will actuate when the containment isolation valve is open, and the lack of water flow alarm does not impact fire protection DID and does not result in compromising automatic fire suppression functions, manual fire suppression, or post-fire safe shutdown capability. Therefore, since both the automatic and manual fire suppression functions are maintained, 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 3.9.2, requirement, because it satisfies the performance goals, objectives, and criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID.

3.1.4.6 NFPA 805, Section 3.5.5, "Water Supply Pump Separation Requirements"

In FPE RAI 08 (Reference 24), as discussed in SE Section 3.1.1.4, the NRC staff identified that Hemyc™ fire wrap or ERFBS, which was credited in a previous NRC approval cited in LAR Attachment A for compliance with NFPA 805, Section 3.5.5, was no longer being maintained as a barrier for NFPA 805 compliance. In its response to FPE RAI 08 (Reference 10), the licensee included Approval Request 6 (Reference 11) to request NRC staff approval for no longer crediting the Hemyc™ fire wrap.

In LAR Attachment L, as supplemented, 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 3.5.5, requirement for water supply pump separation. Specifically, the licensee requested approval for no longer crediting in the FPP a 1-hour fire barrier that was protecting the B MFP power cable. The licensee stated that the power cable for the B MFP was protected by a 1-hour Hemyc™ fire wrap and that this fire wrap was abandoned in place and is no longer required/credited in the FPP.

The licensee stated that it has three full capacity (100 percent of required flow and pressure) vertical shaft, motor driven (electric) fire pumps, and that the three MFPs are located remotely from the remainder of the power block at the LPSW intake structure. The licensee stated that the discharge head and motor for each of the three pumps are located above the operating deck of the LPSW intake structure and that the discharge head and motor for the B MFP are separated from the A and C MFPs by a 3-hour fire rated masonry block wall, and the power cables for all three MFPs are routed in steel conduit underneath the LPSW intake structure operating deck. The licensee further stated that the routing of the conduit for the three MFPs is such that all three sets of conduits do not cross paths and maintain spatial separation and that there are no ignition sources and very limited combustibles beneath the LPSW intake structure operating deck. The licensee further stated that a fire in this area that could damage all three sets of power cables is not a credible event, and in the unlikely event that a fire did occur underneath the LPSW intake structure operating deck, no components required to satisfy the NSPC or the radiation release performance criteria would be affected.

The licensee stated that the bases for the approval request are:

- There are three full capacity (100 percent of required flow and pressure) vertical shaft motor driven (electric) fire pumps.
- There are no ignition sources and limited combustible materials below the LPSW intake structure.
- A fire beneath the LPSW intake structure that could damage the power cables for all three MFPs is not a credible event.
- A fire at the LPSW intake structure would not impact any components required to satisfy the NSPC or the radiation release performance criteria.

The licensee stated that the lack of protection of the B MFP power cable does not affect nuclear safety since a fire at the LPSW intake structure would have no impact on any components required to satisfy the NSPC, and there are no credible fire scenarios that would damage the power cables for all three MFPs; therefore, there is no impact on the NSPC.

The licensee further stated that the radiological review was performed based on the potential location of radiological concerns and is not dependent on the fire pumps, and the lack of protection of the B MFP power cable does not change the results of the radiological release evaluation performed that concluded potentially contaminated water is contained and smoke is monitored. The licensee further stated that the lack of protection of the power cable does not add additional radiological materials to the areas or challenge system boundaries.

The licensee stated that the methods, input parameters, and acceptance criteria used in this analysis were reviewed against those used for NFPA 805, Chapter 3, acceptance and that the methods, input parameters, and acceptance criteria used to determine the adequacy of the fire water distribution system (fire pumps) were not altered. The licensee stated that the redundant fire pumps ensure that the capability to supply the required flow rate and pressure is available. The licensee further stated that the lack of protection of the B MFP power cable will not impact the ability of the suppression system to perform its design objectives, and, therefore, the safety margin inherent in the analysis of the fire event has been preserved.

The licensee stated that the three echelons of DID are to (1) prevent fires from starting; (2) rapidly detect, control, and extinguish fires that do occur (thereby limiting damage); and (3) 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 stated that the lack of protection of the B MFP power cable does not impact fire protection DID and does not result in compromising automatic fire suppression functions, manual fire suppression, or post-fire safe shutdown capability. The licensee further stated that the redundant fire pumps ensure that the capability to supply the required flow rate and pressure is available and that since both the automatic and manual fire suppression functions are maintained, DID is maintained. The licensee further stated that there are no ignition sources and limited combustible materials below the LPSW intake structure, a fire beneath the LPSW intake structure that could damage the power cables for all three MFPs is not a credible event, and a fire at the LPSW intake

structure would not impact any components required to satisfy the NSPC or the radiation release performance criteria.

Based on its review of the information submitted by the licensee, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the proposed PB method is an acceptable alternative to the corresponding NFPA 805, Section 3.5.5, requirement, because it satisfies the performance goals, objectives, and criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID.

3.2 Nuclear Safety Capability Assessment Methods

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

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

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

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":

> 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":

> 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":

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, in part, that:

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

(1) Selection of systems and equipment and their interrelationships necessary to achieve the NSPC in Chapter 1

(2) Selection of cables necessary to achieve the NSPC in Chapter 1

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

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

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

RG 1.205, Revision 1 (Reference 4), endorses NEI 04-02, Revision 2 (Reference 7), and Chapter 3 of NEI 00-01, Revision 2 (Reference 37), and promulgates the method outlined in NEI 04-02 for conducting an NSCA. This NRC-endorsed guidance (i.e., NEI 04-02, Table B-2, "NFPA 805 Chapter 2 – Nuclear Safety Transition – Methodology Review," and NEI 00-01, Chapter 3) has been determined to address the related requirements of NFPA 805, Section 2.4.2. The NRC staff reviewed LAR Section 4.2.1, "Nuclear Safety Capability Assessment Methodology," and LAR Attachment B, "NEI 04-02 Table B-2 – Nuclear Safety Capability Assessment – Methodology Review," against these guidelines.

The endorsed guidance provided in NEI 00-01, Revision 2, provides a framework to evaluate the impact of fires on the ability to maintain post-fire 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, and
- The application of appropriately conservative assumptions to be used in the performance of the NSCA.

The licensee developed the LAR based on the three guidance documents cited above. Although RG 1.205, Revision 1, endorses NEI 00-01, Revision 2, the licensee's review was performed to the guidance in NEI 00-01, Revision 1 (Reference 65), as discussed below. 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 66) provides one acceptable method for documenting the comparison of the NSPC 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 NSCA requirements using the NRC-endorsed process in Chapter 3 of NEI 00-01, Revision 1, and documented the results of the review in the LAR Attachment B, "NEI 04-02 Table B-2 – Nuclear Safety Capability Assessment – Methodology Review," in accordance with NEI 04-02, Revision 2.

In LAR Section 4.2.1.1, the licensee stated that an additional review of NEI 00-01, Revision 2 (Reference 37), Chapter 3, was conducted to identify the substantive changes from NEI 00-01, Revision 1, which are applicable to an NFPA 805 FPP.

The licensee stated that the results of this review are summarized below:

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

  The licensee stated that there are no valves exposed to the fire, which are required to be operated following a fire for [Hot Standby (Mode 3)] only; therefore, this additional guidance is not applicable to CNS.

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

  The licensee stated that it properly considered this additional guidance in the CNS safe shutdown analysis.

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

  The licensee stated that it performed circuit analysis that evaluated for this condition.

The categories used by CNS 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 or not required for the safe shutdown analysis (for example, the attribute may be applicable only to BWRs or PWRs). These are noted in the LAR Table B-2 as "Not Applicable."

The NRC staff has determined that taken together, these methods compose an acceptable approach for documenting compliance with 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

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 an FPP under 10 CFR 50.48. As described above, CNS performed its review to NEI 00-01, Revision 1, with a gap analysis to Revision 2. For several of the NEI 00-01, Chapter 3, attributes, the licensee determined that the SSA aligns directly with the attribute. In these instances, based on the information provided by the licensee, the NRC staff concludes that the licensee's statements of alignment are acceptable.

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

- 3.2.1.2

In SSA RAI 06 (Reference 24), the NRC staff indicated that the NSCA methodology did not address instrument air and instrument sensing lines. The staff requested additional information on how the NSCA addressed heat sensitive piping, including tubing with brazed or soldered joints. In its response to SSA RAI 06 (Reference 9), the licensee stated that the NSCA instruments do not use soldered or brazed connections and that process instrument lines, including instrument air lines, use stainless tubing and/or copper tubing, which use compression fittings that are assumed intact. The licensee further stated that in other applications, any brazed and soldered lines are assumed damaged in the event of a fire and that the instrument air system has not been analyzed for safe shutdown and is, therefore, assumed to be lost. The licensee stated that safe shutdown components that would require instrument air to perform its safe shutdown function were identified as variances from deterministic requirements (VFDRs) due to the effects of a fire, if applicable, and resolved in the FRE. Based on the licensee's response to SSA RAI 06, the NRC staff concludes that the methods, as described by the licensee are acceptable, because the licensee's methods for evaluation of soldered or brazed connections and process instrument lines meet the intent of the endorsed guidance for evaluating fire damage to piping to demonstrate that the damage does not adversely impact the safe shutdown function.

3.2.1.2 Attribute Alignment -- Aligns with Intent

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

- 3.1[C]
- 3.1.1.3
- 3.1.1.4
- 3.1.1.7
- 3.1.1.9
- 3.1.1.11
- 3.1.2.4
- 3.1.2.5
- 3.1.3.4
- 3.2.1.1
- 3.2.1.6
- 3.2.2.1
- 3.2.2.2
- 3.2.2.3
- 3.2.2.4
- 3.3.1.2
- 3.3.1.3
- 3.3.1.6
- 3.3.1.7
- 3.3.3.2
- 3.3.3.3
- 3.5.1.1
- 3.5.1.3
- 3.5.1.5
- 3.5.2.1
- 3.5.2.3A
- 3.5.2.3B
- 3.4.1.4
- 3.4.1.5
- 3.4.1.6
- 3.4.1.7
- 3.4.2.4

In SSA RAI 01 (Reference 24), the NRC staff noted that for some attributes in LAR Attachment B, Table B-2, it was not clear why the licensee's description in the alignment basis does not align with the guidance, and the staff requested the licensee to provide clarification on

the "aligns with intent" category for these attributes. In its response to SSA RAI 01 (Reference 9), the licensee stated that the alignment basis for the following NEI 00-01 elements should be changed to "Aligns" with the guidance:

- 3.1C Spurious Operation
- 3.1.1.3 Use of Pressurizer Heaters
- 3.1.1.7 Offsite Power
- 3.1.1.11 Multiple Units
- 3.1.2.5 Process Monitoring
- 3.3.1.3 Isolation Devices
- 3.3.1.6 Auto Initiation Logic
- 3.3.1.7 Circuit Coordination
- 3.5.1.3 Duration of Circuit Failures
- 3.5.2.1 Circuit Failures due to an Open Circuit
- 3.5.2.3 A/B Circuit Failures Due to a Hot Short
- 3.4.1.4 Manual Actions
- 3.4.1.7 Additional Equipment

For Attribute 3.3.1.7, which the licensee changed to "Aligns" as described above, the NRC staff also requested additional information. In SSA RAI 07 (Reference 24), the NRC staff noted that LAR Attachment S, Table S-2b, lists Modification Items 02, 03, 04, 05, and 06, as circuit coordination modifications; however, LAR Section 4.2.1.1 only identified Modification Items 02 and 03 as necessary to address coordination issues associated with meeting Attribute 3.3.1.7. Specifically, the NRC requested that the licensee provide clarification for only listing Modification Items 02 and 03 in LAR Section 4.2.1.1 as the only modifications to resolve breaker coordination issues. In its response to SSA RAI 07 (Reference 10), the licensee stated that Modification Items 02 and 03 involve affected motor control centers (MCCs) and are correctly identified in LAR Section 4.2.1.1. The licensee further stated that Modification Item 04, which resolves coordination concerns for DC panels EDE and EDF, and Modification Items 05 and 06, which resolve spurious actuation with related coordination concerns, should have also been listed in LAR Section 4.2.1.1. The licensee revised LAR Section 4.2.1.1 and added LAR Attachment S, Table S-2b, Modifications Items 04, 05 and 06, in the list of modifications that resolve breaker coordination issues. The NRC staff concludes that the licensee's response to SSA RAI 07 is acceptable because the licensee acknowledged that Modification Items 04, 05, and 06 resolve breaker coordination issues necessary to align with Attribute 3.3.1.7 and revised the LAR accordingly.

Also, related to Attribute 3.3.1.7 in SSA RAI 08 (Reference 24), the NRC staff requested that the licensee provide a more detailed description for LAR Attachment S, Table S-2b, Modification Items 02, 03, 05, and 06, and discuss how the modifications will address breaker coordination issues. In its response to SSA RAI 08 (Reference 10), the licensee stated that for Modification Items 02 and 03, the incoming breakers to the respective MCCs will be removed and the protective device will be provided from the load center breaker supplying the MCC. The licensee further stated that Modification Items 05 and 06 will prevent hot short spurious operations in a motor-operated valve and pump circuits that could lead to loss of power to associated MCCs. The licensee stated that Modifications 05 and 06 are not specifically resolving the coordination of the breaker, but are resolving spurious operation of equipment that

could result in a loss of power from the associated MCCs. Based on the licensee's response to SSA RAI 08, the NRC staff concludes that the details provided for LAR Attachment S, Table S-2b, Modification Items 02, 03, 05, and 06, are acceptable to ensure that the SSA aligns with the guidance in NEI 00-01 regarding having adequate protective devices that are properly coordinated.

On the basis of the licensee's response to SSA RAI 01, including the validity of the statements that it aligns with the endorsed guidance of NEI 00-01 for the above-listed attributes, the NRC staff concludes that the licensee's statements of alignment are acceptable.

Attribute 3.1.1.4 is associated with the use of alternative shutdown capability. The licensee stated that it utilizes a dedicated SSF for fires in areas where both trains of shutdown equipment may be damaged or the control room may have to be evacuated and that the transfer of control to the SSF of the equipment credited for a SSF shutdown isolates the systems and equipment from the effects of a fire. The NRC staff concludes that the methods, as described by the licensee are acceptable, because its use of the SSF aligns with the intent of the endorsed guidance for alternative shutdown capability.

Attributes 3.1.1.9 and 3.4.1.5 are associated with the criteria for a post-fire 72-hour coping period. The licensee stated that NFPA 805 does not have any explicit requirements to achieve cold shutdown within 72 hours; therefore, the NFPA 805 criteria for nuclear safety performance goals have been applied to ensure the fuel is maintained safe and stable. The licensee further stated that the previous hot and cold shutdown references for equipment were retained in the SSD database. The licensee stated that it maintains the fuel in a safe and stable condition for all modes of operation and that the 'At Power' safe and stable strategy includes entry into hot standby (Mode 3) and stops prior to the point of manually initiating a cooldown; thus, safe and stable conditions at HSB [sic: hot standby] may continue long-term with several activities in place. The NRC staff concludes that the methods as described by the licensee are acceptable and meet the intent of the guidance, because the licensee states it has demonstrated the ability achieve safe and stable conditions in accordance with the requirements of NFPA 805.

Attribute 3.1.2.4 is associated with the decay heat removal function to achieve cold shutdown conditions. The licensee stated that NFPA 805 does not have any explicit requirements to achieve cold shutdown; therefore, the NFPA 805 criteria for the nuclear safety performance goals have been applied to ensure the fuel is maintained in a safe and stable condition. The NRC staff concludes that the methods as described by the licensee are acceptable and meet the intent of the guidance, because the licensee has applied the nuclear safety performance goals to maintain safe and stable conditions in accordance with NFPA 805.

Attribute 3.1.3.4 is associated with assigning shutdown paths to each combination of systems for safe shutdown. The licensee stated that safe shutdown logic diagrams were utilized to show success paths for the various safe shutdown functions and that success paths were designated for each system and performance goal. The licensee further stated that it did not assign a 'path designation' to each combination of systems or equipment; instead the logic diagrams provided numerous combinations of 'success paths' that could be used to achieve safe shutdown. The licensee further stated that it then credited one combination of success paths for each fire area. The NRC staff concludes that the methods as described by the licensee are acceptable

because the licensee's use of safe shutdown logic diagrams meets the intent of the guidance to designate combinations of shutdown components relied on for safe shutdown in each fire area.

Attribute 3.2.1.1 is associated with primary and secondary component selection, categorization, and documentation. NEI 00-01 provides that safe shutdown equipment may be categorized as (1) primary components or (2) secondary components. The licensee stated that the dividing of equipment into a two categories approach was used. 'Primary' components were identified and added to the safe shutdown equipment list (SSEL), 'secondary' components (referred to as subcomponents) were grouped together with the primary components, and although some subcomponents were not individually identified (i.e., relays, fuses, hand switches, etc.), the cables, which connected to the subcomponents, were identified and assigned to the primary component. The licensee stated that in some instances, components were not captured by the cable selection process but were captured within the cascading interlocks analysis as pseudo-components, and the effect of fire on these pseudo-components was evaluated where appropriate. The NRC staff concludes that the methods as described by the licensee are acceptable and that this process meets the intent of the guidance, because the component identification, categorization, and documentation methods described by the licensee are consistent with the NRC-endorsed guidance for categorizing safe shutdown components.

Attribute 3.2.1.6 is associated with equipment that could spuriously operate or maloperate and impact the performance of equipment on a required safe shutdown path during the equipment selection phase. The licensee stated that spurious operation was considered in identification of SSEL components, and conductor-to-conductor shorts within multiconductor cable configurations were considered for power, control, and instrumentation circuits whose fire-induced failures could prevent operation of safe shutdown equipment or through maloperation cause a flow diversion, loss of coolant, or other scenario that could significantly impact the ability to achieve and maintain hot standby. The licensee further stated that all CNS cable conductors used for control have thermoset insulation, and some instrumentation conductors use thermoplastic cables that are armored, which would preclude cable-to-cable interactions. The licensee further stated that it also uses mineral insulated cable in some applications. The NRC staff concludes that the methods as described by the licensee are acceptable and meet the intent of the guidance to consider spurious operating equipment because fire-induced failure of power, control, and instrumentation circuits were considered in the selection of safe shutdown equipment and to not consider intercable interactions for armored cable is consistent with the guidance in NEI 00-01, Revision 2, Appendix B, Table B.1-0, "Types of Fire-Induced Circuit Failures Required to be Considered."

Attributes 3.2.2.1 and 3.2.2.2 are associated with the identification of system flow paths for each shutdown path, including equipment that may spuriously operate and affect system operation. The licensee stated that piping and instrumentation drawings (P&IDs) were marked up and used to determine flow and diversion paths, which were then translated into safe shutdown success path logic diagrams. The licensee further stated that these logic diagrams were then used to identify potential SSEL components, and these P&ID drawings were not maintained as part of the safe shutdown analysis, but instead, the licensee's flow diagrams were marked up and annotated to designate specific flow paths for each system. The licensee further stated that any additional SSD 'success paths' identified were defined on logic diagrams; however, the technique of designating a set number of 'safe shutdown paths' was not used. The NRC staff concludes that the methods as described by the licensee are acceptable and meet the intent of

the guidance, 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.

Attributes 3.2.2.3 and 3.2.2.4 are associated with developing a list of safe shutdown equipment and assigning the corresponding system and safe shutdown path(s) designation to each equipment. The licensee stated that P&IDs were marked up to determine flow and diversion paths for safe shutdown functions to identify potential SSEL components and that spurious operation of these components was included in the analysis. The licensee further stated that an iterative process was utilized to arrive at the final SSEL based on additional support components identified during the cable selection process (such as electrical distribution equipment), and the table listing, as identified in NEI 00-01, Attachment 3, was not utilized because the licensee's database has its own data entry format, which provides the necessary equipment information. The licensee further stated that equipment was not assigned a safe shutdown 'path'; rather, safe shutdown logic diagrams denote system function 'success paths.' The NRC staff concludes that the methods as described by the licensee are acceptable and meet the intent of the guidance, because safe shutdown components are identified in an equipment database and combinations of shutdown components and systems were evaluated using safe shutdown logics to assure a success path for each fire area.

Attributes 3.3.1.2, 3.3.3.2, and 3.3.3.3 are associated with cables affecting multiple components, interlocked circuits, and spurious operation. The licensee stated that for control logic circuits where multiple components receive signals from common control logic, the control logic was analyzed as a primary component, and a pseudo-component was created for the logic with cables selected accordingly. The licensee further stated that this same methodology was used for similar circuit scenarios such as common power supplies, and the effects on each component due to fire damage were evaluated. The licensee further stated that pseudo-components, in which associated cabling can affect another primary component based on common power, were identified in the cable selection for the affected component as an interlocked primary component. The licensee further stated that the cascading power supply and cascading interlocks analyses evaluate these interlocked components. The licensee stated that cables associated with SSEL components were selected in accordance with the guidance and entered into the safe shutdown database for that component; the safe shutdown database also contains the direct and indirect power supplies for the safe shutdown components and any interlocks that could impact component operation. SSEL component cables are associated with interlocks and power supplies. The NRC staff concludes that the methods as described by the licensee are acceptable and meet the intent of the guidance, because the effect of fire damage on a component that could impact multiple components was evaluated.

Attribute 3.5.1.1 is associated with circuit failure types and impact. The licensee stated that all combinations of circuit failures, except intercable hot shorts, are considered and evaluated to determine if spurious component actuation can occur, and intercable hot shorts were not considered due to the use of armored cable at CNS. The licensee further stated that the armor of the cables prevents conductors from one cable shorting to conductors of another cable, and in some cases, circuit analysis did not have to be performed, because the entire population of cables associated with a safe shutdown component was adequately separated as required by the regulations from redundant components and cabling. The NRC staff concludes that the methods as described by the licensee are acceptable and meet the intent of the guidance,

because all circuit failure types were considered and resolved in a manner consistent with the necessary considerations of potential impact to safe shutdown as intended by this attribute.

Attribute 3.5.1.5 [B.b] is associated with cable failure modes for multiconductor thermoplastic cables and spurious operation that may result from intra-cable and inter-cable shorting. The licensee stated that it has thermoplastic covering over its armored sheathing in some plant areas, but the conductor insulation is thermoset for control and power cables. The licensee further stated that some instrumentation cable has thermoplastic conductor insulation; however, these also have armored sheathing. The licensee stated that inter-cable hot shorts are not postulated. The NRC staff concludes that the methods as described by the licensee are acceptable and meet the intent of the guidance, because the licensee considered all credible circuit failure modes as part of the analysis, and inter-cable hot shorts on armored cables are not credible based on the guidance provided in NEI 00-01, Revision 2, Appendix B, Table B.1-0, "Types of Fire-Induced Circuit Failures Required to be Considered."

Attributes 3.4.1.6 and 3.4.2.4 are associated with ensuring that one train of systems necessary to achieve and maintain hot shutdown conditions from either the control room or emergency control stations is free from fire damage. The licensee stated that the safe shutdown success paths were analyzed, potential impacts identified, and these potential impacts were resolved by specifying one or more of the options identified in the guidance such that the least impacted safe shutdown success path could be identified. The licensee further stated that VFDRS were identified, and the mitigating strategies to address the VFDRs in a PB FRE were developed and documented. The licensee further stated that credit for transitioning EEEEs and licensing actions was taken wherever possible and procedural (recovery) action specified as a last resort. The NRC staff concludes that the methods as described by the licensee are acceptable and meet the intent of the guidance, because the resolution of the variances that do not meet the deterministic requirements use methods described in NFPA 805, Chapter 4.

3.2.1.3 NFPA 805 Nuclear Safety Capability Assessment Methods Conclusion

The NRC staff reviewed the documentation provided by the licensee describing the process used to perform the NSCA required by NFPA 805, Section 2.4.2. The licensee performed this evaluation by comparing the SSA against the NFPA 805 NSCA requirements using NEI 00-01, Revision 1, with a gap analysis to the NRC-endorsed process in Chapter 3 of NEI 00-01, Revision 2. The results of the review (including the gap analysis) are documented in LAR Section 4.2.1.1 and 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, and completion of LAR Attachment S, Table S-2b, Modification Items 02, 03, 04, 05 and 06, the NRC staff accepts the method the licensee used to perform the NSCA with respect to the selection of systems and equipment, selection of cables, and identification of the location of nuclear safety equipment and cables, as required by NFPA 805, Section 2.4.2. The NRC staff accepts the licensee's method because it either:

- Met the NRC-endorsed guidance directly, or
- Met the intent of the endorsed guidance and adequate justification was provided.

3.2.2 Maintaining Fuel in a Safe and Stable Condition

The nuclear safety goals, objectives, and performance criteria of NFPA 805 allow more flexibility than the previous deterministic FPPs based on Appendix R to 10 CFR 50 and NUREG-0800, Section 9.5.1.1 (Reference 85), 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 demonstration of the NSPC for safe and stable conditions was performed in two analyses:

- At-power analysis, Modes 1-3, prior to manually initiating a cooldown; and
- Non-power analysis, which includes Mode 3, after initiating a manual cooldown, 4, 5, 6, and No mode.

The licensee stated that the 'At-Power' safe shutdown analysis postulates a single fire occurring at 100 percent power and provides a listing of damaged equipment that may be needed to restore a success path to meet a particular nuclear safety performance goal and that the 'At Power' safe and stable strategy includes entry into HSB (Mode 3) and stops prior to the point of manually initiating a cooldown.

The licensee stated that the following long-term actions can be instituted, as needed:

- The site emergency organization can be established;
- More resources can be made available;
- Additional material can be available from both within and outside the corporation;
- Damage repairs can be completed as desired/needed, resulting in additional success paths being made available; and
- Offsite power is expected to be restored.

In SSA RAI 02a (Reference 24), the NRC staff requested the licensee to clarify if the long-term actions are needed to maintain the fuel in a safe and stable condition and to provide a detailed description of the specific repairs that would be needed, the success paths being restored, and the timeframe required to complete the repair. In its response to SSA RAI 02a (Reference 10), the licensee stated that the long-term actions are not needed or required to maintain the fuel in a safe and stable condition and that no repairs are needed to fire damaged equipment to restore credited success path. The licensee further stated that the safe shutdown deterministic analysis does not credit offsite power as being available or as being restored and that the FPRA analyzed the availability of offsite power but did not credit any restoration of offsite power if damaged by fire. The NRC staff concludes that the licensee's response to SSA RAI 02a is acceptable because the long-term actions described in LAR Section 4.2.1.2 are not needed or required to maintain the fuel in a safe and stable condition, and, therefore, meet the requirements of NFPA 805, Section 1.3.1.

In LAR Section 4.2.1.2, the licensee stated that safe and stable conditions at HSB may continue long-term with the following activities:

- For the fuel oil system for the SSF train, the SSF diesel generator fuel tank needs replenishing approximately every 72 hours and fuel oil may be obtained

from offsite vendors. For the A or B train, the safety related diesel generators need replenishing approximately every 7 days per design basis accident. Alternatively, the fire affected train's respective diesel generator fuel can be pumped to the non-fire affected train diesel generator providing approximately 14 days of fuel. Fuel oil may also be obtained from offsite vendors.

- For the feedwater system, an assured source of 225,000 gallons of condensate grade water is available per unit for A train, B train, or SSF success path. For SSF feedwater, the embedded condenser circulating water piping volume will provide suction to the turbine driven auxiliary feedwater pump for 72 hours. Additionally, for A or B train success paths, although Lake Wylie is expected to be available, the assured source is the standby nuclear service water pond via nuclear service water.

- For the reactor coolant system (RCS), the spent fuel pool will provide available inventory via the standby makeup pump for at least 72 hours for the SSF train. Spent fuel pool makeup can be provided from the refueling water storage tank, as well as several other sources, to extend the available supply. For A or B train, charging flow to the RCP seals will provide a steady supply of inventory. The assured source is the refueling water storage tank (approximately 380,000 gallons) and then realignment to the containment sump.

- For the decay heat removal systems, long-term safe and stable conditions can be maintained with natural circulation and steam generator steaming with assured adequate feedwater.

The licensee stated that the balance of 'At Power' and 'Non-Power' strategies meets the definition of the nuclear safety goal of NFPA 805, Section 1.3.1, in that, "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."

In SSA RAI 02b (Reference 24), the NRC staff requested the licensee to clarify if the actions required to maintain long-term safe and stable at hot standby condition, such as the alignments of fuel oil, feedwater, and reactor coolant inventory, are proceduralized and whether feasibility has been demonstrated. In its response to SSA RAI 02b (Reference 10), the licensee stated that it will assure procedures are in place for the alignment of fuel oil and water sources for feedwater and reactor coolant makeup to maintain long-term safe and stable hot standby conditions, and when applicable, the long-term actions will be analyzed in accordance with the feasibility criteria provided in FAQ 07-0030. The licensee revised LAR Attachment S, Table S-3, by adding Implementation Item 18 (Reference 11), which will assure procedures are provided for long-term alignments for makeup of fuel oil, feedwater, and reactor coolant. The NRC staff concludes that the licensee's response to SSA RAI 02b is acceptable because the long-term actions to align fuel oil and water sources for feedwater and reactor coolant makeup and maintain long-term safe and stable hot standby conditions will be proceduralized after completion of the actions described in LAR Attachment S, Table S-3, Implementation Item 18. The NRC staff concludes that these actions are acceptable because they will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

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

3.2.3 Applicability of Feed and Bleed

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

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

The NRC staff reviewed LAR Table 5-3, "10 CFR 50.48(c) – Applicability/Compliance Reference," and Attachment C, "NEI 04-02 Table B-3 – Fire Area Transition," to evaluate whether CNS 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 CNS 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 areas analyses include the safe shutdown equipment necessary to provide decay heat removal without relying on feed and bleed. In addition, all fire areas either met the deterministic requirements of NFPA 805, Section 4.2.3, or the PB evaluation performed in accordance with NFPA 805, Section 4.2.4, demonstrated that the integrated assessment of risk, DID, and safety 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 relied upon for the sole fire-protected safe shutdown path at CNS.

3.2.4 Assessment of Multiple Spurious Operations (MSOs)

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

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

In addition, NFPA 805, Section 2.4.3.2, states that the PSA evaluation shall address the risk contribution associated with all potentially risk-significant fire scenarios. Because the RI/PB

approach taken used FREs in accordance with NFPA 805, Section 4.2.4.2, "Use of Fire Risk Evaluation," the PSA evaluation is required to address all potentially risk-significant fire scenarios including potential MSO combinations.

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

LAR Section 4.2.1.4 states that as part of the NFPA 805 transition project, a review and evaluation of CNS susceptibility to fire-induced MSOs was performed. The process was conducted in accordance with NEI 04-02 (Reference 7) and RG 1.205 (Reference 4), as supplemented by FAQ 07-0038, Revision 3 (Reference 64). The licensee stated that the PWR Generic MSO list dated March 25, 2008, was utilized, and that the review method used insights from the FPRA developed in support of transition to NFPA 805 and consists of the following steps:

1. Identifying potential MSOs of concern;
2. Conducting an expert panel to assess plant-specific vulnerabilities;
3. Updating the FPRA model and the NSCA to include the MSOs of concern, as applicable;
4. Evaluating for NFPA 805 compliance; and
5. Documenting results.

For Step 1, the licensee stated that the following information sources were used to identify the potential MSOs of concern: safe shutdown analysis, Pressurized-Water Reactor Owners Group generic MSO list, FPRA model, and internal events PRA (IEPRA).

For Step 2, the licensee stated that the expert panel was conducted in April 2009 and that the expert panel consisted of a 3-day meeting with representatives from Duke Energy and contractors with experience in fire protection, post-fire safe shutdown, circuit analysis, system engineering, plant operations, and PRA. The licensee further stated that the panel conducted document reviews and held discussions on potential fire-induced spurious operations that could potentially impact plant safety and that training was conducted in the form of an introductory overview and slide presentation. The licensee further stated that detailed discussion on the types of circuit failures was not held since the focus of the panel was on system and component level failures. Consensus was achieved in the expert panel process by discussing individual scenarios, reaching a conclusion, and asking for any dissenting opinions.

For Step 3, the licensee stated that the NSCA and FPRA were updated to reflect the treatment of applicable MSO scenarios and that this included the identification of equipment and cables and the routing of cables by plant locations.

For Step 4, the MSO combination components of concern were also evaluated as part of the licensee's NSCA, and for cases where the pre-transition MSO combination components did not meet the deterministic compliance, the MSO combination components were added to the scope of the FREs.

For Step 5, the licensee stated the results are documented in the licensee's MSO expert panel report, NSCA, FPRA, and FREs.

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

3.2.5 Establishing Recovery Actions

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

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

NFPA 805, Section 4.2.3.1, states that:

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

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

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

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

The licensee stated that this process was based on FAQ 07-0030 and consists of the following steps:

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

- Step 2: Determine the population of RAs that are required to resolve variances from deterministic requirements (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.

The licensee stated that based on the guidance in RG 1.205, and the additional guidance provided in FAQ 07-0030, the following locations outside the CNS MCR are considered primary control stations(s) (PCS(s)):

- Actions inside the standby shutdown facility (SSF),
- Actions in the plant to transfer control from the MCR to the SSF, and
- Actions inside the plant to transfer power and control to the SSF.

The licensee stated that it utilizes the PCS for alternate shutdown safe and stable operations.

OMAs meeting the definition of an RA are required to comply with the NFPA 805 requirements outlined above. Some of these OMAs may not be required to demonstrate the "availability of a success path," in accordance with NFPA 805, Section 4.2.3.1, but may still be required to be retained in the RI/PB FPP because of DID considerations described in Section 1.2 of NFPA 805.

In LAR Attachment G, the licensee described three categories of actions in CNS post-fire procedures. The licensee stated that the first two categories are RAs required for NFPA 805 compliance. The licensee stated that the first category of RAs are actions required for risk and that these are actions the FPRA credited to reduce the risk numbers. The licensee stated that the second category of RAs are actions required for DID and that these actions are credited as a result of the DID evaluations performed as part of the FREs. The licensee further stated that the first two categories of RAs are evaluated for feasibility against the criteria in NFPA 805, Section B.5.2(e); NEI 04-02; and FAQ 07-0030. The licensee stated that the third category, while associated with VFDRs, are additional actions screened out due to no or very low risk, and these actions are not considered RAs for NFPA 805. Therefore, feasibility is not evaluated against the criteria in NFPA 805, Section B.5.2(e); NEI 04-02; and FAQ 07-0030.

In PRA RAI 06, the NRC staff requested the licensee to clarify (a) how the third category of OMAs was originally identified; (b) the process and criteria for screening out these OMAs; and (c) how these OMAs will be treated in the post-transition fire procedures, if they will be retained in the procedures, and how these OMAs were evaluated for adverse impact on the PRA. In its response to PRA RAI 06 (Reference 10), the licensee stated that the OMAs from the fire response procedure in the third category are identified when they do not qualify for entry into the other categories of actions and that these are actions that do not occur at the primary control stations are not needed to ensure DID, and do not contribute to a risk increase when evaluating VFDRs. The licensee further stated that the criteria used to screen out these OMAs were based on the decisions of an expert panel that determines the OMA is not required for DID, and if the OMA is kept in the fire response procedure, the OMA is evaluated for adverse impacts. Based

on the licensee's response to PRA RAI 06, as described above and evaluated in SE Section 3.4.4, the NRC staff concludes that the third category of OMAs, as described in LAR Attachment G, are not considered RAs required for risk or DID because the OMAs were screened out, and the performance of these RAs was determined to not result in an adverse impact on risk.

The licensee stated that all credited RAs as listed in LAR Attachment G, including DID RAs, were subjected to a feasibility review. In accordance with NRC-endorsed guidance in NEI 04-02, the feasibility criteria used in the licensee's assessment process were based on the criteria in FAQ 07-0030 (Reference 63), and each of the 11 individual feasibility attributes was addressed. LAR Attachment G, Table G-1, "Recovery Actions and Activities Occurring at the Primary Control Stations," describes each RA associated with the resolution of a VFDR from the fire area assessments as documented in LAR Attachment C, "Fire Area Transition." 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 unrecoverable 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.

LAR Attachment G identified certain actions resulting from the feasibility evaluation. The licensee included these actions in LAR Attachment S, Table S-3, Implementation Item 16. These items include:

- Corrective action to add equipment tags to the petcocks for the auxiliary feedwater valves. These equipment numbers will be added to fire procedures.

- Corrective action to revise steps to fire procedures to add valve numbers (or descriptive nomenclature) as applicable to the individual steps for throttling the auxiliary feedwater valves (valve to isolate air, bleed air).

- Corrective action to revise steps to fire procedure to include requiring operators to obtain a climbing harness prior to throttling the auxiliary feedwater valves locally.

- Corrective action to add steps to fire procedure to trip the reactor coolant pumps locally (if unable to trip from the control room).

- Corrective action to add performance of RA drills to operator training.

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 identified Implementation Item 16 in Table S-3.

3.2.6 Conclusion for Section 3.2

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

the fuel in a safe and stable condition, as well as to meet the NFPA 805 NSPC, subject to completion of LAR Attachment S, Table S-3, Implementation Item 18.

The NRC staff confirmed, through review of the documentation provided in the LAR, that feed and bleed was not relied upon as the sole fire-protected 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 NSCA, as well as the applicable FREs. The NRC staff also considers the approach the licensee uses for assessing the potential for MSO combinations to be acceptable, because it was performed in accordance with NRC-endorsed guidance.

The NRC staff concludes that the process used by the licensee to review, categorize, and address RAs during the transition is consistent with RG 1.205 and the NRC-endorsed guidance contained in NEI 04-02. Therefore, the information provided by the licensee provides reasonable assurance that the regulatory requirements of 10 CFR 50.48(c) and NFPA 805 for NSCA methods are met, subject to completion of LAR Attachment S, Table S-3, Implementation Item 16.

3.3 Fire Modeling

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

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

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

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

3.4 Fire Risk Assessments

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

NFPA 805, Section 4.2.4.2, "Use of Fire Risk Evaluations," states that:

> Use of fire risk evaluation for the performance-based approach shall consist of an integrated assessment of the acceptability of risk, 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

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

The NRC staff reviewed LAR Section 4.2.4, "Fire Area Transition"; LAR Section 4.5.2.2, "Fire Risk Approach"; LAR Section 4.8.1, "Results of the Fire Area Review"; and LAR Attachment C, "NEI 04-02, Table B-3 – Fire Area Transition," as well as the associated supplemental information, in order to determine whether the principles of DID were maintained in regard to the planned transition to NFPA 805 at CNS.

The licensee developed a methodology for evaluating each of the three DID elements in NFPA 805, Section 1.2, referred to here as echelons 1, 2, and 3, respectively. In the response to PRA RAI 04 (Reference 9), the licensee provided a table where, for each of the three echelons, several examples of fire protection features, which addressed that echelons were identified, along with a discussion of the considerations used to assess those features. The qualitative assessment determined whether changes were needed to assure that each echelon has been satisfactorily achieved or whether reliance on features in other echelons was needed and should be developed to maintain an adequate balance between the three echelons. Many of the identified fire protection features are required 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 conducted during the NFPA 805 transition (e.g., transient free areas, detection system, suppression system, ERFBSs, use of fire rated cable, use of RAs, etc.).

As described in the LAR and in its response to PRA RAI 04 (Reference 9), the licensee implemented this method for addressing DID in the FREs performed on each PB fire area. The licensee stated that the FREs evaluated VFDRs using an integrated assessment of risk, DID, and safety margins. For CNS, the licensee evaluated the VFDRs and fire area risk and scenario consequences to identify general DID imbalances. In the LAR, the licensee identified DID features to ensure an adequate balance between the DID echelons is maintained for the fire area. DID features identified in the licensee's evaluation included RAs and various plant systems such as suppression and detection systems.

Based on review of the LAR and the FREs, the NRC staff concludes that the licensee systematically and comprehensively evaluated fire hazards, area configuration, detection and suppression features, and administrative controls in each fire area and concludes that the systematic evaluation ensures that an adequate balance between the DID echelons has been achieved, and, therefore, the proposed RI/PB FPP adequately maintains DID.

3.4.1.2 Safety Margins

NFPA 805, Section 2.4.4.3, states that:

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

NEI 04-02 (Reference 7), 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 analyses acceptance criteria in the licensing basis (e.g., Final Safety Analysis Report and supporting analyses) are met, or provide sufficient margin to account for analysis and data uncertainty.

LAR Section 4.5.2.2, "Fire Risk Approach," states that the licensee considered safety margins as part of the FRE process and that the licensee evaluated each retained VFDR against the safety margin criteria of NEI 04-02 and RG 1.205 (Reference 4). An FRE was performed for each fire area containing VFDRs. The FREs contain the details of the licensee's review of safety margins for each PB fire area. The results of the licensee's safety margin assessment by fire area are provided in the LAR Attachment C, Table B-3.

LAR Section 4.5.1.2 states that the CNS FPRA applies methodologies consistent with the guidance in NUREG/CR-6850 (Reference 45) and subsequent clarifications documented in responses to NFPA 805 FAQs. LAR Attachment H lists the NRC-approved FAQs applied in the development of the FPRA. LAR Attachment J explains that FM, including verification and validation performed in support of the FPRA, utilized accepted codes and standards, including NUREG/CR-6850, NUREG-1805 (Reference 48), NUREG-1824 (Reference 49), etc. In its response to PRA RAI 04 (Reference 9), the licensee further described the methodology used to evaluate safety margins in the FREs to include the following evaluations and determinations:

- FM: FM was performed to support the FPRA and utilized codes and standards acceptable to the NRC, and the bases for these codes and standards were not altered in support of the FRE. The results of the FM used in support of the FRE (i.e., as part of the FPRA) were documented as part of the qualitative safety margin review.

- PRA Logic Model: The PRA logic model was reviewed in accordance with the ASME/ANS RA-Sa-2009 PRA standard (Reference 40) and RG 1.200, Revision 2 (Reference 39).

- Plant System Performance: The safety margin inherent in the analyses for the plant design-basis events was preserved in the analysis for fire events. Performance parameters originally established to support nuclear performance criteria in the plant accident analyses were not modified in support of the FRE.

The safety margin criteria described in the LAR and in the licensee's response to PRA RAI 04 (Reference 9) are consistent with the criteria as described in RG 1.174 (Reference 38), and in NEI 04-02, Section 5.3.5.3, and, therefore, the NRC staff concludes that they are acceptable. The NRC staff also concludes that the licensee used appropriate codes and standards (or NRC guidance) and met the safety analyses acceptance criteria in the licensing basis. Based on its review of the LAR and the licensee's response to PRA RAI 04 and a sample of the FREs, the NRC staff concludes that the licensee's approach 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 was to determine whether the plant-specific PRA used to evaluate the proposed LAR was 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, including industry peer review results. The NRC staff reviewed LAR Section 4.5.1, "Fire PRA Development and Assessment"; LAR Section 4.7, "Program Documentation, Configuration Control, and Quality Assurance"; LAR Attachment C, "NEI 04-02, Table B-3 – Fire Area Transition"; LAR Attachment U, "Internal Events PRA Quality"; LAR Attachment V, "Fire PRA Quality"; and LAR Attachment W, "Fire PRA Insights," as well as the associated supplemental information.

The licensee developed its initial IEPRA prior to 2002 when the consensus American Society of Mechanical Engineers (ASME) PRA standard ASME RA-S-2002, "Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications" (Reference 86), was first issued. The licensee continued to maintain and improve the PRA as RG 1.200, and supporting industry standards have evolved. The licensee developed its FPRA model for both Level 1 (core damage) and partial Level 2 (large early release) PRA during at-power conditions. For the development of the FPRA, the licensee modified its IEPRA model to capture the effects of fire.

In LAR Section 4.8.2, the licensee stated that no significant plant changes (beyond those identified and scheduled to be implemented as part of the transition to an FPP based on NFPA 805) are outstanding with respect to their inclusion in the FPRA model.

3.4.2.1 Internal Events PRA Model

The licensee's evaluation of the technical adequacy of the portions of its IEPRA model used to support development of the FPRA model consisted of a full scope peer review by the Westinghouse Owner's Group (WOG) performed in March 2002 using the NEI 00-02 (Reference 87) industry PRA peer review process. Subsequent gap assessments were performed in 2008 against the RA-S-2008 ASME/ANS PRA Standard (Reference 88), which was endorsed by RG 1.200, Revision 1 (Reference 89), and in 2013 against the RA-Sa-2009 ASME/ANS PRA standard, which was endorsed by RG 1.200, Revision 2. In addition, focused-scope peer reviews were performed in December 2012 of the LERF model and in September 2012 of the internal flooding model. Both of these focused-scope peer reviews were performed against the supporting requirements in the ASME/ANS-Ra-S-2009 PRA standard and RG 1.200, Revision 2. The Revision 3 IEPRA model serves as the basis of the FPRA used in performing PRA evaluations for the LAR.

For each supporting requirement (SR) in the PRA standard, there are three degrees of "satisfaction" referred to as Capability Categories (CCs) (i.e., CC-I, CC-II, and CC-III), with CC-I being the minimum; CC-II considered widely acceptable; and CC-III indicating the maximum achievable scope/level of detail, plant specificity, and realism. For many SRs, the CCs may be combined (e.g., the requirement for meeting CC-I may be combined with CC-II) or the requirement may be the same across all CCs so that the SR is simply met or not met. For each SR, the PRA reviewer from the peer review team designates the highest CC met or indicates that the SR is not met.

LAR Attachment U, Table U-1, provides the licensee's resolutions to all Level A (important and necessary to address before the next regular PRA update) and Level B (important and necessary to address, but resolution may be deferred until the next PRA update) facts and observations (F&Os) from the 2002 WOG peer review that were not superseded by the subsequent internal flooding and LERF focused-scope peer reviews. In addition, LAR Attachment U, Table U-1, provides the results of the licensee's 2008 and 2013 self-assessments for SRs that (1) were assessed to not meet the equivalent of CC-II or CC-III in the 2002 WOG peer review, (2) were not assessed in the 2002 WOG peer review, or (3) were assessed to meet CC-II or CC-III or met but had related findings. LAR Attachment U, Table U-2, provides the licensee's resolutions to the three F&Os characterized as findings and the licensee's assessment of the 13 SRs assessed as CC-I or not met by the focused-scope peer review of the LERF model. LAR Attachment U, Table U-3, provides this same information for the findings and SRs assessed as CC-I or not met from the focused-scope peer review of the internal flooding model. In general, an F&O/self-assessment issue is written for any SR that is judged not to be met or does not fully satisfy CC-II of the ASME standard, consistent with RG 1.200, Revision 2.

As described in LAR Attachment U, the licensee resolved each F&O/self-assessment issue by either providing a description of how it resolved the F&O/self-assessment issue or by providing an assessment of the impact of resolution of the F&O/self-assessment issue on the FPRA and the results for the NFPA 805 application. The NRC staff evaluated each F&O/self-assessment issue and the licensee's resolution in LAR Attachment U to determine whether the F&O/self-assessment issue had any significant impact for the application. The NRC staff requested additional information to assess the adequacy of some of the F&O/self-assessment issue resolutions. The NRC staff's review and conclusion for the licensee's resolution of each F&O/self-assessment issue is summarized in SE Attachment D.

In PRA RAI 02.f.e (Reference 24), concerning the resolutions of F&O DA-02, the NRC staff requested that the licensee provide justification for not using updated generic failure data as recommended by the F&O. In its response to RAI 03.b.02 (Reference 16), the licensee stated that it incorporated updated generic data, including NUREG/CR-6928 (Reference 90), for independent failure rates and common cause failure rates in the FPRA. The licensee used the updated failure probabilities in the integrated analysis reported in its response to PRA RAI 05.01 (Reference 16) and revised LAR Attachment W (Reference 19). The NRC staff concludes that the licensee's response to the RAI is acceptable because the FPRA model now uses updated generic failure data, and this change was incorporated in the integrated analysis and updated risk results.

As a result of its review of the LAR, as supplemented, and responses to the PRA RAIs, the NRC staff concludes that the CNS IEPRA is technically adequate and can be used as the basis for the FPRA. To reach this conclusion, the NRC staff reviewed all F&Os provided by the peer reviewers, and self-assessment issues, and determined that the resolution of every F&O/self-assessment issue supports the determination that the quantitative results are adequate or have no significant impact on the FPRA results. Therefore, the NRC staff concludes that the licensee demonstrated that the IEPRA meets the guidance in RG 1.200, Revision 2; was reviewed against the applicable SRs in ASME/ANS-RA-Sa-2009; and is technically adequate to support the FREs and other risk calculations required for the NFPA 805 application.

3.4.2.2 Fire PRA Model

The licensee evaluated the technical adequacy of the FPRA model for this application by conducting a full-scope peer review of the model using the NEI 07-12 process (Reference 91) and the combined PRA standard, ASME/ANS RA-Sa-2009, as clarified by RG 1.200, Revision 2. The full scope peer review of the FPRA was performed in July 2010. This peer review serves as the basis for the quantitative risk evaluations for the LAR. LAR Attachment V, Table V-1, provides the licensee's dispositions to all 20 finding-level F&Os from the 2010 peer review. LAR Attachment V, Table V-2, identifies all 16 SRs that were determined by the peer review to be met only at CC-I and provides an evaluation of those SRs. Per LAR Attachment V, no changes have been made to the FPRA since the peer reviews that would constitute an upgrade as defined in ASME/ANS RA-Sa-2009.

The NRC staff reviewed the licensee's resolutions to all of the F&Os provided in the LAR to determine the technical adequacy of the FPRA for the NFPA 805 application. The NRC staff's review and conclusion for the licensee's resolution of each of the F&Os is summarized in SE Attachment D. A summary of major issues identified during the NRC staff's review of the F&Os and methods used in the FPRA is provided below, along with the associated resolution.

In PRA RAI 01.b (Reference 24), concerning the resolution of F&Os HRA-A4-01 and HRA-B3-01, the NRC staff requested that the licensee provide justification for the use of the multiplier methodology for developing human error probabilities (HEPs) or revise the human reliability analysis (HRA) to utilize HEP values developed using NRC-accepted methods such as NUREG-1921 (Reference 52). In it response to the RAI (Reference 10), the licensee revised the HRA to use the guidance in NUREG-1921. The licensee also confirmed in its response to PRA RAI 03.b.01 (Reference 16) that the multiplier method is no longer used and that it incorporated updated HEPs developed using the NUREG-1921 methodology in the FPRA model, the integrated analysis reported in its response to PRA RAI 05.01 (Reference 16), and revised LAR Attachment W (Reference 19). The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee revised the HRA to utilize NRC-accepted methods and incorporated this change in the integrated analysis and updated risk results.

In PRA RAI 05 (Reference 24), the NRC staff requested that the licensee explain how state-of-knowledge correlations (SOKCs) are taken into account in the FPRA quantification since the FPRA results reported in the LAR appear to be point estimates and not the mean estimates that are to be compared to RG 1.174 guidelines. In its response to the RAI (Reference 10), the licensee stated that it performed a parametric uncertainty analysis, including SOKCs for circuit failure likelihood, hot short duration, severity factors, and non-suppression probabilities. The licensee provided the results of this uncertainty analysis in its response to PRA RAI 05.01 (Reference 16), which showed that the mean fire CDF and Δ CDF were less than 6 percent higher than the point estimate CDF and ΔCDF. The results also showed that the mean fire LERF was less than 6 percent higher than the point estimate LERF for both units and that the mean ΔLERF values were about 19 percent and 10 percent higher than the corresponding point estimate values for Units 1 and 2, respectively. The licensee further clarified in its responses to PRA RAI 05.01 and PRA RAI 03.b.02 (Reference 16) that propagation of uncertainty, including SOKCs, will be

evaluated post-transition by comparing the mean CDF and LERF results to the point estimate CDF and LERF results as the FPRA is revised. The NRC staff concludes that the licensee's response to the RAI is acceptable, because the licensee demonstrated that SOKCs are accounted for in its integrated analysis such that the mean risk results can be compared to the RG 1.174 risk guidelines for small changes, and the impact of SOKCs will continue to be evaluated by the licensee after transition to NFPA 805.

LAR Attachment G describes three categories of Operator Manual Actions (OMAs): (1) RAs to reduce risk, (2) RAs required for DID, and (3) actions associated with VFDRs but were screened out due to there being no or very low risk and they are not considered RAs. In PRA RAI 06 (Reference 24), the NRC staff requested that the licensee justify the treatment in the FPRA model of this third category of OMAs. In its response to the RAI (Reference 10), the licensee clarified that these OMAs were not modeled in the FPRA but were evaluated for potential adverse risk impact. An example of an "adverse risk" would be a preemptive operator action that would remove potentially non-fire affected equipment from service, which would otherwise be available during a fire scenario. The licensee further stated that it determined that none of the OMAs in this category present an adverse risk. The NRC staff concludes that the licensee's treatment of this third category of OMAs is acceptable because they were screened out due to there being very low risk impact and because they were determined to not present an adverse risk. Therefore, their exclusion from the FPRA does not represent a significant non-conservative assumption.

In PRA RAI 09 (Reference 20), 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 92). In its response to the RAI (Reference 11), the licensee stated that (1) the conditional hot short probabilities applied in the FPRA model were either updated to those in NUREG/CR-7150 or the FPRA model probabilities were confirmed to bound those in NUREG/CR-7150, (2) the probabilities of spurious operation duration applied in the FPRA model were updated to those in NUREG/CR-7150, and (3) the FPRA was updated to apply the uncertainty values for circuit failure probabilities and spurious operation duration from NUREG/CR-7150. The updated values for hot short probabilities and spurious operation duration were incorporated in the integrated analysis reported in the licensee's response to PRA RAI 05.01 (Reference 16) and updated LAR Attachment W (Reference 19). The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee utilized NRC-accepted methods in the development of control circuit hot short probabilities, spurious operation duration, and associated uncertainty values, and incorporated this change in the integrated analysis and updated risk results.

In PRA RAI 11 and 11.01 (Reference 24) and (Reference 27), the NRC staff requested that the licensee explain how it modeled the two main control room (MCR) abandonment on loss-of-habitability scenarios (one for main control board (MCB) fires and one for non-MCB fires), including how the analysis of these scenarios accounted for the range of potential fire-induced failures and associated probabilities for successfully shutting down the plant using the alternate shutdown procedure. In its responses to the RAIs (Reference 10), (Reference 11), (Reference 14), and (Reference 16), the licensee explained that the transfer of control to the safe shutdown facility (SSF) according to plant procedures is the only success path available and the only success path credited in the PRA upon MCR abandonment. All other

functions are modeled as failed by the fire or unavailable because of transfer of control to the SSF (e.g., main feedwater would be disabled by the transfer). The licensee further explained that it applied the entire fire ignition frequency for all MCB and non-MCB ignition sources in Fire Area 21, or MCR, to the respective abandonment scenarios. The licensee clarified that it chose the two abandonment scenarios to maximize the CDF and LERF estimates in the post-transition PRA model by assuming the worst case fire-induced failures and spurious operations that can occur prior to transfer of control to the SSF. The worst case post-transition PRA model yields a conservative change in risk estimate because compliant case CDF and LERF values were developed by removing VFDRs from the post-transition model. The NRC staff concludes that the licensee's responses to the RAIs are acceptable because the licensee demonstrated that the modeling of the two scenarios: (1) model the as-operated scenarios and (2) beginning with the maximum risk scenarios in the post-transition plant, should maximize the risk increase associated with the retained VFDRS.

In PRA RAIs 12.01 and 12.02 (Reference 27), the NRC staff requested that the licensee clarify if MCR abandonment on loss of control is credited in the FPRA and, if so, to describe and justify this modeling. In its response to the RAIs (Reference 14) and (Reference 15), the licensee stated that a number of fire areas are designated Appendix R, III.G.3, areas and that fires in these areas, with the exception of the MCR, will not affect the habitability of the MCR. The SSF is the assured NSCA success path for these areas, and plant procedures exist and are trained upon to decide when to electronically isolate the SSF and then shut down the plant using the equipment at the SSF. VFDRs are only assessed against the assured NSCA success path (i.e., the SSF). The licensee clarified that the damage caused by fires in the Appendix R, III.G.3, areas is assessed for each ignition location, and if an alternative successful shutdown path exists such that transfer to the SSF is unnecessary, the PRA models shutting down from the MCR. The licensee further clarified that for fires that damage all success paths within the fire area (e.g., full area burnout), the PRA models the implementation of the plant procedures that electronically isolate the SSF and shut down the plant from the SSF. Therefore, the licensee stated that the FPRA does credit transfer of control to the SSF for certain loss-of-control scenarios, which are then modeled similar to non-abandonment scenarios, although the licensee added that the MCR would never be "abandoned" in these scenarios (i.e., the MCR remains habitable).

In the responses to PRA RAIs 11 and 12 (Reference 10) and (Reference 11), the licensee further explained that the human reliability analysis (HRA) for the loss-of-control scenarios is based on the loss-of-function scenario having the most limiting timing available (i.e., loss of RCP seal cooling) accounting for both cognition and recovery, including transferring to the SSF. In these same RAI responses, the licensee stated that failure to successfully transfer control to the SSF is included in the model.

1. The modeling reflects the as-built, as-operated plant and plant procedures, associated operator training, includes abandonment of the MCR due to loss of control if needed, and describes how the operators make the decision to transfer to the SSF;

2. The HRA for the loss-of-control scenarios modeled in the FPRA is based on cues for the loss-of-control scenario having the most limiting timing for cognition and recovery; and

3. Loss-of-control is specifically modeled in the PRA fault trees, including random failures, fire-induced equipment failures, and operator failures (e.g., failure to transfer control to the SSF).

In PRA RAI 14 (Reference 24), the NRC staff requested that the licensee describe the treatment of sensitive electronics and provide justification for this treatment if different than the guidance in FAQ 13-0004 (Reference 74). FAQ 13-0004 provides guidance for various sensitive electronics configurations on the application of the NUREG/CR-6850 criteria that sensitive electronics should be failed if the temperature of the electronics exceeds 65 degrees Celsius (°C) or the electronics are exposed to a heat flux greater than 3 kilowatt (kW)/m2. In its response to the RAI (Reference 11), the licensee changed the evaluation applied to one physical configuration to be consistent with the FAQ and justified a simplified evaluation applied to a second physical configuration as follows.

- Sensitive electronic components which are mounted on the outside surface of the cabinet or which are mounted inside the cabinet and penetrate the cabinet surface. The licensee explained that it updated the FPRA model to include additional fire scenarios, assuming failure of these sensitive electronics that are in the direct line of sight of the ignition source using the NUREG/CR-6850 radiant heat flux damage criteria for sensitive electronics of 3 kW/m^2.

- Sensitive electronic components which are located inside cabinets having louvers. The licensee explained that if the highest temperature in the hot gas layer (HGL) developed during a fire reaches 80 °C before the fire is extinguished, all sensitive electronics within the HGL are assumed failed. Although 80 °C is greater than the 65 °C sensitive electronic damage criteria, the 80 °C is the highest temperature of the upper gas layer (i.e., near the ceiling) and not at the location of the sensitive electronics, which are generally located in cabinets well below the upper layer, and, therefore, is below the highest HGL temperature. The licensee further explained that even if the cabinet is immersed in relatively high temperatures within the HGL, the thermal protection provided by the cabinet, even considering the louvers, provides additional time before the interior of the cabinet reaches the sensitive electronics damage temperature. The NRC staff finds that the licensee's assumption that the 80 °C HGL temperature will be reached before the sensitive electronics reaches 65 °C is acceptable because it is consistent with heat transfer characteristics and with the physical configurations described.

The licensee stated that it included the updated analysis of sensitive electronics in the integrated analysis reported in its response to PRA RAI 05.01 (Reference 16) and revised LAR Attachment W (Reference 19). The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that its evaluations are consistent with the guidance contained in FAQ 13-0004.

In PRA RAI 15 (Reference 24), the NRC staff requested that the licensee provide justification for the use of reduced heat release rates (HRRs) for transient fires and identify the fire areas where it credited the reduced HRRs. In its response to the RAI (Reference 10), the licensee stated that the only transient HRRs used to develop zones of influence were 317 kW and 142 kW, and the licensee identified 22 fire areas where the reduced HRR of 142 kW was credited in the FPRA. Regarding these 22 fire areas, the licensee stated that it reviewed the location-specific attributes of each in accordance with the guidance in the NRC letter to NEI dated June 21, 2012 (Reference 93). Based on the results of this review, the licensee revised the FPRA for Fire Areas 4, 11, 18, and 22 to use an HRR of 317 kW for modeling certain transient fires in the integrated analysis reported in its response to PRA RAI 05.01 (Reference 16) and revised LAR Attachment W (Reference 19).

For the remaining Fire Areas (5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 41, 42, 43, 44, 45, and 46), the licensee explained that either: (1) additional administrative controls are not needed based on the size and geometry of the fire area that effectively limits the amount of combustible material that can be accumulated and stored, or (2) the CNS transient combustible procedure coupled with the training provided to personnel provides for the rigorous administrative controls necessary to effectively limit the fire size. The licensee described the additional administrative controls as a "tiered approach" in which separation distances and fire load limits are imposed on combustible materials and implementation of compensatory measures when combustible materials are not maintained at defined distances from one another or from plant equipment that is susceptible to fire damage. The location-specific attributes are the limited combustible materials needed for maintenance activities associated with the type of equipment in the area or simply size and geometry constraints of the area.

The licensee also performed a review of past self-identified violations of the combustible control procedure in the above identified fire areas, concluding that the eight identified violations were either administrative (e.g., missing documentation) or occurred during an outage, and, therefore, were not significant. The licensee also concluded that violations of the combustible control procedure are expected to remain insignificant because of implementation of a transient combustible improvement action plan to increase awareness of plant operators concerning transient combustibles. The NRC staff concludes that the licensee's response to the RAI is acceptable, because the licensee demonstrated that its evaluation of additional administrative controls, location-specific attributes, and review of plant records related to self-identified violations of its combustible control procedure is consistent with the guidance in the NRC letter to NEI dated June 21, 2012, justifying a reduced HRR.

In PRA RAI 16 (Reference 24), the NRC staff requested that the licensee describe the configuration of the MCB and provide justification for its treatment in the FPRA relative to the guidance contained in FAQ 14-0008 (Reference 76). In its response to the RAI (Reference 9), the licensee explained that its MCB configuration is consistent with the guidance contained in FAQ 14-0008 for treating the rear side of the MCB as an integral part of the MCB. The licensee also explained that the MCB treatment is consistent with the guidance contained in FAQ 14-0008, namely, that partitions are treated in accordance with alternative 2 of the FAQ and that fire propagation between the front and rear faces of the MCB panels is accounted for in the PRA model. The NRC staff concludes that the licensee's

response to the RAI is acceptable because the licensee demonstrated that the treatment of MCB fires in the PRA model is in accordance with the guidance contained in FAQ 14-0008.

In PRA RAI 17.a.01 (Reference 27), the NRC staff requested that the licensee justify the treatment of electrical cabinets in which fires were assumed to not propagate outside well-sealed cabinets having circuits of 440 volt (V) or greater (high voltage cabinets). In its response to the RAI (Reference 14), the licensee indicated that it revised the FPRA to propagate fires outside of well-sealed motor control centers (MCCs) containing circuits having greater than 440V in accordance with FAQ 14-0009 (Reference 77). In PRA RAI 17.b.01 (Reference 27), the NRC staff requested that the licensee justify assuming no spurious operations within cabinets in non-severe electrical cabinet fire scenarios. In its response to the RAI (Reference 14), the licensee stated that it updated the FPRA to apply internal hot short spurious operation probabilities to the internal spurious events using the guidance in NUREG/CR-7150. The NRC staff concludes that the licensee's responses to the RAIs are acceptable because the licensee demonstrated that the treatment of electrical cabinets in the PRA model is in accordance with the guidance contained in FAQ 14-0009 and NUREG/CR-7150.

In PRA RAI 17.c.01 (Reference 27), the NRC staff requested that the licensee justify including well-sealed electrical cabinets having circuits less than 440V (low voltage cabinets) in the "Bin 15" count. The total Bin 15 fire frequency is distributed to all cabinets counted so including the low voltage cabinets will reduce the fire frequency for the high voltage cabinets. Fires in well-sealed low voltage cabinets are generally not included in fire scenarios because of the low risk contribution. In its response to the RAI (Reference 14), the licensee stated that it updated the FPRA to remove over 400 wall-mounted low voltage cabinets from the Bin 15 count; however, it retained low voltage floor-mounted cabinets in the Bin 15 count and assigned a fire frequency. The licensee further stated that fire scenarios initiated in these cabinets are included in the FPRA quantification because the risk contributions are not insignificant. The licensee stated that removing the low voltage cabinets would increase the fire frequency (and risk) in the higher voltage cabinets, but this risk increase is less than the risk decrease from removing the low voltage cabinet fire scenarios. The licensee further stated that including the low voltage cabinets is beneficial to the development of fire risk insights. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee included the low voltage floor-mounted cabinets in the Bin 15 count, which the NRC staff considers an acceptable alternative, because the subsequent fire scenarios are included in the PRA models consistent with the guidance that the as-built plant be modeled in the PRA.

The licensee included the updated analysis described in its responses to PRA RAIs 17.a.01, 17.b.01, and 17.c.01 (Reference 14) regarding modeling electrical cabinets in the FPRA in its integrated analysis included in its response to PRA RAI 05.01 (Reference 16) and revised LAR Attachment W (Reference 19). The NRC staff concludes that the licensee's responses to these RAIs are acceptable because the licensee updated the PRA model to utilize NRC guidance and because the licensee justified the impact of deviating from the guidance not to model well-sealed low voltage cabinets.

In PRA RAI 18 (Reference 24), the NRC staff requested that the licensee justify the multi-compartment analysis (MCA) wherein a severity factor of 0.2 was applied to all MCA

scenarios and the barrier failure probability did not account for multiple barrier types. In its response to the RAI (Reference 9) and (Reference 10), the licensee updated the MCA to utilize compartment-specific fire ignition frequencies in the MCA analysis, rather than applying a generic factor, and to utilize a fire barrier failure probability equal to the sum of the barrier failure probabilities for each type of barrier present. The licensee also stated that all of the compartments still screen out from consideration as potential MCA scenarios. The NRC staff concludes the licensee's response to the RAI is acceptable because the licensee updated the PRA model to utilize NRC guidance.

In PRA RAI 19 (Reference 24), the NRC staff stated that the list of generic MSOs evaluated for consideration in the FPRA was not consistent with the generic list identified in NEI 00-01, Revision 2 (Reference 37), and requested that the licensee provide an assessment of those MSOs in NEI 00-01, which it did not consider in the LAR. In its response to the RAI (Reference 11), the licensee explained that it reviewed the generic MSO list in NEI 00-01, Revision 2, and it evaluated each MSO not previously considered for applicability. The licensee stated that this evaluation identified three additional MSO scenarios that are applicable and that could impact the FPRA. In its response to PRA RAI 03.b.01 (Reference 16), the licensee explained that an expert panel was held to evaluate these additional MSO scenarios and concluded that they should be further evaluated for applicability to the plant. After further evaluation, the licensee concluded that no additional scenarios needed to be incorporated into the FPRA model. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee evaluated the generic MSO list in NEI 00-01, Revision 2, in accordance with RG 1.205, Section 3.3, and the guidance contained in FAQ 07-0038 (Reference 64), and concluded that no additional scenarios needed to be incorporated into the FPRA model.

In PRA RAI 20 (Reference 24), the NRC staff requested that the licensee justify not modeling junction boxes in the FPRA in accordance with the guidance contained in FAQ 13-0006 (Reference 75). In its response to the RAI (Reference 11), the licensee stated that it analyzed appropriate electrical enclosures as Bin 18 junction boxes in accordance with the guidance contained in FAQ 13-0006 and that it incorporated the revised Bin 18 count in the FPRA model. In its response to PRA RAI 03 (Reference 13), the licensee stated that it used the updated FPRA model in the integrated analysis reported in its response to PRA RAI 05.01 (Reference 16) and revised LAR Attachment W (Reference 19). The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee updated the PRA model to utilize NRC guidance.

In PRA RAI 21 (Reference 24), the NRC staff requested that the licensee justify apportioning the fire ignition frequency for cable fires caused by welding and cutting (CFWC) based on the number of raceways in each compartment in lieu of cable loading or quantity per NUREG/CR-6850. In its response to the RAI (Reference 9), the licensee explained that the number of raceways is a reasonable surrogate for apportioning CFWC fire frequency because fire compartments with the highest number of cable trays are also likely to have the highest quantity of cables or cable loading. The licensee further stated that fire compartments with the highest number of cable trays are also likely to have the highest number of cables (and the highest combustible loading due to cable mass). The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that apportioning CFCW frequency by number of raceways is a

reasonable alternative to cable loading because both criteria are based on physical characteristics related to the relative distribution of cables.

In PRA RAI 22 (Reference 24), the NRC staff requested justification for the treatment of high energy arcing fault (HEAF) scenarios, specifically the non-suppression probabilities applied to both the initial HEAF event and the ensuing fire. In its response to the RAI (Reference 10), the licensee updated the PRA model to not credit a non-suppression probability for the initial HEAF event and to use the Bin 16 non-suppression probability curve for the ensuing fire in accordance with NUREG/CR-6850 and FAQ 08-0050. The licensee also determined that these changes would not impact the MCA evaluation. In the response to PRA RAI 03.b.01 (Reference 16), the licensee stated that the updated FPRA model was used in the integrated analysis reported in its response to PRA RAI 05.01 (Reference 16), and in the updated LAR Attachment W (Reference 19). The NRC staff concludes that the licensee's response to the RAI is acceptable because the NSPs for the initial HEAF events and ensuing fires were updated in the FPRA to utilize NRC-accepted methods, and this change was incorporated in the integrated analysis and updated risk results.

In PRA RAI 08 (Reference14), the NRC staff requested the licensee identify and justify any FPRA methods that deviate from the guidance in NUREG/CR-6850 or other guidance acceptable to the NRC. In its response to the RAI (Reference 10), the licensee stated that the CNS FPRA does not employ any deviations from the NRC guidance. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that it did not employ any deviations from NRC guidance.

In its letter dated June 15, 2016 (Reference 20), the licensee identified a gap in the NFPA 805 safe shutdown analysis related to the RCP seals, which affected the time available to start the SSF standby make-up pump (SMUP). In PRA RAI 24 (Reference 30), the NRC staff requested that the licensee provide a summary of the PRA models in which the time available to start the SSF SMUP are used, describe the changes to the PRA input values that may occur when the time available will change, and provide the risk results of a sensitivity study based on a reasonable bounding estimate of the change in the time available. In its response PRA RAI 24 (Reference 22), the licensee stated that the new analysis is expected to indicate that the time available for the action to start the SSF SMUP on a loss of all seal cooling will be at least the same or exceed the time currently used for this action's HEP. The HEP value would only increase if the available time became shorter than the time used in the evaluation and therefore, the current HEP value (and all the risk results) should be representative or bound the as-built, as operated, HEP. The licensee included an action to perform an evaluation to determine the RCP seal response to loss of seal cooling due to spurious valve operation caused by a fire in LAR Attachment S, Table S-3, Implementation Item 20, and to include any changes as needed in the risk assessment as described in Implementation Item 13. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the HEP value is expected to be representative or bound the as-built, as operated plant, and, after the evaluation is complete, will make changes to the risk estimates if needed.

3.4.2.3 Fire Modeling in Support of the Development of the FREs

The NRC staff performed detailed reviews of the fire modeling (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 (Reference 3) were technically adequate. NFPA 805 has the following requirements that pertain to FM used in support of the development of the FREs:

NFPA 805, Section 2.4.3.3, "On Acceptability":

> 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":

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

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

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

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

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

NFPA 805, Section 2.7.3.5, "Uncertainty Analysis":

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

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

3.4.2.3.1 Overview of Fire Models Used to Support the FREs

The zone of influence (ZOI) around fixed and transient ignition sources was determined based on tables in the Generic Fire Modeling Treatments (GFMTs) approach. The tables provide the horizontal and vertical dimensions of the ZOI for various ignition sources (transient fuel packages, small liquid fuel fires, open cabinets, and cable trays) and different types of targets (i.e., thermoplastic and thermoset cables as defined in NUREG/CR-6850, Volume 2) (Reference 46), and Class A combustibles. The GFMTs approach also contains a set of tables used to

determine if and when the hot gas layer (HGL) temperature exceeds the damage threshold of specified targets, depending on fire size, room volume, and ventilation conditions. The GFMTs approach was used as a basis for the scoping or screening evaluation in support of the FPRA.

The ZOI tables in the GFMTs approach were obtained by using a collection of algebraic models and empirical correlations. The following algebraic fire models and empirical correlations/equations were used for this purpose:

- Heskestad Flame Height Correlation,
- Heskestad Plume Temperature Correlation, and
- Shokri and Beyler Solid Flame Model (Modak's Point Source Radiation Model was used as a conservative upper bound check against the Shokri and Beyler Solid Flame Radiation Model).

These algebraic models and empirical correlations 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 48). Validation and Verification (V&V) of these algebraic models is documented in NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," Volume 3 (Reference 49). The V&V of the fire models that were used to support the FPRA is discussed in SE Section 3.8.3.2.

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

- Mudan flame radiation model (Reference 94),
- Plume heat flux correlation by Wakamatsu et al. (Reference 95),
- Yokoi plume centerline temperature correlation (Reference 96) and (Reference 97),
- Hydrocarbon spill fire size correlation (Reference 98),
- Flame extension correlation (Reference 99),
- Delichatsios line source flame height model (Reference 100),
- Corner flame height correlation (Reference 99),
- Kawagoe natural vent flow equation (Reference 101),
- Yuan and Cox line fire flame height and plume temperature correlations (Reference 102),

- Lee cable fire model (Reference 103), and
- Babrauskas method to determine ventilation-limited fire size (Reference 104).

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 walkdown to identify ignition sources and surrounding targets or SSCs in compartments and to assess whether these targets and SSCs were within the ZOI of the ignition source. Based on the fire hazards present, these generalized ZOIs were used to screen, from further consideration, those plant-specific ignition sources that did not adversely affect the operation of credited SSCs, or targets, following a fire. The licensee's screening was based on the 98th percentile fire HRR from the NUREG/CR-6850 methodology.

The Consolidated Model of Fire and Smoke Transport (CFAST) zone fire model, Version 6.1.1, was used to generate the HGL tables in the GFMTs approach. The FPRA used these calculations 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. CFAST was also used for the MCR abandonment time calculations. The V&V of CFAST is documented in NUREG-1824, Volume 5.

The licensee used various algebraic models and empirical correlations described in NUREG-1805 and the GFMTs approach to determine the ZOIs for fires involving various amounts of high-density polyethylene (HDPE) piping in the service building, the turbine building, and the auxiliary building.

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

3.4.2.3.2 RAIs Pertaining to Fire Modeling in Support of the FPRA

By letters dated November 20, 2014 (Reference 24), and May 10, 2015 (Reference 26), the NRC staff requested additional information. By letters dated January 13, 2015 (Reference 9); January 28, 2015 (Reference 10); February 27, 2015 (Reference 11); March 30, 2015 (Reference 12); July 15, 2015 (Reference 14); and September 3, 2015 (Reference 16), the licensee responded to these RAIs.

- In FM RAI 01.a (Reference 24), the NRC staff requested that the licensee provide technical justification for not considering fires in the break area (kitchen), supervisor's office, storage room next to the supervisor's office, and workstation cubicle in the CFAST MCR abandonment calculations.

  In its response to FM RAI 01.a (Reference 10), the licensee stated that fires in these four areas are bounded by the two-panel workstation fire that is included in the revised MCR abandonment calculations.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the MCR abandonment calculations include a scenario that bounds

potential fires in the break area, supervisor's office, storage room, and workstation cubicle.

- In FM RAI 01.b (Reference 24), the NRC staff requested that the licensee provide the basis for the assumption in the CFAST MCR abandonment calculations that the fire brigade is expected to arrive within 15 minutes and discuss possible adverse effects of not meeting this assumption on the results of the FPRA.

  In its response to FM RAI 01.b (Reference 9), the licensee stated that the FPRA selects the most adverse fire scenario case (regardless of if/when doors are opened) from the MCR abandonment time analysis and incorporates those results into the FPRA. The licensee further stated that the average brigade response time from fire drills is 16.35 minutes, and that while the fire brigade does not conduct drills specifically for fires in the MCR, the dress-out area is located in close proximity to the MCR, the unit supervisors' offices are adjacent to the MCR, and all unit supervisors are trained as fire brigade leaders. In addition, the licensee provided the following five reasons why drill times are conservative:

  - It is industry and Catawba practice that fire brigade drills incorporate a degree of training while performing an overall evaluation of the fire brigade, firefighting equipment performance, and plant administrative controls.
  - Fire brigade drills may vary in types of response, speed of response, and use of equipment. A level of proficiency and safety is desired above simply speed of completion during drills.
  - Another factor affecting response times during drills is delays required for compliance with security, administrative controls, radiological controls, and other barriers. During actual fire events, access/egress routes and administrative procedures are expedited for the fire brigade, further decreasing response time.
  - Industry experience also indicates fire brigade response will quicken based on the human behavioral stimuli provided by an actual event.
  - Finally, the time required for drill controllers to verbally describe and the fire brigade to visualize the fire conditions adds considerable time to the drill process that would not be present during an actual event.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because historical response time data from fire drills indicate that the 15-minute assumption is conservative, given the short distance between the fire brigade dress-out area and the MCR.

- In FM RAI 01.c (Reference 24), the NRC staff requested that the licensee provide technical justification for the assumption in the MCR abandonment time calculations that fire spreads to adjacent cabinets in 15 minutes, instead of 10 minutes, as discussed in NUREG/CR-6850, Appendix S, for the case when

cables in an adjacent electrical cabinet are in direct contact with the separating wall.

In its response to FM RAI 01.c (Reference 10), the licensee explained that the MCR abandonment times for propagating panel fires were recalculated assuming fire spread to adjacent panels in 10 minutes.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee revised the assumption to be consistent with NRC-endorsed guidance.

- In FM RAI 01.d (Reference 24), the NRC staff requested that the licensee provide technical justification for the assumption that transient fires in the MCR grow at a 'medium' t^2 growth rate and for not following the guidance in FAQ 08-0052 (Reference 69).

  In its response to FM RAI 01.d (Reference 10), the licensee stated that it revised the growth time for transient fuel package fires in its updated MCR abandonment calculation to meet the guidance provided in FAQ 08-0052.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee revised the assumed transient fire growth rate and fuel properties so that they are consistent with the guidance in NRC FAQ 08-0052.

- In FM RAI 01.e (Reference 24), the NRC staff requested that the licensee confirm that the fuel soot yield and heat of combustion values that were used in the MCR abandonment analysis result in conservative estimates of the soot generation rate for electrical cabinet and transient fires, or provide technical justification for the values that were chosen.

  In its response to FM RAI 01.e (Reference 10), the licensee explained that the fuel properties for cabinet fires in the revised MCR abandonment calculations were those tabulated in the fourth edition of the SFPE Handbook for XLPE/Neoprene cable. The licensee further stated that those properties were selected because they result in the most conservative estimates for the soot generation rate.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee assumed property values that are representative of the fuels involved in the postulated MCR fire scenarios and that result in conservative abandonment time estimates.

- In FM RAI 01.f (Reference 24), the NRC staff requested that the licensee explain why, based on the sensitivity analysis, a 4 °C increase of the initial ambient temperature in some cases does not affect the MCR abandonment time, and in one case even results in an increase of the abandonment time.

In its response to FM RAI 01.f (Reference 10), the licensee explained that the ambient temperature affects smoke layer depth, temperature (and, therefore, density), and soot concentration; therefore, a higher ambient temperature can result in a longer abandonment time in scenarios in which MCR habitability is controlled by visibility.

The NRC staff concludes that the licensee's response to the RAI is acceptable because although one would expect a shorter abandonment time when habitability is controlled by the HGL temperature criterion since the limit in terms of HGL temperature rise over ambient is lower, this may not be the case when habitability is controlled by visibility.

- In FM RAI 01.g (Reference 24), the NRC staff requested that the licensee explain how the modification to the critical heat flux for a target that is immersed in a thermal plume described in in the GFMTs approach was used in the ZOI and HGL timing determination.

  In its response to FM RAI 01.g (Reference 9), the licensee explained that the modified critical heat flux was implemented using either a two- or three-point treatment in the FPRA. The licensee further stated that the two-point treatment was used in most areas of the plant and that in this approach, the ZOI tables in the GFMTs are applied without any adjustments for HGL temperatures of 80 °C or less. The licensee further stated that full room burnout is assumed when the HGL temperature is higher than 80 °C, and the three-point method was used in the remaining areas. The licensee further stated that in the three-point method, the ZOI tables for thermoplastic cable targets are used to determine the ZOI for thermoset targets when the HGL temperature is between 80 °C and 220 °C, and full room burnout is assumed when the HGL temperature exceeds 220 °C.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee's approach conservatively accounts for the effect of an elevated surrounding gas temperature on the damage of targets exposed to radiant heat.

- In FM RAI 01.i.(i) (Reference 24), the NRC staff requested that the licensee confirm that the armored cables do not have a polyvinyl chloride (PVC) jacket inside the armor and that no jacketed cables are mixed in with the armored cable, or conduct an analysis to account for the impact of the horizontal flame spread, vertical fire propagation, and the resulting additional HRR on the ZOI and HGL temperature timing determination and on the risk and Δ risk for fires that involve cables.

  In its response to FM RAI 01.i(i) (Reference 10), the licensee explained that its "Cable Use Restrictions Specification" went into effect in 1981 with the primary objective of limiting the quantity of combustible loading. The licensee further stated that the specification provides high confidence that any jacketed cable related to the FPRA is minimal. The licensee also quoted the following from a licensee-sponsored analysis of fire propagation associated with armored cables:

"Armored cables similar to the types used at Duke Energy nuclear power generating stations exhibit flame propagation characteristics consistent with cable types considered non-propagating or IEEE 383 or equivalent 'qualified'."

The NRC staff found that the licensee's response to the RAI was not acceptable because the fact that cables behave as IEEE 383 qualified does not mean that they are not susceptible to fire propagation according to the mechanisms described in NUREG/CR-6850, Appendix R. Furthermore, although the "Cable Use Restrictions Specification" might support the assumption that jacketed cable need not be considered in the FM analyses, in its response to FM RAI 02.a, the licensee indicated that more than 5 percent of the cabling in six fire areas is thermoplastic (i.e., armored or unarmored cable with a thermoplastic jacket).

In FM RAI 01.i(i).01 (Reference 26), the NRC staff requested that the licensee explain the apparent inconsistency between the responses to FM RAIs 01.i.(i) and 02.a and provide additional justification for not considering the effect of fire propagation and the resulting HRR of thermoplastic cable trays on the ZOI determination and HGL timing calculations.

In its response to FM RAI 01.i(i).01 (Reference 14), the licensee provided an evaluation for the six areas with greater than 5 percent thermoplastic insulated cables identified in the response to FM RAI 02.a to show that the presence of the additional thermoplastic insulation in these areas would not significantly impact the overall CDF and LERF as a result of the effect of fire propagation and the corresponding HRR of cable trays on the ZOI determination and HGL timing calculations.

The NRC staff concludes that the licensee's response to the followup RAI is acceptable because in one of the six fire areas, full room burnout was assumed, in another area, all targets within each sub-enclosure where the fire scenarios is postulated are assumed to be impacted, in two areas the CDF is based on the conditional core damage probability (CCDP) for full room burnout and the total ignition frequency from all fixed ignition sources is less than 2.1E-8; and the size of the remaining two fire areas (Unit 1 and Unit 2 reactor buildings) precludes the development of a damaging HGL, while conservative assumptions were made in these area regarding target damage since detailed walkdowns could not be performed.

- In FM RAI 01.i(ii) (Reference 24), the NRC staff requested that the licensee provide justification for not considering fire propagation across barriers or into cabinets, junction boxes, etc. due to ignition of pyrolysis gases migrating inside armored cable and escaping at an open cable end remote from the fire.

  In its response to FM RAI 01.i(ii) (Reference 10), the licensee indicated that it's analysis concluded that the following five conditions need to be met to make fire propagation due to migrating pyrolysis products possible:

  - A heat source is needed along the run and not at the open end.

- o The fire must be severe enough and of sufficient duration to generate enough pyrolysis gases and pressure inside the armor.
- o The fire must not be too severe so that it does not damage the armor and provide an escape path for the release of pyrolysis gases.
- o There must be a pathway inside the armor through which the pyrolysis gases can migrate.
- o The concentration and temperature of the pyrolysis products at the escape point must be high enough to sustain flaming combustion.

The licensee further explained that it is highly unlikely that all these conditions are met and concluded that fire propagation due to migrating pyrolysis gases need not be considered. The licensee further stated that fire propagation across fire compartment boundaries as a result of using armored cables is not credible as demonstrated by fire testing conducted to substantiate fire barrier penetration seal designs.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated through testing that fire propagation due to ignition of pyrolysis gases migrating inside armored cable has an insignificant impact on plant risk.

- In FM RAI 01.j (Reference 24), the NRC staff requested that the licensee explain when and how wall and corner effects in the ZOI and HGL timing calculations were accounted for.

  In its response to FM RAI 01.j (Reference 9), the licensee stated that for fuel packages within 2 feet of a wall the HRR is doubled and it is assumed that the fire is centered at the fuel package edge adjacent to the wall, and that for fuel packages within 2 feet of a corner, the HRR is quadrupled and it is assumed that the fire is cenetered at the fuel package corner nearest the wall corner. The licensee further stated that fixed ignition sources located in a corner or against a wall were identified in the battery rooms, but that these cabinets are equipped at the top with deflectors. The licensee further explained that transient wall fires were postulated in the battery rooms and Train B switchgear room, and that the HRR for these transient fires (142 kW) was multiplied by two to determine the ZOI. The licensee also stated that no location factor adjustments were made in the HGL temperature calculations.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee followed the guidance in NUREG/CR-6850 to account for wall and corner effects on the ZOI.

- In FM RAI 01.k (Reference 24), the NRC staff requested that the licensee explain how high energy arcing fault (HEAF) initiated fires were addressed in the ZOI and HGL timing analyses.

- In its response to FM RAI 01.k (Reference 9), the licensee stated that the zone of influence for a HEAF should include: the first adjoining cubicle (if adjoining cubicle is empty, damage to first nonempty adjoining cubicle is to be assumed);

targets, including cable trays, within 5' vertical distance of the top of the panel; and targets within 3' horizontal distance from the front and back of the panel, below the top of the panel and 1' horizontal distance above the top of the panel. The licensee further explained that to account for the involvement of secondary combustibles, the Bin 15 HRR was used without a growth period, and target damage was extended up to the ceiling. In addition, the licensee stated that tray covers and wraps were not credited.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee's approach is consistent with, and more conservative than, the guidance in NUREG/CR-6850.

- In FM RAI 01.l (Reference 24), the NRC staff requested that the licensee explain how non-cable intervening combustibles were identified and accounted for in the FM analyses.

  In its response to FM RAI 01.l (Reference 12), the licensee explained that the installed above-ground HDPE piping was the only non-cable intervening combustible identified with the potential to impact the FPRA. The licensee provided the following two reasons to justify ignoring the contribution from the existing HDPE piping to any pertinent fire scenarios: (1) since the piping in the auxiliary building is primarily located a few inches off the floor, it is physically not possible to place a transient ignition source under the piping, and even if the piping could be ignited by a nearby transient fire, its energy contribution would be insufficient to increase the ZOI of any already evaluated transient fires; and (2) the HDPE piping in the turbine and service buildings is not in the flame zone of any potential ignition source, which is a necessary condition to raise the incident heat flux above the ignition threshold for water-filled HDPE piping.

  The NRC staff found that the licensee's response to the RAI is not acceptable for the following reasons:

  - The licensee stated that the HDPE piping in the auxiliary building is "primarily" located on the floor. This implies that the piping may be at a higher elevation in some areas in the auxiliary building, and justification for not postulating transient fires that may involve the HDPE piping in these areas was not provided.

  - Technical justification is also needed for the statement, "[The] floor level HDPE [in the Auxiliary Building] piping would not contribute any significant amount of energy to increase the zone of influence of an already evaluated transient fire." HDPE melts at a relatively low temperature, and the molten plastic is likely to supply additional fuel to the fire and raise the HRR above that of the ignition source.

  - The response refers to an analysis, which demonstrates that the water-filled HDPE piping in the turbine and service buildings is not expected to ignite at heat fluxes up to 50 kW/m^2 to justify the assumption

that the piping can only contribute as a secondary combustible if it is located in the flame zone. However, the GFMTs and Chapter 2-14 of the SFPE Handbook (Reference 99), which are cited in the licensee's response, list significantly higher heat fluxes to surfaces heated by an impinging flame. Hence, technical justification is needed for the statement that 50 kW/m^2 is well within the flame zone of any potential ignition source. Moreover, the analysis assumes that the HDPE pipe remains intact when exposed in a fire, which is not the case since the pipe will start to melt and drip as soon as the surface reaches the melting temperature.

- Finally, the licensee stated, "The HDPE piping is not in the flame zone [of any potential ignition source]," but did not provide an explanation or justification for why this is the case in the turbine and service buildings.

In FM RAI 01.I.01 (Reference 26), the NRC staff requested that the licensee provide a summary of the results of an analysis that quantifies the contribution of the melted material to the HRR of the fire for the fire scenarios that expose the HDPE piping, determines whether any additional PRA targets would be damaged due to the increased HRR, and assesses the impact of the additional target damage, if any, on CDF, ΔCDF, LERF, and ΔLERF. In addition, the NRC staff requested that the licensee update LAR Attachment J to include the V&V basis for any model used in the analysis.

In its response to FM RAI 01.I.01 (Reference 16), the licensee explained that new HDPE ZOIs have been developed that include the mass of HDPE piping that could melt and contribute to the overall HRR of the ignition source fire scenario, that the new ZOIs were developed under the assumption that the HDPE piping is within the originating ignition source ZOI for melting the piping material, and that the latter depends on whether or not the HDPE piping is filled with water due to the heat sink of the latter. The licensee also explained that there is no assumed difference between water and air-filled piping when determining the new ignition source - HDPE ZOIs. The licensee further stated that a conservative analysis showed that a minimum of 5 minutes is required to melt the HDPE at any fixed location. The licensee further explained that the new HDPE ZOIs consider unconfined spill fires that have a 5-minute or greater burning duration and are based on target damage thresholds obtained from Table H-5 and Table H-7 in NUREG/CR-6850. Finally, the licensee stated that it updated LAR Attachment J to include the V&V basis for the FM that was used in the HDPE ZOI analysis and that the impact of the additional target damage on CDF, ΔCDF, LERF, and ΔLERF is included in the quantification supporting its updated response to PRA RAI 03.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that it revised its ZOI analysis to include the additional target damage due to the contribution from the HDPE piping.

- In FM RAI 02.a (Reference 24), the NRC staff requested that the licensee describe how the installed cabling in the power block was characterized, specifically with regard to the critical damage threshold temperatures and critical heat flux for thermoset and thermoplastic cables, as described in NUREG/CR-6850.

  In its response to FM RAI 02.a (Reference 10), the licensee explained that on average, approximately 99.5 percent of the FPRA cables are thermoset. The licensee further explained that the fraction of thermoplastic FPRA cable targets is higher in only two areas (Reactor Building 1 and Reactor Building 2), but the thermoplastic/thermoset classification does not affect the PRA results. In addition, the licensee stated that the fraction of thermoplastic PRA and non-PRA cables is less than 5 percent in all but six fire areas and showed for each of these six areas that either full room burnout is postulated or the contribution to the CDF is negligible, regardless of how the cables are characterized.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee characterized the PRA cabling in the power block as thermoset, while accounting for the presence of a non-negligible amount of thermoplastic cable in specific fire areas.

- In FM RAI 02.b (Reference 24), the NRC staff requested that the licensee confirm that cable targets characterized as thermoset are not only IEEE 383 qualified but actually can be assigned thermoset damage thresholds as defined in NUREG/CR-6850.

  In its response to FM RAI 02.b (Reference 10), the licensee stated that the characterization of the cable types was based on an analysis of the physical properties of the insulation, and that, therefore, these cables are not only IEEE 383 qualified, but also have damage thresholds consistent with thermoset materials as described in Appendix H of NUREG/CR-6850.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee confirmed that the applicable GFMT tables were used in determining the ZOI and times to damaging HGL development.

- In FM RAI 02.c (Reference 24), the NRC staff requested that the licensee describe how cable tray covers, conduits, and wraps affect the damage thresholds that were used in the FM analyses.

  In its response to FM RAI 02.c (Reference 9), the licensee stated that no credit was taken for tray covers, conduits, and wraps.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee's approach is more conservative than the guidance provided in NUREG/CR-6850.

- In FM RAI 02.d (Reference 24), 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.d (Reference 9), the licensee stated that the damage threshold for non-cable components was based on that of the cables connected to the component.

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

- In FM RAI 02.e (Reference 24), 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.e (Reference 9), the licensee stated that the damage criteria used for temperature-sensitive electronic equipment inside of electrical cabinets were the same as those for thermoset cables, which is consistent with the guidance in FAQ 13-0004 (Reference 74). The licensee further stated that the limitations in FAQ 13-0004 regarding sensitive electronics mounted on the surface of cabinets and the presence of louvers or vents are addressed in the response to PRA RAI 14.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee followed the guidance in FAQ 13-0004 for sensitive electronics in an enclosure and used the damage thresholds for exposed sensitive electronics described in NUREG/CR-6850.

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 licensee's 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 44) and Section III.2.2.4.1, summarizing the NRC staff's review of PRA quality required for an LAR, the NRC staff concludes that the licensee's revised PRA satisfies the guidance in RG 1.174, Section 2.3, and RG 1.205, Section 4.3, regarding the technical adequacy of the PRA used to support risk assessment for transition to NFPA 805.

The NRC staff concludes that the licensee's PRA approach, methods, and data are acceptable, and, therefore, that NFPA 805, Section 2.4.3.3, is satisfied for the licensee's 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 models conforms to the applicable industry PRA standards for internal events and fires, considering the acceptable disposition of the peer review and NRC staff review findings; and 3) the 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 by the licensee to the updated baseline FPRA model to incorporate acceptable methods, as detailed in the licensee's responses to PRA RAIs 03, 03.b.01, and 03.b.02, demonstrate that NFPA 805 criteria are satisfied, and the PRA is acceptable for use to support self-approval changes to the FPP.

In PRA RAIs 07 (Reference 24) and 23 (Reference 27), the NRC staff requested that the licensee address concerns with LAR Attachment S, Table S-3, Implementation Item 13. In its response to PRA RAI 23 (Reference 14), the licensee revised the implementation item to update the FPRA model to incorporate the as-built modifications and procedural implementation items (i.e., Implementation Items 12 and 16). The licensee also revised the implementation item to verify that the revised FPRA risk results do not exceed the RG 1.174 risk guidelines and to take one or more of the following actions if the guidelines are exceeded: (1) implementing additional modifications, (2) making further refinements to the FPRA, or (3) submitting a new LAR to the NRC for review and approval. The licensee included the revised implementation item in LAR Attachment S, Table S-3 (Reference 19). The NRC staff concludes that this action is acceptable because the action provides confidence that the transition change in risk estimates will meet the risk acceptance guidelines in RG 1.174, and the action would be required by the proposed license condition.

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

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 contained in RG 1.205, Section C.2.2.4, "Risk Evaluations," the licensee used an RI approach to justify acceptable alternatives to compliance with NFPA 805 deterministic criteria. The NRC staff reviewed the following information during its evaluation of the FREs: LAR Section 4.5.2, "Performance-Based Approaches"; LAR Attachment C, "NEI 04-02 Table B-3 – Fire Area Transition"; and LAR Attachment W, "Fire PRA Insights," as well as associated supplemental information.

Plant configurations that did not meet the deterministic requirements of NFPA 805, Section 4.2.3.1, were considered VFDRs. VFDRs that will be brought into deterministic compliance through plant modifications do not require risk evaluation. In LAR Attachment C, Table B-3, the licensee identified the VFDRs that it does not intend to bring into deterministic compliance under NFPA 805. For these VFDRs, the licensee performed evaluations using the RI approach, in accordance with NFPA 805, Section 4.2.4.2, to address FPP non-compliances and demonstrate that the VFDRs are acceptable.

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

For MCR abandonment areas, the licensee explained in its response to PRA RAI 12.01i (Reference 14), that the SSF is credited as the assured NSCA success path, and, therefore, it identified VFDRs based on inadequate separation of safe shutdown functions at or controlled from the SSF. As discussed in SE Section 3.5.1.5, the NRC staff considers the licensee's method for identifying VFDRs associated with the SSF acceptable.

In LAR Attachment W, Section W.2.1, the licensee described how it determined the change in risk associated with VFDRs in the FREs. For this calculation, the licensee used the FPRA to develop a logic model representing 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 and that these modifications are included in the post-transition PRA model.

The licensee explained that it created the compliant plant case by manipulating the post-transition plant PRA model to remove the VFDRs. The licensee described this as "toggling off" or excluding specific PRA basic events to remove the fire-induced failure associated with the VFDR. The licensee explained that it obtained the change in risk associated with each fire area by calculating the difference between the core damage frequency (CDF) and LERF of a compliant plant configuration and the post-transition plant configuration. The total change in risk was obtained by summing the change in risk for each fire area and comparing the total for each unit to the RG 1.174 acceptance guidelines. The non-VFDR modifications were not toggled off, and, therefore, the proposed plant risk-reduction modifications were credited in both the post-transition and compliant plant cases.

In PRA RAIs 11.01 and 12.01 (Reference 27), the NRC staff requested that the licensee clarify how it modeled MCR abandonment scenarios, due to either loss of habitability or loss of control. In its response to PRA RAIs 11.01 and 12.01 (Reference 14), (Reference 15), and (Reference 16), the licensee explained that other than removing the fire-induced failures associated with the VFDRs associated with the SSF functions for the compliant case, there is no modeling difference between the variant and compliant plant cases. The licensee further clarified that all of the fire areas where the SSF is credited as the assured NSCA success path have (1) been previously reviewed and approved by the NRC under Appendix R to credit the SSF as the safe

shutdown capability, and (2) determined by the licensee to meet all of the provisions in RG 1.205, Section 2.4b, upon completion of transfer of command and control to the SSF. The NRC staff concludes that the licensee's responses to the RAIs are acceptable, because the SSF can be the single-assured NSCA success path for fire areas designated as 10 CFR Part 50, Appendix R, Section III.G.3, areas, which is consistent with the NFPA 805, Section 4.2.3.2 description of a success path located in a separate fire area.

In LAR Attachment W, Section W.2.1, the licensee explained that not all VFDRs are quantified in the change in risk calculation because it did not model the function of concern for the VFDR in the FPRA. The licensee identified the specific VFDRs not modeled in LAR Attachment C and provided the following justification: (1) the function is not required within the mission time of the PRA and so has minimal risk contribution; (2) the PRA models other plant features that minimize the risk benefit of the particular function of concern; (3) certain safe shutdown equipment identified in the fire safe shutdown analysis was not included in the FPRA, based on the results of implementing the NUREG/CR-6850 procedure for selecting FPRA components; and 4) similarly, certain RAs were not modeled because the function being recovered is not modeled. The licensee also explained that while few instrument and control (I&C) SSCs were directly modeled in the FPRA, some I&C SSCs were modeled indirectly via the HRA performed for RAs credited to recover the associated function. Other I&C SSCs were modeled by using an "actuation" basic event modeled in the PRA as a surrogate for the I&C SSCs.

The NRC staff concludes that the licensee's methods for calculating the change in risk associated with VFDRs are acceptable because they are consistent with RG 1.205, Section 2.2.4.1, and FAQ 08-0054 (Reference 70). 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, 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," as well as the associated supplemental information, during its evaluation of the additional risk presented by the NFPA 805 RAs. SE Section 3.2.5 describes the identification and evaluation of RAs.

LAR Attachment G, Table G-1, provides the RAs that the licensee credited in the FPRA for risk reduction, as well as for DID. The licensee identified all RAs as a result of a VFDR separation issue, including pre-existing OMAs, and the licensee evaluated them all for acceptability through the FRE process. The licensee identified all operator actions performed at the primary control station (PCS) following MCR abandonment In LAR Attachment G, Table G-1, but which as explained above, are not considered RAs.

In PRA RAI 12 (Reference 24), the NRC staff requested that the licensee justify the basis for not classifying the OMAs associated with fire scenarios in Appendix R, Section III.G.3, fire areas as RAs. In its response to this RAI and PRA RAIs 11.01 and 12.01 (Reference 11), (Reference 14), (Reference 15), and (Reference 16), the licensee explained that the SSF

is the NSCA success path in these areas and only OMAs taken in response to a fire-induced failure of the NSCA success path are RAs. The licensee further stated that for fires in these areas, shutdown is from the MCR using alternative success paths instead of the NSCA success path when the alternative paths are not failed by the fire and that any OMAs needed for these scenarios are not RAs. The licensee further stated that if the SSF is activated, OMAs taken at the SSF are actions taken at a PCS and are also not RAs. The NRC staff concludes that the licensee's responses to the RAIs are acceptable, because the NRC staff has concluded that the SSF can be the NSCA success path for fire areas designated as Appendix R, Section III.G.3, areas.

In LAR Attachment W, Section W.2.2, as supplemented, the licensee explained that the additional risk of RAs is bounded by the Δ risk due to VFDRs. This treatment is demonstrated in LAR Attachment W, Tables W-6 and W-7, as supplemented. In these tables, for each fire area where RAs are credited, the additional risk of RAs is presented as the same as the change in risk for each fire area. Per the guidance contained in FAQ 08-0054 (Reference 70), the change in risk can be used to bound the additional risk of RAs, although this approach cannot be used if risk reduction from non-VFDR-related modifications is credited in the post-transition plant and not in the compliant plant PRA models. The changes in risk values presented in LAR Attachment W, Tables W-6 and W-7, do not reflect risk reduction from non-VFDR modification because non-VFDR modifications are credited in both the compliant and post-transition plant models. Therefore, the NRC staff concludes that the additional risk of RA values is bounded properly by the change in risk values presented in LAR Attachment W, Tables W-6 and W-7.

The licensee did not provide the total additional risk of RAs in the LAR. By summing the additional risk of RAs reported for all fire areas presented by the licensee in the LAR, the NRC staff calculated the total additional risk of RAS for Unit 1 to be 1.23E-06 per year for CDF and 9.03E-08 per year for LERF, and for Unit 2 to be 1.10E-06 per year for CDF and 8.32E-08 per year for LERF. The NRC staff concludes that these results are acceptable because they are less than the Region II risk guidelines depicted in Figures 4 and 5 of RG 1.174.

The licensee reviewed all of the RAs for adverse impact and resolved each action as stated in LAR Attachment G. None of the RAs listed in LAR Attachment G, Table G-1, was found to have an adverse impact on the FPRA. The licensee evaluated all RAs listed in LAR Attachment G against the feasibility criteria provided in NEI 04-02, FAQ 07-0030 (Reference 63), and RG 1.205. As a result of the feasibility evaluation, the licensee identified actions that will be performed and included them in LAR Attachment S, Table S-3, Implementation Item 16. The NRC staff concludes that these actions are acceptable because they will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition. The NRC staff concludes that the licensee's methods for determining the additional risk of RAs is consistent with RG 1.205, Section 2.2.4.1, and FAQ 07-0030, and that the estimated values are less than the acceptance guidelines. The NRC staff, therefore, concludes that the additional risk of RAs meets the requirements of NFPA 805, Sections 2.4.4.1 and 4.2.4.

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

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

3.4.6 Cumulative Risk and Combined Changes

In LAR Attachment S, Tables S-2a and S-2b, the licensee identified several plant modifications to reduce plant risk rather than bring the plant into compliance with the deterministic requirements of NFPA 805. LAR Attachment W, Section W.2.1, explained that non-VFDR plant modifications are credited in both the compliant and post-transition plant PRA models used to calculate the fire area change in risk values presented in LAR Attachment W, Tables W-6 and W-7. Therefore, the NRC staff considers the licensee's application to an RI/PB FPP to not be a combined change, as discussed in RG 1.174, Section 1.1.

The total CDF and total LERF are estimated for each unit by adding the risk assessment results for internal (including flooding), fire, and external (seismic and tornado) hazard events. SE Table 3.4.6 provides the total and hazard-specific CDF and LERF results for both Unit 1 and Unit 2 from LAR Attachment W, Table W-5. SE Table 3.4.6 includes the NRC estimated IPEEE weighted average seismic CDF of 2.6E-05 per year instead of the licensee's seismic CDF estimate of 1.1E-05/year from LAR Attachment W, Table W-5. The estimated total CDF for Unit 1 and Unit 2 in SE Table 3.4.6 are marginally greater than the RG 1.174 guidelines of 1E-04/year for Region II changes using the weighted average seismic CDF. The estimated total LERF for Unit 1 and Unit 2 is less than the RG 1.174 guidelines for Region II changes of 1E-05/year.

Table 3.4.6: CDF and LERF for CNS After Transition to NFPA 805

Hazard Group	Unit 1		Unit 2	
	CDF (/year)	**LERF (/year)**	**CDF (/year)**	**LERF (/year)**
Internal Events	1.3E-05	1.1E-06	1.3E-05	1.1E-06
Internal Flooding	2.49E-05	2.81E-07	2.49E-05	2.81E-07
Seismic	2.6E-05	Not Calculated	2.6E-05	Not Calculated
Tornado	1.6E-06	1.4E-07	1.6E-06	1.4E-07
Fire	3.57E-05	3.41E-06	3.64E-05	3.48E-06
TOTAL	1.01E-04	4.93E-06	1.02E-04	5.00E-06

In PRA RAI 02.f.f (Reference 24), the NRC staff stated that the licensee's reported seismic CDF of 1.1E-05/year is lower than the spectral frequency specific seismic hazard CDF estimates of 1.7E-05/year, 2.0E-5/year, and 3.5E-05/year estimated for both Unit 1 and 2 in an NRC memorandum dated January 27, 2010, entitled, "Results of Safety/Risk Assessment of Generic Issue 199, Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants" (Reference 105). In its response to the RAI (Reference 10), the licensee explained that the seismic CDF estimates in the LAR were from the current seismic PRA model using the 1989 EPRI hazard data and component fragility values given in a 1986 report, which were used as inputs to the CNS 1995 Individual Plant Examination for External Events (IPEEE) report. The licensee further stated that recent data shows that CNS is designed to withstand those earthquakes having low spectral frequencies (i.e., less than 5 to 6 hertz), which are the spectral frequencies that have a higher probability of damaging the plant. The NRC staff found that the licensee's response to the RAI is not acceptable and the CDF estimate provided by the licensee is not justified because: (1) the

1989 EPRI seismic hazard curves are out of date, and (2) the evaluation of seismic risk needs to include an analysis of higher spectral frequencies and should not be limited to an assessment of low spectral frequencies.

Seismic risk estimates are generally unimportant in NFPA 805 applications because seismic-fire interactions are qualitatively evaluated, and the NFPA 805 change in risk estimates are unaffected by the seismic risk. If well-defined seismic risk estimates are unavailable, the NRC staff generally uses the NRC estimated IPEEE weighted average seismic CDF (Reference 105) in NFPA 805 reviews. The 2.6E-05/year CDF reported in SE Table 3.4.6 is the IPEEE weighted average seismic CDF for CNS. Using the licensee's seismic risk estimate or the lower NRC staff's spectral frequency specific estimates places the total CDF below 1.00E-04/year; using the higher estimates places the total CDF very slightly above 1.00E-04/year. The NRC staff concludes that the total CDF of 1.00E-04/year using seismic CDF values at the top end of the large uncertainty in the seismic CDF values does not warrant reducing the acceptable risk increase from 1.00E-05/year down to the 1.00E-06/year value, and, therefore, the NRC staff applied the 1.00E-05/year risk increase as the acceptable risk increase guideline.

The licensee provided point estimates for ΔCDF and ΔLERF for each fire area at each unit and for the total ΔCDF and ΔLERF results for each unit in LAR Attachment W, Tables W-6 and W-7. These Δ risk results incorporate the changes made to the FPRA model made in the licensee's responses to PRA RAIs 03, 03.b.01, and 03.b.02, as previously discussed. 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 VFDR risk. The licensee explained in the LAR that these change in risk values represent the risk increases from retained VFDRs. From the LAR, the total estimated ΔCDF is reported as a risk increase of 6.20E-06/year for Unit 1 and 3.83E-06/year for Unit 2. The total estimated ΔLERF is reported as a risk increase of 6.65E-07/year for Unit 1 and 3.58E-07/year for Unit 2. In its response to PRA RAI 05.01 (Reference 16), the licensee reported that the greatest increase between the reported change in risk point estimates and the change in risk mean estimates that should be compared to the RG 1.174 guidelines, was an increase of less than 20 percent. All the risk increases remain below the RG 1.174 guidelines for a Region II change (i.e., 1.0E-5 per year for ΔCDF and 1.0E-6 per year for ΔLERF) when increased by 20 percent. Each of the individual fire area change in risk values for CDF and LERF also met the RG 1.174 guidelines.

The NRC staff concludes that the risk associated with the proposed alternatives to compliance with the deterministic criteria of NFPA 805 is acceptable for the purpose of this application, in accordance with NFPA 805, Section 2.4.4.1, and 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 the LAR and in its responses to RAIs.

The licensee used updated fire bin frequencies provided in NUREG/CR-6850 (Reference 47) (i.e., FAQ 08-0048) (Reference 68). The guidance contained in FAQ 08-0048 recommends that a sensitivity study be performed using the mean of the fire frequency bins contained in

NUREG/CR-6850, Section 6, for those bins with an alpha value less than or equal to one. In LAR Attachment V, Section V.2.6, the licensee stated that the use of the FAQ 08-0048 fire ignition frequencies do not alter the conclusions in the LAR that the RG 1.174 risk guidelines are met.

In PRA RAI 10 (Reference 24), the NRC staff requested the licensee to justify that only fire ignition frequency Bins 4 and 15 are applicable for the FPRA sensitivity analysis. In its response to the RAI (Reference 9), the licensee explained that (1) Bin 13, dryers, is not used in the FPRA; (2) Bin 11, cable fires caused by welding and cutting (plant-wide components), has an insignificant contribution to Δ CDF and LERF of less than 1E-09/year and 1E-10/year, respectively; and (3) the fire scenarios associated with the other bins that are to be included in the sensitivity analysis (i.e., Bins 1, 22, and 31) do not impact the Δ risk results. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that excluding the identified fire ignition frequency bins from the sensitivity analysis will have no impact or an insignificant impact on the Δ risk results.

No other key sources of uncertainty requiring a sensitivity analysis were identified by the licensee or by the NRC staff.

3.4.8 Conclusion for Section 3.4

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

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

- The licensee stated that it has completed changes to the baseline FPRA model that replaced unacceptable approaches, data, and methods identified during the LAR review with acceptable approaches, data, and methods as described. Therefore, the NRC staff concludes that the updated FPRA model may be used to support post-transition self-approval of changes because the identified acceptable methods will be used.

- The licensee's PRA maintenance process is adequate to support self-approval of future RI changes to the FPP, subject to completion of LAR Attachment S, Table S-3, Implementation Item 13.

- The transition process included a detailed review of fire protection DID and safety margins as required by NFPA 805. The NRC staff concludes that the licensee's documentation on DID and safety margins is acceptable. The licensee's process followed the NRC-endorsed guidance contained in NEI 04-02, Revision 2, and is consistent with the approved NRC guidance contained 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. The licensee satisfied the guidance contained in RG 1.205, Revision 1; RG 1.174; and NUREG-0800, Section 19.2. The changes in risk are found to be acceptable to the NRC staff because they meet the acceptance guidelines.

- The licensee determined and provided the risk associated with the use of RAs in accordance with NFPA 805, Section 4.2.4, and the guidance contained in RG 1.205, Revision 1. The licensee conservatively assigned the total VFDR risk increase to the additional risk of RAs in all fire areas that had RAs. The total risk increase from all such fire areas is less than the RG 1.174 acceptance guidelines. The NRC staff concludes that the additional risk associated with the NFPA 805 RAs is acceptable because the total risk associated with RAs meets the acceptance criteria in RG 1.205, Revision 1.

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

- The licensee's application to transition to NFPA 805 is not a combined change, as defined by RG 1.205, Revision 1, because it only includes risk increases identified in the FREs. Based on these values, the changes associated with NFPA 805 meet the guidance contained in RG 1.205, RP 3.2.5, related to meeting the requirements for cumulative risk and combined plant changes.

3.5 Nuclear Safety Capability Assessment Results

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

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

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

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

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

> When applying a deterministic approach, the user shall be permitted to demonstrate compliance with specific deterministic fire protection design

> requirements in Chapter 4 for existing configurations with an engineering equivalency evaluation. These existing engineering evaluations shall clearly demonstrate an equivalent level of fire protection compared to the deterministic requirements.

3.5.1 Nuclear Safety Capability Assessment Results by Fire Area

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

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

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

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

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

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

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

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

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

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

CNS is a dual unit pressurized water reactor (PWR) divided into individual fire areas, including the yard [consisting of the transformers (main and auxiliary), hydrogen storage building, condenser circulating water pumps, and refueling water storage tanks], and each fire area is composed of one or more fire zones. Based on the information provided by the licensee in the LAR, as supplemented, the licensee performed the NSCA on a fire area basis. LAR Attachment C provides the results of these analyses on a fire area basis and also identifies the fire zones within the fire areas.

SE Table 3.5-1 identifies those fire areas that were analyzed using either the deterministic or PB approach in accordance with NFPA 805, Chapter 4, based on the information provided in LAR Attachment C, Table C-1, "NFPA 805 Chapter 4 Compliance (NEI 04-02 Table B-3)."

Table 3.5-1: Fire Area and Compliance Strategy Summary

Fire Area	Area Description	NFPA 805 Compliance Basis
Unit 1		
1	ND & NS Pump Room	Performance-Based
3	Auxiliary Feedwater Pump Room	Performance-Based
4	Auxiliary Bldg. Gen Area & U1 NV pump Room	Performance-Based
6	Electrical Pen Room	Performance-Based
8	4160V Essential B SWGR Room	Performance-Based
10	Battery Room	Performance-Based
11	Auxiliary Bldg. Gen Area & U1 KC pump Room	Performance-Based
13	Electrical Pen Room A	Performance-Based
15	4160V Essential A SWGR Room	Performance-Based
17	Cable Room	Performance-Based
18	Aux Bldg. Gen Area & U2 KC Pump Room	Performance-Based
20	Electrical Pen Room	Performance-Based
21	Control Room	Performance-Based
22	Aux Bldg. Gen Area	Performance-Based
24	Fuel Storage Area	Performance-Based
25	Diesel Generator Bldg. – A	Performance-Based
26	Diesel Generator Bldg. – B	Performance-Based
29	Train A RN Pump Structure	Performance-Based
30	Train B RN Pump Structure	Performance-Based
32	Train A Aux Shutdown Panel	Performance-Based
34	Train B Aux Shutdown Panel	Performance-Based
35	Control Room Tagout Area	Performance-Based
37	Turbine Driven Auxiliary Feedwater Pump Control Panel Room	Performance-Based

Fire Area	Area Description	NFPA 805 Compliance Basis
38	Fuel Storage Area HVAC Room	Performance-Based
40	Turbine Driven Auxiliary Feedwater Pump Pit	Performance-Based
41	DG A Sequencer Tunnel	Performance-Based
42	DG B Sequencer Tunnel	Performance-Based
45	Cable Room Corridor	Performance-Based
49	Inner Doghouse	Performance-Based
51	Outer Doghouse	Performance-Based
ASB	Auxiliary Service Building	Deterministic
RB1	Reactor Building	Performance-Based
SRV	Service Building	Performance-Based
SSF	Standby Shutdown Facility	Deterministic
TB1	Turbine Building	Performance-Based
YRD	Yard Area	Performance-Based
Unit 2		
1	ND & NS Pump Room	Performance-Based
2	Auxiliary Feedwater Pump Room	Performance-Based
4	Aux Bldg. Gen Area & NV Pump Room	Performance-Based
5	Electrical Pen Room (B)	Performance-Based
7	4160V Essential B SWGR Room	Performance-Based
9	Battery Room	Performance-Based
11	Auxiliary Bldg. Gen Area & U1 KC Pump Room	Performance-Based
12	Electrical Pen Room (A)	Performance-Based
14	4160V Essential A SWGR Room	Performance-Based
16	Cable Room	Performance-Based
18	Auxiliary Bldg. Gen Area & U2 KC Pump Room	Performance-Based
19	Electrical Pen Room	Performance-Based
21	Control Room	Performance-Based
22	Aux Bldg. Gen Area	Performance-Based
23	Fuel Storage Area	Performance-Based
27	Diesel Generator Bldg. - A	Performance-Based
28	Diesel Generator Bldg. - B	Performance-Based
29	Train A RN Pump Structure	Performance-Based
30	Train B RN Pump Structure	Performance-Based
31	Train A Aux Shutdown Panel	Performance-Based
33	Train B Aux Shutdown Panel	Performance-Based
35	Control Room Tagout Area	Performance-Based
36	Turbine Driven Auxiliary Feedwater Pump Control Panel Room	Performance-Based
39	Turbine Driven Auxiliary Feedwater Pump Pit	Performance-Based
43	DG A Sequencer Tunnel	Performance-Based
44	DG B Sequencer Tunnel	Performance-Based
46	Cable Room Corridor	Performance-Based
47	Fuel Storage Area	Performance-Based
48	Inner Doghouse	Performance-Based
50	Outer Doghouse	Performance-Based

Fire Area	Area Description	NFPA 805 Compliance Basis
ASB	Auxiliary Service Building	Deterministic
RB2	Reactor Building	Performance-Based
SRV	Service Building	Performance-Based
SSF	Standby Shutdown Facility	Deterministic
TB2	Turbine Building	Performance-Based
YRD	Yard Area	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 SSCs required in order to meet the NSPC.
- Fire detection and suppression systems required to meet the NSPC.
- An evaluation of the effects of fire suppression activities on the ability to achieve the NSPC.
- The resolution of each VFDR using either modifications (completed or committed) or the performance of an FRE in accordance with NFPA 805, Section 4.2.4.2.

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

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

As described in LAR Section 4.8.1, the licensee performed a detailed analysis of fire protection features and identified the fire suppression and detection systems required to meet the NSPC for each fire area. LAR Attachment C, Table C-2, "NFPA 805 Required Fire Protection Systems and Features," lists the fire areas and identifies if the fire suppression and detection systems installed in these areas are required to meet criteria for separation, DID, risk, licensing actions, or EEEEs.

In SSA RAI 04 (Reference 24), the NRC staff requested the licensee to identify the fire protection systems and features in Licensing Action 07 that are credited to meet the NSPC of NFPA 805, Chapter 4, and to confirm if these systems and features meet the applicable requirements of NFPA 805, Chapter 3. In its response to SSA RAI 04 (Reference 9), the licensee stated that Licensing Action 07 pertains to two distinct and independent issues: (1) the installation of suppression and detection in the Unit 1 and Unit 2 reactor building annulus (Fire Areas RB1 and RB2) and (2) the commitment to ensure the fire brigade can respond with extra hose to the pipe tunnel area adjacent to the ND (residual heat removal) and NS (containment spray) pump area at elevation 522 ft of the auxiliary building (Fire Area 01). The licensee further stated that the suppression and detection in the licensing action discussion is pertinent to the annulus area (Fire Areas RB1 and RB2) only and that the pipe tunnel area (Fire Area 01) does not have any required suppression and/or detection systems. Based on the licensee's response to SSA RAI 04, the NRC staff concludes that the identification of fire protection systems and features described in the SSA RAI 04 is acceptable and is adequately described in LAR Attachment C, Table C-1 and Table C-2, which meets the requirements in NFPA 805, Chapters 3 and 4.

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 above, the NRC staff concludes that the CNS treatment of this issue is acceptable, because the licensee has adequately identified the fire detection and suppression systems required to meet the NFPA 805 NSPC on a fire area basis.

3.5.1.2 Evaluation of Fire Suppression Effects on Nuclear Safety Performance Criteria

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

The licensee stated that safe and stable conditions can mostly be achieved and maintained utilizing equipment and cables outside of the area of fire suppression activity, and flooding of the suppression areas and discharge of suppression water to adjacent compartments is controlled and will not jeopardize achievement of safe and stable conditions. In SSA RAI 03 (Reference 24), the NRC staff requested that the licensee provide a more detailed explanation regarding the extent of "can mostly be achieved," in the statement above. The NRC staff further requested that the licensee provide a description of the equipment and functions that may be affected by fire suppression activities, and a description of how suppression effects are controlled or mitigated, so that the NSPC is achievable. In its response to SSA RAI 03 (Reference 9), the licensee stated that the term "mostly" was incorrectly used in LAR Attachment C, Table C-1, "Fire Suppression Activities Effect on Nuclear Safety Performance Criteria" in each fire area. The licensee further stated that plant walkdowns for drainage of fire suppression water did not identify any areas where flooding or runoff could affect achieving and maintaining nuclear safety. The licensee provided a revised LAR Attachment C (Reference 11) that deleted the term "mostly" in Table C-1. The NRC staff concludes that the licensee's response to SSA RAI 03 is acceptable, because the licensee clarified that fire suppression activities will not affect achieving and maintaining nuclear safety and revised the LAR accordingly. Therefore, fire suppression activities will not adversely affect achievement of the NSPC.

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

3.5.1.3 Licensing Actions

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

The LAR states that CNS, Unit 1, was licensed to operate on January 17, 1985, and that CNS, Unit 2, was licensed to operate on May 15, 1986, which is after the date of January 1, 1979, in 10 CFR 50.48(b). Because CNS compliance with Appendix R is not required by 10 CFR 50.48, deviations from Appendix R provisions were not approved via exemptions, but were evaluated in NRC SEs. Since the previously approved deviations are either compliant with 10 CFR 50.48(c) or no longer necessary, as discussed in LAR Attachment M, upon issuance of the new 10 CFR 50.48(c) license condition, the current CNS license condition will be superseded. The licensee understands that implicit in the superseding of the current license condition, all prior FPP SERs and commitments will be superseded in their entirety.

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. The NRC staff reviewed the deviations from the pre-NFPA 805 licensing basis identified in Table 3.5-2, including the description of the previously approved deviation from the deterministic requirements, the basis for and continuing validity of the deviation, and the NRC staff's original evaluation or basis for approval of the deviation. 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.

In FPE RAI 06 (Reference 24), the NRC staff requested that the licensee identify the specific fire areas that are applicable to Licensing Action 02 (unlabeled fire doors), Licensing Action 08 (unlisted water supply valves), Licensing Action 09 (seismic design), Licensing Action 12 (HVAC penetration of fire barriers) and Licensing Action 17 (installation of standby shutdown system) in LAR Attachment K. In its response to FPE RAI 06 (Reference 10), the licensee stated that Licensing Actions 08, 09, and 17 do not apply to specific fire areas; therefore, no fire areas are identified corresponding to these licensing actions. The licensee stated that Licensing Action 02 applies to the following Fire Areas: 04, 05, 06, 07, 08, 09, 10, 11, 12, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 41, 42, 43, 44, 45, 45, 48, 49, SB, ASB, RB1, and RB2. The licensee stated that for Licensing Action 12, the licensing action for specific HVAC duct penetrations applies to Fire Areas 9, 10, 22, 45, and 46. Based on the licensee's response to FPE RAI 06, the NRC staff concludes that not specifying the fire areas for Licensing Actions 08, 09, and 17 is acceptable, because the licensing actions involve fire protection systems and features that are not fire area specific, and listing the fire areas for Licensing Actions 02 and 12 is acceptable because it clarifies the specific applicability of the licensing action as required by the guidance provided in

NEI 04-02. The fire areas applicable to the licensing actions, as described in the licensee's response to FPE RAI 06, are incorporated 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**
01. Commitment to utilize metallic sheathed MI cable as a radiant energy shield in containment per Section III.G.2 of Appendix R to 10 CFR 50.	RB1, RB2	The basis for the deviation to utilize metallic sheathed mineral insulation (MI) cable as a radiant energy shield in containment where in-core thermocouple cabling is not separated by more than 20 feet free of intervening combustible materials, as described by the licensee in LAR Attachment K, is the following: • Meets criteria of BTP CMEB Section 9.5-1, C.7.a - redundant shutdown-related systems within the annulus should be protected by separation of a noncombustible radiant energy shield (one of three compliance methods). • Mineral insulation is a radiant energy shield. Based on the previous staff approval of the engineering justification for this deviation in Supplement 3 to SER dated July 31, 1984 (Reference 34), and the statement by the licensee that the basis remains valid, the NRC staff concludes that transition of this licensing action is acceptable.
02. Unlabeled Fire Doors	In its response to FPE RAI 06 (Reference 9), as discussed above, the licensee stated that the following are applicable fire areas for this licensing action: 04, 05, 06, 07, 08, 09, 10, 11, 12, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 41, 42, 43, 44, 45,	The basis for the deviation to utilize unlabeled fire doors or unrated hollow metal doors with grills to be an equivalent level of protection as described by the licensee in LAR Attachment K, is the following: • Area is normally attended. • The fire load on both sides of the door is low. • The doors are of substantial metal construction. Based on the previous staff approval of the engineering justification for this deviation in SER dated February 28, 1983 (Reference 32), and the statement by the licensee that the basis

Licensing Action Description	Applicable Fire Areas	NRC Staff Evaluation
	45, 48, 49, SB, ASB, RB1, and RB2	remains valid, the NRC staff concludes that transition of this licensing action is acceptable.
07. Deviation from Item C.6.c of BTP CMEB 9.5-1 related to standpipe protection in the annulus and pipe tunnel.	01(U1), 01(U2), RB1, RB2	The basis for the deviation to utilize manual firefighting capability and existing hose stations as described by the licensee in LAR Attachment K, is the following: • A sprinkler system having branch lines on elevations 561 feet, 604 feet and 664 feet. • The line-type heat detectors on six levels of the annulus, located at every other level. • Additional fire hose stored in the fire brigade equipment storage area for use in firefighting a fire in the pipe tunnel. Based on the previous staff approval of the engineering justification for this deviation in Supplement 3 to SER dated July 31, 1984 (Reference 34), the additional discussion in the licensee's response to SSA RAI 04 (Reference 10) described in SE Section 3.5.1.1 above, and the statement by the licensee that the basis remains valid, the NRC staff concludes that transition of this licensing action is acceptable.
08. Deviation from Item C.6.c(1) of BTP CMEB 9.5-1 regarding unlisted water supply valves.	In its response to FPE RAI 06 (Reference 9), as discussed above, the licensee stated that this licensing action does not apply to a specific fire area.	The basis for the deviation to utilize non-UL listed or Factory Mutual (FM) approved valves in the fire water system as described by the licensee in LAR Attachment K, is the following: • These unlisted valves are constructed of stainless steel or carbon steel bodies. • All valves pertaining to this licensing action are designed to specifications outlined in ANSI/ASTM B31.1. • Valves provide an equivalent level of protection as the UL-listed valves. Based on the previous staff approval of the engineering justification for this deviation in SER dated February 28, 1983 (Reference 32), and the statement by the licensee that the basis remains valid, the NRC staff concludes that transition of this licensing action is acceptable.

Licensing Action Description	Applicable Fire Areas	NRC Staff Evaluation
09. Deviation from Item C.6.c(1) of BTP CMEB 9.5-1 related to seismic design of standpipe systems.	In its response to FPE RAI 06 (Reference 9), as discussed above, the licensee stated that this licensing action does not apply to a specific fire area.	The basis for the deviation for a lack of seismic design of the standpipe systems as described by the licensee in LAR Attachment K, is the following: • For plants with construction permits issued before July 30, 1976, the guidelines in BTP ASB 9.5-1 had no requirement for seismic design of standpipe systems. Based on the previous staff approval of the engineering justification for this deviation in SER dated February 28, 1983 (Reference 32), and the statement by the licensee that the basis remains valid, the NRC staff concludes that transition of this licensing action is acceptable.
12. Deviation from Section C.5.a of BTP CMEB 9.5-1 regarding protection of HVAC penetrations of fire barriers.	In its response to FPE RAI 06 (Reference 9), as discussed above, the licensee stated that the following are applicable fire areas for this licensing action: 9, 10, 22, 45 and 46.	The basis for the deviation for the untested fire barrier protection for fire damper sleeves as described by the licensee in LAR Attachment K, is the following: • The fireproofing and foam sealant has successfully passed the acceptance criteria of ASTM E-119. Based on the previous staff approval of the engineering justification for this deviation in Supplement 3 to SER dated July 31, 1984 (Reference 34), and the statement by the licensee that the basis remains valid, the NRC staff concludes that transition of this licensing action is acceptable.
13. Deviation Licensing Action from Section C.5.a of BTP CMEB 9.5-1 regarding unprotected structural steel over the turbine driven auxiliary feedwater pump pit.	39, 40	The basis for the deviation for the unprotected structural steel over the turbine driven auxiliary feedwater pump pit, as described by the licensee in LAR Attachment K, is the following: • Limited quantities of material consisting of armor interlock cable, grease, sealite conduit, and lubricating oil. Because of the limited quantity and distribution of these materials, an uncontrolled fire would not be expected to develop sufficient duration and temperature to threaten the heavy steel members.

Licensing Action Description	Applicable Fire Areas	NRC Staff Evaluation
		• A high pressure carbon dioxide system protects each pit providing additional assurance of barrier integrity. • Photoelectric type smoke detectors are also installed in each pit providing early warning to the Control Room through the EFA system Based on the previous staff approval of the engineering justification for this deviation in Supplement 3 to SER dated July 31, 1984 (Reference 34), and the statement by the licensee that the basis remains valid, the NRC staff concludes that transition of this licensing action is acceptable.
17. Installation of Standby Shutdown System per NRC SER Requirement.	In its response to FPE RAI 06 (Reference 9), as discussed above, the licensee stated that this licensing action does not apply to a specific fire area.	The basis for the installation of the dedicated standby shutdown system (SSS) as described by the licensee in LAR Attachment K, is the following: • The design of the SSS complies with the performance goals outlined in the guidelines of SRP Section .5.1 Position C.5.c • The design function of the SSS is to achieve and maintain safe hot standby conditions in the plant. • Direct readings of process variables are provided at the SSF. Based on the previous staff approval of the engineering justification for this deviation in SER dated February 28, 1983 (Reference 32), and Supplement 4 to the SER dated December 31, 1984 (Reference 35), and the statement by the licensee that the basis remains valid, the NRC staff concludes that transition of this licensing action is acceptable.
18. Protection of penetrations of fire area boundaries in the Reactor Building	RB1, RB2	The basis for the deviation for the reactor building penetrations, as described by the licensee in LAR Attachment K, is the following: • The adequacy of interior walls and floor/ceiling assemblies that define fire area boundaries.

Licensing Action Description	Applicable Fire Areas	NRC Staff Evaluation
		• Two personnel access portals. • Instrumentation tubing and process piping • Process piping penetrating the shell wall ranging in size from 1 inch to 34 inches in diameter. • Penetration of cables through the shell wall of the reactor building. • The design considerations and configuration of the penetration seals, such as materials of construction, thickness of the penetration, fire resistant material utilized, available fire detection, type and amount of combustible materials and fire hazards present on either side of the penetrations. Based on the previous staff approval of the engineering justification for this deviation in Supplement 3 to SER dated July 31, 1984 (Reference 34), and the statement by the licensee that the basis remains valid, the NRC staff concludes that transition of this licensing action is acceptable.

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 areas 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 deviations 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 SE Section 2.5 for further discussion.

The licensee does not have any elements of the current FPP for which NRC clarification is needed.

3.5.1.4 Existing Engineering Equivalency Evaluations (EEEEs)

The EEEEs that support compliance with NFPA 805, Chapters 3 or 4, were reviewed by the licensee using the methodology contained in NEI 04-02. The methodology for performing the EEEE review included the following determinations:

- The EEEE is not based solely on quantitative risk evaluations,
- The EEEE is an appropriate use of an engineering equivalency evaluation,
- The EEEE is of appropriate quality,
- The standard license condition is met,
- The EEEE is technically adequate,
- The EEEE reflects the plant as-built condition, and
- The basis for acceptability of the EEEE remains valid.

In LAR Section 4.2.2, the licensee stated that the guidance in RG 1.205, RP 2.3.2, and FAQ 08-0054 (Reference 70) 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 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 EEEEs and identification of the applicable EEEEs in LAR Attachment C, the NRC staff concludes that the use of EEEEs meets the requirements of NFPA 805 and the guidance of RG 1.205 and FAQ 08-0054, and is acceptable.

3.5.1.5 Variances from Deterministic Requirements

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

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

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

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

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

For all fire areas where the licensee used the PB approach to meet the NSPC, each VFDR and the associated resolution has been described in LAR Attachment C. Based on the NRC staff's review of the VFDRs, and associated resolutions as described in LAR Attachment C, as supplemented, the NRC staff concludes that the licensee's identification and resolution of the VFDRs is acceptable.

3.5.1.6 Recovery Actions

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

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

3.5.1.7 Recovery Actions Credited for Defense-in-Depth

The licensee stated in the LAR that RAs required for DID are not credited as a part of the risk determination for any fire area.

The licensee further 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 (PCE) if subsequently modified or removed.

The NRC staff reviewed LAR Section 4.2.1.3, "Establishing Recovery Actions," and Attachment G, "Recovery Actions Transition," to evaluate whether the licensee meets the associated requirements for the use of RAs per NFPA 805. The NRC staff's evaluation of the licensee's process for identifying RAs and assessing their feasibility is provided in SE Section 3.2.5, "Establishing Recovery Actions."

3.5.1.8 Plant Fire Barriers and Separations

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

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

3.5.1.9 Electrical Raceway Fire Barrier Systems

The licensee stated in LAR Attachment A, Table B-1, Section 3.11.5, that ERFBS is not used at CNS for NFPA 805 to determine the fire protection systems and features required to achieve the NSPC. 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 meets the associated criteria of NFPA 805, Section 4.2.3. This conclusion is based on:

- The licensee's documented compliance with NFPA 805, Section 4.2.3,
- The licensee's assertion that the success path will be free of fire damage without reliance on RAs,
- The licensee's assessment that the suppression systems in the fire area will have no impact on the ability to meet the NSPC, and
- The licensee's appropriate determination of the automatic fire suppression and detection systems required to meet the NSPC.

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

- Deviations from the pre-NFPA 805 fire protection licensing basis that were transitioned to the NFPA 805 licensing basis were reviewed for applicability, as well as continued validity, and found acceptable.
- VFDRs were evaluated and either found to be acceptable based on an integrated assessment of risk, DID, and safety margins, or modifications, or RAs were identified and actions planned or implemented to address the issue.
- RAs used to demonstrate the availability of a success path to achieve the NSPC were evaluated, and the additional risk of their use determined, reported, and found to be acceptable. The licensee's analysis appropriately identified the fire protection SSCs required to meet the NSPC, including fire suppression and detection systems.

- Fire area boundaries (ceilings, walls, and floors) such as fire barriers, fire barrier penetrations, and through penetration fire stops are established for the fire areas described in LAR Attachment C.

Accordingly, the NRC staff concludes that each fire area utilizing the deterministic, or 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 the following:

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

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

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

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

3.5.3.1 NPO Strategy and Plant Operating States

In LAR Section 4.3 and LAR Attachment D, the licensee stated that the process used to demonstrate that the NSPC are met during NPO modes is consistent with the guidance contained in NEI 04-02 and FAQ 07-0040. In LAR Section 4.3.1, the licensee stated that the goal is to ensure that contingency plans are established when the plant is in an NPO mode where the risk is intrinsically high, and that during low risk periods, normal risk management controls and fire prevention/protection processes and procedures will be utilized.

As described in LAR Attachment D, the licensee stated that its plant administrative procedure defines the philosophy and program for assessing and managing risk during shutdown. The licensee stated that HREs are referred to as "Higher Risk Plant Operating State (HRPOS)" and are those higher risk periods of plant operation during an outage where loss of a KSF due to fire may have higher consequences. The licensee stated that the following HRPOS definitions will be used:

- High decay heat loops not filled with upper internals installed.
- Lowered inventory conditions.
- DID sheet for decay heat removal in a Red or Orange condition.

The licensee stated that an Orange condition is when the KSF is degraded and steps are taken to minimize the amount of time in this condition. The licensee stated that the risk management plan is required prior to planned entry, and that planned entry is not allowed without Plant Operational Review Committee (PORC) approval. The licensee further stated that a Red condition is when the KSF is severely threatened and immediate restoration is required. The licensee stated that planned entry into a Red condition is not standard practice and is not normally entered voluntarily.

The licensee stated that it addresses the issues of decay heat removal capability and time to boiling with thermal margin, which is the time to core boiling upon loss of decay heat removal. The licensee further stated that when the RCS is intact, with secondary side heat removal capability available, thermal margin is not an issue, and an estimate of greater than 2 hours on the DID sheets for thermal margin is used.

3.5.3.2 NPO Analysis Process

In LAR Section 4.3.1, the licensee stated that it implemented the process outlined in NEI 04-02 and FAQ 07-0040 and further stated that the process to demonstrate that the NSPC are met during NPO modes involved the following steps:

- Reviewed the existing outage management processes.
- Identified equipment/cables:
    - Reviewed plant systems to determine success paths that support each of the DID key safety functions (KSFs), and
    - Identified cables required for the selected components and determined their routing.
- Performed fire area assessments (identify pinch points – plant locations where a single fire may damage all success paths of a KSF).
- Managed pinch points associated with fire-induced vulnerabilities during the outage.

The licensee indicated that containment control is excluded from consideration, as maintenance of this KSF does not directly support the nuclear safety goals of NFPA 805, and by managing the decay heat removal and inventory control KSF, the need to rapidly establish closure should be eliminated. The licensee further stated that administrative controls are placed on the maintenance of containment closure such that predefined actions for re-establishing closure are put in place before the penetrations are opened, and these controls apply to all containment penetrations. The containment control KSF is relevant to the NFPA 805 radioactive release performance goals, objectives, and criteria. The NRC staff's review of the CNS radioactive release analysis, including NPO POSs, is documented in SE Section 3.6.

In LAR Section 4.3.2, the licensee stated that components from the chosen systems were grouped into NPO function codes, which were then related to establish KSF success paths. The licensee stated that the list of new NPO components, or existing NSCA components with different NPO functional states (e.g., valve open versus closed), is identified as well. The licensee further stated that the selection of cables and spurious operations considerations was performed identically to the NSCA so that a comprehensive and conservative listing of cables and components was selected for the NPO analysis.

3.5.3.3 NPO Key Safety Functions and SSCs Used to Achieve Performance

LAR Attachment D defines the KSFs, the success paths to achieve the KSFs, and the components required for the success paths. The licensee stated that the plant operational states listed are based on FAQ 07-0040. The licensee stated that for purposes of the NPO review, POS-1 from FAQ 07-0040 has been identified as POS-1 (split into POS-1A and POS-1B, depending upon steam generator decay heat removal capability); POS 2; and POS 3, which corresponds to Modes 3-6 and defueled. The licensee further stated that its NPO component selection report documents each POS with respect to its risk for a loss of any one of the KSFs, which included:

- Decay heat removal
- Inventory control
- Reactivity control
- Spent fuel pool cooling
- Electrical power availability

As described in Section 3.5.3.2 above, the licensee indicated that containment control is excluded from consideration, as maintenance of this KSF does not directly support the nuclear safety goals of NFPA 805. The licensee stated that POS2 would be considered the most risk-significant, as this POS includes portions of Mode 5 (cold shutdown) and Mode 6 (refueling) prior to the time when refueling cavity water level is at or above the minimum level required for movement of irradiated fuel assemblies. This POS includes lowered inventory operations by mid-loop operations.

The licensee stated that it identified the components necessary to accomplish the KSFs using a methodology consistent with that identified for the CNS at-power analysis, including identification of components that could spuriously operate and impair the KSF path, and the components comprising each KSF path were compared to the population of components contained in the CNS at-power analysis. The licensee further stated that the majority of equipment required to maintain the NPO KSFs is the same as that required to safely shut down the plant while at power and that some safe shutdown components have a different functional requirement during NPO modes. The licensee stated that in these cases, additional cable selection and routing was performed.

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

components or trains of a system such that all of these cables can be damaged by just one fire scenario.

The licensee stated that it performed an area analysis for the components selected to meet the KSFs that directly impact fuel heatup (i.e., decay heat removal) or lead to uncovering the core (i.e., inventory control), as well as those that affect electrical power availability supporting those KSFs, and the licensee evaluated reactivity control and spent fuel pool cooling functions. The licensee stated that FM was not used to eliminate KSF pinch points. The licensee stated the results of the NPO assessments for each fire area as summarized below:

- Four areas were found to have an adequate number of KSF success paths to survive the entire contents loss of the fire area such that all KSFs are available. No recommendations for additional fire protection measures during HRPOS are made for these areas. (Category 1)

- Thirty areas involve the loss of one or more KSFs on one or both units due to the loss of all unit-specific KSF success paths for a fire in that fire area. These KSF success paths can be preserved through the fire protection/fire prevention actions recommended to be established during HRPOS. (Category 2)

- Twenty-one areas involve the loss of all KSFs in a single unit. These areas have been recommended for limitation or prohibition of hot work and transient combustible storage during HRPOS (which may necessitate rescheduling of work activities) and verification of functionality of available fire detection and suppression systems to manage fire risk at an appropriate level. These success paths can be maintained through use of fire detection/suppression and/or other fire protection/fire prevention actions. (Category 3)

- Seven fire areas common to both units involve loss of all KSFs for both units. With the exception of the control rooms, which are constantly manned, a fire watch is being recommended for those areas to preclude loss of all KSFs due to a single fire. These actions, along with verification of available detection and suppression and control of switch yard operations, provide additional DID to preclude a fire from disabling all KSFs. (Category 4)

In SSA RAI 05 (Reference 24), the NRC staff requested additional information on the description of any actions that are 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 either as a pre-fire plant configuring or as required during the fire response recovery and to describe how RA feasibility is evaluated. In its response to SSA RAI 05 (Reference 9), the licensee stated that no additional actions beyond normal operating procedures for initial system alignments are credited for NPO and that its existing operating procedures, in some cases, require de-energization of key components in the shutdown cooling flow path to preclude a loss-of-shutdown cooling event (i.e., the residual heat removal suction valves 1/2ND VA0001B, 1/2ND VA0002A, 1/2ND VA0036B, and 1/2ND VA0037A from the RCS), and these could be considered preemptive actions. The licensee further stated that this procedure requirement was not used to exclude a pinch point analysis, and those locations

where a fire-induced spurious operation could impact a KSF are identified; where complete loss of a KSF occurs, the location is identified as a pinch point for application of additional fire risk management actions during designated HRPOS. The licensee further stated that no RAs are required to support the NPO analysis assumptions or used to restore a KSF following a potential fire event during NPO conditions, and, therefore, an evaluation of feasibility was not required. The NRC staff concludes that the licensee's response to SSA RAI 05 is acceptable, because the licensee clarified that its NPO strategy does not credit either pre-positioning of components beyond those currently addressed in plant procedures or the use of RAs to support the NPO analysis or restore a KSF, and the licensee's methods are consistent with the guidance provided in RG 1.205 and FAQ 07-0040.

Based on the above, the NRC staff concludes that the licensee used methods consistent with the guidance provided in RG 1.205 and FAQ 07-0040 to identify the equipment required to achieve and maintain the fuel in a safe and stable condition during NPO modes. Furthermore, the licensee has a process in place to ensure that fire protection DID measures will be implemented to achieve the KSFs during plant outages. These actions are described in LAR Attachment D and LAR Attachment S, Table S-3, Implementation Item 12, and the NRC staff concludes that the actions are acceptable because they will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

3.5.3.4 NPO Pinch Point Resolutions and Program Implementation

The licensee identified power-operated components needed to support an NPO KSF that were not included in the post-fire safe shutdown equipment list and required additional circuit analysis. In LAR Section 4.3.2, the licensee stated that the list of new NPO components or existing NSCA components with different NPO functional states (e.g., valve open versus closed) was identified and the selection of cables and spurious operations considerations was performed identically to the NSCA so that a comprehensive and conservative listing of cables and components was selected for the NPO analysis.

The licensee stated that its directive for shutdown risk management implements the philosophy of outage risk management, and that this directive contains recommendations to minimize the fire risk to the key safety functions. The licensee stated that the actions described in LAR Attachment S, Table S-3, Implementation Item 12, will revise the shutdown risk management procedures to implement the following:

- Include HRPOS definition.
- Limit hot work in this fire area during HRPOS.
- Prohibit hot work in this fire area during HRPOS.
- Verify that the available fire detection systems located in the fire area are functional or post-firewatch in affected fire areas prior to entering HRPOS, if system(s) are impaired.
- Verify that the available fire suppression systems located in the fire area are functional or post-firewatch in affected fire areas prior to entering HRPOS, if system(s) are impaired.
- Limit transient combustible storage in this fire area during HRPOS.
- Prohibit transient combustible storage in this fire area during HRPOS.

- Provide a firewatch (continuous or periodic) in this fire area during HRPOS.
- Reschedule activities in fire areas to non-HRPOS periods.

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

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

Accordingly, based on the information provided in the LAR, as supplemented, the NRC staff concludes that the licensee has provided reasonable assurance that the NSPC are met during NPO modes and HREs at CNS because the process used was in accordance with NEI 04-02, as modified by FAQ 07-0040.

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 deviations from the existing FPP were evaluated and found to be valid and acceptable for meeting the requirements of NFPA 805, as allowed by NFPA 805, Section 2.2.7.

- Fire suppression effects were evaluated and found to have no adverse impact on the ability to achieve and maintain the NSPC for each fire area.

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

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

Accordingly, the NRC staff concludes that there is reasonable assurance that each fire area utilizing the deterministic approach does so in accordance with NFPA 805, Section 4.2.3.

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

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

- Fire suppression effects were evaluated and found to have no adverse impact on the ability to achieve and maintain the NSPC for each fire area.

- VFDRs were evaluated using the FRE PB approach (in accordance with NFPA 805, Section 4.2.4.2) to address risk impact, DID, and safety margin and found to be acceptable.

- Modifications required to resolve VFDRs were properly documented for each fire area.

- 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.

- DID RAs were properly documented for each fire area.

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

Accordingly, the NRC staff concludes that there is reasonable assurance that each fire area utilizing the PB approach does so in accordance with NFPA 805, Section 4.2.4.

The NRC staff's review of the licensee's analysis and outage management process during NPO modes concluded that the licensee provided reasonable assurance that the NSPC will be met during NPO modes and HREs, and that the licensee used methods consistent with the guidance provided in RG 1.205 and FAQ 07-0040. The NRC staff also concluded that no RAs are required during NPO modes. The NRC staff concludes that this overall approach for fire protection during NPO modes is acceptable.

3.6. Radioactive Release Performance Criteria

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

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

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

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

Either of the following objectives shall be met during all operational modes and plant configurations.

(1) Containment integrity is capable of being maintained [such that fire-fighting products are monitored and released within the plant's normal effluents program].

(2) The source term is capable of being limited [such that any unmonitored releases would not exceed the performance criteria].

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

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

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

The NRC staff reviewed the licensee's assessment provided in the LAR in order to determine if the existing FPP, with its planned modifications, would meet the radioactive release performance criteria 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 licensee's assessment of the capability of the CNS FPP to meet the goals, objectives, and performance criteria of NFPA 805 was performed for all plant operating modes (power and non-power operations), and plant areas using the methodology described in Section 4.4, "Radioactive Release Performance Criteria," of the LAR. The assessment was comprised of a review of existing fire strategies, fire brigade training materials, and engineering controls.

The licensee's radioactive release review documented in the LAR found that the FPP, as defined in the fire strategies and fire brigade training materials, will be compliant with the requirements of NFPA 805 and the guidance in NEI 04-02 and RG 1.205 upon completion of implementation items identified in the LAR, Attachment S, "Modifications and Implementation Items." The licensee addressed the potential for radioactive releases due to firefighting activities by evaluating fire strategies and training materials.

The licensee performed a review of compartments (fire areas) in a screening process to determine where there was a potential for a radioactive release. Areas outside of the RCA were viewed as having no risk and were screened out from further review. Compartments were identified based on whether or not common smoke and runoff control systems were present. Information for the compartments that were screened in is provided in the LAR, Attachment E, "Radioactive Release Transition." The fire strategies were evaluated for the screened in compartments to ensure that the locations that have potential for radioactive releases are

subject to specific steps for the containment and monitoring of potentially contaminated smoke and fire suppression water.

The screened in areas included plant areas in the RCA such as the Unit 1 and Unit 2 containments, auxiliary building, fuel pool, and fuel handling buildings. For these plant areas, the licensee's review identified that the engineering controls were sufficient to contain and monitor gaseous and liquid effluent. Engineering controls credited for containment of gaseous (e.g., filtered exhaust systems) and liquid (e.g., floor drains that transfer to the floor drain tank for processing) effluents are documented in LAR, Attachment E. No credit was taken for operator action to assure radiological releases were limited. The NRC staff determined that the existing engineering controls for these areas were adequate, because the gaseous effluent is filtered and monitored prior to discharge, and the liquid effluent is collected, processed, and monitored prior to discharge.

The licensee's review also identified other screened in compartments such as the monitoring tank building, retired steam generator storage facility, service building, and turbine building where there are not sufficient engineering controls for containment of gaseous and liquid effluents. The licensee's review also identified, in Attachment E, the yard and miscellaneous areas that are not contained within a building that is specifically designed to contain radioactive material or is otherwise vented and unmonitored. For these areas, administrative controls (e.g., storing materials in metal containers with tight-fitting covers) will be implemented, and existing procedures or guidelines will be enhanced to include more detail on the control measures (e.g., smoke scrubbing and covering drains) used to maintain radioactive release limits. The licensee also performed a quantitative evaluation (i.e., dose calculation) to determine an administrative storage limit. The administrative guidance will be developed in collaboration with radiation protection to ensure that radioactive releases do not exceed the limits.

In its letter to the NRC dated April 28, 2015, (Reference 13), the licensee responded to Radiation Release RAI 08 and described the quantitative evaluation in order to demonstrate that the 10 CFR Part 20 limits will not be exceeded for areas where containment and engineering controls could not be relied upon. The licensee's quantitative evaluation considered a fire involving dry active waste (DAW) stored in an area with no engineered features to control or prevent airborne or liquid effluents to the unrestricted area boundary. The source term was based on the total activity of DAW shipments made in the years 2010 through 2013.
The NRC staff reviewed the licensee's methodology, critical assumptions, input parameters, and resulting dose for the quantitative evaluation. The evaluation was based on conservative assumptions and the methodology contained in Catawba's Offsite Dose Calculation Manual. Based on the evaluation, an administrative limit was established on the activity, which can be stored in a single 'fire fuel bundle.' According to the licensee, "A fire fuel bundle is the amount of material, which can be expected to be involved in a fire either because it is the source of the fire or because it is sufficiently close to the source that the fire will propagate to it." Based on the review of the licensee's quantitative evaluation, the NRC staff concludes that the licensee has adequately quantified and limited the maximum amount of radioactive material that can be safely stored in the event of a fire such that any radioactive material released would not exceed the public dose limits of 10 CFR Part 20.

The licensee reviewed the fire brigade training materials to ensure they were consistent with the fire strategies in terms of containment and monitoring of potentially contaminated smoke and

fire suppression water. Those training materials that need revising were identified and documented. The training material revisions will include more detail on control measures and will instruct radiation protection personnel to respond to fires (where there are radiological concerns). The licensee's planned procedure changes, process updates, and training for affected plant personnel are described in the LAR, Attachment S, Table S-3, Implementation Item 1. The NRC staff considers this action acceptable because it will incorporate the provisions of NFPA 805 in the FPP and it would be required by the proposed license condition.

Based on (1) the information provided in the LAR, as supplemented; (2) the licensee's use of fire strategies; (3) the results of the NRC staff's evaluation of the identified engineered controls used to manage suppression water and combustion products; and (4) the development and implementation of newly revised fire brigade training and procedures, 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 is reasonably achievable and are not expected to exceed the radiological dose limits in 10 CFR Part 20. In conclusion, the NRC staff finds that the licensee's RI/PB FPP complies with the requirements specified in NFPA 805, Sections 1.3.2, 1.4.2, and 1.5.2, and that this approach is acceptable.

3.7 NFPA 805 Monitoring Program

3.7.1 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 (Reference 8):

NFPA 805, Section 2.6, "Monitoring":

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

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

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

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

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

NFPA 805, Section 2.6.3, "Corrective Action":

> If the established levels of availability, reliability, or performance are not met, appropriate corrective actions to return to the established levels shall be

implemented. Monitoring shall be continued to ensure that the corrective actions are effective.

The NRC staff reviewed LAR Section 4.6, "Monitoring Program," which the licensee developed to monitor availability, reliability, and performance of FPP systems and features after the transition to NFPA 805. The focus of the NRC staff's 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 finds acceptable (see SE Section 2.7).

The licensee stated that it will develop an NFPA 805 monitoring program consistent with FAQ 10-0059 (Reference 72) and that 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.

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

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

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

However, since the final values for availability and reliability, as well as the performance criteria for the SSCs being monitored, have not been established for the NFPA 805 monitoring program as of the date of this SE, completion of the monitoring program is an action described in LAR Attachment S, Table S-3, Implementation Item 5. 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.

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

3.7.2 Conclusion for Section 3.7

The NRC staff reviewed the licensee's RI/PB FPP and RAI responses and concludes that there is reasonable assurance that the licensee's monitoring program will meet the requirements specified in NFPA 805, Sections 2.6.1, 2.6.2 and 2.6.3.

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 in regard to the appropriate content, configuration control, and quality of the documentation used to support the CNS FPP transition to NFPA 805.

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

> 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 authority having jurisdiction (AHJ).

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

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

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

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

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

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

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

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

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

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

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

> 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:

> 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:

> 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.

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

> 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 (Reference 8) Section 4.7.1, "Compliance with Documentation Requirements in Section 2.7.1 of NFPA 805," to evaluate the CNS FPP design-basis document and supporting documentation.

The CNS FPP design basis is a compilation of multiple documents (i.e., fire safety analyses, calculations, engineering evaluations, NSCAs, etc.), databases, and drawings, which are identified in LAR Figure 4-9, "NFPA 805 Transition – Planned Post-Transition Documents and Relationships." The licensee stated that the analyses conducted to support the NFPA 805 transition were performed in accordance with CNS processes, which meet or exceed the requirements for documentation outlined in NFPA 805, Section 2.7.1.

Specifically, the licensee stated that its design analysis and calculation procedure provides the methods and requirements to ensure that design inputs and assumptions are clearly defined, results are easily understood by being clearly and consistently described, and that sufficient detail is provided to allow future review of the entire analysis.

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

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

3.8.2 Configuration Control

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

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

The LAR stated that the configuration control process includes provisions for appropriate design, engineering reviews, and approvals, and that approved analyses are considered controlled documents available through the CNS document control system.

Configuration control of the existing FPP during the transition period is maintained by the CNS change evaluation process, as defined in existing CNS configuration management and configuration control procedures. CNS will revise these procedures as necessary for application to the NFPA 805 FPP. This action is included in LAR Attachment S, Table S-3, Implementation Item 10, and the staff considers this action acceptable because it will incorporate the provisions of NFPA 805 in the FPP and it would be required by the proposed license condition.

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

Based on the description of the CNS configuration control process, which indicates that the new FPP design basis and supporting documentation will be controlled documents and that plant changes will be reviewed for impact on the FPP, the NRC staff concludes that the licensee's approach for meeting the requirements of NFPA 805, Sections 2.7.2.1 and 2.7.2.2, regarding configuration control is acceptable.

3.8.3 Quality

The NRC staff reviewed LAR Section 4.7.3, "Compliance with Quality Requirements," in Section 2.7.3 of NFPA 805, to evaluate the quality of the engineering analyses used to support transition of the CNS FPP to NFPA 805 based on the requirements outlined above. The individual SE sections provide the NRC staff's evaluation of the application of the NFPA 805 quality requirements to the licensee's FPP, as appropriate.

3.8.3.1 Review

NFPA 805, Section 2.7.3.1, requires that each analysis, calculation, or evaluation performed be independently reviewed. The licensee stated that its procedures require independent review of analyses, calculations, and evaluations, including those performed in support of compliance with 10 CFR 50.48(c). The LAR also stated that the transition to NFPA 805 was reviewed independently, and that analyses, calculations, and evaluations to be performed post-transition will be reviewed independently, as required by the existing CNS procedures. independently

Based on the licensee's description of the process for performing independent reviews of analyses, calculations, and evaluations, the NRC staff concludes that the licensee's approach for meeting the quality requirements of NFPA 805, Section 2.7.3.1, is acceptable.

3.8.3.2 Verification and Validation

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

3.8.3.2.1 General

NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," Volumes 1-7 (Reference 49), documents the V&V of five selected fire models commonly used to support applications of RI/PB fire protection at nuclear power plants. The seven volumes of this NUREG-series report provide technical documentation concerning the predictive capabilities of a specific set of fire dynamics calculation tools and fire phenomenological models that may be used for the analysis of fire hazards in postulated nuclear power plant scenarios. When used within the limitations of the fire models and considering the identified uncertainties, these models may be employed to demonstrate compliance with the requirements of 10 CFR 50.48(c).

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

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

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

The NRC staff concludes that the theoretical bases of the models and empirical correlations used in the FM calculations that were not addressed in NUREG-1824 were identified and described in authoritative publications, peer-reviewed journal articles, peer-reviewed conference papers, or national research laboratory reports (Reference 106), (Reference 94), (Reference 95), (Reference 96), (Reference 97), (Reference 98), (Reference 99), (Reference 100), (Reference 101), (Reference 102), (Reference 103), (Reference 104), (Reference 107), (Reference 108), (Reference 109), (Reference 110), (Reference 111), (Reference 112), (Reference 113), and (Reference 114). SE Tables 3.8-1 and 3.8-2 summarize the additional fire models and the NRC staff's evaluation of the acceptability of each.

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

Based on the above, the NRC staff concludes that the licensee's approach for the FM used in the development of the fire scenarios for the FPRA is acceptable for use in this application (i.e., transition to NFPA 805).

3.8.3.2.2 Post-Transition

The licensee stated that it will revise the appropriate processes and procedures to include NFPA 805 quality requirements for use during the performance of post-transition FPP changes, including those for V&V. Revision of the applicable post-transition processes and procedures to include NFPA 805 requirements for V&V are identified in LAR Attachment S, Table S-3, Implementation Items 9 and 10, and the NRC staff considers these acceptable because they will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

3.8.3.2.3 Conclusion for Section 3.8.3.2

Based on the licensee's description of the CNS process for V&V of calculational models and numerical methods and its commitment for continued use post-transition, the NRC staff concludes that the licensee's approach to meeting the requirements of NFPA 805, Section 2.7.3.2, is acceptable.

3.8.3.3 Limitations of Use

NFPA 805, Section 2.7.3.3, requires that acceptable engineering methods and numerical models only be used for applications to the extent that these methods have been subject to V&V, and that they are applied within the scope, limitations, and assumptions prescribed for that method. LAR Section 4.7.3, 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 each empirical correlation or other fire model in terms of the limits of its use. Table 3.8-1 in SE Attachment A, and Table 3.8-2 in SE Attachment B, summarize the fire models used, how each was applied in the FREs, the V&V basis for each, and the NRC staff's evaluation for each.

3.8.3.3.2 Discussion of RAI Responses

By letters dated November 20, 2014 (Reference 24), and May 10, 2015 (Reference 26), the NRC staff requested additional information. By letters dated January 13, 2015 (Reference 9); January 28, 2015 (Reference 10); February 27, 2015 (Reference 11); March 30, 2015 (Reference 12); July 15, 2015 (Reference 14); and September 3, 2015 (Reference 16), the licensee responded to these RAIs.

- In FM RAI 04 (Reference 24), the NRC staff requested that the licensee identify any uses of the GFMTs and their supplements outside the limits of applicability, and to explain for those cases how the use of the GFMTs approach was justified.

In its response to FM RAI 04 (Reference 10), the licensee identified the following conditions and configurations for which the GFMT ZOI and HGL data may potentially be non-conservative if applied outside the limitations of the method:

- ZOIs in Elevated Temperature Enclosures.
- ZOIs in Wall and Corner Locations.
- ZOIs for Large Dimension Electrical Panels.
- Flame Height Limitation for ZOIs.
- ZOIs and Hot Gas Layer Temperatures for Scenarios with Secondary Combustibles.
- Application of GFMT CFAST Results in Spaces that Exceed the CFAST Limits.

For each of these configurations and conditions, the licensee further determined if and where at CNS the GFMTs were used outside their limitations, and provided a detailed justification for these applications.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the GFMTs approach and CFAST zone model were either used within their limits of applicability or that uses outside of the limitations were appropriately justified.

3.8.3.3.3 Post-Transition

The licensee also stated that it will revise the appropriate processes and procedures to include the NFPA 805 quality requirements for use during the performance of post-transition FPP changes, including those for limitations of use. Revision of the applicable post-transition processes and procedures to include NFPA 805 requirements for limitations of use are identified in LAR Attachment S, Table S-3, Implementation Items 9 and 10, and the NRC staff considers these acceptable because they 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 FREs were used within their limitations, and the description of the CNS process for placing limitations on the use of engineering methods and numerical models, the NRC staff concludes that the licensee's approach to meeting the requirements of NFPA 805, Section 2.7.3.3, is acceptable.

3.8.3.4 Qualification of Users

NFPA 805, 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 nuclear power plant, nuclear power plant fire protection, and power plant operations. LAR Section 4.7.3, "Compliance with Quality Requirements in Section 2.7.3 of NFPA 805 Fire Protection Quality," states:

> Post-transition, for personnel performing fire modeling or Fire PRA development and evaluation, Duke Energy will develop and maintain qualification requirements for individuals assigned various tasks. Individuals will be qualified to appropriate job performance requirements per ACAD 98-004. Engineering training guidelines will be developed to identify and document required training and mentoring to ensure individuals are appropriately qualified per the requirements of NFPA 805 Section 2.7.3.4 to perform assigned work.

3.8.3.4.1 General

LAR Section 4.7.3 states that cognizant personnel who use and apply engineering analysis and numerical methods in support of compliance with 10 CFR 50.48(c) are competent and experienced as required by Section 2.7.3.4 of NFPA 805.

LAR Section 4.7.3 further states that during the transition to 10 CFR 50.48(c), work was performed in accordance with the quality requirements of Section 2.7.3 of NFPA 805 and that personnel who used and applied engineering analysis and numerical methods (e.g., FM) in support of compliance with 10 CFR 50.48(c) are competent and experienced as required by NFPA 805, Section 2.7.3.4.

The licensee's procedures require that cognizant personnel who use and apply engineering analyses and numerical models be competent in the field of application and experienced in the application of the methods, including those personnel performing analyses in support of compliance with 10 CFR 50.48(c).

Specifically, these requirements are being addressed through the implementation of an engineering qualification process at CNS. The licensee included an action to develop engineering training guidelines 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 in LAR Attachment S, Table S-3, Implementation Item 11, and the NRC staff concludes that this action is acceptable because it will incorporate the provisions of N
FPA 805 in the FPP and would be required by the proposed license condition.

3.8.3.4.2 Discussion of RAI Responses

By letters dated November 20, 2014 (Reference 24), and May 10, 2015 (Reference 26), the NRC staff requested additional information. By letters dated January 13, 2015 (Reference 9); January 28, 2015 (Reference 10); February 27, 2015 (Reference 11); March 30, 2015 (Reference 12); July 15, 2015 (Reference 14); and September 3, 2015 (Reference 16), the licensee responded to these RAIs.

- In FM RAI 05.a (Reference 24), the NRC staff requested that the licensee describe the requirements to qualify personnel for performing FM calculations in the NFPA 805 transition.

  In its response to FM RAI 05.a (Reference 9), the licensee explained that qualifications for fire protection engineers and contractors to perform and review

FM analyses required successful completion of a targeted training program, meeting specific education requirements, and demonstrating comprehension and proficiency in FM. The licensee further explained that in the case of contractors, the contractor's quality assurance process ensured that the personnel performing the FM were properly qualified and trained.

The NRC staff concludes that the licensee's response to FM RAI 05.a is acceptable because the licensee demonstrated that the personnel performing FM are properly qualified and trained.

- In FM RAI 05.b (Reference 24), the NRC staff requested that the licensee describe the process for ensuring that the FM personnel have the necessary qualifications and will continue to meet the qualification requirements post-transition.

  In its response to FM RAI 05.b (Reference 9), the licensee provided details of the qualification process and requirements and stated that FM calculations are required to be performed by a fire protection engineer who meets the qualification requirements of Section 2.7.3.4 of NFPA 805. The licensee further explained that the qualification requirements will continue to be met through Duke Energy procedures and project management of contractor support staff.

  The NRC staff concludes that the licensee's response to FM RAI 05.b is acceptable because the licensee demonstrated an acceptable process for ensuring that the FM personnel have the necessary qualifications and will continue to meet the qualification requirements in the future.

- In FM RAI 05.c (Reference 24), the NRC staff requested that the licensee describe who performed the walkdowns of the MCR and other fire areas in the plant and explain whether the personnel who performed the FM participated in these walkdowns.

  In its response to FM RAI 05.c (Reference 9), the licensee stated that qualified contractor personnel performed the walkdowns and FM analysis for the MCR, that other qualified contracting personnel performed the initial walkdowns for the other areas and then applied the GFMTs, and qualified licensee staff conducted subsequent walkdowns.

  The NRC staff concludes that the licensee's response to FM RAI 05.c is acceptable because the licensee demonstrated that walkdowns of the plant for FM were conducted by appropriate qualified contractor and Duke personnel.

- In FM RAI 05.d (Reference 24), the NRC staff requested that the licensee describe the communication process between the CNS FM analysts, PRA personnel, consulting engineers, and CNS personnel to exchange the necessary information and ensure the FM was performed adequately and will continue to be performed adequately post-transition.

In its response to FM RAI 05.d (Reference 9), the licensee stated that throughout the NFPA 805 transition process, the fire protection engineers who conducted the FM and the PRA engineers maintained frequent communications and worked closely together. The licensee further explained that the same process will be used during implementation and post-transition. The licensee further explained that there has been, and will continue to be, knowledge transfer between the consulting engineers and the station and fleet personnel through the development of fire risk insights, the RAI process, updates to the analysis based on plant modifications, and use of the FPRA analysis to support regulatory activities. The licensee further indicated that portions of the GFMTs and the MCR abandonment calculation methodology are used at its other facilities.

The NRC staff concludes that the licensee's responses to the RAIs are acceptable because the licensee demonstrated that appropriately competent and experienced personnel developed the FREs, including the supporting FM calculations and the additional documentation for models and empirical correlations not identified in previous NRC-approved V&V documents.

3.8.3.4.3 Post-Transition

The post-transition qualification training program will be implemented to include NFPA 805 requirements for qualification of users and is included in LAR Attachment S, Table S-3, as Implementation Item 11. 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.

3.8.3.4.4 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 (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 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 40), includes requirements to address uncertainty. Accordingly, the licensee addressed uncertainty as a part of the development of its FPRA. The NRC staff's evaluation of the licensee's treatment of these uncertainties is discussed in SE Section 3.4.7.

NUREG-1855, Volume 1, "Guidance on the Treatment of Uncertainties Associated with PRAs in RI Decisionmaking" (Reference 51), discusses three types of uncertainty associated with FM calculations as follows:

(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 Application Guide (NPP FIRE MAG)" (Reference 53); and

(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 RAI Responses

By letters dated November 20, 2014 (Reference 24), and May 10, 2015 (Reference 26), the NRC staff requested additional information. By letters dated January 13, 2015 (Reference 9); January 28, 2015 (Reference 10); February 27, 2015 (Reference 11); March 30, 2015 (Reference 12); July 15, 2015 (Reference 14); and September 3, 2015 (Reference 16), the licensee responded to these RAIs.

- In FM RAI 06.a (Reference 24), the NRC staff requested that the licensee explain how the uncertainty associated with the fire model input parameters was accounted for in the FM analyses.

  In its response to FM RAI 06.a (Reference 10), the licensee explained that parameter uncertainty was addressed through the use of conservative and bounding analyses and by performing sensitivity studies. The licensee further provided a detailed discussion for the three primary FM activities for which parameter uncertainty is applicable:

  a. MCR abandonment analysis.
  b. HGL tabulations.
  c. ZOI tabulations.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee adequately accounted for parametric uncertainty in the FM analysis performed in support of the NFPA 805 transition.

- In FM RAI 06.b (Reference 24), the NRC staff requested that the licensee determine how the "model" and "completeness" uncertainty were accounted for in the FM analyses.

  In its response to FM RAI 06.b (Reference 10), the licensee explained that "model" and "completeness" uncertainty were also addressed through conservative and bounding analyses and provided a detailed discussion to explain how this was accomplished for the same three modeling activities discussed in its response to FM RAI 06.a.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee adequately accounted for model and completeness uncertainty in the FM analysis performed in support of the NFPA 805 transition.

3.8.3.5.3 Post-Transition

The licensee stated that it will revise the appropriate processes and procedures to include the NFPA 805 quality requirements for use during the performance of post-transition FPP changes, including those regarding uncertainty analysis. Revision of the applicable post-transition processes and procedures to include NFPA 805 requirements regarding uncertainty analysis is included in LAR Attachment S, Table S-3, Implementation Item 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 CNS process for performing an uncertainty analysis, the NRC staff concludes that the licensee's approach for meeting the requirements of NFPA 805, Section 2.7.3.5, is acceptable.

3.8.3.6 Conclusion for Section 3.8.3

Based on the above, the NRC staff concludes that the CNS RI/PB fire protection quality assurance program is acceptable because the program adequately addresses each of the requirements of NFPA 805, Section 2.7.3, which include conducting independent reviews, performing V&V, limiting the application of acceptable methods and models to within prescribed boundaries, ensuring that personnel applying acceptable methods and models are qualified, and performing uncertainty analyses.

3.8.4 Fire Protection Quality Assurance Program

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

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

The 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 (QA) program will be transitioned to the new NFPA 805 RI/PB FPP.

The licensee stated that it will maintain the existing fire protection QA program and that during the transition to 10 CFR 50.48(c), it performed work in accordance with the quality requirements of NFPA 805, Section 2.7.3. The LAR described how the fire protection QA program meets the applicable requirements of NFPA 805, Sections 2.7.3.1 through 2.7.3.5, but indicated that the QA program would be updated to match post-NFPA 805 criteria. In LAR Attachment S, Table S-3, Implementation Item 15, the licensee included an action to revise its QA topical report, as appropriate, to update the definition of QA 3 to match post-NFPA 805 criteria. In addition, the licensee included an action in LAR Attachment S, Table S-3, Implementation Item 11, to develop engineering training guidelines 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 NRC staff concludes that these actions are acceptable because they will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

Based on its review and the above explanation, the NRC staff concludes that the licensee's fire protection QA program is acceptable, subject to completion of the implementation items, because it will provide reasonable assurance that the requirements of NFPA 805, Sections 2.7.3.1 through 2.7.3.5 are met.

3.8.5 Conclusion for Section 3.8

The NRC staff reviewed the licensee's RI/PB FPP as described in the LAR, as supplemented, to evaluate the NFPA 805 program documentation content, the associated configuration control process, and the appropriate quality assurance requirements. Based on its review, the NRC staff concludes that, upon completion of the associated implementation items, 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 CNS and is, therefore, acceptable.

The following license condition is included in the revised license for CNS, and will replace Operating License Nos. NPF-35 and NPF-52 Condition 2.C(5):

Fire Protection Program

Duke Energy Carolinas, LLC shall implement and maintain in effect all provisions of the approved fire protection program that complies with 10 CFR 50.48(a) and 10 CFR 50.48(c), as specified in the licensee amendment request dated September 25, 2013, as supplemented by letters dated January 13, 2015; January 28, 2015; February 27, 2015; March 30, 2015; April 28, 2015; July 15, 2015; August 14, 2015; September 3, 2015; December 11, 2015; January 7, 2016; March 23, 2016; June 15, 2016; August 2, 2016; September 7, 2016; and January 26, 2017, as approved in the SE dated February 8, 2017. Except where NRC approval for changes or deviations is required by 10 CFR 50.48(c), and provided no other regulation, technical specification, license condition or requirement would require prior NRC approval, the licensee may make changes to the fire protection program without prior approval of the Commission if those changes satisfy the provisions set forth in 10 CFR 50.48(a) and 10 CFR 50.48(c), the change does not require a change to a technical specification or a license condition, and the criteria listed below are satisfied.

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

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

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

2) Prior NRC review and approval is not required for individual changes that result in a risk increase less than $1X10^{-7}$/year (yr) for CDF and less than $1X10^{-8}$/yr for LERF. The proposed change must also be consistent with the DID philosophy and must maintain sufficient safety margins. The change may be implemented following completion of the plant change evaluation.

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

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

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

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

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

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

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

Prior NRC review and approval is not required for changes to the licensee's fire protection program that have been demonstrated to have no more than a minimal risk impact. The licensee may use its screening process as approved in the NRC SE dated February 8, 2017, to determine that certain fire protection program changes meet the minimal criterion. The licensee shall ensure that fire protection defense-in-depth and safety margins are maintained when changes are made to the fire protection program

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

1) Before achieving full compliance with 10 CFR 50.48(c), as specified by 2) and 3), below, risk-informed changes to the Duke Energy Carolinas, LLC fire protection program may not be made without prior NRC review and approval unless the

change has been demonstrated to have no more than a minimal risk impact, as described in 2) above;

2) The licensee shall implement the modifications to its facility, as described in Table S-2, "Plant Modifications Committed," Attachment S, of the Duke Energy Carolinas, LLC letter CNS-17-004, dated January 26, 2017, to complete the transition to full compliance with 10 CFR 50.48(c) by December 31, 2017. The licensee shall maintain appropriate compensatory measures in accordance with its procedures until completion of these modifications.

3) The licensee shall complete the implementation items as listed in Table S-3, "Implementation Items," Attachment S, of the Duke Energy Carolinas, LLC letter CNS-17-004, dated January 26, 2017, within 180 days after issuance of the Safety Evaluation unless that falls within a scheduled outage window, then the completion of implementation items will occur 60 days after startup from the scheduled outage. Implementation Item 13 is associated with modifications and will be completed 180 days after modifications are complete.

5.0 SUMMARY

The NRC staff reviewed the licensee's application, as supplemented by various letters, to transition to an RI/PB FPP in accordance with the requirements established by NFPA 805. The NRC staff concludes that the applicant's approach, methods, and data are acceptable to establish, implement, and maintain an RI/PB FPP in accordance with 10 CFR 50.48(c).

Implementation of the RI/PB FPP, in accordance with 10 CFR 50.48(c), will include the application of a new fire protection license condition. The new license condition includes a list of implementation items that must be completed in order to support the conclusions made in this SE, as well as an established date by which full compliance with 10 CFR 50.48(c) will be achieved. 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 modifications and implementation items must be completed within the timeframe specified.

6.0 STATE CONSULTATION

In accordance with the Commission's regulations, the South Carolina State official was notified on August 30, 2016, of the proposed issuance of the amendment. 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 amendment involves no significant increase in the amounts and no significant change in the types of any effluents that may be released offsite and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no

significant hazards consideration, and there has been no public comment on such finding published in the *Federal Register* on February 4, 2014 (79 FR 6641). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

8.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner; (2) there is reasonable assurance that such activities will be conducted in compliance with the Commission's regulations; and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

9.0 REFERENCES

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3 National Fire Protection Association, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," Standard 805 (NFPA 805), 2001 Edition, Quincy, Massachusetts.

4 U.S. Nuclear Regulatory Commission, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants," Regulatory Guide 1.205, Revision 1, December 2009 (ADAMS Accession No. ML092730314).

5 U.S. Nuclear Regulatory Commission, "Development of a Risk-Informed, Performance-Based Regulation for Fire Protection at Nuclear Power Plants," SECY-98-058, March 1998 (ADAMS Accession No. ML992910106).

6 U.S. Nuclear Regulatory Commission, "Rulemaking Plan, Reactor Fire Protection Risk-Informed, Performance-Based Rulemaking," SECY-00-0009, January 13, 2000 (ADAMS Accession No. ML003671923).

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414, License Amendment Request (LAR) to Adopt National Fire Protection Association (NFPA) 805 Performance-Based Standard for Fire Protection for Light-Water Reactor Generating Plants, 75-Day Response to NRC Request for Additional Information (RAI), (TAC Nos. MF2936 and MF2937)," January 13, 2015 (ADAMS Accession No ML15015A409).

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Attachments:

A. Table 3.8-1 – V&V Basis for Fire Modeling Correlations Used at CNS
B. Table 3.8-2 – V&V Basis for Other Fire Models and Related Calculations Used at CNS
C. Abbreviations and Acronyms
D. NRC Staff Review of Resolutions to CNS Fire and Internal Events PRA Facts and Observations (F&Os)

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

Correlation	Application at Catawba	V&V Basis	NRC Staff Evaluation of Acceptability
Heskestad flame height correlation	Development of ZOI tables in GFMTs approach	NUREG-1805, Chapter 3 (Reference 48) NUREG-1824, Volume 3 (Reference 49) SFPE Handbook (Reference 107)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR, Attachment J). • The correlation is validated in NUREG-1824 and the Society of Fire Protection Engineers (SFPE) Handbook of Fire Protection Engineering. • The licensee stated that in most cases, the correlation has been applied within the validated range reported in NUREG-1824. The licensee provided justification for cases where the correlation was used outside the validated range reported in NUREG-1824 (LAR, Attachment J). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.
Heskestad plume temperature correlation	Development of ZOI tables in GFMTs approach	NUREG-1805, Chapter 9 (Reference 48) NUREG-1824, Volume 3 (Reference 49) SFPE Handbook (Reference 107)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR, Attachment J). • The correlation is validated in NUREG-1824 and the SFPE Handbook of Fire Protection Engineering. • The licensee stated that in most cases, the correlation has been applied within the validated range reported in NUREG-1824. The licensee provided justification for cases where the correlation was used outside the validated range reported in NUREG-1824 (LAR, Attachment J). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.

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

Correlation	Application at Catawba	V&V Basis	NRC Staff Evaluation of Acceptability
Modak point source radiation model	Development of ZOI tables in GFMTs approach	NUREG-1805, Chapter 5 (Reference 48) NUREG-1824, Volume 3 (Reference 49) SFPE Handbook (Reference 108)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR, Attachment J). • The correlation is validated in NUREG-1824 and the SFPE Handbook of Fire Protection Engineering. • The licensee stated that in most cases, the correlation has been applied within the validated range reported in NUREG-1824. The licensee provided justification for cases where the correlation was used outside the validated range reported in NUREG-1824 (LAR, Attachment J). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.
Shokri and Beyler flame radiation model	Development of ZOI tables in GFMTs approach	Peer-reviewed journal article (Reference 106)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR, Attachment J). • The correlation is validated in a peer-reviewed journal article. • The licensee stated that in most cases, the correlation has been applied within the validated range reported in the authoritative publication. The licensee provided justification for cases where the correlation was used outside the reported validated range (LAR, Attachment J). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.

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

Correlation	Application at Catawba	V&V Basis	NRC Staff Evaluation of Acceptability
Mudan flame radiation model	Development of ZOI tables in GFMTs approach	Peer-reviewed journal article (Reference 94)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR, Attachment J). • The correlation is validated in a peer-reviewed journal article. • The licensee stated that in most cases, the correlation has been applied within the validated range reported in the authoritative publication. The licensee provided justification for cases where the correlation was used outside the reported validated range (LAR, Attachment J). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.
Plume heat flux correlation by Wakamatsu et al.	Development of ZOI tables in GFMTs approach	Peer-reviewed conference paper (Reference 95)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR, Attachment J). • The correlation is validated in peer-reviewed conference paper. • The licensee stated that in most cases, the correlation has been applied within the validated range reported in the authoritative publication. The licensee provided justification for cases where the correlation was used outside the reported validated range (LAR, Attachment J). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.

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

Correlation	Application at Catawba	V&V Basis	NRC Staff Evaluation of Acceptability
Yokoi plume centerline temperature correlation	Development of ZOI tables in GFMTs approach	National research laboratory report (Reference 96) Peer-reviewed journal article (Reference 97)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR, Attachment J). • The correlation is validated in an authoritative publication and a peer-reviewed journal article. • The licensee stated that in most cases, the correlation has been applied within the validated range reported in the authoritative publication. The licensee provided justification for cases where the correlation was used outside the reported validated range (LAR, Attachment J). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.
Hydrocarbon spill fire size correlation	Development of ZOI tables in GFMTs approach	SFPE Handbook (Reference 98)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR, Attachment J). • The correlation is validated in the SFPE Handbook of Fire Protection Engineering. • The licensee stated that in most cases, the correlation has been applied within the validated range reported in the authoritative publication. The licensee provided justification for cases where the correlation was used outside the reported validated range (LAR, Attachment J). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.

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

Correlation	Application at Catawba	V&V Basis	NRC Staff Evaluation of Acceptability
Flame extension correlation	Development of ZOI tables in GFMTs approach	SFPE Handbook (Reference 99)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR, Attachment J). • The correlation is validated in the SFPE Handbook of Fire Protection Engineering. • The licensee stated that in most cases, the correlation has been applied within the validated range reported in the authoritative publication. The licensee provided justification for cases where the correlation was used outside the reported validated range (LAR, Attachment J). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.
Delichatsios line source flame height model	Development of ZOI tables in GFMTs approach	Peer-reviewed journal article (Reference 100)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR, Attachment J). • The correlation is validated in a peer-reviewed journal article. • The licensee stated that in most cases, the correlation has been applied within the validated range reported in the authoritative publication. The licensee provided justification for cases where the correlation was used outside the reported validated range (LAR, Attachment J). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.

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

Correlation	Application at Catawba	V&V Basis	NRC Staff Evaluation of Acceptability
Corner flame height correlation	Development of ZOI tables in GFMTs approach	SFPE Handbook (Reference 99)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR, Attachment J). • The correlation is validated in the SFPE Handbook of Fire Protection Engineering. • The licensee stated that in most cases, the correlation has been applied within the validated range reported in the authoritative publication. The licensee provided justification for cases where the correlation was used outside the reported validated range (LAR, Attachment J). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.
Kawagoe natural vent flow equation	Development of ZOI tables in GFMTs approach	National research laboratory report (Reference 101)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR, Attachment J). • The correlation is validated in an authoritative publication. • The licensee stated that in most cases, the correlation has been applied within the validated range reported in the authoritative publication. The licensee provided justification for cases where the correlation was used outside the reported validated range (LAR, Attachment J). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.

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

Correlation	Application at Catawba	V&V Basis	NRC Staff Evaluation of Acceptability
Yuan and Cox line fire flame height and plume temperature correlations	Development of ZOI tables in GFMTs approach	Peer-reviewed journal article (Reference 102)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR, Attachment J). • The correlation is validated in a peer-reviewed journal article. • The licensee stated that in most cases, the correlation has been applied within the validated range reported in the authoritative publication. The licensee provided justification for cases where the correlation was used outside the reported validated range (LAR, Attachment J). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.
Lee cable fire model	Development of ZOI tables in GFMTs approach	NBSIR 85-3196 (Reference 103)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR, Attachment J). • The correlation is validated in an authoritative publication. • The licensee stated that in most cases, the correlation has been applied within the validated range reported in the authoritative publication. The licensee provided justification for cases where the correlation was used outside the reported validated range (LAR, Attachment J). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.

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

Correlation	Application at Catawba	V&V Basis	NRC Staff Evaluation of Acceptability
Babrauskas method to determine ventilation-limited fire size	Development of ZOI tables in GFMTs approach	Peer-reviewed journal article (Reference 104)	• The licensee provided verification of the coding of this correlation in the GFMTs approach (LAR, Attachment J). • The correlation is validated in peer-reviewed journal article. • The licensee stated that in most cases, the correlation has been applied within the validated range reported in the authoritative publication. The licensee provided justification for cases where the correlation was used outside the reported validated range (LAR, Attachment J). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.

Attachment B: Table 3.8-2, V&V Basis for Other Fire Models and Related Calculations Used at CNS

Model	Application at Catawba	V&V Basis	NRC Staff Evaluation of Acceptability
CFAST (Version 6.1.1)	Development of HGL timing tables and MCR abandonment times calculations	NUREG-1824, Volume 5 (Reference 49) NIST SP 1086, 2008 (Reference 110)	• The modeling technique is V&V in NUREG-1824 and an authoritative publication. • The licensee stated that in most cases, the model has been applied within the validated range reported in NUREG-1824. The licensee provided justification for cases where the model was used outside the validated range reported in NUREG-1824 (LAR, Attachment J and Responses to FM RAIs 03.c and 04). Based on its review and the licensee's explanation, the NRC staff concludes that the use of this model is acceptable.
ZOIs involving HDPE piping materials	Determination of the ZOIs for ignition sources that involve HDPE piping in the Service Building, the Auxiliary Building, and the Turbine Building	NUREG-1824, Volume 3 (Reference 49)	• The correlation is V&V in NUREG-1824. • The licensee stated that the correlation has been applied within the validated range reported in NUREG-1824. Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.
HDPE Melting Conditions	Determination of the heat flux conditions necessary to cause the HDPE piping to melt. The piping may be filled with air, stagnant water, or flowing water.	National Research Laboratory Reports (Reference 111) (Reference 112) (Reference 113) (Reference 114)	• The correlation is V&V in several national research laboratory reports. Based on its review and the licensee's explanation, the NRC staff concludes that the use of this correlation is acceptable.

Attachment C: Abbreviations and Acronyms

ADAMS	Agencywide Documents Access and Management System
AHJ	authority having jurisdiction
ANS	American Nuclear Society
ASME	American Society of Mechanical Engineers
BTP	Branch Technical Position
BWR	boiling-water reactor
CAROLFIRE	Cable Response to Live Fire
CC	capability category
CCDP	conditional core damage probability
CDF	core damage frequency
CFAST	Consolidated Model of Fire and Smoke Transport
CFR	Code of Federal Regulations
CFWC	cable fire cause by welding and cutting
CHRISTIFIRE	Cable Heat Release, Ignition, and Spread in Tray Installations During Fire
CMEB	Chemical Engineering Branch
CNS	Catawba Nuclear Station, Units 1 and 2
DESIREE-Fire	Direct Current Electrical Shorting in Response to Exposure Fire
DID RA	defense-in-depth recovery action
DID	defense-in-depth
DG	diesel generator
EEEE	existing engineering equivalency evaluation
EFA	fire detection system
EPRI	Electric Power Research Institute
ERFBS	electrical raceway fire barrier system
F&O	facts and observations
FAQ	frequently asked question
FDS	fire dynamics simulator
FDT	Fire Dynamics Tool
FIVE	Fire Induced Vulnerability Evaluation Methodology
FM	fire modeling
FPE	fire protection engineering
FPP	fire protection program
FPRA	fire probabilistic risk assessment
FR	Federal Register
FRE	fire risk evaluation
GCC	General Cable Corporation
GDC	General Design Criteria
GFMT	Generic Fire Modeling Treatments
GL	generic letter
HDPE	high density polyethylene
HEAF	high energy arcing fault
HEP	human error probability
HGL	hot gas layer
HRA	human reliability analysis
HRE	high(er) risk evolution
HRR	heat release rate
HSB	hot standby
HVAC	heating, ventilation, and air conditioning
IEEE	Institute of Electrical and Electronics Engineers

IEPRA	internal events probabilistic risk assessment
JHEP	joint human error probability
KSF	key safety function
kV	kilovolt
kW	kilowatt
LAR	license amendment request
LERF	large early release frequency
LOCA	loss of coolant accident
LPSW	low pressure service water
MCA	multi-compartment analsysis
MCB	main control board
MCC	motor control center
MCR	main control room
MFP	main fire pump
min	minute(s)
MOV	motor operated valve
MSO	multiple spurious operation
NEI	Nuclear Energy Institute
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
No.	number
NPO	non-power operation
NPP	nuclear power plant
NRC	U.S. Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
NSCA	nuclear safety capability assessment
NSP	non-suppression probability
NSPC	nuclear safety performance criteria
OMA	operator manual action
PB	performance-based
PCE	plant change evaluation
PCS	primary control station
P&ID	piping and instrumentation diagram
POS	plant operating state
PRA	probabilistic risk assessment
PSA	probabilistic safety assessment
PVC	polyvinyl chloride
PWR	pressurized-water reactor
QA	quality assurance
RA	recovery action
RAI	request for additional information
RCP	reactor coolant pump
RCS	reactor coolant system
RES	Office of Nuclear Regulatory Research
RG	Regulatory Guide
RI	risk-informed
RI/PB	risk-informed, performance-based
RP	regulatory position
SCBA	self-contained breathing apparatus
SE	safety evaluation
SER	safety evaluation report

SFPE	Society of Fire Protection Engineers
SOKC	state-of-knowledge correlation
SR	supporting requirement
SS	safety injection system
SSA	safe shutdown analysis
SSC	structures, systems, and components
SSD	safe shutdown
SSEL	safe shutdown equipment list
SSF	standby shutdown facility
TS	Technical Specification
UFSAR	updated final safety analysis report
V	Volt
V&V	verification and validation
VFDR	variance from deterministic requirements
WOG	Westinghouse Owners Group
yr	year
ZOI	zone of influence

Attachment D

NRC Staff's Review of Resolutions of CNS Fire and Internal Events PRA Facts and Observations (F&Os)

The NRC staff reviewed the licensee's resolutions of all of the F&Os to determine the technical adequacy of both the IEPRA and the FPRA for the NFPA 805 application. The NRC staff requested additional information to assess the adequacy of some of the resolutions for the review. The tables in SE Attachment D document the conclusions of the NRC staff's review of the licensee's resolution to each F&O/self-assessment issue. Table D-1 documents these conclusions for the FPRA, Table D-2 documents these conclusions for the FPRA SRs where CC-I was met, and Table D-3 documents these conclusions for the IEPRA.

The NRC staff documents its basis for finding the licensee's resolution of each F&O acceptable by one of two methods. The first method is that the resolution was determined to be acceptable without the need for an RAI for the reasons reflected in the column titled "With No RAI Based on (A/B/C)" as indicated by noting "A" or "B" or "C," which are defined in the key at the end of the table. The second method is that resolution to the F&O was found acceptable based on the licensee's response to RAIs. If the licensee's response to the RAI is discussed in SE Section 3.4, then it is summarized in the "Discussed in SE" column. If the licensee's response to the RAI is not discussed in SE Section 3.4, then it is summarized in the "Not Discussed in SE" column. Generally, an RAI is discussed in SE Section 3.4, if the licensee made a change to the PRA in response to the RAI.

Table D-1, FPRA

Facts and Observations (F&Os) Finding Suggestion ID or Supporting Requirement (SR)		Plant Resolution found Acceptable to the Staff		
		With no RAI based on (A/B/C)	Via RAI Response	
F&O	SR		Not Discussed in the SE	Discussed in the SE
CS-A11-01	CS-A11	A		
CS-B1-01	CS-B1	A		
ES-C1-01	ES-C1	A		
ES-C2-01	ES-C2	A		
FQ-A2-01	FQ-A2	A		
FQ-F1-01	FQ-F1	C		
FQ-F1-02	FQ-F1	B		
FSS-A1-01	FSS-A1	A	See response to PRA RAI 01.a (Reference 11), regarding screening of non-propagating fixed and transient ignition sources. Acceptable to the NRC staff because the licensee states that fixed ignition sources excluded from	

Table D-1, FPRA				
Facts and Observations (F&Os) Finding Suggestion ID or Supporting Requirement (SR)		Plant Resolution found Acceptable to the Staff		
		With no RAI based on (A/B/C)	Via RAI Response	
F&O	SR		Not Discussed in the SE	Discussed in the SE
			quantification of the Fire PRA model were done consistent with the criteria in Section 8.5.3 of NUREG/CR-6850 and that the only instances where the non-severe portion of a fire scenario was excluded involved components that were not credited in the Fire PRA. The licensee also stated that the Fire PRA documentation will be updated accordingly.	
FSS-A2-01	FSS-A2	A		
FSS-H10-01	FSS-H10	A		
HRA-A2-01	HRA-A2			See SE Sections 3.4.3 and 3.4.4 for discussion of PRA RAI 12 and 12.01 regarding identification and classification of abandonment actions.
HRA-A4-01	HRA-A4		See response to PRA RAI 01.b.iv (Reference 10), regarding talk throughs. Acceptable to the NRC staff because the licensee states that all operator actions with risk achievement worth greater than 1.02 or which were considered risk-significant actions were reviewed with operators, and additional operator actions credited in the Fire PRA were also talked through with operators.	
HRA-B3-01	HRA-B3		See response to PRA RAI 01.b.iii (Reference 10), regarding use of JHEPs less than 1E-05. Acceptable to the NRC staff because the licensee identified that the fire PRA applies several JHEPs less than 1E-05 and justifies the lower JHEPs based on 1) large time window between actions, 2) actions are taken based on different cues, and 3) there are intervening	See SE Section 3.4.2.2 for discussion of PRA RAI 01.b.i and ii regarding updating HEPs using the NUREG-1921 (Reference 52), methodology.

Table D-1, FPRA				
Facts and Observations (F&Os) Finding Suggestion ID or Supporting Requirement (SR)		Plant Resolution found Acceptable to the Staff		
		With no RAI based on (A/B/C)	Via RAI Response	
F&O	SR		Not Discussed in the SE	Discussed in the SE
			successes between some of the actions.	
HRA-C1-02	HRA-C1	A		
HRA-D2-01	HRA-H2		See response to PRA RAI 01.c (Reference 10), regarding crediting non-proceduralized operator actions. Acceptable to the NRC staff because the licensee identifies just one additional action beyond that identified by the peer review and determined that it does not impact the risk results.	
PRM-B2-01	PRM-B2	See NRC Staff Evaluation in IEPRA Record of Review		
PRM-B5-01	PRM-B5	A		
PRM-B6-01	PRM-B6		See response to PRA RAI 01.c (Reference 10), regarding crediting non-proceduralized operator actions. Acceptable to the NRC staff because the licensee identifies just one additional action beyond that identified by the peer review and determined that it does not impact the risk results.	
PRM-B7-01	PRM-B7	B		
PRM-B11 (no F&O)	PRM-B11		See responses to PRA RAIs 01.b and 01.c (Reference 10), discussed previously in this table (i.e., F&Os HRA-A4-01, HRA-B4-01, HRA-D2-01, PRM-B6-01).	
SF-A3-01	SF-A3	A		
SF-A5-01	SF-A5	A		

Acceptability Key for SE Attachment D, Table D-1

A: The NRC staff finds that the licensee's resolution for the capability category of the SR as described by the licensee in the LAR provides confidence that the requirements of the SR have been addressed and, if needed, the PRA has been modified, and, therefore, the PRA quality with respect to the SR is acceptable for this application. Examples of acceptable CC-I SRs are modeling methods that yield conservative FRE and change evaluation results.

B: The NRC staff finds that the licensee's resolution of the capability category of the SR as described by the licensee in the LAR and further clarified during the audit provides confidence that requirements of the SR have been addressed and, if needed, the PRA has been modified, and, therefore, the PRA quality with respect to the SR is acceptable for this application. Examples of acceptable CC-I SRs are modeling methods that yield conservative FRE and change evaluation results.

C: The NRC staff finds that the licensee's resolution for the capability category of the SR, as described by the licensee in the LAR, would have a negligible effect on the evaluations relied upon to support fire risk evaluations and has no impact on the conclusions of the risk assessment, and, therefore, the PRA quality with respect to the SR is acceptable for this application. Examples are those SRs that do not affect the FPRA.

Table D-2, FPRA, (CC-I MET)				
Supporting Requirement (SR)	F&O ID	Plant Resolution found Acceptable to the Staff		
		Without RAI based on (A/B/C)	Via RAI Response	
			Not Discussed in the SE	Discussed in the SE
PP-B3	PRM-B3-01	A		
PP-B5	PRM-B5-01	A		
CS-B1	CS-B1-01	A		
FSS-B2	FSS-B2-01			See SE Section 3.4.2.2 for discussion on PRA RAI 11 and 11.01 regarding the MCR abandonment analysis.
FSS-C1	FSS-C1-01	A		
FSS-C2	FSS-C2-01	A		
FSS-C3	FSS-C3-01	A		
FSS-F2	FSS-F2-01	A		
FSS-F3	FSS-F3-01	A		
FSS-G4	FSS-G4-01	A		
FSS-H2	FSS-H2-01	A		
HRA-A3	ES-C2-01	A		
HRA-A4	HRA-A4-01		See response to PRA RAI 01.b.iv (Reference 10), regarding talk throughs. Acceptable to the NRC staff because the licensee states that all operator actions with risk achievement worth greater than 1.02 or which were considered risk-significant actions were reviewed with operators, and additional operator actions credited in the Fire PRA were also talked through with operators.	
HRA-B4	ES-C1-01	A		
HRA-C1	HRA-C1-02			See SE Section 3.4.2.2 for discussion on PRA RAI 01.b.i and ii regarding updating HEPs using the

Table D-2, FPRA, (CC-I MET)				
Supporting Requirement (SR)	F&O ID	Plant Resolution found Acceptable to the Staff		
		Without RAI based on (A/B/C)	Via RAI Response	
			Not Discussed in the SE	Discussed in the SE
				NUREG-1921 methodology.
HRA-D1	PRM-B6-01			See SE Section 3.4.2.2 for discussion on PRA RAI 01.b.i and ii regarding updating HEPs using the NUREG-1921 methodology.

Acceptability Key for SE Attachment D, Table D-2

A: The NRC staff finds that the licensee's resolution for the capability category of the SR as described by the licensee in the LAR provides confidence that the requirements of the SR have been addressed and, if needed, the PRA has been modified, and, therefore the PRA quality with respect to the SR is acceptable for this application. Examples of acceptable CC-I SRs are modeling methods that yield conservative FRE and change evaluation results.

B: The NRC staff finds that the licensee's resolution of the capability category of the SR as described by the licensee in the LAR and further clarified during the audit provides confidence that requirements of the SR have been addressed and, if needed, the PRA has been modified, and, therefore the PRA quality with respect to the SR is acceptable for this application. Examples of acceptable CC-I SRs are modeling methods that yield conservative FRE and change evaluation results.

C: The NRC staff finds that the licensee's resolution for the capability category of the SR, as described by the licensee in the LAR, would have a negligible effect on the evaluations relied upon to support fire risk evaluations and has no impact on the conclusions of the risk assessment and, therefore the PRA quality with respect to the SR is acceptable for this application. Examples are those SRs that do not affect the FPRA.

Table D-3, IEPRA				
Facts and Observations (F&Os) Finding Suggestion ID or Supporting Requirement (SR)		Plant Resolution found Acceptable to the Staff		
		With No RAI based on (A/B/C)	Via RAI Response	
F&O ID	SR		Not Discussed in the SE	Discussed in the SE
AS-01	DA-C16 SY-A10	A		
AS-04	AS-A1 AS-A2 AS-A7 AS-A10 QU-B6	C		
AS-07	AS-A2 AS-A7 AS-A10 AS-B1 AS-B5 QU-B6 SC-A3 SC-A4 SY-B5	A		
DA-01	DA-B1 DA-B2 DA-C2 DA-E1 DA-E2	A		
DA-02	DA-A1 DA-A4 DA-C1 DA-C2 DA-C9			See SE Section 3.4.2.1 for discussion on PRA RAI 02.f.e regarding updating generic failure rate data.
DA-05	DA-A1 DA-C2 DA-C14 DA-C16	A		
DA-06	DA-A1 DA-A4 DA-C1 DA-C2 DA-C9 DA-D3 DA-E1 DA-E2	C		
DA-08	DA-D1	A		
DE-01	SY-C2	C		
DE-04	AS-B1 AS-B3 SY-A10 SY-B5		See response to PRA RAI 02.a (Reference 12), regarding loss of HVAC). Acceptable to the NRC staff because the licensee states that room heatup calculations were performed and a loss of	

Table D-3, IEPRA				
Facts and Observations (F&Os) Finding Suggestion ID or Supporting Requirement (SR)		Plant Resolution found Acceptable to the Staff		
		With No RAI based on (A/B/C)	Via RAI Response	
F&O ID	SR		Not Discussed in the SE	Discussed in the SE
			HVAC for the switchgear rooms, battery rooms, and control room was determined to have no impact on the risk results during the 24-hour mission time of the PRA.	
HR-02	HR-B1 HR-B2 HR-D1 HR-D2 HR-D4	C		
HR-04	HR-E1 HR-E2 HR-E3 HR-E4 HR-F1 HR-F2 HR-G4 HR-G5 HR-H1 HR-H2	A		
HR-05	HR-E1 HR-E2 HR-E3 HR-F2 HR-G1 HR-G3 HR-H1 HR-H2 SC-A2 SC-A6 SC-B3 SC-C1 SC-C2	C		
HR-09	HR-G5	C		
IE-03	IE-AI IE-A5 IE-A6 IE-A9	A		
IE-04	IE-C12 DA-C16	A		
IE-06	AS-B1 IE-A2 IE-C6		See response to PRA RAI 02.a (Reference 12), regarding loss of HVAC). Acceptable to the NRC staff because the licensee states that room heatup calculations were performed and a loss of HVAC for the switchgear rooms, battery rooms, and	

Table D-3, IEPRA				
Facts and Observations (F&Os) Finding Suggestion ID or Supporting Requirement (SR)		Plant Resolution found Acceptable to the Staff		
		With No RAI based on (A/B/C)	Via RAI Response	
F&O ID	SR		Not Discussed in the SE	Discussed in the SE
			control room was determined to have no impact on the risk results during the 24-hour mission time of the PRA.	
IE-08	IE-C9 IE-C10		See response to PRA RAI 2.f.a (Reference 10), regarding treatment of common cause failure in the development of the frequency for loss of service water. Acceptable to the NRC staff because the licensee states that the loss of service water frequency was developed consistent with the guidance in EPRI TR 1016741, "Support System Initiating Events: Identification and Quantification Guideline" (Reference 115).	
IFPP-A2-01	IFPP-A2		See response to PRA RAI 02.f.b (Reference 10), regarding resolution to internal flooding F&Os. Acceptable to the NRC staff because the licensee states that the modeling changes made to address the internal flooding F&Os were incorporated in the PRA model used to generate the risk results reported in the LAR.	
IFSN-A10-01	IFSN-A10		See response to PRA RAI 02.f.b (Reference 10), regarding resolution to internal flooding F&Os. Acceptable to the NRC staff because the licensee states that the modeling changes made to address the internal flooding F&Os were incorporated in the PRA model used to generate the risk results reported in the LAR.	
IFSN-A7-01	IFSN-A7		See response to PRA RAI 02.f.b (Reference 10), regarding resolution to internal flooding F&Os. Acceptable to the NRC staff because the licensee states that the modeling changes made to address the internal flooding F&Os were incorporated in the PRA model used to generate the risk results reported in the LAR.	
IFSN-B1-01	IFSO-B1 IFSN-B1 IFEV-B1	A		
IFSO-A1-01	IFSO-A1 IFEV-A5		See response to PRA RAI 02.f.b (Reference 10), regarding resolution to	

Table D-3, IEPRA				
Facts and Observations (F&Os) Finding Suggestion ID or Supporting Requirement (SR)		Plant Resolution found Acceptable to the Staff		
		With No RAI based on (A/B/C)	Via RAI Response	
F&O ID	SR		Not Discussed in the SE	Discussed in the SE
	IFSN-A10		internal flooding F&Os. Acceptable to the NRC staff because the licensee states that the modeling changes made to address the internal flooding F&Os were incorporated in the PRA model used to generate the risk results reported in the LAR.	
IFSO-A2-01	IFSO-A2 IFSN-A11 IFEV-A4	A		
IFSO-A5-01	IFSO-A5	A		
IFSO-A6-01	IFPP-A5 IFSO-A6	C		
IFSO-B3-01	IFPP-B3 IFSO-B3	C		
2012 Focused-scope Peer Review	LE-B2 LE-C1 LE-C3 LE-C4 LE-C9 LE-C11 LE-D2 LE-D3 LE-D6	A		
LE-E2-01	LE-E2	C		
LE-G3-01	LE-F1 LE-G3	C		
LE-G6-01	LE-G6	C		
LAR	DA-C8	C		
LAR	DA-C9	C		
LAR	DA-C11 DA-C12 DA-C13	C		
LAR	DA-D3	C		
LAR	DA-D4	C		
LAR	DA-D5	C		
LAR	DA-D6	C		
LAR	DA-E3	C		
2008 Self-assessment	IE-A8	C		

Table D-3, IEPRA				
Facts and Observations (F&Os) Finding Suggestion ID or Supporting Requirement (SR)		Plant Resolution found Acceptable to the Staff		
		With No RAI based on (A/B/C)	Via RAI Response	
F&O ID	SR		Not Discussed in the SE	Discussed in the SE
2008 Self-assessment	IE-B2	C		
LAR	IE-C14	C	See response to PRA RAI 02.f.c (Reference 10), regarding crediting of motor operated valves (MOVs) under differential pressure conditions. Acceptable to the NRC staff because the licensee states that crediting these MOVs has an insignificant impact to the PRA results reported in the LAR.	
LAR	QU-E4	C		
LAR	QU-F6	C		
LAR	SY-A11	A		
2008 Self-assessment	SY-A15	C		
2008 Self-assessment	SY-A4	C		
QU-01	QU-B2 QU-B3	A		
QU-02	AS-B5 QU-A4 QU-C1 QU-C2 SC-A3 SC-A4 SY-B5	A		
QU-04	QU-F2	A		
QU-05	HR-G6 QU-A5 DA-C16		See response to PRA RAI 02.b (Reference 10), regarding post-initiator human error probability quantification. Acceptable to the NRC staff because the licensee states that a consistency check of the post-initiator human error probability quantifications have been completed with no changes to the PRA model.	
QU-08	QU-A5 QU-B7 QU-B8	A		
QU-12	QU-A2 QU-A4 QU-D4 QU-D6		See response to PRA RAI 02.f.d (Reference 10), regarding the conditional core damage probabilities (CCDPs) for small loss-of-coolant accident (LOCA),	

Table D-3, IEPRA				
Facts and Observations (F&Os) Finding Suggestion ID or Supporting Requirement (SR)		Plant Resolution found Acceptable to the Staff		
		With No RAI based on (A/B/C)	Via RAI Response	
F&O ID	SR		Not Discussed in the SE	Discussed in the SE
			steam generator tube rupture (SGTR), loss of instrument air, and inadvertent safety injection system (SS) actuation. Acceptable to the NRC staff because the licensee explains the reason for the differences between the small LOCA and SGTR initiating events CCDPs, and explains that the CCDPs for the loss of instrument air and inadvertent SS actuation initiating events is coincidental.	
SY-03	SC-A3 SC-B1 SC-C1 SC-C2 SY-B7 SY-C1 SY-C2 SY-A10 SY-A13 SY-A18 SY-A21 AS-A3		See response to PRA RAI 02.c (Reference 10), regarding the impact on the PRA results of the new success criteria. Acceptable to the NRC staff because the licensee states that the success criteria applied in the LAR PRA model are bounding of the new success criteria or the new success criteria did not result in a change to the PRA model.	
SY-04	SY-A13 SY-A22		See response to PRA RAI 02.e (Reference 10), regarding excluding the failure to isolate the Non-Essential Reactor Building Header from the PRA model. Acceptable to the NRC staff because the licensee states that the MSO evaluation performed for the Fire PRA was performed consistent with the guidance in NEI 00-01 to evaluate plant-specific MSO considerations, which included evaluating many scenarios not originally included in the Internal Events PRA.	
SY-06	AS-B3 SY-A18 SY-A21 SY-A22 SY-B14	A		
TH-01	SC-A2 SC-B1 SC-B3 SC-B4 SC-B5		See response to PRA RAI 02.c (Reference 10), regarding the impact on the PRA results of the new success criteria. Acceptable to the NRC staff because the licensee states that the	

Table D-3, IEPRA				
Facts and Observations (F&Os) Finding Suggestion ID or Supporting Requirement (SR)		Plant Resolution found Acceptable to the Staff		
		With No RAI based on (A/B/C)	Via RAI Response	
F&O ID	SR		Not Discussed in the SE	Discussed in the SE
	SY-B7		success criteria applied in the LAR PRA model are bounding of the new success criteria or the new success criteria did not result in a change to the PRA model. Also see response to PRA RAI 02.d (Reference 9), regarding the meaning of negligible impact. Acceptable to the NRC staff because the licensee states that there is no impact on the PRA results if core damage is defined as 2000 degrees F because there is no change in the success criteria and a new plant-specific HRA timing analysis showed that the HRA timing used in the Fire PRA supported the HEPs used in the PRA.	
TH-02	AS-A8 SC-A1 SC-A2		See response to PRA RAI 2.d (Reference 9), regarding the meaning of negligible impact. Acceptable to the NRC staff because the licensee states that there is no impact on the PRA results if core damage is defined as 2000 degrees F because there is no change in the success criteria and a new plant-specific HRA timing analysis showed that the HRA timing used in the Fire PRA supported the HEPs used in the PRA.	
TH-03	AS-A3 AS-A5 AS-A9 SC-A2 SC-A3 SC-A6 SC-B1 SC-B2 SC-B3 SC-B4 SC-C1 SC-C2 SY-A10 SY-A13 SY-A18 SY-A21 SY-B7		See response to PRA RAI 02.c (Reference 10), regarding the impact on the PRA results of the new success criteria. Acceptable to the NRC staff because the licensee states that the success criteria applied in the LAR PRA model are bounding of the new success criteria or the new success criteria did not result in a change to the PRA model.	

Table D-3, IEPRA				
Facts and Observations (F&Os) Finding Suggestion ID or Supporting Requirement (SR)		Plant Resolution found Acceptable to the Staff		
		With No RAI based on (A/B/C)	Via RAI Response	
F&O ID	SR		Not Discussed in the SE	Discussed in the SE
TH-05	HR-F2 HR-G4 SC-A2 SC-A3 SC-A6 SC-B3 SC-B5 SC-C1 SC-C2		See response to PRA RAI 02.c (Reference 10), regarding the impact on the PRA results of the new success criteria. Acceptable to the NRC staff because the licensee states that the success criteria applied in the LAR PRA model are bounding of the new success criteria or the new success criteria did not result in a change to the PRA model.	
TH-06	AS-B3 SY-B7 SY-B8 SY-A18 SY-A21 SY-A22 SC-A3 SC-A6 SC-B2 SC-B5 SC-C1 SC-C2		See response to PRA RAI 02.a (Reference 12), regarding loss of HVAC). Acceptable to the NRC staff because the licensee states that room heatup calculations were performed and a loss of HVAC for the switchgear rooms, battery rooms, and control room was determined to have no impact on the risk results during the 24-hour mission time of the PRA.	

Acceptability Key for SE Attachment D, Table D-3

A: The NRC staff finds that the licensee's resolution for the capability category of the SR as described by the licensee in the LAR provides confidence that the requirements of the SR have been addressed and, if needed, the PRA has been modified, and, therefore the PRA quality with respect to the SR is acceptable for this application. Examples of acceptable CC-I SRs are modeling methods that yield conservative FRE and change evaluation results.

B: The NRC staff finds that the licensee's resolution of the capability category of the SR as described by the licensee in the LAR and further clarified during the audit provides confidence that requirements of the SR have been addressed and, if needed, the PRA has been modified, and, therefore the PRA quality with respect to the SR is acceptable for this application. Examples of acceptable CC-I SRs are modeling methods that yield conservative FRE and change evaluation results.

C: The NRC staff finds that the licensee's resolution for the capability category of the SR, as described by the licensee in the LAR, would have a negligible effect on the evaluations relied upon to support fire risk evaluations and has no impact on the conclusions of the risk assessment and, therefore, the PRA quality with respect to the SR is acceptable for this application. Examples are those SRs that do not affect the FPRA.

February 8, 2017

Mr. Tom Simril
Site Vice Preisdent
Duke Energy Carolinas, LLC
Catawba Nuclear Station
4800 Concord Road
York, SC 29745

SUBJECT: CATAWBA NUCLEAR STATION, UNITS 1 AND 2 – ISSUANCE OF AMENDMENTS REGARDING NATIONAL FIRE PROTECTION ASSOCIATION STANDARD NFPA 805 (CAC NOS. MF2936 AND MF2937)

Dear Mr. Simril:

The U.S. Nuclear Regulatory Commission (NRC) has issued the enclosed Amendment No. 287 to Renewed Facility Operating License No. NPF-35 and Amendment No. 283 to Renewed Facility Operating License No. NPF-52 for the Catawba Nuclear Station (CNS), Units 1 and 2, respectively. These amendments are in response to your application dated September 25, 2013, as supplemented by letters dated January 13, 2015; January 28, 2015; February 27, 2015; March 30, 2015; April 28, 2015; July 15, 2015; August 14, 2015; September 3, 2015; December 11, 2015; January 7, 2016; March 23, 2016; June 15, 2016; August 2, 2016; September 7, 2016; and January 26, 2017.

The amendments transition CNS, Units 1 and 2, to Title 10 of the *Code of Federal Regulations*, Section 50.48(c), "National Fire Protection Association Standard NFPA 805."

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

Sincerely,
/RA/
Michael Mahoney, Project Manager
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-413 and 50-414

Enclosures:
1. Amendment No. 287 to NPF-35
2. Amendment No. 283 to NPF-52
3. Safety Evaluation

cc w/enclosures: Distribution via Listserv

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PUBLIC	LPL2-1 R/F	RidsACRS_MailCTR Resource
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ADAMS Accession No.: ML16137A308 *by memo

OFFICE	DORL/LPL2-1/PM	DORL/LPL2-1/LA	DRA/APLA/BC*	OGC
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OFFICE	DORL/LPL2-1/LA	DORL/LPL2-1/BC	DORL/LPL2-1/PM	
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