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

October 7, 2016

Vice President, Operations
Arkansas Nuclear One
Entergy Operations, Inc.
1448 S.R. 333
Russellville, AR 72802

SUBJECT: ARKANSAS NUCLEAR ONE, UNIT 1 - ISSUANCE OF AMENDMENT REGARDING TRANSITION TO A RISK-INFORMED, PERFORMANCE-BASED FIRE PROTECTION PROGRAM IN ACCORDANCE WITH 10 CFR 50.48(c) (CAC NO. MF3419)

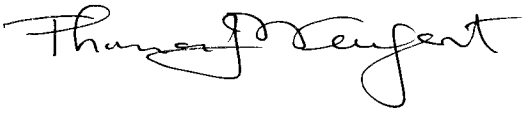
Dear Sir or Madam:

The U.S. Nuclear Regulatory Commission has issued the enclosed Amendment No. 256 to Renewed Facility Operating License No. DPR-51 for Arkansas Nuclear One, Unit 1 (ANO-1). The amendment revises the renewed facility operating license and technical specifications (TSs) in response to your application dated January 29, 2014, as supplemented by letters dated May 19, June 16, July 21, August 12, September 22, November 4, and November 17, 2015; and January 15, March 25, April 7, May 19, and August 29, 2016. Entergy Operations, Inc. (Entergy, the licensee), submitted a license amendment request to revise the fire protection program in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.48(c), for ANO-1 and change the license and TSs, accordingly.

The amendment authorizes the transition of the ANO-1 fire protection program to a risk-informed, performance-based program based on National Fire Protection Association Standard 805 (NFPA 805), "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," 2001 Edition, in accordance with 10 CFR 50.48(c). NFPA 805 allows the use of performance-based methods, such as fire modeling and risk-informed methods such as fire probabilistic risk assessment, to demonstrate compliance with the nuclear safety performance criteria.

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

Sincerely,



Thomas J. Wengert, Senior Project Manager
Plant Licensing IV-2 and Decommissioning
Transition Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-313

Enclosures:
1. Amendment No. 256 to DPR-51
2. Safety Evaluation

cc w/encls: Distribution via Listserv

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

ENTERGY OPERATIONS, INC.

DOCKET NO. 50-313

ARKANSAS NUCLEAR ONE, UNIT 1

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 256
Renewed License No. DPR-51

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

   A. The application for amendment by Entergy Operations, Inc. (the licensee), dated January 29, 2014, as supplemented by letters dated May 19, June 16, July 21, August 12, September 22, November 4, and November 17, 2015; and January 15, March 25, April 7, May 19, and August 29, 2016; complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

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

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

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

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

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.c.(2) of Renewed Facility Operating License No. DPR-51 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 256, are hereby incorporated in the renewed license. EOI shall operate the facility in accordance with the Technical Specifications.

In addition, the license is amended as indicated in the attachment to this license amendment, and paragraph 2.c.(8) of Renewed Facility Operating License No. DPR-51 is hereby amended to read as follows:

(8) Fire Protection

Entergy Operations, Inc. shall implement and maintain in effect all provisions of the approved fire protection program that comply with 10 CFR 50.48(a) and 10 CFR 50.48(c), as specified in the licensee amendment request dated January 29, 2014, and supplements dated May 19, 2015, June 16, 2015, July 21, 2015, August 12, 2015, September 22, 2015, November 4, 2015, November 17, 2015, January 15, 2016, March 25, 2016, April 7, 2016, May 19, 2016, and August 29, 2016, and as approved in the SE dated October 7, 2016. Except where NRC approval for changes or deviations is required by 10 CFR 50.48(c), and provided no other regulation, technical specification, license condition or requirement would require prior NRC approval, the licensee may make changes to the fire protection program without prior approval of the Commission if those changes satisfy the provisions set forth in 10 CFR 50.48(a) and 10 CFR 50.48(c), the change does not require a change to a technical specification or a license condition, and the criteria listed below are satisfied.

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 ANO-1. Acceptable methods to assess the risk of the change may include methods that have been used in the peer-reviewed fire PRA model, methods that have been approved by NRC through a plant-specific license amendment or NRC approval of generic

methods specifically for use in NFPA 805 risk assessments, or methods that have been demonstrated to bound the risk impact.

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

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

Other Changes that may be Made Without Prior NRC Approval

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

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

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

requirement or standard. The four specific sections of NFPA 805, Chapter 3, are as follows:

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

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

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

   Prior NRC review and approval are not required for changes to the licensee's fire protection program that have been demonstrated to have no more than a minimal risk impact. The licensee may use its screening process as approved in the NRC SE dated October 7, 2016, to determine that certain fire protection program changes meet the minimal criterion. The licensee shall ensure that fire protection defense-in-depth and safety margins are maintained when changes are made to the fire protection program.

Transition License Conditions

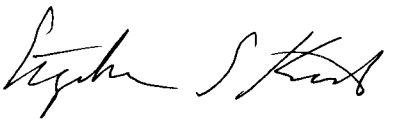
1. Before achieving full compliance with 10 CFR 50.48(c), as specified by 2. below, risk-informed changes to the Entergy Operations, Inc. fire protection program may not be made without prior NRC review and approval unless the change has been demonstrated to have no more than a minimal risk impact, as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

2. The licensee shall implement the modifications to its facility, as described in Table S-1, "Plant Modifications," Attachment S, of Entergy Operations, Inc. letter 1CAN051602, dated May 19, 2016, prior to startup from the second refueling outage following issuance of the Safety Evaluation. The licensee shall maintain appropriate compensatory measures in place until completion of the modifications.

3. The licensee shall complete the implementation items as listed in Table S-2, "Implementation Items," Attachment S, of Entergy Operations, Inc. letter 1CAN051602, dated May 19, 2016, within six months after issuance of the Safety Evaluation.

3. The license amendment is effective as of its date of issuance and shall be implemented as described in the transition license conditions.

FOR THE NUCLEAR REGULATORY COMMISSION



Stephen S. Koenick, Acting Chief
Plant Licensing IV-2 and Decommissioning
Transition Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Renewed Facility
Operating License No. DPR-51
and Technical Specifications

Date of Issuance: October 7, 2016

ATTACHMENT TO LICENSE AMENDMENT NO. 256

TO RENEWED FACILITY OPERATING LICENSE NO. DPR-51

ARKANSAS NUCLEAR ONE, UNIT 1

DOCKET NO. 50-313

Replace the following pages of the Renewed Facility Operating License No. DPR-51 and Appendix A Technical Specifications with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

Operating License

REMOVE	INSERT
-3-	-3-
-5-	-5-
-6-	-6-
---	-7-
---	-8-

Technical Specifications

REMOVE	INSERT
5.0-5	5.0-5

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

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

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

(1) Maximum Power Level

EOI is authorized to operate the facility at steady state reactor core power levels not in excess of 2568 megawatts thermal.

(2) Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 256, are hereby incorporated in the renewed license. EOI shall operate the facility in accordance with the Technical Specifications.

(3) Safety Analysis Report

The licensee's SAR supplement submitted pursuant to 10 CFR 54.21(d), as revised on March 14, 2001, describes certain future inspection activities to be completed before the period of extended operation. The licensee shall complete these activities no later than May 20, 2014.

(4) Physical Protection

EOI shall fully implement and maintain in effect all provisions of the Commission-approved physical security, training and qualification, and safeguards contingency plans, including amendments made pursuant to provisions of the Miscellaneous Amendments and Search Requirements revisions to 10 CFR 73.55 (51 FR 27817 and 27822) and to the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The combined set of plans, which contains Safeguards Information protected under 10 CFR 73.21, is entitled: "Arkansas Nuclear One Physical Security Plan, Training and Qualifications Plan, and Safeguards Contingency Plan," as submitted on May 4, 2006.

(8) Fire Protection

Entergy Operations, Inc. shall implement and maintain in effect all provisions of the approved fire protection program that comply with 10 CFR 50.48(a) and 10 CFR 50.48(c), as specified in the licensee amendment request dated January 29, 2014, and supplements dated May 19, 2015, June 16, 2015, July 21, 2015, August 12, 2015, September 22, 2015, November 4, 2015, November 17, 2015, January 15, 2016, March 25, 2016, April 7, 2016, May 19, 2016, and August 29, 2016, and as approved in the SE dated October 7, 2016. Except where NRC approval for changes or deviations is required by 10 CFR 50.48(c), and provided no other regulation, technical specification, license condition or requirement would require prior NRC approval, the licensee may make changes to the fire protection program without prior approval of the Commission if those changes satisfy the provisions set forth in 10 CFR 50.48(a) and 10 CFR 50.48(c), the change does not require a change to a technical specification or a license condition, and the criteria listed below are satisfied.

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 ANO-1. Acceptable methods to assess the risk of the change may include methods that have been used in the peer-reviewed fire PRA model, methods that have been approved by NRC through a plant-specific license amendment or NRC approval of generic methods specifically for use in NFPA 805 risk assessments, or methods that have been demonstrated to bound the risk impact.

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

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

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

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

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

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

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

   Prior NRC review and approval are not required for changes to the licensee's fire protection program that have been demonstrated to have no more than a minimal risk impact. The licensee may use its screening process as approved in the NRC SE dated October 7, 2016, to determine that certain fire protection program changes meet the minimal criterion. The licensee shall ensure that fire protection defense-in-depth and safety margins are maintained when changes are made to the fire protection program.

Transition License Conditions

1. Before achieving full compliance with 10 CFR 50.48(c), as specified by 2. below, risk-informed changes to the Entergy Operations, Inc. 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-1, "Plant Modifications," Attachment S, of Entergy Operations, Inc. letter 1CAN051602, dated May 19, 2016, prior to startup from the second refueling outage following issuance of the Safety Evaluation. The licensee shall maintain appropriate compensatory measures in place until completion of the modifications.

3. The licensee shall complete the implementation items as listed in Table S-2, "Implementation Items," Attachment S, of Entergy Operations, Inc. letter 1CAN051602, dated May 19, 2016, within six months after issuance of the Safety Evaluation.

(9) Mitigation Strategies

The licensee shall develop and maintain strategies for addressing large fires and explosions that include the following key areas:

1. Fire fighting response strategy with the following elements:
   (a) Pre-defined coordinated fire response strategy and guidance
   (b) Assessment of mutual aid fire fighting assets
   (c) Designated staging areas for equipment and materials
   (d) Command and control
   (e) Training of response personnel
2. Operations to mitigate fuel damage considering the following:
   (a) Protection and use of personnel assets
   (b) Communications
   (c) Minimizing fire spread
   (d) Procedures for implementing integrated fire response strategy
   (e) Identification of readily-available pre-staged equipment
   (f) Training on integrated fire response strategy
   (g) Spent fuel pool mitigation measures
3. Actions to minimize release to include consideration of:
   (a) Water spray scrubbing
   (b) Dose to onsite responders

(10) Upon implementation of Amendment 239 adopting TSTF-448, Revision 3, the determination of control room envelope (CRE) unfiltered air inleakage as required by SR 3.7.9.4, in accordance with Specifications 5.5.5.c.(i), 5.5.5.c.(ii), and 5.5.5.d, shall be considered met. Following implementation:

1. The first performance of SR 3.7.9.4, in accordance with Specification 5.5.5.c.(i), shall be within 15 months of the approval of TSTF-448. SR 3.0.2 will not be applicable to this first performance.

2. The first performance of the periodic assessment of CRE habitability, Specification 5.5.5.c.(ii), shall be within 15 months of the approval of TSTF-448. SR 3.0.2 will not be applicable to this first performance.

3. The first performance of the periodic measurement of CRE pressure, Specification 5.5.5.d, shall be within 15 months of the approval of TSTF-448. SR 3.0.2 will not be applicable to this first performance.

3. This renewed license is effective as of the date of issuance and shall expire at midnight, May 20, 2034.

FOR THE NUCLEAR REGULATORY COMMISSION

Original Signed by:
Jon R. Johnson

Jon R. Johnson, Acting Director
Office of Nuclear Reactor Regulation

Attachment:
Appendix A - Technical Specifications and
Technical Specifications Bases (ML011710071 and ML011710100)

Date of Issuance: June 20, 2001

5.0 ADMINSTRATIVE CONTROLS

5.4 Procedures

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

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

b. The emergency operating procedures required to implement the requirements of NUREG-0737 and NUREG-0737, Supplement 1, as stated in Section 7.1 of Generic Letter 82-33; and

c. Deleted

d. All programs specified in Specification 5.5.

SAFETY EVALUATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

TRANSITION TO A RISK-INFORMED, PERFORMANCE-BASED

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

AMENDMENT NO. 256 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-51

ENTERGY OPERATIONS, INC.,

ARKANSAS NUCLEAR ONE, UNIT 1

DOCKET NO. 50-313

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

SAFETY EVALUATION BY THE

OFFICE OF NUCLEAR REACTOR REGULATION

TRANSITION TO A RISK-INFORMED, PERFORMANCE-BASED

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

AMENDMENT NO. 256 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-51

ENTERGY OPERATIONS, INC.,

ARKANSAS NUCLEAR ONE, UNIT 1

DOCKET NO. 50-313

1.0 INTRODUCTION

1.1 Background

The U.S. Nuclear Regulatory Commission (NRC or the Commission) started developing fire protection requirements in the 1970s. In 1976, the NRC published comprehensive fire protection guidelines in the form of Branch Technical Position (BTP) Auxiliary and Power Conversion Systems Branch (APCSB) 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants" (Reference 1) and Appendix A to BTP APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants Docketed Prior to July 1, 1976" (Reference 2). Subsequently, the NRC performed fire protection reviews for the operating reactors and documented the results in safety evaluations (SEs) or supplements to SEs. In 1980, to resolve issues identified in those reports, the NRC amended its regulations for fire protection in operating nuclear power plants (NPPs) and published its Final Rule, Fire Protection Program for Operating Nuclear Power Plants, in the *Federal Register* (FR) on November 19, 1980 (45 FR 76602), adding Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.48, "Fire protection," and Appendix R to 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 requires each holder of an operating license, and holders of a combined operating license issued under Part 52 to have a fire protection plan that satisfies General Design Criterion (GDC) 3 of Appendix A to 10 CFR Part 50 and states that the fire protection plan must describe the overall fire protection program (FPP); identify the positions responsible for the program and the authority delegated to those positions; and outline the plans for fire protection, fire detection and suppression capability, and limitation of fire damage. Section 50.48(a)(2) states that the fire protection plan must describe the specific features necessary to implement the program described in paragraph (a)(1), including administrative controls and personnel requirements for fire prevention and manual suppression activities; automatic and manual fire detection and suppression systems; and the means to limit fire damage to structures, systems, and components (SSCs) to ensure the capability to safely

shut down the plant. Section 50.48(a)(3) requires that the licensee retain the fire protection plan and each change to the plan as a record until the Commission terminates the license, and that the licensee retain each superseded revision of the procedures for 3 years.

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

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

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

A licensee that elects to adopt NFPA 805 must meet the performance goals, objectives, and criteria that are itemized in Chapter 1 of NFPA 805 through the implementation of PB or deterministic approaches. The goals include ensuring that reactivity control, inventory and pressure control, decay heat removal, vital auxiliaries, and process monitoring are achieved and maintained. The licensee then must establish plant fire protection requirements using the methodology in Chapter 2 of NFPA 805 such that the minimum FPP elements and design criteria contained in Chapter 3 of NFPA 805 are satisfied. Next, the licensee identifies fire areas and fire hazards through a plant-wide analysis, and then applies either a PB or a deterministic approach to meet the performance criteria. As part of a PB approach, the licensee will use engineering evaluations, probabilistic safety assessments (PSAs), and fire modeling (FM) calculations to show that the criteria are met. Chapter 4 of NFPA 805 establishes the methodology to determine the fire protection systems and features required to achieve the performance criteria. It also specifies that at least one success path to achieve the nuclear safety performance criteria (NSPC) shall be maintained free of fire damage by a single fire.

RG 1.205 also states, in part that:

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

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

RG 1.205 also states, in part that:

> In parallel with the Commission's efforts to issue a rule incorporating the risk-informed, performance-based fire protection provisions of NFPA 805, NEI [Nuclear Energy Institute] published implementing guidance for the specific provisions of NFPA 805 and 10 CFR 50.48(c) in NEI 04-02 ["Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c)," Revision 2 (Reference 7)].

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

Accordingly, Entergy Operations, Inc. (Entergy, the licensee) requested a license amendment to allow it to establish and maintain the Arkansas Nuclear One, Unit 1 (ANO-1) FPP in accordance with 10 CFR 50.48(c) and change the Renewed Facility Operating License and Technical Specifications (TS) accordingly.

1.2 Requested Licensing Action

By letter dated January 29, 2014 (Reference 8), as supplemented by letters dated May 19, 2015 (Reference 9), June 16, 2015 (Reference 10), July 21, 2015 (Reference 11), August 12, 2015 (Reference 12), September 22, 2015 (Reference 13), November 4, 2015 (Reference 14), November 17, 2015 (Reference 15), January 15, 2016 (Reference 16), March 25, 2016 (Reference 17), April 7, 2016 (Reference 18), May 19, 2016 (Reference 19), and August 29, 2016 (Reference 20), the licensee submitted an application for a license amendment to transition the ANO-1 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 May 5, 2015 (Reference 21), May 8, 2015 (Reference 22), September 8, 2015

(Reference 23), October 6, 2015 (Reference 24), January 12, 2016 (Reference 25), and March 10, 2016 (Reference 26). The licensee's supplemental letters dated May 19, June 16, July 21, August 12, September 22, November 4, and November 17, 2015; and January 15, March 25, April 7, May 19, and August 29, 2016, provided additional information that clarified the application, but did not expand the overall scope of the application as originally noticed, and did not change the NRC staff's original proposed no significant hazards consideration determination as published in the FR on July 8, 2014 (79 FR 38589).

The licensee requested an amendment to the ANO-1 renewed facility operating license and TSs in order to establish and maintain an RI/PB FPP in accordance with the requirements of 10 CFR 50.48(c).

Specifically, the licensee requested to transition from the existing deterministic fire protection licensing basis established in accordance with the approved FPP as described in Appendix 9A, to the safety analysis report (SAR) for ANO-1, and as approved in the SE dated March 31, 1992 (Reference 27), to an RI/PB FPP in accordance with 10 CFR 50.48(c) that uses risk information, in part, to demonstrate compliance with the fire protection and nuclear safety goals, objectives, and performance criteria of NFPA 805. As such, the proposed FPP at ANO-1 is referred to as RI/PB throughout this SE.

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

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

1. The licensee has identified any orders, license conditions, and the TSs that must be revised or superseded, and that any necessary revisions are adequate, as required by 10 CFR 50.48(c)(3)(i);

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

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

The licensee proposed a new fire protection license condition reflecting the new RI/PB FPP licensing basis, as well as a revision to the TSs that address a 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 NPP fire protection. Section 50.48 includes specific requirements for requesting approval for an RI/PB FPP based on the provisions of NFPA 805 (Reference 3). Section 50.48(c)(3)(i) of 10 CFR states, in part:

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

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

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

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

> This paragraph requires licensees to complete all of the Chapter 2 methodology (including evaluations and analyses) and to modify their fire protection plan before making changes to the fire protection program or to the plant configuration. This process ensures that the transition to an NFPA 805 configuration is conducted in a complete, controlled, integrated, and organized manner. This requirement also precludes licensees from implementing NFPA 805 on a partial or selective basis (e.g., in some fire areas and not others, or truncating the methodology within a given fire area).

As stated in 10 CFR 50.48(c)(3)(i):

> The Director of the Office of Nuclear Reactor Regulation [(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 technical specifications that must be revised or superseded, and that any necessary revisions are adequate.

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

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

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

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

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

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

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

> 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 [the licensee refers to elements as echelons] is provided:
>
> (1) Preventing fires from starting;
>
> (2) Rapidly detecting fires and controlling and extinguishing promptly those fires that do occur, thereby limiting fire damage; and
>
> (3) Providing an adequate level of fire protection for structures, systems, and components important to safety, so that a fire that is not promptly extinguished will not prevent essential plant safety functions from being performed.

2.1 Other Applicable Regulations

The following regulations address fire protection:

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

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

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

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

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

- 10 CFR 50.48(c) incorporates NFPA 805 (2001 Edition) (Reference 3) by reference, with certain exceptions, modifications and supplementation. This regulation establishes the requirements for using an RI/PB FPP in conformance with NFPA 805 as a voluntary alternative to the requirements in 10 CFR 50.48(b) and Appendix R, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979," to 10 CFR Part 50, or the specific plant fire protection license condition.

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

2.2 Applicable Guidance

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

- RG 1.205, Revision 1, issued December 2009 (Reference 4), which provides guidance for use in complying with the requirements that the NRC has promulgated for RI/PB FPPs that comply with 10 CFR 50.48 and the referenced 2001 Edition of the NFPA standard. It endorses portions of NEI 04-02, Revision 2 (Reference 7), where it has been found to provide methods acceptable to the NRC for implementing NFPA 805 and complying with 10 CFR 50.48(c). The 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 regulatory positions, emphasizes certain issues, clarifies the requirements of 10 CFR 50.48(c) and NFPA 805, clarifies the guidance in NEI 04-02, and modifies the NEI 04-02 guidance where required. Should a conflict occur between NEI 04-02 and this RG, the 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), which specifies the minimum fire protection requirements for existing light water NPPs during all phases of plant operations, including shutdown, degraded conditions, and decommissioning. NFPA 805 was developed to provide a comprehensive RI/PB standard for fire protection. The NFPA 805 Technical Committee on Nuclear Facilities is composed of nuclear plant licensees, the NRC, insurers, equipment manufacturers, and subject matter experts. The standard was

developed in accordance with NFPA processes, and consisted of a number of technical meetings and reviews of draft documents by committee and industry representatives. The scope of NFPA 805 includes goals related to nuclear safety, radioactive release, life safety, and plant damage/business interruption. The standard addresses fire protection requirements for nuclear plants during all plant operating modes and conditions, including shutdown and decommissioning, which had not been explicitly addressed by previous requirements and guidelines. NFPA 805 became effective on February 9, 2001.

- NEI 04-02, "Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c)," Revision 2 (Reference 7), which provides guidance for implementing the requirements of 10 CFR 50.48(c), and represents methods for implementing in whole or in part an RI/PB FPP. This implementing guidance for NFPA 805 has two primary purposes: (1) 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, "Guidance for Post Fire Safe Shutdown Circuit Analysis," Revision 2 (Reference 28), provides a deterministic methodology for performing post-fire safe shutdown analysis (SSA). In addition, NEI 00-01 includes information on RI methods (when allowed within a plant's licensing basis) that may be used in conjunction with the deterministic methods for resolving circuit failure issues related to multiple spurious operations (MSOs). The RI method is intended for application by licensees to determine the risk significance of identified circuit failure issues related to MSOs. RG 1.205 indicates that Chapter 3 of NEI 00-01, Revision 2, when used in conjunction with NFPA 805 and RG 1.205, provides one acceptable approach to circuit analysis for a plant implementing an FPP under 10 CFR 50.48(c).

- RG 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," Revision 2, issued May 2011 (Reference 29), which provides the NRC staff's recommendations for using risk information in support of licensee-initiated licensing basis changes to a NPP that require such review and approval. The guidance provided does not preclude other approaches for requesting licensing basis changes. Rather, RG 1.174 is intended to improve consistency in regulatory decisions in areas in which the results of risk analyses are used to help justify regulatory action. As such, the RG provides general guidance concerning one approach that the NRC has determined to be acceptable for

analyzing issues associated with proposed changes to a plant's licensing basis and for assessing the impact of such proposed changes on the risk associated with plant design and operation.

- RG 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," Revision 2, issued March 2009 (Reference 30), 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 decision-making processes.

- American Society of Mechanical Engineers (ASME)/American Nuclear Society (ANS) RA-Sa-2009, "Addenda to ASME/ANS RA-S-2008, Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications" (Reference 31), which provides guidance related to PRAs used to support RI decisions for commercial light water reactor NPPs and prescribes a method for applying these requirements for specific applications. The standard gives guidance for a Level 1 PRA of internal and external hazards for all plant operating modes. In addition, the standard provides guidance for a limited Level 2 PRA sufficient to evaluate large early release frequency (LERF). The only hazards explicitly excluded from the scope are accidents resulting from purposeful human-induced security threats (e.g., sabotage). The standard applies to PRAs used to support applications of RI decision-making related to design, licensing, procurement, construction, operation, and maintenance.

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

- NUREG-0800, Section 9.5.1.2, "Risk-Informed, Performance-Based Fire Protection Program," Revision 0, issued December 2009 (Reference 33), provides the NRC staff with guidance for evaluating LARs that seek to implement an RI/PB FPP in accordance with 10 CFR 50.48(c).

- NUREG-0800, Section 19.1, "Determining the Technical Adequacy of Probabilistic Risk Assessment for Risk-Informed License Amendment Requests After Initial Fuel Load," Revision 3, issued September 2012 (Reference 34), provides the NRC staff with guidance for evaluating the technical adequacy of a licensee's PRA results when used to request RI changes to the licensing basis.

- NUREG-0800, Section 19.2, "Review of Risk Information Used to Support Permanent Plant-Specific Changes to the Licensing Basis: General Guidance," Revision 0, issued June 2007 (Reference 35), provides the NRC staff with guidance for evaluating the risk information used by a licensee to support permanent RI changes to the licensing basis.

- NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities," Volume 1 (Reference 36), Volume 2 (Reference 37), and Supplement 1 (Reference 38), which presents a compendium of methods, data and tools to perform a fire probabilistic risk assessment (FPRA) and develop associated insights. In order to address the need for improved methods, the NRC Office of Nuclear Regulatory Research (RES) and Electric Power Research Institute (EPRI) embarked upon a program to develop state-of-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 clarifications and additional information on recommended approaches, methods, and data for conduct of an FPRA.

- Memorandum from Richard P. Correia, RES, to Joseph G. Giitter, NRR, titled, "Interim Technical Guidance on Fire-Induced Circuit Failure Mode Likelihood Analysis," dated June 14, 2013 (Reference 39), notes that, based on new experimental information documented in NUREG/CR-6931, "Cable Response to Live Fire (CAROLFIRE)," issued April 2008 (Reference 40), and

NUREG/CR-7100, "Direct Current Electrical Shorting in Response to Exposure Fire (DESIREE-Fire): Test Results," issued April 2012 (Reference 41), the reduction in hot short probabilities for circuits provided with control power transformers (CPTs) identified in NUREG/CR-6850 cannot be repeated in experiments, and, therefore, may be too high and should be reduced.

- NUREG-1805, "Fire Dynamics Tools (FDTs): Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program" (Reference 42), which provides quantitative methods known as FDTs, to assist regional fire protection inspectors in performing fire hazard analysis. The FDTs are intended to assist fire protection inspectors in performing RI evaluations of credible fires that may cause critical damage to essential SSD equipment, as required by 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 43), which provide technical documentation regarding the predictive capabilities of a specific set of fire models for the analysis of fire hazards in NPP scenarios. This report is the result of a collaborative program with the EPRI and the National Institute of Standards and Technology (NIST). The selected models are:

  1. FDTs developed by NRC (Volume 3),

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

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

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

  5. The computational fluid dynamics model Fire Dynamics Simulator developed by NIST (Volume 7).

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

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

development of fire models to calculate the heat release rate (HRR) and flame spread of a cable fire.

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

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

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

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

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

- NFPA 30, "Flammable and Combustible Liquids Code" (Reference 50), provides requirements for the safe storage, handling, and use of flammable and combustible liquids.

- NFPA 51B, "Standard for Fire Prevention During Welding, Cutting, and Other Hot Work" (Reference 51), provides requirements for preventing injury, loss of life, and loss of property from fire or explosion as a result of hot work projects such as

welding, heat treating, grinding, and similar applications producing or using sparks, flames, or heat.

- NFPA 72, "National Fire Alarm and Signaling Code" (Reference 52), provides requirements for the application, installation, location, performance, inspection, testing, and maintenance of fire alarm systems, supervising station alarm systems, public emergency alarm reporting systems, fire warning equipment and emergency communications systems, and their components.

- NFPA 76, "Standard for the Fire Protection of Telecommunications Facilities" (Reference 53), provides requirements for fire protection of telecommunications facilities providing telephone, data, internet transmission, wireless, and video services as well as life safety for the occupants plus protection of equipment and service continuity.

- NFPA 241, "Standard for Safeguarding Construction, Alteration, and Demolition Operations" (Reference 54), provides requirements for preventing or minimizing fire damage to structures, including those in underground locations, during construction, alteration, or demolition.

- NFPA 262, "Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces" (Reference 55), provides a test procedure to evaluate the potential for smoke and fire spread along cables and wires housed in a plenum or other air transport spaces.

2.3 NFPA 805 Frequently Asked Questions

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

Table 2.3-1: NFPA 805 Frequently Asked Questions

FAQ #	FAQ Title and Summary	Reference	SE Section
06-0006	"High-Low Pressure Interfaces" • This FAQ provides clarification on the acceptability of using the methodology presented in NEI 00-01, "Guidance for Post-Fire Safe Shutdown Circuit Analysis," Revision 1, (Reference 56), for evaluating high-low pressure interfaces as a method for meeting the requirements of NFPA 805.	(Reference 57)	3.2.1.2
06-0020	"Applicable NFPA Standards" • This FAQ provides clarification of the term "applicable NFPA standards" as used in NFPA 805 Chapter 3.	(Reference 58)	3.1.1.2

FAQ #	FAQ Title and Summary	Reference	SE Section
06-0022	"Electrical Cable Flame Propagation Tests" This FAQ provides a list of acceptable electrical cable flame propagation tests.	(Reference 59)	3.1.4.3
07-0030	"Establishing Recovery Actions" • This FAQ provides an acceptable process for determining the recovery actions (RAs) for NFPA 805, Chapter 4 compliance. The process includes: ▪ Differentiation between RAs and activities in the main control room (MCR) or at primary control station(s) (PCS). ▪ Determination of which RAs are required by the NFPA 805 FPP. ▪ Evaluate the additional risk presented by the use of RAs. ▪ Evaluate the feasibility of the identified RAs. ▪ Evaluate the reliability of the identified RAs.	(Reference 60)	3.2.1.2 3.2.5 3.4.4 3.5.1.6 3.5.1.7
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 61)	3.2.4 3.2.7
07-0039	"Incorporation of Pilot Plant Lessons Learned – Table B-2" • This FAQ provides additional detail for the comparison of the licensee's SSD strategy to the endorsed industry guidance, NEI 00-01 Revision 1. In short, the process has the licensees: ▪ Assemble industry and plant-specific documentation; ▪ Determine which sections of the guidance are applicable; ▪ Compare the existing SSD methodology to the applicable guidance; and ▪ Document any discrepancies.	(Reference 62)	3.2.1

FAQ #	FAQ Title and Summary	Reference	SE Section
07-0040	"Non-Power Operations (NPOs) Clarifications" • This FAQ clarifies an acceptable NFPA 805 NPO program. The process includes: ▪ Selecting NPO equipment and cabling. ▪ Evaluation of NPO Higher Risk Evolutions (HRE). ▪ Analyzing NPO Key Safety Functions (KSFs). ▪ Identifying plant areas to protect or "pinch points" during NPO HREs and actions to be taken if KSFs are lost.	(Reference 63)	3.5.3 3.5.4
08-0048	"Revised Fire Ignition Frequencies" • This FAQ provides an acceptable method for using updated fire ignition frequencies in the licensee's FPRA. The method involves the use of sensitivity studies when the updated fire ignition frequencies are used.	(Reference 64)	3.4.7
08-0052	"Transient Fires - Growth Rates and Control Room Non-Suppression" • This FAQ clarifies and updates the treatment of transient fires in terms of both manual suppression and time-dependent fire growth modeling.	(Reference 65)	3.4.2.3.2
08-0054	"Compliance with Chapter 4 of NFPA 805" • This FAQ provides an acceptable process to demonstrate Chapter 4 compliance for transition: ▪ Step 1 – Assemble documentation ▪ Step 2 – Document Fulfillment of NSPC ▪ Step 3 – Variance From Deterministic Requirements (VFDR) Identification, Characterization, and Resolution Considerations ▪ Step 4 – PB Evaluations ▪ Step 5 – Final VFDR Evaluation ▪ Step 6 – Document Required Fire Protection Systems and Features	(Reference 66)	3.4.3 3.5.1.4
09-0056	"Radioactive Release Transition" • This FAQ provides an acceptable level of detail and content for the radioactive release section of the LAR. It includes: ▪ Justification of the compartmentation, if the radioactive release review is not performed on a fire area basis. ▪ Pre-fire plan and fire brigade training review results. ▪ Results from the review of engineering controls for gaseous and liquid effluents.	(Reference 67)	3.6.1

FAQ #	FAQ Title and Summary	Reference	SE Section
10-0059	"Monitoring Program" • This FAQ provides clarification regarding the implementation of an NFPA 805 monitoring program for transition. It includes: ▪ Monitoring program analysis units; ▪ Screening of low safety significant SSCs; ▪ Action level thresholds; and ▪ The use of existing monitoring programs.	(Reference 68)	3.7.1
12-0062	"Updated Final Safety Analysis Report (UFSAR) Content" • This FAQ provides the necessary level of detail for the transition of the fire protection sections within the UFSAR.	(Reference 69)	2.4.4
12-0064	"Hot Work/Transient Fire Frequency Influence Factors" • This FAQ clarifies and updates the treatment of hot work and transient fire frequency influence factors. The updated treatment involves the use of sensitivity studies when the updated influence factors are used.	(Reference 70)	3.4.2.2
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 71)	3.4.2.2 3.4.2.3.2
14-0009	"Treatment of Well Sealed MCC [(Motor Control Center)] Electrical Panels Greater Than 440V [(440 Volt)]" • This FAQ provides clarification for the treatment of fire propagation from well-sealed MCC electrical cabinets with voltage levels at 440V or greater.	(Reference 72)	3.4.2.2

2.4 Orders, License Conditions and Technical Specifications

Section 50.48(c)(3)(i) of 10 CFR states, in part, that the LAR, "... must identify any orders and license conditions that must be revised or superseded, and contain any necessary revisions to the plant's technical specifications 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 ANO-1 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 ANO-1 are maintained. The licensee discussed the affected orders and exemptions in LAR Attachment O.

The licensee conducted a review of docketed correspondence by performing electronic searches of the docketed correspondence files by using the Entergy Licensing Research System (Autonomy), which contains site licensing documents, including documents pertaining to the operating license, the TS, the FPP, the SAR, correspondence sent to the NRC, and correspondence received from the NRC. The licensee stated that correspondence sent to the NRC includes any outstanding LAR submittals. The licensee also conducted a review to ensure that compliance with the physical protection requirements, security orders, and adherence to those commitments applicable to the plant are maintained.

The licensee determined that no orders need to be superseded or revised to implement an FPP that complies with 10 CFR 50.48(c). The NRC staff accepts the licensee's determination that no orders need to be superseded or revised to implement NFPA 805 at ANO-1.

The licensee also 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 ANO-1. The licensee's review of the Order demonstrated that changes to the FPP during transition to NFPA 805 will not affect the measures required by Section B.5.b of Commission Order EA-02-026 (10 CFR 50.54(hh)(2)). The licensee will continue to have strategies that address large fires and explosions including a firefighting response strategy, operations to mitigate fuel damage, and actions to minimize release upon transition to NFPA 805. The NRC staff concludes that the licensee's determination in regard to Commission Order EA-02-026 (10 CFR 50.54(hh)(2)) is acceptable.

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 ANO-1 fire protection license condition in order to adopt NFPA 805, as required by 10 CFR 50.48(c)(3).

The NRC staff reviewed the revised license condition, which supersedes the current ANO-1 fire protection license condition, for consistency with the format and content guidance described in RP C.3.1 of RG 1.205, Revision 1, and with the proposed plant modifications identified in the LAR.

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

The revised license condition also defines the limitations imposed on the licensee during the transition phase of plant operations when the physical plant configuration does not fully match the configuration represented in the fire risk analysis. The limitations on self-approval are required because NFPA 805 requires that the risk analyses be based on the as-built,

as-operated and maintained plant, and reflect the operating experience at the plant. Until the proposed implementation items and plant modifications are completed, the risk analysis is not based on the as-built, as-operated and maintained plant.

Overall, the licensee's proposed revised license condition would provide structure and detailed criteria to allow self-approval for FPP changes that meet the requirements of NFPA 805 with regard to engineering analyses, fire risk evaluations (FREs) and plant change evaluations (PCEs). The NRC staff's evaluation of the self-approval process for FPP changes (post-transition) is contained in SE Section 2.6. The license conditions also reference the plant-specific modifications and associated implementation schedules that must be accomplished at ANO-1 to complete transition to NFPA 805 and comply with 10 CFR 50.48(c). The license conditions also include a requirement that appropriate compensatory measures will remain in place until implementation of the specified plant modifications is completed. These modifications and implementation schedules are the same as those identified elsewhere in the LAR, as discussed in SE Section 2.7.

SE Section 4.0 provides the NRC staff's review of the proposed ANO-1 FPP license conditions.

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 change to the ANO-1 TSs that are being revised or superseded during the NFPA 805 transition process. According to the LAR, the licensee conducted a review of the ANO-1 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 a change to the TSs needed for ANO-1's adoption of the new fire protection licensing basis and provided applicable justification listed in LAR Attachment N. The licensee identified one change to the TSs that involved deleting TS 5.4.1.c, which requires that procedures be established, implemented, and maintained for FPP implementation.

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

Based on the information provided by the licensee, the NRC staff concludes that the proposed deletion is acceptable because TS 5.4.1.c is an administrative control (i.e., a procedure the licensee puts in place to establish, implement, and maintain the FPP as required by the licensee's fire protection license condition and 10 CFR 50.48(a), 10 CFR 50.48(c), and NFPA 805, Section 3.2.3), and therefore, would be redundant to the NFPA 805 requirement to establish FPP procedures. NFPA 805 requires the licensee to establish FPP procedures, and 10 CFR 50.48(a) and 10 CFR 40.48(c) would become the fire protection licensing basis of ANO-1. In addition, failure by the licensee to establish FPP procedures would result in non-compliance with 10 CFR 50.48(c)(1), which is the licensee's fire protection licensing basis. Changes to fire protection administrative controls are controlled by the proposed fire protection

license condition. For the NRC staff's evaluation of the proposed license condition, see SE Section 4.0.

2.4.4 Safety Analysis Report

In LAR Section 5.4, "Revision to the SAR", the licensee stated that after approval of the LAR and in accordance with 10 CFR 50.71(e), the ANO-1 SAR will be revised. The licensee also stated that the format and content will be consistent with NEI 04-02, as addressed in FAQ 12-0062 (Reference 69).

The NRC staff concludes that the licensee's method to update the SAR is acceptable because the licensee updates its SAR in accordance with 10 CFR 50.71(e) and has stated that the format and content of the update will be consistent with the guidance provided in FAQ 12-0062.

2.5 Rescission of Exemptions

ANO-1 was licensed to operate on May 21, 1974, and, therefore, the FPP is based on compliance with Appendix A to APCSB 9.5-1, 10 CFR 50.48(b) (Appendix R, Sections III.G, III.J, and III.O), and the ANO-1 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 the transition to an FPP licensing basis in conformance with NFPA 805 will supersede. These exemptions will no longer be required because upon approval of the RI/PB FPP, in accordance with NFPA 805, Appendix R will not be part of the licensing basis for ANO-1.

The licensee previously requested and received NRC approval for 21 exemptions from 10 CFR Part 50 Appendix R. These exemptions were discussed in detail in LAR Attachment K. The licensee requested that the exemptions be rescinded and that the underlying engineering evaluation for 1 of the 21 exemptions be transitioned to the new licensing basis under 10 CFR 50.48(a) and 10 CFR 50.48(c) as previously approved (NFPA 805, Section 2.2.7) and compliant with the new regulation.

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

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

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

The following exemptions are rescinded as requested by the LAR and the underlying condition has been evaluated using RI/PB methods and found to be acceptable with no further actions

because the philosophy of DID and sufficient safety margins are maintained (numbering scheme provided by the licensee):

- Exemption 01, Exemption from Appendix R, Section III.G.2 requirement to provide automatic suppression below Elevation 354 feet of the intake structure.

- Exemption 02, Exemption from the Appendix R, Section III.G.2 requirement to provide 20-foot separation and automatic suppression at Elevation 354 feet of the intake structure.

- Exemption 03, Exemption from the Appendix R, Section III.G.2 requirement to provide 20-foot separation and automatic suppression at Elevation 366 feet of the intake structure.

- Exemption 04, Exemption from the Appendix R, Section III.G.2 requirement to provide 20-foot separation, 1-hour fire barrier, and automatic suppression and detection in manholes.

- Exemption 05, Exemption from the Appendix R, Section III.G.2 requirement to provide automatic suppression in the waste monitor tank room.

- Exemption 06, Exemption from the Appendix R, Section III.G.2 requirement to provide automatic suppression in the makeup pump room and adjacent corridor.

- Exemption 07, Exemption from the Appendix R, Section III.G.2 requirement to provide 20-foot separation for the power cables for the decay heat valves in Fire Zone 32-K.

- Exemption 08, Exemption from the Appendix R, Section III.G.2 requirement to provide automatic suppression in Fire Zone 34-Y.

- Exemption 09, Exemption from the Appendix R, Section III.G.2 requirement to provide automatic suppression in Fire Zone 40-Y.

- Exemption 10, Exemption from the Appendix R, Section III.G.3 requirement to provide automatic suppression and detection in Fire Zone 53-Y.

- Exemption 11, Exemption from the Appendix R, Section III.G.3 requirement to provide automatic suppression and detection in Manholes MH09 and MH10.

- Exemption 12, Exemption from the Appendix R, Section III.L requirement to provide 72-hour cold shutdown capability.

- Exemption 13a, Exemption from the Appendix R, Section III.G.2.b requirement to provide 20-foot separation in the emergency diesel generator (EDG) room.

- Exemption 13b, Exemption from the Appendix R, Section III.G.2.b requirement to provide 20-foot separation in the EDG room.

- Exemption 14, Exemption from the Appendix R, Section III.G.2.b requirement to provide 20-foot separation in the radwaste processing area.

- Exemption 15, Exemption from the Appendix R, Section III.G.2.b requirement to provide 20-foot separation in the emergency feedwater pump room.

- Exemption 16, Exemption from the Appendix R, Section III.G.2.c requirement to provide automatic suppression in the pipe area.

- Exemption 17, Exemption from the Appendix R, Section III.J requirement to provide 8-hour battery powered emergency lighting on Elevation 317 feet and portions of the access paths to the steam pipe area on Elevation 404 feet, the intake structure, and the diesel fuel storage vault.

- Exemption 18, Exemption from the Appendix R, Section III.G.2 requirement to provide a 3-hour rated barrier between redundant level transmitters for the safety grade condensate storage tank.

- Exemption 20, Exemption from the Appendix R, Section III.G.2.b requirement to provide automatic suppression to protect emergency feedwater pump cables.

The following exemption is rescinded, but the engineering evaluation of the underlying condition will be used as a qualitative engineering evaluation for transition to NFPA 805 (see SE Section 3.5.1.3):

- Exemption 19, Exemption from the Appendix R, Section III.O requirement to provide a reactor coolant pump (RCP) oil collection system designed to withstand a safe shutdown earthquake and sized to hold the oil from all RCPs.

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

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

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

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

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

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

2.6.1 Post-Implementation Plant Change Evaluation Process

The NRC staff reviewed LAR Section 4.7.2, "Compliance with Configuration Control Requirements in Section 2.2.9 and 2.7.2 of NFPA 805," for compliance with the NFPA 805 PCE requirements to address potential changes to the NFPA 805 RI/PB FPP after implementation is completed. The licensee will develop a change process that is based on the guidance provided in NFPA 805, Sections 2.2(h), 2.2.9, 2.4.4, A.2.2(h), A.2.4.4, and D.5; NEI 04-02, Revision 2 (Reference 7), Section 5.3, "Plant Change Process"; as well as Appendices B, I, and J; and RG 1.205 (Reference 4), RPs 2.2.4, 3.1, 3.2, and 4.3.

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

1. Defining the Change,
2. Performing the Preliminary Risk Screening,
3. Performing the Risk Evaluation, and
4. Evaluating the Acceptance Criteria.

In the LAR, the licensee stated that the PCE process begins by defining the change or altered condition in the LAR to be examined and the baseline configuration. The baseline is defined by the licensing basis. The licensee also stated that the baseline is defined as that plant condition or configuration that is consistent with the licensing basis and that the changed or altered condition or configuration that is not consistent with the licensing basis is defined as the proposed alternative.

The licensee stated that once the definition of the change is established, a screening is then performed to identify and resolve minor changes to the FPP and the screening is consistent with fire protection regulatory review processes currently in place at nuclear plants under traditional licensing bases. The licensee further stated that the screening process is modeled after NEI 02-03, "Guidance for Performing a Regulatory Review of Proposed Changes to the Approved Fire Protection Program," June 2003 (Reference 73), and that the process will address most administrative changes (e.g., changes to the combustible control program, organizational changes, etc.).

The licensee stated that the screening is followed by engineering evaluations that may include FM and risk assessment techniques and the results of these evaluations are then compared to the acceptance criteria. The licensee further stated that changes that satisfy the acceptance criteria of NFPA 805, Section 2.4.4, and the license condition (see LAR Attachment M) can be implemented within the framework provided by NFPA 805, and that the changes that do not satisfy the acceptance criteria cannot be implemented within this framework. The licensee further stated that the acceptance criteria require that the resultant change in core damage frequency (CDF) and LERF be consistent with the license condition, and the acceptance criteria

also include consideration of DID and safety margin, which would typically be qualitative in nature.

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

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

The licensee stated its FPP configuration is defined by the program documentation and, to the greatest extent possible, the existing configuration control processes for modifications, calculations and analyses, and FPP license basis reviews, will be utilized to maintain configuration control of the FPP documents. The licensee further stated the configuration control procedures, which govern the various ANO-1 documents and databases that currently exist, will be revised to reflect the new NFPA 805 licensing bases requirements. This action is included in LAR Attachment S, "Plant Modifications and Items to be Completed During Implementation," Table S-2, Implementation Item S2-6, and the NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

The licensee stated that several NFPA 805 document types, such as NSCA supporting information and non-power mode NSCA treatment, etc., generally require new control procedures and processes to be developed since they are new documents and databases created as a result of the transition to NFPA 805. The licensee further stated the new procedures will be modeled after the existing processes for similar types of documents and databases, and system level design basis documents will be revised to reflect the NFPA 805 role that the system components now play. This action is included in Implementation Item S2-6, which is included in LAR Attachment S, Table S-2. 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 conditions.

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

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

- PB Approach: Utilize the NFPA 805 change process developed in accordance with NEI 04-02, RG 1.205, and the ANO-1 NFPA 805 fire protection license condition to assess the acceptability of the proposed change. This process would be used to determine if the proposed change could be implemented "as-is" or whether prior NRC approval of the proposed change is required.

The licensee stated that this process follows the requirements in NFPA 805 and the guidance outlined in RG 1.174, Revision 2 (Reference 29), which requires the use of qualified individuals, procedures that require calculations to 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 ANO-1 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. NFPA 805, Section 2.4.4 requires that PCEs consist of an integrated assessment of risk, DID, and safety margins. NFPA 805, Section 2.4.3.1 requires that the PSA use CDF and LERF as measures for risk. NFPA 805, Section 2.4.3.3 requires that the risk assessment approach, methods, and data be acceptable to the Authority Having Jurisdiction (AHJ), which is the NRC. NFPA 805, Section 2.4.3.3 also requires that the PSA be appropriate for the nature and scope of the change being evaluated, be based on the as-built and as-operated and maintained plant, and reflect the operating experience at the plant.

The licensee's PCE process includes the required delta risk calculations, uses risk assessment methods acceptable to the NRC, uses appropriate risk acceptance criteria in determining acceptability, involves the use of an FPRA of acceptable quality, and includes an integrated assessment of risk, DID, and safety margins as discussed above.

2.6.2 Requirements for the Self-Approval Process Regarding Plant Changes

Risk assessments performed to evaluate PCEs must use methods that are acceptable to the NRC staff. Acceptable methods to assess the risk of the proposed plant change may include methods that have been (1) used in developing the peer-reviewed FPRA model, (2) approved by the NRC via a plant-specific license amendment or through NRC approval of generic methods specifically for use in NFPA 805 risk assessments, or (3) demonstrated to bound the risk impact.

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

However, before achieving full compliance with 10 CFR 50.48(c) by implementing the plant modifications 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 condition requires the licensee to ensure that fire protection DID and safety margins are maintained during the transition process. The "Transition License Conditions" in the proposed NFPA 805 license condition include the appropriate acceptance criteria and other attributes to form an acceptable method for meeting 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 RI, basis. Specifically, the license condition states that prior NRC review and approval are not required for changes to the NFPA 805, Chapter 3 fundamental FPP elements and design requirements for which an engineering evaluation demonstrates that the alternative to the NFPA 805, Chapter 3 element is functionally equivalent or adequate for the hazard.

The licensee may use an engineering evaluation to demonstrate that a change to an NFPA 805, Chapter 3 element is functionally equivalent to the corresponding technical requirement. A qualified fire protection engineer shall perform the engineering evaluation and conclude that the change has not affected the functionality of the component, system, procedure, or physical arrangement (i.e., has not impacted its contribution toward meeting the nuclear safety and radioactive release performance criteria), using a relevant technical requirement or standard.

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

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

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

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

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

According to the LAR, the licensee intends to use an FPRA to evaluate the risk of proposed future plant changes. 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 is sufficient to support self-approval of future RI changes to the FPP under the proposed license condition and, therefore, the NRC staff concludes that the licensee's process for self-approving future FPP changes is acceptable.

The NRC staff also concludes that the FRE methods used at ANO-1 to model the cause-and-effect relationship of associated changes as a means of assessing the risk of plant

changes during transition to NFPA 805 may continue to be used after implementation of the RI/PB FPP, based on the licensee's administrative controls to ensure that the models remain current and to assure continued quality (see SE Section 3.4.2). Accordingly, these cause-and-effect relationship models may be used after transition to NFPA 805 as a part of the FREs conducted to determine the change in risk associated with proposed plant changes.

2.7 Modifications and Implementation Items

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

The list of modifications and implementation items originally submitted in the LAR have been updated by the licensee in the final version of LAR Attachment S, "Plant Modifications and Items to be Completed during Implementation," provided in the licensee's letter dated May 19, 2016 (Reference 19).

2.7.1 Modifications

The NRC staff reviewed LAR Attachment S, as supplemented, 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 ANO-1 into compliance with either the deterministic or PB requirements of NFPA 805. As described below, LAR Attachment S, Table S-1, "Plant Modifications," provides a description of each of the proposed plant modifications, presents the problem statement explaining why the modification is needed, and identifies the compensatory actions required to be in place pending completion and implementation of the modification.

The NRC staff confirmed that the modifications identified in LAR Attachment S, Table S-1 are the same as those identified in LAR Attachment C, Table B-3, "Fire Area Transition," on a fire area basis, as the modifications being credited in the proposed NFPA 805 licensing basis. The NRC staff also confirmed that LAR Attachment S, Table S-1 modifications and the associated completion schedule are the same as those provided in the proposed NFPA 805 license condition.

LAR Attachment S, Table S-1 provides a detailed listing of the plant modifications that must be completed in order for ANO-1 to be in full accordance with NFPA 805, implements many of the attributes upon which this SE is based, and thereby meet the requirements of 10 CFR 50.48(c). The modifications will be completed in accordance with the schedule provided in the proposed NFPA 805 license condition, which states that all modifications will be completed prior to startup of the second refueling outage following issuance of the SE. In addition, the licensee agreed to keep the appropriate compensatory measures in place until the modifications are complete.

2.7.2 Implementation Items

Implementation Items are items that the licensee has not fully completed or implemented as of the issuance date of the license amendment, but which will be completed during implementation of the license amendment to transition to NFPA 805 (e.g., procedure changes that are still in process, or NFPA 805 programs that have not been fully implemented). The licensee identified the implementation items in LAR Attachment S, Table S-2. 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), which states that the licensee will implement the items listed in LAR Attachment S, Table S-2, within six months after issuance of the license amendment.

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

2.7.3 Schedule

LAR Section 5.5, "Transition Implementation Schedule," supplemented by the licensee's letter dated May 19, 2016 (Reference 19), provides the overall schedule for completing the NFPA 805 transition at ANO-1. The licensee stated that implementation of the new NFPA 805 FPP to include procedure changes, process updates, and training to affected plant personnel will occur within six months after issuance of the license amendment.

LAR Section 5.5, supplemented by the licensee's letter dated May 19, 2016 (Reference 19), also states that modifications will be completed prior to startup from the second refueling outage following issuance of the SE, and that appropriate compensatory measures will be maintained until the modifications are complete.

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

3.0 TECHNICAL EVALUATION

The following sections evaluate the technical aspects of the LAR to transition the FPP at ANO-1 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 used the guidance provided in NUREG-0800, Section 9.5.1.2, "Risk Informed, Performance-Based Fire Protection" (Reference 33), to determine whether the licensee had provided sufficient information in both scope and level of detail to adequately demonstrate compliance with the requirements of NFPA 805, as well as the other associated regulations and guidance documents discussed in SE Section 2.0. Specifically:

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

- Section 3.2 provides the results of the NRC staff review of the methods used by the licensee to demonstrate the ability to meet the NSPC.

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

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

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

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

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

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

SE Attachments A and B provide additional detailed information that was evaluated by the NRC staff during the course of the review 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 FPP and Design Elements

NFPA 805, Chapter 3 (Reference 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 provided a license amendment is granted and the approach satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains safety margins, and maintains fire protection defense-in-depth.

Furthermore, Section 3.1 of NFPA 805 specifically allows the use of alternatives to the NFPA 805, Chapter 3 fundamental FPP requirements that have been previously approved by the NRC (the AHJ as denoted in NFPA 805, and RG 1.205, Revision 1 (Reference 4)), 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, to assess the proposed ANO-1 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 ANO-1 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, and others are provided with multiple compliance statements to fully document compliance with the element.

The methods used 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 FP [Fire Protection] Program and Design Elements," as "Complies." (See discussion in SE Section 3.1.1.1.)

2. The existing FPP element complies through the use of existing engineering equivalency evaluations (EEEEs) whose bases remain valid and are of sufficient quality: noted in LAR Attachment A, Table B-1 as "Complies via Engineering Evaluation." (See discussion in SE Section 3.1.1.2.)

3. 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 via Previous Approval." (See discussion in SE Section 3.1.1.3.)

4. 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 "License Amendment Required." (See discussion in SE Section 3.1.1.4)

The NRC staff determined that, taken together, these methods compose an acceptable approach for documenting compliance with the NFPA 805, Chapter 3 requirements because the licensee followed the compliance strategies identified in the NRC-endorsed NEI 04-02 guidance document. The process defined in the endorsed guidance provides an organized structure to document each attribute in NFPA 805, Chapter 3, allowing the licensee to provide significant detail on how the program meets the requirements. In addition to the basic strategy of "Complies," which itself makes the attribute able to be both audited and inspected, 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," as supplemented, that it evaluated the EEEEs used to demonstrate compliance with the NFPA 805, Chapter 3 requirements in order to ensure continued appropriateness, quality, and applicability to the current plant configuration. The licensee determined that no EEEEs used to support compliance with NFPA 805 required NRC approval.

EEEEs (previously known as GL 86-10 (Reference 74) 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.

In reviewing the licensee's methods for determining compliance with NFPA 805 Chapter 3 elements, the NRC staff identified that the licensee cited NFPA code evaluations in the Compliance Basis in LAR Attachment A for both "Complies" and "Complies with Use of EEEEs" compliance statements. In Fire Protection Engineering (FPE) RAI 04 by letter dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee confirm that those elements associated with the "Complies" statements, and that describe the compliance basis as a code evaluation have been determined to meet all applicable codes or compliance standards as determined by the referenced code evaluation. In its response to FPE RAI 04 by letter dated June 16, 2015 (Reference 10), the licensee stated that the code compliance evaluations associated with the NFPA 805 Chapter 3 sections listed in the LAR Attachment A that utilize a compliance statement of 'Complies' and describe the compliance basis as a code evaluation were reviewed to determine if the code compliance evaluations were fully compliant. The licensee stated that the review determined the following LAR Attachment A sections are associated with code compliance evaluations that are not fully compliant (i.e., justified compliance is utilized):

- 3.4.1(a)
- 3.4.1(a)(1)
- 3.4.3
- 3.4.3(a)(1)
- 3.4.3(a)(2)
- 3.4.3(a)(3)
- 3.4.3(a)(4)
- 3.4.3(c)(1)
- 3.4.3(c)(2)
- 3.4.3(c)(3)
- 3.4.3(c)(4)
- 3.4.3(c)(5)
- 3.4.4
- 3.5.4
- 3.5.5
- 3.5.6
- 3.5.7
- 3.5.8
- 3.5.9
- 3.6.2
- 3.6.3
- 3.9.5
- 3.10.1
- 3.10.1(2)
- 3.10.2
- 3.10.3
- 3.10.5
- 3.10.9
- 3.10.10

The licensee stated that the compliance statement for the listed sections (above) should be changed from "Complies" to "Complies with use of EEEEs." In addition, the licensee stated that code compliance evaluations were performed for the following NFPA 805 Chapter 3 sections and not included in the compliance basis section:

- 3.4.1(b)
- 3.4.1(c)
- 3.4.1(d)
- 3.4.1(e)
- 3.9.2
- 3.9.3

The licensee stated that the compliance statement for the listed sections (above) should be changed from "Complies" to "Complies with use of EEEEs." The licensee stated that with regard to the above reviews and changes, the compliance statement for certain NFPA 805, Chapter 3 sections stated "Complies" and referenced an ANO code compliance report. The licensee stated that when performing the initial code compliance reports, in some instances (but not all) "Justified Compliance" was used for the code section compliance bases and in support of this RAI response, the use of "Justified Compliance" has been conservatively interpreted as use of EEEEs. Therefore, the licensee requested the revised classifications reflected above be used in lieu of those contained in the original LAR.

In its response to FPE RAI 04, the licensee stated that code compliance evaluations were performed for NFPA 805 Sections 3.4.1(b), 3.4.1(c), 3.4.1(d), 3.4.1(e) and the compliance statement was changed to "Complies with Use of EEEEs"; however, these sections address specific requirements for the industrial fire brigade members and do not specify an NFPA code as a means to satisfy the requirements. The calculation referenced by the licensee in its response, and reviewed by the NRC staff, compares the ANO fire brigade to NFPA 600, "Standard on Industrial Fire Brigades" (Reference 75); however, there is not a one-for-one correlation between the requirements in NFPA 805 Sections 3.4.1(b), 3.4.1(c), 3.4.1(d), 3.4.1(e) and NFPA 600. In FPE RAI 04.01 by e-mail dated September 8, 2015 (Reference 23), the NRC requested that the licensee describe how the NFPA code evaluation addresses the specific requirements contained in NFPA 805 Sections 3.4.1(b), 3.4.1(c), 3.4.1(d), 3.4.1(e). In addition, the NRC requested that the licensee clarify if the NFPA code evaluation will replace or supplement the compliance statements in the "Compliance Basis" section of LAR Attachment A and the licensee's response to FPE RAI 02 by letter dated May 19, 2015 (Reference 9), which addressed compliance with NFPA 805 Section 3.4.1(c).

In its response to FPE RAI 04.01 by letter dated September 22, 2015 (Reference 13), the licensee stated, in part, that:

- NFPA 805 Code section 3.4.1(b). The NFPA 600 code evaluation will not be used as a reference and will not replace or supplement the compliance statements for NFPA [805] Code Section 3.4.1(b). The original LAR submitted Compliance Statement, Compliance Basis, and Reference Document will remain unchanged.

- NFPA [805] Code section 3.4.1(c). The NFPA 600 code evaluation will not be used as a reference and will not replace or supplement the compliance statements for NFPA [805] Code Section 3.4.1(c). The Compliance Statement, Compliance Basis, and Reference Documents should be comprised of the original LAR submitted Compliance Statement, Compliance Basis, and Reference Document as supplemented by the response to FPE RAI 02. The response to FPE RAI 02 will remain as originally submitted.

- NFPA [805] code section 3.4.1(d). The NFPA 600 code evaluation will not be used as a reference and will not replace or supplement the compliance statements for NFPA [805] code section 3.4.1(d). The original LAR submitted Compliance Statement and Compliance Basis will remain unchanged.

- NFPA [805] Code section 3.4.1(e). The NFPA 600 code evaluation will be used as a supplemental reference and will not replace or supplement the compliance statements or NFPA [805] Code Section 3.4.1(e). The original LAR submitted Compliance Statement and Compliance Basis will remain unchanged. ...ANO Code Compliance Report for NFPA 600, 2000 Edition, Rev. 1, will be added to the Reference Documents.

In LAR Attachment A, the compliance statements for several NFPA 805 Sections are listed as "Complies" or "Complies with EEEE," but the compliance basis includes a citation or discussion of previous NRC approval and references the original Safety Evaluation Report (SER) dated August 22, 1978 (Reference 76). In FPE RAI 06 dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee clarify the compliance basis for several elements of NFPA 805, Chapter 3, and describe what portion, if any, is based on previous NRC approval. In its response to FPE RAI 06 dated June 16, 2015 (Reference 10), the licensee provided revised compliance basis statements for LAR Attachment A, elements 3.5.4, 3.5.5, 3.5.6, 3.5.8, 3.5.10, 3.6.1, 3.6.2, 3.6.3, 3.7, 3.8.1, 3.9.5, 3.10.1, 3.11.2, 3.11.3, 3.11.4, 3.11.4(a), and 3.11.4(b) that stated the ANO-1 Amendment No. 35 SER is considered for information only and does not support compliance. In addition, the licensee revised the compliance statement for LAR Attachment A, elements 3.5.7 and 3.6.1, to "Complies by previous NRC approval," and "Complies with Clarification," respectively. The compliance statement for element 3.5.7 was previously revised to "Complies with use of EEEE" in the licensee's response to FPE RAI 04 as discussed above.

In FPE RAI 06.01 dated September 8, 2015 (Reference 23), the NRC staff requested additional clarification related to the licensee's proposed compliance statement changes for NFPA 805, Sections 3.5.7, 3.6.1, and 3.11.2 based on the licensee's response to FPE RAI 06. Specifically, for Section 3.5.7, the NRC staff requested clarification between the response to FPE RAI 04 that changed the compliance statement to "Complies with use of EEEEs" and the response to FPE RAI 06 that changed the compliance statement to "Complies by previous NRC approval," and also to provide the citations from the NRC SER that demonstrate previous approval. For Section 3.6.1, the licensee revised the compliance statement from "Complies with use of EEEEs," to "Complies with Clarification" in its response to FPE RAI 06 and the NRC requested that the licensee provide a more appropriate compliance statement because the compliance basis provided by the licensee does not meet the guidance in NEI 04-02 to be considered a clarification. For Section 3.11.2, the licensee revised the compliance basis statement in response to FPE RAI 06 and the NRC staff requested clarification if the compliance basis statement in the RAI response replaced the statement in LAR Attachment A in its entirety and, also, requested confirmation that the associated modification in LAR Attachment S, Table S-1, Modification Item S1-31 was still applicable. In its response to FPE RAI 06.01 dated September 22, 2015 (Reference 13), the licensee confirmed that the compliance basis for NFPA 805, Section 3.5.7, as revised in FPE RAI 06, should be "Complies by previous NRC approval" and the licensee also provided the citation from the NRC SER that supports the determination of previous approval. In its revised response to FPE RAI 06.01b dated November 17, 2015 (Reference 15), the licensee stated that the compliance statement for NFPA 805, Section 3.6.1 should be "Complies with use of EEEEs" and the compliance basis should be revised to state, "The standpipe and hose systems at ANO are Class II and have been evaluated by the NFPA 14 Code Compliance Evaluation." In its revised response to FPE RAI 06.01c dated November 17, 2015 (Reference 15), the licensee stated that the compliance statement for NFPA 805, Section 3.11.2, should be revised to both "Complies by previous NRC approval" and "Complies." The licensee further stated that those fire barriers, which were enveloped by the NRC SER Amendment No. 35 for ANO-1, fall under the "Complies by previous NRC approval" portion of the statement; however, other existing fire barriers have since been added to the program and credited, which were not considered in Amendment No. 35. The licensee stated that these fire barriers (wall, floor, ceiling), as described in the initial

response to FPE RAI 06.01 (Reference 13), were evaluated in Engineering Change EC-1527 and EC-1956 to document acceptability with regard to the 3-hour fire rating requirement. The licensee stated that the barrier penetration items (doors, seals, ducts, etc.) will be inspected and modified, or provided with an adequate-for-the-hazard evaluation, as part of the effort identified in LAR Attachment S, Table S-1, Modification Item S1-31.

Based on the information provided by the licensee, the NRC staff concludes that the licensee's responses to FPE RAIs 04, 04.01, 06, and 06.01 are acceptable because the licensee demonstrated that its compliance statements and bases for the applicable NFPA 805 sections discussed in the RAIs are in accordance with the guidance contained in RG 1.205 and NEI 04-02 regarding the methods and compliance strategies for demonstrating compliance with NFPA 805, Chapter 3.

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 the bases remain valid. The results of these licensing action evaluations are provided in LAR Attachment K.

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

3.1.1.1 Compliance Strategy - Complies

For the majority of NFPA 805, Chapter 3 requirements, as modified by 10 CFR 50.48(c)(2), the licensee determined that the RI/PB FPP complies directly with the fundamental FPP element using the existing FPP element. In these instances, based on the information provided by the licensee, 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, and the applicable implementation item described in LAR Attachment S, Table S-2, required additional review by the NRC staff:

- 3.2.3(3)
- 3.4.1(c)

NFPA 805, Section 3.2.3(3) requires procedures be established to perform reviews of FPP related performance and trends. The licensee identified an action in LAR Attachment S, Table S-2, Implementation Item S-2-1 to address this requirement as part of development and implementation of the NFPA 805 monitoring program. The NRC staff concludes that the licensee's statement of compliance is acceptable because the licensee included an action that will incorporate the provisions of NFPA 805, Chapter 3 in the FPP and because the action would be required by the proposed license condition.

NFPA 805, Section 3.4.1(c), requires that the fire brigade leader and at least two brigade members have sufficient training and knowledge of nuclear safety systems in order to understand the effects of fire and fire suppressants on NSPC. Section 1.6.4.1, "Qualifications,"

of RG 1.189, Revision 2 (Reference 32), provides one acceptable approach for implementing the requirements for qualification of the fire brigade leader that states:

> The brigade leader should be competent to assess the potential safety consequences of a fire and advise control room personnel. Such competence by the brigade leader may be evidenced by possession of an operator's license or equivalent knowledge of plant systems.

In FPE RAI 02 dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee provide additional information regarding the training that is provided to the fire brigade leader and members that addresses their training on plant systems and ability to understand and assess the effects of fire and fire suppressants on the NSPC. In its response to FPE RAI 02 dated May 19, 2015 (Reference 9), the licensee stated that the fire brigade leader is from ANO-1 Operations (the fire affected unit), three fire brigade members are from Arkansas Nuclear One, Unit 2 (ANO-2) Operations (the unaffected unit), and one fire brigade member is a non-licensed operator that may be from either ANO-1 or ANO-2. The licensee stated that no individual can be placed on the fire brigade unless the individual has completed initial fire brigade training and the fire brigade leader and the fire brigade members are required to maintain non-licensed operator qualifications. The licensee further stated that the fire brigade leader is qualified as a waste control operator (WCO), the most qualified non-licensed operator; is required to complete fire brigade leader training and an associated practical examination prior to becoming the leader; and is required to maintain fire brigade member training requirements. The licensee stated that the fire brigade training program ensures that the fire brigade leader is capable of taking charge at the scene of the fire affecting the respective unit to direct the fire brigade members and to coordinate fire brigade actions with the control room staff. The licensee further stated that a WCO will have completed Auxiliary Operator training prior to the WCO training and thus, upon completion of WCO training, is knowledgeable of both primary and secondary systems as well as emergency and abnormal operating procedures. The licensee stated that examples of ANO-1 plant systems included in WCO training are reactor coolant, core flood system, decay heat removal, emergency feedwater, chemical addition, high-pressure injection, low-pressure injection, ventilation, and radiation monitoring. The licensee stated that the ANO approach meets the RG 1.189 guidance to comply with, "...or equivalent knowledge of plant systems." The licensee further stated that non-licensed operator training procedures require completion of plant systems training as part of the qualification program designed to give the non-licensed operator an understanding of the integrated nature and design of plant systems and structures. Since both units are pressurized water reactors (PWRs) and the fire brigade members participate in drills on both units, the understanding of SSD components is reinforced. Based on the information provided by the licensee, the NRC staff concludes that the licensee's response to FPE RAI 02 is acceptable because the licensee demonstrated that the fire brigade leader and members are provided with training and knowledge of nuclear safety systems in order to understand the effects of fire and fire suppressants on the NSPC, which therefore meets the requirements of NFPA 805, Section 3.4.1(c).

In LAR Attachment A, Section 3.4.1, "On-Site Fire-Fighting Capability," the licensee stated, in part, that "The Fire Brigade Leader (Unit 1) and three other members (Unit 2) are from the Operations Department." In FPE RAI 08 dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee discuss how the use of three members from ANO-2 will affect the minimum shift crew staffing contained in the TS and emergency plan for ANO-2. In its response

to FPE RAI 08 dated May 19, 2015 (Reference 9), the licensee described the minimum staffing necessary to meet the plant TS and emergency plan for both ANO-1 and ANO-2 under the assumption that ANO-1 abandons the control room and performs alternate shutdown and ANO-2 simultaneously performs remote shutdown. The fire brigade is comprised of non-licensed operators as previously described. The licensee described the current on-shift staffing requirements as including four non-licensed operators per unit, with one additional non-licensed operator qualified as a fire brigade member assigned to either unit (resulting in nine non-licensed operators between the two units). The licensee stated that two communicators, who are included in the nine non-licensed operators, can have no collateral duties. The fire affected unit provides the fire brigade leader, who is a qualified WCO, three of the members come from the unaffected unit with the fourth member coming from whichever unit has the additional non-licensed operator. The licensee stated that the ANO-2 remote shutdown procedures stated that if ANO-1 is performing an alternate shutdown, all ANO-2 non-licensed operators will be assigned to the fire brigade. The licensee stated that the current on-shift staffing level is sufficient to meet emergency plan requirements while simultaneously providing five individuals to support fire response activities. The NRC staff concludes that the licensee response to FPE RAI 08 is acceptable because the licensee demonstrated that its minimum staffing is sufficient to meet the TS requirements and provide a minimum of five fire brigade members as required by NFPA 805, Section 3.4.1.

Based on the licensee's statement of compliance and the associated action as discussed in LAR Attachment S, Table S-2, for the individual attributes described above, as well as the statement that the action will be completed prior to implementation, the NRC staff concludes the licensee's statements of compliance are acceptable subject to completion of the implementation item as described above.

3.1.1.2 Compliance Strategy – Complies with the Use of EEEEs

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

The following NFPA 805 sections identified in LAR Attachment A, Table B-1, as complying via this method, and the applicable actions described in LAR Attachment S, Tables S-1 and S-2, required additional review by the NRC staff:

- 3.3.1.2(5)
- 3.3.7.1
- 3.3.8
- 3.7
- 3.9.1(1)
- 3.9.1(2)
- 3.11.2
- 3.11.3

NFPA 805, Section 3.3.1.2(5), requires that controls on the use and storage of flammable and combustible liquids be in accordance with NFPA 30, "Flammable and Combustible Liquids Code" (Reference 50), or other applicable standards. The licensee identified an action in LAR Attachment S, Table S-2, Implementation Item S2-3, to address the "other applicable standards" wording of the requirement in plant procedures in accordance with the guidance contained in FAQ 06-0020 (Reference 58). FAQ 06-0020 was incorporated in Appendix K of NEI 04-02, Revision 2, which is endorsed in RG 1.205. The NRC staff concludes that the licensee's

statement of compliance is acceptable because the licensee included an action that will incorporate the provisions of NFPA 805, Chapter 3 in the FPP and because the action would be required by the proposed license condition.

NFPA 805, Section 3.3.7.1, requires that storage of flammable gas be located outdoors, or in separate detached buildings, so that a fire or explosion will not adversely impact systems, equipment, or components important to nuclear safety and cites NFPA 50A, "Standard for Gaseous Hydrogen Systems at Consumer Sites" (Reference 77). The licensee identified actions to modify the ventilation for the hydrogen bottle storage to ensure compliance with NFPA 50A and make electrical equipment and wiring changes to meet the requirements of NFPA 70. The licensee included those actions in LAR Attachment S, Table S-1, Modification Item S1-32. The NRC staff concludes that the licensee's statement of compliance is acceptable because the licensee included an action that will result in compliance with NFPA 805, Chapter 3 and because the action would be required by the proposed license condition.

NFPA 805, Section 3.3.8, "Bulk Storage of Flammable and Combustible Liquids," requires that bulk storage of flammable and combustible liquids not be permitted inside structures containing systems, equipment, or components important to nuclear safety and as a minimum, storage and use shall comply with NFPA 30. The licensee identified two actions to revise its analyses and documentation to address compliance with the provisions of NFPA 30 for oil tanks T-25, T-26, and T-29 and included those actions in LAR Attachment S, Table S-2, Implementation Items S2-7 and S2-8. The NRC staff concludes that the licensee's statement of compliance is acceptable because the licensee included actions that will incorporate the provisions of NFPA 805 and because the actions would be required by the proposed license condition.

NFPA 805, Section 3.7, "Fire Extinguishers," requires that where provided, fire extinguishers of the appropriate number, size, and type shall be provided in accordance with NFPA 10, "Standard for Portable Fire Extinguishers" (Reference 78), and that extinguishers shall be permitted to be positioned outside of fire areas due to radiological conditions. The licensee identified an action to correct fire extinguisher installation issues to address the requirements of NFPA 10 and included this action in LAR Attachment S, Table S-1, Modification Item S1-33. The NRC staff concludes that the licensee's statement of compliance is acceptable because the licensee included an action that will result in compliance with NFPA 805 and because that action would be required by the proposed license condition.

NFPA 805, Section 3.9.1(1), requires automatic sprinkler systems meet the provisions of NFPA 13, "Standard for the Installation of Sprinkler Systems" (Reference 79), where these systems are installed to meet the performance or deterministic requirements of NFPA 805, Chapter 4. The licensee identified an action on sprinkler systems to address code issues and included the action in LAR Attachment S, Table S-1, Modification Item S1-36. The NRC staff concludes that the licensee's statement of compliance is acceptable because the licensee included an action that will result in compliance with NFPA 805, and because the action would be required by the proposed license condition.

NFPA 805, Section 3.9.1(2), requires water spray systems to meet the provisions of NFPA 15, "Standard for Water Spray Fixed Systems for Fire Protection" (Reference 80), where these systems are installed to meet the performance or deterministic requirements of NFPA 805 Chapter 4. The licensee identified an action to address code issues associated with system

flushing activities and included the action in LAR Attachment S, Table S-2, Implementation Item S2-2. The NRC staff concludes that the licensee's statement of compliance is acceptable because the licensee included an action that will incorporate the provisions of NFPA 805, Chapter 3 in the FPP and because the action would be required by the proposed license condition.

NFPA 805, Section 3.11.2, "Fire Barriers," requires that fire barriers required by NFPA 805, Chapter 4 shall include a specific fire-resistance rating and shall be designed and installed to meet the specific fire resistance rating using assemblies qualified by fire tests in accordance with NFPA 251, "Standard Methods of Tests of Fire Endurance of Building Construction and Materials" (Reference 81), or American Society for Testing and Materials (ASTM) E 119, "Standard Test Methods for Fire Tests of Building Construction and Materials" (Reference 82). The licensee identified an action to perform an adequate-for-the-hazard evaluation and if necessary a plant modification to upgrade fire barrier walls, dampers, penetration seals, and doors to rated barriers for those barriers credited for deterministic compliance and subsequently credited in the FPRA analysis. The licensee included this action in LAR Attachment S, Table S-1, Modification Item S1-31. The NRC staff concludes that the licensee's statement of compliance is acceptable because the licensee included an action that will result in compliance with NFPA 805 and because the action would be required by the proposed license condition.

NFPA 805, Section 3.11.3, "Fire Barrier Penetrations," requires that penetrations in fire barriers be provided with listed fire-rated door assemblies or listed rated fire dampers that conform with NFPA 80, "Standard for Fire Doors and Fire Windows" (Reference 83), NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems" (Reference 84), and NFPA 101, "Life Safety Code" (Reference 49), as applicable. The licensee stated that it complies with use of an EEEE, but stated in the "Compliance Basis" that it complies with clarification that the features in NFPA 101 are documented in the code compliance evaluations for NFPA 80 and NFPA 90A. The NRC staff concludes that this clarification is acceptable because NFPA 101 references NFPA 80 and NFPA 90A with regard to door assemblies and fire-rated dampers; and, therefore, the applicable provisions of NFPA 101 are redundant to these other standards.

3.1.1.3 Compliance Strategy - Complies via Previous NRC Approval

Certain NFPA 805, Chapter 3 requirements were supplanted by an alternative that was previously approved by the NRC. The approval was documented in (1) the original 1978 FPP Safety Evaluation Report (Reference 76), or (2) a 1988 exemption from 10 CFR Part 50, Appendix R, Section III.O, approving the licensee's RCP oil collection system configuration (Reference 85).

In FPE RAI 01 dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee confirm the continued validity of the bases for the previous approvals in accordance with the guidance contained in RG 1.205 and NEI 04-02 and include a discussion of any changes or modifications that have been made to the plant that may impact the bases for the previous approvals. In its response to FPE RAI 01 dated June 16, 2015 (Reference 10), the licensee stated that the elements of NFPA 805, Chapter 3, that cite "Complies by previous NRC approval" as the compliance strategy have been reviewed to determine if any changes or modifications have been made that would impact the bases for the previous approvals. The licensee stated that the configuration of the affected NFPA 805, Chapter 3 elements with the

exception of NFPA 805, Chapter 3, Section 3.3.12, have not been modified since the associated NRC documentation evaluated the NFPA 805, Chapter 3 elements. The licensee stated that the cited NRC documentation remains valid for the LAR Attachment A elements, with the exception of NFPA 805, Section 3.3.12, with no identified changes or modifications that invalidate the original approval bases. The licensee further stated that as reflected in LAR Attachment K, Appendix R, Exemption 19, RCP Oil Collection System, Not Meeting Section III.O Criteria, and clarified in LAR Attachment T of the original LAR, modifications associated with the RCP lube oil collection system have been implemented since the original exemption was granted. The licensee stated that it believes the original basis for the above exemption is maintained (i.e., the single difference being that the tanks will not hold the total oil volume from one RCP without minor spillage into the curbed area). The NRC staff's evaluation of the licensing action transition for Exemption 19 as described in LAR Attachment K and clarified in LAR Attachment T, is documented in SE Section 3.5. The NRC staff concludes that the licensee's response to FPE RAI 01 is acceptable because the licensee confirmed that the basis for the previous NRC approval remains valid in accordance with the guidance contained in RG 1.205 and NEI 04-02.

The NRC staff reviewed the information provided by the licensee and concludes that previous NRC approval had been demonstrated using suitable documentation that meets the approved guidance contained in RG 1.205, Revision 1. Based on the licensee's justification for the continued validity of the previously approved alternatives to the NFPA 805, Chapter 3 requirements, the NRC staff concludes that the licensee's statements of compliance in these instances are acceptable.

The licensee identified licensing actions which required clarification for the following Chapter 3 elements:

- 3.3.12(2)

The NRC staff review and evaluation of these clarifications is documented in SE Section 3.5.2.

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:

- 3.5.14

NFPA 805 Section 3.5.14 requires that all fire protection water supply and fire suppression system control valves be under a periodic inspection program and be supervised. In LAR Attachment A, the compliance basis for this element provides a citation from ANO-1, Amendment No. 35 (Reference 76), that states the plant Technical Specifications (TS) require the periodic inspection of fire water system valve position that are not locked, sealed, electronically supervised, or otherwise secured in position to assure that values are maintained in the open position. In FPE RAI 05 dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee confirm that this requirement remains in the TS or identify how this requirement is currently controlled and maintained. In its response to FPE RAI 05 dated May 19, 2015 (Reference 9), the licensee stated that the plant TS associated with the fire suppression control valves have been relocated to a plant manual, and that the requirement of NFPA 805, Section 3.5.14, that all fire protection water supply and fire suppression system

control valves be under a periodic inspection program and supervised, is implemented via that manual. The NRC staff concludes that the licensees response to the RAI is acceptable because the licensee demonstrated that it has maintained the requirements that provide the basis for previous approval to meet the requirements of NFPA 805, Section 3.5.14, because the requirement was moved from the TS to a plant manual, in accordance with GL 88-12, "Removal of Fire Protection Requirements from Technical Specifications" (Reference 86).

3.1.1.4 Compliance Strategy – Submit for NRC Approval

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

- 3.2.3(1), which concerns the establishing of procedures for inspection, testing, and maintenance for fire protection systems and features. The licensee requested approval to use Electric Power Research Institute (EPRI) Technical Report TR-1006756, "Fire Protection Equipment Surveillance Optimization and Maintenance Guide for Fire Protection Systems and Features" (Reference 87), to modify fire protection system surveillance frequencies. See SE Section 3.1.4.1.

- 3.3.3, which concerns the classification of interior floor finish in accordance with NFPA 101, Class 1 criteria. The licensee requested approval to use a PB method to demonstrate an equivalent level of fire protection for its use of epoxy floor coverings. See SE Section 3.1.4.2.

- 3.3.5.1, which concerns maintaining wiring above suspended ceilings to a minimum and where installed, electrical wiring shall be listed for plenum use, routed in armored cable, routed in metallic conduit, or routed in cable trays with solid metal top and bottom covers. The licensee requested approval to use a PB method to demonstrate an equivalent level of fire protection for wiring above suspended ceilings. See SE Section 3.1.4.3.

- 3.3.5.2, which concerns the use of only metal tray and metal conduit for electrical raceways. The licensee requested approval to use a PB method to demonstrate an equivalent level of fire protection for the use of schedule 40 polyvinyl chloride (PVC) conduit for underground and embedded applications. See SE Section 3.1.4.4.

- 3.3.12(1), which concerns the RCP oil collection system capability to collect oil from all potential pressurized and non-pressurized leakage sites in each RCP oil system. The licensee requested approval to use a PB method to demonstrate an equivalent level of fire protection for the acceptability of oil misting from the RCPs/motors that is not collected by the oil collection system. See SE Section 3.1.4.5.

- 3.5.3, which concerns fire pumps designed and installed in accordance with NFPA 20, "Standard for the Installation of Stationary Pumps for Fire Protection," (Reference 88). The licensee requested approval to use a PB method to demonstrate an equivalent level of fire protection for the continued use of existing motor and diesel-driven fire pumps and pump controllers. See SE Section 3.1.4.6.

- 3.5.16, which concerns the dedicated use of the fire water supply system for fire protection use only. The licensee requested approval to use a PB method to demonstrate an equivalent level of fire protection for the use of the fire protection water supply system to supply cooling loads on either unit, during both power operations and unit outages, provided firewater capability remains within limits. See SE Section 3.1.4.7.

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.

3.1.1.5 Compliance Strategy - Multiple Strategies

The licensee did not use multiple compliance strategies for NFPA 805, Chapter 3 requirements.

3.1.1.6 Chapter 3 Sections Not Reviewed

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

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

- Sections that are not applicable to ANO-1 because of the following:

  — The licensee states that it does not have systems of this type installed (e.g., Section 3.6.5, which applies to seismic designed hose stations that are cross-connected to seismic non-fire protection essential water systems or Sections 3.9.1(3) or 3.9.1(4) for water mist and foam-water fire protection systems).

  — The requirements are structured with an applicability statement (e.g., Section 3.3.12, which applies to RCPs in non-inerted containments, or Sections 3.4.1(a)(2) and 3.4.1(a)(3), which apply to the fire brigade standard used, since that depends on the type of brigade specified in the FPP at the site).

3.1.1.7 Compliance with Chapter 3 Requirements Conclusion

As discussed above, the NRC staff evaluated the results of the licensee's assessment of the proposed RI/PB FPP against the NFPA 805, Chapter 3, fundamental FPP elements and minimum design requirements, as modified by the exceptions, modifications, and supplementations in 10 CFR 50.48(c)(2). Based on this review of the licensee's submittal, as supplemented, the NRC staff concludes that the RI/PB FPP is acceptable with respect to the fundamental FPP elements and minimum design requirements of NFPA 805, Chapter 3, as modified by 10 CFR 50.48(c)(2), because the licensee accomplished the following:

- Used an overall process consistent with NRC staff approved guidance to determine the state of compliance with each of the applicable NFPA 805, Chapter 3 requirements.

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

  — With the requirement directly, or with the requirement directly after the completion of an action (modification or implementation item).

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

  — Through the use of an EEEE.

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

3.1.2 Identification of the Power Block

The NRC staff reviewed the ANO-1 structures identified in LAR Attachment I, Table I-1 "Power Block Definition" as comprising the "power block." The plant structures listed are established as part of the power block for the purpose of denoting the structures and equipment included in the RI/PB FPP that have additional requirements in accordance with 10 CFR 50.48(c) and NFPA 805. As stated in the LAR, Section 4.1.3, the power block includes structures that contain equipment that could affect plant operation for power generation; equipment important to safety; equipment that could affect the ability to maintain NSCA in the event of a fire; or structures containing radioactive materials that could potentially be released in the event of a fire. The NRC staff concludes that the licensee appropriately evaluated the structures and equipment at ANO-1, and adequately documented a list of those structures that fall under the definition of "power block" in NFPA 805.

3.1.3 Closure of Generic Letter 2006-03, Hemyc and MT Fire Barrier Issues

GL 2006-03, "Potentially Nonconforming Hemyc and MT Fire Barrier Configurations," (Reference 48), requested that licensees evaluate their facilities to confirm compliance with existing applicable regulatory requirements in light of the results of NRC testing that determined that both Hemyc™ and MT™ fire barriers failed to provide the protective function intended for

compliance with existing regulations, for the configurations tested using the NRC's thermal acceptance criteria. In a letter dated June 7, 2006 (Reference 89), the licensee stated that Hemyc is used as a 1-hour rated barrier to meet 10 CFR Part 50 Appendix R separation requirements, and that it does not use the 3-hour fire rated MT configuration. In LAR Attachment A for NFPA 805, Section 3.11.5, the licensee stated that it does not credit electrical raceway fire barrier system (ERFBS). Since neither Hemyc nor MT ERFBS were used, the NRC staff concludes that the generic issue, GL 2006-03, related to the use of these ERFBS is not applicable.

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

In accordance with 10 CFR 50.48(c)(2)(vii), a licensee may request NRC approval for use of the PB methods permitted elsewhere in the standard as a means of demonstrating compliance with the prescriptive FPP fundamental elements and minimum design requirements of NFPA 805, Chapter 3. The Director or designee may approve PB methods if the Director or designee determines that the PB approach:

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

(B) Maintains safety margins; and

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

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

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

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

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

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

> In the event of a fire during any operational mode and plant configuration, the plant shall be as follows:
>
> (1) *Reactivity Control.* Capable of rapidly achieving and maintaining subcritical conditions.
>
> (2) *Fuel Cooling.* Capable of achieving and maintaining decay heat removal and inventory control functions.

(3) *Fission Product Boundary.* Capable of preventing fuel clad damage so that the primary containment boundary is not challenged.

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

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

(1) Containment integrity is capable of being maintained.

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

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

Fire protection features shall be capable of providing reasonable assurance that, in the event of a fire, the plant is not placed in an unrecoverable condition. To demonstrate this, the following performance criteria shall be met:

(a) *Reactivity Control.* Reactivity control shall be capable of inserting negative reactivity to achieve and maintain subcritical conditions. Negative reactivity inserting shall occur rapidly enough such that fuel design limits are not exceeded.

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

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

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

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

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

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

In LAR Attachment L, "NFPA 805, Chapter 3 Requirements for Approval (10 CFR 50.48(c)(2)(vii))," the licensee requested NRC staff review and approval of PB methods to demonstrate an equivalent level of fire protection for the requirements of the NFPA 805, Chapter 3 elements identified in SE Section 3.1.1.4. 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, the licensee requested NRC staff approval of a PB method to demonstrate an equivalent level of fire protection for the NFPA 805, Section 3.2.3(1) requirement to establish procedures for inspection, testing, and maintenance of fire protection systems and features credited by the FPP. Specifically, the licensee stated that it requests approval to use the EPRI TR-1006756, (Reference 87), guidelines in the future as opportunities arise. The licensee stated that it does not intend to revise any fire protection surveillance, test, or inspection frequencies until after transition to NFPA 805 and existing fire protection surveillance, test, and inspection procedures will remain consistent with the applicable Technical Requirements Manual, insurer, and NFPA Code requirements. The licensee requested the flexibility to evaluate fire protection features using the aforementioned EPRI PB methods to provide evidence of equipment performance beyond that achievable under traditional prescriptive maintenance practices to ensure optimal use of resources while maintaining reliability.

The licensee stated that the 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/licensing basis documents and appropriate NFPA codes and standards. The licensee stated that the scope of the aforementioned activities is determined by the required systems review identified in LAR Table 4-3, "Summary of NFPA 805 Compliance Basis and Required Fire Protection Systems and Features." The licensee further stated that this approval request is specific to the use of EPRI TR-1006756 to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features credited by the FPP. The licensee indicated that EPRI TR-1006756, Section 10.1, states, "The goal of a performance-based surveillance program is to adjust test and inspection frequencies commensurate with equipment performance and desired reliability." The licensee stated that this goal is consistent with the stated requirements of NFPA 805, Section 2.6, "Monitoring," and EPRI TR-1006756 provides an accepted method to establish appropriate inspection, testing, and maintenance frequencies, which ensure the required NFPA 805 availability, reliability, and performance goals are maintained.

In FPE RAI 07b dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee clarify the scope of the approval request to identify the specific fire protection systems and features that are applicable to the PB methods (e.g., existing fire protection systems, components, and features such as fire detection systems, gaseous fire suppression systems, water-based fire suppression systems, fire pumps, water supply tanks and fire water distribution

systems, fire walls, fire extinguishers, etc.) and indicate whether the application of the approval request will apply to any new fire protection systems, components, or features not yet constructed or installed. In its response to FPE RAI 07b dated July 21, 2015 (Reference 11), the licensee stated that EPRI TR-1006756 may be used to establish inspection, testing, and maintenance frequencies for the following fire protection systems and features:

- Detection and Alarm Systems
- Fire Suppression Systems
- Water Supply, Hydrants and Valves
- Fire Pumps
- Standpipes, Hose Stations and Hoses
- Fire Barriers
- Portable Fire Extinguishers

The licensee stated that the application of the approval request will apply to any new fire protection systems, components, or features not yet constructed or installed as well as existing systems. The NRC staff concludes the licensee's response to FPE RAI 07b is acceptable because the licensee identified the types of systems and components to which the EPRI PB method will be applied, currently and for future installations.

The licensee stated that where a PB monitoring program is applied, the target tests, inspections, and maintenance will be those activities associated with the NFPA 805 required fire protection systems and features, and the reliability and frequency goals associated with the NFPA 805 required fire protection systems and features will be established to ensure the assumptions in the NFPA 805 engineering analysis remain valid. The licensee 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 stated that data collection and analysis will follow the guidance contained in EPRI TR-1006756 and the failure probability will be determined based on the EPRI TR-1006756 guidance and a 95-percent confidence level will be utilized. The licensee further stated that performance monitoring will be performed in conjunction with the monitoring program required by NFPA 805, Section 2.6, and will ensure site specific operating experience is considered in the monitoring process.

The licensee stated that the use of PB test frequencies established in accordance with EPRI 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 at levels assumed in the NFPA 805 engineering analysis; and, therefore, the use of the PB methods in EPRI TR-1006756 does not result in an adverse impact to the NSPC.

The licensee stated that the radiological release performance criteria are satisfied based on the determination of the limiting radioactive release and fire protection systems and features are credited as part of the subject evaluation. The licensee further stated that the development of PB test frequencies in accordance with EPRI TR-1006756 methods combined with NFPA 805, Section 2.6, will ensure that the availability and reliability of the fire protection systems and features are maintained at the levels assumed in the NFPA 805 engineering analysis, including assumptions supporting the radioactive release performance criteria; and, therefore, there is no adverse impact to radioactive release performance 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 will ensure that the availability and reliability of the fire protection systems and features are maintained at the levels assumed in the NFPA 805 engineering analysis, including those assumptions supporting the FRE safety margin discussions. The licensee further stated that these methods do not invalidate 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 adequate levels of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed.

The licensee stated that for Echelon 1, fire prevention is not affected by the use of EPRI TR-1006756 methods. The licensee stated that for Echelons 2 and 3, the use of PB test frequencies established in accordance with EPRI TR-1006756 combined with NFPA 805, Section 2.6, will ensure that the availability and reliability of the fire protection systems and features credited for DID are maintained at the levels assumed in the NFPA 805 engineering analysis; and, therefore, there is no adverse impact to Echelons 2 and 3 for the DID.

In FPE RAI 07a dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee provide additional discussion on how DID is maintained with respect to each echelon. In its response to FPE RAI 07a dated July 21, 2015 (Reference 11), for NFPA 805 Section 3.2.3(1), the licensee stated the following for each DID echelon:

1) Prevent fires from starting (combustible/hotwork controls): Maintenance and testing frequency changes to fire protection features do not impact the likelihood of a fire starting. Administrative fire protection controls will remain unchanged when utilizing performance-based methods to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features. Plant procedures for control of combustibles and control of hot work and ignition sources are used to help prevent fires from starting. Therefore, DID Echelon 1 is maintained.

2) Rapidly detect, control and extinguish fires that do occur thereby limiting damage (fire detection systems, automatic fire suppression, manual fire suppression, pre-fire plans): Use of performance-based methods established in accordance with EPRI TR-1006756 combined with the monitoring program specified in NFPA 805, Section 2.6, will ensure the availability and reliability of the fire protection systems and features credited for detecting, controlling, and extinguishing fires. Therefore, DID Echelon 2 is maintained.

3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed (fire barriers, fire rated cable, success path remains free of fire damage, recovery actions): Use of performance-based methods established in accordance with EPRI TR-1006756 will not alter the design of the fire protection systems and features credited for

providing an adequate level of fire protection for systems and structures. Therefore, DID Echelon 3 is maintained.

The NRC staff concludes that the licensee's response to FPE RAI 07a is acceptable because the licensee adequately described how DID is maintained for use of the PB methods used to satisfy the requirements of NFPA 805, Section 3.2.3(1).

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

3.1.4.2 NFPA 805, Section 3.3.3 – Interior Finish

In LAR Attachment L, the licensee requested NRC staff approval of a PB method to demonstrate an equivalent level of fire protection for the NFPA 805, Section 3.3.3 requirement for interior finishes. Specifically the licensee requested approval for the use of epoxy floor coatings.

The licensee stated that an evaluation of the acceptability of the epoxy floor coatings was performed in response to NRC Information Notice (IN) 2007-26, "Combustibility of Epoxy Floor Coatings at Commercial Nuclear Power Plants" (Reference 90), regarding combustibility of epoxy floor coatings at commercial nuclear facilities. The licensee stated that it evaluated coating samples taken from areas containing safety-related equipment to determine the contribution that epoxy floor coating may have to combustible loads in safety-related areas of the plant. The licensee provided the following excerpts from its evaluation:

- The energy required to support combustion of the floor coatings used at ANO will not be produced by an incipient stage compartment fire. Direct impingement of flame or heat onto the coatings will not cause propagation of flame beyond the influence zone of the heat source, as exhibited with incidental hot work contact with floor surfaces. Manual or automatic suppression will provide protective cover to preclude floor coating involvement in fire severity should a fire proceed past the incipient stage.

- The epoxy floor coatings currently applied at the ANO site could potentially be considered a slight contributor, typically of less than 3 minutes, to fire severity, only if the compartment progressed to flashover conditions and automatic or manual suppression is never attempted. Considering the epoxy floor materials used and the conditions anticipated, it can be reasonably concluded that the epoxy floor coatings of the type utilized at ANO do not present a primary fire hazard, will not propagate fire from one fire area to another, or exacerbate the severity of a compartment fire.

The licensee stated that based on the review of epoxy floor coatings at ANO, Duochem 9400 was identified to have the highest flame spread index of any floor coating used at ANO. The licensee described the properties of Duochem 9400 as having a flame spread rating of 31 when applied with a dry film thickness of 1/8-inch and a flame spread rating of 57 when applied with a thickness of 1/4-inch. The licensee stated that the review concluded that the majority of the areas have a maximum dry film thickness that is less than 1/8 inch and as stated in Enclosure 2 to NRC GL 86-10, Section 3.6.2 (Reference 74), material with a 1/8-inch dry film thickness and a flame spread rating less than 50 will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat, which is consistent with the definition of limited combustible described in NFPA 805, Section 1.6.36, "Limited Combustible."

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

- The request recognizes the possibility for limited areas where the floor coating thickness may approach 1/4-inch due to floor smoothness variations that have not been detected. The request to utilize Duochem 9400 bounds the characteristics of other floor coatings used at ANO. In these limited areas, the flame spread rating using Duochem 9400 properties, when averaged over the area, will be less than 50.

- The coatings permitted at ANO, with the exception of Duochem 9400, are either NFPA 101, Class A qualified or ASTM E84 (Reference 91), tested with a flame spread index less than 50. All epoxy floor coatings have been determined by ANO evaluation to have a negligible contribution with regard to combustible loading. In addition, the epoxy coating is on the floor. The ASTM E84 test is conducted with the material on the ceiling of a tunnel. This configuration would allow the flame to directly impinge on the ceiling surface, enhancing flame spread. With the material on the floor, the heat flux to the surface is much less than would be expected in the ceiling configuration since the convective flame is directing the heat away from the surface. This would mean that the overall flame spread would be expected to be much less, even with a slightly greater thickness.

The licensee stated that the use of epoxy floor coatings does not affect nuclear safety as it in general meets the definition of a limited combustible material with isolated thickness excesses. The licensee stated that the floor coating materials were evaluated to have a negligible effect on combustibility and application of epoxy floor coatings is controlled via ANO procedures to ensure that the amount of material does not add appreciable amounts of combustible material to the plant, and, therefore, there is no impact on the NSPC.

The licensee stated that the use of epoxy floor coatings has no impact on the radiological release performance criteria. The licensee stated that the radiological release review was performed based on the manual fire suppression activities in areas containing or potentially containing radioactive materials and is not dependent on the floor coating materials. The licensee further stated the floor coatings do not change the radiological release evaluation performed that potentially contaminated water is contained and smoke monitored and the floor coatings do not add additional radiological materials to the area or challenge systems boundaries that contain such.

The licensee stated that use of epoxy floor coatings does not affect safety margin as it in general meets the definition of a limited combustible material with isolated thickness excesses. The licensee stated the floor coating materials were evaluated to have a negligible effect on combustibility and application of epoxy floor coatings is controlled via ANO procedures. The licensee stated that these precautions and limitations on the use of these materials have been defined by the limitations of the analytical methods (e.g., ignition frequency, heat released) used in the development of the FPRA. The licensee further stated that the FPRA uses historical fires and fire tests as the basis for many inputs, such as the ignition frequencies, the heat released from a fire, how fires will spread, and the probability that a circuit will be damaged in an adverse way; and, therefore, the inherent safety margin present in the internal events PRA (IEPRA) model and extended to the FPRA methods is reasonable because NRC accepted methods are used to perform the FPRA. The licensee stated that deviations are evaluated against the methods and criteria for the overall IEPRA and FPRA model development for consistency, or confirmation of bounding treatment, to confirm that the safety margin inherent in the PRA model is preserved, and if the deviation does not change the FPRA, the safety margin inherent in the FPRA is also unchanged. The licensee stated that the epoxy floor coatings of the type utilized at ANO do not present a primary fire hazard, will not propagate fire from one fire area to another, and will not exacerbate the severity of a compartment fire, and thus, their presence has no impact on the analytical methods used in the FPRA to evaluate potential fire scenarios and the inherent safety margin in these methods remains unchanged.

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 adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed.

The licensee stated that the use of epoxy floor coatings does not affect Echelons 1, 2 and 3, and that the use of epoxy floor coatings does not directly result in compromising automatic fire suppression functions, manual fire suppression functions, or post-fire SSD capability.

In FPE RAI 07a (Reference 21), the NRC staff requested that the licensee provide additional discussion on how DID is maintained with respect to each echelon. In its response to FPE RAI 07a (Reference 11), for NFPA 805 Section 3.3.3, the licensee stated the following for each DID echelon:

1) Prevent fires from starting (combustible/hotwork controls): The epoxy floor coating is considered a slight contributor to combustible loading in its finished state as a hardened floor covering. Plant procedures for control of combustibles and control of hot work and ignition sources, are used to help prevent fires from occurring in all areas of the plant, including those with epoxy floor coverings. Therefore, DID Echelon 1 is maintained.

2) Rapidly detect, control and extinguish fires that do occur thereby limiting damage (fire detection systems, automatic fire suppression, manual fire suppression, pre-fire plans): The epoxy floor covering does not physically interact with systems or equipment required to detect, control, and extinguish fires. The epoxy floor coatings of the type utilized at ANO do not present a primary fire hazard, will not

propagate fire from one fire area to another, and will not exacerbate the severity of a compartment fire. Therefore, the fire detection, suppression, and response is unaffected and DID Echelon 2 is maintained.

3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed (fire barriers, fire rated cable, success path remains free of fire damage, recovery actions): The epoxy floor coating does not degrade or otherwise affect fire protection for systems and structures. Current fire barriers, fire rated cable, success paths, and recovery actions are unaffected. Therefore, DID Echelon 3 is maintained.

The NRC staff concludes that the licensee's response to FPE RAI 07a is acceptable because the licensee adequately described how DID is maintained for use of the PB methods used to satisfy the requirements of NFPA 805 Section 3.3.3.

Based on its review of the information submitted by the licensee, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the proposed PB method is an acceptable alternative to the corresponding NFPA 805, Section 3.3.3 requirement because it satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID (fire prevention, fire detection, fire suppression, mitigation, and post-fire SSD capability).

3.1.4.3 NFPA 805, Section 3.3.5.1 – Wiring above Suspended Ceilings

In LAR Attachment L, 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 to be kept to a minimum, and where installed, listed for plenum use, or routed in armored cable, in metallic conduit, or in cable trays with solid metal top and bottom covers.

The licensee stated that the suspended ceilings and their supports are non-combustible and combustibles in concealed spaces are minimal. The licensee stated that the majority of ANO-1 areas with suspended ceilings inside the NFPA 805 defined power block are office areas in the turbine and auxiliary buildings. The licensee further stated these areas are not risk significant with the exception of the control rooms. The licensee stated that the quantity of video/communication cabling above the suspended ceilings in the CRs is very low and results in limited combustible loading. The licensee further stated that the existing fire detection capability and/or the CR operators who are continuously present in the area would identify the presence of smoke.

In FPE RAI 07c dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee describe any fire protection features (e.g., barriers, detection and suppression systems) available above the suspended ceiling, and clarify that the existing administrative controls will ensure that the requirements of NFPA 805, Section 3.3.5.1 are met for future installations above suspended ceilings. In its response to FPE RAI 07c dated July 21, 2015 (Reference 11), the licensee stated that the ANO-1 MCR utilizes a halon suppression system in the suspended ceiling. The licensee stated that the halon system consists of two separate fire extinguishing

units that discharge halon to the MCR ceiling and the auxiliary CR ceiling upon automatic actuation of smoke detectors or manual actuation. The licensee stated that when two smoke detectors (one in each string) in the system actuate, a solenoid valve is energized that releases nitrogen to the pilot header and this nitrogen actuation pressure triggers the pilot halon cylinder. The licensee stated that halon is released to the discharge header and discharged through nozzles to the fire area. The licensee further stated that local manual actuation may be accomplished by releasing the manual actuator on the pilot cylinder and remote manual actuation may be accomplished by using the appropriate zone module's manual actuation switch on the C-463 panels in the MCR. The licensee further stated that automatic or manual actuation is annunciated on C-26. The licensee stated that the remaining office areas with suspended ceilings contain smoke detectors, with the exception of the decon (decontamination) room. The licensee stated that manual fire extinguishers and/or hose reels are available in the decon room. The licensee stated that the administrative controls for controlling the types of cables installed in ceilings are established in a procedure and the procedure has been revised to include requirements specific to NFPA 805 regarding cables installed in plenum areas (false ceilings). The NRC staff concludes that the licensee's response to FPE RAI 07c is acceptable because the licensee identified the fire protection systems and features located in the areas that have cables or wiring above suspended ceilings and because the licensee established administrative controls in procedures to include the requirements of NFPA 805 for cables above suspended ceilings.

The licensee stated that these areas are assumed to have wiring above the suspended ceilings including that needed for power, control, and video/communication/data. The licensee further stated that power and control cables at ANO are IEEE-383-1974 (Reference 92), or equivalent, and FAQ 06-0022 (Reference 59), identified acceptable electrical cable construction tests for all areas of the power block and the majority of plant cables meet these requirements.

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

- The NFPA 805 requirement is excessive in that plenum rating should not be applied to wiring above suspended ceilings that are not used as plenum and have stagnant air versus flowing air.

- Only a limited amount of the cable installed above the suspended ceilings in these areas is not rated for plenum use, IEEE-383-1974 equivalent, or routed in conduit.

- The cable is low voltage (less than 480 volt (V)) and, therefore, less susceptible to self-ignition and electrical shorts that could result in a fire in the enclosed space.

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

- For the cables that do not meet the NFPA 805, Section 3.3.5.1 criteria, the majority meet one of the cable qualifications listed within FAQ 06-0022.

- Plant procedures contain adequate guidance to ensure suitable cable qualification criteria was provided and is maintained.

The licensee stated that the location of wiring above suspended ceilings does not affect nuclear safety. The licensee stated that power and control cables comply with IEEE-383 or equivalent, and 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, and, 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. The licensee stated that the radiological release review was performed based on the manual fire suppression activities in areas containing or potentially containing radioactive materials and is not dependent on the type of cables or locations of suspended ceilings. The licensee further stated that the location of cables does not change the radiological release evaluation performed that potentially contaminated water is contained and smoke monitored and the cables do not add additional radiological materials to the area or challenge systems boundaries that contain such.

The licensee stated that power and control cables comply with IEEE-383 or equivalent and the use of these materials has been defined by the limitations of the analytical methods (e.g., ignition frequency, heat released) used in the development of the FPRA. The licensee stated that the FPRA uses historical fires and fire tests as the basis for many inputs, such as the ignition frequencies, the heat released from a fire, how fires will spread, and the probability that a circuit will be damaged in an adverse way, and, therefore, the inherent safety margin present in the IEPRA model and extended to the FPRA methods is reasonable because NRC-accepted methods are used to perform the FPRA. The licensee stated that deviations are evaluated against the methods and criteria for the overall IEPRA and FPRA model development for consistency, or confirmation of bounding treatment, to confirm that the safety margin inherent in the PRA model is preserved and if the deviation does not change the FPRA, the safety margin inherent in the FPRA is also unchanged.

The licensee stated that the limited amount of low voltage communications/data cables above suspended ceilings is not susceptible to shorts that would result in a fire, and that their presence above suspended ceilings has no impact on the analytical methods used in the FPRA to evaluate potential fire scenarios and the inherent safety margin in these methods remains unchanged.

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 adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed.

The licensee stated that the prior introduction of non-listed video/communication/data cables routed above suspended ceilings do not impact fire protection DID. The licensee stated that for Echelon 1, this echelon is maintained by the current cable installation procedures that document suitable cable qualification criteria are maintained. The licensee stated that for Echelons 2 and 3, the introduction of video/communication/data cables above suspended ceilings does not

result in compromising automatic fire suppression functions, manual fire suppression functions, fire protection for systems and structures, or post-fire SSD capability.

In FPE RAI 07a (Reference 21), the NRC staff requested that the licensee provide additional discussion on how DID is maintained with respect to each echelon. In its response to FPE RAI 07a (Reference 11), for NFPA 805 Section 3.3.5.1, the licensee stated the following for each DID echelon:

1) Prevent fires from starting (combustible/hotwork controls): The non-listed video/communication/data cables that are routed above suspended ceilings are considered in-situ fire loading for purposes of combustible loading evaluations. The cables are low energy and not susceptible to hot shorts. Plant procedures for control of combustibles and control of hot work and ignition sources are used when working in the plant including the areas with cables installed above ceilings. Therefore, DID Echelon 1 is maintained.

2) Rapidly detect, control and extinguish fires that do occur thereby limiting damage (fire detection systems, automatic fire suppression, manual fire suppression, pre-fire plans): The non-listed cables that are routed above suspended ceilings do not physically or electrically interact with systems or equipment required to detect, control, and extinguish fires. Therefore, DID Echelon 2 is maintained.

3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed (fire barriers, fire rated cable, success path remains free of fire damage, recovery actions): The non-listed cables that are routed above suspended ceilings do not degrade or otherwise affect fire protection for systems and structures. Current fire barriers, fire rated cable, success paths, and RAs are unaffected. Therefore, DID Echelon 3 is maintained.

The NRC staff concludes that the licensee's response to FPE RAI 07a is acceptable because the licensee adequately described how DID is maintained for use of the PB methods used to satisfy the requirements of NFPA 805 Section 3.3.5.1.

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

3.1.4.4 NFPA 805, Section 3.3.5.2 – Metal Tray and Metal Conduit for Electrical Raceways

In LAR Attachment L, 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 only metal tray and metal conduits to be used for electrical raceways. Specifically, the

licensee requested approval for the use of PVC plastic conduit in underground and embedded applications.

In FPE RAI 07d dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee clarify that this approval request is limited to the existing PVC conduits that are currently installed and that administrative controls will ensure that the requirements of NFPA 805, Section 3.3.5.2 will be met for future installations. In its response to FPE RAI 07d dated July 21, 2015 (Reference 11), the licensee stated that the approval request for NFPA 805, Section 3.3.5.2, is for currently installed PVC conduits in the applicable areas. The licensee stated that its procedure for installation of raceway systems will be revised as part of NFPA 805 implementation (reference LAR Attachment S, Table S-2, Implementation Item S2-6) to define which areas are applicable for only using rigid steel conduit. The NRC staff concludes that the licensee's response to FPE RAI 07d is acceptable because the licensee provided the clarification requested by the NRC staff and identified an action that will incorporate the provisions of NFPA 805 in the FPP for future installations and would be required by the proposed license condition.

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

- Access points to embedded conduit are required to be rigid steel. The nonmetallic conduit is used only in concrete embedded applications, thus providing physical protection and separation for the conduit.

- The plastic 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/or damage to the circuits contained within where the conduit is embedded in concrete

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

- The NFPA 70, "National Electric Code," (Reference 93), allows use of rigid nonmetallic conduit for underground and embedded applications.

The licensee stated that the use of non-metallic conduit for raceways embedded in concrete is allowed by NFPA 70 and provides adequate physical and electrical protection for cables. The license stated that the use of plastic conduit in embedded locations does not affect nuclear safety as the material in which conduits are run within an embedded location are not subject to the failure mechanisms potentially resultant in circuit damage or resultant damage to external targets, and, therefore, there is no impact on the NSPC.

The licensee stated that the use of plastic conduit in embedded installations has no impact on the radiological release performance criteria. The licensee stated that the radiological release review was performed based on the manual fire suppression activities in areas containing or potentially containing radioactive materials and is not dependent on the type of conduit material. The licensee stated that the conduit material does not change the radiological release evaluation performed that potentially contaminated water is contained and smoke monitored

and the conduits do not add additional radiological materials to the area or challenge systems boundaries that contain plastic conduits.

The licensee stated that the plastic conduit material is embedded in a non-combustible configuration and the use of these materials has been defined by the limitations of the analytical methods (e.g., ignition frequency, heat released) used in the development of the FPRA. The licensee stated that the FPRA uses historical fires and fire tests as the basis for many inputs, such as the ignition frequencies, the heat released from a fire, how fires will spread, and the probability that a circuit will be damaged in an adverse way; and, therefore, the inherent safety margin present in the IEPRA model and extended to the FPRA methods is reasonable because NRC accepted methods are used to perform the FPRA. The licensee stated that deviations are evaluated against the methods and criteria for the overall IEPRA and FPRA model development for consistency, or confirmation of bounding treatment, to confirm that the safety margin inherent in the PRA model is preserved and if the deviation does not change the FPRA, the safety margin inherent in the FPRA is also unchanged.

The licensee stated that the material in which non-metallic conduits are run within embedded locations is not subject to flame or heat impingement from an external source, which would result in structural failure, contribution to fire load, or damage to the circuits. Also, failure of circuits within the embedded conduit resulting in a fire would not result in damage to external targets. Thus, the use of non-metallic conduit for raceways embedded in concrete has no impact on the analytical methods used in the FPRA to evaluate potential fire scenarios. Therefore, the inherent safety margin in these methods remains unchanged.

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 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 plastic conduit in embedded installations does not impact fire protection DID. The licensee stated the plastic conduit in embedded installations does not affect Echelons 1, 2 and 3. The licensee further stated that the plastic conduits do not directly result in compromising automatic or manual fire suppression functions, fire protection for systems and structures, or post-fire safe shutdown capability.

In FPE RAI 07a (Reference 21), the NRC staff requested that the licensee provide additional discussion on how DID is maintained with respect to each echelon. In its response to FPE RAI 07a (Reference 11), for NFPA 805 Section 3.3.5.2, the licensee stated the following for each DID echelon:

1) Prevent fires from starting (combustible/hotwork controls): The PVC conduit installed at ANO is embedded in concrete within the power block or within underground duct banks that consist of a grouping of PVC conduits surrounded by concrete. The PVC conduit is not subject to flame or heat impingement from an external source, which would result in structural failure, contribution to fire load, or damage to circuits based on configuration (i.e., not exposed). Plant procedures for control of combustibles and control of hot work and ignition sources are used when working in areas with PVC conduits if the PVC is

susceptible to flame or heat impingement. Therefore, DID Echelon 1 is maintained.

2) Rapidly detect, control and extinguish fires that do occur thereby limiting damage (fire detection systems, automatic fire suppression, manual fire suppression, pre-fire plans): The PVC conduits embedded in concrete or located in duct banks do not physically interact with systems or equipment required to detect, control, and extinguish fires. Therefore, DID Echelon 2 is maintained.

3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed (fire barriers, fire rated cable, success path remains free of fire damage, recovery actions): The PVC conduits embedded in concrete or located in duct banks do not degrade or otherwise affect fire protection for systems and structures. Current fire barriers, fire rated cable, success paths, and recovery actions are unaffected. Therefore, DID Echelon 3 is maintained.

The NRC staff concludes that the licensee's response to FPE RAI 07a is acceptable because the licensee adequately described how DID is maintained for use of the PB methods used to satisfy the requirements of NFPA 805 Section 3.3.5.2.

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

3.1.4.5 NFPA 805, Section 3.3.12(1) – Reactor Coolant Pump Oil Collection System

In LAR Attachment L, 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 for the oil collection system for each RCP to be capable of collecting lubricating oil from all potential pressurized and non-pressurized sites in each RCP oil system. The licensee requested approval for non-collection of oil mist that results from normal pump/motor operation.

The licensee stated that the ANO-1 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. The licensee stated 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 an inherent occurrence in the operation of large rotating equipment and 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 ANO-1 does not have a history of significant oil loss from 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 heat release rate (HRR) or accumulation near potential ignition sources or non-insulated reactor coolant piping.
- RCPs are not required to achieve or maintain fire safe shutdown.

In FPE RAI 03a-c dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee provide additional justification for the following:

a) Characterization of the misting in terms of oil quantity and location of deposition.

b) Discussion of the fire hazard associated with the oil misting and deposition locations, including proximity to equipment and ignition sources necessary to meet the NSPC.

c) The actions taken, if any, to clean oil mist deposits from equipment surfaces (e.g., during maintenance outages).

In its response to FPE RAI 03a dated May 19, 2015 (Reference 9), the licensee stated that in recent plant outages, the average amount of oil lost was considered insignificant. The licensee stated that the total amount of oil lost includes the loss due to misting, but no distinction is possible between the amount lost due to misting and other losses. The licensee stated that should a significant quantity of oil difference be identified, then a condition report would be initiated to address any concerns. The licensee stated that with regard to where misted oil may collect, the most common areas include structural steel near the motors, the outside of the motors, and motor area insulation (in general anything near the motor with an apparent preference for cooler surfaces). The licensee stated that in the past, this misting manifests itself as a thin film of oil on the aforementioned surfaces, sometimes including small droplets.

In its response to FPE RAI 03b (Reference 9), the licensee stated that any oil mist from the RCP lube oil system that is not collected by the oil collection system would be expected to accumulate on, or near, the RCP motor and pump assembly. The licensee stated that for a fire

to occur, oil would need to be exposed to an ignition source or come in contact with surfaces that have temperatures in excess of the ignition temperature of the oil. The licensee stated that the attributes which would prevent ignition of any oil accumulation in the vicinity of the RCP motor and pump assemblies include:

- The thermal design parameters of the Reactor Coolant System (RCS) insulation are based on a maximum pipe surface temperature of 650 degrees Fahrenheit (°F). The piping surfaces in the vicinity of the RCP motors are insulated such that lube oil mist would only contact relatively cool surfaces (less than (<) 140 °F) of the insulation and not migrate into the fibrous insulation that could break down oil into components with an auto-ignition temperature lower than the surface temperature. The oil used in the RCP motors have flashpoints of > 190 degrees Centigrade (°C) (374 °F) and greater than (>) 200 °C (392 °F).

- There are few possible sources of potential electrical ignition in close proximity to the RCPs. Electrical junctions in the area are protected with junction/splice boxes and the use of these boxes is typically required for splicing and terminating power cables. The design of the RCPs limits the potential for the ignition of any oil drawn into the motor through the ventilation system. However, RCP motors do get some oil internal to the motor due to oil mist going down the standpipe. Improvements have been made to the motors during refurbishments/rewinds to minimize oil leaks during operation. The oil misting and internal oil leaks pose no threat to the RCP motor from a fire threat based on motor operating temperatures (150-200 °F) being below the ignition temperature of the oil.

- Due to the misting affect, there may be a fine film of oil on components in the area of the RCP motors, which will have no adverse impact of the subject components. No accumulation of oil is expected in the webbed areas of these components, collection pans, or dripping from any of the RCP components. If an abnormal accumulation of oil is found or the integrity of the collection system is determined to be deficient, a work order is initiated to clean surfaces and documented in procedures. This inspection ensures that anything more than a fine film of oil is documented, tracked by a condition report, and acceptable determined prior to unit startup.

In its response to FPE RAI 03c (Reference 9), the licensee stated that with regard to cleaning the surfaces identified with an oil film deposition, the cleaning is performed every refueling outage as a preventive maintenance task for the motor per procedures that include cleaning all accessible areas of each motor. The licensee stated that if the need for cleaning of surrounding structures is identified, a condition report is initiated and a work order may be written for cleanup, as deemed necessary.

The NRC staff concludes that the licensee's responses to FPE RAIs 03a-c are acceptable because the licensee demonstrated that it adequately characterized the oil misting condition, the associated fire hazards, and the procedures to cleanup misting deposits.

The licensee stated that the oil mist resulting from normal operation will not adversely impact nuclear safety. The licensee stated that there are redundant RCPs available as necessary and

the RCPs are not required to achieve and maintain fire safe shutdown, and, therefore, there is no impact on the NSPC.

The licensee stated that the potential for oil mist from the RCPs has no impact on the radiological release performance criteria. The licensee stated that the radiological release review was performed based on the manual fire suppression activities in areas containing or potentially containing radioactive materials and the entire Containment Building in which the RCPs are located is an environmentally sealed radiological area during power operations. The licensee further stated that the oil mist does not add additional radiological materials to the area or challenge systems boundaries that contain such.

The licensee stated that the oil mist resultant from normal operation will not adversely impact the ability of a plant to achieve and maintain fire safe shutdown even if ignition occurred. The licensee stated that there are redundant RCPs, however, the RCPs are not required to achieve and maintain fire safe shutdown, and the use of this equipment has been defined by the limitations of the analytical methods (e.g. Ignition frequency, heat released) used in the development of the FPRA. The licensee stated that the FPRA uses historical fires and fire tests as the basis for many inputs, such as the ignition frequencies, the heat released from a fire, how fires will spread, and the probability that a circuit will be damaged in an adverse way, and, therefore, the inherent safety margin present in the IEPRA model and extended to the FPRA methods is reasonable because NRC accepted methods are used to perform the FPRA. The licensee stated that deviations are evaluated against the methods and criteria for the overall IEPRA and FPRA model development for consistency, or confirmation of bounding treatment, to confirm that the safety margin inherent in the PRA model is preserved and if the deviation does not change the FPRA, the safety margin inherent in the FPRA is also unchanged.

The licensee stated that the oil mist resultant from normal operation of the RCPs does not account for an appreciable HRR or accumulation near potential ignition sources. The licensee stated that the RCPs utilize de-misters and oil loss is evaluated each outage per procedures.

The licensee stated the RCP lube oil system is capable of withstanding the safe shutdown earthquake without rupture and the oil collection system will channel random leaks to a vented, closed container, and will keep overflow oil away from potential ignition sources. The licensee further stated that the RCPs are not required to achieve and maintain fire safe shutdown, nor are they credited in the FPRA; and thus, use of the existing RCP lube oil and oil collection configuration has no impact on the analytical methods used in the FPRA to evaluate potential fire scenarios and the inherent safety margin in these methods remains unchanged.

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 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 oil mist from RCPs does not impact fire protection DID. The licensee stated that Echelon 1 is maintained by the oil collection system and RCP design. The licensee stated that the introduction of a small amount of oil misting does not affect Echelons 2 and 3 and that the potential for oil mists from the RCPs does not result in

compromising automatic fire suppression functions, manual fire suppression functions, fire protection for systems and structures, or post-fire safe shutdown capability.

In FPE RAI 03d and FPE RAI 07a (Reference 21), the NRC staff requested the licensee to provide additional discussion and bases for concluding that there is no impact on the three echelons of DID. In its responses to FPE RAI 03d and FPE RAI 07a (Reference 9) and (Reference 11), the licensee stated the potential for oil mist from RCPs does not impact fire protection DID and stated the following:

- For Echelon 1, the reactor building fire zones are classified as Level 1 combustible control zones which require a continuous fire watch for any combustibles left unattended in these fire zones. The control of hot work activities ensures that any hot work in the RCP areas will include a hot work fire watch and necessary controls for mitigating fires (i.e., local extinguisher). The oil collection system will capture any excess oil that is present on the RCP motor.

- For Echelon 2, the ability to detect and suppress a fire in the reactor building cavities is unchanged by potential oil misting. The type of fire anticipated in the reactor building cavities is unchanged given the existing lube oil quantities within the RCP motor reservoirs. The manual hose stations are located outside the reactor building cavities and are unaffected by the RCP oil misting. Fire extinguishers are installed in the reactor building during refueling outages to provide extra fire suppression capabilities during work activities. The pre-fire plans are not affected by RCP oil misting.

- For Echelon 3, the potential for oil misting from the RCPs does not result in degradation of the level of fire protection for systems or structures. The reactor building outer wall is the 3-hour rated fire barrier for the Reactor Building. RCP oil mist does not affect fire barriers given the oil mist will not come into contact with the Reactor Building fire barrier. The Reactor Building has two analysis areas separated north to south by the primary shield wall. Ignition of condensed oil mist in either cavity will not result in the spread of fire from one cavity to the other cavity. The oil mist will not degrade fire rated cable or affect any success paths. There are no recovery actions in the area of the RCPs. The location of the RCPs and the location of the oil mist does not affect the function of equipment credited to meet any of the nuclear safety performance criteria.

The NRC staff concludes that the licensee's responses to FPE RAI 03d and FPE RAI 07a are acceptable because the licensee demonstrated how DID is maintained for use of the PB methods used to satisfy the requirements of NFPA 805 Section 3.3.12(1).

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, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID (fire prevention, fire detection, fire suppression, mitigation, and post-fire SSD capability).

3.1.4.6 NFPA 805, Section 3.5.3 – Fire Pump Design and Installation

In LAR Attachment L, the licensee requested NRC staff approval of a PB method to demonstrate an equivalent level of fire protection for the NFPA 805, Section 3.5.3 requirement for the design and installation of fire pumps in accordance with NFPA 20. Specifically, ANO-1 requested approval to use a non-Underwriters Laboratories, Inc. (UL) listed/approved fire pump, and also approval for the battery capacity and battery charger design.

The licensee stated that at the time of purchase on October 30, 1969, the electric drive motor for the electric fire pump was not available as a UL listed motor for fire pump service; therefore, the motor could not be purchased as UL listed for fire pump service due to the larger service requirements associated with the fire pump. The licensee stated that a similar issue existed for the fire pump controller; however, the fire pump controller was evaluated to meet the design data requirements needed for the size and type for the electrically driven fire pump and drive motor.

The licensee stated that vendor documents do not identify a certification for the batteries and do not identify the discharge rate of the lead acid batteries. The licensee stated that the vendor manual does identify the battery charger rectifier as being of a semiconductor type (silicone diode rectifier). The licensee stated that the vendor manual and design drawing identify the Cummins diesel fire pump engine with two lead acid battery banks D08 and D09. The licensee stated that the battery charging rectifier function is to automatically adjust its output to the battery's requirement and to the demands of the indicating lamps that draw small amounts of current when in standby. The licensee further stated that the vendor documents do not identify the battery discharge rate for the lead acid batteries.

The licensee stated that the vendor manual for the diesel engine fire pump controller states that this equipment is UL listed and Factory Mutual Research Corporation approved for fire service. The licensee further stated that the vendor's diesel engine fire pump controller is manufactured, inspected, and tested to obtain UL listing and Factory Mutual Research Corporation approvals for fire pump service. The licensee stated that the fire pump controller subcomponents (battery charger, relays, and etc.) were certified by the vendor for fire pump service and a review of historical fire pump testing found no issues identified by maintenance or during the diesel fire pump test, with battery problems related to battery discharge that would impact engine start.

In FPE RAI 07e (Reference 21), the NRC staff requested that the licensee describe the following:

- What "certified by the vendor for fire pump services" for Pump P-6B controller sub-component means with respect to: (a) assuring that the sub-component will perform its intended functions; (b) any impact of using unlisted sub-component on achieving automatic sequenced start functions of the fire pump; and (c) any impact of the unlisted sub-component(s) on the performance of the fire pump to start in the event of failure of the lead pump or that the sub-component will not prevent subsequent pump from starting.

- The significance of using non-UL listed pump controllers or components on the reliability and availability of intended sequence start/stop sequence for Pump P-6A, including the indication of local and remote pump conditions and describe whether the non-UL listed controller presents any challenges to the compliance with NFPA 805, Sections 3.5.6 and 3.5.9 (e.g., start/stop requirements between lead and subsequent fire pumps and indication of operations).

In its response to FPE RAI 07e (Reference 11), the licensee stated the P-6B fire pump controller sub-components (battery charger, relays, etc.) are certified by the vendor for fire pump services. The licensee stated that the ability that the sub-component will perform its intended function is proven by historical evidence and procedural testing. The licensee further stated that monthly tests that demonstrate functionality of the diesel (P-6B) fire pump, along with quarterly vibration tests, are performed in accordance with plant procedures and the following tests are performed for both fire pumps every 18 months:

- Functional and Capacity
- Shutoff Head
- 100 percent Capacity and Valve Setpoint
- 150 percent Capacity
- Controls and Alarms
- Full Actuation

The licensee also identified the following routine fire pump maintenance activities and frequencies:

- P-6B engine and gear oil check (Bi-Weekly)
- P-6B inspection (Semi-Annually, Annually)
- P-6B engine surveillance (Biannually)
- P-6B engine batteries and battery charger maintenance (Weekly, Quarterly, 18-Month)

The licensee further stated that in review of ANO-1 documents, no issues were identified in association with past diesel fire pump tests, specifically with battery problems related to the rectifiers or battery discharge that would prevent the engine from starting. The licensee stated that the vendor manual for the diesel engine fire pump controller states that this equipment is UL listed and Factory Mutual Research Corporation approved for fire service and that the diesel fire pump meets the demands for the fire protection water supply system.

The licensee further stated that the diesel fire pump start circuitry does not interface with the electric fire pump start circuitry. The licensee stated that the diesel fire pump starts automatically if system pressure drops to 90 pounds per square inch gauge (psig) or if alternating current (AC) power is lost to the control cabinet. The licensee stated that the ability of the diesel fire pump to start with the unlisted sub-components as discussed above is maintained, and that there is no impact on pump motor performance based on unlisted sub-components.

The licensee stated that the electric fire pump controls and components are composed of standard electric components. The licensee stated that the functionality of the control circuits are routinely tested, which illustrate that the non-UL listed pump controllers or components do not affect the reliability or availability of the electric fire pump. The licensee stated that the electric fire pump is configured with automatic start/manual stop, and the operating status of the pump is located on the local panel and in the MCR. The licensee stated that the functionality of the electric fire pump is verified using routine tests and maintenance activities. The licensee stated the functional tests for the electric pump are the same as those listed above for the diesel-driven pump. The licensee stated that based on the functionality testing and maintenance activities it is concluded that the use of non-UL listed pump controllers and components has an insignificant effect on the reliability and availability of pump start/stop sequence and associated indications. The NRC staff concludes that the licensee's response to FPE RAI 07e is acceptable because the licensee demonstrated adequate fire pump performance through testing, maintenance, and surveillance procedures that provides reasonable assurance that the fire pumps will reliably perform their function.

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

- The electrical fire pump configuration required the larger size 4160 volts alternating current (VAC) fire pump motor and the 4160 VAC fire pump controller, which was not UL listed/approved for fire pump service in 1969. In addition, historical evidence and procedural testing requirements have shown that the 4160 VAC electric motor, electric fire pump, and electric fire pump controller configuration used at ANO, while not in explicit agreement with the code requirement for a UL listing, meets the intent of electrically driven fire pump design size, type, and function.

- The electric driven fire pump and electric pump controller was manufactured in accordance with the National Electrical Code (NEC).

- The electrical fire pump configuration meets the demands for the fire protection water supply system at ANO.

- In review of ANO documents, no issues were identified in association with past diesel fire pump tests, specifically with battery problems related to the rectifiers or battery discharge that would prevent the engine from starting. The vendor manual for the diesel engine fire pump controller stated that this equipment is UL listed and Factory Mutual Research Corporation approved for fire service. The diesel fire pump meets the demands for the fire protection water supply system.

As described in the LAR, the licensee performs routine testing and maintenance on the electric and diesel fire pumps. The licensee stated that based on a review of condition reports associated with the electric and diesel fire pumps, deficiencies such as field related components causing the auto start of a pump; inspection or corrective maintenance task deficiencies, and sub-component (such as gauges, fittings, or piping) failures were noted. The licensee stated that no applicable operating experience was found that related to a failure of the electrical motor or its controller, or the diesel or the diesel engine battery bank, due to any adverse quality issue

with this equipment and the NFPA 20 code deviation does not degrade the system or equipment and has no adverse impact on the ability of the fire protection water system to perform its function.

The licensee stated that the 4160 VAC fire pump motor and the 4160 VAC electrical fire pump controller were not UL listed/approved for fire pump service at the time of purchase in 1969 due to UL not having the high voltage 4160 VAC electric fire pump motor and controller rated for fire service in 1969. The licensee stated that the vendor manual for the diesel engine fire pump controller states that this equipment is UL listed and FM approved for fire service and the vendor's diesel engine fire pump controller is manufactured, inspected and tested to obtain UL listing and FM approvals for fire pump service. The licensee stated that the fire pump controller sub-components (battery charger, relays, and etc.) were certified by the vendor for fire pump service and a review of historical fire pump testing found no issues identified by maintenance or during the diesel fire pump test with battery problems related to battery discharge that would impact engine start. The licensee stated that the deviations described above have no impact on the NSPC.

The licensee stated that a radiological release review was performed based on the manual fire suppression activities in areas containing, or potentially containing, radioactive materials and is not impacted by the motor driven fire pump and fire pump controller purchased as not UL listed/approved for fire pump service in 1969, and, therefore, this deviation has no impact on radiological controlled areas (RCAs) or the radiological release performance criteria.

The licensee stated the fire protection water supply system has redundant capacity to supply the demands of the system, and that 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 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 pumps (electric fire pump or diesel fire pump), at 100 percent flow rate and pressure, have the excess capacity to supply the demands of the fire protection system in addition to the greatest hose reel demand and, therefore, do not affect Echelons 1, 2 and 3.

In FPE RAI 07a (Reference 21), the NRC staff requested that the licensee provide additional discussion on how DID is maintained with respect to each echelon. In its response to FPE RAI 07a (Reference 11) for NFPA 805, Section 3.5.3, the licensee stated the following for each DID echelon:

1) Prevent fires from starting (combustible/hotwork controls): The function of the fire pumps/motors is not to prevent fires from starting. From a combustible loading perspective the fire pumps/motors and associated controls are considered in-situ combustibles. The exposed part of the fire pumps/motors are standard construction, which are mostly non-combustible. The lack of transient combustibles limits the possibility of a fire from starting. The plant procedure for

control of hot work and ignition sources is utilized when working in areas with the fire pumps/motors. Therefore, DID Echelon 1 is maintained.

2) Rapidly detect, control and extinguish fires that do occur thereby limiting damage (fire detection systems, automatic fire suppression, manual fire suppression, pre-fire plans): The fire pumps/motors physically interact with systems or equipment required to control and extinguish fires. The fire pumps/motors do not physically interact with systems or equipment required to detect fires. The fire pumps, controllers, and motors are part of the configuration of the firewater supply system. Historical evidence and procedural testing requirements have shown that the 4160 VAC electric motor, electric fire pump, and electric fire pump controller configuration used at ANO, while not in explicit agreement with the code requirement for a UL listing, meets the intent of electrically driven fire pump design size, type, and function. No issues have been identified in association with past diesel fire pump tests, specifically with battery problems related to the rectifiers or battery discharge that would prevent the engine from starting. The vendor manual for the diesel engine fire pump controller states that this equipment is UL listed and Factory Mutual Research Corporation approved for fire service. The diesel fire pump meets the demands for the fire protection water supply system. As such the code deviation has no adverse impact on the control and extinguishing aspects of DID. Therefore, DID Echelon 2 is maintained.

3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed (fire barriers, fire rated cable, success path remains free of fire damage, recovery actions). The code deviation for fire pumps, controllers, and motors does not degrade or otherwise affect fire protection for systems and structures. Current fire barriers, fire rated cable, success paths, and recovery actions are unaffected. Therefore, DID Echelon 3 is maintained.

The NRC staff concludes that the licensee's response to FPE RAI 07a is acceptable because the licensee adequately described how DID is maintained for use of the PB methods used to satisfy the requirements of NFPA 805 Section 3.5.3.

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

3.1.4.7 NFPA 805, Section 3.5.16 - Dedicated use of Fire Protection Water Supply System

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

licensee requested NRC approval for use of a temporary pump connected to the fire water supply system to provide cooling water when the auxiliary cooling water (ACW) system is removed from service during both power operations and unit outages provided that the firewater capability remains within limits as demonstrated through the temporary modification process.

The licensee stated that ANO fire protection water supply system is used for installation of a temporary pump to allow both units to supply a protracted and continual supply of cooling water typically during unit outages when the ACW system is removed from service. The licensee stated that past practices of allowing use of the fire water system for non-fire water demands during outages have been authorized by engineering and incorporated into operations procedures. The licensee further stated that significant margin exists in the fire protection water supply system above that required for suppression system demands based on the results of a hydraulic model.

The licensee stated that ACW is not essential for the SSD of the plant and thus the KSFs and NSPC are not impacted upon the loss of ACW cooling capability due to a fire event.

In FPE RAI 07fi (Reference 21), the NRC staff requested that the licensee clarify if the approval request should also include a deviation from the requirements of NFPA 805, Section 3.5.10, which states that the underground yard fire main loop is designed and installed in accordance with NFPA 24 (Reference 94). In its response to FPE RAI 07fi (Reference 11), the licensee stated that NFPA 805, Section 3.5.10, states that an underground yard fire main loop, designed and installed in accordance with NFPA 24 shall be installed to furnish anticipated water requirements. The licensee stated that the ANO fire protection underground fire main loop meets the requirement of NFPA 805, Section 3.5.10, without any deviation associated with the use of domestic water and a deviation from NFPA 805, Section 3.5.10, is therefore not required.

In FPE RAI 07fii (Reference 21), the NRC staff requested that the licensee describe the design and licensing bases to demonstrate that the configuration and system interfaces of using the temporary pump will not degrade or impact reliability and availability of the fire water supply system for fire protection. In its response to FPE RAI 07fii (Reference 11), the license stated that the temporary pump is rated for 2000 gallons per minute (gpm) at 120 psi and the normal auxiliary flow is for the ANO-1 CR chillers. The licensee stated that the required flow is 270 gpm and the maximum operating temporary pump pressure is 154 psig. The licensee stated that the anticipated maximum duration for using the temporary pump can be conservatively assumed to be equal to the length of the associated outage and a typical outage without any major equipment maintenance/replacement is approximately 30 to 45 days.

The licensee further stated that the fire water system has been hydraulically modeled to verify design pressure (65 psig) and flow (100 gpm) from P-6A or P-6B for various configurations. The licensee further stated that the model has the capability to set demands for flow rates at hydrants and hose reels throughout the model and the model has been utilized to evaluate various water loads requested by temporary modifications during outages when the normal cooling source (i.e., ACW) is out-of-service. The licensee stated that the calculation of the impact of non-fire loads combined two larger temporary loads to create a worst case scenario that used a total of 700 gpm for temporary cooling load and three hose reels discharging rated flows of 100 gpm. The licensee stated that the lowest calculated pressure at a hose reel was

95.67 psig, which bounds the design requirement of 65 psig, and the fire pumps (P-6A and/or P-6B) easily maintain design parameters for the fire system with temporary loads connected.

The licensee further stated that the valve lineup for P-6A and P-6B to the fire water headers is normally open per procedure and this lineup will allow the main fire water pumps to supply water to the fire water headers when required. The licensee stated that this valve lineup is maintained open during the operation of the temporary pump except for isolation of either pump to support maintenance. The licensee stated that the temporary pump has a dedicated electrical panel that is utilized to manually start and stop the pump motor and the controls for the temporary pump do not electrically interface with the fire water system low pressure auto-start circuitry associated with the main fire water pumps. The licensee stated that the main fire water pump(s) will start if system conditions meet the pump start criteria (i.e., low pressure) and the temporary pump is rated for 2000 gpm at 120 psig, which will be capable of providing water to lower demand suppression systems.

The licensee further stated that the plant is required to 'Establish a backup fire suppression water supply' within 24 hours if both main fire water pumps are nonfunctional and neither main fire water pump can be restored to functional status within 24 hours. The licensee stated that plant procedures state the temporary fire pump has not been evaluated in, and is not authorized to fulfill the role of the backup fire suppression water supply; and, therefore, it is understood that the temporary pump cannot be used as a primary pump even if both main fire water pumps are out of service. The licensee stated that the temporary pump; however, may serve as the water supply pump for fire suppression systems provided the required suppression flow does not lower the fire water system pressure below the starting value for the main fire water pumps. The licensee further stated that if the temporary pump fails to operate or system pressure is lowered below main fire water pump auto-start value, the main fire water pumps will provide needed flow to the affected suppression systems.

In FPE RAI 07fiii (Reference 21), the NRC staff requested that the licensee discuss how the use of the temporary pump, which is not listed for fire protection use, will affect compliance with other sections of NFPA 805 Chapter 3, which require the use of a listed fire pump (for example, in LAR Attachment A, Section 3.5.2, the licensee stated that fire water is supplied by two fire pumps located in the intake structure), and determine if other deviations from NFPA 805 Chapter 3 will be needed when this temporary pump is in-use. In its response to FPE RAI 07fiii (Reference 11), the licensee stated the temporary pump is not utilized as a fire pump for compliance with any of the NFPA 805, Chapter 3, sections, except Section 3.5.16 for which the exemption has been requested. The licensee stated that the temporary pump is used for fire water system pressure maintenance while having flow capacity to provide water for auxiliary applications. The licensee stated that the applicable sections that discuss fire water supply systems are not affected by the use of the temporary pump and do not require deviations from NFPA 805, Chapter 3, and the normal fire water supply pumps are available if system flow and pressure requirements demand increased fire water flow.

The NRC staff concludes that the licensee's response to FPE RAIs 07f.i-iii is acceptable because the licensee demonstrated that the use of temporary fire water pump does not impact compliance with NFPA 805 Chapter 3, Sections 3.5.2 or 3.5.10, and does not impact the ability of the normal fire pumps, P-6A and P-6B to perform their function to supply adequate flow and pressure in the event of a fire.

The licensee stated that the temporary modification process is highly robust and considers impacts on all interconnecting and, if necessary, surrounding equipment during the evaluation process. The licensee further stated that this process also requires a determination to ascertain whether an evaluation under 10 CFR 50.59 must be performed prior to establishing any temporary modification in the field. The licensee stated that provided firewater capability remains within limits, the firewater system may be used for temporary support of other components over time (other than ACW).

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

- The fire protection water supply system has excess capacity.
- The use of the fire protection water supply system is procedurally controlled.

The licensee stated that the temporary pump and its controls are installed in the ANO-1 intake structure and the pump is configured to take suction from the lake and supply water to the fire water system (FWS) via the FWS test header. The licensee stated that a check valve is installed at the test header to prevent reverse flow from the fire header if the temporary system should fail. The licensee stated that a minimum flow recirculation line, which also contains a manual isolation/throttle valve, is installed in the pump discharge line and a pressure gauge is installed on the pump discharge piping for monitoring pump operation and to allow for proper discharge pressure adjustments.

As described in the LAR, the temporary pump is connected to the fire water supply system via a section of the screen wash system and the FWS test header, which is removed to allow the connection. The licensee stated the installation of the temporary pump is procedurally controlled and there is no change to the configuration, alignment, or operation of the fire water pumps (P-6A and P-6B) when the temporary pump is installed. The licensee stated that the use of the temporary pump avoids unnecessary start and run cycles on fire water pumps P-6A and P-6B.

The licensee stated that in accordance with procedures for CR air conditioning, temporary cooling water may be supplied to the normal CR Chillers, VCH-2A or VCH 2B, from fire water that is routed by hose from a firewater header drain valve on elevation 404 to the desired inlet Y-Strainer drains (2ACW-29 and 2ACW-34).

The licensee stated that the use of the fire protection water supply system for temporary cooling is evaluated as a temporary modification and controlled by approved procedures. The licensee stated that the fire protection water supply system has excess capacity to supply the demands of the system to the greatest hose reel demand as evaluated using a hydraulic model. The licensee stated that administrative controls consisting of procedural direction or a continuously stationed individual, ensure that a hose station or hydrant is secured or otherwise made available in the event of a fire, and, therefore, use of the fire protection water supply system for temporary cooling has no impact on the NSPC.

The licensee stated that the radiological release review was performed based on the manual fire suppression activities in areas containing or potentially containing radioactive materials and is not dependent on the alternate use of the fire water supply system; and, therefore, the use of the fire protection water supply system for non-fire protection uses, including the use of hydrants and hoses for purposes other than fire, has no impact on radiological controlled areas or the radiological release performance criteria.

The licensee stated that the fire protection water supply system has excess capacity to supply the demands of the system to the greatest hose reel demand; and that 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 adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed.

The licensee stated that the use of the fire protection water supply system for non-fire protection uses, including the use of hydrants and hoses for purposes other than fire, does not impact fire protection DID. The licensee stated that administrative controls consisting of procedural direction or continuously stationed individual ensure that a hose station or hydrant is secured or otherwise made available in the event of a fire. The licensee stated that the pumps have the excess capacity to supply the demands of the fire protection system in addition to the greatest hose reel demand and do not affect echelons 1, 2 and 3.

In FPE RAI 07a (Reference 21), the NRC staff requested that the licensee provide additional information on how DID is maintained with respect to each echelon. In its response to FPE RAI 07a (Reference 11), for NFPA 805 Section 3.5.16, the licensee stated the following for each DID echelon:

1) Prevent fires from starting (combustible/hotwork controls): The use of the fire water supply system for non-fire use may require the installation of temporary hoses from the selected connection point on the fire header to the equipment that is to be connected. The temporary combustibles are subject to the transient combustible limits stated in the plant procedure for control of combustibles. Plant procedures for control of combustibles and control of hot work and ignition sources are utilized when working in areas with the non-fire water temporary connections. Therefore, DID echelon 1 is maintained.

2) Rapidly detect, control and extinguish fires that do occur thereby limiting damage (fire detection systems, automatic fire suppression, manual fire suppression, pre-fire plans): The fire water piping system physically interacts with systems or equipment required to control and extinguish fires. The fire water piping system does not physically interact with systems or equipment required to detect fires. The use of the temporary pump will maintain the fire water system pressurized in the event the fire water system is needed to extinguish a fire. The main fire pumps are available and will start if the fire water system pressure parameters are met (i.e., low pressure auto-start). The temporary loads are manually isolated in the event of a confirmed fire. The temporary pump maintains pressure and a higher flow than the installed jockey pump on the firewater

supply system and as such does not have an adverse impact on the control and extinguish aspects of DID. Therefore, DID Echelon 2 is maintained.

3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed (fire barriers, fire rated cable, success path remains free of fire damage, recovery actions): The temporary configuration that utilizes the fire water system for non-fire use does not degrade or otherwise affect fire protection for systems and structures. Current fire barriers, fire rated cable, success paths, and recovery actions are unaffected. Therefore, DID Echelon 3 is maintained.

The NRC staff concludes that the licensee's response to FPE RAI 07a is acceptable because the licensee adequately described how DID is maintained for use of the PB methods used to satisfy the requirements of NFPA 805 Section 3.5.16.

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 performance-based method is an acceptable alternative to the corresponding NFPA 805, Section 3.5.16 requirement because it satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID (fire prevention, fire detection, fire suppression, mitigation, and post-fire SSD capability).

3.2 Nuclear Safety Capability Assessment Methods

NFPA 805 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, in part that:

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

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

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

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

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

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

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

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

3.2.1 Compliance with NFPA 805 Nuclear Safety Capability Assessment Methods

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

> The purpose of this section is to define the methodology for performing a nuclear safety capability assessment. The following steps shall be performed:
>
> (1) Selection of systems and equipment and their interrelationships necessary to achieve the 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 of the topics listed above. SE Section 3.5 addresses the assessment of the fourth topic.

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

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

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

The licensee developed the LAR based on the three guidance documents cited above. Although RG 1.205, Revision 1, endorses NEI 00-01, Revision 2, the licensee's review was performed to the guidance in NEI 00-01, Revision 1 (Reference 56). In addition, the licensee stated that a review of NEI 00-01, Revision 2 (Reference 28), Chapter 3, was conducted to identify the substantive changes from NEI 00-01, Revision 1 that are applicable to an NFPA 805 FPP. Based on the information provided in the licensee's submittal, as supplemented, the

licensee used a systematic process to evaluate the post-fire SSA against the requirements of NFPA 805, Section 2.4.2, Subsections (1), (2), and (3), which meets the methodology outlined in the latest NRC-endorsed industry guidance.

FAQ 07-0039, "Incorporation of Pilot Plant Lessons Learned – Table B-2" (Reference 62), provides one acceptable method for documenting the comparison of the SSA against the NFPA 805 requirements. This method first maps the existing SSA to the NEI 00-01, Chapter 3 methodology, which in turn is mapped to the NFPA 805, Section 2.4.2 requirements.

The licensee performed this evaluation by comparing its SSA against the NFPA 805 NSCA requirements using the NRC endorsed process in Chapter 3 of NEI 00-01, Revision 1, with a gap analysis of NEI 00-01 Revision 2, and documenting the results of the review in LAR Attachment B, "NEI 04-02 Table B-2-Nuclear Safety Capability Assessment - Methodology Review," in accordance with NEI 04-02, Revision 2.

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

1. The SSA directly aligns with the attribute: noted in LAR Attachment B, Table B-2, as "Aligns." (See discussion in SE Section 3.2.1.1.)

2. The SSA aligns with the intent of the attribute: noted in LAR Attachment B, Table B-2, as "Aligns with Intent." (See discussion in SE Section 3.2.1.2.)

Finally, some attributes may not be applicable to the SSA (e.g., the attribute may be applicable only to BWRs or PWRs). These are described in LAR Attachment B, Table B-2, as "Not Applicable."

As described in LAR Section 4.2.1.1 and discussed above, the licensee performed the review of the SSA methodology to the guidance of NEI 00 01, Revision 1, and performed a gap review against NEI 00-01, Revision 2, to identify substantive changes that are applicable to the NFPA 805 FPP. Based on this review, the licensee identified the following gaps:

- 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 it does not credit RAs for valves located in the fire affected area.

- 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 the potential for an open circuit on a current transformer circuit resulting in secondary damage and possibly resulting in the occurrence of an additional fire has been evaluated.

- Analysis of control power for switchgear with respect to breaker coordination (NEI 00-01, Section 3.5.2.4). The licensee stated breaker coordination is addressed in its safe shutdown cable analysis, and as discussed in LAR Attachment B, the licensee verified that breaker control is not lost by ensuring breaker control cables are not impacted and that control power is available to trip the breakers.

- Evaluating proper-polarity DC faults on non-high low pressure interface components (NEI 00-01, Section 3.5.1.1). The licensee stated that its cable analysis calculation includes three relevant criteria:

    - All DC grounded and ungrounded circuits must consider any and all shorts, hot shorts, shorts to ground, and open circuits.

    - All ungrounded circuits [both AC and DC] will be analyzed as if the circuit is grounded. This process accounts for the possibility of the circuit experiencing a ground fault as result of the fire.

    - For ungrounded DC circuits, two hot shorts of the proper polarity (without grounding) causing spurious operation is not considered credible except for high-low pressure interface components.

    The licensee stated that the first two criteria provide the baseline requirements and the appropriate methodology to treat DC circuits as an equivalent AC circuit containing a bonded (grounded) neutral. The licensee stated that this approach simplifies DC circuit analysis where only one fault or hot short is necessary to result in either functional failure or spurious actuation. The licensee further stated that an assumption of a grounded system also envelopes the condition where a separate cable fails due to fire induced damage, and creates half of the path necessary for a complete circuit should a single conductor of the subject cable fail. The licensee stated that the third criteria is included to prevent elimination of spurious actuation of DC motor operated valves (MOVs) in high-low pressure applications due to the proper polarity hot short requirement. The licensee stated that in pressure interface applications that are not high-low, spurious actuation of DC MOVs due to a hot short in the power cables to the motor are excluded as non-credible because spurious actuation of a DC MOV can only occur due to an inter-cable proper polarity short of both the armature and the field windings exclusive of other failures that would disable the power circuit. The licensee further stated that this is similar to a proper rotation 3-phase hot short in AC MOVs, but with the added complexity of a fourth proper polarity hot short.

The NRC staff concludes that, taken together, these methods compose an acceptable approach for documenting compliance with the NFPA 805, Section 2.4.2 "Nuclear Safety Capability Assessment," requirements, because the licensee followed the alignment strategies identified in the endorsed NEI 04-02, guidance document. The process defined in the endorsed guidance provides an organized structure to document each attribute in NEI 00-01, Chapter 3, allowing the licensee to provide significant detail in how the program meets the requirements. In addition to the basic strategy of "Aligns," which itself makes the attribute both auditable and inspectable, additional strategies have been provided allowing for amplification of information, when necessary, regarding how or why the attribute is acceptable.

3.2.1.1 Attribute Alignment – Aligns

RG 1.205 states that NEI 00-01, Chapter 3, Revision 2, when used in conjunction with NFPA 805 and the regulatory guide, provides one acceptable approach to circuit analysis for a plant implementing an FPP under 10 CFR 50.48(c). For a majority of the NEI 00-01, Chapter 3, attributes, the licensee determined that the SSA aligns directly with the attribute. In these instances, based on the information provided by the licensee, 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:

- 3.1.1.11

Attribute 3.1.1.11 requires where a single fire can impact more than one unit of a multi-unit plant, the ability to achieve and maintain SSD for each affected unit must be demonstrated. In SSA RAI 05 dated May 5, 2015 (Reference 21), the NRC staff identified in LAR Attachment B that the licensee stated in the alignment basis for attribute 3.1.1.11 that ANO-1 and ANO-2 do not share resources required to meet performance goals for control of reactivity, inventory, pressure, and DHR. However, in LAR Attachment C for Fire Area I-2 north switchgear room, the licensee stated in the "Method of Accomplishment" for meeting the performance goals for vital auxiliaries (e.g., heating, ventilation, and air conditioning (HVAC)) that ANO-1 shares a common control room envelope with ANO-2. The licensee further stated that ANO-2 condensing units (2VE-1A and 2VE-1B), and the CR emergency recirculation units (2VUC-27A and 2VUC-278) are available. Also, in LAR Section 4.2.1.2, the licensee stated that safe and stable conditions in Mode 3 may continue long term by transferring water between the non-qualified condensate storage tanks maintained in ANO-2 to ANO-1 by manipulation of valves and that fuel oil supplies can be cross-connected between ANO-1 and ANO-2, if needed. The NRC staff requested that the licensee clarify the discrepancy between the alignment bases for NEI 00-01, Attribute 3.1.1.11 and the ANO-2 equipment credited in LAR Attachment C for Fire Area I-2. In its response to SSA RAI 05 dated May 19, 2015 (Reference 9), the licensee provided the following clarification:

- ANO-1 and ANO-2 do not share systems required to meet performance goals for control of reactivity, inventory, pressure, or decay heat removal. Each unit has dedicated Service Water (SW) and electrical distribution vital auxiliaries physically separate from the opposite unit. No single fire results in simultaneous safe shutdown of both units for a fire outside the Control Room envelope. The ANO-1 and ANO-2 Control Rooms share a common envelope and staffing is adequate to perform an alternate shutdown on the fire-affected unit and remote shutdown on the opposite unit. ANO-1 has the capability to share resources with ANO-2 where the resource is available and adequate to support both units. The following describes where shared resources are credited (or not credited) to achieve and maintain safe shutdown:

  - *Condensate/Non-Borated Water* – ANO-1 and ANO-2 share common sources of non-borated water from the Lake Dardanelle Reservoir, Emergency Cooling Pond (ECP), and Qualified

Condensate Storage Tank (QCST); however, each unit maintains its own separate paths to these sources. Other onsite sources of condensate for Steam Generator feedwater are available via normally closed manual valves such as from non-qualified CSTs [condensate storage tanks], but only the SW source (from Lake Dardanelle or the ECP) is credited for long term cooling once depletion of the QCST occurs.

- *Fuel Oil* – Each unit at ANO has dedicated safety-related fuel oil tanks for the Emergency Diesel Generators (EDGs) that are filled from a common non-qualified bulk storage tank. The vaults for each respective unit's tanks are isolated from the other unit's tanks by 3-hour rated walls. Fuel from the ANO-2 safety-related fuel oil tanks can be transferred to ANO-1 via a temporary cross connect, but is not credited within the ANO-1 safe shutdown analysis.

- *Safety Parameter Display System (SPDS)* – The SPDS computer provides backup instrumentation to safety-related instruments for both Control Rooms and is used for alternate shutdown. The SPDS computer is physically located in ANO-2 and is powered from an ANO-2 safety-related EDG and battery-backed inverter. SPDS room cooling can be powered from either ANO-1 or ANO-2.... A fire in ANO-2 that impacts the SPDS does not require a safe or alternate shutdown of ANO-1.

- *Control Room Ventilation* – ANO Control Rooms share a common envelope and the ANO-2 Control Room Emergency Ventilation System (CREVS) is designed to maintain ventilation for both units if either the ANO-1 (VSF-9) or the ANO-2 (2VSF-9) emergency supply fan fails due to fire in the respective unit outside of the Control Room. For a fire in ANO-1, the ANO-2 condensing units (2VE-1A and 2VE-1B) and recirculation units (2VUC-27A and 2VUC-27B) are available as part of the Control Room Emergency Air Conditioning System (CREACS). For a fire in ANO-2, the ANO-1 Control Room emergency unit cooler VUC-9 remains available.

The NRC staff concludes that the licensee's response to SSA RAI 05 is acceptable because the licensee clarified that ANO-1 and ANO-2 do not share resources required to meet performance goals for control of reactivity, inventory, pressure, and DHR in the event of a fire. Additionally, for a fire in the common CR, the licensee demonstrated that staffing is adequate to perform an alternate shutdown on the fire-affected unit and remote shutdown on the opposite unit.

3.2.1.2 Attribute Alignment -- Aligns with Intent

For certain 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, as having this condition are as follows:

- 3.1B
- 3.1C
- 3.1.3
- 3.1.3.3
- 3.1.3.4
- 3.2.2.2
- 3.2.2.3
- 3.2.2.5
- 3.3.1.5
- 3.3.3.1
- 3.5.2.4
- 3.4.1.4

Attribute 3.1 [B, Goals] – Safe Shutdown Systems and Path Development: The guidance states that the goal of post-fire safe shutdown is to assure that one train of shutdown SSCs remains free of fire damage for a single fire in any single plant fire area, and that the SSD systems are selected so that the capability to perform these required functions is a part of each safe shutdown path. The licensee stated that the systems and logical relationships required to ensure that performance goals are met have been developed in the safe shutdown equipment list (SSEL) and safe shutdown capability assessment (SSCA), and that the selection of components and systems is based on achieving the performance goals in each fire area. The licensee further stated that there is no specific shutdown path. The NRC staff concludes that the licensee's statement of aligns with intent is acceptable because the methods as described by the licensee for identification of systems and the development of the logical system and component relationships to demonstrate that ANO-1 meets the nuclear safety performance goals, meet the intent of the NEI 00-01, Chapter 3, attribute identified above, which is to ensure that the post-fire SSA addresses the requirements of NFPA 805, Section 2.4.2.

Attribute 3.1 [C, Spurious Operations] – Safe Shutdown Systems and Path Development: The guidance states that associated circuits with the potential for spurious equipment operation that can affect the accomplishment of the post-fire SSD functions should be considered. The guidance describes typical examples of the effects of the spurious operations of concern, which include a loss of reactor pressure vessel/reactor coolant inventory in excess of the SSD makeup capability, and a flow loss or blockage in the inventory or decay heat removal system being used for the required SSD path. The licensee stated that the cable selection and circuit analysis for 10 CFR Part 50, Appendix R, SSD components considers spurious operation due to associated circuits, common power supplies, and common enclosures. The licensee further stated that a subset of components considered for spurious operation involves reactor coolant pressure boundary components whose spurious operation can lead to an unacceptable loss of reactor pressure vessel/RCS inventory via an interfacing system loss of coolant accident (LOCA). The licensee further stated that this high/low pressure interface boundary valve definition is in alignment with those in NEI 00-01, NEI 00-01 Appendix C, and FAQ 06-0006 (Reference 57), but is limited to those components potentially subject to interfacing LOCAs in excess of makeup capability. The NRC staff concludes that the licensee's statement of aligns with intent is acceptable because the methods as described by the licensee for evaluating spurious operation, including high/low pressure interface boundary valves, meet the intent of the NEI 00-01, Chapter 3, attribute identified above, which is to ensure that the post-fire SSA addresses the requirements of NFPA 805, Section 2.4.2.

Attribute 3.1.3 – Methodology for Shutdown System Selection: The guidance provides a flowchart illustrating the various steps involved in selecting SSD systems and developing the shutdown paths. The licensee stated that the selection of components and systems is based on achieving the performance goals in each fire area, and that there is no specific shutdown path; both red and green train SSD equipment and selected non-1E equipment can be used to

accomplish performance goals. The NRC staff concludes that the licensee's statement of aligns with intent is acceptable because the methods as described by the licensee for the identification of systems and logical relationships to meet the nuclear safety performance goals meet the intent of the NEI 00-01, Chapter 3, attribute identified above, which is to ensure that the post-fire SSA addresses the requirements of NFPA 805, Section 2.4.2.

Attributes 3.1.3.3 and 3.1.3.4 – Define Combinations of Systems for Each Safe Shutdown Path and Assign Shutdown Paths to Each Combination of Systems: The guidance for Attribute 3.1.3.3 states to select combinations of systems with the capability of performing all of the required SSD functions and designate this set of systems as a SSD path, and that in many cases the SSD paths may be defined on a divisional basis since the availability of electrical power and other support systems must be demonstrated for each path. The guidance for Attribute 3.1.3.4 states to assign a path designation to each combination of systems and that the path will serve to document the combination of systems relied upon for SSD in each fire area. The licensee stated that path designations are not used, and that the logical relationship of SSD equipment is established in the fault trees and illustrates how this equipment functions together to achieve and maintain SSD. The NRC staff concludes that the licensee's statement of aligns with intent is acceptable because the methods as described by the licensee for the development of logical relationships of SSD equipment in fault trees to meet the nuclear safety performance goals meets the intent of the NEI 00-01, Chapter 3, attribute identified above, which is to ensure that the post-fire SSA addresses the requirements of NFPA 805, Section 2.4.2.

Attribute 3.2.2.2 – Identify Equipment in Each Safe Shutdown System Flow Path: The guidance states to review the applicable documentation (e.g. piping and instrument drawings (P&ID), electrical drawings, instrument loop diagrams) to assure that all equipment in each system's flow path has been identified and to assure that any equipment that could spuriously operate and adversely affect the desired system function(s) is also identified. The guidance continues to state that these new systems are to be designated with the same SSD path as the primary shutdown system under review. The licensee stated that the SSEL identifies the minimum set of plant equipment that is required to demonstrate the plant's ability to achieve and maintain post-fire safe shutdown for all applicable areas of the plant and that to develop this list, a thorough review of plant documents was conducted, including P&IDs, system training manuals, normal and abnormal operating procedures, and the SAR. The licensee stated that the SSEL is the result of an iterative process including component selection, circuit analysis, and area compliance assessments, and that SSD paths are not designated, but instead the method to achieve and maintain SSD is shown on fault trees for each fire area. The NRC staff concludes that the licensee's statement of aligns with intent is acceptable because the methods as described by the licensee for development of the SSEL included reviewing applicable documentation and developing logical relationships in fault trees to meet the nuclear safety performance goals meets the intent of the NEI 00-01, Chapter 3, attribute identified above, which is to ensure that the post-fire SSA addresses the requirements of NFPA 805, Section 2.4.2.

Attribute 3.2.2.3 – Develop a List of Safe Shutdown Equipment and Assign the Corresponding System and Safe Shutdown Path: The guidance states to prepare a table listing the equipment identified for each system and the shutdown path that it supports, including identifying any valves or other equipment that could spuriously operate and impact the operation of that safe

shutdown system. The licensee stated that the SSEL is controlled in a database and that a shutdown path is not used, but instead a method to achieve and maintain safe shutdown is shown on a fault tree for each fire area. The NRC staff concludes that the licensee's statement of aligns with intent is acceptable because the methods as described by the licensee for maintaining the SSEL in a controlled database and developing logical relationships in fault trees to meet the nuclear safety performance goals meets the intent of the NEI 00-01, Chapter 3, attribute identified above, which is to ensure that the post-fire SSA addresses the requirements of NFPA 805, Section 2.4.2.

Attribute 3.2.2.5 – Identify Dependencies Between Equipment, Supporting Equipment and Safe Shutdown Systems and Paths: The guidance states that in the process of defining equipment and cables for SSD, additional supporting equipment, such as electrical power and interlocked equipment, shall be identified and modeled as a dependency between the equipment and each SSD path either in a relational database or in the form of a SSD logic diagram. The licensee stated that in the process of defining equipment and cables for SSD, identification of additional supporting equipment, such as electrical power and interlocked equipment was completed, and that a fault tree is used to identify the dependency between components instead of a SSD path. The NRC staff concludes that the licensee's statement of aligns with intent is acceptable because the methods as described by the licensee for the generation of fault trees to identify dependency between components meets the intent of the NEI 00-01, Chapter 3, attribute identified above, which is to ensure that the post-fire SSA addresses the requirements of NFPA 805, Section 2.4.2.

Attribute 3.3.1.5 – Identification of Power Supplies: The guidance states that for each circuit requiring power to perform its SSD function, identify the cable supplying power to each safe shutdown and/or required interlock component from the closest power supply, load center or motor control center and to review further the electrical distribution system to capture the remaining equipment from the electrical power distribution system necessary to support delivery of power from either the offsite power source or the EDGs (i.e., onsite power source) to the SSEL. The licensee stated that power supply cable selection shall typically end at the closest electrical isolation device for the component identified in the SSEL. The licensee also stated that since the control power cables are listed against the switchgear, when appropriate, and the switchgear availability is linked to the individual component's availability in the SSD fault trees, control power cables are not included with the circuits selected for each individual load powered by that switchgear. The licensee further stated that this included the circuit analysis performed for individual breakers as well. The NRC staff concludes that the licensee's statement of aligns with intent is acceptable because the methods as described by the licensee for linking the required power supplies to individual components in the fault trees to meet the nuclear safety performance goals meets the intent of the NEI 00-01, Chapter 3, attribute identified above, which is to ensure that the post-fire SSA addresses the requirements of NFPA 805, Section 2.4.2.

Attribute 3.3.3.1 – Identify Circuits Required for Operation of the Safe Shutdown Equipment: The guidance states to review for each piece of SSD equipment the appropriate electrical diagrams to identify the circuits (power, control and instrumentation) required for operation or whose failure may impact the operation of each piece of equipment, including circuits whose failure may cause a coordination concern for the bus under evaluation. The licensee stated that all cables, including those from interlocks, instruments, and power supplies, that could adversely

impact the desired operation of SSD equipment are listed as SSD cables, including cables external to the component control circuit if any cable fault could adversely impact the required state of the component, unless the cables are included with another SSD equipment. The licensee also stated that in some special cases, the circuit analysis was completed based on components being skid mounted. In SSA RAI 04 dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee:

a) Clarify the intent of the statement, "in some special cases, the circuit analysis was completed based on components being skid mounted."

b) Describe how the operator actions are evaluated in the NSCA (i.e., would they be evaluated in the performance-based analysis and credited for DID if not required for risk) for safe shutdown equipment (SSE), which have support systems that are not modeled/credited in the analysis and do not have cables identified, so they are assumed to fail in every fire area such that an operator action is always required to perform their credited safe shutdown function.

c) In the alignment bases for Attribute 3.3.1.2 regarding failure of a single cable that could impact more than one piece of safe shutdown equipment, the licensee stated that "where a cable may affect several SSE, these cables are assigned to those SSE's circuit analysis." The methodology alignment for Attribute 3.3.1.2 appears to contradict the statement for Attribute 3.3.1.1 where the licensee states that "cables are listed as safe shutdown cables..., unless the cable is included with another piece of safe shutdown equipment." Provide an explanation of the intent of these two statements that appear to contradict each other.

In its response to SSA RAI 04 dated May 19, 2015 (Reference 9), the licensee stated that:

a) Skid mounted components are subassemblies of a larger piece of equipment within the same fire area. These skid mounted components are identified with the Safe Shutdown Equipment List (SSEL), but do not have separate circuit analysis as their failure is bounded by the associated equipment. An example is the Emergency Feedwater (EFW) turbine P-7A that is skid mounted along with its control panel C-531. Failure of C-531 bounds P-7A and any cables between C-531 and P-7A.

b) Air-operated valves (AOVs) are the only ANO-1 equipment that have a support system, instrument air that is not modeled/credited in the analysis. All AOVs are initially assumed to fail as the status of instrument air is unknown. If an AOV's control circuits can be shown to be free of fire damage in a given fire area and the AOV fails to the desired position on loss of air, then an allowable CR action is applied. Any AOV that required a RA outside the main CR (i.e., locally vent air) for a success path to achieve and maintain the NSPC was documented as a VFDR and evaluated in fire risk evaluations (FREs) using the RI/PB approach of NFPA 805, Section 4.2.4.

c) The alignment basis for attribute 3.3.1.1 can be refined to note that cables that could cause adverse operation of SSE will be included unless those cable(s) are included with other SSE that can be logically associated in the fault tree to capture failure. Note, as reflected in the response to a) above, skid mounted equipment is an exception.

The alignment bases for attribute 3.3.1.2 addresses cables that are part of an interfacing circuit that can impact multiple pieces of equipment. In this instance, there is no separate basic event within the fault tree and the interfacing circuits become part of the circuit analysis for multiple pieces of equipment.

The NRC staff concludes that the licensee's statement of aligns with intent, and its response to SSA RAI 04, are acceptable, because the methods as described by the licensee for identifying all cables including those from interlocks, instruments and power supplies that are associated with the equipment necessary to meet the nuclear safety performance goals meets the intent of the NEI 00-01, Chapter 3, attribute identified above, which is to ensure that the post-fire SSA addresses the requirements of NFPA 805, Section 2.4.2.

Attribute 3.5.2.4 – Circuit Failures Due to Inadequate Circuit Coordination: The guidance states that the evaluation of associated circuits of a common power source consists of verifying proper coordination between the supply breaker/fuse and the load breakers/fuses for power sources that are required for SSD. The licensee stated that its breaker coordination assures that the protective device nearest the fault operates prior to operation of upstream devices, and that the means of assuring circuit protection and coordination is provided in a series of calculations that demonstrate that the class 1E and non-class 1E power supplies credited for safe shutdown compliance have adequate coordination. The licensee further stated that on switchgear and/or load centers where breaker coordination relies on relays, coordination may fail if control power or breaker control cables are lost, therefore, load power cables are assigned to switchgear as required. The licensee stated an analyst may verify that breaker control is not lost by ensuring that the breaker control cables are not impacted and that control power is available to trip the breakers thus ensuring proper coordination. The licensee stated that the review may take place in the fire area compliance document or may be documented in circuit selection/analysis by revising circuit analysis to add cable to the safe shutdown equipment as required. The NRC staff concludes that the licensee's statement of aligns with intent is acceptable because the methods as described by the licensee for engineering calculations or the fire area compliance analysis to evaluate the effects of breaker coordination, including the effects of loss of breaker control cables and control power, meets the intent of the NEI 00-01, Chapter 3, attribute identified above, which is to ensure that the post-fire SSA addresses the requirements of NFPA 805, Section 2.4.2.

Attribute 3.4.1.4 – [Manual Actions]: The guidance states to use manual actions where appropriate to achieve and maintain post-fire safe shutdown conditions in accordance with NRC requirements. The licensee stated that the process defined in FAQ 07-0030 (Reference 60), was used to determine RAs. The NRC staff concludes that the licensee's statement of aligns with intent is acceptable because the methods as described by the licensee follow the process defined in FAQ 07-0030 to meet the nuclear safety performance goals associated with RAs which meets the intent of the NEI 00-01, Chapter 3, attribute identified above, which is to ensure that the post-fire SSA addresses the requirements of NFPA 805, Section 2.4.2..

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 methodology requirements using NEI 00-01, Revision 1, and also conducted a gap analysis between Revision 1 and Revision 2 of NEI 00-01 to determine if any discrepancies existed. The licensee documented the results of its review in LAR Attachment B, Table B-2 in accordance with NEI 04-02, Revision 2.

Based on the information provided in the licensee's submittal, as supplemented, the NRC staff accepts the method the licensee used to perform the 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 95), since NFPA 805 only requires the licensee to maintain the fuel in a safe and stable condition rather than achieve and maintain cold shutdown (CSD) in 72 hours. In LAR Section 4.2.1.2, the licensee stated that based on the NFPA 805 NSCA methodology described in LAR Attachment B, the NFPA 805 licensing basis is to shut down the reactor and maintain the reactor in a hot standby condition (defined as Mode 3, $K_{eff} < 0.99$, RCS temperature ≥ 280 degrees Fahrenheit (°F)) following any fire occurring with the reactor operating at power. The licensee stated that demonstration of the NSPC for safe and stable conditions was performed in two analyses:

- At-Power Analysis, Mode 1 through achieving and maintaining Mode 3.
- Non-Power Analysis, which includes Mode 4 and below.

The licensee stated that the "At-Power" SSA postulates a single fire occurring at 100 percent power and provides a listing of conflicts that may impact the assured success path to meet a particular nuclear safety performance goal. In SSA RAI 01 dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee describe what is meant by "a listing of conflicts that may impact the assured success path to meet a particular nuclear safety performance goal" and how it addressed these conflicts in meeting the requirements of NFPA 805, Chapter 4. In its response to SSA RAI 01 dated May 19, 2015 (Reference 9), the licensee stated that conflicts are defined as the equipment in a success path that could be impacted by the fire such that the NSPC within a given fire area is not met. The licensee stated that the loss of equipment, documented in the SSA, can be due to fire impact of cables, the equipment being physically in the fire area, or loss of a support system. The licensee further stated that if analysis indicates

the equipment remains in a desired post-fire position or separation is achieved by means of NFPA 805, Section 4.2.3.3, it is documented. The licensee stated that any equipment that required an RA for establishing safe and stable operation is documented as a VFDR and evaluated in FREs using the RI/PB approach of NFPA 805, Section 4.2.4. Based on the information provided, the NRC staff concludes that the licensee's response to SSA RAI 01 is acceptable because the licensee showed that loss of equipment as determined in the SSA that does not meet separation requirements of NFPA 805, Section 4.2.3.3 is evaluated using PB methods in accordance with NFPA 805, Section 4.2.4.

The licensee stated 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. The licensee stated that safe and stable conditions in Mode 3 may continue long term, as described for the following nuclear safety performance goals:

- Reactivity Control

  The licensee stated that adequate shutdown margin (SDM) post-trip is provided by the reactor protection system (RPS) ensuring insertion of the control rods, which requires no motive force or electrical power to fulfill their safety function to insert into the core. The licensee further stated that no addition of boric acid solution is required to support post-trip hot standby conditions and a K_{eff} of < 0.99; however, borated water can be added to the RCS to increase the SDM, as needed, from the boric acid addition tank (BAAT) or the borated water storage tank (BWST). The licensee further stated that adequate SDM in support of a plant cooldown to CSD (Mode 5) is assured using the BAAT or BWST aligned to the high-pressure injection (HPI) pump (makeup pump) suction.

- Pressure Control Systems

  The licensee stated that RCS pressure is maintained by controlling the rate of makeup to the RCS and/or use of pressurizer high point vents and spray. The licensee stated that if RCPs are secured, the HPI pumps provide an auxiliary spray path to support pressurizer pressure reductions. The licensee stated that although the two redundant banks of proportional heaters and the auxiliary spray isolation valve are safety-related, vital-powered components, and the utilization of the pressurizer heaters and/or auxiliary spray reduces operator burden, neither component is required to provide adequate pressure control. The licensee further stated that pressure reductions can be made by allowing the RCS to cool/shrink, thus reducing pressurizer level/pressure. The licensee stated that RCS pressure can be reduced by pressurizer vents, hot leg vents, and reactor head vents may also be available, and RCS pressure can be increased by initiating HPI to maintain pressurizer level/pressure.

- Reactor Coolant Inventory Control

  The licensee stated that inventory makeup to the RCS is only required to account for expected RCS leakage, RCS shrinkage, and RCP seal controlled bleed-off. The licensee stated that design features and procedures are provided to ensure

that an adequate source of borated inventory is maintained for RCS inventory control, with regard to long term Mode 3 operations, and to support cooldown to Mode 5 utilizing the makeup and purification system (i.e., makeup and letdown). The licensee stated that the HPI pumps, taking suction from the BWST, can also be used to control RCS level. The licensee further stated that significant volume of borated water available minimizes any concerns with regard to maintaining the fuel in the reactor vessel in a safe and stable condition during or following a fire event.

- Decay Heat Removal Systems

  The licensee stated that decay heat removal is accomplished using forced or natural circulation via the steam generators (SGs) in Modes 3 and 4. The licensee stated that upon entry into Mode 3, EFW will automatically start or can be manually placed in service (from the CR or locally) and will provide secondary makeup water to the SGs (only one SG is required to remove decay heat from the RCS), with pressure control provided by the atmospheric dump valves (ADVs) or the main steam safety valves (MSSVs). The licensee further stated that when RCS pressure and temperature requirements are met, the DHR system is placed in service to continue decay heat removal through Mode 4 (hot shutdown) and into Mode 5 (CSD), if desired, and further long-term core-cooling established via the DHR system. The licensee further stated that DHR system will maintain the fuel in the reactor vessel in a safe and stable condition via one of two DHR pumps and respective SW-cooled heat exchanger.

- Emergency Feedwater

  The licensee stated that Mode 3 conditions can be maintained via forced or natural circulation supported by steaming from one or both SGs. The licensee stated that a QCST provides a source of condensate grade water to the ANO-1 EFW pumps and, as needed, the ANO-2 EFW pumps. The licensee stated that ANO-1 EFW system also has direct access to a non-qualified CST, and that ANO-2 also maintains two non-qualified CSTs containing condensate grade water, which can be manipulated to transfer water between ANO-2 and ANO-1, if needed.

  The licensee further stated that in addition to the EFW pumps, a new auxiliary feedwater pump is planned for installation as part of the ANO-1 transition to NFPA 805. The licensee stated that the new pump will be capable of supplying feedwater to either SG and includes a local control panel with applicable instrumentation, as committed in LAR Attachment S, Table S-1, Modification Item S1-1.

  The licensee stated that there is a minimum volume of available condensate that ensures sufficient EFW to maintain Mode 3 conditions for 30 minutes (minimum) and then transition to Mode 4. The licensee further stated that the other aforementioned tanks normally contain sufficient volume that would support maintaining Mode 3 conditions for a prolonged period of time, and that all tanks

can receive makeup from the onsite Mobile Water Treatment Facility and the city water supply. The licensee further stated that should condensate sources be exhausted, the EFW pump suctions can be aligned to the SW system (Lake Dardanelle) as an indefinite supply of cooling water, and that the SW system can also be aligned to/from the ECP should Lake Dardanelle become unavailable for any reason, which is designed to provide the heat sink capability for the SW system for up to 30-days. The licensee stated that any of these alignments can be manually performed from the CR or locally, and that the fuel in the reactor vessel will be maintained in a safe and stable condition during or following a fire event.

- Process Monitoring

  The licensee stated that instrumentation selected is based on the guidance of NRC Information Notice 84-09 (Reference 96), and NRC Regulatory Guide 1.189 (Reference 32), which identify the minimum monitoring capability considered necessary for a PWR. Instrumentation is powered from buses that provide power directly from station vital batteries or from EDGs. Battery capacity is maintained via battery chargers powered from EDGs (or offsite power, if available).

- Support Systems

  The licensee stated that sufficient support systems discussed below will remain available to ensure the fuel in the reactor vessel will be maintained in a safe and stable condition during or following a fire event.

  Electrical Systems

  The licensee stated that AC and DC distribution systems are credited in order to meet fire protection performance goals and functions, and that the safeguards 4160 V buses can either be aligned to the EDGs, the alternate AC diesel generator (AACDG), or available offsite power sources.

  Emergency Diesel Generator Fuel Oil

  The licensee stated that a source of fuel oil is required for long term reliance on the EDGs. The licensee stated that a non-qualified bulk fuel oil storage tank supplies fuel oil to four underground safety-related EDG storage tanks (one tank per EDG, two EDGs for ANO-1 and two for ANO-2), and that each underground storage tank supplies a fuel oil day tank associated with the respective EDG. The licensee stated that fuel oil supplies can be cross-connected between ANO-1 and ANO-2, and between EDGs, if needed. The licensee further stated that the bulk tank also supplies fuel oil to the non-qualified AACDG, sometimes referred to as the station blackout diesel.

  - A or B EDGs: The licensee stated that the capacity of one safety related EDG fuel oil tank plus the capacity of the respective fuel oil

day tank will support 3.5 days of operation for one EDG during an extended loss of offsite power condition at full rated load. The licensee further stated that the mission time assumes post-accident conditions with electrical loads significantly greater than those expected to support a fire event with no concurrent design-basis accident.

- AACDG: The licensee stated that the AACDG has a fuel oil day tank to initially supply the AACDG operation pending fuel transfer. The licensee stated that assuming the bulk fuel oil storage tank (described above) is maintained at minimum level, sufficient fuel oil is available for the AACDG to run at full load for a minimum of 4.5 days. The licensee stated that the AACDG acts as a backup to one or both ANO units should EDGs fail for any reason, and that the onsite fuel oil capacity is sufficient to operate the EDGs or AACDG for longer than the time that would be necessary to replenish the onsite supply from outside sources.

Cooling Systems

The licensee stated that active heating, ventilation, and air conditioning (HVAC) systems are required for limited plant areas, which include the Unit 1 CR, EDG rooms, and the SPDS room.

The licensee stated that the fire brigade will respond to fire events within the protected area boundary in accordance with procedures, thus mitigating the overall impact of the event. The licensee further stated that any fire or explosion onsite affecting engineered safety features (ESF) systems will result in an emergency class declaration of alert or higher, which requires emergency response organization (ERO) activation. The licensee stated that the ERO will assist the CR personnel with implementation of the longer term actions necessary to maintain the fuel in a safe and stable configuration. The licensee further stated that following plant stabilization in Mode 3 (assuming the fire required a unit shutdown), assessment and repair activities would commence to restore plant equipment or replenish supplies needed to support long term Mode 3 operation, RCS cooldown, or reactor restart. The licensee stated that the ERO resources will be available to assist the Control Room in fire damage assessment and establishing multiple success paths.

The licensee stated that the "At-Power" safe and stable strategy presents no adverse impact on risk due to the following considerations:

- Procedures exist to address loss of power and other loss of equipment that may result from a fire event.

- The ERO will be activated for fires that could affect one or more ESF equipment trains to provide site technical support.

- Compensatory measures and recovery plans can be developed based on the fire damage scenario.

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 ANO-1 meets the feed and bleed requirements. In LAR Table 5-3, the licensee stated that feed and bleed is not utilized as the sole fire-protected SSD methodology at ANO-1. The NRC staff confirmed this by reviewing the designated SSD path listed in LAR Attachment C for each fire area. This review confirmed that all fire area analyses include the SSD equipment necessary to provide decay heat removal without relying on feed and bleed. 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 utilized as the sole fire-protected safe shutdown path at ANO-1.

3.2.4 Assessment of Multiple Spurious Operations

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

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

NFPA 805, Section 2.4.3.2 requires that the PSA evaluation addresses the risk contribution associated with all potentially risk-significant fire scenarios. Because the RI/PB approach taken

used FREs in accordance with NFPA 805, Section 4.2.4.2, "Use of Fire Risk Evaluation," adequately identifying and including potential MSO combinations is required to ensure that all potentially risk-significant fire scenarios have been evaluated.

As described in LAR Section 4.2.1.4, "Evaluation of Multiple Spurious Operations," and LAR Attachment F, "Fire-Induced Multiple Spurious Operations Resolution," the licensee's process for identification and evaluation of MSOs was conducted in accordance with the guidance of NEI 04-02 and RG 1.205, as supplemented by FAQ 07-0038, Revision 3 (Reference 61), and included the following five steps:

1. Identify potential MSOs of concern;
2. Conduct an expert panel to assess plant specific vulnerabilities;
3. Update the FPRA model and NSCA to include the MSOs of concern;
4. Evaluate for NFPA 805 Compliance; and
5. Document Results.

For Step 1, the licensee utilized information sources recommended by FAQ 07-0038 that included the post-fire SSA, PRA insights from the expert panel experience, and operating experience. The licensee stated that the Pressurized Water Reactor Owners Group (PWROG) generic list of MSOs was not yet available at the time of the expert panel meeting in 2005; however, the list of PWR generic MSOs from Revision 2 of NEI 00-01 was evaluated to ensure that applicable MSOs from this list have been included in the NSCA and FPRA model.

In SSA RAI 02a dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee describe the process and expertise used to perform the review of the list of PWR generic MSOs, such as by reconvening the expert panel or licensee staff. In its response to SSA RAI 02a dated May 19, 2015 (Reference 9), the licensee stated that the review of PWR generic MSOs identified in NEI 00-01, Revision 2, was not performed by the expert panel since the list was not available at the time. The licensee stated that the PWR generic list of MSOs included in NEI 00-01, Revision 2, was assessed by individuals qualified in PRA and SSD using the guidance in FAQ 07-0038. The licensee stated that for each of the PWR MSOs an evaluation was performed, which includes separate discussions of how the MSO was treated in the FPRA model and in the NSCA. The licensee further stated that the FPRA model and NSCA include equipment and cables of concern identified during the 2005 expert panel review and those considered non-risk significant by the 2005 expert panel, as well as the applicable PWR generic MSOs. The NRC staff concludes that the licensee's response to SSA RAI 02a is acceptable because the licensee demonstrated that it reviewed the updated list of PWR generic MSOs in accordance with the guidance in FAQ 07-0038 and incorporated the results in the FPRA and NSCA.

For Step 2, the licensee utilized the information sources from Step 1 as input to the ANO expert panel assessment that was held in September 2005, and consisted of a panel of plant and industry personnel that met to identify those combinations of spurious actuations, which, if they occurred concurrently, could be risk significant. The licensee stated that the expert panel included members with experience in electrical design engineering, mechanical design engineering, nuclear design engineering, system engineering, fire protection, SSA, operations, reactor safety analysis, maintenance, PRA, and accident management. The licensee stated that a specific intent of assembling this panel was to ensure potential combinations of spurious

operations that may not have been considered previously due to the plant's existing licensing basis would be identified, in particular, the synergistic effects of concurrent failures in different systems may not have been considered. The licensee stated that the panel discussion focused on potential transients that could adversely affect achievement and maintenance of the post-fire SSD functions, including those fire-induced transients that would require operator action in the first hour after the fire and subsequent reactor trip, and those that could potentially damage equipment that may be required later, such as the credited low pressure injection (LPI) pump used for shutdown cooling. The licensee further stated that the panel also considered whether the synergistic effects of concurrent spurious actuation in different systems serving different SSD functions could adversely affect SSD.

The licensee utilized the alternate approach described in NEI 04-06, "Guidance for Self-Assessment of Circuit Failure Issues" (Reference 97), to ensure all potentially risk-significant MSO combinations were evaluated for all fire areas, including those spurious actuations that, if they occurred concurrently, could result in an unrecoverable plant condition or lead to unrecoverable equipment damage. The licensee stated that the SSEL had been validated and the circuit analysis validation completed at the time of the assessment.

The licensee stated that the panel assembled at ANO focused on identifying those spurious actuations and combinations thereof that could be risk significant. The licensee further stated that an initial screening was performed by the panel based on the function affected, the potential consequences, and the time available to mitigate the potential transient. The licensee stated that in this manner, spurious actuations and combinations of spurious actuations that did not require a mitigating action in the first hour after the reactor trip were identified. In SSA RAI 02b (Reference 21), the NRC staff requested that the licensee describe how spurious actuations required to be mitigated within the first hour after reactor trip, if any, were evaluated in the MSO review. In its response to SSA RAI 02b (Reference 9), the licensee stated that the expert panel focused on those fire-induced transients that would require operator action in the first hour after the fire and subsequent reactor trip, and those that could potentially damage equipment that may be required later, such as the credited LPI pump used for shutdown cooling. The licensee stated that the panel also considered whether the synergistic effects of concurrent spurious actuation in different systems serving different SSD functions could adversely affect SSD. The licensee stated that its calculations, provide documentation of the disposition of each of the PWR generic MSOs from NEI 00-01, Revision 2 and identifies the MSOs that have been included in the ANO-1 FPRA model and the NSCA. The licensee stated that where an MSO is concerned with the possibility that two different valves may spuriously operate, each fire scenario that impacts cables or components such that the fire-induced failure could result in spurious operation of both valves was evaluated with the basic events for both of the valves; and thus, the impact of the MSO was evaluated in all applicable scenarios. The licensee further stated that timing for operator actions is addressed for feasibility to ensure acceptability of actions. The NRC staff concludes that the licensee's response to SSA RAI 02b is acceptable because the licensee demonstrated that it included MSO's in the FPRA model and NSCA and that it evaluated the feasibility of operator actions to mitigate the MSOs.

For Step 3, the licensee stated that the FPRA addresses spurious operations, including MSOs, identified in the post-fire SSA, including those that resulted from the expert panel review and from review of the more recent PWROG generic list of MSOs (as applicable). The licensee further stated that the FPRA model includes a correlation of SSD components to PRA basic

events and a correlation of PRA basic events to SSD components. The licensee further stated that the NSCA includes equipment and cables of concern identified during the expert panel review and during review of the more recent PWROG generic list of MSOs.

For Step 4, the licensee stated that the MSO combinations included in the NSCA were evaluated with respect to compliance with the deterministic requirements of NFPA 805, Section 4.2.3, "Deterministic Approach." The licensee stated that for those situations in which the MSO combination did not meet the deterministic requirements of NFPA 805, the licensee stated that the components and associated cables were added to the scope of the FREs performed for the associated fire area. The licensee stated that LAR Attachment B describes the NSCA methods and LAR Attachment C provides the transition results for each fire area, indicating which areas required PB analysis. The results of the PB analysis are evaluated in SE Section 3.4.

For Step 5, the licensee stated that the list of PWR generic MSOs from NEI 00-01, Revision 2, was evaluated to ensure that applicable MSOs from this list have been included in the NSCA and FPRA model, and that this evaluation is documented in the licensee's MSO calculation.

The NRC staff reviewed the licensee's expert panel process for identifying circuits susceptible to MSOs as described above, and concludes that the licensee's method is acceptable because the licensee demonstrated that it adopted a systematic and comprehensive process for identifying MSOs to be analyzed using available industry guidance. The NRC staff also concludes that the licensee's process provides reasonable assurance that the FREs appropriately identify and include risk significant MSO combinations.

3.2.5 Establishing Recovery Actions

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

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

NFPA 805, Section 4.2.3.1 states that:

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

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

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

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

The licensee stated that it used the guidance in NEI 04-02, FAQ 07-0030 and RG 1.205 to determine the population of post-transition RAs, and the process, which is based on FAQ 07-0030, consisting of the following steps:

- Step 1: Define the primary control stations (PCSs) and determine which pre-transition operator manual actions (OMAs) are taken at PCSs.
- Step 2: Determine the population of RAs that are required to resolve VFDRs to meet the risk or 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 definition provided in RG 1.205, and the additional guidance provided in FAQ 07-0030, it did not identify any PCSs.

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 NFPA 805, Section 1.2. Accordingly, the licensee defined DID-RA as an action that is not needed to meet the NSPC, but has been retained to provide DID. In each instance, the licensee determined whether a transitioning OMA was an RA, DID-RA, or not necessary for the post-transition RI/PB FPP.

The licensee stated that all credited RAs, as listed in LAR Attachment G, including DID-RAs, were subjected to a feasibility review. In accordance with the NRC-endorsed guidance in NEI 04-02, the feasibility criteria used in the licensee's assessment process were based on the criteria in FAQ 07-0030 and addressed each of the following 11 feasibility attributes:

- 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 (PPE) 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 CR 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 CR and field actions, the use of SCBAs if credited, appropriate use of operator aids) should be performed.

LAR Attachment G, Table G-1, "Recovery Actions and Activities," describes each RA associated with the resolution of a VFDR from the fire area assessments as documented in LAR Attachment C, "NEI 04-02 Table B-3 Fire Area Transition." The licensee included an action in LAR Attachment S, Table S-2, Implementation Item S2-5 to develop and revise post-fire safe shutdown procedures and revise the training program to reflect the procedure changes. In SSA RAI 03 dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee clarify if LAR Attachment S, Table S-2, Implementation Item S2-5 includes the post-transition action to revise the training program, or identify the correct implementation item for the training program

revisions. The NRC staff also requested that the licensee clarify whether or not the training program described in LAR Attachment G includes the performance of periodic drills as described in FAQ 07-0030. In its response to SSA RAI 03 dated May 19, 2015 (Reference 9), the licensee stated that any revisions to the training program will be implemented under LAR Attachment S, Table S-2, Implementation Item S2-6. The NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition. The licensee also stated that the training program currently allows classroom, simulator, or field training, and will be updated as required by Implementation Item S2-6 as discussed above, and because this action involves a broad range of changes, an internal tracking item has been issued to ensure the specific requirements of FAQ 07-0030, Criterion 11, are incorporated in the training program. The NRC staff concludes the licensee's response to SSA RAI 03 is acceptable because the licensee identified an action to incorporate training and drills in its training program and this action would be required by the proposed license condition.

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 because the criteria conforms with the endorsed guidance contained in NEI 04-02 and because the licensee will be in compliance with the regulation upon completion of the implementation item which would be required by the proposed license condition.

3.2.6 Plant-Specific Treatments or Technologies

In LAR Attachment C and LAR Attachment S, Table S-1, the licensee identified several proposed modifications to install an "inhibit switch" (also referred to as a "shorting switch") to prevent spurious operations of valves as described in NRC Information Notice (IN) 92-18, "Potential for Loss of Remote Shutdown Capability During a Control Room Fire" (Reference 98). As described in the LAR, the inhibit switch modifications are credited in the Fire PRA as resolving VFDRs by precluding spurious operation.

In SSA RAI 11 dated September 8, 2015 (Reference 23), the NRC staff requested that the licensee describe the design of the shorting switch and provide additional justification for precluding spurious operation and how fire damage to the shorting switch will not affect the desired nuclear safety function required to achieve the nuclear safety performance criteria. In its response to SSA RAI 11 dated August 12, 2015 (Reference 12), the licensee described the shorting switch design and provided a qualitative discussion of the licensee's basis for assuming the failure of the shorting switch was not credible. As described by the licensee, the ANO-1 inhibit circuit uses conductors and a control switch to intentionally short across the target coil when the device is in its normal de-energized state. This is done so that the coil cannot be electrically actuated by fire-induced failures where a source conductor applies a sufficient voltage either from intracable or intercable faults. The licensee stated that a normally closed contact on the same control switch used for controlling the device is used in the inhibit circuit and manipulation of this "break-before-make" manual control switch by an operator will break the shorting connection, allowing the device to be actuated. The licensee further stated that the inhibit circuit is effectively a low resistance jumper across the coil, which functions to prevent application of a sufficient voltage to actuate the device (pickup voltage), and that if the fault

current through the inhibit circuit is sufficiently high, the protective device will clear the fault and remove power and where the current is not adequate due to overall resistance, the voltage drop across the low resistance inhibit circuit will be less than the pick-up voltage of the contactor.

In SSA RAI 11.01 dated May 8, 2015 (Reference 22), the NRC staff requested that the licensee provide information regarding the effects of circuit failures on the shorting switch cables or provide further justification for concluding that failure of the inhibit switch circuit is unlikely. The NRC staff further requested that if a probabilistic approach (either qualitative or quantitative) is utilized, the licensee is requested to provide the bases for acceptability of the approach when used in the PB analysis considering that the FPRA credits the modification to "preclude the spurious operation." The NRC staff also requested that the licensee discuss how the results of the fire test used to justify fire damage assumptions to the shorting switches in the control room bound the fire modeling parameters defined in NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities," Volume 2: "Detailed Methodology" (Reference 37) (i.e., HRRs, rate of fire growth, non-suppression probability, etc.), and discuss how the integrity of the shorting switch is affected if the FM parameters defined in NUREG/CR-6850 are considered. In its response to SSA RAI 11.01 dated November 4, 3015 (Reference 14), the licensee provided additional discussion in support of its qualitative justification for concluding that the combined failure of the shorting switch and subsequent fault causing spurious operation is a non-credible failure mode. The licensee also provided additional discussion supporting its conclusion that fire scenarios within the control room will not lead to damage of the shorting switch with the exception of very low frequency events, which are mitigated with recovery actions or DID actions. The licensee summarized the suitability of the shorting switch design based on:

- The MCR is a continuously occupied space with access controlled by operations.
- Postulated bounding fire scenarios external to the cabinets that reach switch damage threshold are of very low frequency.
- Information from NUREG/CR-4527, "An Experimental Investigation of Internally Ignited Fires in Nuclear Power Plant Control Cabinets" (Reference 99), was used by another licensee for test results and FM of internal cabinet fires since NUREG/CR 6850 does not adequately address internal cabinet fires.
- Cables and internal cabinet wiring are thermoset and meet Institute of Electrical and Electronics Engineers (IEEE) 383 requirements.
- The authors of scoping tests for NUREG/CR-4527 reached a conclusion that qualified cable fires in vertical cabinets do not spread throughout the cabinet and the thermal environment in the enclosure does not become severe enough to cause melting of components or result in flashover.
- Fire induced failure of the conductors that results in application of a suitable voltage to the target conductor causing spurious actuation is required in addition to shorting switch failure.

- DID features include redundancy for LERF valves and actions to secure the power source to valves credited for CDF reduction following MCR abandonment.

In a letter dated January 12, 2016 (Reference 25), the NRC staff requested that the licensee provide additional information regarding the licensee's response to SSA RAI 11.01 in order for the NRC to determine whether spurious actuations can be precluded; and, therefore, not modeled in the FPRA. The NRC staff identified that spurious actuation need not be modeled if the risk is insignificant for both transition and post-transition risk evaluations and requested that the licensee provide a sensitivity study demonstrating that the risk impact of failing the protected valves is insignificant, or that the risk of the excluded scenarios in which a fire causes a spurious actuation and the inhibit switch fails is insignificant with regard to the plant change evaluations. In its response dated January 15, 2016 (Reference 16), the licensee described the risk evaluation methods to be applied to the shorting switches. The licensee stated that the aggregate risk results of this modeling will be included in the final PRA results to be included in response to PRA RAI 03. The NRC staff evaluation of the acceptability of the risk evaluation methods and risk results is documented in SE Section 3.4. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that it used PB methods which are an acceptable approach for resolving non-compliant plant configurations.

3.2.7 Conclusion for Section 3.2

The NRC staff reviewed the licensee's LAR, as supplemented, for conformity with the requirements contained in NFPA 805, Section 2.4.2 regarding the process used to perform the NSCA. The NRC staff concludes that the licensee's declared safe and stable condition is acceptable because the licensee's analysis process has adequately and appropriately identified and located the systems, equipment, and cables required to provide reasonable assurance of achieving and maintaining the fuel in a safe and stable condition, as well as meet the NFPA 805 NSPC.

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

The NRC staff also reviewed the licensee's process to identify and analyze MSOs. Based on the LAR, as supplemented, the NRC staff concludes that the process the licensee used to identify and analyze MSOs is 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 concludes that the approach the licensee used for assessing the potential for MSO combinations is acceptable because the licensee performed it 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 the NRC-endorsed guidance contained in NEI 04-02 and RG 1.205, and, 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.

3.3 Fire Modeling

NFPA 805 (Reference 3) allows both FM and FREs as PB alternatives to the deterministic approach outlined in the standard. These two PB approaches are described in NFPA 805, Sections 4.2.4.1 and 4.2.4.2, respectively. Although FM and 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 structures, systems, or components, based on the conservation equations or empirical data."

The NRC staff reviewed LAR Section 4.5.2, "Performance-Based Approaches," which describes how the licensee used FM as part of the transition to NFPA 805 at ANO-1, 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 (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. Therefore, the NRC staff concludes that there are no plant-specific FM methods acceptable for use to support compliance with NFPA 805, Section 4.2.4.1 for supporting the transition to NFPA 805.

3.4 Fire Risk Assessments

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

NFPA 805, Section 4.2.4.2 states, in part, that:

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

calculated using the approach described in [NFPA 805, 2.4.3 "Fire Risk Evaluations"].

3.4.1 Maintaining Defense-in-Depth and Safety Margins

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

3.4.1.1 Defense-in-Depth

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

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

The NRC staff reviewed LAR (Reference 8), Section 4.5.2.2, "Fire Risk Approach," LAR Section 4.8.1, "Results of the Fire Area Review," LAR Section 4.8.1, Table 4-3, "Summary of NFPA 805 Compliance Basis and Required Fire Protection Systems and Features," 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.

The licensee provided a high level overview of its method for evaluating DID in LAR Section 4.5.2.2 as part of the FREs performed on each PB fire area, and provided additional detail in its response to PRA RAI 16 dated July 21, 2015 (Reference 11). The licensee followed guidance contained in NEI-04-02, Revision 2 (Reference 7), on consideration of DID as part of the change process. The licensee's method defines each of the three DID elements identified in NFPA 805, Section 1.2, as Echelons 1, 2, and 3. In its response to PRA RAI 16, the licensee identified fire protection features and issues associated with each of the three DID echelons. The licensee stated that each fire area was evaluated for the adequacy of DID by consideration of the VFDRs, associated fire area risk (CDF), and scenario consequences (conditional core damage probability (CCDP)) to identify DID echelon imbalances. The evaluation determined whether there was an overreliance on an echelon of DID and whether changes were needed to assure that an echelon of DID had been adequately achieved.

LAR Attachment C, Table B-3 and LAR Table 4.3, as supplemented, document the results of the licensee's review of fire protection features and issues. The results, 1) document the fire protection systems/features required to either meet the deterministic criteria of NFPA 805, Section 4.2.3 or to support the FPRA; 2) note whether changes or improvements are necessary for each fire protection system/feature to maintain a balance among the DID echelons; and 3) provide a justification or basis for why the required fire protection systems/features are adequate for DID. As such, the information developed as part of the FRE and provided in the LAR is the licensee's internal record of the systems required to meet the NSPC and DID requirements of NFPA 805.

Based on its review of the LAR, the licensee's response to PRA RAI 16, and the review of the FREs during the audit (Reference 100), the NRC staff concludes that the licensee has systematically and comprehensively evaluated fire hazards, area configuration, detection and suppression features, and administrative controls in each fire area and concludes that the methodology as proposed in its LAR, as supplemented, adequately evaluates DID against fires as required by NFPA 805, and therefore the proposed RI/PB FPP adequately maintains DID.

3.4.1.2 Safety Margins

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

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

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

- Codes and Standards or their alternatives accepted for use by the NRC are met, and,
- Safety analyses acceptance criteria in the licensing basis (e.g., final safety analysis report (FSAR), supporting analyses, etc.) are met, or the change provides sufficient margin to account for analysis and data uncertainty.

LAR Section 4.5.2.2, discusses how safety margins are addressed as part of the FRE process and that this process is based on the requirements of NFPA 805, industry guidance in NEI 04-02, Revision 2 and RG 1.205, Revision 1 (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 performance-based fire area.

In response to PRA RAI 16 dated July 21, 2015 (Reference 11), supported by information in LAR Attachment H, "NFPA 805 Frequently asked Question Summary Table"; and LAR Attachment J, "Fire Modeling Verification and Validation (V&V)" the licensee described the methodology used to evaluate safety margins in the FREs to include the following evaluations and determinations:

- FM for the FPRA was specifically reviewed for adequate safety margin and, in general, was developed utilizing industry and NRC guidance, including NUREG/CR-6850 (Reference 36), NEI 04-02, and associated FAQs resolutions as described in LAR Section 3.4, "NFPA 805.Asked Questions (FAQs)," and specifically identified throughout the LAR. Verification and validation performed in support of FM utilized accepted codes and standards.

- Plant system performance was evaluated given the specific demands associated with the postulated fire event and determined the safety margin established in the plant design basis events was preserved.

- The FPRA logic model, including supporting FM, was developed in accordance with NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities," and reviewed against ASME/ANS RA-Sa-2009, "Addenda to ASME/ANS RA-S-2008, Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," (Reference 31).

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

The safety margin criteria described in NEI 04-02, Section 5.3.5.3 and the LAR, as supplemented, are consistent with the criteria as described in RG 1.174, Revision 2 (Reference 29), and, therefore, the NRC staff considers the safety margin criteria acceptable. The NRC staff 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, the response to PRA RAI 16, and the FREs, the NRC staff concludes that the licensee's approach has adequately addressed the issue of safety margins in the implementation of the FRE process.

3.4.2 Quality of the Fire Probabilistic Risk Assessment

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

The licensee developed its FPRA model for both Level 1 (core damage) and Level 2 (large early release) PRAs during at-power conditions. For the development of the FPRA, the licensee modified its IEPRA model to capture the effects of fire as an initiator of an event and as a potential failure mode for affected circuits and individual targets. In LAR Section 4.8.2, "Plant Modifications and Items to be Completed During the Implementation Phase," the licensee stated

that the FPRA will represent the as built, as operated plant following the modifications listed in LAR Attachment S, which is scheduled to be implemented as part of the transition to a FPP based on NFPA 805.

3.4.2.1 Internal Events PRA Model

The licensee evaluated the technical adequacy of its IEPRA model used to support development of the FPRA model by having a full scope peer review performed by the PWROG in August 2009. In its response to PRA RAI 17 dated August 12, 2015 (Reference 12), the licensee clarified that this peer review was performed using the NEI 05-04 (Reference 101), process and the combined ASME/ANS-RA-Sa-2009 PRA standard as qualified by RG 1.200, Revision 2 (Reference 30). This review was conducted on both the IEPRA and the internal flooding PRA (IFPRA). The IEPRA model that was reviewed for the full scope peer review serves as the basis of the FPRA used in performing PRA evaluations for the LAR.

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

LAR Attachment U, Table U-1, "Internal Events PRA Peer Review – Findings and Observations," provides the licensee's resolutions to the facts and observations (F&Os) from the IEPRA and IFPRA peer review. In general, an F&O is written for any SR that is judged not to be met or does not fully satisfy CC-II of the ASME standard and RG 1.200, Revision 2.

In LAR Attachment U, the licensee resolved each F&O by either providing a description of how the F&O was resolved or providing an assessment of the impact of resolution of the F&O on the FPRA and the results for the NFPA 805 application. The NRC staff evaluated each F&O and the licensee's resolution in LAR Attachment U to determine whether the F&O had any significant impact for the application. The NRC staff's review and conclusion for the licensee's resolution of each F&O and basis of acceptability of SRs that are "not met" or only meet at CC-I is summarized in the NRC's Record of Review dated August 12, 2016 (Reference 102).

The F&O on SRs SY-B14/SY-A22/AS-B3 stated there was no purposeful description of the phenomenological conditions associated with each accident sequence and the potential for the conditions to fail SSCs. In PRA RAI 02.a dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee provide information about whether these conditions had been assessed to determine their impact on credited SSC functions. In its response to PRA RAI 02.a dated July 21, 2015 (Reference 11), the licensee stated that it used guidance from the PWROG to evaluate the accident sequences in the final FPRA. The licensee explained that the guidance is provided on the phenomenological conditions that should be considered in the accident scenarios based on phenomena identified in the ASME PRA standard, from phenomena currently addressed in plant specific PRAs, from phenomena identified by the NRC, and finally from phenomena identified from operating experience. The licensee summarized its evaluation for each of the phenomena identified in the guidance in the RAI response. As a result of applying this guidance, the licensee added modelling of consequential pressure-induced

SG tube rupture to the final FPRA used in the integrated analysis as discussed in its response to PRA RAI 03 dated March 25, 2016 (Reference 17). The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee applied a systematic and comprehensive review of the potential for SSCs to fail as a result from operation in adverse conditions as described in the ASME PRA standard supporting requirements and updated the FPRA to include the results of this review.

The F&O on SR LE-G5 indicated that limitations in the LERF modeling that might impact applications had not been addressed. In PRA RAI 02.b dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee identify the limitations and explain how they impacted the FPRA. In its response to PRA RAI 02.c dated June 16, 2015 (Reference 10), the licensee explained that it used guidance on important LERF modeling assumptions and uncertainties from the PWROG to review the LERF modeling for limitations that could impact the application. As a result of this review the licensee added fault tree modeling of the ADVS and RCS electromatic relief valve (ERV) to the final FPRA used in the integrated analysis as discussed in its response to PRA RAI 03 (Reference 17). The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee applied a systematic and comprehensive evaluation of its LERF models that could impact this application and updated the FPRA to include the results of this review.

The F&O on SRs LE-A4/LE-E1/LE-C7 stated there was no dependency analysis between human failure events (HFEs) before core damage and HFEs between core damage and LERF HFEs. In PRA RAI 02.c (Reference 21), NRC staff requested that the licensee describe and justify the treatment of these and other possible dependency elements. In its response to PRA RAI 02.c (Reference 10), the licensee identified the LERF HFEs and stated that only two LERF HFE operator actions (RCS depressurization and bumping the RCPs) were credited in the FPRA. The licensee summarized its dependency analysis using the methodology in NUREG-1921 (Reference 46), and provided the results. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that its analysis is consistent with the process described in NUREG-1921.

The F&O on SR DA-C10 stated that the licensee did not provide evidence of a review of component sub-element testing that would identify a test that should or should not be counted in the estimation of the number of demands. The NRC staff found that the resolution to the F&O did not appear to fully evaluate the surveillance tests to adjust the demand count of component failures based on what failure modes are modeled in the PRA and evaluated in the tests. In PRA RAI 02.d (Reference 21), the NRC staff requested that the licensee provide justification for not fully evaluating surveillance tests to determine the demand counts. In its response to PRA RAI 02.d (Reference 11), the licensee performed a review of surveillance tests associated with components for which plant-specific demand data was developed and determined that the proper number of tests were identified, and that tests on unmodeled components were not included. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee used the proper amount of demand counts from surveillance tests and excluded tests on unmodeled components, which is consistent with CC-II of the PRA standard SR DA-C10.

The F&O on SRs DA-C4/DA-E2 suggested that the licensee limited its consideration of plant-specific component data to the data in the maintenance rule (MR) database. In PRA RAI 02.e

(Reference 21), the NRC staff requested that the licensee provide justification for not considering other sources of plant-specific failure data. In its response to PRA RAI 02.e (Reference 11), the licensee reviewed the MR program to ensure significant plant-specific SSC failures were not overlooked. The licensee explained that SSC excluded from the MR database are not risk significant because the SSCs in these systems that are modeled in the PRA have a risk achievement worth (RAW) less than 2 and a fussel-vessely importance less than 0.005. Therefore plant-specific data excluded from the MR database does not include information on SSCs that could be significant to the PRA. The NRC staff concludes that the licensee's consideration of plant specific failure data is acceptable because plant-specific failure data is considered for risk significant failures in the PRA.

In PRA RAI 17 dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee identify any changes made to the IEPRA since the last full-scope peer review that are consistent with the definition of a "PRA upgrade" as defined by the ASME/ANS PRA Standard, necessitating the need for further peer review. In its response to PRA RAI 17 dated August 12, 2015 (Reference 12), the licensee explained that no changes to the IEPRA that would be considered an upgrade were identified. (Revisions to the FPRA for which focused-scope peer review were performed are discussed in the next section). The NRC staff finds the licensee's response to the RAI acceptable because the licensee's determination of the need for followup peer review of PRA upgrades is based on the ASME/ANS PRA Standard and RG 1.200 guidance.

In PRA RAI 19 dated March 10, 2016 (Reference 26), NRC staff requested that the licensee provide information on how its fleet PSA maintenance procedure has been applied to update the IEPRA to incorporate previous plant changes unrelated to NFPA 805 into the PRA used to develop the FPRA. In its response to PRA RAI 19 dated April 7, 2016 (Reference 18), the licensee explained that the IEPRA used to develop the FPRA was last updated in 2009 and the next update is scheduled to be completed in April 2016. The licensee explained that a review of plant modifications and procedure changes between 2008 and 2015 identified only a few changes that might impact the FPRA and none that would result in a risk increase that would change the conclusions presented in the LAR, as supplemented. The NRC staff finds that the licensee's response to the RAI acceptable because the licensee evaluated the new information available and determined that incorporating the information into the PRA would not change the conclusions reported in the LAR as supplemented.

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

3.4.2.2 Fire PRA Model

The licensee evaluated the technical adequacy of the FPRA model by having a full-scope peer review performed by the PWROG and followup focused-scope peer reviews performed by contractors. The peer reviews were performed using the NEI 07-12 process (Reference 103) and (Reference 104), and the FPRA part (Part 4) of the combined ASME/ANS-RA-Sa-2009 PRA Standard, as clarified by RG 1.200, Revision 2. A full-scope peer review was performed in October 2009 and focused scope peer reviews were performed in May 2012 on SRs FSS-G3, FSS-G4, FSS-G5, and FSS-G6, and in October 2012 on PRA standard high level requirements for fire scenario selection and analysis (FSS) elements FSS-A, FSS-C, FSS-D, FSS-E, and FSS-H. In its response to PRA RAI 01.g dated June 16, 2015 (Reference 10), the licensee explained that an additional focused-scope peer review was performed in June 2014 on the HRA subsequent to the LAR submittal because the HRA had been revised. These peer reviews of the FPRA establish the technical adequacy for the quantitative risk evaluations presented in the LAR.

LAR Attachment V, Table V-1, "Fire PRA Peer Review – Findings and Observations," provides the licensee's resolutions to 42 F&Os from the full-scope peer review. LAR Attachment V, Table V-1a, "Focus Scope Fire PRA Peer Review – Finding and Observations," provides the licensees resolutions to 6 F&Os from the FSS element focused-scope peer reviews. All F&Os presented in LAR Attachment V, Tables V-1 and V-1a are characterized as findings per the NEI 07-12 peer review guideline. LAR Attachment V-2 identifies SRs determined by the peer reviews that do not meet CC-II and provides justification that CC-I is adequate to support the FPRA. SRs identified in LAR Attachment V, Table V-2, "Fire PRA – Category I Summary," are encompassed by F&Os presented in LAR Attachment V, Table V-1. In its response to PRA RAI 01.g.01 dated September 22, 2015 (Reference 13), the licensee provided the three F&Os from the focused-scope peer review performed in June 2014 on HRA and their resolutions.

The licensee resolved each F&O by assessing the impact of the F&O on the FPRA and on the results for the LAR. The NRC staff requested that the licensee provide additional information to assess the adequacy of some of the resolutions for the review. The NRC staff evaluated each F&O as well as the licensee's respective resolution provided in LAR Attachment V. In PRA RAI 01 (Reference 21), the NRC staff requested that the licensee provide additional information to determine whether the issue had any significant impact for the LAR. The NRC staff's review and conclusions for the resolution of each F&O and unreviewed SR is summarized in the NRC's Record of Review dated August 12, 2016 (Reference 102).

The F&O for SR PP-B3 stated that the licensee should perform a systematic review of the PRA physical analysis units (PAUs) to identify and justify when spatial separation is credited by the PRA. The resolution to this F&O states, in part, that: "No fires were judged to credibly breach the spatial separation and no hot gas layer potential exists." In PRA RAI 01.a (Reference 21), the NRC staff requested that the licensee provide information about the distance used to define spatial separation and the basis for justifying that combustibles and fire sources did not exist in the separation area. In its response to PRA RAI 01.a (Reference 10), the licensee explained that though allowed by NUREG/CR-6850, no credit was taken for spatial separation to contain the damaging effects of fire. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee clarified the definition of spatial separation in its PRA, which is consistent with the guidance in NUREG/CR-6850.

The F&O for SRs PP-B5-01, FSS-G4-01, and FSS-G5-01 questioned how fire barriers were credited in the FPRA. The resolutions for the F&Os explained that failure of fire barriers, including active fire barriers, is evaluated in the multiple-compartment analysis (MCA) by assigning a generic failure probability of 0.0074 from NUREG/CR-6850 based on the probability of fire door failure. In PRA RAI 01.b (Reference 21), the NRC staff found that consideration of fire barrier failure appeared to only apply the generic failure probability of a fire door in MCA scenarios. As a result, the NRC staff requested that the licensee provide justification of the treatment of active barriers and that the licensee update its treatment of passive fire barrier failure to be consistent with NUREG/CR-6850. In its response to PRA RAI 01.b (Reference 10), and PRA RAI 03 (Reference 17), the licensee explained that the FPRA does not credit water curtains or any other active system that requires an activation system for defining PAU. Fire dampers activated with a fusible link were credited but were considered passive components. The licensee further explained that the MCA supporting the final FPRA was revised to apply the sum of the generic fire barrier failure probabilities for each type of barrier consistent with guidance in NUREG/CR-6850. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that its treatment of fire barriers in the MCA is consistent with the guidance in NUREG/CR-6850.

The F&O on SR FSS-C1 stated that the licensee should use a two point fire intensity model to assign characteristics to the ignition source. The resolution for this F&O stated that a "Conditional Probability of Propagating Fire Factors" method was used for vented panels based on split fraction specifying the "fraction of the fires impacting only the ignition source panel versus those fires which impact targets within the zone of influence of the panels." In PRA RAI 01.c (Reference 21), the NRC staff requested that the licensee explain its approach and whether the split fraction referred to in the resolution to FSS-C1-01 implied that the "Panel Factors method" (Reference 105), not accepted by NRC was used. In its response to PRA RAI 01.c (Reference 10), the licensee clarified that that the "Panel Factors" method was not used but rather generic fire modeling treatments (GFMTs) were used to define a three-point fire model to meet SR FSS-C1. The licensee explained that the first fire in the three-point fire treatment is a non-severe fire in which the source panel and the cables terminating at the source panel are damaged but the nearest target is not damaged. The second fire in the three-point fire treatment is a severe fire in which all targets within the 98th percentile zone of influence (ZOI) are impacted. The third fire of the three-point fire treatment is a fire that results in a hot gas layer (HGL) exceeding a 80 degree Centigrade (°C) criterion in which all targets in the fire zone are conservatively assumed to be damaged. These three fire models are discussed in the licensee's response to FM RAI 01.f discussed in SE Section 3.4.2.3. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that it used a multiple-point fire intensity and duration model encompassing low likelihood but risk-contributing fire events consistent with the requirements in the PRA standard.

The F&O on SR CF-A1 stated that the licensee needed to review cables where failure probabilities other than 1.0 are credited and ensure the appropriate inter- and intra-cable short probabilities are applied. The licensee's resolution outlined the circuit hot short probabilities as they related to CPTs and non-CPTs. In PRA RAI 01.e (Reference 21), the NRC staff indicated that guidance on circuit failure mode likelihood analysis in NUREG/CR-6850 has been superseded by new guidance in NUREG/CR-7150, Volume 2 (Reference 106), and requested that the licensee explain how specific aspects of the new guidance had been implemented and

provide justification for instances where it had not been applied. In its response to PRA RAI 01.e (Reference 11), the licensee indicated that conservative values relative to those provided in NUREG/CR-7150, Volume 2 would be updated and included in its final response to PRA RAI 03 (Reference 17). The licensee also explained that the final FPRA incorporated the guidance, and hot short probabilities and hot short duration probabilities values from NUREG/CR-7150, Volume 2. In its response to PRA RAI 01.e.01 (Reference 13), the licensee further clarified that the state of knowledge correlation (SOKC) included these new values. In its response to PRA RAI 03, the licensee clarified that guidance and suggested values from NUREG/CR-7150 are used to model panel wiring, trunk cables, and instrument panel cables in the FPRA. The NRC staff concludes that the licensee's response to the RAIs is acceptable because the licensee demonstrated that its treatment of circuit failure mode likelihood is consistent with guidance in NUREG/CR-7150 Volume 2.

The F&Os related to SRs HRA-A3 and ES-C2 questioned how spurious indications that could result in undesirable operator actions were evaluated. The resolution to the F&Os discusses instrument failures but does not clarify how operator actions resulting from spurious indications are addressed by the analysis. In PRA RAI 01.f (Reference 21), NRC staff requested that the licensee explain how spurious instrument indications that could cause undesirable operator actions were treated in the FPRA. In its response to PRA RAI 01.f (Reference 11), the licensee explained that guidance in the post-fire shutdown procedure identifies, on a fire zone basis, instrumentation that has been confirmed to be unaffected by fire and should be relied upon by the operator for safe shutdown. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that its treatment of undesirable operator actions caused by spurious instrument actuations that could be affected by fires in each zone, would not be on the unaffected instrumentation list and any spurious indications would not affect the operator actions.

F&Os HRA-B3-01 and HRA-E1-01 stated that new, fire-specific HFEs had not been evaluated for viability nor been peer reviewed. The licensee's response indicated that the new, fire-specific HFEs were developed in the same manner as the internal events (IE) HFEs and therefore did not need a peer review. In PRA RAI 01.g (Reference 21), the NRC staff requested that the licensee provide confirmation that fire-specific HFEs were evaluated using fire-specific HFE guidance in NUREG-1921 (Reference 46). In its response to PRA RAI 01.g (Reference 11), the licensee explained that the HRA methodology was revised to be consistent with NUREG-1921 guidance and a focused-scope peer review was conducted on the revised approach. In PRA RAI 01.g.01 dated September 8, 2015 (Reference 23), the NRC staff indicated that the F&Os from this focused-scope peer review had not been provided in the LAR and requested that these F&Os be provided along with their resolutions. In its response to PRA RAI 01.g.01 dated September 22, 2015 (Reference 13), the licensee provided three F&Os (i.e., HR-G3-01, HR-G3-02, and HR-G7-01) from the June 2014 focused-scope peer review of the HRA along with their resolutions. The NRC staff reviewed the F&Os and found that the resolutions sufficiently address the issues raised in the F&Os to support the transition to NFPA 805. The NRC staff concludes that the licensee's responses to the RAIs are acceptable because the licensee provided the F&Os and resolutions as requested which the NRC staff found acceptable and also included the changes identified in the FPRA in the aggregate analysis provided in its response to PRA RAI 03 (Reference 17).

The F&Os associated with SRs FQ-A4 and UNC-A1 stated that the uncertainty interval for CDF was not estimated as required by SR QU-E3. The resolutions to these F&Os indicate that quantitative analysis of uncertainty intervals was performed. In PRA RAI 01.h dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee provide information about whether the SOKCs had been accounted for in the risk estimates presented in the LAR. In its response to PRA RAI 01.h dated June 16, 2015 (Reference 10) and its response to PRA RAI 03 (Reference 17), the licensee explained that SOKC was applied to ignition frequencies, circuit failure probabilities, non-suppression probabilities, HRA basic events, and IEPRA basic event data to address the correlation between parameters. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee included the contribution of SOKC in its aggregate analysis included in its response to PRA RAI 03 (Reference 17), and because the license demonstrated the capability to include the effect of SOKC in post-transition evaluations as needed.

In PRA RAI 04 dated May 5, 2015 (Reference 21), the NRC staff indicated that the licensee used transient fire HRRs below the recommended NUREG/CR-6850 98th-percentile HRR of 317 kilowatts (kW). The NRC staff requested that the licensee identify the locations where reduced HRRs were credited in the FPRA and provide justification for their use based on the NRC guidance letter to NEI dated June 21, 2012 (Reference 105). In response to PRA RAI 04 dated June 16, 2015 (Reference 10), the licensee identified seven fire zones where a reduced HRR of 69 kW was used to model transient fires and stated that transient combustibles are unlikely in these locations. The licensee explained that controls have been implemented for maintenance activities that might be required in these reduced HRR fire zones (i.e., "zero transient area") that disallow transient combustibles into the areas without evaluation or establishing appropriate compensatory actions. The licensee explained that it performed a review of non-conformances associated with transient combustibles for the period of February 2007 through June 2014 for fire areas with the highest level of controls and identified three violations. The licensee explained that for these three cases the new enhanced transient combustible control program would have precluded the combustibles cited in the violations from being admitted into the reduced HRR fire zones. In PRA RAI 04.01 dated September 8, 2015 (Reference 23), the NRC staff indicated that the licensee had not described what kind of evaluations would be performed or compensatory actions would be implemented for the controlled areas if maintenance activities in these area were required. In its response to PRA RAI 04.01 dated September 22, 2015 (Reference 13), the licensee explained that evaluations would be performed to determine what materials could be admitted into the area based on classification of the area. If the combustibles materials brought into the zero transient areas must remain when maintenance personnel are not present, then a continuous fire watch would be required. The licensee explained that if a continuous fire watch could not be implemented for reasons such a high radiation, then the evaluation would identify other compensatory actions such as separation of combustible materials and ignition sources. The NRC staff concludes that the licensee's responses to the RAIs are acceptable because the licensee demonstrated that the use of a reduced transient HRR for particular fire zones is consistent with guidance in the NRC letter to NEI dated June 21, 2012.

In PRA RAI 05 dated May 5, 2015 (Reference 21), the NRC staff noted that the failure of sensitive electronics was only considered for cabinets that were adjacent to each other ("touching or nearly touching") and was not considered for cabinets in areas such as the MCR, "where the fire would be expected to be extinguished quickly." In PRA RAI 05, the NRC staff

requested that the licensee provide an explanation of how the licensee's approach was consistent with guidance in FAQ 13-0004 (Reference 71), including caveats about configurations that could invalidate the FAQ 13-0004 approach. In its response to PRA RAI 05 dated July 21, 2015 (Reference 11), and its response to PRA RAI 03 (Reference 17), the licensee explained that walkdowns were performed at locations with sensitive electronics and the failure of sensitive electronics were addressed per the guidance in FAQ 13-0004 and incorporated in the final FPRA. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that its treatment of sensitive electronic is consistent with guidance in FAQ 13-0004.

In PRA RAI 06 dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee explain how the FPRA addressed "pinch points" (i.e., locations where CCDPs are highest within a PAU). In its response to PRA RAI 06 dated June 16, 2015 (Reference 10), the licensee explained that its evaluation was not limited to analysis of pinch points but rather included all targets within a PAU in a least one transient scenario. The licensee stated some transient fire scenarios were developed across ZOI boundaries to account for targets along the edge of a ZOI boundary. The licensee stated that a hot work fire is postulated in every plant cable tray as specified in NUREG/CR-6850. The licensee explained that the transient fire and hot work fire frequencies were allocated to scenarios by the ratio of the floor area encompassed by the fire (associated with the ZOI) to the total floor area in the fire area or by equally dividing the frequency among the fire scenarios in the fire area. The licensee explained that the transient fire evaluation of the turbine building was performed more conservatively by assigning all non-risk significant components to one large transient fire scenario and assuming total failure of all components for a fire in that area. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee modeled all areas where transient fire ignition sources could occur in the FPRA and therefore locations where the CCDPs are the highest in a PAU are included; and also because the licensee's approach to apportion fire compartment transient and hot work ignition frequencies provides a reasonable distribution of fires within a PAU.

In PRA RAI 07 dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee explain and justify its treatment of well-sealed and robustly secured electrical cabinets. In its response to PRA RAI 07 dated July 21, 2015 (Reference 11), the licensee explained that based on the definition of a well-sealed electrical cabinet provided in NUREG/CR-6850, Supplement 1, Chapter 8, and walkdown information, well-sealed electrical cabinets below 440V were removed from the Bin 15 count for the final FPRA. The licensee also explained that well-sealed electrical cabinets above 440V were re-evaluated using the guidance in FAQ 14-0009 (Reference 72), and incorporated into the final FPRA. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee's treatment of well-sealed electrical cabinets is consistent with NRC guidance including NUREG/CR-6850, NUREG/CR-6850 Supplement 1, and FAQ 14-0009. In addition, the licensee indicated in its response to PRA RAI 03 (Reference 17), that the updated modeling was incorporated into the final FPRA.

In PRA RAI 08 dated May 5, 2015 (Reference 21), the NRC staff indicated that the licensee used a transient frequency adjustment factor of 0.1 to represent the fraction of time that transient combustibles are allowed in the room, which is inconsistent with the treatment of transient fires in NUREG/CR-6850, Section 6.5.7.2, and requested that the licensee remove or replace this method. In its response to PRA RAI 08 dated July 21, 2015 (Reference 11), and PRA RAI 03 (Reference 17), the licensee explained that the transient frequency adjustment

factor was removed from the FPRA and replaced with a frequency adjustment that is consistent with FAQ 12-0064 (Reference 70), and incorporated into the final FPRA. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee replaced the unacceptable method used for modeling transient fire scenarios with an approach consistent with NRC guidance and included that method in its response to PRA RAI 03.

In PRA RAI 09 dated May 5, 2015 (Reference 21), the NRC staff indicated that the licensee's modeling of fire scenarios in the MCR did not appear to address the potential for the propagation of fire between adjacent electrical cabinets, and requested that the licensee explain and justify its modeling of MCR fire scenarios. In its response to PRA RAI 09 dated July 21, 2015 (Reference 11), the licensee explained that most MCR fire scenarios, except for abandonment of the MCR due to habitability, were modeled to be limited to the source cabinet based on guidance in NUREG/CR-6850, Appendix S, because the cabinets are closed and separated by double walls and an air gap. The licensee explained that in the limited configurations where this was not the case, that the source fires were assumed to spread to adjacent panels. The licensee explained during the audit (Reference 100), an additional MCR cabinet was identified that did not have a full partition and, therefore, walk-downs were performed to identify electrical cabinets not closed or separated by double walls and an air gap where fire scenarios were needed to model fire propagation. In its response to PRA RAI 03 (Reference 17), the licensee indicated that the updated modelling of these scenarios was incorporated into the final FPRA. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee's modelling of fire propagation in MCR cabinets is consistent with NUREG/CR-6850, Appendix S.

In PRA RAI 10 dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee explain how MCR abandonment due to loss of habitability was modelled. In its response to PRA RAI 10 dated August 12, 2015 (Reference 12), the licensee explained that multiple ignition sources and subsequent fires were modelled within the MCR, most which did not lead to loss of habitability. The licensee further stated that whenever the FM indicated a loss of MCR habitability, a single bounding MCR abandonment scenario was quantified for the FPRA. The licensee explained that the post-transition plant abandonment scenario assumed that all cables in the MCR were failed by the fire and that the compliant plant abandonment scenario was modeled by eliminating damage from VFDRs in the post-transition plant scenario. Assuming all cables are damaged maximized the post-transition risk estimate, conservatively increasing the change-in-risk estimate. Eliminating all damage from VFDRs in the compliant plant model but retaining the loss of all other cables may or may not yield a minimum estimate of the compliant plant risk (a minimum compliant plant risk estimate also conservatively increases the change in risk estimate). However, as discussed in SE Section 3.4.7, the licensee's response to PRA RAI 03 (Reference 17), included a sensitivity study conservatively assuming that the compliant plant risk from this scenario was zero and demonstrating that the RG 1.174, Revision 2 (Reference 29), acceptance guidelines would still be met. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that its use of a single worst-case scenario associated with MCR abandonment does not affect its conclusion that the risk increase from transition is less than the applicable RG 1.174 guidelines. The NRC staff further concludes that the licensee's approach to quantify MCR abandonment risk may be used in the post-transition PRA because only changes that affect MCR abandonment scenarios would be affected by these assumptions and each FRE for future changes will include an evaluation of the capability of the PRA to adequately model the proposed changes.

In PRA RAI 11 dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee explain how MCR abandonment due to loss of control was modeled for both the post-transition and compliant plants. In its response to PRA RAI 11 dated August 12, 2015 (Reference 12), the licensee stated that MCR abandonment only occurs as a result of loss of MCR habitability (i.e., all MCR fire scenarios which do not cause loss of habitability and all cable spreading room fires, are modelled based on the equipment failed in each fire scenario and that in these scenarios command-and-control remains in the MCR). The licensee explained that this is achievable because the new common feedwater (CFW) pump and controls needed to mitigate spurious actuations are available from both the MCR and a panel local to the new CFW pump. In its response to PRA RAI 11.01 dated November 4, 2015 (Reference 14), the licensee clarified that actions taken outside the MCR in these scenarios are identified and treated as recovery actions (RAs). The NRC staff concludes that the licensee's responses to the RAIs are acceptable because the licensee used detailed fire scenario modelling that uses the same methodology as the general fire scenario modeling.

In PRA RAI 12 dated May 5, 2015 (Reference 21), the NRC staff indicated that for FM performed to determine when the MCR must be abandoned due to loss of MCR habitability, the licensee assumed that half the panels involved single cables bundles and the other half involved multiple bundle cables. The NRC staff requested that the licensee provide justification for this or update this approach. In its response to PRA RAI 12 dated June 16, 2015 (Reference 10), the licensee explained that for the integrated analysis provided in its response to PRA RAI 03 (Reference 17), that all MCR panel fires were assumed to involve multiple bundle cables. The NRC staff concludes that licensee's response to the RAI is acceptable because the licensee's modeling of the HRR associated with cable bundles in the MCR reflects or bounds actual cable configurations within the MCR producing bounding abandonment times.

In PRA RAI 17 dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee identify any changes made to the FPRA since the last full-scope peer review that are consistent with the definition of a "PRA upgrade" as defined by the ASME/ANS PRA Standard (Reference 31), necessitating the need for further peer review. In its response to PRA RAI 17 dated August 12, 2015 (Reference 12), the licensee explained that no changes that would be considered a PRA upgrade were identified beyond updates to the FPRA for which a focused-scope peer review was performed before the LAR was submitted, and the focused scope peer review on HRA performed after the LAR was submitted, which is described in its response to PRA RAI 01.g (Reference 10). The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee's determination of the need for followup peer review of PRA upgrades is based on the ASME/ANS PRA Standard as clarified by RG 1.200, Revision 2.

In PRA RAI 18 dated May 5, 2015 (Reference 21), and PRA RAI 18.01 dated October 6, 2015 (Reference 24), the NRC staff requested that the licensee provide justification for joint HEP values used in the FPRA below 1.0E-05, and requested that the licensee provide an estimate of the number of joint HEP values used in the FPRA below 1.0E-05 and at least two different examples of justification. In its response to PRA RAI 18.01 dated November 4, 2015 (Reference 14), and response to PRA RAI 03 (Reference 17), the licensee explained that it understood that any joint HEP used in the FPRA should have its own justification but clarified in its response to PRA RAI 03 that the FPRA did not credit any joint HEP values lower than 1E-05. The NRC staff concludes that the licensee's responses to the RAIs are acceptable because the

licensee demonstrated that it did not use any joint HEP values below 1E-05 in the FPRA, and that in the future if values less than 1E-05 are used in the PRA then each case will have its own justification per guidance in NUREG-1921.

In SSA RAI 11.01 dated January 12, 2016 (Reference 25), the NRC staff indicated that though not modeled in the FPRA, "shorting switches" (i.e., inhibit circuits) were credited with precluding spurious actuations associated with certain motor operated and air actuated operated valves (MOVs and AOVs) that are vulnerable to the circuit failure modes identified in IN 92-18 (Reference 98); and NRC staff requested that the licensee justify this modeling exclusion. In its response to SSA RAI 11.01 dated January 15, 2016 (Reference 16), the licensee explained that it incorporated modeling of the shorting switches in the updated FPRA. The licensee explained that for fires in the MCR panel where the shorting switches are located that no credit was taken for the shorting switch. The licensee also explained that for other fires involving cables containing shorting switch conductors located near a DC circuit, a failure probability for the shorting switch was incorporated in the integrated analysis described in its response to PRA RAI 03 (Reference 17). The licensee further explained that for these scenarios a value of 1E-03 was assigned as the probability that the shorting switch fails. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the FPRA includes the possibility that the shorting switch fails. While the probability of 1.0E-03 that the licensee applied to circuits with shorting switches is somewhat arbitrary, the NRC staff considers the likelihood of the conditions required to fail a shorting switch to be insignificant.

As a result of its review of the LAR, as supplemented, the NRC staff concludes that the FPRA is of sufficient technical adequacy and that its quantitative results, considered together with the sensitivity studies, can be used to demonstrate that the change in risk due to the transition to NFPA 805 meets the acceptance guidelines in RG 1.174 and is therefore acceptable.

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

The NRC staff performed detailed reviews of the FM used to support the 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, states, in part, that:

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

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

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

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

> Acceptable engineering methods and numerical models shall only be used for applications to the extent these methods have been subject to verification and

> validation. These engineering methods shall only be applied within the scope, limitations, and assumptions prescribed for that method.

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

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

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

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

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

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

The licensee determined the ZOI around ignition sources based on tables in the GFMTs approach. These tables provide the horizontal and vertical dimensions of the ZOI for various ignition sources (transient fuel packages, small liquid fuel fires, open cabinets and cable trays) and different types of targets (i.e., thermoplastic and thermoset cables as defined in NUREG/CR-6850, Volume 2 (Reference 37) and Class A combustibles). The GFMTs approach also contains a set of tables that are used to determine if and when the HGL temperature exceeds the damage threshold of specified targets depending on fire size, room volume, and ventilation conditions. The licensee used the GFMTs approach as a basis for the scoping or screening evaluation as part of the FM to support the FREs.

The NRC staff reviewed the GFMTs approach including the supplementary ZOI and HGL tables for additional critical damage temperatures, ignition sources with time-dependent HRRs, and combinations of an ignition source and an intervening combustible; and the supplementary ZOI tables for transient fuel packages in the open, wall, and corner configuration with HRRs per unit area and fire durations based on transient fire test data referenced in NUREG/CR-6850.

The licensee also used the GFMTs approach in conjunction with selected tables in NUREG/CR-6850, Appendix H, to determine the time to failure of cable targets located in the plume of an electrical cabinet fire. The ZOI tables in the GFMTs approach were obtained by primarily using the following algebraic fire models and empirical correlations:

- Heskestad's Flame Height Correlation;
- Heskestad's Plume Centerline Temperature Correlation;
- Shokri and Beyler Flame Radiation Model; and,

- Modak's Point Source Radiation Model (used as a conservative upper bound check against the Shokri and Beyler Solid Flame Radiation Model).

These algebraic models are described in NUREG-1805 (Reference 42). The V&V of these algebraic models is documented in NUREG-1824, Volume 3 (Reference 43). 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 used the Consolidated Model of Fire and Smoke Transport (CFAST) computational fire model, Version 6 (Reference 107), 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. The licensee also used CFAST for the main control room abandonment time calculations. The V&V of CFAST is documented in NUREG-1824, Volume 5 (Reference 43).

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 and its supplementary material.

- Mudan flame radiation model (Reference 108)
- Plume heat flux correlation by Wakamatsu et al. (Reference 109);
- Yokoi plume centerline temperature correlation (Reference 110) (Reference 111);
- Hydrocarbon spill fire size correlation (Reference 112);
- Flame extension correlation (Reference 113);
- Delichatsios line source flame height model (Reference 114);
- Corner flame height correlation (Reference 113);
- Kawagoe natural vent flow equation (Reference 115);
- Yuan and Cox line fire flame height and plume temperature correlations (Reference 116);
- Lee cable fire model (Reference 117); and
- Babrauskas method to determine ventilation-limited fire size (Reference 118).

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

- Correlation for Flame Spread over Horizontal Cable Trays, FLASH-CAT, described in NUREG/CR-7010, "Cable Heat Release, Ignition, and Spread in

Tray Installations during Fire (CHRISTIFIRE), Volume 1: Horizontal Trays" (Reference 44).

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

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

The licensee also used Modak's Point Source Radiation Model and the Solid Flame Radiation Model described in NUREG-1805 to determine whether there is adequate separation between the administration building and the ANO-1 turbine building. The Solid Flame Radiation Model is the same as that developed by Shokri and Beyler (Reference 119), used in the development of the GFMTs.

The licensee used finite difference conduction heat transfer model HEATING, Version 7.3 (Reference 120) to calculate the fire resistance of conduit embedded in concrete.

The V&V of fire models used in the development of FREs is discussed in SE Section 3.8.3.2.

The licensee used the ZOI approach as a screening tool to distinguish between fire scenarios that required further evaluation and those that did not. The licensee stated that qualified personnel performed a plant walkdown to identify ignition sources, surrounding targets, and safety-related SSCs and applied the GFMTs approach to assess whether the SSCs were within the ZOI of a fire scenario. Based on the fire hazard present in the fire areas, these generalized ZOIs were used to screen from further consideration those specific ignition sources that did not adversely affect the operation of credited SSCs or targets, following a fire. The licensee's screening was based on the 98th percentile HRR from the NUREG/CR-6850 methodology.

3.4.2.3.2 Discussion of RAIs Pertaining to Fire Modeling

By letters dated May 5, 2015 (Reference 21), and September 8, 2015 (Reference 23), the NRC staff requested additional information concerning the FM conducted to support the FPRA. By letters dated June 16, 2015 (Reference 10), July 21, 2015 (Reference 11), and September 22, 2015 (Reference 13), the licensee responded to these RAIs.

- In FM RAI 01.a (Reference 21), the NRC staff requested that the licensee identify any applications of FM tools and methods used in the development of the LAR that are not discussed in LAR Attachment J.

  In its response to FM RAI 01.a (Reference 11), the licensee explained that all applications of FM tools and methods used in support of the FPRA are discussed in LAR Attachment J.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that LAR Attachment J provides the V&V bases for all fire models and correlations that it applied in support of the FPRA.

- In FM RAI 01.b (Reference 21), the NRC staff requested that the licensee describe how non-cable intervening combustibles were identified and accounted for in the fire modeling analysis and the FREs.

  In its response to FM RAI 01.b (Reference 11), the licensee explained that it performed additional walkdowns to identify non-cable intervening combustibles, and incorporated the findings from these walkdowns into the FPRA. The licensee further explained that it developed criteria to screen compartments with negligible quantities of non-cable combustibles so that only fire scenarios that have the potential to alter the FPRA results will be examined, and that it discussed the resulting changes to the FPRA in its response to PRA RAI 03.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee properly accounted for fire scenarios involving non-cable intervening combustibles in the risk quantification.

- In FM RAI 01.c(i) (Reference 21), the NRC staff requested that the licensee explain how it determined the possible expansion of the ZOI of an ignition source due to the contribution of secondary combustibles (cable trays).

  In its response to FM RAI 01.c(i) (Reference 11), the licensee stated that it used the FLASH-CAT model to calculate the HRR increase due to fire propagation in cable trays, and that it determined the expanded vertical and horizontal ZOI based on the total HRR of the ignition source and secondary combustibles using the methods described in the GMFTs.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee properly accounted for the HRR contribution of secondary combustibles (cable trays) in determining the ZOI.

- In FM RAI 01.c(ii) (Reference 21), the NRC staff requested that the licensee explain if and how cable tray covers, fire-resistant coatings, and fire wraps were credited in the FM analysis, and explain how holes in cable tray covers were treated.

  In its response to FM RAI 01.c (Reference 11), the licensee stated that it did not credit fire-resistant coatings and fire wraps. The licensee further stated that ignition and flame spread was assumed not to occur in covered cable trays, and that it did not credit covers to prevent or delay damage. The licensee also stated that holes in cable tray covers do not affect damage criteria.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because its approach for treating fire-resistant coatings, fire wraps, and cable tray covers is consistent with or more conservative than the guidance contained in NUREG/CR-6850.

- In FM RAI 01.d (Reference 21), the NRC staff requested that the licensee provide the criteria used to determine whether a cable tray in the vicinity of an electrical cabinet will ignite after a high-energy arcing fault (HEAF) event, explain the method for calculating the initially ignited area and subsequent fire propagation, and describe how tray covers and fire-resistant wraps were treated in terms of their effect on HEAF-induced cable tray ignition and fire propagation.

  In its response to FM RAI 01.d (Reference 11), the licensee stated that it treated HEAF fires similarly to the non-HEAF fires but with the peak HRR occurring instantaneously following the HEAF, and that it determined subsequent fire propagation in secondary combustibles (cable trays) using the same methodology as for non-HEAF fires involving cable trays. The licensee further stated that it did not credit cable tray covers and fire-resistant wraps in HEAF scenarios.

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

- In FM RAI 01.e (Reference 21), the NRC staff requested that the licensee describe the fire area and elevation that it assumed for transient fires, and explain how the model assumptions in terms of location and HRR of transient combustibles in a fire area or zone will not be violated during and post-transition.

  In its response to FM RAI 01.e (Reference 11), the licensee explained that it based the area for transient fires on the size of the combustibles used in the tests that formed the basis for the transient fire HRRs recommended in NUREG/CR-6850, Appendix G, and that, based on this approach, it determined that the area of a 98^{th} percentile transient fire is approximately 0.88 m^2. The licensee further stated that combustible controls require that transient combustibles be stored in approved containers, that the default transient base location for FPRA scenarios is the floor to represent miscellaneous loose material, that transient combustible loading is prohibited in fire sensitive areas without strict controls, and that larger quantities of transient material may be stored in designated combustible storage zones based on an assessment of their potential impact on risk-significant targets.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee provided adequate technical justification for the assumed area of transient fires, which is consistent with plant conditions.

- In FM RAI 01.f (Reference 21), 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 was used in the ZOI determination.

  In its response to FM RAI 01.f (Reference 11), the licensee explained that it implemented the modified critical heat flux using either a two- or three-point treatment in the FPRA. The licensee further stated that it used the two-point

treatment in most areas of the plant, that in this approach the ZOI tables in the GFMTs are applied without any adjustments for HGL temperatures of 80 °C or less, and that full room burnout is assumed when the HGL temperature is higher than 80 °C. The licensee further stated that it used the three-point method in the remaining areas, and that in this approach 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 that 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 to determine the damage threshold for targets immersed in a plume or HGL is conservative because the FPRA assumes a full room burnout.

- In FM RAI 01.g (Reference 21), the NRC staff requested that the licensee explain how it accounted for wall and corner effects in the ZOI calculations for transient fires.

  In its response to FM RAI 01.g (Reference 11), the licensee stated that it multiplied the HRR and fire area by 2 or 4 to determine the ZOI of transient fires against a wall or in a corner, respectively.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because its approach to account for location effects on the ZOI is consistent with that described in IMC 0609, Appendix F (Reference 121).

- In FM RAI 01.h (Reference 21), the NRC staff requested that the licensee describe how transient combustibles in an actual plant setting are characterized in terms of the three fuel package groupings in the GFMTs; identify areas, if any, where the NUREG/CR-6850 transient combustible HRR characterization may not encompass typical plant configurations; and explain if any administrative action will be used to control the type of transients in a fire area.

  In its response to FM RAI 01.h (Reference 11), the licensee explained that transient combustibles are categorized as miscellaneous materials that do not contain combustible liquids, and that ANO-1 does not differ in any significant manner from other plants with respect to its transient combustible controls to warrant a significant increase or decrease of the 98th percentile HRR of 317 kW recommended in NUREG/CR-6850. The licensee further stated that to address the potential for violations, it applied a 69 kW peak HRR fire in areas that have been designated as "no transient combustible areas." The licensee further explained that an administrative procedure will be used to limit the combustible configurations in high hazard areas to configurations that are bound by the analysis or, where impractical, to provide for the necessary compensatory measures via a prescribed transient combustible analysis. The licensee included this action in LAR Attachment S, Table S-2, Implementation Item S2-3 and the NRC staff considers this acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee justified its approach to categorize transient combustibles in terms of their nature and HRR characteristics and because the action to revise the licensee's administrative procedure would be required by the proposed license condition.

- In FM RAI 01.i (Reference 21), the NRC staff requested that the licensee explain how it accounted for wall and corner effects in the HGL timing calculations.

  In its response to FM RAI 01.i (Reference 11), the licensee stated that it accounted for wall and corner fire effects in the CFAST HGL calculations by doubling or quadrupling the HRR, ventilation area, enclosure width and length, for wall and corner fires, respectively.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee used a method to account for wall and corner effects on the time to reach damaging HGL conditions (the "image" method) that is documented in an authoritative publication and endorsed by the NRC.

- In FM RAI 01.j (Reference 21), the NRC staff requested that the licensee explain how it determined the time to ignition of the lowest tray in the FLASH-CAT cable tray fire propagation calculations.

  In its response to FM RAI 01.j (Reference 11), the licensee explained that it assumed the lowest tray in a stack to ignite 1 minute after the ignition source, and that this assumption is based on the minimum ignition time for thermoset cables listed in Tables H-5 and H-7 of NUREG/CR-6850.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the assumed ignition time is shorter than the five minutes described in NUREG/CR-7010.

- In FM RAI 01.k (Reference 21), the NRC staff requested that the licensee explain the differences between the updated and original MCR abandonment analyses, in particular the differences in the assumptions and modeled scenarios, and provide technical justification for substantive, potentially non-conservative changes.

  In its response to FM RAI 01.k (Reference 11), the licensee summarized the major changes between the original and updated MCR abandonment reports as follows:

  - Volumes and dimensions are now based on field measurements instead of drawings;

  - The parametric sensitivity analysis was expanded and updated;

- Baseline wall and corner fire scenarios, and scenarios involving fires in the ANO-2 MCR resulting in ANO-1 MCR abandonment were added;
- The transient fire growth time was changed according to the guidance in FAQ 08-0052 (Reference 65);
- Fire propagation time between cabinets was changed to 10 minutes in accordance with the guidance in NUREG/CR-6850, Appendix S;
- Model verification and validation was expanded and updated, and model uncertainty was quantified using the processes described in NUREG 1934 (Reference 47); and
- The abandonment criteria were changed to those recommended in NUREG/CR-6850.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the changes the licensee made to the MCR abandonment analysis resulted in consistency with plant conditions and the guidance contained in NUREG/CR-6850.

- In FM RAI 01.l (Reference 21), the NRC staff requested that the licensee provide the basis for the assumption that the fire brigade is expected to arrive at the MCR within 15 minutes, and to explain how the uncertainty of this assumption affects control room abandonment and the FPRA.

  In its response to FM RAI 01.l (Reference 11), the licensee explained that a review of reports of fire brigade drills conducted in 2011 and 2012 indicated that the fire brigade response time for fires in the general area of the MCR is approximately 9-10 minutes. The licensee further stated that it performed a sensitivity analysis, which showed that changing the time when the door is opened from 15 to 10 minutes or from 15 to 20 minutes, either causes a reduction or an insignificant increase of the probability for abandonment.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that reducing the time to open the door in the MCR abandonment calculations from 15 to 10 minutes, which is more consistent with fire drill data, leads to comparable or lower estimated probabilities for abandonment.

- In FM RAI 01.m (Reference 21), the NRC staff requested that the licensee provide technical justification for using transient fire growth rates in the MCR abandonment time calculations that are different from those specified in NRC FAQ 08-0052, and to discuss the effect of these differences on plant risk.

In its response to FM RAI 01.m (Reference 11), the licensee explained that the transient fire growth time in the revised MCR abandonment calculations is consistent with the guidance contained in FAQ 08-0052.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the transient fire growth time assumed by the licensee in the revised MCR abandonment calculations for transient fire scenarios is consistent with the guidance contained in FAQ 08-0052.

- In FM RAI 01.n (Reference 21), the NRC staff requested that the licensee justify the assumption in the MCR abandonment calculations that propagating panel fires spread to adjacent panels in 15 minutes, instead of 10 minutes, as described in NUREG/CR-6850.

  In its response to FM RAI 01.n (Reference 11), the licensee explained that it changed the fire propagation time to adjacent cabinets in the revised MCR abandonment calculations for propagating electrical cabinet fire scenarios to 10 minutes.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the fire propagation time to adjacent cabinets assumed in the revised MCR abandonment calculations for propagating electrical cabinet fire scenarios is consistent with the guidance contained in NUREG/CR-6850.

- The NRC staff identified plastic containers with SCBA, a partially covered vertical cable tray, and electrical cabinets with acrylic glass doors in the equipment area. In FM RAI 01.o (Reference 21), the NRC staff requested that the licensee provide technical justification for not modeling fire scenarios involving these combustibles in the MCR abandonment calculations.

  In its response to FM RAI 01.o (Reference 11), the licensee explained that it performed additional sensitivity studies to identify bounding electrical cabinet and transient scenarios that can be used as surrogates for fires that involve electrical cabinets with acrylic glass covers or plastic SCBA containers, respectively.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that fires involving the identified combustibles are bounded by scenarios that are included in the MCR abandonment calculations.

- In FM RAI 01.p(i) (Reference 21), the NRC staff requested that the licensee provide technical justification for its assumption that a baseline fire scenario in the MCR abandonment calculations is considered insensitive if a variation of an input parameter does not increase the probability of CR abandonment by 15 percent or more.

  In its response to FM RAI 01.p(i) (Reference 11), the licensee explained that the sensitivity analysis identified the fire model input parameters that significantly

affect the probability for CR abandonment over the potential range of values that could be assigned to these parameters, and those conservative values are assigned to these parameters in the final MCR abandonment analysis. The licensee further explained that the results of the MCR abandonment calculations are one of many inputs to the PRA model, that each input contributes to the uncertainty of the risk calculation, and that the uncertainty contribution associated with the assumed 15 percent threshold is insignificant compared to that of the other inputs.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the contribution to the total uncertainty in the PRA by an uncertainty of 15 percent in the probability of CR abandonment is negligible.

- In FM RAI 01.p(ii) (Reference 21), the NRC staff requested that the licensee provide justification for not assuming a higher fire elevation in the baseline MCR abandonment calculations, since the sensitivity study showed that raising the fire base to 1.2 m or 2.4 m significantly reduces abandonment times for scenarios without operating HVAC.

  In its response to FM RAI 01.n (Reference 11), the licensee explained that the baseline fire elevation for the electrical panels was set to 2.4 m in the revised MCR abandonment calculations.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee assumed a conservative fire elevation when compared to the guidance provided in NUREG/CR-6850, in the revised MCR abandonment analysis.

- In FM RAI 02.a (Reference 21), the NRC staff requested that the licensee describe how it characterized the installed cabling in the power block in terms of the critical damage threshold temperatures and heat fluxes.

  In its response to FM RAI 02.a (Reference 11), the licensee stated that it treated all cables at ANO-1 as thermoset, IEEE-383 qualified cables.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee's characterization of the cables in the power block in terms of damage thresholds is consistent with the types of cables that are actually present in the plant.

- In FM RAI 02.b (Reference 21), the NRC staff requested that the licensee explain how it credited cable tray covers, fire-resistant coatings, and fire wraps in terms of delaying or preventing cable damage, and to explain how it treated holes in cable tray covers in regards to the FM damage criteria.

  In its response to FM RAI 02.b (Reference 11), the licensee stated that it did not credit cable tray covers, fire-resistant coatings, and fire wraps for delaying or

preventing cable damage, but it did credit solid cable tray covers to isolate cables from contributing to the scenario HRR.

The NRC staff concludes that the licensee's response to the RAI is acceptable because its approach to treat cable tray covers, fire-resistant coatings, and fire wraps in terms of delaying or preventing cable damage is consistent with or more conservative than the guidance contained in NUREG/CR-6850.

- In FM RAI 02.c (Reference 21), the NRC staff requested that the licensee explain how it determined the damage thresholds for non-cable components.

  In its response to FM RAI 02.c (Reference 11), the licensee stated that it applied thermoset, IEEE-383 qualified cable damage temperatures to non-cable components such as pumps, valves, electrical cabinets, etc.

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

- In FM RAI 02.d (Reference 21), the NRC staff requested that the licensee describe the damage criteria that it used for exposed temperature-sensitive electronic equipment, and explain how it treated temperature-sensitive equipment inside an enclosure.

  In its response to FM RAI 02.d (Reference 11), the licensee stated that plant walkdowns did not identify any exposed sensitive electronic equipment that is credited in the FPRA, and that it assigned thermoset cable damage thresholds to sensitive electronics located inside enclosures.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee assumed thermoset damage thresholds for sensitive electronics in enclosures which is consistent with the guidance contained in FAQ 13-0004 (Reference 71).

3.4.2.3.3 Conclusion for Section 3.4.2.3

Based on the licensee's description in the LAR, as supplemented, of the process for performing FM in support of the FREs and clarifications provided in response to the RAIs, the NRC staff concludes that the licensee's approach for meeting the requirements of NFPA 805, Section 2.4.3.3 is acceptable.

3.4.2.4 Conclusion for Section 3.4.2

Based on NUREG-0800, Section 19.2 (Reference 35), Section III.2.2.4.1, summarizing the NRC staff's review of PRA Quality required for an LAR, the NRC staff concludes that the licensee's PRA satisfies the guidance in RG 1.174, Section 2.3, and RG 1.205, Section 4.3, regarding the technical adequacy of the PRA used to support risk assessment for transition to NFPA 805.

The FPRA methods used to support the LAR were evaluated by the NRC staff in SE Section 3.4.2.2, and the NRC staff did not accept some of the methods proposed by the licensee. FPRA methods that are not accepted by the NRC are not considered alternatives to NRC accepted codes and standards. In all but one case, the licensee removed the method from the PRA or demonstrated that the method did not impact its ability to meet the risk acceptance guidelines of RG 1.174. In one case related to modeling cable spreading room (CSR) fires in the compliant plant PRA model, discussed in the evaluation of the licensee's response to PRA RAI 13.01 in SE Section 3.4.2.2, the NRC determined that the method did not impact the licensee's ability to meet the transition risk acceptance guidelines and that the modeling in the post-transition PRA is acceptable.

The NRC staff concludes that the PRA approach, methods, and data are acceptable, and that NFPA 805, Section 2.4.3.3 is satisfied for transition to NFPA 805. The NRC staff based this conclusion on the findings that (1) the PRA model meets the criteria in that it adequately represents the current, as-built, as-operated configuration, and is, therefore, capable of being adapted to model both the post-transition and compliant plant as needed; (2) the PRA model conforms sufficiently to the applicable industry PRA standards for internal events and fires at an appropriate CC, 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.

Finally, based on the licensee's administrative controls to maintain the PRA models current and assure continued quality, using only qualified staff and contractors (as described in SE Section 3.8.3), the NRC staff concludes that the PRA maintenance process can assure that the quality of the PRA is sufficient to support self-approval of future RI changes to the FPP under the NFPA 805 license condition, subject to completion of all implementation items described in LAR Attachment S, Table S-2.

3.4.3 Fire Risk Evaluations

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

Plant configurations that did not meet the deterministic requirements of NFPA 805, Section 4.2.3.1 were considered VFDRs. VFDRs that will be brought into deterministic compliance through plant modifications do not require a risk evaluation. In LAR Attachment C, the licensee identified the VFDRs that it does not intend to bring into deterministic compliance under NFPA 805. For these VFDRs, that will be retained and become part of the licensing basis, the licensee used the RI approach, in accordance with NFPA 805, Section 4.2.4.2, to demonstrate that the increased risk from the retained VFDRs is acceptable.

In LAR Section 4.2.4 the licensee stated that all of the VFDRs evaluated by the FPRA were categorized as separation issues or degraded fire protection systems or features. The separation-related VFDRs can generally be categorized into the following four types of plant configurations: (1) inadequate separation resulting in fire-induced damage of process equipment or associated cables required for the identified success path; (2) inadequate separation resulting in fire-induced spurious operation of equipment that may defeat the identified success path; (3) inadequate separation resulting in fire-induced failure of process monitoring instrumentation or associated cables required for the identified success path; or (4) combinations of the above configurations. In PRA RAI 13 (Reference 21), the NRC staff requested that the licensee discuss its treatment of VFDRs identified but not modeled in the FPRA. In its response to PRA RAI 13 (Reference 12), the licensee explained that VFDRs were excluded from the change-in-risk calculations if they were qualitatively determined not to be associated with functional requirements that could impact the risk of a fire event scenario. The licensee explained that examples of such functional requirements are those associated with the pressurizer heaters and overcooling of the RCS.

In its response to PRA RAI 13 and LAR Attachment W, Section W.2, "Risk Change Due to NFPA 805 Transition," the licensee described how the change-in-risk associated with VFDRs is performed. The licensee explained that the change-in-risk associated with each fire area is obtained by calculating the difference between the CDF and LERF of a compliant plant configuration and the variant (post-transition) plant configuration for each fire area. The total change-in-risk was obtained by summing the change-in-risk for all fire areas. The post-transition plant model includes all planned modifications, all fire-induced component failures for retained VFDRs, all RA failure probabilities set at their nominal values, and fire-induced MSOs. Fire induced component failure of components affected by VFDRs were set to "failed by fire" (i.e., probability of 1.0). The licensee explained that the compliant plant PRA model was created by removing VFDR failures from the post-transition plant by setting the failure probability of affected components to their random failure probabilities and by removing credit for committed modifications. The licensee stated that some committed modifications do not resolve a VFDR but have been included to reduce risk in the post transition plant (i.e., risk-reduction modifications).

In its response to PRA RAIs 10 and 11 dated August 12, 2015 (Reference 12), the licensee provided a description of how fires that might cause MCR abandonment on loss of habitability or loss of control are modelled in the compliant and post-transition plants. As discussed in SE Section 3.4.2.2, the MCR would only be abandoned upon loss of habitability. For loss of control scenarios the licensee stated that the MCR would not be abandoned although additional actions outside the MCR may be necessary. In all scenarios, the post-transition plant model includes all fire induced SSC failures and modeling the required operator actions as taken at locations where they will be taken. The compliant plant model was created by eliminating fire-induced SSC failures associated with VFDRs and modelling all operator actions as being taken in the MCR. As with other fire areas, the change-in-risk associated with transition in fire areas that could cause MCR abandonment is obtained by calculating the difference between the CDF and LERF of a compliant plant configuration and the post-transition plant configuration for each fire area.

The NRC staff concludes that the licensee's responses to the RAIs are acceptable because the licensee demonstrated that its methods for calculating the change in risk associated with

VFDRs are consistent with RG 1.205, Section 2.2.4.1, and FAQ 08-0054 (Reference 66). The NRC staff further concludes that the results of these calculations for each fire area, which are summarized in LAR Attachment W, Table W-2, as supplemented (Reference 17), 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, LAR Attachment G, and LAR Attachment W, during its evaluation of the additional risk presented by the NFPA 805 RAs. SE Section 3.2.5 describes the identification and evaluation of RAs.

The licensee used the guidance in RG 1.205, Revision 1, and FAQ 07-0030 (Reference 60), for addressing RAs which included the definition of a PCS and RA. Accordingly, any actions required to transfer control to, or operate equipment from the PCS were not considered RAs per NFPA 805 and RG 1.205. Conversely, any OMAs required to be performed outside the control room and not at the PCS were considered RAs. In its response to PRA RAI 11 (Reference 12), the licensee stated that command and control for post fire shutdown is expected to remain in the MCR for all non-loss of habitability scenarios and therefore the operator actions taken outside the MCR in all non-loss of habitability scenarios were treated as RAs consistent with the guidance in RG 1.205. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that it treated operator actions taken outside the MCR in all non-loss of habitability scenarios as RAs, which is consistent with the guidance in RG 1.205.

The licensee identified 11 RAs and 23 DID-RAs in LAR Attachment G, Table G-1, as supplemented. The licensee differentiated between RAs credited in the PRA to reduce the risk impact of retained VFDRs and RAs credited for DID. The licensee clarified in LAR Attachment W that DID-RAs are not modeled in the FPRA.

The additional risk of RAs for each fire area is presented in LAR Attachment W, Table W-2, as supplemented. In its response to PRA RAI 14 dated June 16, 2015 (Reference 10), the licensee explained that the additional risk of RAs associated with each fire area was obtained by calculating the difference in risk between the post-transition plant configuration with all RAs at their nominal values and this same configuration with all RAs assumed to always succeed (i.e., their probability of failure set to zero). The total additional risk of RAs was obtained by summing the additional risk for each fire area. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the difference in risk from this calculation estimates the reduction in risk that could be achieved if all RAs were assumed to always succeed, which can then be compared to the acceptance guidelines.

In LAR Attachment W, Table W-2, as supplemented, (Reference 17), the additional risk of RAs is shown as an increase in CDF of 3.14E-05/year and an increase in LERF of 5.58E-07/year. Accordingly, the LERF risk is below the risk acceptance guideline of 1E-6/year in RG 1.174, while the CDF risk is above acceptance guidelines of 1E-05/year. RG 1.205, Regulatory Position (RP) 2.2.4.2 states that, "If the additional risk associated with the previously approved recovery actions is greater than the acceptance guidelines in Regulatory Guide 1.174, then the

net change in total plant risk incurred by any proposed alternatives to the deterministic criteria in NFPA 805, Chapter 4 (other than the previously approved recovery actions), should be risk-neutral or represent a risk decrease." The licensee reported that the net change-in-risk associated with the proposed alternatives in its NFPA 805 program is a risk decrease, therefore, the NRC staff finds that the additional risk of RAs above the guidelines is acceptable.

In LAR Attachment G, the licensee stated that it used guidance in NEI 04-02, Revision 2 (Reference 7), FAQ 07-0030, and RG 1.205 to evaluate additional risk of RAs. The licensee reviewed all of the RAs for adverse impact on plant risk per FAQ 07-0030 and stated that no RAs listed in LAR Attachment G, Table G-1, were found to have an adverse impact. The licensee stated that all RAs listed in LAR Attachment G were evaluated against the feasibility criteria provided in FAQ 07-0030. LAR Attachment S, Table S-2, includes Implementation Item S2-5 to update the post-fire shutdown procedures to incorporate the results of the RA feasibility evaluation and the NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

The NRC staff concludes that the licensee's methods for determining the additional risk of RAs is acceptable because they are consistent with RG 1.205, Section 2.2.4.1 and FAQ 07-0030. Furthermore, there is a net decrease in risk resulting from transition to NFPA 805. Therefore the NRC concludes that, subject to completion of Implementation Item S2-5, 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 comply with NFPA 805.

3.4.6 Cumulative Risk and Combined Changes

In LAR Attachment S, Table S-1, the licensee identified the modifications needed to implement NFPA 805. These include modifications that remove VFDRs as well as modifications that do not bring the facility into compliance with deterministic requirements of NFPA 805 (i.e., non-VFDR modifications) but do reduce fire risk. The licensee credited non-VFDR modifications by including them in the post-transition risk but not the compliant plant risk. The licensee's application to transition to a RI/PB FPP is, therefore, a combined change request per Section 1.1, "Combined Change Requests," of RG 1.174, Revision 2.

The total plant CDF and LERF are estimated by adding the risk assessment results for internal events, internal flooding, fire, seismic, and other external hazard events. RG 1.174 does not require a total CDF and LERF to be reported when the total change in CDF and LERF for an application are less than 1.00E-6/year and 1.00E-7/year, respectively. Although there is an estimated net risk decrease in the transition to a RI/PB FPP, the licensee provided an estimate of contributors to the total CDF and LERF in LAR Attachment W, which is summarized below in SE Table 3.4.6. The licensee explained that the seismic CDF estimate is based on the NRC staff's bounding risk assessment from "Generic Issue 199 - Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants" (Reference

122). The total risk results indicate that CDF increase of up to 1E-5/year and a LERF increase of up to 1E-6/year would be acceptable.

Table 3.4.6: CDF and LERF for ANO-1 after Transition to NFPA 805

Hazard Group	ANO-1	
	CDF (/year)	LERF (/year)
Internal Events	2.88E-06	5.82E-08
Internal Flooding	1.04E-06	1.73E-07
Internal Fire	7.62E-05	8.74E-06
Seismic	4.1E-06	4.1E-07[2]
TOTAL[1,3]	8.42E-05	9.38E-06

Notes:

1. LAR Attachment W, Section W.2, states that the CDF associated with external flooding and other external events is estimated to be less than 1E-06/year per NUREG-1407 and is not included in this total.
2. LAR Attachment W, Section W.2, explains that this LERF is based on the assumption that it is 0.1 of the total CDF.
3. These total values are based on the sum of values presented above, which include a seismic contribution.

RG 1.205, Section 3.2.5, "Combined Changes and Cumulative Risk of Changes," states that risk decreases may be combined with risk increases for the purposes of evaluating combined changes with regulatory positions presented in RG 1.174, Revision 2, Sections 1.1 and 1.2, if the total increase and total decrease in CDF and LERF are provided. In PRA RAI 15 dated November 17, 2015 (Reference 21), the NRC staff requested that the licensee provide the total risk increase associated with unresolved VFDRs and the total risk decrease associated with non-VFDR modifications. In its response to PRA RAI 15 dated March 25, 2016 (Reference 17), the licensee reported that the total risk increase associated with unresolved VFDRs was a ΔCDF of 3.71E-05/year and a ΔLERF of 3.18E-06/year and that the risk decrease associated with non-VFDR risk reduction modifications was a ΔCDF of –3.78E-05/year and a ΔLERF of -1.57E-05/year.

The licensee provided the ΔCDF and ΔLERF estimates for each non-deterministically compliant fire area that is not deterministically compliant, in accordance with NFPA 805, Section 4.2.3. In its response to PRA RAI 03 (Reference 17), the licensee provided change-in-risk estimates in an updated LAR Attachment W, Section W.2, based on the final FPRA after implementing a number of FPRA model and method refinements to use methods accepted by the NRC. The risk estimates for these fire areas address the completed and planned modifications and administrative controls that will be implemented as part of the transition to NFPA 805, as well as RAs to reduce VFDR risk. The total change in CDF was reported to be -6.74E-07/year and total change in LERF was reported to be -1.25E-05/year, both below the RG 1.174 acceptance guidelines. The change-in-risk reported for each individual fire area is negative or less than the risk acceptance guideline in RG 1.174 of 1E-05/year for CDF and 1E-06/year for LERF with the

exception of the 2.77E-05/year ΔCDF for Fire Area G, which exceeds the acceptance guidelines. However, the total reported change-in-risk for this application is a net negative based on all fire area changes, and the acceptance guidelines in RG 1.174 are based on the total change and therefore the NRC staff concludes the licensee's responses to PRA RAI 15 and PRA RAI 03 are acceptable because the change-in-risk meets the acceptance criteria in RG 1.174 and RG 1.205.

In PRA RAI 15 (Reference 21), the NRC staff requested that the licensee provide additional information regarding the conservative modeling of the compliant plant that could over-estimate the compliant plant risk. If the conservative modeling's risk impact is substantively reduced in the post-transition plant model by risk-reduction modifications, an overestimate of the risk reduction can result in non-conservative change in risk estimates. These modeling assumptions are addressed by the licensee in sensitivity studies discussed in SE Section 3.4.7. The NRC staff concludes that the licensee's response to the RAI is acceptable because the risk reduction is consistent with the extensive plant modifications that will be implemented and the lower end of the range of results reported in the sensitivity studies are more likely and therefore the estimated ΔCDF -6.74E-07/year (which is above the lower end value of -1.17E-06/year) is a reasonable acceptable estimate. In addition, since all estimated values of ΔLERF are negative, the NRC staff considers them acceptable.

The NRC staff concludes that the risk associated with the proposed alternatives to compliance with the deterministic criteria of NFPA 805 is acceptable and in accordance with NFPA 805, Section 2.4.4.1, 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

In its letter dated March 25, 2016 (Reference 17), the licensee indicated that updated fire ignition bin frequencies provided in NUREG/CR-6850, Supplement 1 (i.e., FAQ-08-0048) were used in the final FPRA model. The licensee explained that per the guidance in FAQ-08-0048 (Reference 64), a sensitivity study was performed using the mean of the fire ignition frequency bins contained in NUREG/CR-6850, Section 6, for those bins having an alpha factor from EPRI TR 1016735 "Fire PRA Methods Enhancements, Additions, Clarifications, and Refinements to EPRI 1019189" (Reference 123), less than or equal to one. The licensee stated that the results of the sensitivity study "slightly exceed" the risk guidelines in RG 1.174. The licensee explained that DID-RAs are identified in LAR Attachment G for the high risk areas including MCR fires that would restore important systems credited in the FPRA such as EDGs, SW and HPI. The NRC staff found that updated LAR Attachment W, Table W-1a, "Fire PRA CDF significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)," shows that the accident sequences with the highest CDF contribution are MCR fires. The NRC staff concludes that the use of the updated bin frequencies is acceptable, because results of the required sensitivity study show that although the RG 1.174 guidelines are minimally exceeded, the licensee identified substantial existing DID measures and therefore satisfies the guidance in FAQ 08-0048.

In the NRC Triennial Fire Protection Inspection Report dated August 4, 2016 (Reference 124), NRC inspectors found that the ignition frequency for air compressors was different from the generic ignition frequency for air compressors outlined in NUREG/CR-6850 (Reference 36). In

addition, the inspectors found that the exhaust fan motors of five horsepower or less were identified and counted as ignition sources, contrary to the criteria established in NUREG/CR-6850. In its letter dated August 29, 2016 (Reference 20), the licensee provided a sensitivity study evaluating the impact of correcting these two issues on the FPRA risk estimates. Correcting the first issue by using the NUREG/CR-6850 frequency increased fire risk very slightly. Correcting the second issue increased the frequency of motor ignition sources, but also resulted in the removal of the small motor ignition source scenarios consistent with NUREG/CR-6850. The licensee stated that the decrease in risk from removing the small ignition source scenarios was greater than the increase in risk from the increased frequency for the larger ignition sources. The net change after correcting both issues was a risk decrease for post-transition CDF and LERF of -9.4E-07/year and -3.7E-9/year respectively. The licensee stated that a new transition change in risk was not calculated because these changes did not introduce any new VFDRs. The NRC Staff finds these small reductions unrelated to any new VFDRs and need not be incorporated into the reported results because they will not cause the current -6.74E-07/year change in CDF and -1.25E-05/year change in LERF to increase to the 1.0E-5/year and 1.0E-6/year acceptance guidelines for CDF and LERF respectively. PRAs are expected to be periodically changed and these minor corrections can be incorporated into the PRA for post-transition FREs using the PRA configuration control program.

In PRA RAI 15 (Reference 21), the NRC staff requested that the licensee provide additional information about conservative modeling in the PRA that might over-estimate the risk decreases caused by the risk-reduction modifications. In its responses to PRA RAI 15 dated August 12, 2015 (Reference 12) and PRA RAI 10 dated March 25, 2016 (Reference 17), the licensee evaluated the two most conservative assumptions of 1) assuming all cables with unknown routing are failed by every fire and 2) assuming all cables in the MCR are failed by fire in the MCR abandonment scenario.

The most conservative modeling assumption is that all cables with unknown routing (unrouted cables) are damaged by all fires, an assumption consistent with guidance in NUREG/CR-6850. The licensee performed two sensitivity studies. In the first study the licensee assumed that all unrouted cables are damaged in the post-transition model but none are damaged in the compliant plant model. In reality, some of the unrouted cables assumed failed in the post-transition model would be available because every unrouted cable cannot physically be present in every fire scenario. Therefore the risk of the post-transition plant is overestimated. Similarly, some of the unrouted cables assumed available in the compliant plant model will be failed by fire because unrouted cables cannot be protected from every fire. Therefore, the risk of the compliant plant is underestimated. Subtracting the overestimated post-transition risk from an underestimated compliant plant risk will overestimate the change in risk. The resulting transition ΔCDF from this sensitivity study was 1.21E-05/year while the ΔLERF remained negative. In the second sensitivity study the licensee assumed that all the unrouted cables never failed in both the post-transition and the compliant plant models. The resulting ΔCDF from this sensitivity study was -4.77E-06/year while the ΔLERF remained negative. Therefore, if the locations of all cables were known and modeled, the ΔCDF would be between 1.21E-05/year and -4.77E-06/year.

The licensee also performed a sensitivity study on the second assumption (i.e., assuming all cables in the MCR are failed by fire in the MCR abandonment scenario). The licensee assumed the compliant plant risk could be brought to zero by adding the entire CDF and LERF associated

with the MCR abandonment scenario to the total change-in-risk. This conservative treatment results in a total plant ΔCDF of 3.6E-06/year while the ΔLERF remained negative.

When the maximum ΔCDF increase from the MCR abandonment sensitivity study is added to the range of risk estimates for the two unknown cable routing sensitivity studies, the result is a range of ΔCDF values from the sensitivity studies from a high of 1.57E-05/year to a low of -1.17E-06/year. Aside from the infrequent full room burnout, the zone of fire induced failures for each fire is relatively small. Given the unrouted cables are distributed throughout numerous fire areas, most cables will be unaffected by a fire in a given location, and the NRC staff finds it acceptable to assume that the risk contribution from unrouted cable failures results in a ΔCDF on the lower end of the range cited above. The licensee's estimated ΔCDF of -6.74E-07/year is greater than the lower bound ΔCDF estimate of -1.17E-06/year and the staff concludes that the licensee reported value is an acceptable estimate of the transition change-in-risk.

In its updated response to PRA RAI 15 (Reference 17), the licensee discussed the most risk significant compliant plant model scenarios. The NRC staff reviewed this discussion of the dominant risk scenarios for the compliant plant information and did not identify other modeling assumptions that should be addressed in a sensitivity study.

The NRC staff concludes that licensee's responses to PRA RAIs 10 and 15 are acceptable because the licensee demonstrated that its use of modeling assumptions in the FPRA compliant plant model that could contribute to underestimation of the change-in-risk is offset by the risk decrease associated with the non-VFDR risk reduction modifications.

3.4.8 Conclusion for Section 3.4

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

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

- The licensee stated that it has completed changes to the PRA model which 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 FPRA model may be used to support post-transition self-approval of FPP changes subject to completion of all implementation items identified in LAR, Attachment S, Table S-2, because the identified acceptable methods will be used unless replaced by other acceptable methods.

- LAR Attachment S, Table S-2, Implementation Item S2-9, states that the licensee will re-evaluate the risk and the change-in-risk results after completing

implementation of the transition to NFPA 805 to ensure that the as-built change in risk does not exceed the RG 1.205 risk acceptance criteria.

- 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-2, Implementation Item S2-9.

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

- The licensee's application to transition to NFPA 805 is a combined change as defined by RG 1.205, Revision 1 that includes risk increases from retained VFDRs and risk decreases resulting from non-VFDR related modifications. Based on the combination of these risk values, the change-in-risk associated with the proposed alternatives to compliance with the deterministic criteria of NFPA 805 is acceptable. The licensee satisfied the guidance contained in RG 1.205, Revision 1, RG 1.174, Section 2.4, and NUREG-0800, Section 19.2, regarding acceptable risk. By meeting the guidance contained in these documents, the changes in risk are found to be acceptable to the NRC staff.

- The total additional risk from RAs is 3.14E-05/year for CDF and 5.58E-07/year for LERF. Accordingly, the LERF risk value is below the risk acceptance guideline in RG 1.174 of 1E-06/year while the CDF value is above the 1E-05/year acceptance guidelines. RG 1.205 Position 2.2.4.2 states, in part, that:

  > If the additional risk associated with the previously approved recovery actions is greater than the acceptance guidelines in Regulatory Guide 1.174, then the net change in total plant risk incurred by any proposed alternatives to the deterministic criteria in FPA 805, Chapter 4 (other than the previously approved recovery actions), should be risk-neutral or represent a risk decrease.

  In general, the application of this guidance to RAs (other than the previously approved RAs) is found to be acceptable because the licensee has reported a total decrease in the change-in-risk for this application.

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

3.5 Nuclear Safety Capability Assessment Results

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

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

NFPA 805, Section 2.2.4, "Performance Criteria," states that:

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

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

> When applying a deterministic approach, the user shall be permitted to demonstrate compliance with specific deterministic fire protection design requirements in Chapter 4 for existing configurations with an engineering equivalency evaluation. These existing engineering evaluations shall clearly demonstrate an equivalent level of fire protection compared to the deterministic requirements.

3.5.1 Nuclear Safety Capability Assessment Results by Fire Area

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

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

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

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

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

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

NFPA 805, Section 4.2.2, "Selection of Approach," states that:

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

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

The NRC staff reviewed LAR Section 4.2.4, "Fire Area Transition"; 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, "Plant Modifications and Items to be Completed During Implementation"; and LAR Attachment W, "Fire PRA Insights," during its evaluation of the ability of each fire area to meet the NSPC of NFPA 805.

ANO-1 is a single unit PWR with 37 individual fire areas including the yard and manholes, and each fire area is composed of one or more fire zones. ANO-2 is an adjacent unit, but the licensee stated that ANO-1 and ANO-2 do not share resources required to meet performance goals for control of reactivity, inventory, pressure, and decay heat removal. Based on the information provided by the licensee in the LAR, as supplemented, the licensee performed the nuclear safety capability assessment on a fire area basis. LAR Attachment C provides the results of these analyses on a fire area basis and also identified the fire zones within the fire areas.

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 3.5-1: Fire Area and Compliance Strategy Summary

Fire Area	Area Description	NFPA 805 Compliance Basis
A	East Decay Heat Removal Pump Room	Deterministic
ADMIN	ADMIN - Administration Building	Deterministic
B-1@120-E, 125-E, 128-E, 149-E and 79-U	North Auxiliary Building	Performance-Based
B-1@170-Z	Steam Pipe Room (Penthouse)	Performance-Based
B-1@40-Y	Pipeway Room (Under intermediate cooling water (ICW) Coolers)	Performance-Based
B-1@73-W	Condensate Demineralizer Room	Performance-Based
B-1@BOFZ	Chemical Addition Area, Spent Fuel Area, Computer Room, Ventilation Equipment Area, Reactor Building Purge Room, Computer Transformer Room, Transformer Room, Lube Oil Storage Tank Room, Dirty & Clean Lube Oil Storage Tank Room, Unit 1 Turbine Building, Unit 1 Drumming Station, Boiler Room, Gas Bottle Storage Area	Performance-Based
B-1@197-X	West Heater Deck	Performance-Based
B-7	Auxiliary Building Elevation 317'	Deterministic
B-8@104-S, 105-T, 144-D, & 76-W	South Electrical Equipment and Penetration Rooms	Performance-based
B-8@46-Y and 77-V	Auxiliary Building South Side	Performance-Based
B-9	General Access 354' Elevation	Performance-Based
B-10	Stairwell No. 1	Performance-Based
C	General Access Elevation 354	Performance-Based
D	North Emergency Diesel Generator Room	Deterministic
E	South Switchgear Room	Performance-Based
F	South Battery and DC Equipment Room	Performance-Based
G	Cable Spreading Room and Control Rooms	Performance-Based
H	South Emergency Diesel Generator Room	Deterministic
I-1	Corridor	Performance-Based
I-2	North Switchgear Room	Performance-Based
I-3	Lower North Electrical Penetration Room	Performance-Based
J Unit 1 Reactor Building - North	North Side Reactor Building	Performance-Based
J Unit 1 Reactor Building - South	South Side Reactor Building	Performance-Based
K	Tank Vaults	Deterministic
L	Diesel Fuel Storage Vault Area	Deterministic
MH01	Manholes Between Aux Bldg and Intake Structure	Deterministic
MH02	Manholes Between Aux Bldg and Intake Structure	Deterministic
MH03	Manholes Between Aux Bldg and Intake Structure	Performance-Based
MH04	Manholes Between Aux Bldg and Intake Structure	Deterministic
MH05	Manholes Between Aux Bldg and Intake Structure	Performance-Based

Fire Area	Area Description	NFPA 805 Compliance Basis
MH06	Manholes Between Aux Bldg and Intake Structure	Deterministic
MH09	Manholes Between Aux Bldg and Diesel Fuel Vault	Deterministic
MH10	Manholes Between Aux Bldg and Diesel Fuel Vault	Deterministic
N	Unit 1 Intake Structure	Performance-Based
O	North Battery Room	Performance-Based
YD	Miscellaneous Yard Locations	Deterministic

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 a FRE in accordance with NFPA 805, Section 4.2.4.2.

In SSA RAI 07 (Reference 21), the NRC staff requested that the licensee clarify differences in the listing of fire areas between LAR Attachment C and LAR Attachment W. Specifically, Fire Area ADMIN – administration building is included in LAR Attachment C, but not in LAR Attachment W, and Fire Area AAC, "SBOD [station blackout diesel] alternate diesel building" is included in LAR Attachment W, but not in LAR Attachment C. In its response to SSA RAI 07 dated July 21, 2015 (Reference 11), the licensee stated the technical support center (TSC) located within the administration building is used to monitor plant conditions using the SPDS and coordinates activities when necessary to abandon the MCR as the result of a fire in the MCR (Fire Zone 129-F) or cable spreading room (Fire Zone 97-R). The licensee stated that the administration building is important to the ANO FPP as it contains cables and equipment required for monitoring and, therefore, is included in LAR Attachment C, but is not part of the power block as defined within LAR Attachment I, "Definition of Power Block." The licensee further stated that since the administration building is not part of the power block and does not contribute to overall plant risk, it is not included in LAR Attachment W. The licensee stated that the SBOD is documented in ANO-2's LAR Attachment C as it is physically located on the ANO-2 side of the site, interfaces directly with, and is controlled from ANO-2. The licensee stated that the SBOD is not credited in the ANO-1 deterministic analysis, which makes it unnecessary to be included in LAR Attachment C. The licensee further stated that the SBOD is included in LAR Attachment W due to its risk importance in the FPRA for ANO-1. The licensee stated that the FPRA, developed using the guidance of NUREG/CR-6850, performs a quantitative

assessment of risk which contains elements that are not considerations within the deterministic SSA. On the basis of the information provided, the NRC staff concludes that the licensee's response to SSA RAI 07 is acceptable because the licensee adequately clarified the basis for the differences in the fire area listings between LAR Attachment C and LAR Attachment W.

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. They are as follows: (1) fire detection systems in accordance with Section 3.8.2, (2) automatic water-based fire suppression systems in accordance with Section 3.9.1, (3) gaseous fire suppression systems in accordance with Section 3.10.1, and (4) passive fire protection features in accordance with Section 3.11. The features/systems addressed in these sections are only required when the analyses performed in accordance with NFPA 805, Chapter 4, indicate the features and systems are required to meet the NSPC.

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

The NRC staff reviewed LAR Attachment C for each fire area to ensure fire detection and suppression met the principles of DID in regard to the planned transition to NFPA 805.

Based on the statements provided in LAR Attachment C, the NRC staff concludes that the ANO-1 treatment of this issue is acceptable because the licensee 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 NSPC

Each fire area in LAR Attachment C, "NEI 04-02, Table B-3 – Fire Area Transition," included a discussion of the licensee's evaluation of fire suppression effects on the ability to meet the NSPC.

The licensee stated that safe and stable conditions can be achieved and maintained utilizing equipment and actions outside the affected fire areas or outside the area of fire suppression activity. For several fire areas, the licensee described its evaluation of the potential for ponding of suppression water and identified several areas where the accumulation of water discharged from automatic fire protection systems and manual suppression would ultimately migrate to adjacent compartments, including the turbine building basement and have no impact on equipment necessary to achieve and maintain safe and stable conditions and, 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 NRC staff concludes that the licensee's evaluation of the suppression effects on the NSPC is acceptable because the licensee evaluated fire suppression effects on meeting the NSPC and determined that fire suppression activities will not adversely affect achievement of the NSPC.

3.5.1.3 Licensing Actions

Based on the information provided in the LAR Attachment C, the licensee identified an exemption from the deterministic requirements for two fire areas that were previously approved by the NRC and will be transitioned with the NFPA 805 FPP. This exemption is summarized in LAR Attachment C on fire area basis and described in further detail in LAR Attachment K, "Existing Licensing Action Transition."

The licensee has proposed clarifications to a previously approved licensing action and documented these clarifications in LAR Attachment T, "Clarification of Prior NRC Approvals." The licensee utilized the process described in LAR Section 4.2.3, which requires a determination of the basis of acceptability and a determination that the basis of the acceptability was still valid for the licensing action that will be transitioned. The licensing action being transitioned, including the clarifications, is summarized in Table 3.5-2.

Table 3.5-2 Previously Approved Licensing Actions Being Transitioned

Licensing Action Description	Applicable Fire Areas	Clarification	NRC Staff Evaluation
Appendix R Exemption 19, RCP Oil Collection System Not Meeting III.O Criteria	J Unit 1 Reactor Building - North J Unit 1 Reactor Building - South	Subsequent to the exemption, the RCP P-32B motor was replaced with a new motor with a larger lube oil capacity. The design of the RCP lube oil collection system was modified to accommodate the increased lube oil capacity of the new motor. An overflow tank was installed to supplement the capacity of the original tank. The licensee stated that subsequent calculations determined that the lube oil from the new motor would exceed the capacity of the collection and overflow tank by 6-gallons. However, the licensee stated that the total volume of oil from both RCPs, P-32A/P-32B, is 367 gallons, which is well within the 488-gallon combined capacity of the original tank, the overflow tank and curbed area and, therefore continues to meet the intent of the original exemption, which considered the capacity of the original collection tank and the associated curbed area.	Based on the previous staff approval of this exemption in an SE dated October 26, 1988 (Reference 85), and the statement by the licensee that the basis remains valid, the NRC staff concludes that this licensing action is acceptable to be transitioned.

The NRC staff reviewed the exemption from the pre-NFPA 805 licensing basis identified in Table 3.5-2, above, including the description of the previously approved exemption from the deterministic requirements, the basis for and continuing validity of the exemption, and the NRC staff's original evaluation or basis for approval of the exemption. In LAR Attachment K, the licensee stated that for each transitioned exemption, the review of the existing licensing actions included a determination of the basis of acceptability and a determination that the basis of acceptability is still valid, except as identified in LAR Attachment T, and further described in SE Section 3.5.2.

Based on the NRC staff's review of the licensing action identified and described in LAR Attachments C and K, and the clarifications in LAR Attachment T, the NRC staff concludes that the licensing actions are identified by applicable fire area and remain valid to support the proposed license amendment because the licensee utilized the process described in NEI 04-02, as endorsed by RG 1.205, which includes a determination of the basis of acceptability and a determination that the basis is still valid.

Based on the previous NRC staff approval of the exemption and the statement by the licensee that the basis remains valid, as presented in each appropriate fire area, the NRC staff concludes that the engineering evaluation being carried forward supporting the NFPA 805 transition as identified in Table 3.5-2, is acceptable because it is in accordance with NFPA 805, Section 2.2.7. (See SE Section 2.5, "Rescission of Exemptions," for further discussion.)

3.5.1.4 Existing Engineering Equivalency Evaluations

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

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

In LAR Section 4.2.2, "Existing Engineering Equivalency Evaluation Transition," the licensee stated that the guidance in RG 1.205, RP 2.3.2 and FAQ 08-0054 (Reference 66), was followed. EEEEs that demonstrate that a fire protection system or feature is adequate for the hazard are to be addressed in the LAR as follows:

- If not requesting specific approval for an adequate for the hazard EEEEs, 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 EEEEs, then the EEEE is referenced where required to demonstrate compliance and is included in LAR Attachment L for NRC review and approval.

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

Based on the NRC staff's review of the licensee's methodology for review of EEEE's and identification of the applicable EEEEs in LAR Attachment C, the NRC staff concludes that the licensee's use of EEEEs meets the requirements of NFPA 805 and the guidance provided in 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, "NEI 04-02 Table B-3 Fire Area Transition," for each fire area. Documented VFDRs were all represented as separation issues. The following strategies were used by the licensee in resolving these VFDRs:

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

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

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

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

For all fire areas where the licensee used the PB approach to meet the NSPC, each VFDR and the associated resolution are described in LAR Attachment C. The NRC staff concludes that the licensee's identification and resolution of the VFDRs is acceptable because the licensee performed its analysis in accordance with the criteria in NEI 04-02, Revision 2 (Reference 7) as endorsed by RG 1.205, Revision 1 (Reference 4).

3.5.1.6 Recovery Actions

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

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

In SSA RAI 06 dated May 5, 2015 (Reference 21), the NRC staff identified that VFDRs B173-03, B8SEPR-04, and I3-04 state that fire damage to cables associated with the power supply to battery charger D-03B, D-03A, and D-04A, respectively, would require a local manual transfer for the redundant battery charger, if it is not aligned; however, the resolution of the VFDRs and their associated FRE, state that no further action is required. The NRC staff requested that the licensee clarify whether the local manual transfer for the non-affected redundant battery charger is credited in the FREs, and if so, discuss how the local manual transfer is modeled with respect to risk-related RAs. In its response to SSA RAI 06 dated June 16, 2015 (Reference 10), the licensee stated that ANO-1 has two independent safety-related 125 volt battery-backed buses that provide DC power to plant equipment and each 125 volt direct current (VDC) bus is equipped with two battery chargers that allow for maintenance and improved system reliability. The licensee stated that only one battery charger is aligned to each bus at a given time to maintain bus voltage and the battery in a charged condition and a plant operator is needed to manually perform the local transfer from one charger to the other. The licensee stated that a review of the FREs associated with VFDRs B173-03, B8SEPR-04, and I3-04 confirmed there are no RAs for risk reduction benefit or DID credited to perform a local manual transfer to the non-affected alternate battery charger in the event the aligned charger fails due to fire. The licensee stated that other considerations that support not requiring a RA to align the battery charger include the opposite train of DC remaining unaffected in each subject fire area. The NRC staff concludes that the licensee's response to SSA RAI 06 is acceptable because the licensee confirmed that no RAs are necessary to resolve VFDRs B173-03, B8SEPR-04, and I3-04.

In LAR Attachment C, for a fire in Fire Area G, CR, and associated fire zones, the licensee stated in the "method of accomplishment" for the process monitoring performance goal that instrumentation is available in the TSC to monitor neutron flux, pressurizer level, RCS pressure, RCS temperature, and credited SG level and pressure using the SPDS. In SSA RAI 10 dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee clarify that the process monitoring function performed at the SPDS is maintained free of fire damage by a fire in Fire Area G, as required by NFPA 805 Section 4.2.1, including the power source and instrumentation input data to the SPDS; discuss the means to achieve each of the feasibility criteria of FAQ 07-0030 for the process monitoring function; and confirm that RAs credited in the NSCA are described in LAR Attachment G and evaluated for risk in accordance with NFPA 805, Section 4.2.4. In its response to SSA RAI 10 dated July 21, 2015 (Reference 11), the licensee stated that the instruments, equipment, and plant cabling needed by the SPDS to provide the necessary monitoring capability of critical parameters in the TSC are included in the ANO cable and raceway database (plant data management system (PDMS)) and the plant safe shutdown capability assessment confirms that SPDS is maintained free of fire damage by a fire in Fire Area G. The licensee stated that in an MCR abandonment scenario the shift manager and shift technical advisor are directed by the alternate shutdown procedure to transition to the TSC and the cognitive supporting tasks within the TSC are an implicit part of RAs, limited to the monitoring of plant parameters displayed by SPDS and procedural coordination with operators

within the power block using the available communication system. The licensee stated that these cognitive tasks at the TSC are equivalent to non-abandonment MCR tasks that support execution of RAs in the current SSA and described how each of the feasibility criteria are met for these cognitive actions. The licensee stated that the probability of failure for an RA encompasses the cognitive portion, which accounts for errors in detection, diagnosis, or decision-making, and the execution portion, in which possible errors in carrying out a decision can be made.

The licensee further stated that the RAs of equipment in LAR Attachment G, exclusive of the new CFW, are prescriptive actions for risk mitigation that require no instrumentation cues for performance. The license stated that these actions will close isolation valves to ensure the integrity of the RCS (CV-1221 and PSV-1000), secure RCPs for prevention of a seal LOCA, and secure HPI pumps to prevent over pressurization of the RCS. The licensee stated that the risk analysis for these RAs appropriately includes cognitive error for additional stress and procedure usage and the execution error includes actions to open the breaker and locally operate the valve where required.

The licensee further stated that the RA and its associated risk for the future new CFW pump are based upon MCR abandonment and local operation at a dedicated control panel for the pump and valves. The licensee stated that while starting the pump and establishing flow to the SGs is a prescriptive action, this recovery will require monitoring of instrumentation and the availability of the instrumentation is considered part of the HFE for this scenario and is not an independent recovery action.

The NRC staff concludes that the licensee's response to SSA RAI 10 is acceptable because the licensee demonstrated that the process monitoring function provided by the SPDS is free of fire damage and the actions, including failures, to monitor plant parameters are included in the PB analysis, as appropriate.

3.5.1.7 Recovery Actions Credited for Defense in Depth

In the LAR, the licensee stated that RAs required for DID are not credited in the fire safety analysis and/or change evaluation as a part of the risk determination for any fire area. RAs credited for DID are listed in LAR Attachment G, Table G-1, "Recovery Actions and Activities." The licensee stated in the results of Step 3, that it reviewed all the RAs for adverse impact and none were found to have an adverse impact on the FPRA. As described in the results of Step 4, the licensee stated that it assessed each of the feasibility criteria in FAQ 07-0030 (Reference 60) for the RAs credited for DID.

LAR Attachment G identified a number of DID-RAs. In SSA RAI 09 dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee provide the following information to clarify how it evaluated these RAs in the NSCA:

a) A description of the methodology for identifying DID-RAs and how they were credited, if at all, in the risk determination for the fire area.

b) Clarification of how the NFPA 805 nuclear safety and radioactive release performance goals, objectives and criteria, including the risk acceptance

guidelines, are met without these actions and provide the bases for this conclusion.

c) In LAR Attachments C and G, DID-RAs are credited in Fire Area G to resolve VFDRs that involve spurious operation of valves, such as CV-1227, CV-1228, CV-1408, CV-1274, and CV-3807, that may be affected by hot short issues described in IN 92-18, "Potential for Loss of Remote Shutdown Capability During a Control Room Fire," (Reference 98). In LAR Attachment G, Step 4, the licensee stated that it evaluated the RAs against the feasibility criteria of NEI 04-02; FAQ 07-0030, Revision 5; and RG 1.205. Discuss how the feasibility of performing these specific DID-RAs for spuriously operated valves are met if its respective circuit(s) are damaged as described in IN 92-18.

In its response to SSA RAI 09 dated July 21, 2015 (Reference 11), the licensee stated, in part, that:

a) The response to PRA RAI 16... provides an overview of the qualitative methodology used for identifying where recovery actions are desirable for Defense in Depth (DID). DID actions are not quantitatively assessed for risk within the Fire Risk Evaluations (FREs) performed for those fire areas where the performance-based approach of NFPA 805, Section 4.2.4, is applied.

b) In accordance with NFPA 805, the nuclear safety performance 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 nuclear safety performance criteria require that in the event of a fire, fire protection features shall be capable of providing reasonable assurance that the plant is not placed in an unrecoverable condition. As stated in NFPA 805, Section 4.2.2, the use of a performance-based approach satisfies the nuclear safety performance criteria for those fire areas not in deterministic compliance. Since the use of DID recoveries has no impact on the quantified risk (CDF and LERF) in any performance-based fire area, there is no additional risk in their use to demonstrate the availability of a success path for any performance goal listed in [LAR] Attachment C.... No defense-in-depth recovery actions are needed to ensure the nuclear safety goal or performance criteria are met.

The NFPA 805 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. The Radioactive Release Performance Criteria states that radiation release to any unrestricted area due to the direct effects of fire suppression activities (but not involving fuel damage) shall be as low as reasonably achievable and shall not exceed applicable 10 CFR 20 limits. The ANO-1 evaluation of radioactive release included a review of areas in which radiological hazards existed or might exist. Many of these areas have engineering

controls (i.e., ventilation systems or monitored drain paths). The DID recovery actions are not needed to support any of these systems. For those areas where there are no engineering controls, radiation protection and chemistry personnel would be summoned by the Main Control Room (MCR) to monitor gaseous releases and contain pooling suppression water. There are no DID actions related to these areas.

c) Fire scenarios within the ANO-1 MCR (Fire Area G) quantified for risk in the FRE include a base scenario for a room exposure fire and individual scenarios for fixed locations inclusive of control panels. The qualitatively selected DID recoveries listed in LAR Attachment G are for the base MCR scenario. [The] fire scenario report...assumes that MCR electrical panel fires will be contained and controlled within the panel by operations personnel response to the fire.

If the fire ignites and is contained within MCR panel C16 (motor operated valves (MOVs) CV-1227, CV-1228, CV-1408, and CV-1274) or panel C19 (MOV CV-3807), the low conditional core damage probabilities (CCDPs) in the E-04 range and corresponding low CDFs do not warrant DID recoveries to maintain balance of the DID echelons.

If MCR abandonment were required due to the base scenario, then the fire would have occurred outside of these panels. The frequency of MCR abandonment shown in the fire scenario report is in the E-05 range per reactor year, which is of low likelihood. MCR abandonment is based upon habitability concerns from criterion contained within NUREG/CR-6850 and considered to have occurred when the temperature at a point greater than 6' above the floor exceeds 200 °F or a smoke layer descends below 6' causing visual impairment of the operators. Abandonment performed at or before this threshold temperature allows time to perform ex-MCR actions prior to reaching the thermoset cable damage threshold of 330 °C (625 °F) listed in Appendix H of NUREG/CR-6850. Cable fire testing summarized in EPRI TR-1003326, "Characterization of Fire-Induced Circuit Faults: [Results of Cable Fire Testing," (Reference 125)], Section 12.2.5.2, shows the shortest time to spurious actuation of thermoset cable was 14 minutes and only one out of 28 spurious actuations occurred within 20 minutes. The average time to spurious operation of thermoset cable was 46.3 minutes. This provides indication that there will be time, assuming a fire is of sufficient size to cause damage, to take actions before spurious operation could occur. The circuits associated with the subject MOVs are not routed overhead or within the zone of influence for other fire scenarios within the MCR. Control switches for these MOVs are installed on the panels at or below 6' and the associated wires and cables descend through penetrations in the floor. The control panel also provides additional protection from the radiant heat of the fire. Therefore, these valves may be appropriately aligned from the MCR panel in the event of a MCR fire. To further ensure the valves remain in the desired position, a

> DID action is performed to locally de-energize load center B-6. This is not a complex action and will remove power from the downstream Motor Control Centers that control the subject MOVs. Once this action is performed, there is no longer motive power to allow spurious operation. Based upon these qualitative arguments for qualitatively selected DID actions, there will be sufficient time once the MCR is abandoned to remove power and thereby prevent spurious actuation caused from fire induced damage.

The NRC staff concludes that the licensee's response to SSA RAI 09 is acceptable because the licensee adequately described the methods for use of DID actions and confirmed that DID actions are not needed to ensure the nuclear safety or radioactive release goals or performance criteria are met.

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 PCE if subsequently modified or removed.

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

3.5.1.8 Plant Fire Barriers and Separations

With the exception of 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 that 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 that the ERFBS installed at ANO-1 are not credited in the NSCA, and, therefore, the requirement to meet the deterministic requirements of NFPA 805, Chapter 3, Section 3.11.5, "Electrical Raceway Fire Barrier Systems (ERFBSs)," is not applicable. The licensee further stated that no VFDRs are associated with ERFBS.

3.5.1.10 Conclusion for Section 3.5.1

As documented in LAR Attachment C, for those fire areas that used a deterministic approach in accordance with NFPA 805, Section 4.2.3, the NRC staff concludes that each of the fire areas analyzed using the deterministic approach meet the associated criteria of NFPA 805, Section 4.2.3. This conclusion is based on:

- The licensee's documented compliance with NFPA 805, Section 4.2.3;
- The licensee's assertion that the success path will be free of fire damage without reliance on RAs;
- The licensee's assessment that the suppression systems in the fire area will have no impact on the ability to meet the 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 the NFPA 805 requirements has been demonstrated as follows:

- Deviations from the pre-NFPA 805 fire protection licensing basis that were transitioned to the NFPA 805 licensing basis were reviewed for applicability, as well as continued validity, and found acceptable (see SE Sections 3.5.1.3 and 3.5.1.4).
- 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 (see SE Section 3.5.1.5).
- 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 (see SE Sections 3.5.1.6 and 3.5.1.7).
- The licensee's analysis appropriately identified the fire protection SSCs required to meet the NSPC, including fire suppression and detection systems, as well as required fire protection features (see SE Sections 3.5.1.1 and 3.5.1.2).
- The licensee's analysis appropriately identified fire area boundaries (ceilings, walls, and floors), such as fire barriers, fire barrier penetrations, and through penetration fire stops (see SE Section 3.5.1.8).

Accordingly, the NRC staff concludes that each fire area utilizing the PB approach is able to achieve and maintain the NSPC, and the associated FREs meet the applicable NFPA 805 requirements for risk, DID, and safety margins.

3.5.2 Clarification of Prior NRC Approvals

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

3.5.3 Fire Protection During Non-Power Operational Modes

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

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

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

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

The NRC staff reviewed LAR Section 4.3, "Non-Power Operational Modes," and LAR Attachment D, "NEI 04-02 Non-Power Operational Modes Transition," to evaluate the licensee's treatment of potential fire impacts during NPOs. The NRC staff's evaluation determined that the licensee used the process described in NEI 04-02, as modified by FAQ 07-0040 (Reference 63), for demonstrating that the NSPC are met for 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 FAQ 07-0040 (Reference 63). As described in LAR Attachment D, the licensee's shutdown operations protection document defines HREs and describes six shutdown conditions that range from low relative risk (i.e., reactor vessel defueled) to highest relative risk (i.e., reduced inventory, with the RCS open and fuel in the reactor vessel). The licensee stated that during NPO, a RI evaluation is performed to determine if DID strategies are adequate to ensure maintenance of each KSF. The licensee further stated that HREs are outage activities, plant configurations, or conditions during shutdown where the plant is more susceptible to an event causing the loss of a KSF, and that the strategy contains specific actions to address reduced inventory conditions that consider short time to boil, limited methods for decay heat removal, and low RCS inventory.

The licensee stated that the shutdown conditions are based on fuel location, RCS and fuel transfer canal inventory and RCS status of either "intact" or "open." The licensee described the six shutdown conditions from low to high risk, as follows:

1. The reactor vessel defueled with all fuel in the spent fuel pool.

2. Fuel transfer canal (FTC) is flooded greater than 23 feet above the core with fuel in the vessel and no refueling in progress.

3. FTC is flooded greater than 23 feet above the core with fuel in the vessel and refueling is in progress.

4. RCS is intact with fuel in the vessel and the RCS level is greater than 376.5 feet (reactor vessel flange).

5. RCS is open with fuel in the vessel, the RCS is greater than 376.5 feet, and the FTC level is less than 23 feet.

6. RCS is open, with fuel in the vessel, and the RCS level is in a lowered inventory condition less than 376.5 feet.

As described in the LAR, the licensee identified equipment and cables necessary to support the KSFs success paths. The licensee stated that operational modes and functional requirements for the systems and components were reviewed, and the KSF success path equipment and cables were incorporated in the NPO database model. Following identification of KSF equipment and cables, the licensee performed analysis on a fire area basis to identify areas where redundant equipment and cables credited for a given KSF might fail due to fire damage (i.e., pinch points). The licensee used a deterministic approach to identify these pinch points and mitigated these pinch points through the use of RAs and/or fire prevention/protection controls. As stated in LAR Attachment D, no pinch point was excluded in the current NPO analysis

3.5.3.2 NPO Analysis Process

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

As described in LAR Section 4.3, once the licensee identified the applicable plant operating state for NPOs, it identified the systems necessary to maintain and support each KSF and developed a fault tree. The licensee stated that the fault tree provides all associations for power supplies, supporting equipment, and other equipment dependencies that could fail equipment necessary to NPO. The licensee's cable and raceway software provides the controlled database for NSCA equipment and associated circuit analysis, which the licensee used to perform the pinch-point analysis. The licensee stated that it evaluated each fire area for NPO to determine which equipment could be rendered unavailable, and that equipment, which could

spuriously operate or fail resulting in the loss of a KSF in a fire area was given a compliance strategy (i.e. RA) to allow NPO compliance (top gate success). The licensee further stated that this effectively captured affected equipment necessary to maintain a KSF in any plant area/zone which could be compromised due to a fire.

As stated in LAR Section 4.3.2, "Results of the Evaluation Process," NPO equipment, in general, is a subset of NSCA equipment. The licensee evaluated existing equipment to determine if the circuit analysis was appropriate for NPO. Additional equipment identified as being needed for NPO, but not previously evaluated, was evaluated for NPO, and all new circuit analysis was performed in accordance with existing methodologies established at ANO consistent with guidance provided within NEI 00-01.

In SSA RAI 08a dated May 5, 2015 (Reference 21), the NRC staff requested that the licensee provide a list of the additional components and a list of those at-power components that have a different functional requirement for NPO. The NRC staff requested that the licensee describe the difference between the at-power SSD function and the NPO function and include with this list a general description by system indicating why components would be selected for NPO and not be included in the at-power analysis. In its response to SSA RAI 08a dated June 16, 2015 (Reference 10), the licensee provided a tabulated listing of equipment required to support NPO that was not currently in the SSD program with discussion of why each is included in NPO and not at-power. This listing included instrumentation for RCS level that are only used for NPO; local pump suction temperature indication for low-pressure decay heat removal system that is not credited at-power; and the ANO-1 unit auxiliary transformers used for offsite power during refueling outages with the startup transformer out-of-service for maintenance. The licensee stated that NPO calculations contain the compiled NPO equipment list for ANO-1 and include approximately 142 pieces of equipment listed with functional requirements at power, hot shutdown (HSD), CSD, and for NPO. The licensee stated that support equipment (electrical, service water) that is in the NPO list has the same requirement for safe and stable. The licensee further stated that RCS interface valves to low-pressure DHR system are closed at power and opened for NPO. The NRC staff concludes that the licensee's response to SSA RAI 08a is acceptable because the licensee identified the equipment credited for NPO that is different than the at-power analysis and confirmed that the equipment is included in the NPO calculations and equipment listings.

3.5.3.3 NPO KSFs and SSCs Used to Achieve Performance

LAR Attachment D defines the KSFs. The licensee stated that the equipment needed for each KSF was determined by review of applicable P&IDs, single line diagrams, schematics and procedures to determine the extent needed for NPO.

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

In SSA RAI 08b (Reference 21), the NRC staff requested that the licensee provide a list of KSF pinch points by fire area that were identified in the NPO fire area reviews using FAQ 07-0040 guidance including a summary level identification of unavailable paths in each fire area. The NRC staff also requested that the licensee describe how these locations will be identified to the plant staff for implementation. In its response to SSA RAI 08b (Reference 10), the licensee stated that its NPO calculation contains all fire area evaluations for ANO-1 and identifies KSF pinch points and provided a tabular summary listing of KSF paths for each fire area due to NPO pinch points. The licensee stated that LAR Attachment S, Table S-2, Implementation Item S2-4 addresses incorporation of these insights from the ANO-1 NPO calculation into operating procedures and the operating procedure changes will provide necessary input to the plant staff for KSF pinch-point issues. The NRC staff considers this action acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition. The NRC staff concludes that the licensee's response to SSA RAI 08b is acceptable because the licensee identified pinch-points by fire area and identified an action that would be required by the proposed license condition to incorporate the insights from the NPO analyses into its plant procedures.

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

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 SSEL and required additional circuit analysis. The evaluation of these components is addressed in SE Section 3.5.3.2.

The licensee stated the normal FPPs such as combustible and hot work control are maintained during NPO modes, and that the operability of detection and suppression systems is maintained. In fire areas/zones where a pinch point is created, a RI evaluation is performed to determine if DID strategies are adequate to assure maintenance of each KSF. The type of equipment present and its role in maintenance of KSFs provide locations where no hot work is to be performed during NPO without additional compensatory actions in place, such as securing of equipment in the safe position (i.e. power removed). The licensee further stated that the identification of modifications is included to reduce risk.

The licensee stated that insights from the FPRA analyses have been used to provide a RI assessment of fire areas determined to be a pinch point, and that consideration and usage of the following methods to manage risk were applied as applicable to any fire area that is a pinch point:

- Prohibition or limitation of hot work in fire zones during periods of increased vulnerability.

- Limitation of combustible materials in fire zones during periods of increased vulnerability.

- Preemptive actions such as opening breakers or re-aligning of equipment, if hot work is to be performed.

- Modification to eliminate spurious operation in areas determined to be pinch points.

During NPO modes, spurious actuation of valves can have a significant impact on the ability to maintain decay heat removal and inventory control. In SSA RAI 08c (Reference 21), the NRC staff requested that the licensee provide a description of any actions being credited to minimize the impact of fire-induced spurious actuations on power-operated valves (e.g., AOVs and MOVs) during NPO (e.g., prefire rack-out, actuation of pinning valves, and isolation of air supplies). In its response to SSA RAI 08c (Reference 10), the licensee stated that the NPO assessment identified procedural changes to pre-position and open breakers for two MOVs with a modification to the third in-series MOV associated with the single line from the RCS to the DHR system (LAR Attachment S, Table S-1, Modification Item S1-35). The licensee stated that no other actions for pre-positioning of equipment are relied upon as a strategy to reduce fire risk during HREs by the NPO assessment. The licensee stated that the decision to use additional pre-positioning actions will be controlled by a procedure that includes provisions for a fire protection specialist to be included in the outage risk assessment team (ORAT) for fire risk management. The licensee stated that risk management actions can include procedure changes for pre-positioning of valves and the racking down or opening of breakers preventing spurious operation. The NRC staff concludes that the licensee's response to SSA RAI 08c is acceptable because the licensee identified prepositioned components and actions to manage risk through pre-positioning equipment to mitigate spurious operations which are controlled by procedures.

In SSA RAI 08d (Reference 21), the NRC staff requested that the licensee describe the types of compensatory actions that will be used during equipment downtime for normal outage evolutions where certain NPO credited equipment will have to be removed from service. In its response to SSA RAI 08d (Reference 10), the licensee stated that operating procedures contain guidance concerning management of risk during evolutions where equipment may be removed from service, including:

- Maintain DID by alternate means when pre-outage planning reveals that specified SSCs will be unavailable.

- Planning and scheduling outage activities in a manner that optimizes safety system availability.

- Protect key plant equipment/systems/train while redundant or related equipment is out-of-service. Limiting access to these sensitive areas prevents introduction of transients and performance of risk significant tasks.

The NRC staff concludes that the licensee's response to SSA RAI 08d is acceptable because the licensee has procedures to manage outages of NPO equipment.

In SSA RAI 08e (Reference 21), the NRC staff requested that the licensee identify those RAs and instrumentation relied upon in NPO, and describe how RA feasibility is evaluated. The NRC staff also requested that the licensee include in the description whether these variables have been or will be factored into operator procedures supporting these actions. In its response to SSA RAI 08e (Reference 10), the licensee stated that each fire area evaluation contained in the NPO calculation is either classified as deterministically compliant with all KSFs maintained or as being a pinch point due to one or more KSFs being impacted. The licensee stated that in those areas that are not in deterministic compliance, it performed an assessment to identify a set of equipment that could require recovery based upon a total fire area burn up with worst case failures postulated and all redundant paths and equipment failed. The licensee stated that these potential DID-RAs for NPO are considered feasible as they are a smaller set of the same actions used and previously evaluated by the manual action feasibility study for Appendix R. The licensee stated that the NPO calculation concluded that fire areas not in deterministic compliance are demonstrated to be acceptable based upon DID and RI processes. The licensee further stated that available instrumentation needed to support NPO is identified in the summary portion of each fire area evaluation in the NPO calculation and this instrumentation is RCS level indication (inventory), neutron monitoring (reactivity), and RCS temperature. The NRC staff concludes that the licensee's response to SSA RAI 08e is acceptable because the licensee's NPO analysis identified potential RAs and necessary instrumentation, and determined that these actions are feasible.

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

- Identified the KSFs required to support the NSPC during NPOs;
- Identified the plant operating states where further analysis is necessary during NPOs;
- Identified the SSCs required to meet the KSFs during the plant operating states analyzed;
- Identified the location of these SSCs and their associated cables;
- Performed analyses on a fire area basis to identify pinch points where one or more KSF could be lost as a direct result of fire-induced damage; and
- Planned/implemented changes 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 ANO-1.

3.5.4 Conclusion for Section 3.5

The NRC staff reviewed the licensee's RI/PB FPP as described in the LAR, as supplemented, to evaluate the NSCA results. The licensee used a combination of the deterministic and the PB approaches 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 confirmed that:

- The engineering evaluations for an exemption 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; and
- 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 meets NFPA 805, Section 4.2.3.

For those fire areas where the licensee used a PB approach, the NRC staff confirmed that:

- The engineering equivalency evaluations from the existing FPP were evaluated and found to be valid and acceptable for meeting the requirements of NFPA 805, Section 2.2.7;
- Fire suppression effects were evaluated and found to have no adverse impact on the ability to achieve and maintain the NSPC for each fire area;
- All VFDRs were evaluated using the FRE PB method (in accordance with NFPA 805, Section 4.2.4.2) to address risk impact, DID, and safety margin, and found to be acceptable;
- All RAs necessary to demonstrate the availability of a success path were evaluated with respect to the additional risk presented by their use and found to be acceptable in accordance with NFPA 805, Section 4.2.4;
- All DID RAs were properly documented for each fire area; and
- The required automatic fire suppression and automatic fire detection systems were appropriately documented for each fire area.

Accordingly, the NRC staff concludes that each fire area utilizing the PB approach in accordance with NFPA 805, Section 4.2.4 is able to achieve and maintain the NSPC.

Furthermore, there is reasonable assurance that the associated FREs meet the requirements for risk, DID, and safety margin.

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

3.6 Radioactive Release Performance Criteria

3.6.1 Method of Review

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

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

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

NFPA 805, Section 1.4.2, "Radioactive Release Objective"

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

NFPA 805, Section 1.5.2, "Radioactive Release Performance Criteria,"

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

In RG 1.205, the NRC staff has endorsed (with certain exceptions) the methodology given in NEI 04-02 as providing methods acceptable to the staff for establishing an FPP consistent with NFPA 805 and 10 CFR 50.48(c). Using these methods, the licensee assessed the capability of its FPP to meet the NFPA 805 performance criteria as contained in NEI 04-02 and FAQ 09-0056 (Reference 67). 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 requirements of a RI/PB FPP, in accordance with 10 CFR 50.48(a) and (c) using the guidance in RG 1.205 and NUREG-0800, Section 9.5.1.2.

The NRC staff also performed an audit of the licensee's evaluation to determine whether the FPP and its planned modifications would be capable of meeting the NFPA radioactive release goals, objectives, and performance criteria. The results of the NRC staff evaluation and audit are provided below.

3.6.2 Scope of Review

The licensee performed its review of the FPP against NFPA 805 requirements for fire suppression related to radioactive release using the methodology described in its radioactive release transition report which consisted of the following:

- A review of ANO-1 Pre-Fire Plans (PFP) (including the common area between ANO-1 and ANO-2) to determine if the PFPs meet the NFPA 805 fire protection goals, objectives, and criteria.

- A review of engineering controls to determine if there was adequate containment of gaseous and liquid effluents (e.g., smoke and fire fighting agents).

- A review of the fire brigade training materials to determine if there was adequate training of the fire brigade and radiation protection staff to limit radiation release in a manner sufficient to meet the radioactive release goals, objectives, and performance criteria.

The licensee's review found that the fire suppression methods were valid for all plant areas and operating modes (i.e., power and non-power operations). The NRC staff concludes that the scope of the licensee's assessment was adequate because the review included all modes of plant operation and all plant areas.

3.6.3 Identification of Plant Areas Containing Radioactive Materials

The licensee performed a screening of plant fire areas in LAR Attachment E, "NEI 04-02 Radioactive Release Transition," to determine where radioactive materials were present and where there was a potential for generating radioactive effluents during fire suppression activities (i.e., fire-fighting operations). The fire areas eliminated from further review were those areas where there were minimal radioactive materials, such as areas with controlled storage of radioactive sources, transitional areas, and some isolated areas with low levels of fixed contamination.

The remaining fire areas were "screened in" for consideration based on radiation levels and the presence of radiological hazards. The screened-in areas included the reactor containment, auxiliary building, and common areas such as the old radwaste storage building, the low-level radwaste storage building, and the radiation protection storage building.

3.6.4 Pre-Fire Plans

The review of the ANO-1 PFP and common area PFP determined that the PFP contains information which may be utilized by the fire brigade or other support personnel in responding to a fire within the facility. In addition, information was included in the PFP, which may be pertinent to operation's support personnel in performing SSD activities in response to any single fire scenario.

The results of the licensee's review are documented in the LAR Attachment E. This review included the PFP, "Guidelines for Fire Attack," which is a descriptive listing of general fire brigade actions, specific attack methodologies to be implemented based on the previously listed information, and strategies to be implemented both at the fire scene and by the CR.

The PFP also includes "Special Precautions/Notes"; (i.e., a descriptive listing of special precautions or actions to be taken in affected fire zones (e.g., ponding concern for zones containing suppression systems whose operation could flood the area or areas below the fire floor)).

The NRC staff concludes that the licensee's evaluation of the PFP was adequate because the review was comprehensive and was performed in accordance with the guidance in NEI 04-02, Appendix G, as endorsed by RG 1.205.

3.6.5 Gaseous Effluent Controls

The licensee performed a review of engineering controls to ensure containment of gaseous and liquid effluents (e.g., smoke and fire fighting agents) for ANO-1 and areas common between ANO-1 and ANO-2. This review included all plant operating modes (including full power and non-power conditions). Where applicable, the engineering controls are identified in LAR Attachment E.

The licensee identified those plant areas where adequate engineering controls exist for the containment, filtering, and monitoring of gaseous effluent. The NRC staff review concludes that the gaseous effluent controls are adequate because the effluent is either contained, or filtered to remove radioactive materials and subsequently monitored prior to discharge.

For the reactor building, containment is provided by the isolation provided by the reactor building structure. The potential for smoke escaping through the equipment hatch and emergency personnel hatch is not likely since the hatches are closed during operation and are actively controlled when open during outages. The reactor building hatches are normally open during outages, however, a negative pressure is maintained, which thereby prevents gaseous effluent flow through the equipment hatch or emergency personnel hatch. In addition, radiation protection staff monitor the airflow at the equipment hatch per plant procedures and a continuous air monitor is maintained.

For the auxiliary building, credit is taken for the containment of gaseous effluent and removal of radioactive materials by the auxiliary building ventilation system exhaust fans and filters. In addition, the licensee will utilize portable fans with flexible ductwork as needed to contain and control smoke from the auxiliary building.

In the turbine building, steel vessels and piping containing potential sources of radioactivity are not expected to be breached as a result of firefighting activities. In addition, existing smoke vents or roof exhaust fans were identified as the engineering controls for a fire in the turbine building.

The licensee identified other plant areas with limited or no engineering controls to contain the gaseous effluent. The licensee performed a qualitative assessment of the ability to contain a radioactive release to within the NFPA 805 radioactive release goals, objectives, and performance criteria. For these areas, the licensee will use administrative controls and compensatory actions for the fire brigade and radiation protection personnel to manually establish containment using portable fans with flexible ductwork to control and contain smoke. In addition, the radiation protection staff has procedures for monitoring potential radioactive effluent. The NRC staff concludes that a combination of limited engineered controls and compensatory manual actions taken by the fire brigade and radiation protection personnel will be adequate to contain a radioactive release to within the NFPA 805 radioactive release goals, objectives, and performance criteria.

The NRC staff reviewed the potential gaseous effluent controls, and determined the licensee's assessment to be adequate because the methods used were consistent with the qualitative assessment methodology contained in NEI 04-02. The NRC staff concludes that upon completion of LAR Attachment S, Table S-2, Implementation Item S2-6, the licensee will be able to contain a potential radiological gaseous effluent release during fire suppression activities in a manner sufficient to not exceed the radiological release performance criteria of NFPA 805 and the public dose limits of 10 CFR Part 20, "Standards for Protection Against Radiation." The NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

3.6.6 Liquid Effluent Controls

The reactor building provides adequate containment of liquid effluents because potential release points are controlled via sumps, tanks, piping, processing and monitoring prior to discharge. In the auxiliary building and turbine building, liquid effluent from fire suppression activities drains are collected and monitored per plant procedures. Turbine building drains are routed to the turbine building sump and retained for monitoring prior to processing and/or release.

For other areas without engineered liquid collection systems, the PFP addresses potential run-off areas or ponding areas where fire suppression water may occur. The PFPs "Guidelines for Fire Attack" and "Special Precautions/Notes" sections include specific steps to be taken based on the potential problems for the fire zone. The licensee has a procedure in place that provides a standard method for handling, controlling, storing, and accountability of radioactive material that is not contained in process streams such as tanks, pipes and other installed equipment. All radioactive material is required to be identified and monitored within the plant protected area.

Potentially contaminated water from fire suppression activities are controlled by plant procedure. This is re-enforced through general hazardous material training in which liquid effluent containment such as dikes or dams of flowing material are considered.

The NRC staff reviewed the licensee's methods of limiting potential liquid effluent releases and concludes that the licensee has adequate methods of containing potential liquid effluent from fire suppression activities. The NRC staff concludes that upon completion of LAR Attachment S, Table S-2, Implementation Item S2-6, the licensee will be able to contain a potential radiological liquid effluent release such as to not exceed the radiological release performance criteria of NFPA 805 and the public dose limits of 10 CFR Part 20. The NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

3.6.7 Fire Brigade Training Materials

The licensee reviewed the training materials in support of the FPP. The licensee has procedures in place that describe the fire brigade training sequence to assure the capability to fight potential fires is established and maintained. The procedure is applicable to the initial training and retraining of the fire brigade personnel at ANO-1 and ANO-2. Fire Protection Engineering has the responsibility for reviewing and being knowledgeable of the training requirements of the fire brigade and for assessing the effectiveness of the fire brigade training.

Initial training for fire brigade members and support members consists of a scheduled 40-hour program of instruction as detailed in the fire brigade training program and course summary. The fire brigade initial training program includes classroom training and hands-on-training and practice, as well as firefighting scenarios using controlled fire environments. The fire brigade leader training is provided to operation's personnel to ensure that personnel meeting the requirements for fire brigade leader are capable of taking charge at the scene of a fire. Continuing fire brigade training is provided to ensure that the capability to fight fires is maintained. Topic areas of the fire brigade initial training are repeated every 2 years in the continuing training program. In addition, the fire brigade members and support members attend annual practice class and drills to maintain needed skills.

Training on radiological release potential is provided through the fire brigade training program. This training addresses radioactive contamination and the need for monitoring and containment. Specifically, the areas of "Flooding Concerns" and "Ventilation Concerns" are addressed. The training indicates that "consideration must be given to the path the smoke and gases will take when they are evacuated." Additionally, "any ventilation path that does not provide for the smoke and gases from the fire to be monitored for radiological contamination should be discussed with the Control Room and Radiation Protection prior to being used." These principles are further supported and enhanced in fire brigade leader training.

Fire brigade members receive training in responding to fires in controlled access areas with the support of radiation protection personnel and for fire-fighting strategy and tactics. Following each fire drill, the fire brigade leader critiques the drill using response criteria that include consideration of radiological/chemical hazards during drills. The licensee has a procedure in place for drills and emergency response that includes a fire tactical worksheet that addresses notification for additional assistance, if required, from radiation protection or other personnel.

Radiation protection personnel are involved when responding to fires in radiologically controlled areas, including areas where radioactive materials are stored. A plant procedure specifies that

fire brigade drills shall be conducted to include radiological control practices at least once per year.

The NRC staff reviewed the licensee's evaluation of training materials and concludes that upon completion of LAR Attachment S, Table S-2, Implementation Item S2-6, that the training materials will be adequate to instruct the licensee's staff to implement effluent control measures because plant staff will be informed and capable of taking actions to limit effluent releases to within the radiological release performance criteria of NFPA 805 and, therefore within the public dose limits. The NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

3.6.8 Conclusions

The NRC staff's evaluation is based on:

(1) Information and analyses provided in the LAR;
(2) Use of installed and manual engineered controls to contain potential releases;
(3) Use of fire pre-plans; and,
(4) Use of revised fire brigade response procedures and training procedures.

Based on these factors, the NRC staff concludes that upon completion of the implementation items, that the licensee's RI/PB FPP will provide reasonable assurance that radioactive releases to any unrestricted area resulting from the direct effects of fire suppression activities are as low as reasonably achievable and are not likely to exceed the radiological release performance criteria of NFPA 805 and the public dose limits in 10 CFR Part 20. The NRC staff therefore concludes that, subject to completion of the implementation items, the licensee's FPP will comply with the requirements specified in NFPA 805, Sections 1.3.2, 1.4.2, and 1.5.2, and is considered acceptable.

3.7 NFPA 805 Monitoring Program

3.7.1 Monitoring Program

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

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

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

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

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

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

> Methods to monitor availability, reliability, and performance shall be established. The methods shall consider the plant operating experience and industry operating experience.

NFPA 805, Section 2.6.3, "Corrective Action," states that:

> If the established levels of availability, reliability, or performance are not met, appropriate corrective actions to return to the established levels shall be implemented. Monitoring shall be continued to ensure that the corrective actions are effective.

The NRC staff reviewed LAR Section 4.6, "Monitoring Program," that the licensee developed to monitor availability, reliability, and performance of FPP systems and features after the transition to NFPA 805. The NRC staff focused 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 license stated that the monitoring program will be implemented after issuance of the SE, as part of the FPP transition to NFPA 805 and that in order to assess the impact of the transition to NFPA 805 on the current monitoring program, the FPP documentation, such as maintenance program processes, FPP implementing procedures, and plant change processes will be reviewed. The licensee further stated that its review would include the use of NEI 04-02 (Reference 7), as clarified by FAQ 10-0059 (Reference 68). Completion of the licensee's NFPA 805 monitoring program is an implementation item addressed in LAR Attachment S, Table S-2, Implementation Item S2-1 and the NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

The licensee stated that the scope of SSCs and programmatic elements to monitor, and the levels of availability, reliability, or other criteria for those elements that require monitoring, will be appropriately documented in its monitoring program.

The licensee stated that the monitoring process will be comprised of four phases including scoping, screening using risk criteria, risk target value determination, and monitoring implementation.

The licensee stated that during the scoping phase, the following categories of SSCs and programmatic elements will be reviewed for inclusion in the program:

- SSCs required to comply with NFPA 805;
- Fire protection programmatic elements; and
- Key assumptions in engineering analyses.

The licensee stated that during the screening phase, the SSCs identified during the scoping phase will be part of an inspection and test program and/or system/program health reporting process. The licensee further stated that fire protection systems and features are candidates for additional monitoring commensurate with risk significance. The licensee further stated that NSCA equipment will be screened for safety significance using the FPRA and the maintenance rule scope and basis guidelines. The licensee further stated that additional monitoring for SSCs relied upon for radioactive release criteria is not considered necessary because the equipment is considered inherently low risk. The licensee further stated that monitoring of programmatic elements is required in order to assess the performance of the FPP in meeting the performance criteria.

The licensee stated that the risk target value determination establishes the target values for reliability and availability of the fire protection systems and features that meet or exceed the screening criteria for highly safety significant NSCA SSCs. The target values for reliability and availability for the fire protection systems and features are established at the component level, program level, or functionally through the use of the pseudo-system or the "performance monitoring group" (PMG) concept.

The licensee stated that monitoring implementation will occur once the monitoring scope and criteria are established and that monitoring will consist of periodically gathering, trending, and evaluating information pertinent to the performance and/or availability of the equipment, and comparing the results with established goals and performance criteria to verify the goals and criteria are being met. The licensee further stated that the results of monitoring activities will be analyzed in a timely manner to assure that appropriate corrective action is identified and taken and that the corrective action process will be used to address performance of fire protection and nuclear safety SSCs that do not meet performance criteria.

Based on the information provided in the LAR, as supplemented, the NRC staff concludes that the licensee's NFPA 805 monitoring program, and development and implementation process will be acceptable subject to completion of the implementation item and will assure that the licensee will implement an effective program for monitoring risk-significant fires because it will:

- Establish the appropriate SSCs to be monitored;
- Use an acceptable screening process for determining the SSCs to be included in the monitoring program;
- Establish availability, reliability, and performance criteria for the SSCs being monitored; and
- Require corrective actions when SSC availability, reliability, and performance criteria targets are exceeded in order to bring performance back within the required range.

The NRC staff concludes that completion of the monitoring program on the same schedule as the implementation of NFPA 805 is acceptable because the monitoring program will be

completed with the other implementation items as described in LAR Attachment S, Table S-2, 6 months following the amendment issuance, which is prior to completion of the modifications to achieve full compliance with 10 CFR 50.48(c) (which is prior to startup from the second refueling outage following the amendment issuance).

3.7.2 Conclusion for Section 3.7

The NRC staff reviewed the licensee's RI/PB FPP and concludes that there is reasonable assurance that the licensee's monitoring program will meet the requirements specified in Sections 2.6.1, 2.6.2, and 2.6.3 of NFPA 805 because the licensee identified an action to develop a monitoring program required by NFPA 805 that will include a process to monitor and trend the FPP based on specific goals established to measure effectiveness, and included that action as an implementation item that would be required by the proposed license condition.

3.8 Program Documentation, Configuration Control, and Quality Assurance

For this SE, 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 ANO-1 FPP transition to NFPA 805.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3.8.1 Documentation

The NRC staff reviewed LAR, Section 4.7.1, "Compliance with Documentation Requirements in Section 2.7.1 of NFPA 805," to evaluate the ANO-1 FPP design basis document and supporting documentation.

The ANO-1 FPP design basis is a compilation of multiple documents (i.e., fire safety analyses, calculations, engineering evaluations, NSCAs, etc.), databases, and drawings, which are identified in LAR Figure 4-10, "NFPA 805 Planned Post-Transition Documents and Relationships." The licensee stated that it performed the analyses to support the NFPA 805 transition in accordance with ANO-1 processes, which meet or exceed the requirements for documentation outlined in NFPA 805, Section 2.7.1.

Specifically, the licensee stated that the design analysis and calculation procedures provide the methods and requirements to ensure that design inputs and assumptions are clearly defined, results are easily understood by being clearly and consistently described, and that sufficient detail is provided to allow future review of the entire analysis. The licensee further stated that the process includes provisions for appropriate design and engineering review and approval and that the approved analyses are considered controlled documents, and are accessible via ANO-1's document control system and that being analyses, they are also subject to review and revision consistent with the other plant calculations and analyses, as required by the plant design change process.

In the LAR, the licensee 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 and inspectors.

Based on the information provided in the LAR, as supplemented, regarding 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 2.2.9 and 2.7.2 of NFPA 805," in order to evaluate the ANO-1 configuration control process for the new NFPA 805 FPP.

To support the many other technical, engineering and licensing programs, 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, which require that all plant changes be reviewed for potential impact on the various ANO-1 licensing programs, including the FPP.

In the LAR, the licensee 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 document control system. The licensee also stated that analyses based on the PRA program, which includes the FREs, are issued as formal analyses subject to these same configuration control processes, and are additionally subjected to the PRA peer review process specified in the ASME/ANS PRA standard (Reference 31).

Configuration control of the existing FPP during the transition period is maintained by the change evaluation process, as defined in existing configuration management and configuration control procedures. In LAR Attachment S, Table S-2, Implementation Item S2-6, the licensee included an action to update configuration control procedures to reflect the new NFPA 805 licensing bases requirements. The NRC staff concludes that this action is acceptable because the action will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

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

Based on the description of the ANO-1 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, subject to completion of the implementation item that there is reasonable assurance that the requirements of NFPA 805 Sections 2.7.2.1 and 2.7.2.2 will be met.

3.8.3 Fire Modeling Quality

The NRC staff reviewed LAR Section 4.7.3, "Compliance with Quality Requirements in Section 2.7.3 of NFPA 805," to evaluate the quality of the engineering analyses used to support transition of the FPP to NFPA 805 based on the requirements outlined above. The individual sections of this SE below, 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 stated that the transition to NFPA 805 was independently reviewed, and that analyses, calculations, and evaluations to be performed post-transition will be independently reviewed, as required by existing procedures.

The NRC staff concludes that the licensee's approach for meeting the quality requirements of NFPA 805, Section 2.7.3.1 is acceptable because the licensee demonstrated that procedures, analyses, calculations, and evaluations are independently reviewed.

3.8.3.2 Verification and Validation

NFPA 805, Section 2.7.3.2 requires that each calculational model or numerical method used be verified and validated through comparison to test results or other acceptable models. The licensee stated that the calculational models and numerical methods used in support of the transition to NFPA 805 were verified and validated, and that the calculational models and numerical methods used post-transition will be similarly verified and validated. As an example, the licensee provided extensive information related to the V&V of fire models used to support

the development of the FREs. The NRC staff's evaluation of this information is discussed below.

3.8.3.2.1 General

NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," Volumes 1-7 (Reference 43), documents the V&V of five selected fire models commonly used to support applications of RI/PB fire protection at NPPs. The seven volumes of this NUREG-series report provide technical documentation concerning the predictive capabilities of a specific set of fire dynamics calculation tools and fire phenomenological models that may be used for the analysis of fire hazards in postulated NPP scenarios. When used within the limitations of the fire models and considering the identified uncertainties, these models may be employed to demonstrate compliance with the requirements of 10 CFR 50.48(c) as part of an approved PB approach in accordance with NFPA 805, Chapter 4.

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

In LAR Section 4.5.1.2, "Fire PRA," and LAR Attachment J, "Fire Modeling Verification and Validation (V&V)," the licensee also identified the use of several empirical correlations that are not addressed in NUREG-1824. The NRC staff reviewed these correlations, as well as the related material provided in the LAR, in order to determine whether the licensee adequately demonstrated alignment with specific portions of the applicable NUREG-1824 guidance.

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

The NRC staff concludes that the theoretical bases of the models and empirical correlations used in the FM calculations that were not addressed in NUREG-1824 were identified and described in authoritative publications, peer reviewed journal articles, peer reviewed conference papers, and national research laboratory reports (Reference 108), (Reference 109), (Reference 110), (Reference 111), (Reference 112), (Reference 113), (Reference 114), (Reference 115), (Reference 116), (Reference 117), (Reference 118), (Reference 119), (Reference 120), (Reference 126), (Reference 127), (Reference 128), (Reference 129), and (Reference 130). SE Attachment A, Table 3.8-1 and SE Attachment B, Table 3.8-2 summarize the additional fire models, and the NRC staff's evaluation of the acceptability of each.

The FM employed by the licensee in the development of the FREs used empirical correlations that provide bounding solutions for the ZOI and conservative input parameters, which produced conservative results for the FM analysis. The majority of the empirical correlations and models were used to develop a generic methodology to determine the ZOI from pre-calculated tables, which is documented in the GFMTs approach. See SE Section 3.4.2.3 for further discussion of the licensee's FM method.

3.8.3.2.2 Discussion of RAIs

By letters dated May 5, 2015 (Reference 21), and September 8, 2015 (Reference 23), the NRC staff requested additional information concerning the FM conducted to support the FPRA. By letters dated June 16, 2015 (Reference 10), July 21, 2015 (Reference 11), and September 22, 2015 (Reference 13), the licensee responded to these RAIs.

- In FM RAI 03 (Reference 21), the NRC staff request that the licensee provide the V&V basis for any FM tools or methods that were used in support of the transition, and that are not discussed in LAR Attachment J.

  In its response to FM RAI 03 (Reference 10), the licensee explained that the V&V basis for all known FM tools or methods used in support of the ANO-1 FPRA have been described in LAR Attachment J. The licensee further explained that it used an interpolation of the cable damage times described in Appendix H of NUREG/CR-6850, Volume 2 in the ANO-1 FPRA, but that this interpolation is not considered to be a FM tool or method and is therefore not included in the LAR Attachment J discussion.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee confirmed that it did not use any fire models in support of the FPRA for which the V&V is not discussed in LAR Attachment J.

3.8.3.2.3 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-2, Implementation Item S2-6 and the NRC staff considers this action acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

3.8.3.2.4 Conclusion for Section 3.8.3.2

Based on the licensee's description of the ANO-1 process for V&V of calculational models and numerical methods and their commitment for continued use post-transition, the NRC staff concludes that subject to completion of the implementation item, the licensee's approach to meeting the requirements of NFPA 805, Section 2.7.3.2 is acceptable because the models are consistent with approved uses in NRC guidance or other authoritative publications and the licensee has identified an action that will result in compliance with NFPA 805 and would be required by the proposed license condition.

The NRC staff concludes that the licensee's approach will provide reasonable assurance that the FM used in the development of the fire scenarios for the ANO-1 FPRA is appropriate, and thus acceptable for use in transition to NFPA 805 because the V&V of the empirical correlations used by the licensee were consistent with either NUREG-1824 or authoritative publications such as the SFPE Handbook of Fire Protection Engineering.

3.8.3.3 Limitations of Use

NFPA 805 requires that only acceptable engineering methods and numerical models be used for transition to the extent that these methods have been subject to V&V and that they are applied within the scope, limitations, and assumptions prescribed for that method. The LAR stated that the engineering methods and numerical models used in support of the transition to NFPA 805 were subject to the limitations of use outlined in NFPA 805, Section 2.7.3.3, and that the engineering methods and numerical models used post-transition will be subject to these same limitations of use.

3.8.3.3.1 General

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

3.8.3.3.2 Discussion of RAIs

By letters dated May 5, 2015 (Reference 21), and September 8, 2015 (Reference 23), the NRC staff requested additional information concerning the FM conducted to support the FPRA. By letters dated June 16, 2015 (Reference 10), July 21, 2015 (Reference 11), and September 22, 2015 (Reference 13), the licensee responded to these RAIs.

- In FM RAI 04 (Reference 21), the NRC staff requested that the licensee identify any uses of the GFMTs approach outside the limits of applicability of the method, and to explain for those cases how it justified the use of the GFMTs approach.

  In its response to FM RAI 04 (Reference 11), the licensee explained that there are two broad categories of limitations that are applicable to the GFMTs approach (i.e., limitations associated with the implementation of the ZOI and limitations associated with the CFAST FM of HGL conditions). The licensee provided a detailed discussion of the five basic GFMTs limitations that represent conditions or configurations for which the ZOI data may potentially be non-conservative if applied outside the particular limitation, and explained how it addressed these basic limitations. The licensee further discussed the four key CFAST limitations that apply to the HGL evaluations, and explained how it addressed these key limitations. The licensee also discussed the two key CFAST limitations that apply to the MCR abandonment calculations, and demonstrated that it used CFAST in all abandonment scenarios within these limits.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that it used the GFMTs and CFAST within their limits of applicability, or that uses outside of the limitations were appropriately justified.

3.8.3.3.3 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 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-2, implementation item S2-6 and the NRC staff considers this action acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

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 ANO-1 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 will be acceptable because the models are consistent with approved uses in NRC guidance or other authoritative publications and the licensee identified an action that will result in compliance with NFPA 805 and would be required by the proposed license condition.

3.8.3.4 Qualification of Users

NFPA 805, Section 2.7.3.4 requires that personnel performing engineering analyses and applying numerical methods (e.g. FM) be competent in that field and experienced in the application of these methods as they relate to NPPs, NPP fire protection, and power plant operations. LAR Section 4.7.3, "Compliance with Quality Requirements in Section 2.7.3 of NFPA 805," states, in part, that:

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

3.8.3.4.1 General

The licensee has developed procedures that require that cognizant personnel who use and apply engineering analyses and numerical models be competent in the field of application and experienced in the application of the methods, including those personnel performing analyses in support of compliance with 10 CFR 50.48(c). These requirements are being addressed through the implementation of an engineering qualification process. ANO-1 has developed qualification or training requirements for personnel performing engineering analyses and numerical methods.

3.8.3.4.2 Discussion of RAIs

By letters dated May 5, 2015 (Reference 21), and September 8, 2015 (Reference 23), the NRC staff requested additional information concerning the FM conducted to support the FPRA. By

letters dated June 16, 2015 (Reference 10), July 21, 2015 (Reference 11), and September 22, 2015 (Reference 13), the licensee responded to these RAIs.

- In FM RAI 05.a (Reference 21), the NRC staff requested that the licensee describe the necessary qualifications of the engineers performing the FM.

  In its response to FM RAI 05.a (Reference 10), the licensee explained that the qualification requirements for the technical leads are consistent with and often exceed those described in NEI 07-12 for qualification of peer reviewers; and stated that it ensured that each task was performed by individuals with the appropriate education, experience and training in the FM area being performed. The licensee further stated that there are no specific qualifications for those in a support role as the assigned technical lead retains the technical responsibility for the entire body of work, and that the overall acceptability of the resulting body of work is established through the review and approval process of the associated analysis documentation.

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

- In FM RAI 05.b (Reference 21), the NRC staff requested that the licensee describe the process for ensuring the adequacy of the appropriate qualifications of the engineers and personnel performing the fire analyses and modeling activities.

  In its response to FM RAI 05.b (Reference 10), the licensee explained that its process for evaluating bids and proposals and for selection of suppliers ensures that individuals contracted to perform FM tasks have the appropriate background and meet the qualification requirements described in the response to FM RAI 05.a.

  The NRC staff concludes that the licensee's response was incomplete because it did not address the process for qualifying its personnel. In FM RAI 05.01 (Reference 23), the NRC staff requested that the licensee describe how the qualifications of its personnel involved in FM activities met or will meet the requirements of NFPA 805 section 2.7.3.4 during the development of the application, before transition, during the transition period, and after transition.

  In its response to FM RAI 05.b.01 (Reference 13), the licensee explained that work performed during the development of the LAR application and during transition has been and will continue to be completed by contracted individuals that have the appropriate background and meet the necessary qualification requirements in NFPA 805 Section 2.7.3.4. The licensee further explained that it developed a qualification card for personnel that will perform FM at the NFPA 805 plants post-transition, and that qualified contractors will continue to be used at ANO until sufficient licensee personnel meet the qualification requirements.

The NRC staff concludes that the licensee's response to the RAIs is acceptable because the licensee demonstrated that its process and procedures ensure that contractors and its own personnel involved in the FM during and post-transition are and will continue to be appropriately qualified and meet the requirements of NFPA 805, Section 2.7.3.4.

- In FM RAI 05.c (Reference 21), the NRC staff requested that the licensee describe the communication process between the FM analysts and PRA personnel, and any measures taken to assure that the FM was performed adequately and will continue to be performed adequately during post-transition.

  In its response to FM RAIs 05.c (Reference 10), the licensee explained that, during the preparation of the LAR, meetings were held between PRA and FM personnel to ensure the FM results accurately reflected the needs of the FPRA model. The licensee further explained that FM calculations were reviewed by qualified licensee personnel in accordance with the appropriate quality assurance programs and procedures, and stated that a similar process and its same procedures will be used post-transition.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the necessary interactions between FM and PRA personnel were maintained to ensure that the FM was performed adequately, and explained that a similar process and the same procedures will be used post-transition.

3.8.3.4.3 Post-Transition

The post-transition qualification training program that will be implemented to include NFPA 805 requirements for qualification of users is included in LAR Attachment S, Table S-2, Implementation Item S2-6. 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

The NRC staff concludes that appropriately competent and experienced personnel developed the ANO-1 FREs, including the supporting FM calculations and including the additional documentation for models and empirical correlations not identified in previous NRC approved V&V documents.

In addition, based on the licensee's description of the procedures for ensuring personnel who use and apply engineering analyses and numerical methods are competent and experienced, the NRC staff concludes that the licensee's approach for meeting the requirements of NFPA 805, Section 2.7.3.4, is acceptable.

3.8.3.5 Uncertainty Analysis

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

3.8.3.5.1 General

The industry consensus standard for PRA development (i.e., the ASME/ANS PRA standard, (Reference 31)) includes requirements to address uncertainty. Accordingly, the licensee addressed uncertainty as a part of the development of the ANO-1 FREs. 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 Decision Making" (Reference 45), 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 47).

(3) Completeness Uncertainty: This refers to the fact that a model is not a complete description of the phenomena it is designed to simulate. Some consider this a form of model uncertainty because most fire models neglect certain physical phenomena that are not considered important for a given application. Completeness uncertainty is addressed by the description of the algorithms found in the model documentation. It is addressed indirectly by the same process used to address the Model Uncertainty.

3.8.3.5.2 Discussion of RAIs

By letters dated May 5, 2015 (Reference 21), and September 8, 2015 (Reference 23), the NRC staff requested additional information concerning the fire modeling conducted to support the Fire PRA. By letters dated June 16, 2015 (Reference 10), July 21, 2015 (Reference 11), and September 22, 2015 (Reference 13) the licensee responded to these RAIs. The following

paragraphs describe the RAI responses related to the uncertainties associated with of the fire models used.

- In FM RAI 06.a (Reference 21), 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 11), the licensee stated that the uncertainty associated with the fire model input parameters was implicitly accounted for through the use of conservative and bounding analyses as demonstrated by various sensitivity studies that were performed. The licensee provided a detailed discussion of the approach for the four primary FM activities at ANO-1 where parameter uncertainty is applicable (i.e., the MCR abandonment analysis, the HGL tabulations, the ZOI tabulations, and the building separation calculations).

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that FM parameter uncertainty was properly accounted for.

- In FM RAI 06.b (Reference 21), the NRC staff requested that the licensee explain how the "completeness" and "model" uncertainty were accounted for in the FM analyses.

  In its response to FM RAI 06.b (Reference 11), the licensee explained that the combined model and completeness uncertainty is applicable to the four FM activities discussed in the response to FM RAI 06.a. The licensee further provided a detailed discussion to show that this uncertainty in all four cases either does not (significantly) contribute to the risk uncertainty or is bounded by the conservatisms in the analysis.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that it properly accounted for model uncertainty and completeness uncertainty.

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 are identified in LAR Attachment S, Table S-2, Implementation Item S2-6 and the NRC staff considers this action acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

3.8.3.5.4 Conclusion for Section 3.8.3.5

Based on the licensee's description of the ANO-1 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, subject to completion of the implementation item.

3.8.3.6 Conclusion for Section 3.8.3

Based on the above, the NRC staff concludes that the ANO-1 RI/PB fire protection quality assurance program will adequately address each of the requirements of NFPA 805, Section 2.7.3, which includes conducting independent reviews, performing V&V, limiting the application of acceptable methods and models to within prescribed boundaries, ensuring that personnel applying acceptable methods and models are qualified, and performing uncertainty analyses, subject to completion of the implementation items.

3.8.4 Fire Protection Quality Assurance Program

GDC 1 of Appendix A to 10 CFR Part 50 states, in part:

> 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 NEI 04-02 (Reference 7), Appendix C 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 during the transition to 10 CFR 50.48(c) and upon implementation of NFPA 805, it will perform work in accordance with the quality requirements of Section 2.7.3 of NFPA 805 and that future analysis will be conducted in accordance with the requirements of NFPA 805, Section 2.7.3.

The LAR described how the fire protection QA program meets the applicable requirements of NFPA 805, Section 2.7.3.1 through 2.7.3.5, but indicated that the QA program would be updated to meet the applicable requirements of NFPA 805, Section 2.7.3.4. The licensee stated that position specific guides will be developed to identify and document required training and mentoring to ensure individuals are appropriately qualified per the requirements of NFPA 805, Section 2.7.3.4. The licensee included this action in LAR Attachment S, Table S-2, Implementation Item S2-6 and the NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the FPP and would be required by the proposed license condition.

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 item, 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 QA requirements and concludes that the licensee's approach for meeting the requirements specified in Section 2.7 of NFPA 805 is acceptable.

4.0 FIRE PROTECTION LICENSE CONDITION

The licensee proposed an FPP license condition regarding transition to an RI/PB FPP under NFPA 805, in accordance with 10 CFR 50.48(c)(3)(i). The new license condition adopts the guidelines of the standard fire protection license condition promulgated in RG 1.205, Revision 1, 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 ANO-1 and the NRC staff concludes that it is acceptable.

The following license condition is included in the revised license for ANO-1 and will replace Renewed Facility Operating License No. DPR-51, Condition 2.c(8):

(8) Fire Protection

Entergy Operations, Inc. shall implement and maintain in effect all provisions of the approved fire protection program that comply with 10 CFR 50.48(a) and 10 CFR 50.48(c), as specified in the licensee amendment request dated January 29, 2014, and supplements dated May 19, 2015, June 16, 2015, July 21, 2015, August 12, 2015, September 22, 2015, November 4, 2015, November 17, 2015, January 15, 2016, March 25, 2016, April 7, 2016, May 19, 2016, and August 29, 2016, and as approved in the SE dated October 7, 2016. Except where NRC approval for changes or deviations is required by 10 CFR 50.48(c), and provided no other regulation, technical specification, license condition or requirement would require prior NRC approval, the licensee may make changes to the fire protection program without prior approval of the Commission if those changes satisfy the provisions set forth in 10 CFR 50.48(a) and 10 CFR 50.48(c), the change does not require a change to a technical specification or a license condition, and the criteria listed below are satisfied.

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 ANO-1. Acceptable methods to assess the risk of the

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

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

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

Other Changes that may be Made Without Prior NRC Approval

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

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

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

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

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

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

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

   Prior NRC review and approval are not required for changes to the licensee's fire protection program that have been demonstrated to have no more than a minimal risk impact. The licensee may use its screening process as approved in the NRC SE dated October 7, 2016, to determine that certain fire protection program changes meet the minimal criterion. The licensee shall ensure that fire protection defense-in-depth and safety margins are maintained when changes are made to the fire protection program.

Transition License Conditions

1. Before achieving full compliance with 10 CFR 50.48(c), as specified by 2. below, risk-informed changes to the Entergy Operations, Inc. 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-1, "Plant Modifications," Attachment S, of Entergy Operations, Inc. letter 1CAN051602, dated May 19, 2016, prior to startup from the second refueling outage following issuance of the Safety Evaluation. The licensee shall maintain appropriate compensatory measures in place until completion of the modifications.

3. The licensee shall complete the implementation items as listed in Table S-2, "Implementation Items," Attachment S, of Entergy Operations, Inc. letter 1CAN051602, dated May 19, 2016, within six months after issuance of the Safety Evaluation.

5.0 SUMMARY

The NRC staff reviewed the licensee's application, as supplemented by various letters, to transition to an RI/PB FPP in accordance with the requirements established by NFPA 805. The NRC staff concludes that, subject to completion of the modifications and implementation items in LAR Attachment S, the applicant's approach, methods, and data are acceptable to establish, implement and maintain an RI/PB FPP in accordance with 10 CFR 50.48(c).

Accordingly, implementation of the RI/PB FPP in accordance with 10 CFR 50.48(c) is reflected by a new fire protection license condition, which identifies the list of implementation items that must be completed in order to support the conclusions made in this SE, and establishes a date by which full compliance with 10 CFR 50.48(c) will be achieved. Before the licensee is able to fully implement the transition to an FPP based on NFPA 805 and apply the new fire protection license condition, to its full extent, the implementation items must be completed within the timeframe specified.

6.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Arkansas State official was notified of the proposed issuance of the amendment. The State official had no comments.

7.0 ENVIRONMENTAL CONSIDERATION

The amendments change a requirement with respect to the installation or use of facility components located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involve no significant increase in the amounts and no significant change in the types of any effluents that may be released offsite and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendments involve no significant hazards consideration, and there has been no public comment on such finding published in the FR on July 8, 2014 (79 FR 38589). 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 amendments will not be inimical to the common defense and security or to the health and safety of the public.

9.0 REFERENCES

1 U.S. Nuclear Regulatory Commission, Branch Technical Position (BTP) APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants," (Agencywide Documents Access and Management System (ADAMS) Accession No. ML070660461).

2 U.S. Nuclear Regulatory Commission, Appendix A to BTP APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants Docketed Prior to July 1, 1976," (ADAMS Accession No. ML070660458).

3 National Fire Protection Association, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," Standard 805 (NFPA 805), 2001 Edition, Quincy, Massachusetts.

4 U.S. Nuclear Regulatory Commission, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants," Regulatory Guide 1.205, Revision 1, December 2009 (ADAMS Accession No. ML092730314).

5 U.S. Nuclear Regulatory Commission, "Development of a Risk-Informed, Performance-Based Regulation for Fire Protection at Nuclear Power Plants," SECY-98-058, March 1998 (ADAMS Accession No. ML992910106).

6 U.S. Nuclear Regulatory Commission, "Rulemaking Plan, Reactor Fire Protection Risk-Informed, Performance-Based Rulemaking," SECY-00-0009, January 13, 2000 (ADAMS Accession No. ML003671923).

7 Nuclear Energy Institute, "Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c)," NEI 04-02, Revision 2, Washington, DC, April 2008 (ADAMS Accession No. ML081130188).

8 Browning, Jeremy G., Entergy Operations, Inc., letter to U.S. Nuclear Regulatory Commission, "License Amendment Request to Adopt NFPA 805 Performance-Based Standard for Fire Protection for Light Water Reactor Generating Plants (2001 Edition), Arkansas Nuclear One – Unit 1, Docket No. 50-313, License No. DPR-51," January 29, 2014 (ADAMS Accession No. ML14029A438).

9 Browning, Jeremy G., Entergy Operations, Inc., letter to U.S. Nuclear Regulatory Commission, "Response to Request for Additional Information, Adoption of National Fire Protection Association Standard NFPA-805, Arkansas Nuclear One, Unit 1, Docket No. 50-313, License No. DPR-51," May 19, 2015 (ADAMS Accession No. ML15139A196).

10 Browning, Jeremy G., Entergy Operations, Inc., letter to U.S. Nuclear Regulatory Commission, "60-Day Response to Request for Additional Information, Adoption of National Fire Protection Association Standard NFPA-805, Arkansas Nuclear One, Unit 1, Docket No. 50-313, License No. DPR-51," June 16, 2015 (ADAMS Accession No. ML15167A503).

11 Browning, Jeremy G., Entergy Operations, Inc., letter to U.S. Nuclear Regulatory Commission, "90-Day Response to Request for Additional Information, Adoption of National Fire Protection Association Standard NFPA-805, Arkansas Nuclear One, Unit 1, Docket No.

50-313, License No. DPR-51," July 21, 2015 (ADAMS Accession No. ML15203A205).

12 Browning, Jeremy G., Entergy Operations, Inc., letter to U.S. Nuclear Regulatory Commission, "120-Day Response to Request for Additional Information, Adoption of National Fire Protection Association Standard NFPA-805, Arkansas Nuclear One, Unit 1, Docket No. 50-313, License No. DPR-51," August 12, 2015 (ADAMS Accession No. ML15224A729).

13 Browning, Jeremy G., Entergy Operations, Inc., letter to U.S. Nuclear Regulatory Commission, "Round 2 Response to Request for Additional Information, Adoption of National Fire Protection Association Standard NFPA-805, Arkansas Nuclear One, Unit 1, Docket No. 50-313, License No. DPR-51," September 22, 2015 (ADAMS Accession No. ML15265A113).

14 Browning, Jeremy G., Entergy Operations, Inc., letter to U.S. Nuclear Regulatory Commission, "Second Set of Round 2 Responses to Request for Additional Information, Adoption of National Fire Protection Association Standard NFPA-805, Arkansas Nuclear One, Unit 1, Docket No. 50-313, License No. DPR-51," November 4, 2015 (ADAMS Accession No. ML15308A452).

15 Browning, Jeremy G., Entergy Operations, Inc., letter to U.S. Nuclear Regulatory Commission, "Clarification of Response to Round 2 Request for Additional Information, Adoption of National Fire Protection Association Standard NFPA-805, Arkansas Nuclear One, Unit 1, Docket No. 50-313, License No. DPR-51," November 17, 2015 (ADAMS Accession No. ML15321A076).

16 Browning, Jeremy G., Entergy Operations, Inc., letter to U.S. Nuclear Regulatory Commission, "Response to Round 3 Request for Additional Information, Adoption of National Fire Protection Association Standard NFPA-805, Arkansas Nuclear One, Unit 1, Docket No. 50-313, License No. DPR-51," January 15, 2016 (ADAMS Accession No. ML16015A421).

17 Browning, Jeremy G., Entergy Operations, Inc., letter to U.S. Nuclear Regulatory Commission, "Response to PRA RAI 03, Adoption of National Fire Protection Association Standard NFPA 805, Arkansas Nuclear One, Unit 1, Docket No. 50-313, License No. DPR-51," March 25, 2016 (ADAMS Accession No. ML16088A299).

18 Browning, Jeremy G., Entergy Operations, Inc., letter to U.S. Nuclear Regulatory Commission, "Response to PRA RAI 19, Adoption of National Fire Protection Association Standard NFPA 805, Arkansas Nuclear One, Unit 1, Docket No. 50-313, License No. DPR-51," April 7, 2016 (ADAMS Accession No. ML16099A057).

19 Browning, Jeremy G., Entergy Operations, Inc., letter to U.S. Nuclear Regulatory Commission, "Update to Tables S-1 and S-2, Adoption of National Fire Protection Association Standard NFPA-805, Arkansas Nuclear One, Unit 1, Docket No. 50-313, License No. DPR-51," May 19, 2016 (ADAMS Accession No. ML16145A349).

20 Warren, Clay, C., Entergy Operations, Inc., letter to U.S. Nuclear Regulatory Commission,

"General Updates, Adoption of National Fire Protection Association Standard NFPA-805, Arkansas Nuclear One, Unit 1, Docket No. 50-313, License No. DPR-51," August 29, 2016 (ADAMS Accession No. ML16243A127).

21 George, Andrea E., U.S. Nuclear Regulatory Commission, letter to Vice President, Operations, Entergy Operations, Inc., "Arkansas Nuclear One, Unit No. 1 - Request for Additional Information Regarding License Amendment Request to Adopt National Fire Protection Association Standard 805 (TAC No. MF3419)," May 5, 2015 (ADAMS Accession No. ML15091A431).

22 George, Andrea, U.S. Nuclear Regulatory Commission, e-mail to Bice, David B., Entergy Operations, Inc., "Corrections to ANO-1 NFPA 805 Requests for Additional Information - TAC No. MF3419," May 8, 2015 (ADAMS Accession No. ML15128A178).

23 George, Andrea, U.S. Nuclear Regulatory Commission, e-mail to Bice, David B., Entergy Operations, Inc., "2nd Round Requests for Additional Information ANO-1 NFPA 805 LAR - TAC No. MF3419," September 8, 2015 (ADAMS Accession No. ML15251A220).

24 George, Andrea, U.S. Nuclear Regulatory Commission, e-mail to Bice, David B., Entergy Operations, Inc., "Second Round Follow-up Requests for Additional Information - ANO-1 NFPA 805 LAR - TAC No. MF3419," October 6, 2015 (ADAMS Accession No. ML15280A114).

25 George, Andrea, U.S. Nuclear Regulatory Commission, e-mail to Bice, David B., Entergy Nuclear Operations, Inc., "3rd Round Request for Additional Information - ANO-1 NFPA 805 LAR - TAC No. MF3419," January 12, 2016 (ADAMS Accession No. ML16012A049).

26 George, Andrea, U.S. Nuclear Regulatory Commission, e-mail to Bice, David B., Entergy Operations, Inc., "4th Roud Request for Additional Information - ANO-1 NFPA 805 LAR - TAC No. MF3419," March 10, 2016 (ADAMS Accession No. ML16070A131).

27 Alexion, Thomas W. and Peterson, Sheri R., U.S. Nuclear Regulatory Commission, letter to Carns, Neil S., Entergy Operations, Inc., "Issuance of Amendment Nos. 158 and 132 to Facility Operating License Nos. DPR-51 and NPF-6 - Arkansas Nuclear One, Units 1 and 2 (TAC Nos. M81999 and M82000)," March 31, 1992 (ADAMS Accession No. ML021260247).

28 Nuclear Energy Institute, "Guidance for Post Fire Safe Shutdown Circuit Analysis," NEI 00-01, Revision 2, Washington, DC, May 2009 (ADAMS Accession No. ML091770265).

29 U.S. Nuclear Regulatory Commission, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," Regulatory Guide 1.174, Revision 2, May 2011 (ADAMS Accession No. ML100910006).

30 U.S. Nuclear Regulatory Commission, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," Regulatory Guide 1.200, Revision 2, March 2009 (ADAMS Accession No. ML090410014).

31 American Society of Mechanical Engineers (ASME) and American Nuclear Society (ANS) , "Addenda to ASME/ANS RA-S-2008, Standard for Level 1/Large Early Release Frequency

Probabilistic Risk Assessment for Nuclear Power Plant Applications," Standard ASME/ANS RA-Sa-2009, dated Februrary 2, 2009.

32 U.S. Nuclear Regulatory Commission, "Fire Protection for Nuclear Power Plants," Regulatory Guide 1.189, Revision 2, October 2009 (ADAMS Accession No. ML092580550).

33 U.S. Nuclear Regulatory Commission, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Chapter 9.5.1.2, "Risk-Informed, Performance-Based Fire Protection Program," NUREG-0800, Revision 0, December 2009 (ADAMS Accession No. ML092590527).

34 U.S. Nuclear Regulatory Commission, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Chapter 19.1, "Determining the Technical Adequacy of Probabilistic Risk Assessment for Risk-Informed License Amendment Requests after Initial Fuel Load," NUREG-0800, Revision 3, September 2012 (ADAMS Accession No. ML12193A107).

35 U.S. Nuclear Regulatory Commission, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Chapter 19.2, "Review of Risk Information Used to Support Permanent Plant-Specific Changes to the Licensing Basis: General Guidance," NUREG-0800, Revision 0, June 2007 (ADAMS Accession No. ML071700658).

36 U.S. Nuclear Regulatory Commission, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities, Volume 1: Summary & Overview," NUREG/CR-6850, September 2005 (ADAMS Accession No. ML052580075).

37 U.S. Nuclear Regulatory Commission, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities, Volume 2: Detailed Methodology," NUREG/CR-6850, September 2005 (ADAMS Accession No. ML052580118).

38 U.S. Nuclear Regulatory Commission, "Fire Probabilistic Risk Assessment Methods Enhancements," NUREG/CR-6850, Supplement 1, September 2010 (ADAMS Accession No. ML103090242).

39 Correia, R. P., U.S. Nuclear Regulatory Commission, memorandum to Joseph G. Giitter, U.S. Nuclear Regulatory Commission, "Interim Technical Guidance on Fire-Induced Circuit Failure Mode Likelihood Analysis," June 14, 2013 (ADAMS Package Accession No. ML13165A194).

40 U.S. Nuclear Regulatory Commission, "Cable Response to Live Fire (CAROLFIRE)," NUREG/CR-6931, Volumes 1, 2, and 3, April 2008 (ADAMS Accession Nos. ML081190230, ML081190248, and ML081190261, respectively).

41 U.S. Nuclear Regulatory Commission, "Direct Current Electrical Shorting in Response to Exposure Fire (DESIREE-Fire): Test Results," NUREG/CR-7100, April 2012 (ADAMS Package Accession No. ML121600316).

42 U.S. Nuclear Regulatory Commission, "Fire Dynamics Tools (FDTs): Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection

Inspection Program," NUREG-1805, December 2004 (ADAMS Accession No. ML043290075).

43 U.S. Nuclear Regulatory Commission, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," Volume 1: Main Report, Volume 2: Experimental Uncertainty, Volume 3: Fire Dynamics Tools (FDTs), Volume 4: Fire-Induced Vulnerability Evaluation (FIVE-Rev. 1), Volume 5: Consolidated Fire Growth and Smoke Transport Model (CFAST), Volume 6: MAGIC, Volume 7: Fire Dynamics Simulator, NUREG-1824, May 2007 (ADAMS Accession Nos. ML071650546, ML071730305, ML071730493, ML071730499, ML071730527, ML071730504, ML071730543, respectively).

44 U.S. Nuclear Regulatory Commission, "Cable Heat Release, Ignition, and Spread in Tray Installations during Fire (CHRISTIFIRE), Phase 1: Horizontal Trays," NUREG/CR-7010, Volume 1, July 2012 (ADAMS Accession No. ML12213A056).

45 U.S. Nuclear Regulatory Commission, "Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decision Making," NUREG-1855, Volume 1, March 2009 (ADAMS Accession No. ML090970525).

46 U.S. Nuclear Regulatory Commission, "EPRI/NRC-RES Fire Human Reliability Analysis Guidelines," NUREG-1921, July 2012 (ADAMS Accession No. ML12216A104).

47 U.S. Nuclear Regulatory Commission, "Nuclear Power Plant Fire Modeling Analysis Guidelines (NPP FIRE MAG)," NUREG-1934, November 2012 (ADAMS Accession No. ML12314A165).

48 U.S. Nuclear Regulatory Commission, "Potentially Nonconforming Hemyc and MT Fire Barrier Configurations," Generic Letter 2006-03, April 10, 2006 (ADAMS Accession No. ML053620142).

49 National Fire Protection Association, "Life Safety Code," Standard 101 (NFPA 101), Quincy, Massachusetts.

50 National Fire Protection Association, "Flammable and Combustible Liquids Code," Standard 30 (NFPA 30), Quincy, Massachusetts.

51 National Fire Protection Association, "Standard for Fire Prevention During Welding, Cutting, and Other Hotwork," Standard 51B (NFPA 51B), Quincy, Massachusetts.

52 National Fire Protection Association, "National Fire Alarm and Signaling Code," Standard 72 (NFPA 72), Quincy, Massachusetts.

53 National Fire Protection Association, "Standard for the Fire Protection of Telecommunications Facilities," Standard 76 (NFPA 76), Quincy, Massachusetts.

54 National Fire Protection Association, "Standard for Safeguarding Construction Alteration, and Demolition Operations," Standard 241 (NFPA 241), Quincy, Massachusetts.

55 National Fire Protection Association, "Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces," Standard 262 (NFPA 262), Quincy, Massachusetts.

56 Nuclear Energy Institute, "Guidance for Post-Fire Safe Shutdown Circuit Analysis," NEI 00-01, Revision 1, Washington, DC, January 2005 (ADAMS Accession No. ML050310295).

57 Weerakkody, Sunil D., U.S. Nuclear Regulatory Commission, memorandum to AFPB File, "Closure of National Fire Protection Association Standard 805 Transition Program Frequently Asked Question Number 06-0006," March 12, 2007 (ADAMS Accession No. ML070030117).

58 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to AFPB File, "Closure of National Fire Protection Association 805 Frequently Asked Question Number 06-0020," November 28, 2007 (ADAMS Accession No. ML072420286).

59 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to AFPB File, "Close-out of National Fire Protection Association Standard 805 Frequently Asked Question 06-0022 on Electrical Cable Flame Propagation Tests," May 5, 2009 (ADAMS Accession No. ML091240278).

60 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to AFPB Files, "Close-out of National Fire Protection Association Frequently Asked 07-0030 on Establishing Recovery Actions," February 4, 2011 (ADAMS Accession No. ML110070485).

61 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to AFPB Files, "Close-out of National Fire Protection Association Frequently Asked 07-0038 on Lessons Learned on Multiple Spurious Operations," February 3, 2011 (ADAMS Accession No. ML110140242).

62 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to AFPB File, "Close-out of National Fire Protection Association Standard 805 Frequently Asked Question 07-0039 Incorporation of Pilot Plant Lessons Learned - Table B-2," January 15, 2010 (ADAMS Accession No. ML091320068).

63 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to AFPB File, "Close-out of National Fire Protection Association 805 Frequently Asked Question 07-0040 on Non-Power Operations Clarifications," August 11, 2008 (ADAMS Accession No. ML082200528).

64 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to AFPB File, "Closure of National Fire Protection Association 805 Frequently Asked Question 08-0048 Revised Fire Ignition Frequencies," September 1, 2009 (ADAMS Accession No. ML092190457).

65 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to AFPB File, "Closure of National Fire Protection Association 805 Frequently Asked Question 08-0052 Transient Fires - Growth Rates and Control Room Non-Suppression," August 4, 2009 (ADAMS Accession No. ML092120501).

66 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to AFPB Files, "Close-out of National Fire Protection Association Frequently Asked Question 08-0054 on Demonstrating Compliance with Chapter 4 of National Fire Protection Association 805,

Revision 1," March 10, 2015 (ADAMS Accession No. ML15016A280).

67 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to AFPB Files, "Close-out of National Fire Protection Association 805 Frequently Asked Question 09-0056 on Radioactive Release Transition," January 14, 2011 (ADAMS Accession No. ML102920405).

68 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to AFPB File, "Close-out of National Fire Protection Association Standard 805 Frequently Asked Question 10-0059: National Fire Protection 805 Monitoring Program," March 19, 2012 (ADAMS Accession No. ML120750108).

69 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to AFPB File, "Close-out of National Fire Protection Association Standard 805 Frequently Asked Question 12-0062 on Updated Final Safety Analysis Report Content," September 5, 2012 (ADAMS Accession No. ML121980557).

70 Klein, Alexander R., U.S. Nuclear Regulatory Commission, memorandum to AFPB Files, "Close-out of National Fire Protection Association 805 Frequently Asked Question 12-0064 on Hot Work/Transient Fire Frequency Influence Factors," January 17, 2013 (ADAMS Accession No. ML12346A488).

71 Hamzehee, Hossein G., U.S. Nuclear Regulatory Commission, memorandum to APLA Files, "Close-out of Fire Probabilistic Risk Assessment Frequently Asked Question 13-0004 On Clarifications Regarding Treatment of Sensitive Electronics," December 3, 2013 (ADAMS Accession No. ML13322A085).

72 Hamzehee, Hossein G., U.S. Nuclear Regulatory Commission, memorandum to APLA Files, "Close-out of Fire Probabilistic Risk Assessment Frequently Asked Question 14-0009 on Treatment of Well Sealed MCC Electrical Panels Greater Than 440V," April 29, 2015 (ADAMS Package Accession No. ML15119A176).

73 Marion, Alexander, Nuclear Energy Institute, letter dated June 17, 2003, to John Hannon, U.S. Nuclear Regulatory Commission transmitting Revision 0 of NEI 02-03, "Guidance for Performing a Regulatory Review of Proposed Changes to the Approved Fire Protection Program," June 2003 (ADAMS Accession No. ML031780500).

74 U.S. Nuclear Regulatory Commission, "Implementation of Fire Protection Requirements," Generic Letter 86-10, April 24, 1986 (ADAMS Accession No. ML031150322).

75 National Fire Protection Association, "Standard on Industrial Fire Brigades," Standard 600 (NFPA 600), Quincy, Massachusetts.

76 Reid, R.W., U.S. Nuclear Regulatory Commission, letter to Cavanaugh, L.W., Arkansas Power & Light Company, "Amendment 35 to License DPR-51, Safety Evaluation and Notice of Issuance and Availability," August 22, 1978 (ADAMS Accession No. ML021210569).

77 National Fire Protection Association, "Standard for Gaseous Hydrogen Systems at Consumer Sites," Standard 50A (NFPA 50A), Quincy, Massachusetts.

78 National Fire Protection Association, "Standard for Portable Fire Extinguishers," Standard

10 (NFPA 10), Quincy, Massachusetts.

79 National Fire Protection Association, "Standard for the Installation of Sprinkler Systems," Standard 13 (NFPA 13), Quincy, Massachusetts.

80 National Fire Protection Association, "Standard for Water Spray Fixed Systems for Fire Protection," Standard 15, (NFPA 15), Quincy, Massachusetts.

81 National Fire Protection Association, "Standard Methods of Tests of Fire Endurance of Building Construction and Materials," Standard 251 (NFPA 251), Quincy, Massachusetts.

82 American Society for Testing and Materials, "Standard Test Methods for Fire Tests of Building Construction and Materials," Standard E 119 (ASTM E 119).

83 National Fire Protection Association, "Standard for Fire Doors and Fire Windows," Standard 80 (NFPA 80), Quincy, Massachusetts.

84 National Fire Protection Association, "Standard for the Installation of Air-Conditioning and Ventilating Systems," Standard 90A (NFPA 90A), Quincy, Massachusetts.

85 Calvo, Jose A., U.S. Nuclear Regulatory Commission, letter to Mr. T. Gene Campbell, Arkansas Power and Light Company, "Exemptions from the Technical Requirements of Appendix R to 10 CFR Part 50 - Arkansas Nuclear One, Unit 1 (TAC No. 55669)," October 26, 1988 (ADAMS Accession No. ML021230444).

86 U.S. Nuclear Regulatory Commission, "Removal of Fire Protection Requirements from Technical Specifications," Generic Letter 88-12, dated August 2, 1988 (ADAMS Accession No. ML031150471).

87 Electric Power Research Institute (EPRI), "Fire Protection Equipment Surveillance Optimization and Maintenance Guide for Fire Protection Systems and Features," Final Report, Technical Report TR-1006756, Palo Alto, CA, July 2003.

88 National Fire Protection Association, "Standard for the Installation of Stationary Pumps for Fire Protection," Standard 20 (NFPA 20), Quincy, Massachusetts.

89 Marlow, Thomas A., Entergy Operations, Inc., letter to U.S. Nuclear Regulatory Commission, "Response to Generic Letter 2006-03, Potentially Nonconforming Hemyc and MT Fire Barrier Configurations, Plant Name Arkansas Nuclear One, Units 1 and 2, Docket Nos. 50-313 and 50-368, License No. DPR-51 and NPF-6," June 7, 2006 (ADAMS Accession No. ML061720459).

90 U.S. Nuclear Regulatory Commission, "Combustibility of Epoxy Floor Coatings at Commercial Nuclear Power Plants," Information Notice 2007-26, August 13, 2007 (ADAMS Accession No. ML071920090).

91 American Society for Testing and Materials, "Standard Test Method for Surface Burning Characteristics of Building Materials," Standard E-84 (ASTM E-84), West Conshohocken, PA.

92 Institute of Electrical and Electronics Engineers , "Standard for Qualifying Class 1E Electric Cables and Field Splices for Nuclear Power Generating Stations," Standard 383 (IEEE

383), New York, NY.

93 National Fire Protection Association, "National Electric Code," Standard 70, (NFPA 70), Quincy, Massachusetts.

94 National Fire Protection Association, "Standard for the Installation of Private Fire Service Mains and Their Appurtenances," Standard 24 (NFPA 24), Quincy, Massachusetts.

95 U.S. Nuclear Regulatory Commission, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Chapter 9.5.1, "Fire Protection Program," NUREG-0800, Revision 3, July 1981, (ADAMS Accession No. ML052350030).

96 U.S. Nuclear Regulatory Commission, "Lessons Learned from NRC Inspections of Fire Protection Safe Shutdown Systems (10 CFR 50, Appendix R)," Information Notice 84-09, February 13, 1984 (ADAMS Accession No. ML070180073).

97 Nuclear Energy Institute, "Guidance for Self-Assessment of Circuit Failure Issues," NEI 04-06, Draft Revision G, March, 2004 (ADAMS Accession No. ML041530299).

98 U.S. Nuclear Regulatory Commission, "Potential for Loss of Remote Shutdown Capability During a Control Room Fire," Information Notice 92-18, February 28, 1992 (ADAMS Accession No. ML031200481).

99 U.S. Nuclear Regulatory Commission, "An Experimental Investigation of Internally Ignited Fires in Nuclear Power Plant Control Cabinets," NUREG/CR-4527, April, 1987 (ADAMS Accession No. ML060960351).

100 George, Andrea, E., U.S. Nuclear Regulatory Commission, letter to Entergy Operations, Inc., "Summary of Arkansas Nuclear One, Unit No. 1, April 20 - 23, 2015, Audit Associated with License Amendment Request to Transition to NFPA Standard 805, Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," 2001 Edition (TAC No. MF3419) dated August 14, 2015 (ADAMS Accession No. ML15225A254).

101 Nuclear Energy Institute, "Process for Performing Internal Events PRA Peer Reviews Using the ASME/ANS PRA Standard," NEI 05-04, Revision 2, Washington, DC, November, 2008 (ADAMS Accession No. ML083430462).

102 U.S. Nuclear Regulatory Commission, "U.S. NRC Staff Review of Resolutions of Arkansas Nuclear One Internal Events and Fire PRA Facts and Observations (F&Os)," August 12, 2016 (ADAMS Accession No. ML16225A540).

103 Nuclear Energy Institute, "Fire Probabilistic Risk Assessment (FPRA) Peer Review Process Guidelines," NEI 07-12, Revision 0, Washington, DC, November 2008 (ADAMS Accession No. ML083430464).

104 Nuclear Energy Institute, "Fire Probabilistic Risk Assessment Peer Review Process Guidlines," NEI 07-12, Revision 1, Washington, DC, June 2010 (ADAMS Accession No. ML102230070).

105 Giitter, Joseph, U.S. Nuclear Regulatory Commission, letter to Bradley, Biff, Nuclear Energy Institute, "Recent Fire PRA Methods Review Panel Decisions and EPRI 1022993,

Evaluation of Peak Heat Release Rates in Electrical Cabinet Fires," June 21, 2012 (ADAMS Accession No. ML12172A406).

106 U.S. Nuclear Regulatory Commission, "Joint Assessment of Cable Damage and Quantification of Effects from Fire (JACQUE-FIRE), Volume 2: Expert Elicitation Exercise for Nuclear Power Plant Fire-Induced Electrical Circuit Failure," NUREG/CR-7150, Vol. 2 and EPRI 3002001989 and BNL-NUREG-98204-2012, May, 2014 (ADAMS Accession No. ML14141A129).

107 R., Jones, W., Reneke, P. Peacock, "CFAST – Consolidated Model of Fire Growth and Smoke Transport (Version 6) Software Development and Model Evaluation Guide," National Institute of Standards and Technolocgy, Gaithersburg, MD, NIST Special Publication 1086, 2009.

108 Mudan, K., "Thermal Radiation Hazards from Hydrocarbon Pool Fires," *Progress in Energy and Combustion Science*, vol. 10, pp. 59-80, 1984.

109 Wakamatsu, T., Hasemi, Y., Kagiya, K., and Kamikawa, D, "Heating Mechanism of Unprotected Steel Beam Installed Beneath Ceiling and Exposed to a Localized Fire: Verification Using the Real-Scale Experiment and Effects of the Smoke Layer," Proceedings of the Seventh International Symposium on Fire Safety Science, International Association for Fire Safety Science, London, UK, 2003, pp. 1099-1110.

110 Yokoi, S., "Study on the Prevention of Fire Spread Caused by Hot Upward Current," Report Number 34, Building Research Institute, Tokyo, Japan, 1960.

111 Beyler, C., "Fire Plumes and Ceiling Jets," Fire Safety Journal, vol. 11, pp. 53-75, 1986.

112 Gottuk, D., and White, D., "Liquid Fuel Fires," in *The SFPE Handbook of Fire Protection Engineering*, 3rd ed. Quincy, Massachusetts: National Fire Protection Assocation, 2002, ch. 2-15.

113 Lattimer, B., "Heat Fluxes from Fires to Surfaces," in *The SFPE Handbook of Fire Protection Engineering*, 4th ed. Quincy, Massachusetts: National Fire Protection Association, 2008, ch. 2-14.

114 Delichatsios, M., "Flame Heights in Turbulent Wall Fires with Significant Flame Radiation," Combustion Science and Technology, Volume 39, pp. 195-214, 1984.

115 Kawagoe, K., "Fire Behavior in Rooms," Report Number 27, Building Research Institute, Tokyo, Japan, 1958.

116 Yuan, L., and Cox, F., "An Experimental Study of Some Line Fires," *Fire Safety Journal*, vol. 27, pp. 123-139, 1996.

117 Lee, B., "Heat Release Rate Characteristics of Some Combustible Fuel Sources in Nuclear Power Plants," NBSIR 85-3196, U.S. Department of Commerce, National Bureau of Standards (NBS), Washington, DC July, 1985.

118 Babrauskas, V., "Estimating Room Flashover Potential," *Fire Technology*, vol. 16, pp. 94-104, 1980.

119 Shokri, M., and Beyler, C., "Radiation from Large Pool Fires," *SFPE Journal of Fire Protection Engineering*, vol. 1, pp. 141-150, 1989.

120 Childs, K., "HEATING 7: Multidimensional, Finite-Difference Heat Conduction Analysis Code System," Technical Report PSR-199, Oak Ridge National Laboratory (ORNL), Oak Ridge, TN, 1998.

121 U.S. Nuclear Regulatory Commission, Inspection Manual Chapter (IMC) 0609, Appendix F, "Fire Protection Significance Determination Process," Washington, DC, September 20, 2013.

122 Hiland, P., U.S. Nuclear Regulatory Commission, memo to Brian W. Sheron, U.S. Nuclear Regulatory Commission, "Safety/Risk Assessment Results for Generic Issue 199, Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants," September 2, 2010 (ADAMS Accession Nos. ML100270598, ML100270639, ML100270664, ML100270691, ML100270731, ML100270756, respectively).

123 Electric Power Research Institute, "Fire PRA Methods Enhancements, Additions, Clarifications, and Refinements to EPRI 1019189," Technical Report 1016735, December 2008 (ADAMS Accession No. ML090290195).

124 Graves, Samuel, T., U.S. Nuclear Regulatory Commission, letter to Warren Clay, Entergy Operations, Inc., "Arkansas Nuclear One - NRC Triennial Fire Protection Inspection Report (05000313/2016009 and 05000368/2016009)," August 4, 2016 (ADAMS Accession No. ML16218A299).

125 Electric Power Research Institute, "Characterization of Fire-Induced Circuit Faults: Results of Cable Fire Testing," Technical Report 1003326, Palo Alto, California, November 18, 2002.

126 Heskestad, G., "Fire Plumes, Flame Height, and Air Entrainment," in *The SFPE Handbook of Fire Protection Engineering*, 4th ed. Quincy, Massachusetts: National Fire Protection Association, 2008, ch. 2-1.

127 Beyler, C., "Fire Hazard Calculations for Large, Open Hydrocarbon Fires," in *The SFPE Handbook of Fire Protection Engineering*, 4th ed. Quincy, Massachusetts: National Fire Protection Association, 2008, ch. 3-10.

128 Childs, C., Giles, K., Bryan, G., "HEATING 6 Verification," Oak Ridge National Laboratory, Oak Drive, TN, Technical Report K/CSD/TM-61, 1986.

129 Chu, W., "HEATCHEK: A Computer Program to Automate Verification of New Versions of HEATING," Union Carbide Corp., Nuclear Div., Gaseous Diffusion Plant, Oak Ridge, TN, Technical Report K/CSD/INF-89/4, 1989.

130 Tatem, P., Budnick, E., Hunt, S., Trelles, J., Scheffey, J., White, D., Bailey, J., Hoover, J., Williams, F., "Verification and Validation Final Report for Fire and Smoke Spread Modeling and Simulation Support of T-AKE Test and Evaluation," NRL/MR/6180-04-8746, Naval Research Laboratory, Washington, DC, 2004.

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Attachments:
A. Table 3.8-1 – V&V Basis for Fire Modeling Correlations Used at ANO-1
B. Table 3.8-2 - V&V Basis for Other Fire Models and Related Calculations Used at ANO-1
C. Abbreviations and Acronyms

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

Correlation	Application at ANO-1	V&V Basis	NRC Staff Evaluation of Acceptability
Heskestad flame height correlation	Development of ZOI tables in GFMTs approach	NUREG-1805 (Reference 42) NUREG-1824 (Reference 43) SFPE Handbook, Chapter 2-1 (Reference 126)	• The correlation is validated in NUREG-1824 and the SFPE Handbook of Fire Protection Engineering. • The licensee stated that in most cases, it applied the correlation within the validated range reported in NUREG-1824. The licensee provided justification for cases where it used the correlation outside the validated range reported in NUREG-1824 (Response to FM) RAI 04, (Reference 11)). Based on its review and evaluation, 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 (Reference 42) NUREG-1824 (Reference 43) SFPE Handbook, Chapter 2-1 (Reference 126)	• The correlation is validated in NUREG-1824 and the SFPE Handbook of Fire Protection Engineering. • The licensee stated that in most cases, it applied the correlation within the validated range reported in NUREG-1824. The licensee provided justification for cases where it used the correlation outside the validated range reported in NUREG-1824 (Response to FM RAI 04, (Reference 11)). Based on its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.

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

Correlation	Application at ANO-1	V&V Basis	NRC Staff Evaluation of Acceptability
Modak point source radiation model	Development of ZOI tables in GFMTs approach and determination of adequacy of separation between the Administration Building and the Arkansas Nuclear One, Unit 1 (ANO-1) Turbine Building	NUREG-1805 (Reference 42) NUREG-1824 (Reference 43) SFPE Handbook, Chapter 3-10 (Reference 127)	• The correlation is validated in NUREG-1824 and the SFPE Handbook of Fire Protection Engineering. • The licensee stated that in most cases, it applied the correlation within the validated range reported in NUREG-1824. The licensee provided justification for cases where it used the correlation outside the validated range reported in NUREG-1824 (Response to FM RAI 04, (Reference 11)). Based on its review and evaluation, 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 and determination of adequacy of separation between the Administration Building and the ANO-1 Turbine Building	NUREG-1805 (Reference 42) NUREG-1824 (Reference 43) SFPE Journal of Fire Protection Engineering (Reference 119)	• The correlation is validated in NUREG-1824 and a peer reviewed journal article. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the article. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04, (Reference 11)). Based on its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.

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Correlation	Application at ANO-1	V&V Basis	NRC Staff Evaluation of Acceptability
Mudan flame radiation model	Development of ZOI tables in GFMTs approach	Peer-reviewed journal article (Reference 108)	• The correlation is validated in a peer reviewed journal article. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the article. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04, (Reference 11)). Based on its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.
Plume heat flux correlation by Wakamatsu et al.	Development of ZOI tables in GFMTs approach	Peer-reviewed conference paper (Reference 109)	• The correlation is validated in a peer reviewed conference paper. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the paper. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04, (Reference 11)). Based on its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.

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Correlation	Application at ANO-1	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 110) Fire Safety Journal (Reference 111)	• The correlation is validated in an authoritative publication and a peer reviewed journal article. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the authoritative publication and article. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04, (Reference 11)). Based on its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.
Hydrocarbon spill fire size correlation	Development of ZOI tables in GFMTs approach	SFPE Handbook, Chapter 2-15 (Reference 112)	• The correlation is validated in the SFPE Handbook of Fire Protection Engineering. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the handbook. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04, (Reference 11)). Based on its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.

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

Correlation	Application at ANO-1	V&V Basis	NRC Staff Evaluation of Acceptability
Flame extension correlation	Development of ZOI tables in GFMTs approach	SFPE Handbook, Chapter 2-14 (Reference 113)	• The correlation is validated in the SFPE Handbook of Fire Protection Engineering. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the handbook. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04, (Reference 11)). Based on its review and evaluation, 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 114)	• The correlation is validated in a peer reviewed journal article. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the article. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04, (Reference 11)). Based its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.

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Correlation	Application at ANO-1	V&V Basis	NRC Staff Evaluation of Acceptability
Corner flame height correlation	Development of ZOI tables in GFMTs approach	SFPE Handbook, Chapter 2-14 (Reference 113)	• The correlation is validated in the SFPE Handbook of Fire Protection Engineering. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the handbook. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04, (Reference 11)). Based its review and evaluation, 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 115)	• The correlation is validated in an authoritative publication. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the authoritative publication. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04, (Reference 11)). Based on its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.

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Correlation	Application at ANO-1	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	Fire Safety Journal (Reference 116)	• The correlation is validated in a peer reviewed journal article. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the article. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04, (Reference 11)). Based on its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.
Lee cable fire model	Development of ZOI tables in GFMTs approach	NBSIR 85-3196 (Reference 117)	• The correlation is validated in an authoritative publication. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the authoritative publication. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04, (Reference 11)). Based on its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.

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Correlation	Application at ANO-1	V&V Basis	NRC Staff Evaluation of Acceptability
Babrauskas method to determine ventilation-limited fire size	Development of ZOI tables in GFMTs approach	Fire Technology (Reference 118)	• The correlation is validated in a peer reviewed journal article. • The licensee stated that in most cases, it applied the correlation within the validated range reported in the article. The licensee provided justification for cases where it used the correlation outside the reported validated range (Response to FM RAI 04, (Reference 11)). Based on its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.
Correlation for Flame Spread over Horizontal Cable Trays (FLASH-CAT)	The FLASH-CAT method was used to calculate the growth and spread of a fire within a vertical stack of horizontal cable trays	NUREG/CR-7010 (Reference 44)	• The modeling technique is validated in an authoritative publication of National Institute of Standards and Technology (NIST). Based on its review and evaluation, the NRC staff concludes that the use of this correlation is acceptable.

Attachment B: Table 3.8-2, V&V Basis for Other Fire Models and Related Calculations Used at ANO-1

Model	Application at ANO-1	V&V Basis	NRC Staff Evaluation of Acceptability
Consolidated Fire Growth and Smoke Transport Model (CFAST) (Version 6)	Development of hot gas layer (HGL) tables, and main control room (MCR) abandonment time calculations	NUREG-1824 (Reference 43) NIST Special Publication 1086 (Reference 107)	• The modeling technique is validated in NUREG-1824 and an authoritative publication of NIST. • 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 (Response to FM RAI 04, (Reference 11)). Based on its review and evaluation, the NRC staff concludes that the use of this model in the ANO-1 application is acceptable.
HEATING (Version 7.3)	HEATING was used to calculate the fire resistance of conduit embedded in concrete	Heating 7 (Reference 120) Heating 6 (Reference 128) Heatchek (Reference 129) T-AKE Test and Evaluation (Reference 130)	• The model is validated in authoritative publications. Based on its review and evaluation, the NRC staff concludes that the use of this model in the ANO-1 application is acceptable.

Abbreviations and Acronyms

AACDG	alternate AC diesel generator
AC	alternating current
ACW	auxiliary cooling water
ADAMS	Agencywide Documents Access and Management System
ADV	atmospheric dump valve
AHJ	authority having jurisdiction
ANO-1	Arkansas Nuclear One, Unit 1
ANO-2	Arkansas Nuclear One, Unit 2
ANS	American Nuclear Society
AOV	air-operated valve
APCSB	Auxiliary and Power Conversion Systems Branch
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BAAT	boric acid addition tank
BTP	Branch Technical Position
BWR	boiling-water reactor
BWST	borated water storage tank
°C	degrees Centigrade
CC	Capability Categories
CCDP	conditional core damage probability
CDF	core damage frequency
CFAST	consolidated model of fire and smoke transport
CFR	*Code of Federal Regulations*
CFW	common feedwater
CHRISTIFIRE	Cable Heat Release, Ignition, and Spread in Tray Installations During Fire
CPT	control power transformer
CR	control room
CREACS	control room emergency air conditioning system
CREAVS	control room emergency ventilation system
CRS	control room supervisor
CSD	cold shutdown
CSR	Cable Spreading Room
CST	condensate storage tank
°F	degrees Fahrenheit
DC	direct current
DHR	decay heat removal
DID	defense-in-depth
DID RA	defense-in-depth recovery action
ECA	equipment cabinet area
ECP	emergency cooling pond
EDG	emergency diesel generator
EEEE	existing engineering equivalency evaluation
EFW	emergency feedwater
Entergy	Entergy Operations, Inc.
EPRI	Electric Power Research Institute
ERFBS	electrical raceway fire barrier system

ERO	emergency response organization
ERV	electromatic relief valve
ESF	engineered safety feature
F&O	fact and observation
FAQ	frequently asked question
FCV	flow control valve
FDT	fire dynamics tool
FLASH-CAT	Flame Spread over Horizontal Cable Trays
FM	fire modeling
FMDB	fire modeling database
FPE	fire protection engineering
FPP	fire protection program
FPRA	fire probabilistic risk assessment
FR	*Federal Register*
FRE	fire risk evaluation
FSAR	final safety analysis report
FSS	fire scenario selection and analysis
ft.	foot/feet
FTC	fuel transfer canal
FWS	firewall system
GDC	General Design Criterion/Criteria
GFMT	generic fire modeling treatment
GL	generic letter
Gpm	gallons per minute
HDPE	high-density polyethylene
HEAF	high-energy arcing fault
HEP	human error probability
HFE	human failure event
HGL	hot gas layer
HPI	high-pressure injection
HRA	human reliability analysis
HRE	high(er) risk evolution
HRR	heat release rate
HSD	hot shutdown
HVAC	heating, ventilation, and air conditioning
IEEE	Institute of Electrical and Electronics Engineers
IEPRA	internal events probabilistic risk assessment
IFPRA	internal flooding probabilistic risk assessment
IN	Information Notice
ICW	intermediate cooling water
KSF	Key Safety Function
kV	kilovolt
kW	kilowatt
LAR	license amendment request
LERF	large early release frequency
LOCA	loss-of-coolant accident
LPI	low-pressure injection

MCA	multi-compartment analysis
MCB	main control board
MCC	motor control center
MCR	main control room
MOV	motor operated valve
MR	maintenance rule
MSO	multiple spurious operations
MSSV	main steam safety valve
NEC	National Electrical Code
NEI	Nuclear Energy Institute
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
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	nuclear safety performance
NSPC	nuclear safety performance criteria
OMA	operator manual action
ORAT	outage risk assessment team
P&ID	piping and instrument drawing
PAU	physical analysis unit
PB	performance-based
PCE	plant change evaluation
PCS	primary control station
PDMS	plant data management system
PE	polyethylene
PFP	pre-fire plan
PMG	performance monitoring group
PORV	power-operated relief valve
PRA	probabilistic risk assessment
PSA	probabilistic safety assessment
psi	pounds per square inch
psig	pounds per square inch gauge
PVC	polyvinyl chloride
PWR	pressurized-water reactor
PWROG	Pressurized-Water Reactor Owners Group
QA	quality assurance
QCST	qualified condensate storage tank
RA	recovery action
RAI	request for additional information
RAW	risk achievement worth
RCA	Radiologically Controlled Area
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
RPS	reactor protection system
RWST	refueling water storage tank
SAR	safety analysis report
SBOD	station blackout diesel
SCBA	self-contained breathing apparatus
SDM	shutdown margin
SE	safety evaluation
SER	safety evaluation report
SFPE	Society of Fire Protection Engineers
SG	steam generator
SOKC	state of knowledge correlation
SPDS	safety parameter display system
SR	supporting requirement
SSA	safe shutdown analysis
SSC	structures, systems, and components
SSCA	safe shutdown capability assessment
SSD	safe shutdown
SSEL	safe shutdown equipment list
SW	service water
TR	Technical/Topical Report
TS	technical specifications
TSC	Technical Support Center
UFSAR	Updated Final Safety Analysis Report
UL	Underwriters Laboratories, Inc.
V	volt
V&V	verification and validation
VAC	volts alternating current
VDC	volt direct current
VFDR	variance from deterministic requirements
WCO	waste control operator
yr	year
ZOI	zone of influence

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

Sincerely,

/RA/

Thomas J. Wengert, Senior Project Manager
Plant Licensing IV-2 and Decommissioning
Transition Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-313

Enclosures:
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2. Safety Evaluation

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