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

February 18, 2015

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

SUBJECT: ARKANSAS NUCLEAR ONE, UNIT NO. 2 – ISSUANCE OF AMENDMENT REGARDING TRANSITION TO A RISK-INFORMED, PERFORMANCE-BASED FIRE PROTECTION PROGRAM IN ACCORDANCE WITH 10 CFR 50.48(c) (TAC NO. MF0404)

Dear Sir or Madam:

The U.S. Nuclear Regulatory Commission (NRC) has issued the enclosed Amendment No. 300 to Renewed Facility Operating License (FOL) No. NPF-6 for Arkansas Nuclear One, Unit No. 2 (ANO-2). The amendment revises the FOL and Technical Specifications (TSs) in response to your application dated December 17, 2012, as supplemented by letters dated November 7 and December 4, 2013; and January 6, May 22, June 30, August 7, September 24, and December 9, 2014. 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-2 and change the license and TS accordingly.

The amendment authorizes the transition of the ANO-2 fire protection program to a risk-informed, performance-based program based on National Fire Protection Association Standard 805 (NFPA 805), "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," 2001 Edition, in accordance with 10 CFR 50.48(c). NFPA 805 allows the use of performance-based methods, such as fire modeling and risk-informed methods such as fire probabilistic risk assessment, to demonstrate compliance with the nuclear safety performance criteria.

The fire protection license condition in ANO-2's license is revised to reflect the use of NFPA 805. To assure proper pagination of the license, the NRC is issuing license pages 3 through 9, but the only changes are the changes to the fire protection license condition.

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

Sincerely,

AEGeorge

Andrea E. George, Project Manager
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-368

Enclosures:
1. Amendment No. 300 to NPF-6
2. Safety Evaluation

cc w/encls: Distribution via Listserv

ENCLOSURE 1

AMENDMENT NO. 300

TO RENEWED FACILITY OPERATING LICENSE NO. NPF-6

ENTERGY OPERATIONS, INC.

ARKANSAS NUCLEAR ONE, UNIT NO. 2

DOCKET NO. 50-368

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

ENTERGY OPERATIONS, INC.

DOCKET NO. 50-368

ARKANSAS NUCLEAR ONE, UNIT NO. 2

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 300
Renewed License No. NPF-6

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

   A. The application for amendment by Entergy Operations, Inc. (the licensee), dated December 17, 2013, as supplemented by letters dated November 7 and December 4, 2013; and January 6, May 22, June 30, August 7, September 24, and December 9, 2014; complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

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

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

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

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

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and Paragraph 2.C.(2) of Renewed Facility Operating License No. NPF-6 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 300, are hereby incorporated in the renewed license. The licensee shall operate the facility in accordance with the Technical Specifications.

In addition, the license is amended as indicated in the attachment to this license amendment, and Paragraph 2.C.(3)(b) of Renewed Facility Operating License No. NPF-6 is hereby amended to read as follows:

(b) 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 license amendment request dated December 17, 2012, and supplements dated November 7, 2013, December 4, 2013, January 6, 2014, May 22, 2014, June 30, 2014, August 7, 2014, September 24, 2014, and December 9, 2014, and as approved in the SE dated February 18, 2015. Except where NRC approval for changes or deviations is required by 10 CFR 50.48(c), and provided no other regulation, technical specification, license condition or requirement would require prior NRC approval, the licensee may make changes to the fire protection program without prior approval of the Commission if those changes satisfy the provisions set forth in 10 CFR 50.48(a) and 10 CFR 50.48(c), the change does not require a change to a technical specification or a license condition, and the criteria listed below are satisfied.

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-2. Acceptable methods to assess the risk of the change may include methods that have been used in the peer-reviewed fire PRA model, methods that have been approved by NRC through a plant-specific license amendment or NRC approval of generic methods specifically for use in NFPA 805 risk assessments, or methods that have been demonstrated to bound the risk impact.

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

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

Other Changes that May Be Made Without Prior NRC Approval

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

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

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

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

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

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

   Prior NRC review and approval are not required for changes to the licensee's fire protection program that have been demonstrated to have no more than a minimal risk impact. The licensee may use its screening process as approved in the NRC SE dated February 18, 2015, to determine that certain fire protection program changes meet the minimal criterion. The licensee shall ensure that fire protection defense-in-depth and safety margins are maintained when changes are made to the fire protection program.

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 5, of Entergy Operations, Inc. letter 2CAN081401, dated August 7, 2014, 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, of Entergy Operations, Inc. letter 2CAN091402, dated September 24,

2014, within six months after issuance of the Safety Evaluation.

In addition, the license is amended as indicated in the attachment to this license amendment, and Paragraph 2.C.(3)(e) of Renewed Facility Operating License No. NPF-6 is hereby amended and revised to read as follows:

2.C.(3)(e) Deleted per Amendment 300, 2/18/15.

3. This license amendment is effective as of its date of issuance and shall be implemented within 6 months from the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

E. R. Oesterle

Eric R. Oesterle, Acting Chief
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Renewed Facility Operating License No. NPF-6 and Technical Specifications

Date of Issuance: February 18, 2015

ATTACHMENT TO LICENSE AMENDMENT NO. 300

TO RENEWED FACILITY OPERATING LICENSE NO. NPF-6

DOCKET NO. 50-368

Replace the following pages of Renewed Facility Operating License No. NPF-6 with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

REMOVE	INSERT
3	3
4	4
5	5
6	6
7	7
8	8
9	9

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

REMOVE	INSERT
6-3	6-3

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

(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 or instrument calibration or associated with radioactive apparatus or components; and

(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 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; and is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

EOI is authorized to operate the facility at steady state reactor core power levels not in excess of 3026 megawatts thermal. Prior to attaining this power level EOI shall comply with the conditions in Paragraph 2.C.(3).

(2) Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 300, are hereby incorporated in the renewed license. The licensee shall operate the facility in accordance with the Technical Specifications.

Exemptive 2nd paragraph of 2.C.2 deleted per Amendment 20, 3/3/81.

(3) Additional Conditions

The matters specified in the following conditions shall be completed to the satisfaction of the Commission within the stated time periods following issuance of the renewed license or within the operational restrictions indicated. The removal of these conditions shall be made by an amendment to the renewed license supported by a favorable evaluation by the Commission.

2.C.(3)(a) Deleted per Amendment 24, 6/19/81.

(b) 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 license amendment request dated December 17, 2012, and supplements dated November 7, 2013, December 4, 2013, January 6, 2014, May 22, 2014, June 30, 2014, August 7, 2014, September 24, 2014, and December 9, 2014, and as approved in the SE dated February 18, 2015. Except where NRC approval for changes or deviations is required by 10 CFR 50.48(c), and provided no other regulation, technical specification, license condition or requirement would require prior NRC approval, the licensee may make changes to the fire protection program without prior approval of the Commission if those changes satisfy the provisions set forth in 10 CFR 50.48(a) and 10 CFR 50.48(c), the change does not require a change to a technical specification or a license condition, and the criteria listed below are satisfied.

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-2. 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 an NFPA 805, Chapter 3, element is functionally equivalent to the corresponding technical requirement. A qualified fire protection engineer shall perform the engineering evaluation and conclude that the change has not affected the functionality of the component, system, procedure, or physical arrangement, using a relevant technical requirement or standard.

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

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

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

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

   Prior NRC review and approval are not required for changes to the licensee’s fire protection program that have been demonstrated to have no more than a minimal risk impact. The licensee may use its screening process as approved in the NRC SE dated February 18, 2015, to determine that certain fire protection program changes meet the minimal criterion. The licensee shall ensure that fire protection defense-in-depth and safety margins are maintained when changes are made to the fire protection program.

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 5, of Entergy Operations, Inc. letter 2CAN081401, dated August 7, 2014, 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, of Entergy Operations, Inc. letter 2CAN091402, dated September 24, 2014, within six months after issuance of the Safety Evaluation.

(c) Less Than Four Reactor Coolant Pump Operation

EOI shall not operate the reactor in operational Modes 1 and 2 with fewer than four reactor coolant pumps in operation, except as allowed by Special Test Exception 3.10.3 of the facility Technical Specifications.

2.C.(3)(d) Deleted per Amendment 24, 6/19/81.

2.C.(3)(e) Deleted per Amendment 300, 2/18/15.

2.C.(3)(f) Deleted per Amendment 24, 6/19/81.

2.C.(3)(g) Deleted per Amendment 93, 4/25/89.

2.C.(3)(h) Deleted per Amendment 29, (3/4/82) and its correction letter, (3/15/82).

(i) Containment Radiation Monitor

AP&L shall, prior to July 31, 1980 submit for Commission review and approval documentation which establishes the adequacy of the qualifications of the containment radiation monitors located inside the containment and shall complete the installation and testing of these instruments to demonstrate that they meet the operability requirements of Technical Specification No. 3.3.3.6.

2.C.(3)(j) Deleted per Amendment 7, 12/1/78.

2.C.(3)(k) Deleted per Amendment 12, 6/12/79 and Amendment 31, 5/12/82.

2.C.(3)(l) Deleted per Amendment 24, 6/19/81.

2.C.(3)(m) Deleted per Amendment 12, 6/12/79.

2.C.(3)(n) Deleted per Amendment 7, 12/1/78.

2.C.(3)(o) Deleted per Amendment 7, 12/1/78.

2.C.(3)(p) Deleted per Amendment 255, 9/28/04.

2.C.(4) (Number has never been used.)

2.C.(5) Deleted per Amendment 255, 9/28/04.

2.C.(6) Deleted per Amendment 255, 9/28/04.

2.C.(7) Deleted per Amendment 78, 7/22/86.

(8) Antitrust Conditions

EOI shall not market or broker power or energy from Arkansas Nuclear One, Unit 2. Entergy Arkansas, Inc. is responsible and accountable for the actions of its agents to the extent said agent's actions affect the marketing or brokering of power or energy from ANO, Unit 2.

(9) Rod Average Fuel Burnup

Entergy Operations is authorized to operate the facility with an individual rod average fuel burnup (burnup averaged over the length of a fuel rod) not to exceed 60 megawatt-days/kilogram of uranium.

(10) Mitigation Strategies

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

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

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

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

(11) Upon implementation of Amendment 288 adopting TSTF-448, Revision 3, the determination of control room envelope (CRE) unfiltered air inleakage as required by SR 4.7.6.1.2.d, in accordance with Specifications 6.5.12.c.(i), 6.5.12.c.(ii), and 6.5.12.d, shall be considered met. Following implementation:

(i) The first performance of SR 4.7.6.1.2.d, in accordance with Specification 6.5.12.c.(i), shall be within 15 months of the approval of TSTF-448. SR 4.0.2 will not be applicable to this first performance.

(ii) The first performance of the periodic assessment of CRE habitability, Specification 6.5.12.c.(ii), shall be within 15 months of the approval of TSTF-448. SR 4.0.2 will not be applicable to this first performance.

(iii) The first performance of the periodic measurement of CRE pressure, Specification 6.5.12.d, shall be within 15 months of the approval of TSTF-448. SR 4.0.2 will not be applicable to this first performance.

D. 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, Safeguards Contingency and Training & Qualification Plan," as submitted on May 4, 2006.

EOI shall fully implement and maintain in effect all provisions of the Commission-approved cyber security plan (CSP), including changes made pursuant to the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The EOI CSP was approved by License Amendment No. 294 as supplemented by changes approved by License Amendment Nos. 295 and 298.

E. This renewed license is subject to the following additional condition for the protection of the environment:

Before engaging in additional construction or operational activities which may result in an environmental impact that was not evaluated by the Commission, EOI will prepare and record an environmental evaluation for such activity. When the evaluation indicates that such activity may result in a significant adverse environmental impact that was not evaluated, or that is significantly greater than that evaluated, in the Final Environmental Statement (NUREG-0254) or any addendum thereto, and other NRC environmental impact assessments, EOI shall provide a written evaluation of such activities and obtain prior approval from the Director, Office of Nuclear Reactor Regulation.

F. Updated Final Safety Analysis Report Supplement

The Final Safety Analysis Report supplement, as revised, shall be included in the next scheduled update to the Final Safety Analysis Report required by 10 CFR 50.71(e)(4) following issuance of this renewed license. Until that update is complete, ANO-2 may make changes to the programs and activities described in the supplement without prior Commission approval, provided that ANO-2 evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59 and otherwise complies with the requirements of that section.

The ANO-2 Final Safety Analysis Report supplement, submitted pursuant to 10 CFR 54.21(d), describes certain future activities to be completed prior to the period of extended operation. ANO-2 shall complete these activities no later than July 17, 2018, and shall notify the NRC in writing when implementation of these activities is complete and can be verified by NRC inspection.

G. Reactor Vessel Material Surveillance Capsules

All capsules in the reactor vessel that are removed and tested must meet the test procedures and reporting requirements of American Society for Testing and Materials (ASTM) E 185-82 to the extent practicable for the configuration of the specimens in the capsule. Any changes to the capsule withdrawal schedule, including spare capsules, must be approved by the NRC prior to implementation. All capsules placed in storage must be maintained for future insertion.

4. This renewed license is effective as of the date of issuance and shall expire at midnight, July 17, 2038.

FOR THE NUCLEAR REGULATORY COMMISSION

Original signed by J. E. Dyer

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

Attachments:

1. Appendix A - Technical Specifications
2. Preoperational Tests, Startup Tests and other items which must be completed by the indicated Operational Mode

Date of Issuance: June 30, 2005

6.3 UNIT STAFF QUALIFICATIONS

6.3.1 Each member of the unit staff shall meet or exceed the minimum qualifications of ANSI/ANS 3.1-1978 for comparable positions with exceptions specified in the Entergy Quality Assurance Program Manual (QAPM).

6.3.2 For the purpose of 10 CFR 55.4, a licensed Senior Reactor Operator (SRO) and a licensed Reactor Operator (RO) are those individuals who, in addition to meeting the requirements of Specification 6.3.1, perform the functions described in 10 CFR 50.54(m).

6.4 PROCEDURES

6.4.1 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;

c. Deleted

d. All programs specified in Specification 6.5; and

e. Modification of core protection calculator (CPC) addressable constants. These procedures shall include provisions to ensure that sufficient margin is maintained in CPC type I addressable constants to avoid excessive operator interaction with the CPCs during reactor operation.

   Modifications to the CPC software (including changes of algorithms and fuel cycle specific data) shall be performed in accordance with the most recent version of "CPC Protection Algorithm Software Change Procedure," CEN-39(A)-P, which has been determined to be applicable to the facility. Additions or deletions to CPC addressable constants or changes to addressable constant software limit values shall not be implemented without prior NRC approval.

ENCLOSURE 2

SAFETY EVALUATION BY THE

OFFICE OF NUCLEAR REACTOR REGULATION

TRANSITION TO A RISK-INFORMED, PERFORMANCE-BASED

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

AMENDMENT NO. 300 TO RENEWED FACILITY OPERATING LICENSE NO. NPF-6

ENTERGY OPERATIONS, INC.

ARKANSAS NUCLEAR ONE, UNIT NO. 2

DOCKET NO. 50-368

Table of Contents

ATTACHMENTS

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. 300 TO RENEWED FACILITY OPERATING LICENSE NO. NPF-6

ENTERGY OPERATIONS, INC.

ARKANSAS NUCLEAR ONE, UNIT NO. 2

DOCKET NO. 50-368

1.0 INTRODUCTION

1.1 Background

The U.S. Nuclear Regulatory Commission (NRC) started developing fire protection requirements in the 1970s, and in 1976, the NRC published comprehensive fire protection guidelines in the form of Branch Technical Position (BTP) APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants" (Reference 1), and Appendix A to BTP APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants Docketed Prior to July 1, 1976" (Reference 2). Subsequently, the NRC performed fire protection reviews for the operating reactors, and documented the results in safety evaluation reports (SERs) or supplements to SERs. In 1980, to resolve issues identified in those reports, the NRC amended its regulations for fire protection in operating nuclear power plants and published its Final Rule, Fire Protection Program for Operating Nuclear Power Plants, in the *Federal Register* (FR) on November 19, 1980 (45 FR 76602), adding Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.48, "Fire protection," and Appendix R to 10 CFR Part 50, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979." Section 50.48(a)(1) requires each holder of an operating license, and holders of a combined operating license issued under Part 52 to have a fire protection plan that satisfies General Design Criterion (GDC) 3 of Appendix A to 10 CFR Part 50 and states that the fire protection plan must describe the overall fire protection program; identify the positions responsible for the program and the authority delegated to those positions; 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 the industry to develop a risk-informed (RI), performance-based (PB) consensus standard for fire protection. In 2001, the NFPA Standards Council issued NFPA 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants" (Reference 3), which describes a methodology for establishing fundamental fire protection program (FPP) design requirements and elements, determining required fire protection systems and features, applying PB requirements, and administering fire protection for existing light-water reactors during operation, decommissioning, and permanent shutdown. It provides for the establishment of a minimum set of fire protection requirements but allows PB or deterministic approaches to be used to meet performance criteria.

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

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

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

It also specifies that at least one success path to achieve the nuclear safety performance criteria (NSPC) shall be maintained free of fire damage by a single fire.

RG 1.205 also states, in part, that:

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

Throughout this safety evaluation (SE), where the NRC staff states that the licensee's FPP element is in compliance with (or meeting the requirements of) NFPA 805, the NRC staff is referring to the 2001 edition of NFPA 805 with the exceptions, modifications, and supplements described in 10 CFR 50.48(c)(2).

RG 1.205 also states, in part, that:

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

RG 1.205 provides the NRC staff's position on 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 NRC 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 the licensee to revise the Arkansas Nuclear One, Unit No. 2 (ANO-2) FPP in accordance with 10 CFR 50.48(c) and change the license and technical specifications (TSs) accordingly.

1.2 Requested Licensing Action

By letter dated December 17, 2012 (Reference 8), as supplemented by letters dated November 7, 2013 (Reference 9), December 4, 2013 (Reference 10), January 6, 2014 (Reference 11), May 22, 2014 (Reference 12), June 30, 2014 (Reference 13), August 7, 2014 (Reference 14), September 24, 2014 (Reference 15), and December 9, 2014 (Reference 16), the licensee submitted an application for a license amendment to transition the FPP from 10 CFR 50.48(b) to 10 CFR 50.48(c), National Fire Protection Association Standard NFPA 805. The supplemental letters were in response to the NRC staff's requests for additional information

(RAIs) dated September 11, 2013 (Reference 17), March 28, 2014 (Reference 18), and June 9, 2014 (Reference 19). The licensee's supplemental letters dated November 7, and December 4, 2013; January 6, May 22, June 30, August 7, September 24, and December 9, 2014, provided additional information that clarified the application, but did not expand the overall scope of the application as originally noticed, and did not change the NRC staff's original proposed opportunity for a hearing on the initial application as published in the *Federal Register* on July 23, 2013 (78 FR 44171).

The licensee requested an amendment to the ANO-2 renewed operating license and TSs to establish and maintain an RI/PB FPP in accordance with the requirements of 10 CFR 50.48(c).

Specifically, the licensee requested to transition ANO-2 from the existing deterministic fire protection licensing basis established in accordance with all provisions of the approved FPP as described in Amendment 9A (Reference 20) to the Safety Analysis Report and as approved in the SE dated March 31, 1992 (Reference 20), 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-2 is referred to as RI/PB FPP 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 identified any orders and license conditions that must be revised or superseded, and has provided the necessary revisions to the plant's TSs and Bases, as required by 10 CFR 50.48(c)(3)(i);

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

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

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

2.0 REGULATORY EVALUATION

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

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

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

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

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

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

As stated, in part, in 10 CFR 50.48(c)(3)(i),

> The Director of the Office of Nuclear Reactor Regulation [(NRR)], or a designee of the Director, may approve the application if the Director or designee determines that the licensee has identified orders, license conditions, and the 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," may do so by submitting an LAR in accordance with 10 CFR 50.48(c)(2)(vii). This regulation further provides that:

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

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

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

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

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

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

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

2.1 Applicable Regulations

The following regulations address fire protection:

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

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

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

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

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

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

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

2.2 Applicable Staff Guidance

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

- RG 1.205, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants," Revision 1, issued December 2009 (Reference 4), provides guidance for use in complying with the requirements that the NRC has promulgated for RI/PB FPPs that comply with 10 CFR 50.48 and the referenced 2001 Edition of the NFPA standard. It endorses portions of NEI 04-02, Revision 2, where it has been found to provide methods acceptable to the NRC for implementing NFPA 805 and complying with 10 CFR 50.48(c). The regulatory positions in Section C of RG 1.205 include clarification of the guidance provided in NEI 04-02, as well as NRC exceptions to the guidance. RG 1.205 sets forth regulatory positions, emphasizes certain issues, clarifies the requirements of 10 CFR 50.48(c) and NFPA 805, clarifies the guidance in NEI 04-02, and modifies the NEI 04-02 guidance where required. Should a conflict occur between NEI 04-02 and this RG, the regulatory positions in RG 1.205 govern.

- The 2001 edition of NFPA 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants" (Reference 3), specifies the minimum fire protection requirements for existing light water nuclear power plants during all phases of plant operations, including shutdown, degraded conditions, and decommissioning. NFPA 805 was developed to provide a comprehensive RI/PB standard for fire protection. The NFPA 805 Technical Committee on Nuclear Facilities is composed of nuclear plant licensees, the NRC, insurers, equipment manufacturers, and subject matter experts. The standard was developed in accordance with NFPA processes, and consisted of a number of technical meetings and reviews of draft documents by committee and industry representatives. The scope of NFPA 805 includes goals related to nuclear safety, radioactive release, life safety, and plant damage/business interruption. The standard addresses fire protection requirements for nuclear plants during all plant operating modes and conditions, including shutdown and decommissioning. 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, issued April 2008 (Reference 7), provides guidance for implementing the requirements of 10 CFR 50.48(c), and represents methods for implementing in whole or in part an RI/PB FPP. This implementing guidance for NFPA 805 has two primary purposes: (1) 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, issued May 2009 (Reference 21), 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 current licensing basis) that may be used in conjunction with the deterministic methods for resolving circuit failure issues related to multiple spurious operations (MSOs). The RI method is intended for application by licensees to determine the risk significance of identified circuit failure issues related to MSOs.

- RG 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," Revision 2, issued May 2011 (Reference 22), provides the NRC staff's recommendations for using risk information in support of licensee-initiated licensing basis changes to a nuclear power plant that require such review and approval. The guidance provided does not preclude other approaches for requesting licensing basis changes. Rather, RG 1.174 is intended to improve consistency in regulatory decisions in areas in which the results of risk analyses are used to help justify regulatory action. As such, the RG provides general guidance concerning one approach that the NRC has determined to be acceptable for analyzing issues associated with proposed changes to a plant's current 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 23), provides guidance to licensees for use in determining the technical adequacy of the base probabilistic risk assessment (PRA) used in an RI regulatory activity, and endorses standards and industry peer review guidance. The RG provides guidance in four areas:

  (1) a definition of a technically acceptable PRA;

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

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

  (4) documentation needed to support a regulatory submittal.

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

- American Society of Mechanical Engineers (ASME)/American Nuclear Society (ANS) RA-Sa-2009, "Addenda to ASME/ANS RA-S-2008, Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications" (Reference 24), provides guidance for PRAs used to support RI decisions for commercial light water reactor nuclear power plants and prescribes a method for applying these requirements for specific applications. The standard gives guidance for a Level 1 PRA of internal and external hazards for all plant operating modes. In addition, the standard provides guidance for a limited Level 2 PRA sufficient to evaluate large early release frequency (LERF). The only hazards explicitly excluded from the scope are accidents resulting from purposeful human-induced security threats (e.g., sabotage). The standard applies to PRAs used to support applications of RI decision-making related to design, licensing, procurement, construction, operation, and maintenance.

- RG 1.189, "Fire Protection for Nuclear Power Plants," Revision 2, issued October 2009 (Reference 25), provides guidance to licensees on the proper content and quality of engineering equivalency evaluations used to support the FPP. The NRC staff developed the RG to provide a comprehensive fire protection guidance document and to identify the scope and depth of fire protection that the NRC staff would consider acceptable for nuclear power plants.

- NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Section 9.5.1.2, "Risk-Informed, Performance-Based Fire Protection Program," Revision 0, issued December 2009 (Reference 26), which provides guidance for the NRC staff for evaluation of 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 Results for Risk-Informed License Amendment Requests after Initial Fuel Load," Revision 3, issued September 2012 (Reference 27), which provides guidance for the NRC staff for evaluation of 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 28), provides guidance for the NRC staff for evaluation of the risk information used by a licensee to support permanent, RI changes to the licensing basis for the plant.

- NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities," Volume 1, issued September 2005 (Reference 29), Volume 2, issued September 2005 (Reference 30), and Supplement 1, issued September 2010 (Reference 31), present a compendium of methods, data and tools to perform a fire PRA (FPRA) and develop associated insights. In order to address the need for improved methods, the NRC Office of Nuclear Regulatory Research (RES) and the 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, fire modeling, electrical engineering, human reliability analysis, and systems engineering for methods development. A formal technical issue resolution process was developed to direct the deliberative process between RES and EPRI. The process ensures that divergent technical views are fully considered, yet encourages consensus at many points during the deliberation. Significantly, the process provides that each party maintain its own point of view if consensus is not reached. Consensus was reached on all technical issues documented in NUREG/CR-6850. The methodology documented in this report reflects the current state-of-the-art in FPRA. These methods are expected to form a basis for RI analyses related to the plant FPP. Volume 1, the Executive Summary, provides general background and overview information, including programmatic, technical, and project insights, and conclusions. Volume 2 provides a detailed discussion of the recommended approach, methods, data, and tools for conduct of an FPRA.

- Memorandum from Richard P. Correia, RES, to Joseph G. Giitter, NRR, titled "Interim Technical Guidance on Fire-Induced Circuit Failure Mode Likelihood Analysis," dated June 14, 2013 (Reference 32), notes that, based on new experimental information documented in NUREG/CR-6931, "Cable Response to Live Fire (CAROLFIRE)," issued April 2008 (Reference 33), and NUREG/CR- 7100, "Direct Current Electrical Shorting in Response to Exposure Fire (DESIREE-Fire): Test Results," issued April 2012 (Reference 34), 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-1570, "Risk Assessment of Severe Accident-Induced Steam Generator Tube Rupture," issued March 1998 (Reference 35), presents the basis, results, and related risk implications of an analysis performed by an NRC working group to assess the containment bypass potential attributable to steam generator tube rupture induced by severe accident conditions. The main result of the analysis was an estimate of the probabilities of pressure and temperature-induced failure of steam generator tubes and containment bypass frequency for the severe accident conditions considered.

- NUREG-1805, "Fire Dynamics Tools (FDTs): Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program," issued December 2004 (Reference 36), 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 safe shutdown equipment.

- NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," Volumes 1 through 7, issued May 2007 (Reference 37), provide technical documentation regarding the predictive capabilities of a specific set of fire models for the analysis of fire hazards in nuclear power plant scenarios. This report is the result of a collaborative program with the EPRI and the National Institute of Standards and Technology (NIST). The selected models are:

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

    (2) The Fire-Induced Vulnerability Evaluation, Revision 1 (FIVE) developed by EPRI (Volume 4);

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

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

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

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

- NUREG/CR-7010, "Cable Heat Release, Ignition, and Spread in Tray Installations during Fire (CHRISTIFIRE), Phase 1: Horizontal Trays," Volume 1 (Reference 38), 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," issued March 2009 (Reference 39), provides guidance on how to treat uncertainties associated with PRA in RI decision-making. The objectives of this guidance include fostering an understanding of the uncertainties associated with PRA and their impact on the results of PRA and providing a pragmatic approach to addressing these uncertainties in the context of the decision-making. To meet the objective of the NUREG, it is necessary to understand the role that PRA results play in the context of the decision process. To define this context, NUREG-1855 provides an overview of the RI decision making process itself.

- NUREG-1921, "EPRI/NRC-RES Fire Human Reliability Analysis Guidelines – Final Report," issued July 2012 (Reference 40), presents the state of the art in fire human reliability analysis (HRA) practice. This report was developed jointly between RES and EPRI to develop the methodology and supporting guidelines for estimating human error probabilities for human failure events following the fire-induced initiating events of an FPRA. The report builds on existing HRA methods, and is intended primarily for practitioners conducting a fire HRA to support an FPRA.

- NUREG-1934, "Nuclear Power Plant Fire Modeling Analysis Guidelines (NPP FIRE MAG)," issued November 2012 (Reference 41), describes the implications of the verification and validation (V&V) results from NUREG-1824 for fire model users. The features and limitations of the fire models documented in NUREG-1824 are discussed relative to their use to support nuclear power plant

(NPP) fire hazard analyses. The report also provides information to assist fire model users in applying this technology in the NPP environment.

- NUREG/CR-6595, "An Approach for Estimating the Frequencies of Various Containment Failure Modes and Bypass Events," Revision 1, issued October 2004 (Reference 42), provides a simplified approach for using PRA to estimate the frequency of containment failure and bypass events that result in radioactive releases to the environment with the potential for causing early fatalities. The approach uses LERF as a measure of the risk of early fatality, and provides guidance for estimating LERF under low power and shutdown conditions.

- Generic Letter (GL) 2006-03, "Potentially Nonconforming Hemyc and MT Fire Barrier Configurations," dated April 10, 2006 (Reference 43), requested that licensees evaluate their facilities to confirm compliance with the existing applicable regulatory requirements in light of the information provided in this GL and, if appropriate, take additional actions.

- Branch Technical Position (BTP) Chemical Engineering Branch (CMEB) 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants," Revision 2, July 1981 (Reference 44), provides the NRC staff with guidance for implementing a deterministic FPP in accordance with 10 CFR 50, Section 50.48 and Appendix R.

- NFPA 13, "Standard for the Installation of Sprinkler Systems" (Reference 45), is the industry benchmark for design and installation of automatic fire sprinkler systems. NFPA 13 addresses sprinkler system design approaches, system installation, acceptance testing, and component options.

- NFPA 14, "Standard for the Installation of Standpipe and Hose Systems" (Reference 46), provides the minimum requirements for the installation of standpipes and hose systems to ensure that systems will work as intended to deliver adequate and reliable water supplies in a fire emergency. NFPA 14 covers all system components and hardware, including piping, fittings, valves, and pressure-regulation devices, as well as system requirements; installation requirements; design; plans and calculations; water supply; and system acceptance.

- Regulatory Issue Summary (RIS) 2004-03, Revision 1, "Risk-Informed Approach for Post-Fire Safe-Shutdown Circuit Inspections," dated December 29, 2004 (Reference 47), informed the industry that the NRC has risk-informed its inspection procedure for post-fire safe shutdown (SSD) circuit analysis inspections to concentrate inspections on circuit failures that have a relatively high likelihood of occurrence. The RIS describes three categories, or bins, of circuit failure likelihood and the inspection process used to assess circuit configurations in each of the three bins. This RIS also describes the process the NRC will use to implement the Reactor Oversight Process for post-fire SSD circuit inspection findings.

- NRC Information Notice (IN) 84-09, Revision 1, "Lessons Learned from NRC Inspections of Fire Protection Safe Shutdown Systems (10 CFR 50, Appendix R)," dated March 7, 1984 (Reference 48), provides the industry with supplemental guidance on meeting the fire protection SSD requirements in 10 CFR 50 Appendix R. IN 84-09 includes supplemental guidance on establishing fire areas, fire barrier testing and configuration, protection of equipment necessary to achieve hot shutdown, performing reassessments for conformance with Appendix R, identification of SSD systems and components, assessing combustibility of electrical cable insulation, detection and automatic suppression, instrumentation and procedures necessary for alternative shutdown, fire protection features for cold shutdown systems, and configuration of reactor coolant pump oil collection systems.

2.3 NFPA 805 Frequently Asked Questions

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

Table 2.3-1: NFPA 805 Frequently Asked Questions

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 49)	3.1.4
07-0030	"Establishing Recovery Actions" • This FAQ provides an acceptable process for determining the recovery actions (RAs) for NFPA 805 Chapter 4 compliance. The process includes: ▪ Differentiation between RAs and activities in the main control room or at primary control station(s). ▪ Determination of which RAs are required by the NFPA 805 FPP. ▪ Evaluate the additional risk presented by the use of RAs. ▪ Evaluate the feasibility of the identified RAs. ▪ Evaluate the reliability of the identified RAs.	(Reference 50)	3.2.5 3.4.4

FAQ #	FAQ Title and Summary	Reference	SE Section
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 51)	3.2.4
07-0039	"Incorporation of Pilot Plant Lessons Learned – Table B-2" • This FAQ provides additional detail for the comparison of the licensee's SSD strategy to the endorsed industry guidance, NEI 00-01 "Guidance for Post-Fire Safe Shutdown Circuit Analysis," Revision 1 (Reference 52). 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 53)	3.2.1
07-0040	"Non-Power Operations (NPO) Clarifications" • This FAQ clarifies an acceptable NFPA 805 NPO program. The process includes: ▪ Selecting NPO equipment and cabling. ▪ Evaluation of NPO Higher Risk Evolutions (HRE). ▪ Analyzing NPO key safety functions (KSF). ▪ Identifying plant areas to protect or "pinch points" during NPO HREs and actions to be taken if KSFs are lost.	(Reference 54)	3.5.3

FAQ #	FAQ Title and Summary	Reference	SE Section
08-0046	"Incipient Fire Detection Systems" • This FAQ provides guidance for modeling non-suppression probability when an incipient fire detection system is installed in electrical cabinets outside the Main Control Room.	(Reference 55)	3.2.6 3.4.2
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 56)	3.4.7
08-0050	"Manual Non-Suppression Probability" • This FAQ updates the treatment of manual suppression and fire brigade response. The update includes a process to adjust the non-suppression analysis for scenario-specific fire brigade responses.	(Reference 57)	3.4.2
08-0052	"Transient Fires - Growth Rates and Control Room Non-Suppression" • This FAQ clarifies and updates the treatment of transient fires in terms of both manual suppression and time-dependent fire growth modeling.	(Reference 58)	3.4.2
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 59)	3.4.1 3.4.3 3.5.1

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 60)	3.7
12-0062	"Updated Final Safety Analysis Report (UFSAR) Content" • This FAQ provides the necessary level of detail for the transition of the fire protection sections within the UFSAR.	(Reference 61)	2.4.4

2.4 Orders, License Conditions, and Technical Specifications

Paragraph 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-2 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-2 are maintained. The licensee discussed the affected orders and exemptions in LAR Attachment O.

The licensee requested that two exemptions be transitioned into the NFPA 805 FPP and that 18 exemptions be rescinded. The licensee also determined that no orders need to be superseded or revised to implement an FPP at ANO-2 that complies with 10 CFR 50.48(c).

The licensee's review included an assessment of docketed correspondence files and electronic searches. The review was performed to ensure that compliance with the physical protection requirements, security orders, and adherence to commitments applicable to ANO-2 are maintained. The NRC staff accepts the licensee's determination that two exemptions should be transitioned into the NFPA 805 FPP and that 18 exemptions should be rescinded as listed in LAR Attachment K, "Existing Licensing Action Transition," of the LAR, and that no orders need to be superseded or revised to implement NFPA 805 at ANO-2. See SE Section 2.5 for the NRC staff's evaluation of the exemptions being rescinded.

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

2.4.2 License Conditions

The NRC staff reviewed LAR Section 5.2.1, "License Condition Changes," and Attachment M, "License Condition Changes," regarding changes the licensee seeks to make to the ANO-2 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-2 fire protection license condition 2.C.(3)(b), for consistency with the content guidance outlined by Regulatory Position C.3.1 of RG 1.205, Revision 1, and with the proposed plant modifications identified in the LAR.

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

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

Overall, the licensee's proposed revised license condition allows self-approval for FPP changes that meet the requirements of NFPA 805 with regard to engineering analyses, fire risk evaluations (FREs), and plant change evaluations (PCEs). The NRC staff's evaluation of the self-approval process for FPP changes (post-transition) is contained in SE Section 2.6. The license condition also references the plant-specific modification and associated implementation item schedules that must be accomplished at ANO-2 to complete transition to NFPA 805 and comply with 10 CFR 50.48(c). In addition, the license condition includes a requirement that appropriate compensatory measures remain in place until the specified plant modifications are completed. These modifications and implementation schedules are identical to those identified elsewhere in the LAR, as discussed by the NRC staff in SE Sections 2.7.1 and 2.7.2, and reviewed in SE Section 3.0.

SE Section 4.0 provides the NRC staff's review of the proposed ANO-2 FPP license condition.

2.4.3 Technical Specifications

The NRC staff reviewed LAR Section 5.2.2, "Technical Specifications," and Attachment N, "Technical Specification Changes," with regard to proposed changes to the ANO-2 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-2 TSs to determine which, if any, TS sections will be impacted by the transition to an RI/PB FPP based on 10 CFR 50.48(c). The licensee identified changes to the TSs needed for 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 6.4.1.c, which requires that procedures be established, implemented, and maintained for FPP implementation.

Specifically, the licensee stated that deleting TS 6.4.1.c is acceptable for adoption of the new fire protection licensing basis since the requirement for establishing, implementing, and maintaining fire protection procedures is contained in 10 CFR 50.48(a) and 10 CFR 50.48(c). The regulations in 10 CFR 50.48(c) approve the incorporation of NFPA 805 by reference and NFPA 805 Section 3.2.3, "Procedures," states that "Procedures shall be established for implementation of the fire protection program."

Based on the information provided by the licensee, the NRC staff concludes that the proposed deletion is acceptable because TS 6.4.1.c is an administrative control (i.e., a procedure the licensee puts in place to establish, implement, and maintain the FPP as required by the licensee's fire protection license condition and 10 CFR 50.48(a), 10 CFR 50.48(c), and NFPA 805, Section 3.2.3), and would be redundant to the NFPA 805 requirement to establish FPP procedures. NFPA 805 requires the licensee to establish FPP procedures, and 10 CFR 50.48(a) and 10 CFR 40.48(c) would become the fire protection licensing basis of ANO-2. 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 licensee condition, see SE Section 4.0.

2.4.4 Safety Analysis Report

The NRC staff reviewed LAR Section 5.4 "Revision to the SAR," which states: "After the approval of the LAR and in accordance with 10 CFR 50.71(e), the ANO-2 SAR will be revised," and that "the format and content will be consistent with NEI 04-02, as addressed in FAQ 12-0062."

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

2.5 <u>Rescission of Exemptions</u>

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. These exemptions will no longer be required since upon approval of the RI/PB FPP in accordance with NFPA 805, Appendix R will not be part of the licensing basis for ANO-2.

The licensee previously requested and received NRC approval for 20 exemptions from 10 CFR Part 50 Appendix R. These exemptions were discussed in detail in LAR Attachment K. The licensee stated that the exemptions are either compliant with 10 CFR 50.48(c), or are no longer necessary in accordance with the requirements of 10 CFR 50.48(c)(3)(i). The licensee requested, in accordance with the requirements of 10 CFR 50.48(c)(3)(i), that 18 of the exemptions be rescinded.

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

- The exemption is found to be unnecessary since the underlying condition has been evaluated using RI/PB methods (fire modeling and/or FRE) and found to be acceptable and no further actions are necessary by the licensee; and

- 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, originally approved by NRC SERs dated March 22, 1983 (Reference 62), October 26, 1988 (Reference 63), and October 1, 1999 (Reference 64) are rescinded, as requested by the LAR, and the underlying condition has either been evaluated using RI/PB methods, has been evaluated using an existing engineering equivalency evaluation, or has been found to be deterministically compliant, and found to be acceptable with no further actions (numbering scheme provided by the licensee):

- Appendix R Exemption 01, FA - OO, Not Meeting III.G.2 Criteria, Exemption to the requirement for automatic suppression/detection, intake structure.

- Appendix R Exemption 02, FA - OO, Not Meeting III.G.2 Criteria, Exemption to the requirement for separation with detection/suppression, intake structure.

- Appendix R Exemption 03, FA - CC, Not Meeting 3-hour Rated Barrier, III.G.2 Criteria, Exemption to the requirement for three hour rated barrier, turbine driven emergency feedwater pump room.

- Appendix R Exemption 04, FA - NN, Not Meeting III.G.2 Criteria, Exemption to the requirement for separation with no intervening combustibles, containment building.

- Appendix R Exemption 05, FA - DD, Not Meeting III.G.2 Criteria, Exemption to the requirement for automatic suppression and rated barriers, corridor.

- Appendix R Exemption 06, FA – EE-L (Originally a portion of FA – EE), Not Meeting III.G Criteria, Exemption to the requirement for three hour rated door, lower south piping penetration room.

- Appendix R Exemption 07, FA - JJ, Lack of Barrier/Separation III.G.2 Criteria, Exemption to the requirement for separation with no intervening combustibles, corridor.

- Appendix R Exemption 08, FA - GG, Not Meeting III.G.3 Criteria, Exemption to the requirement for suppression and direction, upper north and lower north piping penetration room.

- Appendix R Exemption 09, FA - HH, Not Meeting III.G.3 Criteria, Exemption to the requirement for automatic suppression, motor control center, degasifier vacuum pump room, corridor.

- Appendix R Exemption 10, FA – B-3, Not Meeting III.G.3 Criteria, Exemption to the requirement automatic suppression, north electrical equipment room.

- Appendix R Exemption 11, FA – B-2, Not Meeting III.G.3 Criteria, Exemption to the requirement for automatic suppression, pipeway equipment access room.

- Appendix R Exemption 12, FA - G, Not Meeting III.G.3 Criteria, Exemption to the requirement for automatic suppression, health physics corridor, old core protection calculator room.

- Appendix R Exemption 13, FA – KK (Originally FA – B), Not Meeting III.G.2 Criteria, Exemption to the requirement for separation with suppression/detection, emergency diesel generator air intake room.

- Appendix R Exemption 13A, FA – QQ (Originally FA – B), Not Meeting III.G.2 Criteria, Exemption to the requirement for separation with suppression/detection, emergency diesel generator air intake room.

- Appendix R Exemption 14, FA - G, Not Meeting III.G.3 Criteria, Exemption to the requirement for suppression, unit 2 control room.

- Appendix R Exemption 15, FA – EE-L (Originally a portion of FA – EE), Not Meeting III.G.2 Criteria, Exemption to the requirement for automatic suppression, lower south piping penetration room, upper south piping penetration room and waste gas equipment room.

- Appendix R Exemption 16, FA - YD, Not Meeting III.G.2 Criteria, Exemption to the requirement for separation, miscellaneous yard locations.

- Appendix R Exemption 18, FA - YD, Emergency Lighting, Not Meeting III.J Criteria, Exemption to the requirement for emergency lighting, miscellaneous yard locations.

The following exemptions are rescinded but the engineering evaluation of the underlying condition will be used as a qualitative engineering evaluation for transition to NFPA 805:

- Appendix R Exemption 17, FA - NN, RCP Oil Collection, Not Meeting III.O Criteria, Exemption to the requirement to contain entire oil supply and meet SSD earthquake requirements, containment building.

- Appendix R Exemption 19, FA - NN, RCP Oil Fill Line, Not Meeting III.O Criteria, Exemption to the requirement to contain remote oil addition line leakage, containment building.

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 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 plant change evaluation (PCE) process requirements to address potential changes to the NFPA 805 RI/PB FPP after implementation is completed. The licensee will develop a change process that is based on the guidance provided in NEI 04-02, Section 5.3, "Plant Change Process," as well as Appendices B, I, and J, as modified by RG 1.205, Regulatory Positions 2.2.4, 3.1, 3.2, and 4.3.

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

1. Defining the change;
2. Performing the preliminary risk screening;
3. Performing the risk evaluation; and
4. Evaluating the acceptance criteria.

In the LAR, the licensee stated that the PCE process begins by defining the change or altered condition to be examined and the baseline configuration. The licensee stated that the baseline is defined as that plant condition or configuration that is consistent with the licensing basis (NFPA 805 licensing basis post-transition) 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 that the screening is consistent with fire protection regulatory review processes currently in place at nuclear plants under traditional licensing bases. The licensee stated that the screening process is modeled after the NEI 02-03, "Guidance for Performing a Regulatory Review of Proposed Changes to the Approved Fire Protection Program," issued June 2003 (Reference 65), a process that will address most administrative changes (e.g., changes to the combustible control program, organizational changes, etc.). The licensee further stated in LAR Section 4.7.2 that if the characteristics of an acceptable screening process that meets the assessment of the acceptability of risk requirement of Section 2.4.4 of NFPA 805 are not met, then the licensee will proceed to the risk evaluation step of the PCE process.

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

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

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

The licensee stated that the ANO-2 FPP configuration is defined by the program documentation and that, to the greatest extent possible, the existing configuration control processes for modifications, calculations and analyses, and FPP license basis reviews will be utilized to maintain configuration control of the FPP documents. The licensee further stated that the configuration control procedures, which govern the various ANO-2 documents and databases that currently exist, will be revised to reflect the new NFPA 805 licensing bases requirements. The licensee included an action to develop or revise technical documents and procedures that relate to the new fire protection design and licensing basis as required for implementation of NFPA 805 in LAR Attachment S, Table S-2, Implementation Item S2-7. The NRC staff concludes that this action is acceptable because the action will incorporate the provisions of NFPA 805 into the licensee's FPP and because the action is included as an implementation item which is required by the proposed license condition.

The licensee stated that several NFPA 805 document types, such as Nuclear Safety Capability Assessment (NSCA) Supporting Information, Non-Power Mode NSCA Treatment, etc., generally require new control procedures and processes to be developed since they are new documents and databases created as a result of the transition to NFPA 805. In addition, the new procedures will be modeled after the existing processes for similar types of documents and databases. The licensee further stated that system-level design basis documents will be revised to reflect the NFPA 805 role that the systems and components now play. The licensee included an action to develop or revise technical documents and procedures that relate to the new fire protection design and licensing basis as required for implementation of NFPA 805 in LAR Attachment S, Table S-2, Implementation Item S2-7. The NRC staff concludes that this action is acceptable because the action will incorporate the provisions of NFPA 805 into the licensee's FPP and because the action is included as an implementation item which is required by the proposed license condition.

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

- Performance-Based Approach: Utilize the NFPA 805 change process developed in accordance with NEI 04-02, RG 1.205, and the ANO-2 NFPA 805 fire protection license condition to assess the acceptability of the proposed change. This process will be used to determine if the proposed change could be implemented “as-is” or whether prior NRC approval of the proposed change is required.

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

Since NFPA 805 always requires the use of a PCE, regardless of what element requires the change, 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-2 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 and the evaluation above, 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 margin. NFPA 805, Section 2.4.3.1 requires that the probabilistic safety assessment (PSA) use CDF and LERF as measures for risk. NFPA 805, Section 2.4.3.3 requires that the risk assessment approach, methods, and data 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.

2.6.2 Requirements for the Self-Approval Process Regarding Plant Changes

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

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

However, before achieving full compliance with 10 CFR 50.48(c) by completing the plant modifications and implementation items listed in SE Section 2.7 (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 Regulatory Position C.3.1 of RG 1.205, Revision 1 (Reference 4), with respect to the requirements for FPP changes during transition, and therefore demonstrate compliance with 10 CFR 50.48(c).

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

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

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

The four 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. Section 3.4.2, "Quality of the Fire Probabilistic Risk Assessment," of this SE discusses the technical adequacy of the FPRA, including the licensee's process to ensure that the FPRA remains current. Based on information provided by the licensee, the NRC staff concludes that the quality of the licensee's FPRA and associated administrative controls and processes for maintaining the quality of the PRA model is sufficient to support self-approval of future RI changes to the FPP under the proposed license conditions, and, therefore, the licensee's process for self-approving future FPP changes is acceptable.

The NRC staff further concludes, based on the licensee's administrative controls to ensure that the models remain current and to assure continued quality (see SE Section 3.4.2, "Quality of the Fire Probabilistic Risk Assessment"), that the FRE methods used to model the cause-and-effect relationship of associated changes as a means of assessing the risk of plant changes during transition to NFPA 805 may continue to be used after implementation of the RI/PB FPP. 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), says that a license condition included in a NFPA 805 LAR should include: (1) a list of modifications being made to bring the plant into compliance with 10 CFR 50.48(c); (2) a schedule detailing when these modifications will be completed; and (3) a statement that the licensee shall maintain appropriate compensatory measures in place until implementation of the modifications are completed.

The list of modifications and implementation items originally submitted in the LAR have been updated by the licensee with the final version of LAR Attachment S, "Plant Modifications and Items to be Completed during Implementation," provided in the licensee's letters dated August 7, 2014 (Reference 14), and September 24, 2014 (Reference 15).

2.7.1 Modifications

The NRC staff reviewed LAR Attachment S, "Plant Modifications and Items to be Completed During Implementation," which describes the plant modifications necessary to implement the NFPA 805 licensing basis, as proposed. These modifications are identified in the LAR as necessary to bring ANO-2 into compliance with either the deterministic or PB requirements of NFPA 805. As described below, LAR Attachment S, Table S-1 provides a description of each of the proposed plant modifications, presents the problem statement explaining why the modification is needed, and identifies the compensatory actions required to be in place pending completion/implementation of the modification.

The NRC staff's review confirmed that the modifications identified in LAR Table S-1 are the same as those identified in LAR Table B-3, "Fire Area Transition," on a fire area basis, as the modifications being credited in the proposed NFPA 805 licensing basis. The NRC staff also confirmed that the LAR Attachment S, Table S-1 modifications, and 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-2 to be fully in accordance with NFPA 805, implement many of the attributes upon which this SE is based, and thereby meet the requirements of 10 CFR 50.48(c). The modifications will be completed in accordance with the schedule provided in the proposed NFPA 805 license condition, which states that the modifications will be completed by the startup of the second refueling outage after issuance of the SE and that appropriate compensatory measures will be maintained until the modifications are complete.

2.7.2 Implementation Items

Implementation Items are items that the licensee has not fully completed or implemented as of the issuance date of the license amendment, but which will be completed during implementation of the license amendment to transition to NFPA 805 (e.g., procedure changes that are still in process, or NFPA 805 programs that have not been fully implemented). The licensee identified the implementation items in LAR Attachment S, Table S-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 and the proposed license condition does not change or impact the bases for the safety conclusions made by the NRC staff in the SE.

Each implementation item will be completed prior to the deadline for implementation of the RI/PB FPP based on NFPA 805, as specified in the license condition and the letter transmitting the amended license (i.e., implementation period), which states that the implementation items listed in LAR Attachment S, Table S-2, will be completed 6 months following issuance of the SE.

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

2.7.3 Schedule

LAR Section 5.5 provides the licensee's proposed overall schedule for completing the NFPA 805 transition at ANO-2. The licensee stated that it will complete the implementation of new NFPA 805 FPP to include procedure changes, process updates, and training to affected plant personnel within 6 months after issuance of the SE.

LAR Section 5.5 also states that modifications will be completed by the startup of the second refueling outage after issuance of the SE and that appropriate compensatory measures will be maintained until modifications are complete.

3.0 TECHNICAL EVALUATION

The following sections evaluate the technical aspects of the requested license amendment to transition the FPP at ANO-2 to one based on NFPA 805 (Reference 3) in accordance with 10 CFR 50.48(c). While performing the technical evaluation of the licensee's submittal, the NRC staff utilized the guidance provided in NUREG-0800, Section 9.5.1.2, "Risk-Informed, Performance-Based Fire Protection" (Reference 26), 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 Fire Protection Program and Design Elements."
- Section 3.2 provides the results of the NRC staff review of the methods used by the licensee to demonstrate the ability to meet the NSPC.

- Section 3.3 provides the results of the NRC staff review of the fire modeling (FM) methods used by the licensee to demonstrate the ability to meet the NSPC using a fire modeling 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.

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

3.1 NFPA 805 Fundamental FPP Elements and Minimum Design Requirements

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

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

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

- 10 CFR 50.48(c)(2)(vii) – *Performance-based methods*. While Section 3.1 of NFPA 805 prohibits the use of PB methods to demonstrate compliance with the NFPA 805, Chapter 3 requirements, 10 CFR 50.48(c)(2)(vii) specifically permits that the 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 (which is the authority having jurisdiction (AHJ), as denoted in NFPA 805 and Regulatory Guide (RG) 1.205), and are contained in the currently approved FPP for the facility.

3.1.1 Compliance with NFPA 805, Chapter 3 Requirements

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

The methods used by ANO-2 for achieving compliance with the fundamental FPP elements and minimum design requirements are as follows:

1. The existing FPP element directly complies with the requirement: noted in LAR Attachment A, "NEI 04-02 Table B-1, Transition of Fundamental FPP and Design Elements," (also called the B-1 Table), as "Complies." (see discussion in SE Section 3.1.1.1)

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

3. The existing FPP element complies through the use of existing engineering equivalency evaluations (EEEEs) whose bases remain valid and are of sufficient quality: noted in the B-1 Table as "Complies with use of EEEEs." (see discussion in SE Section 3.1.1.3)

4. The existing FPP element complies with the requirement based on prior NRC approval of an alternative to the fundamental FPP attribute and the bases for the NRC approval remain valid: noted in the B-1 Table as "Complies by previous NRC approval." (see discussion in SE Section 3.1.1.4)

5. The existing FPP element does not comply with the requirement, but the licensee is requesting specific approval for a performance-based method in accordance with 10 CFR 50.48(c)(2)(vii): noted in the B-1 Table as "Submit for NRC approval." (see discussion in SE Section 3.1.1.5)

The NRC staff concludes 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 endorsed NEI 04-02 guidance document.

The licensee stated in LAR Section 4.2.2, "Existing Engineering Equivalency Evaluation Transition," that it evaluated the EEEEs used to demonstrate compliance with the NFPA 805, Chapter 3 requirements in order to ensure continued appropriateness, quality, and applicability to the current ANO-2 plant configuration. The licensee determined that no EEEE used to support compliance with NFPA 805 required NRC approval.

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

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

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

3.1.1.1 Compliance Strategy – Complies

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

The following NFPA 805 sections identified in LAR Table B-1, as complying via this method, and the applicable NFPA 805, Chapter 3 implementation items in LAR Attachment S, Table S-2, required additional review by the NRC staff:

- NFPA 805, Section 3.2.3(3), requires that procedures be established to accomplish reviews of FPP performance and trends. LAR Attachment A, Table B-1 states, "the monitoring program required by NFPA 805 will include a process that monitors and trends the FPP based on specific goals established to measure effectiveness." The development of the monitoring program is addressed in LAR Attachment S, Table S-2 as Implementation Item S2-1. The NRC staff concludes that the licensee's statement of compliance is acceptable because the licensee identified a required action that will incorporate the provisions of NFPA 805, Chapter 3 in the licensee's FPP, and included the action as an implementation item in LAR Attachment S, which is required by the proposed license condition.

- NFPA 805 Section 3.4.1(c) requires that the brigade leader and at least two brigade members have sufficient training and knowledge of nuclear safety systems to understand the effects of fire and fire suppressants on NSPC. In fire protection engineering request for additional information (FPE RAI) 11 (Reference 17), the NRC staff requested that the licensee provide additional discussion regarding how the training and knowledge requirements of NFPA 805 are met. In addition, since ANO-2 will transition to NFPA 805 before Arkansas Nuclear One, Unit 1 (ANO-1), and fire brigade members are shared between the units, the NRC staff requested that the licensee describe how training will be addressed in the interim period when ANO-1 and ANO-2 have differing fire protection licensing bases. In its response to FPE RAI 11 (Reference 9), the licensee stated that the fire brigade leader and fire brigade members are required to maintain Non-Licensed Operator (NLO) qualifications, which include completion of plant systems training designed to give the NLO an integrated understanding of plant systems and structures. The licensee further stated that the fire brigade leader is from the fire-affected unit and the fire brigade members are from the other unit and that since both units are PWRs and fire brigade members drill on both units, understanding of SSD components is reinforced. The licensee further stated that during the interim when the two units have differing licensing bases, the fire brigade training will be controlled by common requirements since NFPA 805 is bounding for Appendix R with regard to the training requirements.

  In FPE RAI 11.01 (Reference 18), the NRC staff requested that the licensee describe the training provided to the fire brigade leader that addresses their ability to assess the effects of fire and fire suppressants on NSPC. In its response to FPE RAI 11.01 (Reference 12), the licensee stated that the fire brigade leader is qualified as a Waste Control Operator (WCO), the most qualified NLO. 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 and that examples of ANO-2 plant systems included in WCO training are reactor coolant, chemical and volume control, emergency feedwater, boron management, high-pressure safety injection, low-pressure safety injection/shutdown cooling, auxiliary building service water, electrical distribution, fire protection, ventilation, and radiation monitoring. The licensee further stated that the fire brigade leader 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 further 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 NRC staff concludes that the licensee's statement of compliance and responses to the RAIs are acceptable because the licensee demonstrated that the fire brigade leader is provided with sufficient training and knowledge of nuclear safety systems to understand the effects of fire and fire suppressants on NSPC as required by NFPA 805 Section 3.4.1(c).

3.1.1.2 Compliance Strategy – Complies with Clarification

The licensee uses this strategy only in conjunction with the strategy "Complies with use of EEEEs," and then only with regard to compliance with NFPA 805, Chapter 3, Section 3.11.3, including subparts (1) - (3). NFPA 805, Section 3.11.3 addresses requirements for fire barrier penetrations and references NFPA 80, "Standard for Fire Doors and Other Opening Protectives" (Reference 66); NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems" (Reference 67); and NFPA 101, "Life Safety Code" (Reference 68); with regard to passive fire protection devices such as doors and dampers. For these NFPA 805, Chapter 3 requirements, the licensee provided additional clarification when describing its means of compliance with the fundamental FPP element. The licensee clarifies in the Compliance Basis in the LAR Attachment A, Table B-1, that the elements of NFPA 101 associated with the fire barrier requirements of NFPA 805, Section 3.11.3 are addressed in the EEEEs for NFPA 80 and NFPA 90A. In these instances, the NRC staff reviewed the additional clarifications and concludes that the licensee will meet the underlying requirement for the FPP element, as clarified, because NFPA 80 and NFPA 90A are referenced within NFPA 101 and compliance with these standards is also specifically addressed in the LAR.

3.1.1.3 Compliance Strategy – Complies with Use of EEEEs

For certain NFPA 805, Chapter 3 requirements, the licensee demonstrated compliance with the fundamental FPP element through the use of EEEEs. For NFPA 805 Sections 3.3.7.1, 3.7, and 3.11.2, the licensee identified in LAR Attachment S, Modification Items S1-14, S1-16, and S1-15, respectively; and for NFPA 805 Sections 3.3.1.2(5), 3.6.1, 3.9.1(1), and 3.9.1(2), the licensee identified Implementation Items S2-4, S2-3, S2-8, and S2-2, respectively, to address additional NFPA code requirements. The NRC staff reviewed the licensee's statement of continued validity for the EEEEs, the identified implementation items, 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 because the licensee demonstrated the appropriate use of EEEEs.

3.1.1.4 Compliance Strategy – Complies by 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 SE Report (Reference 69), (2) a 1988 exemption approving the use of a reactor coolant pump (RCP) oil collection system that does not have the capacity to hold the contents of the entire lube oil system (Reference 63), or (3) a 1997 exemption approving RCP lubricating system oil fill lines without a collection system (Reference 70).

In FPE RAI 02 (Reference 17), the NRC staff requested that the licensee describe the continued validity of the previously approved exemptions that provide the basis for previous NRC approval of the RCP oil collection system as required in NFPA 805, Section 3.3.12. In its response to FPE RAI 02 (Reference 9), the licensee stated that the basis for the previous exemption approvals remains valid.

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

3.1.1.5 Compliance Strategy – Submit for NRC Approval

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

- 3.3.3, which concerns the classification of interior floor finish in accordance with NFPA 101, Class I criteria. The licensee requested approval for epoxy floor coverings that may not meet the NFPA 805 requirements for interior finish. See SE Section 3.1.4.1.

- 3.3.5.1, which concerns minimizing the installation of wiring above suspended ceilings, and where installed the wiring shall be listed for plenum use, routed in armored cable, routed in metallic conduit or routed in cable trays with solid metal top and bottom covers. The licensee requested approval for wiring above suspended ceilings that may not comply with the requirements of NFPA 805. See SE Section 3.1.4.2.

- 3.3.5.2, which concerns the use of only metal tray and metal conduits for electrical raceways. The licensee requested approval for the use of non-metallic [e.g., polyvinyl chloride (PVC)] conduit in underground and embedded applications. See SE Section 3.1.4.3.

- 3.3.12(1), which concerns the capability of the RCP oil collection system to collect lubricating oil from all potential pressurized and non-pressurized leakage sites in each RCP oil system. The licensee requested approval of a deviation from the oil collection requirement for oil mist that is inherent in normal pump operations and collects on surfaces in the vicinity of the RCP and is not collected by the oil collection system. See SE Section 3.1.4.4.

- 3.5.3, which concerns the design and installation of fire pumps in accordance with NFPA 20, "Standard for the Installation of Stationary Pumps for Fire Protection (Reference 71). The licensee requested approval of specific deviations from NFPA 20 regarding the lack of Underwriters Laboratories listing/approval for the electric motor driven fire pump and controller, as well as the battery and battery charger design capacity for the diesel driven fire pump. See SE Section 3.1.4.5; and

- 3.5.16, which concerns the dedication of the fire water system for fire protection use only. The licensee requested approval to use a temporary pump and portions of the fire water system to supply cooling water to Control Room and Auxiliary Building Extension chiller units when the Auxiliary Cooling Water system is removed from service. See SE Section 3.1.4.6.

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

3.1.1.6 Compliance Strategy – Multiple Strategies

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

3.1.1.7 Chapter 3 Sections Not Reviewed

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

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

- Sections that are not applicable because of the following:

  - The licensee stated 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., Sections 3.4.1(a)(2) and 3.4.1(a)(3), which apply to the fire brigade standards used since they depend on the type of brigade specified in the FPP).

3.1.1.8 Compliance with Chapter 3 Requirements Conclusion

As discussed above, the NRC staff evaluated the results of the licensee's assessment of the proposed RI/PB FPP against 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:

- Used an overall process consistent with NRC staff approved guidance to determine the state of compliance with each of the applicable NFPA 805, Chapter 3 requirements.
- Provided appropriate documentation of the state of compliance with the NFPA 805, Chapter 3 requirements, which adequately demonstrated compliance in that the licensee was able to substantiate that it complied:
  - With the requirement directly, or with the requirement directly after the completion of an implementation item.
  - With the intent of the requirement (or element) and adequate justification was provided.
  - Via previous NRC staff approval of an alternative to the requirement.
  - Through the use of an engineering equivalency evaluation.
  - Through the use of a PB method that the NRC staff has specifically approved in accordance with 10 CFR 50.48(c)(2)(vii).

3.1.2 Identification of Power Block

The NRC staff reviewed the structures identified in LAR Table I-1, "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 ANO-2 RI/PB FPP that have additional requirements in accordance with 10 CFR 50.48(c) and NFPA 805. As stated in LAR Section 4.1.3, the power block includes a list of plant structures that was derived from a review of plant layout drawings and supplemented by plant walk downs in order to provide a complete listing of the structures in the owner controlled area. Each structure was reviewed to determine if it was required to meet the NFPA 805 nuclear safety goal, meet the

NFPA 805 radioactive release goal, or be evaluated for other NFPA 805 considerations. The NRC staff concludes that the licensee appropriately evaluated the structures and equipment at ANO-2, and adequately documented a list of those structures that fall under the definition of "power block" in NFPA 805.

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

GL 2006-03 requested that licensees evaluate 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 72), the licensee stated that Hemyc is used as a one hour rated barrier to meet 10 CFR 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 ERFBS. Since Hemyc™ or MT™ electrical raceway fire barrier systems (ERFBS) are not credited, the NRC staff concludes that the generic issue (GL 2006-03 (Reference 43)) 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 NFPA 805, Chapter 3, fundamental FPP elements and minimum design requirements. The regulations in 10 CFR 50.48(c)(2)(vii) require that an acceptable PB approach accomplish the following:

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

(B) Maintains safety margins; and

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

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

3.1.4.1 NFPA 805, Section 3.3.3 – Interior Finish

The licensee requested review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement of NFPA 805, Section 3.3.3 regarding interior finishes.

Specifically, ANO-2 uses epoxy floor coatings that do not meet the specific requirements for interior finish cited in Section 3.3.3.

The licensee stated that the coatings permitted at ANO-2 are either NFPA 101 Class A or American Society of Testing Materials (ASTM) E-84 (Reference 73) tested with a flame spread of less than 50 with the exception of Duochem 9400. The licensee also stated that epoxy floor coatings have been evaluated in response to NRC Information Notice (IN) 2007-26, "Combustibility of Epoxy Floor Coatings at Commercial Nuclear Power Plants," dated August 13, 2007 (Reference 74), and have been determined to have negligible contribution to combustible loading. The licensee also stated that the ASTM E-84 test is conducted with the material on the ceiling of a tunnel and that this configuration would allow the flame to directly impinge on the ceiling surface, enhancing flame spread. The licensee further stated that with the material on the floor, the heat flux to the surface is much less than would be expected in the ceiling configuration since the convective flame is directing the heat away from the surface and that this would mean that the overall flame spread would be expected to be much less, even with a slightly greater thickness.

In FPE RAI 03 (Reference 17), the NRC staff requested that the licensee provide the classification or flame spread rating for Duochem 9400, since the licensee identified it as an exception to meeting the flame spread criteria, but did not provide any additional information regarding the acceptability of its use. In its response to FPE RAI 03 (Reference 9), the licensee stated that Duochem 9400 applied with a thickness of 1/8-inch has a flame spread rating of 31, and if applied with a thickness of 1/4-inch, has a flame spread rating of 57. The licensee further stated that the majority of areas at ANO-2 have a thickness of less than 1/8-inch, but floor surface variations could result in limited areas where the coating may approach 1/4-inch. The licensee further stated that, as stated in Enclosure 2 to NRC Generic Letter (GL) 86-10, Section 3.6.2, material with a surfacing not over 1/8-inch thick that has 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 used in NFPA 805, Section 1.6.36. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the properties and application of Duochem 9400 along with the conservatism in the use of ASTM E-84 in testing floor finishes, that Duochem 9400 does not contribute significantly to combustible loading.

The licensee stated that the use of epoxy floor coating does not affect nuclear safety as it in general meets the definition of a limited combustible material with isolated thickness excesses and that the floor coating materials were evaluated to have a negligible effect on combustibility. The licensee further stated that application of epoxy floor coatings is controlled via 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 the use of epoxy floor coatings has no impact on the radiological release performance criteria and that the radiological release review was performed based on the manual fire suppression activities in areas containing or potentially containing radioactive materials and is not dependent on the floor coating materials. The licensee further stated that the floor coatings do not change the radiological release evaluation performed that potentially contaminated water is contained and smoke monitored and that floor coatings do not add additional radiological materials to the area or challenge systems boundaries that contain such.

The licensee stated that the use of epoxy floor coating does not affect safety margin, since it meets the NFPA 805 definition of a limited combustible material with isolated thickness excesses. The licensee further stated that the floor coating materials were evaluated to have a negligible effect on combustibility and application is controlled via procedures. In FPE RAI 04 (Reference 17), the NRC staff requested that the licensee provide clarification of the generic statements that "these precautions and limitations on the use of these materials have been defined by the limitation of that analytical methods used in the development of the FPRA. Therefore, the inherent safety margin and conservatisms in these methods remain unchanged." In its response to FPE RAI 04 (Reference 9), the licensee further clarified that the epoxy floor coatings of the types utilized at ANO-2 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. The licensee stated that their presence has no impact on the analytical methods used in the FPRA to evaluate potential fire scenarios and therefore, the inherent safety margin in these methods remains unchanged. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the epoxy floor coatings do not present a primary fire hazard, will not propagate fire from one area to another, and will not exacerbate the severity of a compartment fire and, therefore, their presence has no impact on the methods used in the FPRA.

The licensee stated that the three echelons of DID are 1) to prevent fires from starting (combustible/hot work controls), 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), 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 (fire barriers, fire rated cable, success path remains free of fire damage, RAs). The licensee also stated that the use of epoxy floor coatings does not affect echelons 1, 2, and 3 and that it does not directly result in compromising automatic fire suppression functions, manual fire suppression functions, or post-fire SSD capability.

Based on its review of the LAR, as supplemented, 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, objectives, and criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate DID.

3.1.4.2 NFPA 805, Section 3.3.5.1 – Wiring above Suspended Ceilings

The licensee requested review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement in NFPA 805, Section 3.3.5.1, regarding wiring installed above suspended ceilings being listed for plenum use, routed in armored cable, routed in metallic conduit, or routed in cable trays with solid metal top and bottom covers. Specifically, the licensee requested approval of a PB method to justify the installation of limited amounts of wiring above suspended ceilings in the power block that does not meet the requirements of NFPA 805, Section 3.3.5.1.

The licensee stated that the only risk-significant area with suspended ceilings inside the power block is the Control Room. The licensee further stated that the suspended ceilings and supports are non-combustible and combustibles in the concealed spaces above the ceilings are minimal. The licensee further stated that power and control cables are qualified to Institute of Electrical and Electronics Engineers (IEEE) 383-1974 (Reference 75) or equivalent. The licensee provided the following as the basis for the approval request:

- Plenum rating should not be applied to wiring above suspended ceilings that are not used as a plenum and have stagnant air versus flowing air.
- Only a limited amount of cable installed above suspended ceilings is not rated for plenum use, IEEE 383-1974 equivalent, or routed in conduit.
- The cable is low voltage (less than 480V) and, therefore, less susceptible to self-ignition and shorting that could result in fire.
- There are no additional ignition sources above the suspended ceilings.
- For cables that do not meet NFPA 805 Section 3.3.5.1 criteria, the majority meet one of the cable qualifications in FAQ 06-0022 (Reference 49).
- Plant procedures contain adequate guidance to ensure suitable cable qualification criteria is provided and maintained.

The licensee stated the location of wiring above the suspended ceilings does not affect nuclear safety and that wiring that is not armored cable, in metallic conduit, or plenum rated, is low voltage cable and not susceptible to shorts that would result in a fire and therefore, there is no impact on the NSPC. The licensee also stated that the location of cables above suspended ceilings does not impact the radiological release criteria and that the radiological release review was performed based on the manual fire suppression activities in areas containing or potentially containing radioactive materials and is not dependent on the type of cables or locations of suspended ceilings. The licensee further stated that the cables do not add additional radiological materials to the area or challenge system boundaries that contain radiological materials.

The licensee provided a generic statement in the approval request that "the use of these materials has been defined by the limitations of the analytical methods used in the development of the FPRA. Therefore, the inherent safety margin and conservatisms in these methods remain unchanged." In FPE RAI 04 (Reference 17), the NRC staff requested that the licensee provide clarification of the generic statement on safety margin in the context of the specific approval request. In its response to FPE RAI 04 (Reference 9), the licensee stated that the limited amount of other wiring above suspended ceilings consists of low voltage communications/data cable, which is not susceptible to shorts that would result in a fire and that their presence above suspended ceilings has no impact on the analysis of potential fire scenarios and therefore, the inherent safety margin in these methods remains unchanged. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the wiring is not susceptible to shorts that would result in a fire and that the presence of the wiring above suspended ceilings has no impact on the analysis of potential fire scenarios and no impact on safety margin.

The licensee stated that the introduction of the cables above the suspended ceilings does not impact fire protection DID and that DID echelon 1 is maintained by the current cable installation procedures. The licensee further stated that the introduction of cables above suspended ceilings does not affect DID echelons 2 and 3 and that the video/communication/data cables routed above suspended ceilings do not result in compromising automatic fire suppression functions, manual fire suppression functions, fire protection for systems and structures, or SSD capability.

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

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

The licensee requested NRC staff review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement of NFPA 805 Section 3.3.5.2 regarding use of metal tray or conduit for electrical raceways. Specifically, the licensee requested approval of a PB method to justify the use of plastic conduit embedded in concrete.

The licensee provided the following as the basis for the approval request:

- 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 National Electric Code (NEC) (Reference 76) allows use of rigid nonmetallic conduit for underground and embedded applications.

The licensee 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 also stated that the use of embedded plastic conduit has no effect on the radiological release performance criteria, and that the conduit material does not change the radiological release evaluation performed, which concluded that potentially contaminated water is contained and smoke is monitored. The licensee further stated that the conduits do not add additional radiological materials to the area or challenge systems boundaries that contain plastic conduits.

The licensee provided a generic statement in the approval request that "the use of these materials has been defined by the limitations of the analytical methods used in the development of the FPRA. Therefore, the inherent safety margin and conservatisms in these methods remain unchanged." In FPE RAI 04 (Reference 17), the NRC staff requested the licensee provide clarification of the generic statement on safety margin in the context of the specific approval request. In its response to FPE RAI 04 (Reference 9), the licensee stated that the material in which nonmetallic 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. The licensee further stated that failure of circuits within the embedded conduit resulting in a fire would not result in damage to external targets and that the use of nonmetallic conduit for raceways embedded in concrete has no impact on the analytical methods used in the FPRA to evaluate potential fire scenarios and therefore, the inherent safety margin in these methods remains unchanged. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the use of plastic conduit embedded in concrete has no impact on the analytical methods used in the FPRA and no impact on safety margin.

The licensee stated that fire protection DID will be maintained, because the use of plastic embedded conduit in concrete does not affect DID echelons 1, 2, and 3, and because the conduit is not a fire prevention feature and does not compromise fire detection, suppression or control, or impact post-fire SSD capability.

Based on its review of the LAR, as supplemented, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the proposed PB method is an acceptable alternative to the corresponding NFPA 805, Section 3.3.5.2 requirement because it satisfies the performance goals, objectives, and criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID.

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

The licensee requested NRC staff review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement of NFPA 805 Section 3.3.12(1) regarding the capability of the RCP oil collection system to collect lubricating oil from all potential pressurized and non-pressurized leakage sites in the RCP oil system. The licensee stated that although the oil collection system was reviewed in accordance with 10 CFR 50 Appendix R, Section III.O, including the capability to collect leakage from pressurized and non-pressurized leakage sites in the RCP oil system, this previous review may not have included collection of oil mist as a result of pump/motor operation. The licensee further stated that oil misting is not leakage due to equipment failure, but an inherent occurrence in the operation of large rotating equipment and that it is normal for large motors to lose some oil through seals and the oil to potentially become 'atomized' in the ventilation system. The licensee further stated that this atomized oil mist can then collect on surfaces in the vicinity of the RCP as the pump design is not completely sealed to permit airflow for cooling. The licensee further stated that the oil mist resulting from normal operation will not adversely impact the ability of a plant to achieve and maintain SSD even if ignition occurred.

The licensee provided the following as the basis for the approval request:

- 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 or accumulation near potential ignition sources or non-insulated reactor coolant piping.
- RCPs are not required to achieve or maintain fire SSD.

In FPE RAI 05 (Reference 17), the NRC staff requested that the licensee provide additional characterization of the oil quantity and deposition location, the associated fire hazards, and the actions taken, if any, to clean the oil mist deposits from equipment surfaces. In its response to FPE RAI 05 (Reference 9), the licensee stated that oil losses were not significant when measured during outages (i.e., within 1 to 2 gallons of which misting is a portion). The licensee further stated that the deposition is on the pump and nearby structural surfaces and does not present a significant fire hazard, as there are no significant ignition sources or high-temperature surfaces above the flashpoint of the oil. The licensee further stated that the oil deposition is cleaned on a refueling outage basis. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the oil misting is minimal, that it does not present a significant fire hazard due to lack of ignition sources, and that the misting deposits are cleaned up on an appropriate frequency.

The licensee stated that the oil mist resulting from normal operation will not adversely impact the ability of the plant to achieve and maintain SSD, even if ignition occurs. The licensee further stated that the RCPs are not required to achieve and maintain SSD and, therefore, there is no impact on the NSPC. The licensee further stated that the potential for oil mist from the RCPs has no impact on the radiological release performance criteria. 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. The licensee further stated that the entire containment building in which the RCPs are located is an environmentally sealed radiological area during power operations, and that the oil mist does not add additional radiological materials to the area or challenge boundaries of systems which contain radiological materials.

The licensee provided a generic statement in the approval request that "the use of these materials has been defined by the limitations of the analytical methods used in the development of the FPRA. Therefore, the inherent safety margin and conservatisms in these methods remain unchanged." In FPE RAI 04 (Reference 17), the NRC staff requested the licensee provide clarification of the generic statement on safety margin in the context of the specific approval request. In its response to FPE RAI 04 (Reference 9), the licensee stated the oil mist resultant from normal operation of the RCPs does not account for an appreciable heat release rate or accumulation near potential ignition sources. The licensee also stated that the RCPs utilize de-misters and that oil loss is evaluated each outage per procedure. The licensee further stated that the RCP lube oil system is capable of withstanding the SSD earthquake without rupture and that 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 SSD, nor are they credited in the FPRA. The licensee further stated that use of the existing RCPs lube oil and oil collection configuration has no impact on the analytical methods used in the FPRA to evaluate potential fire scenarios and therefore, the inherent safety margin in these methods remains unchanged. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the current configuration of the RCP lube oil collection system has no impact on the analytical methods used in the FPRA and has no impact on safety margin.

The licensee stated that fire protection DID will be maintained because the potential for oil mist from RCPs does not impact fire protection DID. The licensee stated that DID echelon 1 is maintained by the oil collection system and RCP design and that the introduction of a small amount of oil misting does not affect DID echelons 2 and 3. The licensee further stated that the potential for oil mist 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 SSD capability.

Based on its review of the LAR, as supplemented, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the proposed PB method is an acceptable alternative to the corresponding NFPA 805, Section 3.3.12(1) requirement because it satisfies the performance goals, objectives, and criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID.

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

The licensee requested NRC staff review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement of NFPA 805, Section 3.5.3, regarding the design and installation of fire pumps in accordance with NFPA 20. Specifically, the licensee stated that ANO-2 does not meet NFPA 20 (1969), Sections 457 and 511c, which require that the electric fire pump motor and controller to be Underwriters Laboratories, Inc. (UL) listed for fire pump service. The licensee further stated that ANO-2 does not meet NFPA 20 (1969), Sections 626a, 626d.e2 and 626d.e5, since vendor documents do not identify a certification for the batteries and do not identify the discharge rate for the lead acid batteries.

The licensee stated that at the time of purchase on October 30, 1969, the 400 horsepower (HP) electric-drive motor that was necessary to meet the fire pump size requirements for the electric fire pump was not available as a UL listed motor for fire pump service and 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 ANO-2 does not meet the NFPA 20 requirements for the diesel engine controller, since 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 for the diesel engine fire pump controller stated that this equipment is UL Listed and Factory Mutual Research Corporation (FMRC) Approved (i.e., Listed/Approved) for fire service, and that the fire pump controller subcomponents (battery charger, relays, etc.) were certified by the vendor for fire pump service. The licensee further stated that 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 provided the following as the basis for the approval request:

- 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 were not UL Listed/(FMRC)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.

- 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 states that this equipment is UL Listed and FMRC Approved for fire service. The diesel fire pump meets the demands for the fire protection water supply system.

In FPE RAI 06 (Reference 17), the NRC staff requested that the licensee provide additional discussion of the historical testing and experience that support the conclusions and basis for approval. In its response to FPE RAI 06 (Reference 9), the licensee provided a discussion and listing of current fire pump system testing and maintenance procedures, and indicated that although routine maintenance issues have been identified, no applicable operating experience was found in review of condition reports that was 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. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the lack of fire protection approvals has not resulted in any fire pump equipment failures.

The licensee stated the 4160 VAC fire pump motor and pump controller were not Listed/Approved for fire pump service at the time of purchase in 1969 due to UL and FMRC not having the high voltage 4160 VAC electric fire pump motor and controller rated for fire service in 1969. The licensee further stated that the vendor manual for the diesel engine fire pump controller stated that this equipment is UL Listed and FMRC Approved for fire service and that the vendor's diesel engine fire pump controller is manufactured, inspected and tested to obtain UL listing and FMRC approvals for fire pump service. The licensee further stated that the fire pump controller subcomponents (battery charger, relays, etc.) were certified by the vendor for fire pump service and that 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 further stated that the deviations from NFPA 20 have no impact on the NSPC. The licensee further 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/FMRC approved for fire pump service in 1969 and, therefore, this deviation has no impact on radiological controlled areas 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 therefore, the safety margin inherent in the analysis for the fire event has been preserved.

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 DID echelons 1, 2, and 3 and thus, DID is maintained.

Based on its review of the LAR, as supplemented, 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, objectives, and criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID.

3.1.4.6 NFPA 805, Section 3.5.16 – Dedicated Use of Fire Protection Water Supply System

The licensee requested NRC staff review and approval of a PB method to demonstrate an equivalent level of fire protection for the requirement of NFPA 805, Section 3.5.16, regarding dedicating the fire protection water supply system for fire protection use only.

The licensee stated that the fire protection water supply system is used for installation of a temporary fire pump to allow both units to supply a protracted and continual supply of cooling water during unit outages when the auxiliary cooling water system is removed from service. The licensee further stated that past practices of allowing use of the fire water system for non-fire water demands during outages have been evaluated by engineering and incorporated into operations procedures. The licensee stated that significant margin exists in the fire protection water supply system above that required for suppression system demands and that a calculation provides an evaluation that addresses the use of fire water for non-fire issues based on the results of a hydraulic model. The licensee provided the following as the basis for the approval request:

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

In FPE RAI 07 (Reference 17), the NRC staff requested that the licensee provide additional technical justification addressing the configuration of the temporary fire pump and connections, the normal fire pump configuration and operation during use of the temporary pump, and the capability to meet the fire water system demand with the temporary system in operation. In its response to FPE RAI 07 (Reference 9), the licensee described the configuration in which the temporary fire pump located at the ANO-1 Intake Structure is connected per established procedures to the fire water supply system through temporary connections to the fire pump test header piping. The licensee stated that hoses from hose stations 2HR-22 and 2HR-74 can be temporarily connected to the control room chiller and auxiliary building extension chiller, respectively, to provide cooling water to the chillers and that this configuration allows the use of the fire water system without unnecessary start and run cycles on the normal fire pumps, which remain in the normal standby configuration. The licensee further stated that administrative controls ensure that a hose station or hydrant is available in the event of a fire and that the flow demands of the system have been calculated and demonstrate that the temporary cooling flow and fire water demands are within the capacity of the system. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the fire water system capacity is sufficient to meet the temporary cooling and fire suppression demands, that hose stations or hydrants are available in the event of a fire, and that the temporary configuration is administratively controlled.

In SSA RAI 08 (Reference 17), the NRC staff requested that the licensee describe the impact on key safety functions (KSFs) or NSPC if the temporary cooling flow was isolated in response to a fire. In its response to SSA RAI 08 (Reference 9), the licensee stated the auxiliary cooling water system is not essential for SSD of the plant and thus KSFs and NSPC are not impacted. In this RAI response, the licensee also requested that the NRC approve use of the temporary connection during at-power operations as long as the fire water capacity remains within limits. The NRC staff found that this request is a change to the original approval request as stated in the LAR, which only addressed use of the temporary auxiliary cooling water system connections during unit outages. The NRC staff concludes that the licensee's response to the RAI is acceptable, including the additional change request, because the licensee demonstrated that the fire protection water supply is sufficient to meet the temporary cooling and fire suppression demands, because the temporary configuration is administratively controlled, and because the auxiliary cooling water system is not required for KSFs or to meet 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 and therefore, the safety margin inherent in the analysis for the fire event has been preserved.

The licensee stated that fire protection DID will be maintained, because 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 further stated that administrative controls consisting of procedural direction or continuously stationed individuals ensure that a hose station or hydrant is secured or otherwise made available in the event of a fire. The licensee further 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 DID echelons 1, 2, and 3.

Based on its review of the LAR, as supplemented, and in accordance with 10 CFR 50.48(c)(2)(vii), the NRC staff concludes that the proposed PB method is an acceptable alternative to the corresponding NFPA 805, Section 3.5.16 requirement because it satisfies the performance goals, objectives, and criteria specified in NFPA 805 related to nuclear safety and radiological release, maintains sufficient safety margin, and maintains adequate fire protection DID.

3.2 Nuclear Safety Capability Assessment Methods

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

NFPA 805, Section 2.4, "Engineering Analyses," states 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. A summary of the goals, objectives, and performance criteria is found below.

- 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; and

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

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

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

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

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

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

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

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

3.2.1 Compliance with NFPA 805 Nuclear Safety Capability Assessment Methods

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

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

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

Regulatory Guide (RG) 1.205, Revision 1 (Reference 4), endorses NEI 04-02, Revision 2 (Reference 7), and Chapter 3 of NEI 00-01, Revision 2 (Reference 52), 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 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 21), with a subsequent gap analysis to NEI 00-01 Revision 2, as described in LAR Section 4.2.1.1. The NRC staff concludes that based on the information provided in the licensee's submittal, as supplemented, a systematic process to evaluate the post-fire safe shutdown analysis against the requirements of NFPA 805, Section 2.4.2, Subsections (1), (2), and (3), was used, which meets the methodology outlined in the latest NRC-endorsed industry guidance.

FAQ 07-0039 (Reference 53) provides one acceptable method for documenting the comparison of the safe shutdown analysis against the NFPA 805 requirements. This method first maps the existing SSD analysis to the NEI 00-01, Chapter 3 methodology, which in turn, is mapped to the NFPA 805 Section 2.4.2 requirements.

The licensee performed this evaluation by comparing its SSD analysis against the NFPA 805 NSCA requirements using the NRC-endorsed process in Chapter 3 of NEI 00-01, Revision 1, and documenting the results of the review in LAR Attachment B, "NEI 04-02 Table B-2, NFPA 805 Chapter 2 – Nuclear Safety Capability Assessment – Methodology Review," in accordance with NEI 04-02, Revision 2. The licensee performed a subsequent gap analysis to NEI 00-01, Revision 2 and documented the results in LAR Section 4.2.1.1.

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 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 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 boiling-water reactors or pressurized-water reactors). These are noted in the LAR Table B-2 as "Not Applicable."

In SSA RAI 01 (Reference 17), the NRC staff requested that the licensee provide additional information regarding how the current SSD licensing basis documents referenced in LAR Table B-2 support meeting NFPA 805, Section 2.4.2, including any changes necessary for transition to NFPA 805 and the status of the NSCA if different from the results presented in these referenced documents. In the licensee's response to SSA RAI 01 (Reference 10), the licensee stated that the methodology and subsequent analyses used in the current Appendix R SSD capability assessment meet NFPA 805, Section 2.4.2 requirements for a nuclear safety capability assessment. The licensee further stated that only editorial revisions to the existing Appendix R documents are needed to reflect terminology and definitions used for the NFPA 805 licensing basis, and the existing Appendix R analysis conservatively bounds a transition to an NFPA 805 nuclear safety capability assessment as there are no new credited systems in the current as-built design of ANO-2 or expansions of these system boundaries. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee stated that the methodology and subsequent analyses used in the current Appendix R SSD capability assessment meets the requirements of NFPA 805, Section 2.4.2, for a nuclear safety capability assessment.

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

3.2.1.1 Attribute Alignment – Aligns

For the majority of the NEI 00-01, Chapter 3 attributes, the licensee determined that the SSA aligns directly with the attribute. In these instances, based on the information provided by the licensee in the LAR, as supplemented, and the information provided during the NFPA 805 site audit on July 15-18, 2013 (i.e., the documents reviewed, discussions held with the licensee, and the plant tours performed) (Reference 77), the NRC staff concludes that the licensee's statements of alignment are acceptable because the analyses are consistent with regulatory guidance for selecting the systems and equipment and their interrelationships necessary to achieve the NSPC, selection of the cables necessary to achieve the NSPC, and the identification of the location of nuclear safety equipment and cables.

3.2.1.2 Attribute Alignment – Aligns with Intent

For certain 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 Table B-2 as having this condition are as follows:

- 3.1 SSD Systems and Path Development;

- 3.1.1.11 Regarding a single fire affecting more than one unit;
- 3.1.3 Methodology for Shutdown System Selection;
- 3.1.3.3 Define Combination of Systems for Each SSD Path;
- 3.1.3.4 Assign Shutdown Paths to Each Combination of Systems;
- 3.2.2.2 Identify the Equipment in Each SSD System Flow Path Including Equipment That May Spuriously Operate and Affect System Operation;
- 3.2.2.3 Develop a List of SSD Equipment and Assign the Corresponding System and SSD Path(s) Designation to Each;
- 3.2.2.4 Identify Equipment Information Required for the SSA;
- 3.2.2.5 Identify Dependencies Between Equipment, Supporting Equipment, SSD Systems and SSD Paths;
- 3.3.1.5 Regarding identification of power circuits;
- 3.4.1.3 Regarding assessing impacts to required components in a fire area;
- 3.4.1.4 Regarding use of manual actions;
- 3.5.1.1 Regarding circuit failure types to be considered on unprotected SSD cables;
- 3.5.1.3 Regarding criteria/assumptions duration/assumptions for spurious operations;
- 3.5.1.5[B] Regarding guidance under sub-heading "Cable Failure Modes";
- 3.5.1.5[C] Regarding guidance under sub-heading "Likelihood of Undesired Consequences"; and
- 3.5.2.4 Circuit Failures Due to Inadequate Circuit Coordination.

For Attribute 3.5.1.1, the licensee stated that for ungrounded direct current (DC) circuits, proper-polarity hot shorts were only considered for high-low pressure interface components. In SSA RAI 02 (Reference 17), the NRC staff requested that the licensee describe how it meets the guidance for Attribute 3.5.1.1 in NEI 00-01, Revision 2 for evaluating proper-polarity DC faults on non-high low pressure interface components. In its response to SSA RAI 02 (Reference 9), the licensee stated that all DC grounded and ungrounded circuits must consider all shorts, hot shorts, shorts to ground, and open circuits and that the methodology treats DC circuits as an equivalent AC circuit containing a bonded (grounded) neutral. The licensee stated that this approach simplifies DC circuit analysis since only one fault or hot short is necessary to result in either functional failure or spurious actuation. The licensee further stated that a grounded system also includes 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 further clarified that inter-cable proper-polarity hot shorts in DC power cables to motor-operated valves were not considered, except for high-low pressure interface valves. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee satisfactorily demonstrated how it meets the guidance for Attribute 3.5.1.1 in NEI 00-01, Revision 2 for evaluating proper-polarity DC faults on non-high low pressure interface components.

The NRC staff concludes, based on the information provided by the licensee in the LAR Table B-2, as supplemented, the documents reviewed, and discussions held with the licensee's technical staff during the on-site audit (Reference 77), that the licensee's methodology used for all DC grounded and ungrounded circuits is acceptable, and that the licensee's statements of alignment with the endorsed guidance of Attribute 3.5.1.1 in NEI 00-01 is acceptable because the licensee demonstrated that the FPP features and systems provide sufficient capability to meet the requirements of 10 CFR 50.48(c).

The remaining NEI 00-01 attributes for which the licensee stated aligns with intent, describe similar means or methods that were applied to achieve the intended result of the NEI 00-01 guidance. The NRC staff concludes that the methods as described by the licensee are similar to the specific methods in NEI 00-01, and therefore align with intent of NEI 00-01.

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

The licensee did not identify any attributes in this category.

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

The licensee did not identify any attributes in this category.

3.2.1.5 Attribute Alignment – Not in Alignment

The licensee did not identify any attributes in this category.

3.2.1.6 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 SSD against the NFPA 805 NSCA requirements using NEI 00-01, Revision 1 with a gap analysis to the NRC-endorsed process in Chapter 3 of NEI 00-01, Revision 2. The results of the review are documented in LAR Attachment B, Table B-2, in accordance with NEI 04-02, Revision 2 and the gap analysis of NEI 00-01, Revision 2.

Based on the information provided in the licensee's submittal, as supplemented, the NRC staff concludes that 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, is acceptable. The NRC staff concludes that the licensee's method is acceptable because it either:

- Met the NRC-endorsed guidance directly;
- 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 FPP requirements based on Appendix R to 10 CFR 50 and NUREG-0800, Section 9.5.1 (Reference 78), since NFPA 805 only requires the licensee to maintain the fuel in a safe and stable condition rather than achieve and maintain cold shutdown in 72 hours. In LAR Section 4.2.1.2, the licensee stated that the NFPA 805 licensing basis is to maintain the reactor in a hot standby condition (defined as Mode 3, Keff < 0.99, reactor coolant system (RCS) temperature ≥ 300 degrees Fahrenheit (°F)) following any fire occurring with the reactor operating at power. The "At Power" safe and stable strategy includes entry into hot standby (Mode 3) and stops prior to the point of manually initiating a cool down.

In LAR Section 4.2.1.2, the licensee described the means to achieve and maintain safe and stable conditions for each of the NSPC. With the exception of the diesel fuel oil storage supply, which the licensee indicates will provide a minimum of 3.5 days of emergency diesel generator operation at full load, there are no system limitations (e.g., reactivity or cooling water supply) identified in the LAR that require actions to replenish systems beyond the use of the capabilities normally available (e.g., aligning alternative primary makeup or secondary cooling water sources using existing plant systems and procedures).

Based on a review of the licensee's analysis as described in the LAR, as supplemented, the NRC staff concludes that the licensee provided information to provide reasonable assurance that the fuel can be maintained in a safe and stable condition, post-fire, for an extended period of time because the licensee has developed response procedures for responding to an event, will activate its emergency response organization, implement long term actions necessary to maintain the fuel in a safe and stable condition, and assess and implement repair activities to support either Mode 3 operation, RCS cooldown, or reactor restart.

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 LAR Attachment C, "NEI 04-02 Table B-3 – Fire Area Transition," to evaluate whether ANO-2 meets the feed and bleed requirements. The licensee stated that feed and bleed is not utilized as the sole fire-protected SSD path for any scenario. The NRC staff confirmed this statement by reviewing the designated SSD path listed in LAR Attachment C for each fire area. This review confirmed that the analysis of all fire areas included 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, based on the information provided in LAR Table 5-3 as well as the fire area analyses documented in LAR Attachment C, that the licensee meets the requirements of 10 CFR 50.48(c)(2)(iii) because feed and bleed is not utilized as the sole fire-protected SSD path.

3.2.4 Assessment of Multiple Spurious Operations

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

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

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

The NRC staff reviewed LAR Section 4.2.1.4, "Evaluation of Multiple Spurious Operations," and LAR Attachment F, "Fire-Induced Multiple Spurious Operations Resolution," to determine whether the licensee adequately addressed MSO concerns. As described in the LAR, the licensee's process for identification and evaluation of MSOs used an expert panel and followed the guidance of NEI 04-02 (Reference 7), RG 1.205, Revision 1 (Reference 4), and FAQ 07-0038 (Reference 51). The licensee stated that the expert panel used by the licensee consisted of members with experience in electrical design engineering, mechanical design engineering, nuclear design engineering, system engineering, fire protection, SSD, operations, reactor safety analysis, maintenance, probabilistic risk assessment, and accident management.

The licensee stated that the initial MSO expert panel review was conducted in September 2005 and that the expert panel sources for identifying MSOs included the SSD, generic lists (e.g., developed by Reactor Owner Groups), self-assessment results, probabilistic risk assessment insights, and operating experience. The licensee further stated that the results of the review were integrated into the NSCA and the FPRA model. In LAR Attachment F, the licensee stated that the complete Pressurized-Water Reactor Owners Group (PWROG) generic list of MSOs was not yet available at the time the expert panel met in September 2005; however, the list of generic MSOs for PWRs 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 models.

In SSA RAI 06 (Reference 17), the NRC staff requested that the licensee describe the use of plant-specific FPRA or NSCA analyses performed subsequent to the September 2005 expert panel review, as well as plant operating experience in identifying any additional MSOs or insights to existing MSOs. In its response to SSA RAI 06 (Reference 9), the licensee stated that the most recent update of the MSO analysis was performed in February 2013 and that the analysis describes how the guidance of FAQ 07-0038 was followed and identifies the MSOs that have been included in the FPRA model and NSCA to support the transition to NFPA 805, including the most recent industry information from the PWROG included in the FPRA model, and the NSCA. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the most recent update to the MSO analysis was performed in accordance with applicable guidance documents.

LAR Attachment F describes the process the licensee utilized to address MSOs, which follows the guidance of FAQ 07-0038. That process includes 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 the results. As described in LAR Attachment F, under the results for Steps 3, 4, and 5, the MSOs identified in Steps 1 and 2 were incorporated in the FPRA model and evaluated for inclusion in the NSCA. The licensee stated that variances from deterministic requirements (VFDRs) were created where MSO combinations did not meet the deterministic requirements of NFPA 805, Section 4.2.3 and these VFDRs were addressed using the PB approach of NFPA 805, Section 4.2.4 and the results are included in the risk values reported in LAR Attachment W. The licensee further stated that fire-induced MSOs are included in the FPRA model, and their associated risk is included in the quantification of each fire scenario, the total plant fire risk, and evaluation of each VFDR.

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

3.2.5 Establishing Recovery Actions

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

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

NFPA 805, Section 4.2.3.1 states that:

> One success path of required cables and equipment to achieve and maintain the nuclear safety performance criteria without the use of recovery actions shall be protected by the requirements specified in either 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 used the endorsed guidance provided in NEI 04-02, Section 4.6 and the guidance in FAQ 07-0030 (Reference 50) to establish the population of RAs being carried forward in the RI/PB FPP. RAs addressed during the NFPA 805 transition process included the consideration of existing operator manual actions (OMAs) in the deterministic FPP, as well as those being added based on the VFDRs identified in the individual fire area assessments. OMAs are actions performed by plant operators to manipulate components and equipment from outside the main control room to achieve and maintain post-fire hot shutdown, not including repairs. OMAs include an integrated set of actions needed to ensure that hot standby can be accomplished for a fire in a specific plant area. OMAs are transitioned to RAs under NFPA 805. RAs are activities to achieve the NSPC that take place outside of the main control room or outside of the primary control stations for the equipment being operated, including the replacement or modification of components.

As stated in LAR Attachment G, the licensee did not identify any locations designated as primary control stations as defined in RG 1.205 and therefore, any OMAs required to be performed outside the main control room were considered RAs.

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 a defense-in-depth recovery action (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, a 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 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 each of the 11 individual feasibility attributes were addressed. LAR Attachment G, Table G-1, "Recovery Actions and Activities," describes each RA associated with the disposition of a VFDR from the fire area assessments as documented in LAR Attachment C, "Fire Area Transition." The feasibility review was based on documentation only, including previous feasibility evaluations for SSD OMAs. The licensee included Implementation Item S2-6 in LAR Attachment S, Table S-2 to revise OMA procedures/documents to include feasibility criteria in FAQ 07-0030 for the recovery actions listed in LAR Attachment G, Table G-1. The NRC staff concludes that the licensee's action is acceptable because it will incorporate the provisions of NFPA 805, Chapter 3, and because the action is included as an implementation item in LAR Attachment S, which is required by the proposed license condition.

In LAR Attachment G, the licensee referenced its manual action feasibility review for compliance with 10 CFR 50, Appendix R, as demonstrating feasibility for the RAs listed in LAR Attachment G. In SSA RAI 07.a (Reference 17), the NRC staff requested that the licensee confirm that the RAs necessary to meet NFPA 805 were assessed consistent with the 11 feasibility criteria described in FAQ 07-0030. In its response to SSA RAI 07.a (Reference 9), the licensee provided a comparison of the feasibility analysis criteria used with the specific criteria of FAQ 07-0030. The NRC staff concludes that the licensee's response to the RAI is acceptable because the criteria described by the licensee are similar to the criteria discussed in FAQ 07-0030 and therefore, the criteria meet the intent of the guidance.

In SSA RAI 07.b (Reference 17), the NRC staff requested that the licensee confirm that the feasibility assessment calculation addressed all the RAs listed in LAR Attachment G because the calculation was based on 10 CFR 50, Appendix R. In its response to SSA RAI 07.b (Reference 9), the licensee stated the only new RAs are associated with the proposed new auxiliary feedwater pump (see LAR Attachment S, Table S-1, Modification S1-11) and the existing auxiliary feedwater pump valves needed for cross-connection of the emergency feedwater pumps. The licensee stated that LAR Attachment S, Table S-2, Item S2-6, indicates that FAQ 07-0030 feasibility criteria will be incorporated in plant procedures for OMAs. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee identified a required action that will incorporate the provisions of NFPA 805, Chapter 3, and because the action is included as an implementation item in LAR Attachment S, which is required by the proposed license condition.

In SSA RAI 07.c (Reference 17), the NRC staff requested that the licensee provide a description of the actions necessary to transition the referenced manual action analysis that is based on compliance with 10 CFR 50 Appendix R, to one that meets NFPA 805 and RG 1.205. In its response to SSA RAI 07.c (Reference 9), the licensee stated that the current analysis for

Appendix R bounds those for NFPA 805 and that only the cold shutdown actions required under Appendix R will not be part of NFPA 805 NSCA for safe and stable operation. The current analysis will be superseded by the NFPA 805 NSCA and non-power operations (NPO) analyses. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the previous analysis for 10 CFR 50 Appendix R is bounding for NFPA 805.

Based on information provided by the licensee and the above evaluations, the NRC staff concludes that the licensee followed the endorsed guidance of NEI 04-02 and RG 1.205 to identify and evaluate RAs in accordance with NFPA 805. The NRC staff concludes that the feasibility criteria applied to RAs are acceptable based on conformance with the endorsed guidance contained in NEI 04-02 and successful completion of Implementation Item S2-6 in LAR Attachment S, Table S-2, to revise OMA procedures/documents to include feasibility criteria per FAQ 07-0030 for the RAs, which is included in the proposed license condition. Therefore, the NRC staff has reasonable assurance that the licensee's RA process meets the regulatory requirements of 10 CFR 50.48(c).

3.2.6 Plant-Specific Treatments or Technologies

3.2.6.1 Very Early Warning Fire Detection System

The licensee proposed the installation of a very early warning fire detection system (VEWFDS) to monitor conditions, as well as provide indication and alarms, inside key electrical cabinets during the incipient stage of a fire. The following discussion is based on the information provided by the licensee in the LAR Attachment C, Fire Area B-4; LAR Attachment S, Table S-1, Modification S1-10; and LAR Attachment V, Section V.2.2.

As described in LAR Attachment C, a modification to install a VEWFDS is credited with reducing risk in fire area B-4, "Control Element Drive Mechanism (CEDM) Room." LAR Attachment S, Table S-1, Modification S1-10, states that, as part of the transition process, the licensee will install VEWFDS in electrical cabinets 2C-70, 2C-71, 2C-72, 2C-73, 2C-75, 2C-80, and 2C-409 to reduce the risk of fire induced circuit and equipment failures that could result in the loss of the CEDM room panels. Each VEWFDS in the system will connect to the main control room fire panel. In FPE RAI 09 (Reference 17), the NRC staff requested that the licensee provide additional details regarding system design, installation, testing, maintenance, procedures, and training for the new VEWFDS. In its response to FPE RAI 09 (Reference 9), the licensee provided a detailed discussion of the type of system, the system settings, procedures, training, testing, and maintenance for the system. The licensee stated that the system follows the guidance contained in FAQ 08-0046, "Incipient Fire Detection Systems" (Reference 55). The licensee further stated that the VEWFDS incipient fire detector panel has the capability to output a fault condition, alert/pre-alarm, and three fire alarm levels. The licensee stated that the alert/pre-alarm signal set to occur prior to the flaming stage is typically referred to as "Alert" and that the alarm signals set to occur when the device has entered the flaming or true fire stage are called "Alarms." The licensee further stated that an alert/pre-alarm and alarm level response procedure will be developed for the VEWFDS incipient fire detector panel signals and address alarm response actions for each pre-alarm, alarm level, and fault condition. LAR Attachment S, Table S-1, Modification S1-10 includes the licensee's action to install VEWFDS which also includes developing or revising procedures related to operation, response, and maintenance. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee provided appropriate additional details regarding the VEWFDS and because the licensee's action to develop procedures related to the VEWFDS is included in a modification item in LAR Attachment S, Table S-2, which is required by the proposed license condition.

In SSA RAI 09 (Reference 17), the NRC staff requested that the licensee describe if the VEWFDS is credited to initiate any operator actions for SSD. In its response to SSA RAI 09 (Reference 9), the licensee stated that the VEWFDS is only credited in the probabilistic risk assessment for reducing the non-suppression probability. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee provided an appropriate description of the credit being taken for the VEWFDS.

The NRC staff concludes that the fire protection aspects related to the proposed installation of the VEWFDS are acceptable because:

- The installation of the VEWFDS will be performed in accordance with the appropriate NFPA codes, the equipment manufacturers' requirements, and the guidance in FAQ 08-0046, "Incipient Fire Detection Systems";

- The VEWFDS will be properly tested during commissioning such that the alert and alarm setpoints will be set to provide an appropriate level of sensitivity without unnecessary nuisance or spurious alarms;

- The licensee's design and configuration control process will control and maintain the setpoints for both alert and alarm functions for the VEWFDS;

- The VEWFDS equipment will be periodically tested and maintained in accordance with the vendor and manufacturer requirements, as well as guidance contained in FAQ 08-0046, "Incipient Fire Detection Systems" (Reference 55) ; and

- As part of the modification, which is required by the proposed license condition, the licensee will revise or develop procedures to address system operation and alarm response.

In addition, the FPRA modeled the installation of the VEWFDS and took credit for its use in assessing the risk in fire area B-4. SE Section 3.4 addresses the technical review of the FPRA analysis, as well as the acceptability of the risk credit taken for the associated fire area.

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. Based on information provided by the licensee, the NRC staff concludes that the declared safe and stable condition proposed is acceptable and that the licensee's process is adequate to appropriately identify and locate the systems, equipment, and cables, required to provide reasonable assurance of achieving and maintaining the fuel in a safe and stable condition, as well as to meet the NFPA 805 NSPC.

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

The NRC staff also reviewed the licensee's process to identify and analyze MSOs. Based on the LAR, as supplemented, the NRC staff concludes that the process 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 licensee's approach for assessing the potential for MSO combinations is acceptable, because it was performed consistent with NRC-endorsed guidance.

The NRC staff concludes that, based on the information provided in the LAR, as supplemented, and the information obtained during the NFPA 805 site audit (Reference 77) (documents reviewed and discussions with the licensee's staff) that the process used by the licensee to review, categorize and address RAs during the transition from the existing deterministic fire protection licensing basis to an RI/PB FPP is consistent with the NRC-endorsed guidance contained in NEI 04-02 and RG 1.205 regarding the identification of RAs. Upon completion of Implementation Item S2-6 as described in LAR Attachment S, Table S-2, the NRC staff concludes that the licensee provided reasonable assurance that the regulatory requirements of 10 CFR 50.48(c) and NFPA 805 for NSCA methods are met.

The NRC staff reviewed the proposed installation of a VEWFDS to monitor conditions in certain key electrical cabinets and based on the information provided in the LAR, as supplemented, and pending completion of Modification Item S1-10 as described in LAR Attachment S, Table S-1, the NRC staff concludes that the fire protection aspects of the proposed VEWFDS installation are acceptable because the installation will be done in accordance with appropriate NFPA codes and the guidance provided in NRC FAQ 08-0046.

3.3 Fire Modeling

NFPA 805 (Reference 3) allows both fire modeling and FREs as PB alternatives to the deterministic approach outlined in the standard. These two PB approaches are described in NFPA 805, Sections 4.2.4.1 and 4.2.4.2, respectively. Although fire modeling and FREs are presented as two different approaches for PB compliance, the FREs approach generally involves some degree of fire modeling to support engineering analyses and fire scenario development. NFPA 805, Section 1.6.18, defines a fire model as a "mathematical prediction of fire growth, environmental conditions, and potential effects on SSCs 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 fire modeling as part of the transition to NFPA 805, and LAR Section 4.7.3, "Compliance with Quality Requirements in Section 2.7.3 of NFPA 805," which describes how the licensee performed fire modeling calculations in compliance with the NFPA 805 PB evaluation quality requirements for fire protection systems and features, to determine whether the fire modeling used to support transition to NFPA 805 is acceptable.

In LAR Section 4.5.2.1, the licensee stated that the fire modeling approach (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 fire modeling analyses. Therefore, the NRC staff reviewed the technical adequacy of the FREs, including the supporting fire modeling analyses, as documented in SE Section 3.4.2, to evaluate compliance with the NSPC.

The licensee did not propose any fire modeling methods to support PB evaluations in accordance with NFPA 805, Section 4.2.4.1, as the sole means for demonstrating compliance with the NSPC. There are no plant-specific fire modeling methods acceptable for use to support compliance with NFPA 805, Section 4.2.4.1, as part of this licensing action supporting the transition to NFPA 805 at ANO-2.

3.4 Fire Risk Assessments

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

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

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

3.4.1 Maintaining Defense-in-Depth and Safety Margins

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

3.4.1.1 Defense-in-Depth

NFPA 805, Section 1.2, states that:

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

The NRC staff reviewed LAR Section 4.2.4, "Fire Area Transition," LAR Section 4.5.2.2, "Fire Risk Approach," LAR Section 4.8.1, "Results of the Fire Area Review," LAR Table 4-3 "Summary of NFPA 805 Compliance Basis and Required Fire Protection Systems and Features," and LAR Attachment C Table B-3, "NEI 04-02 Table B-3 Fire Area Transition," as well as the associated supplemental information, in order to determine whether the principles of DID were maintained in regard to the planned transition to NFPA 805.

When implementing the PB approach, the licensee followed the guidance contained in NEI 04-02 (Reference 7), Section 5.3, "Plant Change Process," which includes a detailed consideration of DID and safety margins as part of the change process. The licensee documented the method used to meet the DID requirements of NFPA 805 in LAR Attachment C, Table B-3. LAR Attachment C, Table B-3 and LAR Table 4.3 document the results of the licensee's review of fire suppression and fire detection systems.

The licensee developed a methodology for evaluating DID which evaluated each of the three elements in NFPA 805 Section 1.2 referred to as echelons 1, 2, and 3 respectively. This evaluation method is described in LAR Section 4.5.2.2. The licensee explained that the DID review methodology employed is based upon the requirements of NFPA 805, and the guidance contained in NEI 04-02, RG 1.205 (Reference 4), and FAQ 08-0054 (Reference 59).

This method for addressing DID was implemented in the FREs performed on each PB fire area. The FREs, evaluate variance from deterministic requirements (VFDRs) using an integrated assessment of risk, DID, and safety margins. The FREs 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 fire probabilistic risk assessment (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 FREs are the licensee's internal record of the systems required to meet the NSPC and DID requirements of NFPA 805.

Based on the review of the LAR and a sample of the FREs during the audit of the NFPA 805 transition RI/PB FPP (Reference 77), the NRC staff concludes that the licensee systematically and comprehensively evaluated fire hazards, area configurations, detection and suppression features, and administrative controls in each fire area. The NRC staff also concludes that the methodology proposed in its LAR, as supplemented, adequately evaluates DID against fires as required by NFPA 805, and, therefore, that the proposed RI/PB FPP adequately maintains DID.

3.4.1.2 Safety Margins

NFPA 805 Section 2.4.4.3 states, in part, that:

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

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

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

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

LAR Section 4.5.2.2, "Fire Risk Approach," states that safety margins were considered as part of the FRE process and that each retained VFDR was evaluated against the safety margin criteria of NEI 04-02 and RG 1.205. A FRE was performed for each fire area containing VFDRs. The FREs contain the details of the licensee's review of safety margins for each PB fire area.

The licensee further described the methodology used to evaluate safety margins in the FREs to include the following evaluations and determinations:

- Fire modeling for the FPRA was specifically reviewed for adequate safety margin and, in general, was developed utilizing industry and NRC guidance, including NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities" (Reference 29), NEI 04-02, and associated frequently asked question resolutions as described in LAR Section 3.4 and specifically identified throughout the LAR.

- Plant system performance evaluated given the specific demands associated with the postulated fire events did not result in changes to performance criteria.

- The FPRA logic model, including supporting fire modeling, was developed in accordance with NUREG/CR-6850 and ASME/ANS RA-Sa-2009, "Addenda to

ASME/ANS RA-S-2008, Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications" (Reference 24).

The safety margin criteria described in NEI 04-02, Section 5.3.5.3 and the LAR are consistent with the criteria described in RG 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis" (Reference 22), and are, therefore, acceptable. The licensee used appropriate codes and standards (or NRC-approved guidance) and met the safety analysis acceptance criteria in the licensing basis. Based on its review of the LAR and a sample of the FREs during its audit of the NFPA 805 transition RI/PB FPP (Reference 77), the NRC staff concludes that the licensee's approach has adequately addressed the issue of safety margins in the implementation of the FRE process.

3.4.1.3 Defense-in-Depth and Safety Margin Conclusion

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

3.4.2 Quality of the Fire Probabilistic Risk Assessment

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

The licensee developed an internal events PRA during its Individual Plant Examination process and continued to maintain and improve the PRA as RG 1.200, "An Approach For Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities" (Reference 23), and supporting industry standards have evolved. The licensee developed its FPRA model for both Level 1 (core damage) and partial Level 2 (large early release) PRA during at-power conditions. For the development of the FPRA, the licensee modified its internal events PRA model to capture the effects of fire.

The licensee did not identify any: (1) known outstanding plant changes that would require a change to the FPRA model, or (2) any planned plant changes that would significantly impact the PRA model, beyond those identified and scheduled to be implemented as part of the transition to an FPP based on NFPA 805. Based on the information provided by the licensee, the NRC staff concludes that the FPRA model is consistent with NEI 04-02 and RG 1.200, that it represents the current, as-built, as-operated configuration, and is, therefore, capable of being adapted to model both the post-transition and the NFPA 805 compliant plant, as needed.

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

3.4.2.1 Internal Events PRA Model

The licensee's evaluation of the technical adequacy of its internal events PRA model used to support development of the FPRA model consisted of a full-scope peer review of the internal events and internal flooding PRA performed in July 2008. The review was based on the NEI 05-04 process (Reference 79) and the combined ASME/ANS PRA Standard, ASME-RA-Sb-2005 (Reference 80), as clarified by RG 1.200, Revision 1. Given that the internal flooding PRA was not complete at the time of the peer review, a peer review was not completed on the flooding elements. The internal events PRA model revised in response to the peer review serves as the basis of the FPRA used in performing PRA evaluations for the LAR.

For each Supporting Requirement (SR) in the ASME/ANS PRA Standard (Reference 24), there are three degrees of "satisfaction" referred to as Capability Categories (CCs) (i.e., I, II, and III), with I being the minimum, II considered widely acceptable, and III indicating the maximum achievable. For many SRs, the CCs are combined (e.g., the requirement for meeting CC-I may be combined with CC-II) or the requirement is the same across all CCs so that the SR is simply met or not met. For each SR, the PRA Peer Review team designates the highest CC met or indicates that the SR is met or not met.

LAR Attachment U, Table U-1 provides the licensee's dispositions to 51 facts and observations (F&Os) from the full-scope peer review which include F&Os against SRs that were met, not met, or achieved CCs I, II, or III, were not reviewed, or only met CC-I. Thirty-four of the F&Os are categorized as findings, as defined in peer review guidelines (Reference 79). In general, an F&O is written for any SR that is judged not to be met or does not fully satisfy CC-II of the ASME standard, consistent with RG 1.200, Revision 1. LAR Attachment U, Table U-1 also includes the results of an evaluation of the internal flooding PRA methodology as explained above.

In PRA RAI 20 (Reference 19), the NRC staff requested that the licensee explain how the change in SRs from the PRA standard used in the peer review to the 2009 version of the ASME/ANS PRA standard were addressed, and similarly, how the changes in SR clarifications from RG 1.200, Revision 1 to Revision 2, were addressed. In its response to PRA RAI 20 (Reference 13), the licensee explained that a detailed comparison of the SRs in ASME RA-Sb-2005 and ASME/ANS RA-Sa-2009 was performed and that the changes in RG 1.200 clarifications were reviewed. The licensee stated that the changes would not invalidate the peer review and indicated that a new analysis was not required. The NRC staff concludes that this RAI is resolved because of the relatively minor changes in the internal events SRs endorsed by Revision 1 of RG 1.200 and those endorsed by Revision 2, and that the licensee reviewed and determined none to be significant to the PRA.

In LAR Attachment U, the licensee provided a description of how each F&O was resolved along with an assessment of the impact on the FPRA and the NFPA 805 application. The NRC staff evaluated the licensee's resolution to each F&O to determine whether they had any significant impact on the application. The NRC's Record of Review dated August 15, 2014 (Reference 81), summarized the NRC staff's review of the licensee's resolution of each F&O. The NRC staff requested supplemental information for the review of some of the F&Os, which were provided by the licensee in its RAI response (Reference 9).

Based on information provided by the licensee and the above evaluations, the NRC staff concludes that the internal events PRA is technically adequate and that its quantitative results, considered together with the sensitivity study results, can be used to demonstrate that the change in risk due to the transition to NFPA 805 meets the acceptance guidelines in RG 1.174. The NRC staff has reviewed all F&Os provided by the peer reviewers and concludes that the resolution of every F&O supports the determination that the quantitative results required to support the transition to NFPA 805 are adequate. Accordingly, the NRC staff concludes that the licensee demonstrated that the internal events PRA meets the guidance in RG 1.200, Revision 2, that it is reviewed against the applicable SRs in ASME/ANS-RA-Sa-2009, and that it is technically adequate to support the FREs required for the NFPA 805 application.

3.4.2.2 Fire PRA Model

The licensee evaluated the technical adequacy of the FPRA model by conducting a peer review in June 2009 using the NEI 07-12, "Fire Probabilistic Risk Assessment Peer Review Process Guidelines" (Reference 82), and the combined PRA standard, ASME/ANS RA-Sa-2009 PRA standard (Reference 24), as clarified by RG 1.200, Revision 2 (Reference 23). The licensee also performed two follow-on focused-scope peer reviews in October 2011 and November 2012 to address the adequacy of changes to the fire scenarios caused by resolving some F&Os from the original peer review and the removal of several unapproved analysis methods (UAMs). LAR Attachment V, Table V-1, presents the 33 F&Os defined as findings in peer review guidelines (Reference 82), and the licensee's dispositions from the original peer review. LAR Attachment V, Table V-2, lists the F&Os from the two focused-scope peer reviews, and provides the disposition of each finding. LAR Attachment V, Table V-3, identifies the SRs that were determined by the peer reviews to be met only at CC-I, and provides an evaluation of the CC-I acceptability for the LAR.

The NRC staff evaluated each F&O and the licensee's disposition in LAR Attachment V to determine whether the F&O had any significant impact on the application. The NRC staff's review and conclusion regarding the licensee's resolution of each F&O and basis of acceptability of SRs that are "not met" or only meet CC-I is summarized in the NRC's Record of Review dated October 22, 2014 (Reference 81). The NRC staff requested supplemental information in support of the review of some of the F&Os. Issues identified from that review are discussed below.

In PRA RAI 01.d (Reference 17), associated with F&O FSS-B1-01 presented in LAR Attachment V, Table V-1, the NRC staff requested that the licensee provide additional information regarding whether the impact of a fire in the Main Control Room (MCR) of one unit was addressed in the assessment of the opposite unit's MCR. In its response to PRA RAI 01.d (Reference 10), the licensee explained that evaluation of smoke and heat buildup was performed using a consolidated model of fire and smoke transport for the combined ANO-1 and ANO-2 control rooms and associated heating, ventilation, and air conditioning (HVAC) systems. The licensee explained that this calculation includes an evaluation of impact of a fire initiating in the ANO-2 MCR, as well as a fire initiating in the ANO-1 MCR, and the transfer of heat and smoke to the ANO-2 MCR. The MCRs are separated by a solid concrete wall with the exception of a glass portion topped with louvers, but there is 2 feet of separation between the glass wall and the nearest panel. There is no exposed cable in the ANO-2 control room near the glass partition; therefore, fire in the ANO-1 control room does not cause damage to cables or sensitive electronics in the ANO-2 control room. The NRC staff concludes that the RAIs related to a common control room have been addressed because the licensee specifically evaluated the interactions and included the effects in the FPRA.

In PRA RAI 01.e (Reference 17), associated with F&O FSS-B2-01 presented in LAR Attachment V, Table V-1, the NRC staff requested that the licensee provide information about how the Conditional Core Damage Probability (CCDP) of 6.97E-02 given MCR abandonment was estimated. In its response to PRA RAI 01.e (Reference 9), the licensee explained that the CCDP for the MCR abandonment scenario is only credited upon loss of MCR habitability and is determined by setting the failure probability of all but three operator actions to 1.0. The three post-abandonment actions that are credited consist of: 1) isolation of letdown flow from outside the MCR, 2) ensuring RCPs are tripped at the switchgear, and 3) alignment of the new auxiliary feedwater pump at its control station. These three actions were assessed using detailed human reliability analysis (HRA). Subsequently, in its response to PRA RAI 01.e.01 (Reference 14), the licensee provided a new CCDP of 0.151 that was developed using the HRA methodology specified in NUREG-1921, "EPRI/NRC-RES Fire Human Reliability Analysis Guidelines" (Reference 40).

The NRC staff determined that the licensee's evaluation treated failure of MCR abandonment as a single scenario supported by single HEP for MCR abandonment failure. As a result, in PRA RAI 01.e.01 (Reference 19), the NRC staff requested that the licensee provide information on how fire-induced failures such as spurious operations that might result from a fire leading to MCR abandonment were considered. In its response to PRA RAI 01.e.01 (Reference 14), the licensee stated that the single MCR abandonment approach was conservative because it was based on the assumption that all cables in the control room are damaged and therefore included the most complex spurious actions that make successful plant shutdown unlikely. The NRC staff found that the assumption could result in a conservative estimate of risk. However, combined change evaluations where a conservative estimate of the compliant plant risk is subsequently reduced by risk reduction modifications can result in an overestimation of the risk reduction and subsequent underestimation of the change in risk.[1]

[1] Overestimation of the compliant plant risk that results in underestimation of the risk increase is illustrated by the sensitivity study reported in the discussion related to PRA RAI 15.c in this SE.

The licensee's justification included consideration of risk reduction modifications that substantially reduce risk. The total change-in-risk for transition to NFPA 805 estimated by the licensee (Reference 15), was -1.19E-04/year for delta (Δ) CDF and -4.47E-06/year for ΔLERF. In its response to PRA RAI 01.e.01 (Reference 14), the licensee reported the total MCR abandonment frequency to be 8.20E-05/year. Assuming that all MCR abandonment scenarios lead to core damage in the compliant case and none lead to core damage in the post-transition case would result in a conservative ΔCDF for transition of -3.70E-05/year. Revised LAR Attachment W, Table W-1 (Reference 14), reported the risk from the single MCR abandonment scenario (2199-G/A). The information indicated that the conditional large early release probability given core damage for these scenarios is 0.01 resulting in a conservative ΔLERF for transition of -3.65E-6/year. Based on the information provided by the licensee and the evaluations above, the NRC staff concludes that the overestimation of the compliant plant risk associated with MCR abandonment does not affect the 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 the approach used by the licensee is expected to overestimate the risk increase.

In PRA RAI 01.f (Reference 17), associated with F&O FSS-D8-01 presented in LAR Attachment V, Table V-1, the NRC staff requested that the licensee provide additional information about the new administrative controls and the review of transient combustible violations that justified a heat release rate (HRR) of 69 kiloWatt (kW) instead of the commonly used HRR of 317 kW. In its response to PRA RAI 01.f (Reference 9), the licensee clarified that new transient combustible control procedures will include a continuous fire watch that will be posted for any transient combustible left in fire zones that credit a reduced HRR. The licensee also stated that review of transient control non-conformances between February 2007 and September 2011 resulted in identification of only three violations of the current transient combustible control procedures. Noting that the response referred to "levels of control," but only one level was discussed, in PRA RAI 01.f.01 (Reference 19), the NRC staff requested additional information about these levels of control and how the new controls will address the specific locations of existing and potential combustibles. In its response to PRA RAI 01.f.01 (Reference 13), the licensee explained that there are four levels of control with the most stringent control being level 1, also referred to as a zero transient zone. Levels 2, 3, and 4 provide fewer restrictions than a level 1 area. All fire areas for which reduced HRRs are credited will be administered by level 1 controls. The licensee further explained that the fire control procedures will address unique concerns and special needs for level areas and may require additional limitations such as storage of material in a metal container and staging material away from ignition sources. The NRC staff concludes that the use of reduced HRRs in the licensee's FPRA is acceptable because the licensee reviewed past violations and established additional controls on transient combustible consistent with the NRC guidance on the subject of peak HRRs (NRC letter dated June 21, 2012, to B. Bradley, Nuclear Energy Institute (Reference 83)).

In PRA RAI 01.g (Reference 17), associated with F&O FSS-E2-01 presented in LAR Attachment V, Table V-1, the NRC staff requested that the licensee provide additional information about the fire modeling performed to remove the "panel factors" method referred to in the disposition in LAR Attachment V, Section V.2.2. The "panel factors" method assigns the likelihood of electrical cabinet fire propagation a probability rather than evaluating the robustness of the cabinet. This method was previously reviewed and denied acceptance by the NRC (Reference 83). In its response to PRA RAI 01.g (Reference 11), the licensee stated that additional fire modeling for certain fire scenarios was performed after removal of the "panel factors." This included modeling the suppression and detection systems in fire zones 2109-U and 2098-C not previously credited, and additional modeling in support of the Multi-Compartment Analysis (MCA). The new FPRA modeling was reviewed during the November 2012 focused-scope peer review discussed earlier in this SE section. In its response to PRA RAI 21 (Reference 14), the licensee stated that the use of electrical panel factors has been eliminated in the post-transition and final composite analysis treatment. The NRC staff concludes that this RAI response is acceptable because the unacceptable method has been removed and replaced with an acceptable method.

In PRA RAI 01.i (Reference 17), associated with F&O IGN-A7-01 presented in LAR Attachment V, Table V-1, the NRC staff requested that the licensee provide additional information regarding how the transient fire frequency was distributed throughout the Turbine Building (TB) and justification for any areas excluded from consideration. In its response to PRA RAI 01.i (Reference 9), the licensee explained that due to the size of the TB and limited number of high-risk cables routed through the TB, it was divided into 12 areas where important targets in different safety divisions could be impacted by the same fire (i.e., pinch-points). The transient frequency applied to each area was proportional to the floor area comprised by the area compared to the total TB floor area. TB locations without important targets were assigned to one scenario (i.e., 2200-MM/A) representing the balance of the TB floor area. All cables not already included in one of the other 12 areas were assumed to be damaged in this scenario. The NRC staff concludes that this treatment of transient fires in the TB is acceptable because the pinch-points were identified and quantified consistent with the guidance in NUREG/CR-6850, and the risk from other cables in the turbine building was evaluated by assigning the remaining fire frequency to scenarios that damage all remaining cables.

In PRA RAI 01.k (Reference 17) associated with F&O UNC-A1-01 presented in LAR Attachment V, Table V-1, the NRC staff requested that the licensee clarify whether propagation of parametric uncertainty included the state of knowledge correlations (SOKC) between related PRA input values. In its response to PRA RAI 01.k (Reference 9), the licensee stated that an uncertainty quantification that includes the SOKC resulted in mean values that increased 1.7 percent for CDF and 3.7 percent for LERF above the point estimates presented in LAR Attachment W. This SOKC analysis included fire ignition frequencies, spurious operations probabilities, non-suppression probabilities, and component failure probabilities. In its response to PRA RAI 21 (Reference 14), the licensee stated that the SOKC has been incorporated into the uncertainty analysis. The NRC staff concludes that the SOKC evaluation is acceptable because the effect on the transition risk estimates is negligible with respect to meeting the risk acceptance guidelines, and because the licensee demonstrated the capabilities to develop and use mean values when needed.

In PRA RAI 03 (Reference 17), the NRC staff requested that the licensee provide additional information regarding whether the incipient detection system in the control rod drive mechanism (CRDM) cabinets was credited to limit damage within the cabinet where incipient detection would be installed. Guidance in FAQ 08-0046 (Reference 55) states that incipient detection can be credited to avoid fire damage outside of the cabinet but that all targets within the cabinet should be failed by the fire. In its response to PRA RAI 03 (Reference 9), the licensee stated that the incipient detection system was credited to limit damage within the cabinet as well as to avoid damage outside the cabinet. The licensee also stated that credit for the incipient detection to limit damage within the cabinet will be removed before reporting the final NFPA 805 transition risk results. In its response to PRA RAI 21.a (Reference 14), the licensee addressed PRA RAI 03 and stated that the credit for the incipient detection system to limit damage within a cabinet has been eliminated. The NRC staff concludes that this RAI is resolved because the licensee removed the unacceptable method and replaced it with an acceptable method.

In its response to PRA RAI 04.a (Reference 9), the licensee explained how the impact of a fire in ANO-1 is accounted for in the CDF and LERF of ANO-2. The licensee explained that fire areas in two units are generally adjacent, rather than intermingled, so most fires are associated with just one of the units. However, the impact of a fire in each of ANO-1 fire areas on ANO-2 targets was specifically evaluated for the few common areas that contain equipment for both units. The licensee further stated that any fire in ANO-1 is conservatively assumed to result in a trip of ANO-2. In its response to PRA RAI 04.b (Reference 9), the licensee stated that the risk values for ANO-2 reported in the LAR include the risk to ANO-2 from fires originating in ANO-1. The NRC staff has reviewed the information provided by the licensee and concludes that the licensee's quantitative analyses include the fire impact on targets in areas adjacent to Units 1 and 2, and in common areas of Units 1 and 2 and are, therefore, acceptable.

LAR Attachment V, Section V.2 identified deviations from the accepted methods in NUREG/CR-6850 (Reference 29) and the FAQs, and performed sensitivity studies that evaluated the effects of these deviations. The deviations included the use of the "panel factors," control power transformer (CPT) credit, and not using the NUREG/CR-6850 value of 1E-3 as the minimum non-suppression probability. In PRA RAI 06.a (Reference 17), the NRC staff requested that the licensee replace these deviations with acceptable methods or provide additional justification. In its response to PRA RAI 06.a (Reference 9), the licensee stated that it had removed the CPT credit. In its response to PRA RAI 01.g (Reference 9) and PRA RAI 06.02 (Reference 13), the licensee provided additional information about the acceptable methods used to replace panel factors and minimum non-suppression probability, respectively. In its response to PRA RAI 21.a (Reference 14), the licensee stated that it had eliminated electrical panel factors, eliminated CPT credit, and incorporated a floor value non-suppression probability of 1E-3 in the final composite and post-transition analysis treatment. The NRC staff concludes that the issue associated with the use of the identified unacceptable methods is resolved because they were replaced with acceptable methods and values.

In PRA RAI 07 (Reference 17), the NRC staff requested that the licensee explain how transient fires were placed, including pinch points (i.e., where CCDPs are highest for a given physical analysis unit (PAU)). In its response to PRA RAI 07 (Reference 9), the licensee explained that in addition to locations that impact redundant trains or risk significant equipment, transient fires were postulated at locations where a fire could impact any plant component or raceway (with the exception of the TB which is done differently, as described in the response to PRA RAI 01.i (Reference 9)). Accordingly, all targets within a PAU are impacted by at least one transient fire. The licensee explained that, to account for overhead cable tray congestion, those targets not identified in the walkdowns of the transient zones of influence (ZOIs) were assumed to fail in all transient fires within the PAU. The licensee also explained that the floor area covered by transient fire scenarios were arranged to overlap each other, if needed, to account for additional combinations of targets along the edge of transient fire ZOI. The NRC staff concludes that this approach is acceptable because it systematically searches for sensitive locations for transient fires including pinch-points, and places transient fires at these sensitive locations.

In PRA RAI 08.a (Reference 17), the NRC requested additional information regarding how propagation of fires between cabinets in the MCR was evaluated. In its response to PRA RAI 08.a (Reference 10), the licensee explained that most Main Control Boards (MCBs) and back cabinets in the MCR are separated by double walls and an air gap, and do not have open backs. Therefore, non-abandonment fire scenarios for these kinds of cabinets, per the guidance in NUREG/CR-6850, Appendix S, were assumed not to propagate. However, fire propagation was modeled for Panels 2C01, 2C02, 2C03, 2C04, and 2C100 because it was "conservatively assumed that the panels are not separated with double walls and an air gap, although each panel is an individual console, with its own outer walls." Panels 2C09 and 2C10 were treated as one panel because there is a 6-inch opening between panels. The NRC staff concludes that these evaluations are acceptable because they are consistent with the guidance in NUREG/CR-6850.

In PRA RAI 08.c (Reference 17), the NRC requested that the licensee justify modeling half the MCR panel fires as single-bundle cable fires and half as multiple-bundle cable fires. In its response to PRA RAI 08.c (Reference 10), the licensee stated that it is "implausible" for a fire to start in a multiple-bundle cable. In PRA RAI 08.01 (Reference 19), the NRC staff requested that the licensee treat electrical panels as having either multiple- or single-bundle cables consistent with the guidance in NUREG/CR-6850. In its response to PRA 08.01 (Reference 13), the licensee stated that the general assumption was eliminated and replaced with the assumption that all panels are multiple bundles unless visually verified to be single bundle. Subsequently, the licensee stated in its response to PRA RAI 21.a (Reference 14), that the analysis "now incorporates multiple cable bundles for all control room panels," which implies that no single-bundle panels were identified or that the walkdowns were not conducted, either of which is acceptable. The NRC staff concludes that this RAI response is acceptable because the unacceptable method has been removed and replaced with an acceptable method.

Based on information obtained during the NFPA 805 audit (Reference 77), the NRC staff determined that the licensee used the approach from NUREG/CR-6850, Appendix L, but that the MCB fire-ignition frequency (i.e., Bin 4) was allocated among scenarios. Per NRC guidance in FAQ 14-0008 on MCB treatment (Reference 84), target damage probabilities from NUREG/CR-6850, Appendix L, Figure L-1 should be re-calculated, if the MCB fire ignition frequency is allocated among scenarios. In PRA RAI 08.02 (Reference 19), the NRC staff requested that the licensee provide the correct application of the Appendix L guidance or further explanation of an alternative method. In its response to PRA RAI 08.02 (Reference 13), the licensee stated that a single-bounding scenario will be developed to model MCB fire risk. In the scenario, the entire Bin 4 ignition frequency will be applied, the damage of all cables in the MCB will be assumed, and the zero-separation distance from Figure L-1 of NUREG/CR-6850 will be applied, which is consistent with the guidance in FAQ 14-0008 and NUREG/CR-6850 and therefore acceptable. In its response to PRA RAI 21.a (Reference 14), the licensee stated that the analyses described in response to PRA RAI 08.02 have been incorporated into the FPRA.

The NRC staff concludes that this RAI response is acceptable because the unacceptable method has been removed and replaced with an acceptable method.

In PRA RAI 09 (Reference 17), the NRC requested that the licensee explain how its HRA "multiplier approach" compares to the guidance in NUREG-1921 (Reference 40). The licensee applied a multiplier to Human Error Probabilities (HEPs) developed for internal events Human Failure Events (HFEs) to determine the HEP for fire HFEs. In its response to PRA RAI 09 (Reference 9), the licensee explained its approach but could not conclude that its approach was consistent or conservative with respect to the NUREG-1921 guidance. The licensee proposed to retain its approach but augment it with a sensitivity study using NUREG-1921 methods for important HFEs. In PRA RAI 09.01 (Reference 19), the NRC staff requested additional information about the risk impacts of retaining the approach and whether the sensitivity study would be retained for post-transition and self-approval risk evaluations. In its response to PRA RAI 09.01 (Reference 13) and PRA RAI 21.a (Reference 14), the licensee stated that the "multiplier approach" has been replaced with the approach specified in NUREG-1921. The NRC staff concludes that this RAI is resolved because the unacceptable method has been removed and replaced with an acceptable method.

In PRA RAI 10 (Reference 17), the NRC staff requested clarification about whether a minimum joint HEP was applied to combinations of human actions in single cut sets instead of the product of the individual HEPs. In its response to PRA RAI 10 (Reference 9), the licensee stated that minimum joint HEP of 1E-06 was used, consistent with the value used in its internal events PRA. The licensee further indicated that a sensitivity study using a minimum value of 1E-05, as recommended for FPRA in NUREG-1792, "Good Practices for Implementing Human Reliability Analysis (HRA)," issued April 2005 (Reference 85), would be provided. Instead of a sensitivity study, the licensee clarified in its supplement dated September 24, 2014 (Reference 15), that no joint HEPs less than 1E-05 were used in the final FPRA. The NRC staff concludes that this RAI is resolved because an acceptable minimum joint HEP, as described in NUREG-1792, is reflected in the final transition risk estimates and is used in the FPRA.

In its response to PRA RAI 11 (Reference 9), regarding fire-induced instrument failure, the licensee explained that instrumentation needed to provide cues for operator actions either is incorporated directly into the fault tree logic, or is addressed in the HEP for the operator action that it supports. For instrumentation modeled in the fault tree, the fire-induced failure of the instrumentation will preclude credit for associated HFEs in a fire scenario. The licensee explained that instrumentation needed to support SSD is confirmed to be available on a fire area basis by deterministic analysis. The licensee also explained that post-fire operating procedures provide guidance about available instrumentation for each fire area that no actions would be initiated based on a single spurious indication or annunciator. This guidance ensures that the operators use only protected instruments, and that off-scale, incorrect, or misleading readings will not lead to inappropriate actions. The NRC staff concludes that fire-induced instrument failures are adequately addressed in the fire HRA because the PRA models appropriately reflect the operating procedures and the physical layout of the instrumentation and cables.

In PRA RAI 12 (Reference 17), NRC staff indicated that LAR Attachment C identified HVAC as needed in certain cases for SSD, and requested that the licensee provide additional information about HVAC modeling and cable tracing performed for the FPRA. In its response to PRA RAI 12 (Reference 9), the licensee stated that integrated room heat-up analyses was performed to determine the environmental conditions for Auxiliary Building rooms and to determine when HVAC is needed for SSD. Based on these analyses, HVAC is only required for the Emergency Diesel Generator room and Safety Parameter Display System room (the Safety Parameter Display System is needed to support MCR abandonment scenarios). The licensee explained that applicable HVAC system modeling and cable tracing was performed in support of the FPRA. The licensee identified modifications S1-12 and S1-13 as described in LAR Attachment S, Table S-1, as being needed to ensure that acceptable room temperatures are maintained. The NRC staff concludes that HVAC was appropriately addressed because the licensee used acceptable PRA and FPRA techniques for system modelling and cable tracing and because the needed modifications are included in LAR Attachment S, which is required by the proposed license condition.

In its response to PRA RAI 13 (Reference 9), the licensee clarified that the analysis of smoke damage impact was performed consistent with the guidance in NUREG/CR-6850, Appendix T, and discussed how Appendix T failure modes were addressed in the FPRA. The licensee also stated that potentially vulnerable components within the same electrical panel or an interconnected bank of panels were considered to be failed by fire (either by thermal or smoke damage) unless a specific design feature existed to preclude damage. The NRC staff concludes that the impact of smoke has been adequately addressed because the impact of smoke has been evaluated when design features do not limit the impact of smoke.

In its response to PRA RAI 14 (Reference 11), regarding the impact of fire on sensitive electronics, the licensee explained that the criteria for damage to sensitive electronics mounted within a panel, or other kind of robust enclosure, was assumed to be the heat flux damage threshold of thermoset cable. The licensee also stated that during its walkdowns, no instances were identified where sensitive electronics were mounted on the surface of the enclosure or in a way to be susceptible to convective or radiant energy impact, and that all electronics were mounted inside "robust" enclosures. The licensee concluded that the fire impact on sensitive electronics has no effect on the risk estimates. The NRC staff concludes that the licensee's treatment of sensitive electronics is acceptable because it is consistent with the guidance in FAQ 13-0004 (Reference 86).

In its response to PRA RAI 15.c (Reference 9), the licensee stated that, "due to lack of cable routing information, some components are assumed to be failed in all fire scenarios, unless credited by exclusion." The licensee's response to PRA RAI 02 (Reference 9), clarified that "credit by exclusion" was used to remove 2,757 failures from a total population of 451,276 cable failure events. In PRA RAI 16.01 (Reference 19), the NRC staff determined that the assumption that all un-routed cables fail in every fire overestimates the plant risk, which can overestimate risk-decrease caused by risk reduction modifications. In its response to PRA RAI 16.01 (Reference 13), the licensee evaluated this issue and estimated the greatest possible increase in the change-in-risk from the unknown cable routing by continuing to fail all unknown routed cables in the post-transition PRA but not failing any of them in the compliant plant PRA. This overestimates the change in risk associated with unknown cable routing because some cables would normally fail in both the compliant and the post-transition plant. The ΔCDF changed from -2.62E-04/year in the baseline results to -1.42E-04/year in the RAI response. The ΔLERF changed from -9.04E-06/year in the baseline results to -5.11E-06/year in the RAI response. Given that the change in risk remains negative, even when treatment of unknown cable routing is conservatively evaluated, the NRC staff concludes that additional cable tracing or expanding the credit for exclusion evaluation will not cause the large risk decrease to become an unacceptable risk increase. The NRC staff further concludes that the licensee's approach is acceptable for use in the post-transition PRA because the approach used by the licensee is expected to overestimate the risk increase in FREs that can be used to support self-approval.

In PRA RAI 17 (Reference 17), NRC staff described some of the committed modifications in LAR Attachment S, Table S-1 as complex and requested that the licensee describe how the design of these modifications were communicated to the PRA analysts and how the corresponding PRA models were developed. In its response to PRA RAI 17 (Reference 11), the licensee explained that scoping designs for complex modifications (e.g., installing a new auxiliary feedwater pump and installing backup control power) were provided to the PRA analysts. The licensee summarized examples of extensive interactions between the design engineers and the PRA analysts that improved both the design and the PRA models. In PRA RAI 01.h (Reference 17), the NRC staff requested similar clarification regarding how HEPs were being developed when the procedures were not yet completed. In its response to PRA RAI 01.h (Reference 9), the licensee discussed Implementation Items S2-6 and S2-9 in LAR Attachment S, Table S-2. Implementation Item S2-6 states that the licensee will update existing procedures and complete new procedures as needed, and Implementation Item S2-9 states that the PRA will be reviewed and revised, as needed, to address each completed modification credited directly or indirectly in the PRA. Implementation Item S2-9 also states that the PRA review will ensure that the as-built change in risk does not exceed the change in risk estimates reported in the LAR. The NRC staff concludes that the PRA modelling of planned modifications and procedures is necessary and is acceptable because it uses the best available information, and the FPRA will be updated to reflect the final plant configurations and procedures when the modifications are completed, and because the required implementation items are included in LAR Attachment S and are required by the proposed license condition.

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

3.4.2.3 Fire Modeling in Support of the Development of the Fire Risk Evaluation (FRE)

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

NFPA 805, Section 2.4.3.3, 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's reviews of the acceptability of the fire modeling (first requirement). The results of the NRC staff's review of compliance with the remaining requirements are discussed in SE Sections 3.8.3.2 through 3.8.3.5.

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

The ZOI around ignition sources was determined based on tables in the Generic Fire Modeling Treatments (GFMTs) approach. The tables in this document provide the horizontal and vertical dimensions of the ZOI for various ignition sources (transient fuel packages, small liquid fuel fires, open cabinets, and cable trays) and different types of targets (i.e., thermoplastic and thermoset cables as defined in NUREG/CR-6850 (Reference 29) (Reference 30), and Class A combustibles). The GFMTs approach also contains a set of tables that are used to determine if and when the hot gas layer (HGL) temperature exceeds the damage threshold of specified targets depending on fire size, room volume, and ventilation conditions. The GFMTs approach was used as a basis for the scoping or screening evaluation as part of the fire modeling to support FREs.

During the NFPA 805 audit (Reference 77), the NRC staff reviewed the GFMTs approach including the HGL tables for additional critical damage temperatures, ignition sources with time-dependent HRR combinations of an ignition source and an intervening combustible, the range of HRRs per unit area and fire durations for the transient fire test data referenced in NUREG/CR-6850, and revised ZOI tables for transient fuel packages in the open, wall, and corner configuration.

The GFMTs approach were also used in conjunction with selected tables in Appendix H of NUREG/CR-6850 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 and its supplementary tables were obtained by using a collection of algebraic models and empirical correlations. The primary algebraic fire models and empirical correlations that were used for this purpose are the following:

- Heskestad Flame Height Correlation;
- Heskestad Plume Temperature Correlation; and
- Shokri and Beyler Solid Flame Model.

These algebraic models are described in NUREG-1805, "Fire Dynamics Tools (FDT^s): Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program," issued December 2004 (Reference 36). The V&V of these algebraic models is documented in NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," Volume 3, issued May 2007 (Reference 37). The V&V of the fire models that were used to support the FPRA is discussed in SE Section 3.8.3.2.

The Consolidated Model of Fire and Smoke Transport (CFAST) computational fire model, Version 6 (Reference 87), was used to generate the HGL tables in the GFMTs approach and its supplementary material. The FPRA used these calculations to further screen ignition sources, scenarios, and compartments that would not be expected to generate an HGL, and to identify the ignition sources that have the potential to generate an HGL for further analysis. CFAST was also used for the main control room abandonment time calculations. The V&V of CFAST is documented in NUREG-1824, Volume 5 (Reference 37).

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.

- Shokri and Beyler flame radiation model (Reference 88)
- Mudan flame radiation model (Reference 89)
- Plume heat flux correlation by Wakamatsu et al. (Reference 90);
- Yokoi plume centerline temperature correlation (Reference 91) (Reference 92);

- Hydrocarbon spill fire size correlation (Reference 93);
- Flame extension correlation (Reference 94);
- Delichatsios line source flame height model (Reference 95);
- Corner flame height correlation (Reference 94);
- Kawagoe natural vent flow equation (Reference 96);
- Yuan and Cox line fire flame height and plume temperature correlations (Reference 97);
- Lee cable fire model (Reference 98); and
- Babrauskas method to determine ventilation-limited fire size (Reference 99).

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

- Correlation for Flame Spread over Horizontal Cable Trays, FLASH-CAT, described in NUREG/CR-7010, "Cable Heat Release, Ignition, and Spread in Tray Installations During Fire (CHRISTIFIRE), Volume 1: Horizontal Trays" (Reference 38).
- CFAST Version 6 to calculate the times to reach various HGL temperature thresholds.
- Heskestad's correlation (Reference 36), (Chapter 9) to calculate the plume temperature at a fixed elevation above an ignition source.

The finite difference conduction heat transfer model HEATING, Version 7.3 (Reference 100) was used 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's ZOI approach was used as a screening tool to distinguish between fire scenarios that required further evaluation and those that did not. The licensee stated that qualified personnel performed a plant walk-down to identify ignition sources, surrounding targets, and safety-related SSCs 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 RAIs Pertaining to Fire Modeling in Support of the Fire PRA

By letters dated September 11, 2013 (Reference 17), and March 28, 2014 (Reference 18), the NRC staff requested additional information concerning the fire modeling conducted to support the FPRA. By letters dated November 7, 2013 (Reference 9), December 4, 2013 (Reference 10), January 6, 2014 (Reference 11), and May 22, 2014 (Reference 12), the licensee responded to these RAIs.

- In FM RAI 01.a (Reference 17), the NRC staff requested that the licensee provide the basis for the assumption that the fire brigade is expected to arrive at the MCR within 15 minutes, and to explain how the uncertainty of this assumption affects the FPRA.

  In its response to FM RAI 01.a (Reference 11), the licensee reported that a review of reports of fire brigade drills conducted in 2011 and 2012 indicates that the fire brigade response time for fires in the general area of the main control room is approximately 9-10 minutes. The licensee further stated that a sensitivity analysis was performed, which shows that decreasing the time when the door is opened from 15 to 10 minutes reduces the probability for abandonment by up to 61.7 percent in all but one scenario. The licensee further stated that for the latter, the probability increases by 14.8 percent, which is not considered significant, and that a sensitivity analysis shows that increasing the time, when the door is opened to 20 minutes either has no effect or decreases the probability for abandonment by up to 73.8 percent. The licensee further stated that the FPRA is based on the probability for abandonment for the closed door configuration, because this configuration produces the shortest abandonment time when applied to all scenarios.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that a 15-minute fire brigade response time is consistent with fire brigade drill results and that using the 15 minutes in the FPRA produces consistent results for control room abandonment if the door is left closed for a longer period of time.

- In FM RAI 01.b (Reference 17), 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.b (Reference 11), the licensee explained that the MCR abandonment times for propagating panel fires were re-calculated assuming fire spread to adjacent panels in 10 minutes.

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

- In FM RAI 01.c (Reference 17), 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 (Reference 58), and to discuss the effect of these differences on plant risk.

  In its response to FM RAI 01.c (Reference 11), the licensee stated that the MCR abandonment calculations for transient fire scenarios were revised based on the assumption that the peak HRR is reached in 2 minutes and that this assumption is consistent with the guidance for loose trash provided in FAQ 08-0052. The licensee further stated that the revised MCR abandonment time calculations also include a sensitivity case which assesses the effect of assuming a time to peak HRR of 8 minutes.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the assumptions used for the fire growth rate for transient fires assumed in the MCR abandonment time calculations is consistent with NRC-endorsed guidance.

- In FM RAI 01.d (Reference 17), the NRC staff requested that the licensee provide technical justification for modifying the HGL temperature and smoke concentration calculated in the MCR abandonment calculations.

  In its response to FM RAI 01.d (Reference 11), the licensee explained that the modifications were applied to the CFAST output to account for the bias reported in NUREG-1934 (Reference 41) for the calculated HGL temperature and smoke concentration. The licensee further explained that the MCR abandonment calculations were revised to no longer include the modifications.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee removed the modifications from the HGL temperature and smoke concentration calculated in the MCR abandonment calculations.

- In FM RAI 01.e (Reference 17), the NRC staff requested that the licensee explain how the modification to the critical heat flux for a target that is immersed in a thermal plume described in the GFMTs approach was used in the ZOI determination.

  In its response to FM RAI 01.e (Reference 11), the licensee explained that the modified critical heat flux was implemented using either a two- or three-point treatment in the FPRA. The licensee further stated that the two-point treatment was used in most areas of the plant and that in this approach, the ZOI tables in the GFMTs are applied without any adjustments for HGL temperatures of 80 degrees Celsius (°C) or less. The licensee further stated that full room burnout is assumed when the HGL temperature is higher than 80 °C and that the three-point method was used in the remaining areas. The licensee further stated that 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 justified the use of the modification to the critical heat flux for a target that is immersed in a thermal plume.

- In FM RAI 01.f (Reference 17), the NRC staff requested that the licensee demonstrate that the GFMTs approach as used to determine the ZOI of fires that involve multiple burning items is conservative and bounding.

  In its response to FM RAI 01.f (Reference 11), the licensee explained that if secondary combustibles are involved, the current approach to determine the ZOI based on the GFMTs is not conservative for a number of fires originating in an electrical cabinet, and for most fire scenarios with transient ignition sources. The licensee further stated that to address this problem, new ZOI tables were developed that are applicable to ignition source-cable tray configurations. The licensee further stated that the ZOI was calculated for a range of ignition sources without any intervening combustibles, and in combination with various cable tray configurations and that the ZOI dimensions are tabulated as a function of time and for different fire locations (open, wall and corner) and ambient temperatures.

  In FM RAI 01.03 (Reference 18), the NRC staff requested that the licensee explain up to what extent the GFMTs ZOI tables for fires involving secondary combustibles are still used, to describe the use of the new ZOI tables for ignition sources without intervening combustibles, and to explain how the effect of ambient temperature is accounted for in the ZOI determination.

  In its response to FM RAI 01.03 (Reference 12), the licensee explained that the ZOI developed in the GFMTs was expanded and replaced with the new ZOI for scenarios where the presence of secondary combustibles resulted in additional target damage. The licensee further stated that the new ZOIs for ignition sources without secondary combustibles were not used, and that the ZOI for ignition sources were based on the tables in the GFMTs approach. The licensee further stated that the multi-tiered approach was used to calculate HGL timing as described in the response to FM RAI 01.e.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the GFMTs approach used to determine the ZOI of fires that involve multiple burning items is conservative and bounding.

- In FM RAI 01.g (Reference 17), the NRC staff requested that the licensee describe how the flame spread and fire propagation in cable trays and the corresponding HRR of cables was determined, and to also explain how these calculations affect the ZOI determination and HGL temperature calculations.

In its response to FM RAI 01.g (Reference 11), the licensee explained that new ZOI and HGL tables were developed for the ignition source-cable tray configurations that are present. The licensee further stated that the ZOI tables are discussed in the response to FM RAI 01.f and that the times to HGL conditions were calculated and tabulated for different compartment volumes, vent sizes and fire locations (open, wall and corner). The licensee further stated that the new HGL timing tables were used in lieu of those in the GFMTs approach and that to develop the new ZOI and HGL tables, the fire propagation in cable trays and corresponding HRR were determined based on the models described in NUREG/CR-6850 (Reference 29) (Reference 30) and NUREG/CR-7010 (FLASH-CAT) (Reference 38).

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the fire propagation in cable trays and corresponding HRR were consistent with NRC-endorsed guidance.

- In FM RAI 01.h (Reference 17), the NRC staff requested that the licensee describe how transient combustibles in an actual plant setting are characterized in terms of the three fuel package groupings in the GFMTs approach; to identify areas, if any, where the NUREG/CR-6850 transient combustible HRR characterization may not encompass typical plant configurations; and to explain if any administrative action will be used to control the type of transients in a fire area.

  In its response to FM RAI 01.h (Reference 11), the licensee explained that transient combustibles are categorized as miscellaneous materials that do not contain combustible liquids. The licensee further stated that it does not differ in any significant manner from other plants with respect to its transient combustible controls to warrant a significant increase or decrease of the 98th percentile HRR of 317 kW recommended in NUREG/CR-6850. The licensee further stated that to address the potential for violations, a 69 kW peak HRR fire was applied in areas that have been designated as "no transient combustible areas." The licensee further stated that the combustible control 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 NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that transient combustibles are appropriately characterized and are appropriately controlled by administrative procedures.

- In FM RAI 01.i (Reference 17), the NRC staff requested that the licensee describe why thermoplastic HRR per unit area and flame spread rate values were used in the calculations of fire propagation in cable trays.

  In its response to FM RAI 01.i (Reference 11), the licensee explained that cables are considered to be thermoset, and that thermoplastic properties were assumed in the fire propagation calculations to provide a conservative margin in the results.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the thermoplastic HRR per unit area and flame spread rate values used in the calculations of fire propagation in cable trays are conservative.

- In FM RAI 01.k (Reference 17), the NRC staff requested that the licensee explain how non-cable intervening combustibles were identified and accounted for in the fire modeling analysis.

  In its response to FM RAI 01.k (Reference 11), the licensee explained that during additional walkdowns, non-cable intervening combustibles were identified that were not considered in the fire modeling analyses. The licensee stated that changes may be required to ensure that non-cable intervening combustibles are appropriately controlled to support transition to NFPA 805 and that the changes will be evaluated as part of Implementation Item S2-7 as described in LAR Attachment S, Table S-2.

  In FM RAI 08 (Reference 18), the NRC staff requested that the licensee provide a quantitative assessment of the impact on plant risk (CDF, ΔCDF, LERF, and ΔLERF) of the fire scenarios that involve the non-cable intervening combustibles that were identified in the walkdowns.

  In its response to FM RAI 08 (Reference 12), the licensee explained that plant walkdowns of the fire compartments in which full area burn-up is not assumed were performed, and that most of the non-cable intervening combustibles identified during these walkdowns are much smaller than the standard transient fuel package for the area and were therefore considered insignificant. The licensee further stated that the fire scenarios were updated to incorporate the impact of the non-cable intervening combustible configurations deemed to be significant and that the results of the corresponding update of the FPRA are discussed in the response to PRA RAI 21.

  The NRC staff concludes that the licensee's response to the RAIs are acceptable because the licensee demonstrated that the non-cable intervening combustibles were properly accounted for in the fire modeling analysis and because the licensee identified a required action to appropriately control these types of combustibles which is included as an implementation item in LAR Attachment S, which is required by the proposed license condition.

- In FM RAI 01.l (Reference 17), the NRC staff requested that the licensee explain why wall and corner effects were only considered for transient ignition sources, and not for fixed ignition sources.

In its response to FM RAI 01.l (Reference 11), the licensee explained that fixed ignition sources near a wall or corner were identified during the walkdowns performed to support the responses to FM RAIs 01.f and 01.g and that the information gathered during the walkdowns was then used to update the ZOI and HGL timing for fixed ignition sources within 0.61 m (2 ft) of a wall or corner.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee considered wall and corner effects for transient and fixed ignition sources, which is based on actual plant conditions.

- In FM RAI 01.m (Reference 17), the NRC staff requested that the licensee describe the process for determining which targets are damaged before suppression occurs in areas where suppression or detection is credited.

  In its response to FM RAI 01.m (Reference 11), the licensee stated that credit is taken for suppression and detection to prevent HGL formation in the HGL and multi-compartment analysis evaluation. The licensee further stated that the presence of a detection system in a fire zone supports the use of NRC FAQ 08-0050 (Reference 57) non-suppression probabilities and that absence of a detection system requires reduction of the time for non-suppression by a 15-minute period to account for the delayed detection, based on NRC Significance Determination Process guidance.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee followed NRC-endorsed guidance for determining which targets are damaged before suppression occurs.

- In FM RAI 01.n (Reference 17), the NRC staff requested that the licensee explain what is meant by "partial" suppression or detection in LAR Table 4-3.

  In its response to FM RAI 01.n (Reference 11), the licensee explained that "partial" suppression and detection indicates that the suppression system does not provide coverage throughout the associated fire zone and that partial coverage systems were not credited in the FPRA, except in one fire zone where detailed fire modeling was performed to justify the credit.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that no credit was taken for partial suppression or detection except in one case and where detailed fire modeling was performed to justify the credit.

- In FM RAI 02 (Reference 17), the NRC staff requested that the licensee provide technical justification for using thermoset cable damage thresholds for temperature-sensitive equipment inside cabinets.

In its response to FM RAI 02 (Reference 9), the licensee explained that the approach for assigning damage thresholds to temperature-sensitive equipment follows the guidance in FAQ 13-0004.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the justification for using thermoset cable damage thresholds for temperature-sensitive equipment inside cabinets is consistent with NRC-endorsed guidance.

- In FM RAI 09 (Reference 18), the NRC staff requested that the licensee explain how high energy arcing fault initiated fires were addressed in the HGL and multi-compartment analysis calculations and to provide technical justification for the approach that was used to calculate HGL development timing for these fires.

  In its response to FM RAI 09 (Reference 12), the licensee stated that electrical cabinet fires with the potential for a high energy arcing fault can occur in six fire compartments and that the compartment volume and interaction with the outside atmosphere preclude development of a HGL in two of these compartments, and that in the remaining four compartments, HGL fire scenarios were calculated assuming an instantaneous full-room burnout with no credit for a time delay due to fire growth. The licensee further stated that the non-suppression probability for the multi-compartment analysis related to high energy arcing fault initiated fire scenarios were calculated based on the HRR instantaneously reaching its peak at the time of the high energy arcing fault event.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the approach used to characterize high energy arcing fault initiated fires in the HGL and multi-compartment analysis calculations is consistent with the NRC-endorsed guidance provided in NUREG/CR-6850.

3.4.2.3.3 Conclusion for Section 3.4.2.3

Based on the licensee's description in the LAR, as supplemented, of the process for performing fire modeling 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 Conclusions Regarding Fire PRA Quality

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

The NRC staff concludes that the PRA approach, methods, and data are acceptable and that Section 2.4.3.3 of NFPA 805 is satisfied for the request to transition to NFPA 805. The NRC staff based this conclusion on the findings that: (1) the PRA model for ANO-2 adequately represents the current, as-built, as-operated configuration, and is therefore capable of being adapted to model both the post-transition and compliant plant as needed; (2) the PRA models conform sufficiently to the applicable industry PRA standards for internal events and fires at an appropriate Capability Category, considering the acceptable disposition of the peer review and NRC staff review findings; and (3) the fire modeling used to support the development of the ANO-2 FPRA has been confirmed to be appropriate and acceptable.

The licensee made a number of modifications to the FPRA during the review and these modifications are discussed in SE Section 3.4. The NRC staff concludes that, prior to using the FPRA results to support RI self-approval of changes to the FPP, the following requirements, as prescribed in the fire protection license condition, must be completed since the self-approval acceptance guidelines are more stringent than the transition acceptance guidelines:

- According to the NFPA 805 license condition, post-transition self-approval requires that the change-in-risk for individual changes be less than the applicable acceptance guidelines and that the licensee may not self-approve a combined change request where risk increases are offset by risk decreases. When risk offsets are not authorized, conservative estimates should always result in conservative change-in-risk estimates. Therefore, the NRC staff concludes that the licensee may retain the conservative assumptions associated with unknown cable routing and MCR abandonment scenarios to support risk calculations used for self-approval.

- A number of changes to the baseline FPRA were identified by the licensee in response to PRA RAI 21 (Reference 14), which have been made for the final integrated analysis to support transition to NFPA 805. In the licensee's response to PRA RAI 21 (Reference 14), the licensee stated that these changes will be retained in the FPRA. Based on the information provided by the licensee, the NRC staff concludes that retaining these changes in the FPRA is acceptable.

- Per Implementation Item S2-9 presented in Table S-2 of the LAR, which is included in the fire protection license condition, the licensee will revise the FPRA when modifications and implementation items are complete, and will ensure that the as-built change-in-risk does not exceed the PRA change-in-risk estimates reported in the LAR, and confirm that the change in risk estimates meet RG 1.174 risk acceptance guidelines.

Finally, based on the licensee's administrative controls to maintain the PRA models current and to assure continued quality by using only qualified staff and contractors (as described in SE Section 3.8.3), the NRC staff concludes that the licensee's PRA maintenance process is adequate to maintain the quality of the ANO-2 PRA to support self-approval of future RI changes to the FPP under the NFPA 805 license condition following the completion of all implementation items described in Table S-2 of the LAR, as supplemented.

3.4.3 Fire Risk Evaluations

The licensee used FREs in accordance with NFPA 805 (Reference 3) Section 4.2.4.2 to demonstrate the acceptability of the plant configuration in areas where it used a PB approach to meet the NSPC. In accordance with the guidance in RG 1.205 (Reference 4), Section C.2.2.4, "Risk Evaluations," the licensee used an RI approach to justify acceptable alternatives to compliance with NFPA 805 deterministic criteria. The NRC staff reviewed the following information during its evaluation of the FREs: LAR Section 4.5.2, "Performance-Based Approaches," LAR Attachment C, "NEI 04-02 Table B-3 – Fire Area Transition," and LAR Attachment W, "Fire PRA Insights," as well as associated supplemental information.

Plant configurations that did not meet the deterministic requirements of NFPA 805, Section 4.2.3.1, were considered variances from deterministic requirements (VFDRs). VFDRs that will be brought into deterministic compliance through plant modifications do not require a risk evaluation. The licensee identified the VFDRs in LAR Attachment C Table B-3, "NEI 04-02 Table B-3 – Fire Area Transition," that it does not intend to bring into deterministic compliance under NFPA 805. For these VFDRs, the licensee performed evaluations using the RI approach in accordance with NFPA 805, Section 4.2.4.2 to demonstrate that retaining the VFDRs is acceptable. The licensee also identified several modifications not associated with eliminating VFDRs but that will reduce risk (risk-reduction modifications).

All of the VFDRs identified by the licensee were categorized as separation issues. The VFDRs can generally be categorized into the following three types of plant configurations: (1) inadequate separation resulting in fire-induced damage of process equipment or associated cables required for the identified success path; (2) inadequate separation resulting in fire-induced spurious operation of equipment that may defeat the identified success path; (3) inadequate separation resulting in fire-induced failure of process monitoring instrumentation or associated cables required for the identified success path; and (4) combinations of the above configurations.

The licensee summarized its change in risk evaluations in LAR Attachment W, Section W.2.1 and in the response to PRA RAI 17.a.01 (Reference 13). The change in risk for transition (ΔCDF and ΔLERF) was evaluated by subtracting the risk of a compliant plant configuration from the risk of the post-transition plant for each fire area. The licensee clarified that the compliant case was based on the current plant design and operation with VFDRs removed from the model and, generally, without the risk-reduction modifications. The VFDRs are removed from the compliant case model by setting the failure probability of VFDR affected components to the random failure probability of the component. The post-transition case was based on the anticipated plant design and operation including all planned modifications and all retained VFDRs. In the post-transition plant model, the failure probability of components affected by retained VFDRs are set to "failed by the fire" (i.e., probability 1.0). VFDRs that are eliminated by modifications are removed from the post-transition model by modeling the new configuration which eliminates the failed-by-fire failure mode.

The NRC staff concludes that the licensee's methods for calculating the change in risk associated with VFDRs are acceptable because they are consistent with RG 1.205, Section 2.2.4.1, and FAQ 08-0054 (Reference 59). The NRC staff further concludes that the results of these calculations for each fire area, discussed specifically in SE Section 3.4.6, demonstrate that the difference between the risk associated with implementation of the deterministic requirements and that of the VFDRs meets the risk acceptance criteria described in NFPA 805, Section 2.4.4.1.

3.4.4 Additional Risk Presented by Recovery Actions

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

The licensee used the guidance in RG 1.205, Revision 1 (Reference 4) for addressing RAs. Based on consideration of the definition of primary control station (PCS), and RA, as clarified in RG 1.205, Revision 1, and FAQ 07-0030 (Reference 50), the licensee stated in LAR Attachment G that it does not have any locations considered to be PCS. Accordingly, any actions credited in the FPRA required outside the MCR were considered RAs per the guidance in RG 1.205 and in accordance with NFPA 805.

The licensee identified the RAs in LAR Attachment G, Table G-1. LAR Attachment G presents 42 RAs in 12 fire areas that the licensee credited for risk reduction, and 18 additional RAs the licensee credited to maintain adequate DID. These DID-RAs were not credited in the FPRA fire area risk estimates.

LAR Attachment W, Section W.2.1 explains that the post-transition plant model was used to calculate the additional risk of RAs. In one version of the post-transition plant model, RAs were set to their nominal values and in the other version (a surrogate to the compliant case) RAs were set to "0" probability. The difference in the resulting CDF and LERF from these two models was used to determine the additional risk of RAs. The NRC staff concludes that the difference in risk from this calculation estimates the risk that could be reduced if all RAs were replaced with unfailing equipment in the post-transition plant and is, therefore, an appropriate measure of the additional risk of RAs that can be compared to the acceptance guidelines.

The licensee reviewed all of the RAs for adverse impact and dispositioned each action as stated in LAR Attachment G. None of the RAs listed in LAR Attachment G, Table G-1 were found to have an adverse impact on the FPRA. The licensee evaluated all RAs against feasibility criteria provided in NEI 04-02 (Reference 7), FAQ 07-0030, and RG 1.205. Additionally, Implementation Item S2-6, identified in LAR Attachment S, Table S-2 OMA procedures/documents will be revised to include the feasibility criteria in FAQ 07-0030 for the RAs listed in LAR Attachment G, Table G-1, Recovery Action Transition, and the NRC staff concludes that this action is acceptable because it is included in LAR Attachment S, which is required by the proposed license condition.

The licensee reported in LAR Attachment W, Table W-1 that the total additional risk of RAs is an increase in CDF of 2.41E-05/year and an increase in LERF of 4.77E-07/year (Reference 14). The additional CDF associated with RAs in one fire area also slightly exceeded 1E-05 (this value is part of the total value). As discussed in RG 1.205, the RG 1.174 (Reference 22), acceptable risk increase guidelines of 1E-05/year for CDF and 1E-06/year for LERF can be used as acceptance guidelines for the additional risk of RAs. The additional CDF attributable to RAs exceeds the 1E-05/year guideline. However, the addition of the new auxiliary feedwater pump and other risk-reduction improvements are considered by the NRC staff to be substantive risk improvements as illustrated by the large risk decrease associated with transition to NFPA 805.

The NRC staff concludes that the licensee's approach for calculating the additional risk of RAs is acceptable because it is consistent with RG 1.205, Section 2.2.4.1 and the guidance in FAQ 07-0030. As discussed in SE Sections 3.4.6 and 3.4.7, the NRC staff concludes that these results demonstrate that the total risk of transition, which includes the additional risk of RAs, is less than the risk acceptance guidelines in RG 1.174 and, therefore, the additional risk associated with the RAs is acceptable.

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

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

3.4.6 Cumulative Risk and Combined Changes

In LAR Attachment S, Table S-1, the licensee identified its planned modifications. In its response to PRA RAI 17 (Reference 11) and PRA RAI 17.a.01 (Reference 13), the licensee stated that some modifications are being implemented to reduce plant risk (risk-reduction modifications). Other modifications identified in LAR Attachment S, Table S-1 of the LAR are being implemented to bring the plant into compliance with the deterministic requirements of NFPA 805, Chapters 3 or 4. Given that the risk-reduction modifications are credited in the post-transition plant model and not in the compliant plant model, the licensee's application to an RI/PB FPP is a combined change as discussed in RG 1.205 (Reference 4), Section 3.2.5.

The total CDF and total LERF are estimated by adding the risk assessment results for internal events, internal flooding, internal fire, seismic, high winds, and other external hazard events. The total CDF and LERF estimated by the licensee are provided in SE Table 3.4.6-1 below and determine which acceptable risk increase guidelines from RG 1.174 are applicable. The total values indicate that CDF and LERF increases of 1E-05/year and 1E-6/year would normally be acceptable. The licensee reported a net risk decrease associated with transition to NFPA 805, which would be acceptable regardless of the total risk since the total risk is reduced.

Table 3.4.6-1: CDF and LERF for ANO-2 after Transition to NFPA 805

Hazard Group	ANO Unit 2	
	CDF (/year)	LERF (/year)
Internal Events	9.5E-07	1.1E-07
Internal Flood	8.0E-07	5.6E-08
Internal Fire[1]	7.5E-05	1.7E-06
Other External (seismic, external flooding, off-site industry)	<1.0E-05	<1.0E-06
TOTAL	8.7E-05	2.9E-06
Notes: 1. Per update to Section W.2.2 of the LAR provided in response to PRA RAI 21 (Reference 14).		

The licensee reported a number of different change-in-risk estimates resulting from changes made to the PRA in response to the NRC staff's RAIs. In its response to PRA RAI 21.a (Reference 14), the licensee estimated the risk increase associated with retained VFDRs as 3.02E-05/year for ΔCDF and 5.75E-07/year for ΔLERF. From these values and the estimated total change-in-risk provided in the same response, the risk decrease associated with the risk-reduction modifications is -1.89E-04/year for ΔCDF and -5.88-06/year for ΔLERF. The risk-reduction modification results in a factor of 4 larger risk decrease for CDF and a factor of 10 larger risk decrease for LERF compared to the increases from retained VFDRs.

The updated estimates of (-1.19E-04/year and -4.47E-06 for ΔCDF and ΔLERF, respectively) (Reference 15), are the appropriate estimates for the change-in-risk associated with transition to NFPA 805 because they include all method modifications, and the final 0.1 probability of fires escaping well-sealed cabinets. As discussed in SE Section 3.4.3, the NRC staff concludes that two evaluations, a single conservative MCR estimate (PRA RAI 01.e.01) (Reference 14), and the assumption that cables with unknown routing always fail (PRA RAI 16.01) (Reference 13), may result in non-conservative change-in-risk estimates. However, replacing the evaluations with a very conservative assumption does not cause the acceptance guidelines to be exceeded. The licensee is planning to make a number of major risk-reduction modifications (e.g., a new AFW pump train, incipient detection, etc.) and remove a number of VFDRs (e.g., new control circuits, reroute cables, etc.). Therefore, the NRC staff concludes that removing the identified conservative assumptions will not cause the large estimated risk decrease to exceed the risk acceptance guidelines.

In a letter dated August 7, 2014 (Reference 14), the licensee provided an update to LAR Attachment W, Table W-2 with the estimated changes in risk for each fire area. The NRC staff reviewed this information and determined that most fire areas have a net decrease in risk and the fire area with the largest risk increase showed increases of 2E-7/year for CDF and 2E-9/year for LERF. The results in the updated LAR Attachment W, Table W-2 do not include the potential to damage components outside the well-sealed electrical cabinets which is a deviation from the accepted method that is described in NUREG/CR-6850 (Reference 29). However, the NRC staff concludes that the fire area risk results, as stated by the licensee in the updated LAR Attachment W, Table W-2, are well below the risk acceptance guidelines and replacing this deviation with an accepted method will not cause any fire area risk to exceed the risk acceptance guidelines.

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

3.4.7 Uncertainty and Sensitivity Analyses

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

The licensee used updated fire-ignition bin frequencies provided in NUREG/CR-6850, Supplement 1 (Reference 31) (i.e., FAQ-08-0048). The guidance in FAQ-08-0048 (Reference 56) states that a sensitivity study must be performed using the mean of the fire frequency bins contained in Section 6 of NUREG/CR-6850 (Reference 29) for those bins with an alpha value less than or equal to one. LAR Attachment V, Section V.2.1 indicates that fire bin frequencies from NUREG/CR-6850, Supplement 1 were not used, but that the licensee performed a sensitivity study to evaluate the impact of updating the NUREG/CR-6850 Section 6 fire-ignition frequencies used in the baseline PRA with the NUREG/CR-6850, Supplement 1 fire-ignition bin frequencies. In its response to PRA RAI 06 (Reference 9), the licensee explained that the FPRA was updated to incorporate the NUREG/CR-6850 Supplement 1 fire bin frequencies. In PRA RAI 06.01 (Reference 19), the NRC staff indicated that if the updated ignition frequencies were used in the baseline FPRA, then a sensitivity study should be performed using the guidance in FAQ-08-0048 and that if RG 1.174 (Reference 22), guidelines are exceeded then appropriate DID actions should be considered. In its response to PRA RAI 06.01 (Reference 13), the licensee stated that an updated fire-ignition frequency sensitivity study meeting the criteria defined above would be provided along with the integrated analysis that was provided in response to PRA RAI 21 (Reference 14). However, the results from this sensitivity study were not provided. No other key sources of uncertainty requiring a sensitivity analysis were identified by the licensee or by the NRC staff. The NRC staff concludes that the licensee provided information to assure that the final large negative change-in-risk and final total CDF and LERF values, which are well below the RG 1.174 acceptance guidelines, provide confidence that small changes caused by the required sensitivity study will not cause the change-in-risk acceptance guidelines to be exceeded. The NRC staff concludes that the results of the fire frequency sensitivity study would not require DID actions to be identified and, therefore, a sensitivity study need not be performed.

3.4.8 Conclusion for Section 3.

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

- The licensee's PRA used to perform the risk assessments in accordance with NFPA 805, Section 2.4.4 (PCEs) and NFPA 805, Section 4.2.4.2 (FREs), is of sufficient quality to support the application to transition the ANO-2 FPP to NFPA 805. The licensee incorporated all method changes into the PRA discussed above and summarized in its response to PRA RAI 21.a (Reference 14) except the conservative MCR and cable routing analyses. 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.

- LAR Attachment S, Table S-2, Implementation Item S2-9 states that the licensee will, "revise the PRA model for each modification or implementation item completed that is credited either directly or indirectly by PRA. The PRA review plan will ensure the as-built change-in-risk from each modification or implementation item does not exceed the PRA model change-in-risk estimates reported in the LAR." The NRC staff concludes that the licensee's implementation of this item provides reasonable assurance that the PRA and PRA results will adequately represent the as-built and as-operated post-transition plant.

- The PRA maintenance process is adequate to support self-approval of future RI changes to the FPP.

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

- The changes in risk (i.e., ΔCDF and ΔLERF) associated with the proposed alternatives with the deterministic criteria of NFPA 805 (FREs) are acceptable for the purposes of this application, and 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 changes in risk. By meeting the guidance contained in these approved regulatory documents, the changes in risk have been concluded to be acceptable to the NRC staff, and therefore meet the requirements of NFPA 805.

- The risk presented by the use of RAs was determined to be in accordance with the guidance in RG 1.205, Revision 1, and NFPA 805, Section 4.2.4. The total additional risk of RAs and the additional risk in one fire area exceed the risk acceptance guidelines in RG 1.174. The NRC staff concludes that the additional risk associated with the NFPA 805 RAs is acceptable because the licensee is implementing a number of substantial safety improvements which, even after including this additional risk of RAs, results in a significant decrease in total risk from fires.

- The licensee did not utilize any RI or PB alternatives to comply with 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, in part, 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 nuclear safety performance criteria (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 (Reference 8) Section 4.2.4, "Fire Area Transition," Section 4.8.1, "Results of the Fire Area Review," LAR Attachment C, "NEI 04-02 Table B-3 – Fire Area Transition," LAR Attachment G, "Recovery Actions Transition," LAR Attachment S, "Plant Modifications and Items to be Completed During Implementation," and LAR Attachment W, "Fire PRA Insights," during its evaluation of the ability of each fire area to meet the NSPC of NFPA 805.

ANO-2 is a PWR with 34 individual fire areas including the yard, and each fire area is composed of one or more fire zones. Based on the information provided by the licensee in the LAR, as supplemented, the licensee performed the NSCA on a fire area basis. LAR Attachment C provides the results of these analyses on a fire area basis and also identifies the fire zones within the fire areas.

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

Table 3.5-1 Fire Area and Compliance Strategy Summary

Fire Area	Area Description	NFPA 805 Compliance Basis
2MH01E	Concrete Manhole East Between Aux Bldg and Intake Structure	Performance-Based
2MH01W	Concrete Manhole West Between Aux Bldg and Intake Structure	Deterministic
2MH02E	Concrete Manhole East Between Aux Bldg and Intake Structure	Performance-Based
2MH02W	Concrete Manhole West Between Aux Bldg and Intake Structure	Deterministic
2MH03E	Concrete Manhole East Between Aux Bldg and Intake Structure	Performance-Based

Fire Area	Area Description	NFPA 805 Compliance Basis
2MH03W	Concrete Manhole West Between Aux Bldg and Intake Structure	Deterministic
AA	"B" HPSI, LPSI and Containment Spray Pump Room and Gallery	Performance-Based
AAC	Alternate AC Diesel	Deterministic
ADMIN	Administration Building	Deterministic
B-2	Unit 2 General Plant Multiple Elevations	Performance-Based
B-3	North Penetration Areas	Performance-Based
B-4	CEDM Room	Performance-Based
B-5	North and South Aux Bldg Stair	Deterministic
B-6	Aux Bldg General Access Area, A & C Pump Rooms	Performance-Based
CC	Emergency Feedwater Pump Room (Turbine Driven)	Deterministic
DD	Unit 2 General Area 335' Elevation	Performance-Based
EE-L	South Piping Penetration Rooms	Performance-Based
EE-U	Lower South Electrical Penetration	Performance-Based
FF	Emergency Feedwater Pump Room (Motor Driven)	Deterministic
G	Unit 2 Alternate Shutdown Areas	Performance-Based
GG	Unit 2 North Electrical and Piping Penetration Area	Performance-Based
HH	Unit 2 General Area 354' Elevation	Performance-Based
II	North Switchgear Room	Performance-Based
JJ	Corridor	Performance-Based
K	Tank Rooms	Deterministic
KK	Unit 2 South Emergency Diesel Generator and Boric Acid Makeup Tank Rooms	Performance-Based
L	Diesel Fuel Storage Vault Area	Deterministic
MM	West Battery and DC Equipment Rooms	Performance-Based
NN	Unit 2 Containment Building	Performance-Based
OO	Unit 2 Intake Structure	Performance-Based
QQ	North Emergency Diesel	Deterministic
SS	South Switchgear and East DC Equipment and Battery Rooms	Performance-Based
TT	Electrical Equipment (2B9/2B10) 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 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; and
- The disposition of each VFDR using either modifications (completed or committed) or the performance of an FRE in accordance with NFPA 805, Section 4.2.4.2.

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

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

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

In FPE RAI 08 (Reference 17), the NRC staff requested clarification regarding the need for fire detection in fire area K. In its response to FPE RAI 08 (Reference 9), the licensee stated that fire area K should not be identified as an area that needs fire detection, per a required EEEE in LAR Attachment C. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee resolved the discrepancy by demonstrating that fire detection is not required.

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 information provided by the licensee in LAR Attachment C, as supplemented, the NRC staff concludes that the licensee's treatment of this issue is acceptable because the fire detection and suppression systems required to meet the NFPA 805 NSPC on a fire area basis have been adequately identified.

3.5.1.2 Evaluation of Fire Suppression Effects on Nuclear Safety Performance Criteria

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

The licensee stated that damage to plant areas and equipment from the accumulation of water discharged from manual and automatic fire protection systems and the discharge of manual suppression water to adjacent compartments is controlled. The licensee stated that each fire area was evaluated for the effects of fire suppression activities on the NSPC considering the following:

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

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

In FPE RAI 10 (Reference 17), the NRC staff requested that the licensee provide justification for not including water-based suppression systems in fire zones 2136-1 and 2137-1 in the fire suppression effects evaluation for fire area G. In its response to FPE RAI 10 (Reference 9), the licensee provided a revision to LAR Attachment C of the discussion of the suppression effects in fire area G that included the additional systems in fire zones 2136-1 and 2137-1. The licensee stated that with consideration of the additional systems, the analysis continues to support that fire suppression activities should not adversely affect the plant's ability to achieve the NSPC. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee corrected the discrepancy and included the suppression systems in the fire suppression effects evaluation and concluded that there was no impact on the plants ability to achieve the NSPC.

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

3.5.1.3 Licensing Actions

In LAR Attachment C, the licensee identified exemptions from the deterministic licensing basis for each fire area that were previously approved by the NRC and will be transitioned with the NFPA 805 FPP. Each of these exemptions is summarized in LAR Attachment C on a fire area basis and described in further detail in LAR Attachment K, "Existing Licensing Action Transition." The licensee does not have any elements of the current FPP for which NRC clarification is needed. The licensing actions being transitioned are summarized in SE Table 3.5-2.

Table 3.5-2 Previously Approved Licensing Actions Being Transitioned

Licensing Action Description	Applicable Fire Areas	Clarification [as applicable]	NRC Staff Evaluation
Appendix R Exemption 17, RCP Oil Collection, Not Meeting III.O Criteria The original exemption was for the inability to contain the entire oil supply of all RCPs in the lube oil collection system and meet the SSD earthquake requirements of Appendix R, Section III.O. The transitioned compliance basis is NFPA 805 Section 3.3.12.	NN	The basis for approval as described by the licensee in LAR Attachment K is the NRC SER conclusion that the lube oil system at ANO-2 is capable of withstanding the SSD earthquake (SSE) without rupture and that the existing oil collection system will channel random leaks to a vented and closed container capable of holding the quantity of oil from one pump in accordance with the guidance in Generic Letter 86-10. In response to FPE RAI 02 (see discussion below), the licensee stated that the basis for the previous NRC approval of the exemption remains valid.	Based on previous staff approval of the exemption and the statement by the licensee that the basis remains valid, the NRC staff concludes that the applicability of this licensing action is acceptable.
Appendix R Exemption 19, RCP Oil Fill Line, Not Meeting III.O Criteria The original exemption was for the inability to contain remote oil addition line leakage in the RCP lube oil collection system as required by Appendix R, Section III.O. The transitioned compliance basis is NFPA 805 Section 3.3.12.	NN	The basis for approval as described in LAR Attachment K is the compensatory actions taken to minimize the potential for, and the magnitude of, an oil fire due to a leak. Each time oil is added from lines of the remote oil addition system that do not have an oil collection system, specific compensatory measures are in effect. The specific compensatory measures are: • Limit initial oil addition to 2 gallons to minimize potential fire size if a leak occurs. • Verify that the 2 gallons of oil has reached the reservoir of the correct RCP motor.	Based on previous staff approval of the exemption and the statement by the licensee that the basis remains valid, the NRC staff concludes that the applicability of this licensing action is acceptable.

		• Add the remaining oil only after confirmation that the initial 2 gallons has reached the appropriate oil reservoir. • Limit the total oil added to less than the amount calculated to result in an indicated reservoir level of 95 percent. • Verify the oil addition funnel is empty prior to closing the lube oil manifold ball valve after oil has been added. • Remove any oil in the drip pan under the lube oil manifold prior to exiting the containment building. • Inspect for evidence of smoke following the oil addition. If smoke is detected, a fire brigade will be dispatched to the area. In response to FPE RAI 02 (see discussion below), the licensee stated that the basis for the previous NRC approval of the exemption remains valid.	

The NRC staff reviewed the exemptions from the pre-NFPA 805 licensing basis identified in SE Table 3.5-2, including the description of the previously approved exemption from the deterministic requirements, the basis for and continuing validity of the exemption, and the NRC staff's original evaluation or basis for approval of the exemption. The licensee stated in LAR Section 4.2.3, that the methodology for review of these existing licensing actions included a determination of the basis of acceptability and a determination that the basis of acceptability was still valid. In FPE RAI 02 (Reference 17), the NRC staff identified that the results of the licensing action evaluations in LAR Attachment K did not include a discussion of the continued acceptability and validity of the licensing actions in meeting the requirements of NFPA 805 and requested the licensee provide this information. In response to FPE RAI 02 (Reference 9), the licensee stated that modifications to improve the RCP oil collection system have been made since the original exemption was granted and these modifications were performed in accordance with the licensee's modification and change evaluation processes. The licensee stated that as a result of following these processes, the original basis for the licensing action remains valid. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee provided a discussion of the continued acceptability and validity of the licensing actions in meeting the requirements of NFPA 805.

Based on the NRC staff's review of the licensing actions identified and described in LAR Attachments C and K, the NRC staff concludes that the licensing actions are identified by applicable fire area and remain valid to support the proposed license amendment because the licensee utilized the process described in NEI 04-02 (Reference 7) as endorsed by RG 1.205 (Reference 4), which requires a determination of the basis of acceptability and a determination that the basis is still valid.

Based on the previous NRC staff approval of the exemptions and the statement by the licensee that the basis remains valid, as presented in each appropriate fire area, the NRC staff concludes that the engineering evaluations being carried forward supporting the NFPA 805 transition, as identified in SE Table 3.5-2, are acceptable. See SE Section 2.5 for further discussion.

3.5.1.4 Existing Engineering Equivalency Evaluations

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

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

In LAR Section 4.2.2, the licensee stated that the guidance in RG 1.205, Regulatory Position 2.3.2, and FAQ 08-0054 (Reference 59) was followed. EEEEs that demonstrate that a fire protection system or feature is "adequate for the hazard" are to be addressed in the LAR as follows:

- If not requesting specific approval for "adequate for the hazard" EEEEs, then the EEEE is referenced where required and a brief description of the evaluated condition is provided.
- If requesting specific NRC approval for "adequate for the hazard" EEEEs, then the EEEE is referenced where required to demonstrate compliance and is included in 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 review and approve any of these EEEEs.

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

3.5.1.5 Variances from Deterministic Requirements

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

- A FRE determined that applicable risk, DID, and safety margin criteria were satisfied without further action; or
- A FRE determined that applicable risk, DID, and safety margin criteria were satisfied with a credited RA; or
- A FRE determined that applicable risk, DID, and safety margin criteria were satisfied with a DID-RA; or
- A FRE determined that applicable risk, DID, and safety margin criteria were satisfied with a plant modification(s), as identified in the LAR, as supplemented.

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

3.5.1.6 Recovery Actions

LAR Attachment G lists the RAs identified in the resolution of variances from deterministic requirements 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). In SSA RAI 04 (Reference 17), the NRC staff identified that LAR Attachment G included RAs for VFDRs EEU-01, GG-02, JJ-02, MM-01, SS-01, and TT-01, however, the RAs were not described in the dispositions of these VFDRs in LAR Attachment C. In response to SSA RAI 04 (Reference 9), the licensee provided revised text to amend the VFDRs dispositions in LAR Attachment C to incorporate the corresponding RAs in LAR Attachment G. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee amended the VFDRs dispositions in LAR Attachment C to incorporate the corresponding RAs in LAR Attachment G.

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

3.5.1.7 Recovery Actions Credited for Defense-in-Depth

The licensee stated that in addition to proposed modifications and RAs identified as part of the risk analysis, additional defense-in-depth recovery actions (DID-RAs) have been identified for fire area G in LAR Attachment G, Table G-1, "Recovery Actions and Activities" (i.e., Unit 2 Alternate Shutdown Areas) to enhance plant control and reduce the likelihood that additional equipment is damaged due to spurious operation.

The licensee stated that the nuclear safety and radioactive release performance goals, objectives, and criteria of NFPA 805, including the risk acceptance guidelines, are met without these actions. However, DID-RAs are retained to meet the requirements to maintain a sufficient level of DID and are therefore considered part of the RI/PB FPP, which necessitates that these actions would be subject to a plant change evaluation (PCE) if subsequently modified or removed.

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

3.5.1.8 Plant Fire Barriers and Separations

With the exception of electrical raceway fire barrier systems (ERFBS), passive fire protection features include the fire barriers used to form fire area boundaries (and barriers separating SSD 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 disposition differences in barrier design and performance from applicable criteria. The acceptability of fire barriers and separations is also evaluated as part of the NRC staff's review of LAR Attachment A, Table B-1 process and as such are addressed in SE Section 3.1.

3.5.1.9 Electrical Raceway Fire Barrier Systems

The licensee stated in LAR Attachment A that ERFBS are not credited at ANO-2.

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 demonstrated as follows:

- Deviations from the pre-NFPA 805 fire protection licensing basis that were transitioned to the NFPA 805 licensing basis were reviewed for applicability, as well as continued validity, and found acceptable;
- VFDRs were evaluated and either found to be acceptable based on an integrated assessment of risk, DID, and safety margins, or modifications or RAs were identified and actions planned or implemented to address the issue;
- RAs used to demonstrate the availability of a success path to achieve the NSPC were evaluated by the licensee and the additional risk of their use determined, reported, and found to be acceptable;
- The licensee's analysis appropriately identified the fire protection SSCs required to meet the NSPC, including fire suppression and detection systems; and
- Fire area boundaries (ceilings, walls, and floors), such as fire barriers, fire barrier penetrations, and through penetration fire stops have been established by the licensee and the NRC staff considers them acceptable.

Accordingly, the NRC staff concludes that each fire area utilizing the deterministic or PB approach, the licensee's approach is acceptable because it meets the applicable requirements of NFPA 805, Section 4.2.

3.5.2 Clarification of Prior NRC Approvals

As stated in LAR Attachment T, there are no elements of the current FPP for which NRC clarification is needed.

3.5.3 Fire Protection during Non-Power Operational Modes

NFPA 805, Section 1.1, "Scope," states the following:

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

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

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

The NRC staff reviewed LAR Section 4.3, "Non-Power Operational (NPO) Modes," and LAR Attachment D, "NEI 04-02 Non-Power Operational Modes Transition," to evaluate the licensee's treatment of potential fire impacts during NPO. The licensee used the process described in NEI 04-02, as modified by NRC FAQ 07-0040 (Reference 54), for demonstrating that the NSPC are met for higher risk evolutions 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. The licensee stated in LAR Section 4.3.1 that the process undertaken to demonstrate that the NSPC was met during NPO modes included:

- Reviewing the existing outage management processes;
- Identifying necessary equipment and cables;
- Performing fire area assessments to identify plant locations where a single fire may damage all success paths of a key safety function (KSF); and
- Managing those locations (called pinch-points) that are associated with fire-induced vulnerabilities during an outage.

The licensee implemented the process outlined in NEI 04-02 and FAQ 07-0040, "Non-Power Operations Clarifications" (Reference 54). As described in LAR Attachment D, the licensee's Shutdown Operations Protection Plan defines high risk evolutions (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 reactor coolant system (RCS) open, and fuel in the reactor vessel). During NPO modes, RI evaluations are performed to determine if DID strategies are adequate to ensure maintenance of each KSF. 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." 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.

In SSA RAI 05a (Reference 17), the NRC staff requested that the licensee provide additional descriptions of the six shutdown conditions used in the outage management process to define the risk of operations. In its response to SSA RAI 05a (Reference 10), the licensee stated that the six shutdown conditions from low to high risk are:

1. The reactor vessel defueled with all fuel in the spent fuel pool;

2. The fuel transfer canal is flooded greater than 23-feet above the core with fuel in the vessel and no refueling in progress;

3. The fuel transfer canal is flooded greater than 23-feet above the core with fuel in the vessel and refueling is in progress;

4. The reactor coolant system is intact with fuel in the vessel and the reactor coolant system level is greater than 377-feet 10.5-inches (reactor vessel flange);

5. The reactor coolant system is open with fuel in the vessel, the reactor coolant system level is greater than 377-feet, 10.5-inches, and the fuel transfer canal level is less than 23-feet; and

6. The reactor coolant system is open with fuel in the vessel, and the reactor coolant system is in a lowered inventory condition less than 377-feet, 10.5-inches.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee appropriately described the six shutdown conditions used in the outage management process to define the risk of operations.

As described in the LAR, the licensee identified equipment and cables necessary to support the KSF success paths. The licensee reviewed the operational modes and functional requirements for the systems and components and the licensee incorporated the KSF success path equipment and cables 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.

The NRC staff concludes that the NPO process described and documented by the licensee in LAR Section 4.3 and LAR Attachment D is acceptable because it is consistent with the guidance in FAQ 07-0040.

3.5.3.2 NPO Analysis Process

The licensee stated that its goal is to ensure that contingency plans are established when the plant is in an HRE and it is possible to lose a KSF due to fire. LAR Section 4.3 and LAR Attachment D discuss these additional controls and measures, however, the licensee indicated that during low-risk periods, 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 applicable plant operating state for NPO was defined, the licensee identified the systems necessary to maintain and support each KSF and a fault tree was developed. The fault tree provides all associations for power supplies, supporting equipment, and other equipment dependencies that could fail equipment necessary to NPO modes. The Plant Data Management System (PDMS) is the cable and raceway software that provides the controlled database for NSCA equipment and associated circuit analysis. The licensee performed the pinch-point analysis using ARC™ software, which extracts the necessary data from PDMS and maps it to the NPO fault tree. The licensee evaluated each fire area for NPO modes to determine which equipment could be rendered unavailable. 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), which effectively captured affected equipment necessary to maintain a KSF in any plant area/zone which could be compromised due to a fire.

In general, NPO equipment is a subset of NSCA equipment. The licensee evaluated existing equipment in PDMS to determine if the circuit analysis was appropriate for NPO modes and additional equipment identified as being needed for NPO modes, but not previously evaluated, was evaluated and added as necessary to PDMS and, where added, flagged accordingly as being only required for NPO modes. The licensee performed all new circuit analysis in accordance with existing methodologies consistent with guidance provided in NEI 00-01.

In SSA RAI 05.b (Reference 17), 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 during NPO modes. The NRC staff also requested that the licensee describe the difference between the at-power SSD function and the NPO function and include a general description by system indicating why components would be selected for NPO modes and not be included in the at-power analysis. In response to SSA RAI 05.b (Reference 10), the license identified 19 additional components required for NPO modes and provided the basis for not including these components in the at-power analysis. The licensee stated that nominally 167 components on the equipment list for NPO modes have functional requirements for hot shutdown and NPO modes. The licensee further stated that support equipment (e.g., electrical, service water) that is in the NPO list has the same requirement for safe and stable, and RCS interface valves to low-pressure shutdown cooling systems that are normally closed at power will have an "open" NPO position. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee provided a list of at-power components that have a different functional requirement during NPO modes and also demonstrated an adequate process for determining what components would not be included in the at-power analysis.

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

3.5.3.3 NPO Key Safety Functions and SSCs Used to Achieve Performance

LAR Attachment D defines the KSFs. The success paths to achieve the KSFs and the components required for the success paths are included in the PDMS and fault trees for NPO modes. In SSA RAI 05.c (Reference 17), 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 and how these locations will be identified to the plant staff for implementation. In its response to SSA RAI 05.c (Reference 10), the licensee identified 19 fire areas and provided a summary of the affected KSF paths in these areas. The licensee stated that LAR Attachment S, Table S-2, Implementation Item S2-5, addresses incorporation of these insights from the NPO calculation into operating procedures and that the operating procedure changes will provide necessary input to the plant staff for KSF pinch-point issues. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee provided a list of KSF pinch-points by fire area and identified an action to incorporate KSF pinch-point issues into appropriate operating procedures and included that action as an implementation item in LAR Attachment S, Table S-2, which is required by the proposed license condition.

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

In SSA RAI 05.d (Reference 17), the NRC staff requested that the licensee provide a description of any actions being credited to minimize the impact of fire-induced spurious actuations on power-operated valves (e.g., air-operated and motor-operated valves) during NPO modes (e.g., pre-fire rack-out, actuation of pinning valves, and isolation of air supplies). In its response to SSA RAI 05.d, (Reference 10), the licensee stated that reviews of plant operating procedures were conducted to identify equipment that would be secured during NPO modes and that secured equipment that could challenge KSFs was included in the NPO equipment list and incorporated into the fault trees. The licensee further stated that impacts to secured or prepositioned equipment were assigned strategies in the fire area compliance assessments to prevent undesired actuations and that these strategies include pre-throttling to prevent failure on loss of instrument air and the racking down or opening of breakers to prevent spurious operation. The licensee further stated that the analyses explicitly indicate equipment procedurally pre-positioned for NPO. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee identified actions that are credited to minimize the impact of fire-induced spurious actuations on power-operated valves during NPO modes and is consistent with the guidance in RG 1.205 and FAQ 07-0040.

In SSA RAI 05.f (Reference 17), the NRC staff indicated that the description of the NPO review in the LAR does not identify locations where KSFs are achieved via RAs or for which instrumentation not already included in the at-power analysis is needed to support RAs required to maintain safe and stable conditions. The NRC staff requested that the licensee identify those RAs and additional instrumentation relied upon in NPO modes and describe how RA feasibility is evaluated and 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 response to SSA RAI 05.f (Reference 10), the licensee stated that those fire areas that are not in deterministic compliance were evaluated to identify a set of equipment that could require recovery based upon a total fire area burnup with worse case failures postulated and all redundant paths and equipment failed. The licensee further stated these DID-RAs for NPO modes 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 further stated that the available instrumentation needed for NPO modes is identified in the summary portion of each fire area evaluation and includes RCS level indication (inventory), neutron monitoring (reactivity), and RCS temperature. The licensee further stated that fire areas not in deterministic compliance are demonstrated to be acceptable with no credited RAs. The licensee further stated that the NPO calculation identifies a plant modification (LAR Attachment S, Table S-1, Item S1-6) to address potential Information Notice (IN) 92-18, "Potential for Loss of Remote Shutdown Capability During a Control Room Fire," dated February 28, 1992 (Reference 101), concerning failure of motor-operated valves in the single line from the reactor coolant system to the shutdown cooling system. The licensee further stated this modification, with procedural controls, removes this vulnerability by preventing spurious actuations and thereby eliminating potential RAs. The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee identified RAs, additional instrumentation relied upon in NPO modes consistent with the guidance in RG 1.205 and FAQ 07-0040, demonstrated how RA feasibility is evaluated, and identified an action to modify plant equipment to eliminate RAs and included that action as a modification which is required by the proposed license condition.

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

3.5.3.4 NPO Pinch-Point Resolutions and Program Implementation

The licensee identified power-operated components needed to support an NPO KSF that were not included in the post-fire SSD equipment list and required additional circuit analysis. The evaluation of these components is addressed in SE Section 3.5.3.2 above.

In LAR Section 4.3 and LAR Attachment D, the licensee stated the normal FPP requirements such as combustible and hot work control are maintained during NPO modes, as are detection and suppression systems. The licensee further stated that in fire areas/zones where a pinch-point is created, an RI evaluation is performed to determine if DID strategies are adequate to assure maintenance of each KSF and that the type of equipment present and its role in the maintenance of KSFs provide locations where no hot work is to be performed during NPO modes without additional compensatory actions in place, such as securing equipment in the safe position (i.e., power removed).

The licensee stated that insights from the FPRA have been used to provide an 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:

- 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;
- Pre-emptive actions such as opening breakers or re-aligning of equipment if hot work is to be performed;
- Establishment of additional fire watches as appropriate;
- Verification of operable detection and/or suppression in the vulnerable areas; and
- Modification to eliminate spurious operation in areas determined to be pinch-points.

In SSA RAI 05.e (Reference 17), the NRC staff requested that the licensee describe the types of compensatory actions that will be used during normal outage evolutions when certain NPO-credited equipment will have to be removed from service. In its response to SSA RAI 05.e (Reference 10), the licensee stated that established outage guidance addresses management of risk during evolutions where equipment may be taken out of service as allowed by the TS, which includes:

- Maintaining 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; and

- Protecting key plant equipment/systems/trains 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 the RAI is acceptable because the licensee demonstrated an appropriate process for determining the types of compensatory actions that will be used during normal outage evolutions when certain NPO credited equipment is removed from service.

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 KSFs could be lost as a direct result of fire-induced damage; and

- Planned/implemented modifications to appropriate procedures in order to employ a fire protection strategy for reducing risk at these pinch-points during HREs.

Accordingly, based on the information provided in the LAR, as supplemented, the NRC staff concludes that the licensee provided reasonable assurance that the NSPC are met during NPO modes and HREs.

3.5.4 Conclusion for Section 3.5

The NRC staff reviewed the licensee's RI/PB FPP, as described in the LAR and its supplements, to evaluate the NSCA results. The licensee used a combination of the deterministic approach and the PB approach, in accordance with NFPA 805, Sections 4.2.3 and 4.2.4.

For those fire areas that utilized a deterministic approach, the NRC staff confirmed the following:

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

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

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

Accordingly, the NRC staff concludes, based on the information in the LAR, as supplemented, that the licensee provided reasonable assurance that each fire area utilizing the deterministic approach does so in accordance with NFPA 805, Section 4.2.3.

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

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

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

- All VFDRs were evaluated using the 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, based on information in the LAR, as supplemented, that the licensee provided adequate documentation that each fire area utilizing the PB approach, in accordance with NFPA 805, Section 4.2.4, is able to achieve and maintain the nuclear safety performance criteria. The licensee followed appropriate NRC and industry guidance in performing the fire area analyses. Recovery actions were appropriately addressed and the risk of their use was evaluated. Taken together, there is reasonable assurance that the associated evaluations meet the requirements for risk, defense-in-depth and safety margins.

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

3.6 Radioactive Release Performance Criteria

3.6.1 Method of Review

NFPA 805 (Reference 3) Chapter 1 defines the radioactive release goals, objectives, and performance criteria that must be met by the FPP in the event of a fire at a nuclear power plant in any plant operational mode as follows:

> Radioactive Release Goal - The radioactive release goal is to provide reasonable assurance that a fire will not result in a radiological release that adversely affects the public, plant personnel, or the environment.
>
> Radioactive Release Objective
>
> Either of the following objectives shall be met during all operational modes and plant configurations.
>
> (1) Containment integrity is capable of being maintained.
>
> (2) The source term is capable of being limited.
>
> Radioactive Release Performance Criteria
>
> Radiation release to any unrestricted area due to the direct effects of fire suppression activities (but not involving fuel damage) shall be as low as reasonably achievable and shall not exceed applicable 10 CFR Part 20 limits.

The NRC reviewed the licensee 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 an RI/PB FPP, in accordance with 10 CFR 50.48(a) and (c) using the guidance in RG 1.205 (Reference 4) and NUREG-0800, Section 9.5.1.2 (Reference 26).

The NRC staff also performed an audit (Reference 77) to determine whether the FPP and its planned modifications would be capable of meeting the NFPA 805 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's evaluation of the capability of the FPP to meet the goals, objectives, and performance criteria of NFPA 805 was performed for all plant areas and all plant operating modes (including power and non-power operations). The licensee's review found that the fire suppression activities, as defined in the pre-fire plans and fire brigade firefighting instruction operating guidelines, were written and valid for any plant operating mode. The NRC staff concludes that the scope of the licensee's assessment is 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 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 where there was no possibility of radioactive materials being present were identified and eliminated from further review (e.g., the Turbine Building was identified as generally open to the outdoors; however, potential sources of radioactivity are generally contained within steel vessels and piping that is not expected to be breached as a result of fire-fighting activities, and therefore, the Turbine Building was screened out from further evaluation).

The screened-in areas included those areas where most of the radioactive materials were present such as in the Reactor Containment, Auxiliary Building and Low Level Radwaste Building. The licensee's review also identified other plant areas where radioactive materials were present where there were limited engineered controls for containment of effluents.

The licensee's procedure EN-RP-121, "Radioactive Material Control," provides requirements for handling, controlling, storing and accountability of radioactive material. All radioactive material (RAM) stored outside of a radiologically controlled area is required to be identified and monitored. RAM storage outside of the radiologically control area requires permission of a radiation protection supervisor and must be properly contained and logged. There are three areas that store low level radioactive waste or materials and these three areas are common to both units and are identified as the Old Radwaste Storage Building, the Low Level Radwaste Storage Building, and the Radiation Protection Storage Building.

The NRC staff concludes that the licensee's evaluation and screening of plants areas is an adequate identification of the potentially affected areas because the licensee provided information to show that its review incorporated all plant areas.

3.6.4 Pre-Fire Plans

The licensee's evaluation reviewed the existing FPP to determine whether the FPP was adequate to ensure that gaseous and liquid radioactive effluents generated as a direct result of fire suppression activities would be contained and monitored before release to unrestricted areas.

This licensee's review included a review of the pre-fire plans that includes information on:

- Occupancy;
- Manual Suppression;
- Fire Brigade Access;
- Ventilation;
- Plant Personnel Egress;
- SSD Impacts;
- Lighting / Communication;
- Guidelines for Fire Attack;
- Hazards;

- Special Precautions/Notes;
- Fixed Fire Systems; and
- Map of the Fire Zone.

The common pre-fire plans specifically address three areas that store low level radioactive waste or materials. These three areas are common to both units and are identified as the Old Radwaste Storage Building, the Low Level Radwaste Storage Building, and the Radiation Protection Storage Building.

The pre-fire plans also address other areas where run-off or ponding of fire suppression water could occur. The pre-fire plans include "Guidelines for Fire Attack" and "Special Precautions/Notes" that contain specific steps to implement based on the potential problems for the given fire zone. The results of the licensee's review are documented in the LAR Attachment E, Table E-1.

The NRC staff concludes that the licensee's evaluation of the pre-fire plans is acceptable 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 Engineering Controls

A review of engineering controls was performed by the licensee to ensure containment of gaseous and liquid effluents (e.g., smoke and fire fighting agents) for ANO-2 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 specific engineering controls are provided in LAR Attachment E, "NEI 04-02 Radioactive Release Transition," Table E-1.

3.6.6 Gaseous Effluent Controls

In its LAR, as supplemented, the licensee identified those plant areas with higher levels of radioactive materials where adequate engineering controls exist for the containment, filtering, and monitoring of gaseous effluent. The NRC staff concludes that the gaseous effluent controls for these higher levels of radioactive materials are acceptable because the effluent is either contained or filtered to remove radioactive materials and subsequently monitored prior to discharge.

The licensee identified other plant areas with limited engineering controls to contain the gaseous effluent. In the Low Level Radwaste Building (LLRWB), located away from the major plant buildings, the inventory of radiological material/fluids is lower than the inventory of higher radioactivity contained in the Auxiliary Building. The LLRWB is also equipped with a Super Particulate Iodine and Noble Gas (SPING) monitor in support of gaseous releases via the building ventilation exhaust system, which may also be monitored manually by Radiation Protection and Chemistry personnel. Three areas that are common to both units are identified as the Old Radwaste Storage Building, the Low Level Radwaste Storage Building, and the Radiation Protection Storage Building. These areas have installed ventilation systems with separately installed radiation monitors or local monitoring. Any potential spills or leaks, such as during a fire, are controlled by licensee procedure EN-RP-113, "Response to Contaminated Spills / Leaks."

For these plant areas with limited engineering controls, the NRC staff concludes that a combination of radiation monitoring and compensatory 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 licensee's assessment of potential gaseous effluent controls, and concludes that the assessment is acceptable because the methods used were consistent with the qualitative assessment methodology given NEI 04-02 and consistent with NFPA 805 and 10 CFR 50.48(c). The NRC staff further concludes that the licensee's gaseous effluent controls are acceptable because the licensee will be able to sufficiently contain a potential radiological gaseous effluent release during fire suppression activities such as to not exceed the radiological release performance criteria of NFPA 805 and the public dose limits of 10 CFR 20.

3.6.7 Liquid Effluent Controls

In its LAR, as supplemented, the licensee identified those plant areas with higher levels of radioactive materials where engineering controls exist for the containment of liquid effluents (e.g., floor drains routed to sumps and tanks). The Reactor Containment building was identified as having adequate engineering controls to contain liquid from fire suppression activities. The Auxiliary Building was identified as being maintained in a relatively clean radiological condition (i.e., having very low level of surface radioactivity or none at all). In addition, liquids from fire suppression activities would be collected by floor drains and openings leading to below grade portions of the building where several tanks are housed for the storage, holdup, and decay of potential radioactive liquids. The floor drains and storage tanks within the Auxiliary Building are capable of containing radiologically contaminated fire water resulting from fire suppression activities. ANO-2 has up to 10 tanks available below grade in the Auxiliary Building (over 200,000 gallon total storage capacity), six of which are housed in "vaults" that can contain substantial amounts of liquid should tank capacities be exceeded. The licensee concluded that potentially contaminated firewater is not likely to reach areas outside the Auxiliary Building.

The NRC staff reviewed the engineering controls described above and concludes that they provide adequate containment because the effluent is collected, stored, processed, and monitored prior to discharge, and are consistent with the NFPA 805 radioactive release goals, objectives, and performance criteria.

The licensee's review also identified those plant areas where there may not be sufficient engineered controls to adequately contain potential liquid effluents released during firefighting activities. The pre-fire plans address areas where run-off or ponding of fire suppression water may be an issue. The pre-fire plans include "Guidelines for Fire Attack" and "Special Precautions/Notes" sections that contain specific steps to implement based on the potential problems for the given fire zone.

For example, in the Low Level Radwaste Building (LLRWB), located away from the major plant buildings, the inventory of radiological material/fluids is lower than the inventory of higher radioactivity contained in the Auxiliary Building. While capable of containing some amount of potentially contaminated water resulting from fire-fighting activities, the licensee will monitor and control any liquid release from the LLRWB in accordance with the pre-fire plans. The Radiation Protection personnel will be summoned and ensure appropriate actions are taken by the Fire Brigade, Operations personnel, or others, as needed.

The NRC staff reviewed the licensee's methods of limiting potential liquid effluent releases. The NRC staff concludes that the licensee will be able to adequately limit potential radiological liquid effluent releases using engineering controls in plant areas where higher levels of radioactive materials exist, and using administrative controls (monitoring and instructions to Fire Brigade members) in areas with lower levels of radioactive materials, such as to not exceed the radiological release performance criteria of NFPA 805 and the public dose limits of 10 CFR 20.

3.6.8 Fire Brigade Training Materials

The licensee reviewed the Fire Brigade training program and determined that training on radiological release potential is provided in lesson plan ASLP-FP-CAFRS, "Responding to Fires in Controlled Access." This lesson plan addresses radioactive contamination and the need for monitoring and containment. Specifically, the areas of "Flooding Concerns" and "Ventilation Concerns" are addressed.

The lesson plan states 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."

The NRC staff reviewed the licensee's evaluation of training materials, as presented in LAR Attachment E, and concludes that the training materials are acceptable, because they instruct the licensee's staff to implement effluent control measures and compensatory actions in order to not exceed the radiological release performance criteria of NFPA 805 and the public dose limits of 10 CFR 20.

3.6.9 Actions to Be Taken

No new actions beyond existing pre-fire plans and training were identified as necessary to further limit radioactive release.

3.6.10 Conclusion for Section 3.6

The NRC staff's evaluation is based on:

(1) Information and analyses provided in the LAR;

(2) Use of pre-fire plans;

(3) Use of installed and manual engineered controls to contain potential releases;

(4) Use of radiation monitoring to provide detection of radioactive effluent, and instructions to the Fire Brigade on when and how to limit effluent releases;

(5) Use of revised fire brigade response procedures and training procedures; and

(6) The licensee's qualitative assessment that the amount of radioactive contamination in areas where containment of effluent is lower than areas with higher levels of contamination with engineered controls.

Based on these evaluations, the NRC staff concludes that the licensee's RI/PB FPP provides reasonable assurance that radiation releases to any unrestricted area resulting from the direct effects of fire suppression activities are as low as reasonably achievable and are not likely to exceed the radiological release performance criteria of NFPA 805 and the radiological dose limits in 10 CFR Part 20. The NRC staff concludes that the licensee's FPP complies with the requirements of NFPA 805, Sections 1.3.2, 1.4.2, and 1.5.2 and is, therefore, acceptable.

3.7 NFPA 805 Monitoring Program

For this SE section, the following requirements from NFPA 805, Section 2.6, are applicable to the NRC staff's review of the LAR:

NFPA 805 Section 2.6, "Monitoring," states that:

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

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

> Acceptable levels of availability, reliability, and performance shall be established.

NFPA 805 Section 2.6.2, "Monitoring Availability, Reliability, and Performance," states that:

> Methods to monitor availability, reliability, and performance shall be established. The methods shall consider the plant operating experience and industry operating experience.

NFPA 805 Section 2.6.3, "Corrective Action," states that:

> If the established levels of availability, reliability, or performance are not met, appropriate corrective actions to return to the established levels shall be implemented. Monitoring shall be continued to ensure that the corrective actions are effective.

The NRC staff reviewed LAR Section 4.6, "Monitoring Program," that the licensee developed to monitor availability, reliability, and performance of ANO-2 FPP systems and features after the transition to NFPA 805. The focus of the NRC staff review was on the critical elements related to the monitoring program, including the selection of FPP systems and features to be included in the program, the attributes of those systems and features that will be monitored, and the methods for monitoring those attributes. The licensee stated that implementation of the monitoring program will occur on the same schedule as the NFPA 805 RI/PB FPP implementation, which the NRC staff concludes is acceptable.

The licensee stated that it will develop an NFPA 805 monitoring program consistent with FAQ 10-0059 (Reference 60). The licensee stated that development of the monitoring program will include a review of existing surveillance, inspection, testing, compensatory measures, and oversight processes for adequacy. The review will examine adequacy of the scope of SSCs within the existing plant programs, performance criteria for availability and reliability of SSCs, and the adequacy of the plant corrective action program. The licensee further stated that the monitoring program will incorporate phases for scoping, screening using risk criteria, risk target value determination, and monitoring implementation. The scope of the program will include fire protection systems and features, NSCA equipment, SSCs relied upon to meet radioactive release criteria, and fire protection programmatic elements.

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

Based on the information provided in the LAR, as supplemented, the NRC staff concludes that the licensee's NFPA 805 monitoring program development and implementation process is acceptable because it:

- Establishes the appropriate performance monitoring groups to be monitored;
- Uses an acceptable screening process for determining the SSCs to be included in the performance monitoring groups;
- Establishes availability, reliability and performance criteria for the SSCs being monitored; and
- Requires corrective actions when SSC availability, reliability, and performance criteria targets are exceeded to bring performance back within the required range.

However, since the final values for availability and reliability, as well as the performance criteria for the SSCs being monitored, have not been established for the monitoring program as of the date of this SE, completion of the licensee's NFPA 805 Monitoring Program is an implementation item, as addressed in LAR Attachment S, Table S-2, Implementation Item S2-1.

The NRC staff concludes that the completion of the monitoring program on the same schedule as the implementation of NFPA 805 is acceptable, because the monitoring program will be completed with the other implementation items as described in LAR Attachment S, Table S-2, within 6 months after issuance of the SE which is prior to completion of the modifications to achieve full compliance with 10 CFR 50.48(c).

3.7.1 Conclusion for Section 3.7

The NRC staff reviewed the licensee's RI/PB FPP and concludes that the licensee's approach for meeting the requirements of NFPA 805, Sections 2.6, regarding the monitoring program is acceptable and that there is reasonable assurance that the licensee will develop a monitoring program that meets the requirements specified in NFPA 805, Sections 2.6.1, 2.6.2, and 2.6.3, because the licensee identified an action to revise plant documents to monitor and trend the FPP, and included that action as an implementation item which is required by the proposed license condition.

3.8 Program Documentation, Configuration Control, and Quality Assurance

For this SE section, the requirements from NFPA 805 (Reference 3), Section 2.7, "Program Documentation, Configuration Control, and Quality," are applicable to the NRC staff's review of the LAR in regard to the appropriate content, configuration control, and quality of the documentation used to support the ANO-2 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 Validations" 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-2 FPP design basis document and supporting documentation.

The ANO-2 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 the analyses conducted to support the NFPA 805 transition were performed in accordance with ANO-2 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-2'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.

The LAR also stated that the documentation associated with the FPP will be maintained for the life of the plant (as required by NFPA 805) 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 in LAR, as supplemented, 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 regarding adequate development and maintenance of the FPP design basis documentation is acceptable because it meets the requirements of NFPA 805, Sections 2.7.1.1, 2.7.1.2, and 2.7.1.3.

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-2 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-2 licensing programs, including the FPP.

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 further stated that analyses based on the probabilistic risk assessment program, which includes the FREs, are issued as formal analyses subject to these same configuration control processes, and are additionally subjected to the probabilistic risk assessment peer review process specified in the ASME/ANS PRA standard (Reference 24).

Configuration control of the existing FPP during the transition period is maintained by the change evaluation process, as defined in existing configuration management and configuration control procedures. LAR Attachment S, Table S-2 includes Implementation Item S2-7 to update configuration control procedures to reflect the new NFPA 805 licensing bases requirements. The NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 into the licensee's FPP and because it is included as an implementation item in LAR Attachment S, Table S-2, which is required by the proposed license condition.

The NRC staff reviewed 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 information in the LAR, as supplemented, the NRC staff concludes that the ANO-2 configuration control process, which indicates that the new FPP design basis and supporting documentation will be controlled, that plant changes will be reviewed for impact on the FPP, and upon completion of the implementation item, is acceptable because 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 following sections of this SE provide the NRC staff's evaluation of the application of the NFPA 805 quality requirements to the licensee's FPP, as appropriate.

3.8.3.1 Review

NFPA 805 requires that each analysis, calculation, or evaluation performed be independently reviewed. The licensee stated that its procedures require independent review of analyses, calculations, and evaluations, including those performed in support of compliance with 10 CFR 50.48(c). The licensee further stated that the transition to NFPA 805 was independently reviewed, and that analyses, calculations, and evaluations to be performed post-transition will be independently reviewed, as required by existing procedures.

Based on the licensee's description of the process for performing independent reviews of analyses, calculations, and evaluations, the NRC staff concludes that the licensee's approach is acceptable because it meets the quality requirements of NFPA 805, Section 2.7.3.1.

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 (V&V) through comparison to test results or other acceptable models. In its LAR, as supplemented, 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 information related to the V&V of fire models used to support the development of the ANO-2 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 37), documents the V&V of five selected fire models commonly used to support applications of RI/PB fire protection at nuclear power plants. The seven volumes of this NUREG-series report provide technical documentation concerning the predictive capabilities of a specific set of fire dynamics calculation tools and fire phenomenological models that may be used for the analysis of fire hazards in postulated nuclear power plant scenarios. When used within the limitations of the fire models and considering the identified uncertainties, these models may be employed to demonstrate compliance with the requirements of 10 CFR 50.48(c) as part of an approved PB approach in accordance with NFPA 805, Chapter 4.

Accordingly, for those fire modeling elements performed by the licensee using the V&V applications contained in NUREG-1824 to support the transition to NFPA 805, 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 Attachment J, the licensee identified the use of several empirical correlations that are not addressed in NUREG-1824. The NRC staff reviewed these correlations, as well as the related material provided in the LAR, in order to determine whether the licensee adequately demonstrated alignment with specific portions of the applicable NUREG-1824 guidance.

Table 3.8-1, "V&V Basis for Fire Modeling Correlations Used at ANO-2," in SE Attachment A and Table 3.8-2, "V&V Basis for Other Fire Models and Related Calculations Used at ANO-2," in SE Attachment B, identify these empirical correlations and algebraic models, respectively, and include an NRC staff disposition for each.

The NRC staff concludes that the theoretical bases of the models and empirical correlations used in the fire modeling calculations that were not addressed in NUREG-1824 were identified and described in the publications listed in SE Tables 3.8-1 and 3.8-2 (References 88 – 100 and 103 – 107). SE Tables 3.8-1 and 3.8-2, in SE Attachments A and B, summarize the additional fire models, and the NRC staff's evaluation of the acceptability of each.

The fire modeling employed by the licensee in the development of the FREs used empirical correlations that provide bounding solutions for the zone of influence and conservative input parameters, which produced conservative results for the fire modeling analysis. The empirical correlations and models were used to develop a generic methodology to determine the zone of influence 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 fire modeling method.

3.8.3.2.2 Discussion of RAIs

By letters dated September 11, 2013 (Reference 17), and March 28, 2014 (Reference 18), the NRC staff requested additional information concerning the fire modeling conducted to support the FPRA. By letters dated November 7, 2013 (Reference 9), December 4, 2013 (Reference 10), January 6, 2014 (Reference 11), and May 22, 2014 (Reference 12), the licensee responded to these RAIs.

- In FM RAI 03.a (Reference 17), the NRC staff request that the licensee confirm that the Froude number was within the NUREG-1824 validated range for the fire scenarios that were modeled with CFAST, or to provide technical justification for the use of CFAST with a Froude number outside the validated range.

  In its response to FM RAI 03.a (Reference 9), the licensee discussed the Froude numbers calculated for the different types of ignition sources that were specified in the CFAST runs (i.e., closed electrical panels, transient ignition sources, and cable trays). The licensee explained that closed electrical panel fires are modeled as open source fires with a Froude number that is within the validated range. The licensee stated that its calculations show that the Froude number is either within or below the validated range for transient fires. The licensee further stated that the Froude number is not readily calculated for cable tray fires due to the relatively complex geometry of the fuel package and that two sets of Froude numbers were calculated for fires involving stacks of horizontal cable trays, one set using the tray width as a characteristic dimension and a second set using the equivalent fire diameter. Based on these calculations, the licensee concluded that the Froude number for cable tray fires is either within or below the NUREG-1824 validated range. The licensee provided additional information to show that the cases with low Froude numbers produce results that are more conservative than comparable cases with a Froude number that falls within the NUREG-1824 validated range.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee justified the use of a Froude number outside the NUREG-1824 validated range when applicable.

- In FM RAI 03.b (Reference 17), the NRC staff requested that the licensee identify cases where CFAST was used to model fires with flames that impinge on the ceiling, and to provide technical justification for applying CFAST in these cases.

In its response to FM RAI 03.b (Reference 9), the licensee explained that the flame height to ceiling height ratio is a measure of the degree to which flames impinge on the ceiling surface. The licensee further stated that flame impingement on a ceiling surface can affect the predictions of the ceiling jet temperature, the heat transfer to the ceiling surface, and the radiant heat flux at a specific target location and that none of these three model output parameters affect the FPRA. The licensee further stated that flame impingement results in heat losses to the ceiling are not accounted for in the CFAST calculations and that accounting for the additional heat losses would result in lower and therefore less conservative, calculated HGL temperatures.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee provided adequate justification to use CFAST to model fires with flames that impinge on the ceiling.

- In FM RAI 07 (Reference 18), the NRC staff requested that the licensee identify and provide the V&V basis for fire modeling tools and methods that have been used in the development of the NFPA 805 LAR that are not documented in LAR Attachment J.

  In its response to FM RAI 07 (Reference 12), the licensee stated that Attachment J to the LAR describes the V&V basis for all fire modeling tools and methods that were used to develop the FPRA. In addition, the licensee explained that the "damage accrual" method combines heat fluxes calculated from the GFMTs ZOI tables with the NUREG/CR-6850 (Reference 29) (Reference 30) heat release rate and t^2 fire growth profile for electrical cabinet fires, and cable target damage delay times as a function of heat flux in Appendix H of NUREG/CR-6850.

  The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that it included the V&V basis for all the fire modeling tools and methods that have been used.

3.8.3.2.3 Post-Transition

The licensee also stated that it will revise the appropriate processes and procedures to include NFPA 805 quality requirements for use during the performance of post-transition FPP changes, including those for V&V. Revision of the applicable post-transition processes and procedures to include NFPA 805 requirements for V&V is identified in LAR Attachment S, Table S-2, implementation item S2-7 and the NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the licensee's FPP and is 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-2 process for V&V of calculational models and numerical methods and their commitment for continued use post-transition, the NRC staff concludes that the licensee's approach to meeting the requirements of NFPA 805 Section 2.7.3.2 is acceptable because the models are consistent with approved uses in NRC guidance or other authoritative publications, as listed in SE Tables 3.8-1 and 3.8-2, and the licensee identified actions that will result in compliance with NFPA 805 and those actions are required by the proposed license condition.

The NRC staff concludes that the licensee's fire modeling approach used in the development of the fire scenarios for the ANO-2 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, the Society of Fire Protection Engineers (SFPE) *Handbook of Fire Protection Engineering,* or other authoritative publications.

3.8.3.3 Limitations of Use

NFPA 805, Section 2.7.3.3 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. In its LAR, the licensee stated that the engineering methods and numerical models used in support of the transition to NFPA 805 were subject to the limitations of use outlined in NFPA 805, Section 2.7.3.3, and that the engineering methods and numerical models used post-transition will be subject to these same limitations of use..

3.8.3.3.1 General

The NRC staff assessed the acceptability of empirical correlation and fire model in terms of the limits of its use. Table 3.8-1 in SE Attachment A and Table 3.8-2 in SE Attachment B, summarize the fire models used, how each was applied in the ANO-2 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 September 11, 2013 (Reference 17), and March 28, 2014 (Reference 18), the NRC staff requested additional information concerning the fire modeling conducted to support the FPRA. By letters dated November 7, 2013 (Reference 9), December 4, 2013 (Reference 10), January 6, 2014 (Reference 11), and May 22, 2014 (Reference 12), the licensee responded to these RAIs.

- In FM RAI 04 (Reference 17), the NRC staff requested that the licensee identify any uses of the GFMTs approach, including its supplements, and CFAST outside the limits of applicability of the method, and to explain for those cases how the use of the GFMTs approach or CFAST was justified.

  In its response to FM RAI 04 (Reference 11), the licensee explained that there are two broad categories of limitations that are applicable to the GFMTs approach and that these include limitations associated with the implementation of the ZOI and limitations associated with the CFAST fire modeling of HGL conditions. The licensee further stated that limitations apply to the CFAST fire modeling conducted in support of the main control room abandonment calculations. The licensee further identified five basic limitations that should be considered when applying the original GFMT ZOI that represent conditions or configurations for which the GFMT ZOI data may potentially be non-conservative if applied outside the particular limitation. The licensee discussed these five limitations in detail and explained how they were addressed. The licensee also identified the CFAST limitations that apply to the HGL and MCR abandonment calculations, and explained that the FPRA was updated to account for uses of CFAST outside its range of applicability that lead to non-conservative results.

The NRC staff concludes that the licensee's response to the RAI is acceptable because the licensee demonstrated that the GFMTs approach and CFAST were either used within their limits of applicability or that uses outside of the limitations were appropriately justified.

3.8.3.3.3 Post-Transition

The licensee also stated that it will revise the appropriate processes and procedures to include the NFPA 805 quality requirements for use during the performance of post-transition FPP changes, including those for limitations of use. Revision of the applicable post-transition processes and procedures to include NFPA 805 requirements for limitations of use are identified in LAR Attachment S, Table S-2, implementation item S2-7 and the NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 in the licensee's FPP and because it is 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-2 process for placing limitations on the use of engineering methods and numerical models, the NRC staff concludes that the licensee's approach to meeting the requirements of NFPA 805 Section 2.7.3.3 is acceptable because the models are consistent with approved uses in NRC guidance or other authoritative publications and the licensee identified actions that will result in compliance with NFPA 805 and those actions are 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., fire modeling) be competent in that field and experienced in the application of these methods as they relate to nuclear power plants, nuclear power plant fire protection, and power plant operations. The licensee's procedures require that cognizant personnel who use and apply engineering analyses and numerical models be competent in the field of application and experienced in the application of the methods, including those personnel performing analyses in support of compliance with 10 CFR 50.48(c).

The licensee stated that these requirements are being addressed through the implementation of an engineering qualification process at ANO-2. The licensee stated that it 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). ANO-2 has developed qualification or training requirements for personnel performing engineering analyses and numerical methods.

The NRC staff requested that the licensee provide additional information pertaining to qualifications of the personnel who supported the ANO-2 fire modeling. Applicable RAIs and responses are discussed below:

- In FM RAI 05.a (Reference 17), the NRC staff requested that the licensee describe the necessary qualifications of the engineers performing the fire modeling.

  In its response to FM RAI 05.a (Reference 9), the licensee explained that the qualification requirements for the technical leads are consistent with and often exceed those described in NEI 07-12 (Reference 82) for qualification of peer reviewers. The licensee further stated that it ensured that each task was performed by individuals with the appropriate education, experience and training in the fire modeling area being performed.

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

- In FM RAI 05.b (Reference 17), 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 9), the licensee explained that, prior to assigning the task, individuals selected to perform fire modeling were required to have the appropriate background for these activities as described in the response to FM RAI 05.a.

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

- In FM RAI 05.c and 05.d (Reference 17), the NRC staff requested that the licensee describe the communication process between the fire modeling analysts and probabilistic risk assessment personnel and between consultants and plant personnel, and any measures taken to assure that the fire modeling was performed adequately and will continue to be performed adequately during post-transition.

> In its response to FM RAIs 05.c and 05.d (Reference 9), the licensee explained that, during the preparation of the LAR, meetings were held between probabilistic risk assessment staff and fire modeling staff to review the fire modeling. The licensee further stated that the fire modeling reports were reviewed in accordance with the appropriate quality assurance programs and that the fire modeling calculations were also reviewed by licensee staff who are qualified to the respective engineering processes, and by the probabilistic risk assessment staff before the results were incorporated in the FPRA model and that a similar process will be used post-transition.
>
> The NRC staff concludes that the licensee's responses to the RAIs are acceptable because the licensee demonstrated appropriate interactions between fire modeling staff and probabilistic risk assessment staff to ensure that fire modeling was adequately performed.

The NRC staff concludes that appropriately competent and experienced personnel developed the ANO-2 FREs. The development of the ANO-2 FPREs included the supporting fire modeling calculations and the additional documentation for models and empirical correlations not identified in previous NRC-approved V&V documents, in accordance with the requirements at 10 CFR 50.48(c).

In LAR Section 4.7.3, "Compliance with Quality Requirements in Section 2.7.3 of NFPA 805," the licensee stated that:

> Post-transition, for personnel performing fire modeling or fire PRA 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 (see Attachment S).

The licensee stated that the post-transition qualification training program will be implemented to include NFPA 805 requirements for qualification of users as described in LAR Attachment S, Table S-2, implementation item S2-7 and the NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 into the licensee's FPP and because the action is included as an implementation item which is required by the proposed license condition.

Furthermore, the NRC staff concludes that the licensee's approach for ensuring personnel who use and apply engineering analyses and numerical methods are competent and experienced is acceptable because it meets the requirements of NFPA 805, Section 2.7.3.4.

3.8.3.5 Uncertainty Analysis

NFPA 805, Section 2.7.3.5 requires that an uncertainty analysis be performed to provide reasonable assurance that the performance criteria have been met. (Note: 10 CFR 50.48(c)(2)(iv) states that an uncertainty analysis performed in accordance with

NFPA 805, Section 2.7.3.5, is not required to support calculations used in conjunction with a deterministic approach.) The licensee stated that an uncertainty analysis was performed for the analyses used in support of the transition to NFPA 805, and that an uncertainty analysis will be performed for post-transition analyses.

3.8.3.5.1 General

The industry consensus standard for probabilistic risk assessment development (i.e., the ASME/ANS PRA standard (Reference 24)), includes requirements to address uncertainty. Accordingly, the licensee addressed uncertainty as a part of the development of the ANO-2 FREs. The NRC staff's evaluation of the licensee's treatment of these uncertainties is discussed in SE Section 3.4.7.

According to NUREG-1855, Volume 1, "Guidance on the Treatment of Uncertainties Associated with PRAs in RI Decision Making" (Reference 39), there are three types of uncertainty associated with fire modeling calculations:

(1) Parameter Uncertainty: Input parameters are often chosen from statistical distributions or estimated from generic reference data. In either case, the uncertainty of these input parameters affects the uncertainty of the results of the fire modeling analysis.

(2) Model Uncertainty: Idealizations of physical phenomena lead to simplifying assumptions in the formulation of the model equations. In addition, the numerical solution of equations that have no analytical solution can lead to inexact results. Model uncertainty is estimated via the processes of V&V. An extensive discussion of quantifying model uncertainty can be found in NUREG-1934, "Nuclear Power Plant Fire Modeling Application Guide (NPP FIRE MAG)" (Reference 41).

(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 September 11, 2013 (Reference 17), and March 28, 2014 (Reference 18), the NRC staff requested additional information concerning the fire modeling conducted to support the FPRA. By letters dated November 7, 2013 (Reference 9), December 4, 2013 (Reference 10), January 6, 2014 (Reference 11), and May 22, 2014 (Reference 12), the licensee responded to these RAIs.

- In FM RAI 06.a (Reference 17), the NRC staff requested that the licensee explain how the uncertainty associated with the fire model input parameters was accounted for in the fire modeling 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 a conservative and bounding analysis. The licensee provided a detailed discussion of the approach for the four primary fire modeling activities where parameter uncertainty is applicable, (i.e., the MCR abandonment analysis, the HGL tabulations, the ZOI tabulations, and the smoke detector response calculations). For the MCR abandonment analysis, the licensee's sensitivity assessment was used to limit the increase in the probability of abandonment to fifteen percent or less for credible model input parameter variations. Cases in which the sensitivity is shown to be greater than fifteen percent were used to establish model application limits or the licensee provided a basis that the parameter variation was not applicable.

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

- The NRC staff issued FM RAI 06.b (Reference 17), the NRC staff requested that the licensee explain how the "completeness" and "model" uncertainty were accounted for in the fire modeling analyses.

  In its response to FM RAI 06.b (Reference 11), the licensee explained that the combined model and completeness uncertainty is applicable to the four fire modeling activities discussed in the response to FM RAI 06.a. The licensee provided a detailed discussion to show that this uncertainty in all 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 model uncertainty and completeness uncertainty were properly accounted for.

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 items S2-7, which are included in the proposed fire protection license condition.

The NRC staff concludes that this action is acceptable because it will incorporate the provisions of NFPA 805 into the licensee's FPP and because it is included in implementation items which would be required by the proposed fire protection license condition.

3.8.3.5.4 Conclusion for Section 3.8.3.5

Based on the licensee's description of the ANO-2 process for performing an uncertainty analysis, the NRC staff concludes that the licensee's approach for meeting the requirements of NFPA 805 Section 2.7.3.5 is acceptable.

3.8.3.6 Conclusion for Section 3.8.3

Based on the above discussions, the NRC staff concludes that subject to the completion of the implementation items which are included in the proposed license condition, the ANO-2 RI/PB fire protection quality assurance program adequately addresses each of the requirements of NFPA 805, Section 2.7.3, which includes conducting independent reviews, performing V&V, limiting the application of acceptable methods and models to within prescribed boundaries, ensuring that personnel applying acceptable methods and models are qualified, and performing uncertainty analyses.

3.8.4 Fire Protection Quality Assurance Program

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

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

The licensee established its fire protection quality assurance program in accordance with the guidelines of NUREG-0800, Section 9.5.1 position C.4, "Quality Assurance Program," (Reference 102). In addition, 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 program will be transitioned to the new NFPA 805 RI/PB FPP as discussed below.

The licensee stated in its LAR that the existing fire protection quality assurance program will be maintained and is included within and implemented by the ANO-2 nuclear quality assurance program, although certain aspects of that program are not applicable to the FPP.

Based on information provided by the licensee, the NRC staff concludes that the licensee's changes to the fire protection quality assurance program are acceptable because the existing program includes the fire protection systems that are required by NFPA 805 transition and post-transition.

3.8.5 Conclusion for Section 3.8

The NRC staff reviewed the licensee's RI/PB FPP as described in the LAR, as supplemented, to evaluate the NFPA 805 program documentation content, the associated configuration control process, and the appropriate quality assurance requirements. The NRC staff concludes that subject to completion of the implementation items described in LAR Attachment S, the licensee's approach for the NFPA 805 program documentation content, the associated configuration control process, and the appropriate quality assurance requirements is acceptable because it will meet the requirements specified in NFPA 805, Section 2.7.

4.0 FIRE PROTECTION LICENSE CONDITION

The licensee proposed an FPP license condition regarding transition to an RI/PB FPP under NFPA 805, in accordance with 10 CFR 50.48(c)(3)(i). The new license condition adopts the guidelines of the standard fire protection license condition promulgated in RG 1.205, Revision 1, Regulatory Position C.3.1, as issued on December 18, 2009 (74 FR 67253). Plant-specific changes were made to the sample license condition; however, the proposed plant-specific FPP license condition is consistent with the standard fire protection license condition, incorporates all of the relevant features of the transition to NFPA 805 at ANO-2 and is, therefore, acceptable.

The following license condition is included in the revised license for ANO-2, and will replace Renewed Facility Operating License No. NPF-6 Condition 2.C.(3)(b):

> Fire Protection Program
>
> 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 license amendment request dated December 17, 2012, and supplements dated November 7, 2013, December 4, 2013, January 6, 2014, May 22, 2014, June 30, 2014, August 7, 2014 September 24, 2014, and December 9, 2014, as approved in the SE dated February 18, 2015. Except where NRC approval for changes or deviations is required by 10 CFR 50.48(c), and provided no other regulation, technical specification, license condition or requirement would require prior NRC approval, the licensee may make changes to the fire protection program without prior approval of the Commission if those changes satisfy the provisions set forth in 10 CFR 50.48(a) and 10 CFR 50.48(c), the change does not require a change to a technical specification or a license condition, and the criteria listed below are satisfied.

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-2. Acceptable methods to assess the risk of the change may include methods that have been used in the peer-reviewed fire PRA model, methods that have been approved by NRC through a plant specific license amendment or NRC approval of generic methods specifically for use in NFPA 805 risk assessments, or methods that have been demonstrated to bound the risk impact.

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

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

Other Changes that May Be Made Without Prior NRC Approval

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

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

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

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

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

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

Prior NRC review and approval are not required for changes to the licensee's fire protection program that have been demonstrated to have no more than a minimal risk impact. The licensee may use its screening process as approved in the NRC SE dated February 18, 2015, to determine that certain fire protection program changes meet the minimal criterion. The licensee shall ensure that fire protection defense-in-depth and safety margins are maintained when changes are made to the fire protection program.

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 5, of Entergy Operations, Inc. letter 2CAN081401, dated August 7, 2014, 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, of Entergy Operations, Inc. letter 2CAN091402, dated September 24, 2014, within six months after issuance of the Safety Evaluation.

Renewed Facility Operating License No. NPF-6 Condition 2.C.(3)(e) is deleted and revised to read as follows:

2.C.(3)(e) Deleted per Amendment 300, 2/18/15.

5.0 SUMMARY

The NRC staff reviewed the licensee's application, as supplemented by various letters, to transition to an RI/PB FPP in accordance with the requirements established by NFPA 805. The NRC staff concludes that the applicant's approach, methods, and data are acceptable to establish, implement and maintain an RI/PB FPP in accordance with 10 CFR 50.48(c).

Implementation of the RI/PB FPP in accordance with 10 CFR 50.48(c) will include the application of a new fire protection license condition. The new license condition includes a list of implementation items that must be completed in order to support the conclusions made in this SE, as well as an established date by which full compliance with 10 CFR 50.48(c) will be achieved. Before the licensee is able to fully implement the transition to an FPP based on NFPA 805 and apply the new fire protection license condition, to its full extent, the modifications and implementation items must be completed within the timeframe specified.

6.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Arkansas State official was notified of the proposed issuance of the amendment. The State official had no comments.

7.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to the installation or use of facility components located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts and no significant change in the types of any effluents that may be released offsite and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding published in the *Federal Register* on July 23, 2013 (78 FR 44171). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

8.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner; (2) there is reasonable assurance that such activities will be conducted in compliance with the Commission's regulations; and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

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Attachments:
A. Table 3.8-1 – V&V Basis for Fire Modeling Correlations Used at ANO-2
B. Table 3.8-2 – V&V Basis for Other Fire Models and Related Calculations Used at ANO-2
C. Abbreviations and Acronyms

Attachment A: Table 3.8-1, V&V Basis for Fire Modeling Correlations Used at ANO-2

Correlation	Application at ANO-2	V&V Basis	NRC Staff Evaluation of Acceptability
Heskestad flame height correlation	Development of ZOI tables in GFMTs approach	NUREG-1805 (Reference 36) NUREG-1824 (Reference 37) SFPE Handbook (Reference 103)	• The correlation is validated in NUREG-1824 and in the SFPE Handbook of FPE. Based on its review and evaluation, the NRC staff concluded that the use of this correlation in the ANO-2 application is acceptable.
Heskestad plume temperature correlation	Development of ZOI tables in GFMTs approach	NUREG-1805 (Reference 36) NUREG-1824 (Reference 37) SFPE Handbook (Reference 103)	• The correlation is validated in NUREG-1824 and in the SFPE Handbook of FPE.. Based on its review and evaluation, the NRC staff concluded that the use of this correlation in the ANO-2 application is acceptable.
Modak point source radiation model	Development of ZOI tables in GFMTs approach	NUREG-1805 (Reference 36) NUREG-1824 (Reference 37) SFPE Handbook (Reference 104)	• The correlation is validated in NUREG-1824 and in the SFPE Handbook of FPE. Based on its review and evaluation, the NRC staff concluded that the use of this correlation in the ANO-2 application is acceptable.
Shokri and Beyler flame radiation model	Development of ZOI tables in GFMTs approach	Peer-reviewed journal article (Reference 88)	• The correlation is validated in a peer reviewed journal article.. Based on its review and evaluation, the NRC staff concluded that the use of this correlation in the ANO-2 application is acceptable.

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Correlation	**Application at ANO-2**	**V&V Basis**	**NRC Staff Evaluation of Acceptability**
Mudan flame radiation model	Development of ZOI tables in GFMTs approach	Peer-reviewed journal article (Reference 89)	• The correlation is validated in a peer reviewed journal article.. Based on its review and evaluation, the NRC staff concluded that the use of this correlation in the ANO-2 application is acceptable.
Plume heat flux correlation by Wakamatsu et al.	Development of ZOI tables in GFMTs approach	Peer-reviewed conference paper (Reference 90)	• The correlation is validated in a peer reviewed conference paper. Based on its review and evaluation, the NRC staff concluded that the use of this correlation in the ANO-2 application is acceptable.
Yokoi plume centerline temperature correlation	Development of ZOI tables in GFMTs approach	National research laboratory report (Reference 91) Peer-reviewed journal article (Reference 92)	• The correlation is validated in a peer reviewed journal article and a national research laboratory report. Based on its review and evaluation, the NRC staff concluded that the use of this correlation in the ANO-2 application is acceptable.
Hydrocarbon spill fire size correlation	Development of ZOI tables in GFMTs approach	SFPE Handbook (Reference 93)	• The correlation is validated in the SFPE handbook of FPE. Based on its review and evaluation, the NRC staff concluded that the use of this correlation in the ANO-2 application is acceptable.
Flame extension correlation	Development of ZOI tables in GFMTs approach	SFPE Handbook (Reference 94)	• The correlation is validated in the SFPE Handbook of FPE. Based on its review and evaluation, the NRC staff concluded that the use of this correlation in the ANO-2 application is acceptable.

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Correlation	Application at ANO-2	V&V Basis	NRC Staff Evaluation of Acceptability
Delichatsios line source flame height model	Development of ZOI tables in GFMTs approach	Peer-reviewed journal article (Reference 95)	• The correlation is validated in a peer reviewed journal article. Based its review and evaluation, the NRC staff concluded that the use of this correlation in the ANO-2 application is acceptable.
Corner flame height correlation	Development of ZOI tables in GFMTs approach	SFPE Handbook (Reference 94)	• The correlation is validated in the SFPE Handbook of FPE. Based its review and evaluation, the NRC staff concluded that the use of this correlation in the ANO-2 application is acceptable.
Kawagoe natural vent flow equation	Development of ZOI tables in GFMTs approach	National research laboratory report (Reference 96)	• The correlation is validated in publication national research laboratory report. Based on its review and evaluation, the NRC staff concluded that the use of this correlation in the ANO-2 application is acceptable.
Yuan and Cox line fire flame height and plume temperature correlations	Development of ZOI tables in GFMTs approach	Peer-reviewed journal article (Reference 97)	• The correlation is validated in a peer reviewed journal article. Based on its review and evaluation, the NRC staff concluded that the use of this correlation in the ANO-2 application is acceptable.
Lee cable fire model	Development of ZOI tables in GFMTs approach	NBSIR 85-3196 (Reference 99)	• The correlation is validated in NBSIR 85-3196. Based on its review and evaluation, the NRC staff concluded that the use of this correlation in the ANO-2 application is acceptable.

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Correlation	Application at ANO-2	V&V Basis	NRC Staff Evaluation of Acceptability
Babrauskas method to determine ventilation-limited fire size	Development of ZOI tables in GFMTs approach	Peer-reviewed journal article (Reference 99)	• The correlation is validated in a peer reviewed journal article. Based on its review and evaluation, the NRC staff concluded that the use of this correlation in the ANO-2 application 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 38)	• The modeling technique is validated in NUREG/CR-7010. Based on its review and evaluation, the NRC staff found the use of this correlation in the ANO-2 application acceptable.

Attachment B: Table 3.8-2, V&V Basis for Other Fire Models and Related Calculations Used at ANO-2

Model	Application at ANO-2	V&V Basis	NRC Staff Evaluation of Acceptability
CFAST (Version 6)	Development of HGL tables, and MCR abandonment time calculations	NUREG-1824 (Reference 37) NIST Special Publication 1086 (Reference 87)	• The modeling technique is validated in NUREG-1824 and NIST Special Publication 1086. Based on its review and evaluation, the NRC staff concluded that the use of this model in the ANO-2 application is acceptable.
HEATING (Version 7.3)	HEATING was used to calculate the fire resistance of conduit embedded in concrete	National research laboratory reports (Reference 100) (Reference 105) (Reference 106) (Reference 107)	• The correlation is validated in national research laboratory reports. Based on its review and evaluation, the NRC staff concluded that the use of this model in the ANO-2 application is acceptable.

Attachment C: Abbreviations and Acronyms

AC	alternating current
ADAMS	Agencywide Documents Access and Management System
AHJ	authority having jurisdiction
ANO-1	Arkansas Nuclear One, Unit 1
ANO-2	Arkansas Nuclear One, Unit 2
ANS	American Nuclear Society
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing Materials
BTP	Branch Technical Position
BWR	boiling-water reactor
CAROLFIRE	Cable Response to Live Fire
CC	Capability Category
CCDP	conditional core damage probability
CDF	core damage frequency
CEDM	control element drive mechanism
CFAST	consolidated model of fire and smoke transport
CFR	*Code of Federal Regulations*
CHRISTIFIRE	Cable Heat Release, Ignition, and Spread in Tray Installations During Fire
CPT	control power transformer
CRDM	control rod drive mechanism
DC	direct current
DESIREE-Fire	Direct Current Electrical Shorting in Response to Exposure Fire
DID	defense-in-depth
DID-RA	defense-in-depth recovery action
EEEE	existing engineering equivalency evaluation
EPRI	Electric Power Research Institute
ERFBS	electrical raceway fire barrier system
F&O	facts and observations
FAQ	frequently asked question
FDS	fire dynamics simulator
FDT	fire dynamics tool
FIVE	Fire Induced Vulnerability Evaluation Methodology
FM	fire modeling
FMRC	Factory Mutual Research Corporation
FPE	fire protection engineering
FPP	fire protection program
FPRA	fire probabilistic risk assessment
FR	*Federal Register*
FRE	fire risk evaluation
FSAR	final safety analysis report
GDC	general design criteria
GFMT	generic fire modeling treatments
GL	Generic Letter
HEP	human error probability
HGL	hot gas layer
HRA	human reliability analysis
HRE	high(er) risk evolution
HRR	heat release rate
HVAC	heating, ventilation, and air conditioning

IEEE	Institute of Electrical and Electronics Engineers
IN	Information Notice
KSF	key safety function
kW	kilowatt
LAR	license amendment request
LERF	large early release frequency
LLRWB	low level radwaste building
MCB	main control board
MCR	main control room
min	minute(s)
MSO	multiple spurious operation
NEC	National Electric Code
NEI	Nuclear Energy Institute
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NLO	Non-licensed operator
No.	number
NPO	non-power operation
NPP	nuclear power plant
NRC	U.S. Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
NSCA	nuclear safety capability assessment
NSPC	nuclear safety performance criteria
OMA	operator manual action
PAU	physical analysis unit
PB	performance-based
PCE	plant change evaluation
PCS	primary control station
PDMS	Plant Data Management System
PORV	power-operated relief valve
PRA	probabilistic risk assessment
PSA	probabilistic safety assessment
PWR	pressurized-water reactor
PWROG	Pressurized-Water Reactor Owners Group
RA	recovery action
RAI	request for additional information
RCP	reactor coolant pump
RCS	reactor coolant system
RES	Office of Nuclear Regulatory Research
RG	Regulatory Guide
RI	risk-informed
RI/PB	risk-informed, performance-based
RIS	Regulatory Issue Summary
SE	safety evaluation
SER	safety evaluation report
SFPE	Society of Fire Protection Engineers
SOKC	state of knowledge correlation
SR	supporting requirement

SSA	safe shutdown analysis
SSC	structures, systems, and components
SSD	safe shutdown
TB	turbine building
TS	Technical Specification
UFSAR	updated final safety analysis report
UL	Underwriters Laboratories
V	Volt
V&V	verification and validation (verified and validated)
VAC	Volts alternating current
VEWFDS	very early warning fire detectors
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 biweekly *Federal Register* notice.

Sincerely,

/RA/

Andrea E. George, Project Manager
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-368

Enclosures:
1. Amendment No. 300 to NPF-6
2. Safety Evaluation

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