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

May 12, 2017

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

SUBJECT: ARKANSAS NUCLEAR ONE, UNIT 2 - ISSUANCE OF AMENDMENT RE: REQUEST TO REVISE THE NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) STANDARD 805 MODIFICATIONS (CAC NO. MF8691)

Dear Sir or Madam:

The U.S. Nuclear Regulatory Commission (NRC) has issued the enclosed Amendment No. 306 to Renewed Facility Operating License (RFOL) No. NPF-6 for Arkansas Nuclear One, Unit 2 (ANO-2). The amendment consists of changes to the RFOL in response to your application dated October 27, 2016, as supplemented by letters dated December 2, 2016, and February 21, 2017.

The amendment implements a new risk-informed, performance-based fire protection licensing basis for ANO-2, with revised modifications, recovery actions, ignition frequencies, and the application of an NRC-approved fire modeling method. The amendment also updates Attachment M, "License Condition Changes"; Attachment S, "Plant Modifications and Items to be Completed during Implementation"; and Attachment W, "Fire PRA [Probabilistic Risk Assessment] Insights," of the previously approved National Fire Protection Association (NFPA) 805 amendment.

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

Sincerely,

Thomas J. Wengert, Senior Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-368

Enclosures:
1. Amendment No. 306 to NPF-6
2. Safety Evaluation

cc w/encls: Distribution via Listserv

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

ENTERGY OPERATIONS, INC.

DOCKET NO. 50-368

ARKANSAS NUCLEAR ONE, UNIT 2

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 306
Renewed License No. NPF-6

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

   A. The application for amendment by Entergy Operations, Inc. (the licensee), dated October 27, 2016, as supplemented by letters dated December 2, 2016, and February 21, 2017, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

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

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

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

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

2. Accordingly, the license is amended as indicated in the attachment to this license amendment, and portions of paragraph 2.C.(3)(b) [i.e., the first paragraph under "(b)" and Transition License Condition paragraph "2."] of Renewed Facility Operating License No. NPF-6 are 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 requests dated December 17, 2012, and October 27, 2016, and supplements dated November 7, 2013, December 4, 2013, January 6, 2014, May 22, 2014, June 30, 2014, August 7, 2014, September 24, 2014, December 9, 2014, December 2, 2016, and February 21, 2017, and as approved in the SEs dated February 18, 2015, and May 12, 2017. Except where NRC approval for changes or deviations is required by 10 CFR 50.48(c), and provided no other regulation, technical specification, license condition or requirement would require prior NRC approval, the licensee may make changes to the fire protection program without prior approval of the Commission if those changes satisfy the provisions set forth in 10 CFR 50.48(a) and 10 CFR 50.48(c), the change does not require a change to a technical specification or a license condition, and the criteria listed below are satisfied.

* * *

Transition License Conditions

* * *

2. The licensee shall implement the modifications to its facility, as described in Table S-1, "Plant Modifications," Attachment 2, of Entergy Operations, Inc. letter 2CAN101601, dated October 27, 2016, prior to startup from the second refueling outage following issuance of the Safety Evaluation. The licensee shall maintain appropriate compensatory measures in place until completion of the modifications.

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

FOR THE NUCLEAR REGULATORY COMMISSION

Robert J. Pascarelli, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

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

Date of Issuance: May 12, 2017

ATTACHMENT TO LICENSE AMENDMENT NO. 306

RENEWED FACILITY OPERATING LICENSE NO. NPF-6

ARKANSAS NUCLEAR ONE, UNIT 2

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.

Operating License

REMOVE	INSERT
4	4
6	6

(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 requests dated December 17, 2012, and October 27, 2016, and supplements dated November 7, 2013, December 4, 2013, January 6, 2014, May 22, 2014, June 30, 2014, August 7, 2014, September 24, 2014, December 9, 2014, December 2, 2016, and February 21, 2017, and as approved in the SEs dated February 18, 2015, and May 12, 2017. Except where NRC approval for changes or deviations is required by 10 CFR 50.48(c), and provided no other regulation, technical specification, license condition or requirement would require prior NRC approval, the licensee may make changes to the fire protection program without prior approval of the Commission if those changes satisfy the provisions set forth in 10 CFR 50.48(a) and 10 CFR 50.48(c), the change does not require a change to a technical specification or a license condition, and the criteria listed below are satisfied.

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.

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 2, of Entergy Operations, Inc. letter 2CAN101601, dated October 27, 2016, prior to startup from the second refueling outage following issuance of the Safety Evaluation. The licensee shall maintain appropriate compensatory measures in place until completion of the modifications.

3. The licensee shall complete the implementation items as listed in Table S-2, "Implementation Items," Attachment, 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.

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 306 TO

RENEWED FACILITY OPERATING LICENSE NO. NPF-6

ENTERGY OPERATIONS, INC.

ARKANSAS NUCLEAR ONE, UNIT 2

DOCKET NO. 50-368

1.0 INTRODUCTION

1.1 Background

On December 17, 2012 (Reference 1), Entergy Operations, Inc. (the licensee), requested to revise the Arkansas Nuclear One, Unit 2 (ANO-2), fire protection program (FPP) in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.48(c). On February 18, 2015 (Reference 2), the U.S. Nuclear Regulatory Commission (NRC or the Commission) issued Amendment No. 300 to Renewed Facility Operating License (RFOL) No. NPF-6 for ANO-2. The amendment consisted of changes to the operating license to transition the ANO-2 FPP to a risk-informed (RI), performance-based (PB) (RI/PB) FPP based on National Fire Protection Association (NFPA) 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants" (2001 Edition) (NFPA 805) (Reference 3), in accordance with 10 CFR 50.48(c). NFPA 805 allows the use of PB methods such as fire modeling (FM) and RI methods such as fire probabilistic risk assessment (FPRA) to demonstrate compliance with the nuclear safety performance criteria.

1.2 Requested Licensing Action

By application dated October 27, 2016 (Reference 4), as supplemented by letters dated December 2, 2016 (Reference 5), and February 21, 2017 (Reference 6), the licensee submitted a license amendment request (LAR) to change Fire Protection License Condition 2.C(3)(b). Transition License Condition 2.C(3)(b) was included in Amendment No. 300, which referenced Table S-1, "Plant Modifications," of the licensee's letter dated August 7, 2014 (Reference 7). Table S-1 describes the plant modifications the licensee must complete prior to startup from the second refueling outage following issuance of the safety evaluation (SE) for NFPA 805.

The supplemental letter dated February 21, 2017, provided additional information that clarified the application, did not expand the scope of the application as originally noticed, and did not change the NRC staff's original proposed no significant hazards consideration determination as published in the *Federal Register* (FR) on January 31, 2017 (82 FR 8869).

The proposed changes would revise previously approved modifications S1-1, S1-2, S1-4, S1-7, S1-8 and S1-9 as described in Table S-1, "Plant Modifications." The proposed changes are described below:

- S1-1: A separation issue was identified concerning two emergency feedwater (EFW) valves in Fire Area HH. The licensee originally proposed to relocate the interposing relays and affected cables associated with the valves from Fire Area HH, Fire Zone 2096-M to Fire Area G, Fire Zone 2098-C. The licensee revised the proposed plant modification to relocate just the relays from Fire Area HH to Fire Area B-3, Fire Zone 2091-BB, which is where the motor control centers for the affected valves are located;

- S1-2: A separation issue was identified in Fire Area JJ concerning direct current (DC) power cable control wiring for two valves. The licensee originally proposed to relocate the cable from Fire Area G to Fire Area EE-L, and separately fuse a cable in the main control room (MCR) panel. The licensee revised the proposed plant modification to instead modify the control circuits of the valves by installing new four-position switches;

- S1-4: A separation issue was identified in Fire Area TT concerning power cables for EFW, chemical volume and control system (CVCS), and service water (SW) components. The licensee originally proposed to relocate the cable from Fire Area G to Fire Area EE-L, and separately fuse the cable in the MCR panel. The licensee revised the proposed plant modification to instead modify the control circuits of these components by installing new four-position switches;

- S1-7: An issue was identified with two motor operated valves (MOVs) in Fire Area G, to meet Information Notice (IN) 92-18, "Potential for Loss of Remote Shutdown Capability during a Control Room Fire" (Reference 8). The licensee originally proposed to modify the control circuits for the two MOVs by separating the cable conductors to prevent contact with potentially energized conductors. The licensee revised the proposed plant modification to instead use interposing relays to ensure hot shorts will not bypass the valve torque switches.

- S1-8: An issue was identified regarding the spurious opening of an MOV from a fire. The licensee originally proposed to modify the control circuits for the MOV by separating the cable conductors to prevent contact with potentially energized conductors. The licensee revised its proposed change to instead install an inhibit circuit to prevent spurious operation. The licensee also proposed to change the description of the valve from "pressurizer low temperature – overpressure (LTOP) relief" to "RCS [Reactor Coolant System] Pressurizer Emergency Core Cooling Vent Valve."

- S1-9: An issue was identified regarding the fire impacts of two solenoid valve control circuits in Fire Area G. The licensee proposed to modify the control circuits by installing a grounded metallic sleeve and/or barriers to prevent a conductor of a certain cable from contacting energized conductors. The licensee revised the proposed plant modification to instead install an inhibit circuit for each of the valves utilizing an existing spare closed contact in the CLOSE-OPEN control switch.

In addition to the proposed changes to modifications identified in the Table S-1 items listed above, the licensee is proposing to make the following additional changes to the data and methods used in the probabilistic risk assessment (PRA):

- Use the mean value for Bin 9 ignition frequencies from NUREG/CR-6850, Supplement 1, "Fire Probabilistic Risk Assessment Methods Enhancements" (Reference 9), instead of the Bayesian statistical update based on an incorrect alpha term.

- Remove the motors less than or equal to 5 horsepower (Bins 14, 21, and 26) and transformers less than or equal to 45 kilovolt-amperes (kVA) (Bin 23) from the ignition frequency analysis, and consequently remove the corresponding fire scenarios.

- Add a new recovery action (RA) in Fire Area JJ for the safety parameter display system (SPDS) instrumentation.

- Add a dual unit MCR abandonment scenario to the fire risk results.

- Use the fire dynamics simulator (FDS) to analyze the thermal response of an electrical cable associated with the power supply to the conditioning cabinet that sends the instrumentation signals to the control room and to the SPDS.

- Request the use of a PB method to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features required by NFPA 805.

2.0 REGULATORY EVALUATION

The following regulations address fire protection:

- Section 50.48(a)(1) of 10 CFR requires that each holder of an operating license have a fire protection plan that satisfies General Design Criterion (GDC) 3, "Fire Protection," of Appendix A to 10 CFR 50, "General Design Criteria for Nuclear Power Plants."

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

- Appendix A to 10 CFR Part 50, GDC 3, states, in part, that:

> 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 are designed to assure that their rupture or inadvertent operation does not significantly impair the safety capability of these structures, systems, and components.

Section 50.48, "Fire protection," of 10 CFR, provides the NRC requirements for nuclear power plant fire protection. The NRC regulations include specific requirements for requesting approval for an RI/PB FPP based on the provisions of NFPA 805.

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 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.

Paragraph 50.48(c)(3)(i) of 10 CFR states, in part, that:

> A licensee may maintain a fire protection program that complies with NFPA 805 as an alternative to complying with [10 CFR 50.48(b)] for plants licensed to operate before January 1, 1979, or the fire protection license conditions for plants licensed to operate after January 1, 1979. The licensee shall submit a request to comply with NFPA 805 in the form of an application for license amendment under § 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.

Pursuant to 10 CFR 50.90, whenever a holder of a license desires to amend the license or permit, an application for an amendment must be filed with the Commission describing the changes desired, and following, as far as applicable, the form prescribed for original applications. Accordingly, a licensee who seeks to amend its NFPA 805 authorizations must file an amendment stating, as applicable, the desired changes to orders, license conditions, and technical specifications.

In addition, 10 CFR 50.48(c)(3)(i) states, in part, 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 licensee has identified orders, license conditions, and the technical specifications that must be revised or superseded, and that any necessary revisions are adequate. Any approval by the Director or the designee must be in

> the form of a license amendment approving the use of NFPA 805 together with any necessary revisions to the technical specifications.

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

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

Pursuant to 10 CFR 50.92(a), in determining whether an amendment to a license will be issued to the applicant, the Commission will be guided by the considerations, which govern the issuance of initial licenses to the extent applicable and appropriate. Under 10 CFR 50.40, common standards for issuance of licenses include considerations of safety and satisfaction of the requirements of the National Environmental Policy Act of 1969 as implemented in 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." Under 10 CFR 50.57(a), to issue an operating license, the Commission must find, among other things, that (1) there is reasonable assurance that the activities authorized by the operating license can be conducted without endangering the health and safety of the public; (2) there is reasonable assurance that such activities will be conducted in compliance with the regulations in this chapter; and (3) the issuance of the license will not be inimical to the common defense and security or to the health and safety of the public. Additional findings required to issue amendments related to fire protection are provided in 10 CFR 50.48, as discussed below.

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

> The Director of the Office of Nuclear Reactor Regulation, or a designee of the Director, may approve the application if the Director or designee determines that the performance-based approach;

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

(B) Maintains safety margins; and

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

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

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

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

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

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

> Protecting the safety of the public, the environment, and plant personnel from a plant fire and its potential effect on safe reactor operations is paramount to this standard. The fire protection standard shall be based on the concept of defense-in-depth. Defense-in-depth shall be achieved when an adequate balance of each of the following elements is provided:
>
> (1) Preventing fires from starting;

(2) Rapidly detecting fires and controlling and extinguishing promptly those fires that do occur, thereby limiting fire damage; and

(3) Providing an adequate level of fire protection for structures, systems and components important to safety, so that a fire that is not promptly extinguished will not prevent essential plant safety functions from being performed.

In addition, in accordance with 10 CFR Part 50, Appendix A, GDC 3, fire detection and fighting systems must be designed such that their rupture or inadvertent operation does not significantly impair the ability of the structures, systems, and components important to safety to perform their intended safety functions.

In addition, 10 CFR 50.32, "Elimination of repetition," states, in part, that the applicant may incorporate by reference information contained in previous applications, statements or reports filed with the Commission: *Provided*, That such references are clear and specific.

2.1 Applicable Staff Guidance

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

- RG 1.205, Revision 1 (Reference 10), 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. 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 Nuclear Energy Institute (NEI) 04-02, "Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c)," (Reference 11), and provides exceptions to the NEI-04-02 guidance where required. Should a conflict occur between NEI 04-02 and this RG, the regulatory positions in RG 1.205 govern.

- 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 12), 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.

- NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities," Volumes 1 and 2 and Supplement 1, September 2005 and September 2010, respectively (Reference 13), (Reference 14), and (Reference 9), presents a compendium of methods, data, and tools to perform an FPRA and develop associated insights.

3.0 TECHNICAL EVALUATION

3.1 Maintaining Defense-in-Depth and Safety Margins

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

3.1.1 Defense-in-Depth (DID)

As a supplement to the definition of DID provided in NFPA 805, Section 1.2, the NRC-endorsed guidance in NEI 04-02, Section 5.3.5.2, states, in part, that:

> In general, the defense-in-depth requirement is satisfied if the proposed change does not result in a substantial imbalance in:
>
> - Preventing fires from starting;
> - Detecting fires quickly and extinguishing those that do occur, thereby limiting fire damage; and
> - Providing 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.

3.1.2 Safety Margins

Although not a part of the requirements of NFPA 805, and thus not required under 10 CFR 50.48(c), NFPA 805, Appendix A, Section A.2.4.4.3, provides the following background related to the meaning of the term "safety margins":

> An example of maintaining sufficient safety margins occurs when the existing calculated margin between the analysis and the performance criteria compensates for the uncertainties associated with the analysis and data. Another way that safety margins are maintained is through the application of codes and standards. Consensus codes and standards are typically designed to ensure such margins exist.

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

- Codes and standards or their alternatives accepted for use by the NRC are met; and,
- Safety analysis acceptance criteria in the licensing basis (e.g., FSAR [Final Safety Analysis Report], supporting analyses) are met, or provides sufficient margin to account for analysis and data uncertainty.

3.2 Discussion

Amendment No. 300 to RFOL No. NPF-6 for ANO-2 implemented the licensee's transition to an RI/PB FPP based on NFPA 805, in accordance with 10 CFR 50.48(c). As part of the transition license condition in 2.C(3)(b), the licensee must complete certain plant modifications as listed in Attachment S, Table S-1, of the licensee's letter dated August 7, 2014 (Reference 7), prior to startup from the second refueling outage following issuance of the SE. The SE was issued on February 18, 2015 (Feb 2015 SE) (Reference 2). As noted in the licensee's October 27, 2016, application, ANO-2 cannot restart the plant from the spring 2017 outage until all stated NFPA 805 requirements have been met.

The proposed changes would revise previously approved modifications S1-1, S1-2, S1-4, S1-7, S1-8 and S1-9, as described in Table S-1, "Plant Modifications." The proposed changes are described below:

- S1-1: A separation issue was identified concerning two EFW valves in Fire Area HH. The licensee originally proposed to relocate the interposing relays and affected cables associated with the valves from Fire Area HH, Fire Zone 2096-M to Fire Area G, Fire Zone 2098-C. The licensee revised the proposed plant modification to relocate just the relays from Fire Area HH to Fire Area B-3, Fire Zone 2091-BB, which is where the motor control centers for the affected valves are located;

- S1-2: A separation issue was identified in Fire Area JJ concerning DC power cable control wiring for two valves. The licensee originally proposed to relocate the cable from Fire Area G to Fire Area EE-L, and separately fuse a cable in the MCR panel. The licensee revised the proposed plant modification to instead modify the control circuits of the valves by installing new four-position switches;

- S1-4: A separation issue was identified in Fire Area TT concerning power cables for EFW, CVCS, and SW components. The licensee originally proposed to relocate the cable from Fire Area G to Fire Area EE-L, and separately fuse the cable in the MCR panel. The licensee revised the proposed plant modification to instead modify the control circuits of these components by installing new four-position switches;

- S1-7: An issue was identified with two MOVs in Fire Area G, to meet IN 92-18 (Reference 8). The licensee originally proposed to modify the control circuits for the two MOVs by separating the cable conductors to prevent contact with potentially energized conductors. The licensee revised the proposed plant modification to instead use interposing relays to ensure hot shorts will not bypass the valve torque switches.

- S1-8: An issue was identified regarding the spurious opening of an MOV from a fire. The licensee originally proposed to modify the control circuits for the MOV by separating the cable conductors to prevent contact with potentially energized conductors. The licensee revised its proposed change to instead install an inhibit circuit to prevent spurious operation. The licensee also proposed to change the description of the valve from "pressurizer low temperature – overpressure (LTOP) relief" to "RCS Pressurizer Emergency Core Cooling Vent Valve."

- S1-9: An issue was identified regarding the fire impacts of two solenoid valve control circuits in Fire Area G. The licensee proposed to modify the control circuits by installing

a grounded metallic sleeve and/or barriers to prevent a conductor of a certain cable from contacting energized conductors. The licensee revised the proposed plant modification to instead install an inhibit circuit for each of the valves utilizing an existing spare closed contact in the CLOSE-OPEN control switch.

The licensee stated that the plant modifications have been evaluated using the accepted FPRA methods and approaches as summarized in the Feb 2015 SE. Pursuant to 10 CFR 50.32, the NRC staff concludes that the LAR adequately incorporates by reference the same methods and approaches as those used in support of Amendment No. 300 for ANO-2, and, therefore, a description of the methods and approaches need not be included in the licensee's October 27, 2016 (Reference 4), application for the changes to the modifications. Additionally, because the NRC staff found these methods and approaches acceptable for evaluating changes to the FPP as described in the Feb 2015 SE, the NRC staff assessment of the modification changes in this proposed license amendment need not reevaluate the approved methods and approaches. The methods and approaches previously used by the licensee can be found in the licensee's LAR to adopt NFPA 805 dated December 17, 2012 (Reference 1), and subsequent related submittals as described the Feb 2015 SE (Reference 2).

The licensee is proposing to make the following additional changes to the data and methods used in the PRA:

- Use the mean value for Bin 9 ignition frequency from NUREG/CR-6850, Supplement 1, instead of the Bayesian statistical update based on an incorrect alpha term.

- Remove the motors less than or equal to 5 horsepower (Bins 14, 21, and 26) and transformers less than or equal to 45 kVa (Bin 23) from the ignition frequency analysis, and consequently remove the corresponding fire scenarios

- Add a new RA in Fire Area JJ for the SPDS Instrumentation.

- Add a dual unit MCR abandonment scenario to the fire risk results.

- Use FDS to analyze the thermal response of an electrical cable associated with the power supply to the conditioning cabinet that sends the instrumentation signals to the control room and to the SPDS.

- Request the use of a PB method to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features required by NFPA 805.

The licensee stated that it used the FDS computer code to evaluate an impact on instrumentation that was not evaluated in the original NFPA 805 application. The NRC staff considers the use of FDS at ANO-2 a change that utilizes a PRA method and approach that has been used by other licensees to transition to NFPA 805 and has been accepted in the associated SE. To facilitate a prompt and efficient review by the NRC staff, applicants using these types of methods and approaches should include the following information:

1. A summary of all accepted PRA methods being used that weren't used in the original NFPA 805 amendment request and a reference to the NRC document accepting the method;

2. A demonstration of the applicability of the accepted method for the configuration and conditions to which it is being applied;

3. A summary of the changes made to the Nuclear Safety Capability Analysis and associated changes to LAR Attachments C and G that reflect any changes in compliance strategies being used on a fire area basis in redline/strikeout; and

4. Justification for the creation of new and/or removal of previously existing variance from deterministic requirements (VFDRs) and RAs.

3.3 S1-1: Fire Area HH, Separation Issue, EFW Valves 2CV-1026-2 and 2CV-1076-2

In its LAR to adopt NFPA 805, dated December 17, 2012 (Reference 1), the licensee included modification S1-1 to relocate relays and affected cables associated with 2CV-1026-2 and 2CV-1076-2 from Fire Area HH, Fire Zone 2096-M, to Fire Area G, Fire Zone 2098-C.

The proposed new modification will relocate the relays to Fire Zone 2091-BB instead of 2096-M, and the cables will not be rerouted.

3.3.1 Risk Evaluation

In Table 3 of the licensee's letter dated February 21, 2017 (Reference 6), the transition change-in-risk associated with modification S1-1 is shown to decrease slightly. In its letter dated December 2, 2016 (Reference 5), the licensee explained why fewer modifications resulted in a decrease in the transition change-in-risk. The licensee clarified that fires in Fire Zone 2091-BB currently fail the valves' motor control centers (MCCs), which fails the valves. Moving the relays to the same fire zone does not increase the transition change-in-risk for the zone because the valves already fail from damage to the MCCs during a fire. Conversely, the transition change-in-risk in Fire Zone 2096-M decreased because new targets (i.e., the relays) were not added to the zone. Although not rerouting the cables could increase the transition change-in-risk from the retained VFDR, the licensee reported that the net result is the observed slight reduction in transition change-in-risk.

Evaluation of the risk from fires on relays and cables is an integral task in fire risk analysis and the licensee demonstrated its capability to perform these analyses using acceptable methods in its LAR to transition to NFPA 805 LAR, as supplemented, which was reviewed and approved by the NRC staff in the Feb 2015 SE. The NRC staff concludes that the licensee's evaluation of the proposed revised modification used the methods described in the ANO-2 PRA used to transition to NFPA 805, and therefore, the risk results using this method can be used to update the change-in-risk evaluation.

3.3.2 Defense-in-Depth/Safety Margins

The licensee stated that the revision to the modification continues to ensure the original intent of the modifications, reduces the risk impact originally credited for this modification, and has no impact on any of the DID echelons, which are to: 1) Prevent fires from starting; 2) Rapidly detect, control and extinguish promptly those fires that do occur, thereby preventing fire damage; and 3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed.

The licensee stated that adequate safety margin is maintained because the codes and standards used have been accepted for use by the NRC and the changes do not impact any safety analysis acceptance criteria used in the licensing basis. The licensee further stated that these codes and standards were applied in a manner that would provide FPRA results that contain and complement safety margin and that the bases for the application of these FPRA codes and standards were not altered to support this fire risk evaluation (FRE).

3.3.3 Conclusion for Section 3.3

Based on the above, the NRC staff concludes that the licensee's revision of modification S1-1 to relocate the relays associated with 2CV-1026-2 and 2CV-1076-2 from Fire Area HH, Fire Zone 2096-M, to Fire Area B-3, Fire Zone 2091-BB, where the MCCs for the affected valves are located is acceptable because the licensee assessed DID and safety margin in accordance with NFPA 805, Section 4.2.4.2, and demonstrated that DID and safety margins, as developed in the original LAR, are maintained. The NRC staff also finds that the licensee evaluated the new configuration using acceptable methods and therefore, the risk results can be used to update the change-in-risk evaluation.

3.4 S1-2: Fire Area JJ, Separation Issue, DC Power Cables Control Wiring; S1-4: Fire Area TT, Separation Issue, Power Cables for EFW, CVCS, and SW Components

In its LAR to adopt NFPA 805, dated December 17, 2012, the licensee included modifications S1-2 and S1-4 for 2CV-4816 and 2CV-4817 to reroute cable 2I016N by using embedded conduit C4080, which is located between Fire Area G (cable spreading room) and Fire Area EE-L, to relocate the cable from Fire Area G to Fire Area EE-L. In addition, the licensee also planned to separately fuse cable 2I016N in MCR panel 2C-09 to prevent failure of 2I016N caused by failure of cable 2I016P.

The proposed new modification will alter the control circuits for the subject valves by replacing switch 2HS-4817 with a new four-position switch in MCR panel 2C09 instead of rerouting cable 2I016N and fusing cable 2I016P.

The licensee stated that the new switch configuration allows the operator to place the switch in the CLOSE position to isolate the transducer and its field cable from the controller, and bond the positive and negative conductors of the current loop to each other, and that this arrangement de-energizes the target cable eliminating intractable faults as a potential failure, prevents spurious operation of the controller from opening the valve, and provides protection from postulated intercable faults.

The licensee also stated that bonding of the positive and negative conductors to each other by closing 2HS-4817 places both at the same potential and should not allow the creation of a current flow in the event of the multiple proper polarity intercable hot short. The licensee explained that, based upon the multiple failures required, the sensitivity of the transducer electronics to failure, and the bonding of target cable conductors by closing 2HS-4817 preventing a flow of current, the fire-induced spurious operation of the transducers, which could open the valves, is not credible. The licensee stated that this modification eliminates circuit impacts in Fire Areas TT, JJ, and EE-U.

3.4.1 Risk Evaluation

In Table 3 of the licensee's letter dated February 21, 2017, the transition change-in-risk associated with modifications S1-2 and S1-4 is shown to decrease slightly. In its letter dated December 2, 2016, the licensee stated that the transition change-in-risk decreased because the spurious failures of 2CV-4816 and 2CV-4817 were removed from the scenarios, which were previously assumed to fail.

The licensee stated that its new control circuit modification would prevent spurious operation of the transducers that could open the valves and therefore, remove the spurious operation reducing the transition change-in-risk. Based on the licensee's statements, the NRC staff finds that the licensee's replacement modification eliminates some spurious operation failures. Evaluation of the risk from fires on relays and cables is an integral task in fire risk analysis and the licensee demonstrated its capability to perform such analyses in its NFPA 805 LAR, as supplemented. The NRC staff finds that the licensee identified and evaluated the new configuration using acceptable methods as described in its NFPA 805 LAR and the NRC staff's Feb 2015 SE, and therefore, the risk results can be used to update the change-in-risk evaluation.

3.4.2 Defense-In-Depth/Safety Margin

The licensee stated that the originally planned modification to relocate cabling associated with 2CV-4816 and 2CV-4817 to Fire Area EE-L, provided assurance that a fire in Fire Areas TT, JJ, or EE-U would not impact the operation of these valves. The licensee indicated that the revision to this modification continues to ensure the original intent of all of the modifications, reduces the risk impact below that originally credited for this modification, and has no impact on any of the DID echelons, which are to: 1) Prevent fires from starting; 2) Rapidly detect, control and extinguish promptly those fires that do occur, thereby preventing fire damage; and 3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed.

The licensee stated that adequate safety margin is maintained because the codes and standards used have been accepted for use by the NRC and the changes do not impact any safety analysis acceptance criteria used in the licensing basis. The licensee further stated that these codes and standards were applied in a manner that would provide FPRA results that contain and complement safety margin, and that the bases for the application of these FPRA codes and standards were not altered in support of this FRE.

3.4.3 Conclusion for Section 3.4

Based on the above, the NRC staff concludes that the licensee's proposed change of installing a four position switch is acceptable because the licensee assessed DID and safety margin in accordance with NFPA 805, Section 4.2.4.2, and demonstrated that DID and safety margins, as developed in the original LAR, are maintained. The NRC staff also finds that the licensee evaluated the new configuration using acceptable methods and therefore, the risk results can be used to update the change-in-risk evaluation.

3.5 S1-7: Fire Area G, MOV Modifications to Meet Information Notice 92-18

In its LAR to adopt NFPA 805, dated December 17, 2012, the licensee included modification S1-7 for 2CV-1075-1 and 2CV-1036-2 to separate the cable conductors, inclusive of internal

panel wiring, and also protecting them with suitable barriers to prevent inadvertent energizing of target conductors. The licensee further stated that for MOV 2CV-1075-1, control cables R2B53J2C and R2B53J2N that enter panel 2C-17 or 2C-9 from floor penetrations have been identified as the cables of concern applicable to this modification, and that for MOV 2CV-1036-2, control cable G2B63H1E that enters panel 2C-40 from a floor penetration has been identified as the cable of concern applicable to this modification.

The proposed new modification will prevent inadvertent energizing of cable conductors by the use of interposing relays to ensure hot shorts will not bypass the valve torque switches, instead of by separation and added barriers. The licensee stated that this will ensure hot shorts will not bypass the valve torque switches, and therefore, the cables to and from the MCR (where the interposing relays are located) no longer maintain a fire-induced adverse impact. Therefore, the interposing relays will be installed instead of separating and protecting cable conductors.

3.5.1 Risk Evaluation

In Table 3 of the licensee's letter dated February 21, 2017, the transition change-in-risk associated with modification S1-7 is shown to decrease slightly. In its letter dated December 2, 2016, the licensee stated that the revised modification uses interposing relays to ensure hot shorts will not bypass the valve torque switches. Therefore, the cables to and from the MCR (where the interposing relays are located) no longer have a fire-induced adverse impact.

The licensee stated that its new control circuit modification will ensure hot shorts will not bypass the valve torque switches for EFW valves 2CV-1036-2 and 2CV-1075-1 control cables. The licensee further stated that this modification prevents non-recoverable valve position failures for all fires except those in the vicinity of the interposing relays, and that local operation of these valves is not credited for a fire in the vicinity of the interposing relays. Based on the licensee's statements, the NRC staff finds that the licensee's revised modification eliminates some fire-induced circuit failures. Evaluation of the risk from fires on relays and cables is an integral task in fire risk analysis and the licensee demonstrated its capability to perform such analyses in its NFPA 805 LAR, as supplemented. The NRC staff finds that the licensee identified and evaluated the new configuration using acceptable methods as described in its NFPA 805 LAR and the NRC staff's Feb 2015 SE, and therefore, the risk results can be used to update the change-in-risk evaluation.

3.5.2 Defense-in-Depth/Safety Margins

The licensee stated that the proposed change to the modification continues to ensure the original intent of the modifications, reduces the risk impact below that originally credited for this modification, and has no impact on any of the DID echelons, which are to: 1) Prevent fires from starting; 2) Rapidly detect, control and extinguish promptly those fires that do occur, thereby preventing fire damage; and 3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed.

The licensee stated that adequate safety margin is maintained because the codes and standards used have been accepted for use by the NRC and the changes do not impact any safety analysis acceptance criteria used in the licensing basis. The licensee further stated that these codes and standards were applied in a manner that would provide FPRA results that contain and complement safety margin and that the bases for the application of these FPRA codes and standards were not altered in support of this FRE.

3.5.3 Conclusion for Section 3.5

Based on the above, the NRC staff concludes that the licensee's proposed change of not separating cables and, instead, installing interposing relays to ensure hot shorts will not bypass the valve torque switches for 2CV-1075-1 and 2CV-1036-2 is acceptable because the licensee assessed the DID and safety margin in accordance with NFPA 805, Section 4.2.4.2, and demonstrated that DID and safety margins, as developed in the original LAR, are maintained. The NRC staff also finds that the licensee evaluated the new configuration using acceptable methods and therefore, the risk results can be used to update the change-in-risk evaluation.

3.6 S1-8: Fire Areas B-3 and G, Spurious Opening of an MOV

In its LAR to adopt NFPA 805, dated December 17, 2012, the licensee included modification S1-8 for MOV 2CV-4698-1 to separate cable conductors, inclusive of internal panel wiring, and also to protect them with suitable barriers to prevent inadvertent energizing of target conductors. The licensee further stated that control cable R2D27A3J, which enters MCC 2D-27 in Fire Area B-3 and the other end of cable that enters cabinet 2C-09 in Fire Area G from the floor penetrations, has been identified as the cable of concern applicable to this modification.

The new modification will prevent inadvertent energizing of cable conductors by installing an inhibit circuit to prevent spurious operation in the event of a fire-induced short circuit. The licensee further stated that the failure of this inhibit switch circuit is quantified in the same manner as that addressed in the ANO, Unit 1 (ANO-1) NFPA 805 application.

The licensee also proposed to change the description of the valve from "pressurizer low temperature – overpressure (LTOP) relief" to "RCS Pressurizer Emergency Core Cooling Vent Valve." The NRC staff finds this change acceptable because it is a change in name only and is a more accurate description of the valve than was previously provided. The other change to S1-8 is evaluated below.

3.6.1 Risk Evaluation

In Table 3 of the licensee's letter dated February 21, 2017, the transition change-in-risk associated with modification S1-8 is shown to increase slightly. In its letter dated December 2, 2016, the licensee stated that the revised modification uses an inhibit circuit instead of cable separation and protection.

The licensee stated that the inhibit circuit utilizes an existing spare closed contact in the CLOSE-OPEN control switch to effectively ground the valve opening circuit except when the control switch is moved to the OPEN position. A fire-induced circuit failure will result in a short-to-ground through the closed contact. This will prevent a cable failure from causing spurious operation of the valve.

The licensee further stated that the risk evaluation associated with the new modification design used the same methodology as that used in the ANO-1 NFPA 805 application, including associated responses to NRC requests for additional information (RAIs) dated August 12, 2015 (Reference 15), November 4, 2015 (Reference 16), and January 15, 2016 (Reference 17), and subsequently approved in the associated NRC SE for ANO-1 dated October 7, 2016 (Reference 18). Consistent with the ANO-1 analysis, fires outside the cabinet that impact cabling associated with the inhibit circuits assumed a hot short failure probability of 1E-03 in the event DC power cables (fused greater than 10 amps) are routed in the same cable trays. Fires inside

the cabinet were assumed to cause spurious operation using the guidance in NUREG-7150, "Joint Assessment of Cable Damage and Quantification of Effects from Fire (JACQUE-FIRE)," Volumes 1 and 2, (Reference 19) and (Reference 20), hot short probability.

The NRC staff finds that the licensee used a previously acceptable method, which it used before for ANO-1, to assess the transition change-in-risk, including the new modification, and therefore, the risk results can be used to update the change-in-risk evaluation.

3.6.2 Defense-in-Depth/Safety Margins

The licensee stated that the originally planned modification to 2CV-4698-1 prevented fire-induced spurious operation, and that the proposed change to the modification results in a small risk increase but continues to ensure the original intent of the modifications, and has no impact on any of the DID echelons, which are to: 1) Prevent fires from starting; 2) Rapidly detect, control and extinguish promptly those fires that do occur, thereby preventing fire damage; and 3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed.

The licensee stated that adequate safety margin is maintained because the codes and standards used have been accepted for use by the NRC and the changes do not impact any safety analysis acceptance criteria used in the licensing basis. The licensee further stated that the codes and standards were applied in a manner that would provide FPRA results that contain and complement safety margin, and that the bases for the application of these FPRA codes and standards were not altered in support of this FRE.

3.6.3 Conclusion for Section 3.6

Based on the above, the NRC staff concludes that the licensee's proposed change of not separating cable conductors and instead installing an inhibit circuit to prevent spurious operating in the event of a fire-induced short circuit is acceptable because the licensee assessed DID and safety margin in accordance with NFPA 805, Section 4.2.4.2, and demonstrated that DID and safety margins, as developed in the original LAR, are maintained. The NRC staff also finds that the licensee evaluated the new configuration using acceptable methods and therefore, the risk results can be used to update the change-in-risk evaluation.

3.7 S1-9: Spurious Operation of Reactor Coolant System High Point Vent Valves

In its LAR to adopt NFPA 805, dated December 17, 2012, the licensee included modification S1-9 to modify the reactor coolant system vent solenoid valve control circuits with the installation of metallic sleeves and/or barriers, to eliminate impacts from fire in Fire Area G. The revised proposed modifications are described below:

> 2SV-4670-2 – A modification to the control circuit in cabinet 2C-336-2 is planned to prevent conductor (wire P3) of cable G2SI122E from contacting energized conductors by installing a grounded metallic sleeve and/or barriers up to load side of hand-switch 2HS-4670-2.
>
> 2SV-4669-1 – A modification to the control circuit in cabinet 2C-336-1 is planned to prevent conductor (wire P3) of cable R2SI121E from contacting energized conductors by installing a grounded metallic sleeve and/or barriers up to load side of hand-switch 2HS-4669-1.

The new modification would modify the valves' control circuits by installing an inhibit circuit in each to prevent spurious operation in the event of a fire-induced short circuit. Metallic sleeves and/or barriers will not be installed. The licensee stated that the inhibit circuit will utilize a (currently) spare closed contact in the CLOSE/OPEN control switch to effectively ground the valve opening circuit except when the control switch is moved to the OPEN position.

3.7.1 Risk Evaluation

In Table 3 of the licensee's letter dated February 21, 2017, the change in the transition change-in-risk associated with modification S1-9 was described as "no more than minimal." In its letter dated December 2, 2016, the licensee summarized the reactor coolant system vent solenoid valve configuration and the new spurious operation scenarios developed for the risk assessment. The licensee stated that risk of the new modification was calculated using the same methodology as that used in the ANO-1 RAI response for inhibit circuits, and approved in the associated SE.

The licensee did not provide changes in core damage frequency (CDF) and large early release frequency (LERF), or changes in transition change-in-risk, associated with the change to this modification. Instead the licensee stated that the risk impact of this modification change is "considered no more than minimal."

The NRC staff finds that the licensee used a previously acceptable method that it used before at ANO-1 to assess the transition change-in-risk, including the new modification, and therefore, the risk results can be used to update the change-in-risk evaluation.

3.7.2 Defense-in-Depth/Safety Margins

The licensee stated that the proposed change to the modification continues to ensure the original intent of the modification, has no more than minimal risk impact with respect to that originally credited for this modification, and has no impact on any of the DID echelons, which are to: 1) Prevent fires from starting; 2) Rapidly detect, control and extinguish promptly those fires that do occur, thereby preventing fire damage; and 3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed.

The licensee stated that adequate safety margin is maintained because the codes and standards used have been accepted for use by the NRC and the changes do not impact any safety analysis acceptance criteria used in the licensing basis. The licensee further stated that these codes and standards were applied in a manner that would provide FPRA results that contain and complement safety margin and that the bases for the application of these FPRA codes and standards were not altered in support of this FRE.

3.7.3 Conclusion for Section 3.7

Based on the above, the NRC staff concludes that the licensee's proposed change of not installing a grounded metallic sleeve and/or barriers, and instead installing an inhibit circuit to prevent spurious operation in the event of a fire-induced short circuit is acceptable because the licensee assessed the DID and safety margin in accordance with NFPA 805, Section 4.2.4.2, and demonstrated that DID and safety margins, as developed in the original LAR, are maintained. The NRC staff also finds that the licensee evaluated the new configuration using

acceptable methods and therefore, the risk results can be used to update the change-in-risk evaluation.

3.8 Additional Changes to the PRA

The licensee proposed to make several additional changes to the data and methods used in support of its RI FPP. Two changes are proposed in response to the June 14, 2016, ANO Triennial Fire Inspection (Reference 21), Severity Level IV non-cited violation of License Condition 2.C(3)(b), "Fire Protection," for the failure to properly implement the RI/PB FPP and accurately capture component ignition frequencies in the FPRA. Four additional changes are described in the October 27, 2016, LAR. The NRC staff evaluation of the remaining changes included in the LAR is discussed below.

3.8.1 Revise the Bayesian Statistical Update for Bin 9 Ignition Frequencies

In its LAR to adopt NFPA 805, dated December 17, 2012, the licensee included the results of a Bayesian statistical update that was performed using the Bin 9 alpha term from NUREG/CR-6850, Supplement 1, in the ANO-2 FPRA analysis; however, NUREG/CR-6850, Supplement 1, Page 10-2, indicates that the Bin 9 alpha value appears to be an error and thus, should not be used for the Bayesian update. The licensee stated that the NRC staff identified this error (in the licensee's analysis) during the recent ANO-2 triennial fire inspection and that in order to correct the analysis, the mean value for the Bin 9 ignition frequency from NUREG/CR-6850, Supplement 1, has now been incorporated (i.e., no Bayesian update performed) and the corrected ignition frequency was used to calculate the results provided in its application dated October 27, 2016. The NRC staff finds this acceptable because the values and methods in NUREG/CR-6850, Supplement 1, have been incorporated into the PRA.

3.8.2 Remove the Motors Less Than or Equal to 5 Horsepower (Bins 14, 21, and 26) and Transformers Less Than or Equal to 45 kVA (Bin 23) from the Ignition Frequency Analysis, and Consequently Remove the Corresponding Fire Scenarios

The licensee stated that the NRC staff identified that some 5 horsepower motors were included in development of ignition frequencies, contrary to the criteria established in NUREG/CR-6850 (including Supplement 1). The licensee further stated that the impact of this inconsistency has not yet been documented for ANO-2 due to resource loading, however, a sensitivity analysis was performed in support of the ANO-1 transition to NFPA 805 and the results reflected that the removal of the scenarios associated with the inappropriate ignition sources more than offset the increase in risk for the revised ignition frequency. Therefore, this issue is not expected to impact the results in a significant manner. However, since ANO-1 is not similar to ANO-2 and the results from one unit do not automatically apply to the other, the NRC staff requested a sensitivity analysis for ANO-2. The licensee performed a sensitivity study consistent with Chapter 6 of NUREG/CR-6850, Supplement 1, and Frequently Asked Question (FAQ) 07-0031 (Reference 22), and included only electric motors, pumps, and ventilation systems (Bins 14, 21, and 26) greater than 5 horsepower and only transformers greater than 45 kVA (Bin 23), and eliminated scenarios from those removed ignition sources from the analysis. The NRC staff finds the analysis acceptable because it removed the appropriate ignition sources from the ignition frequency analysis using acceptable methods and removed the corresponding fire scenarios in the PRA.

3.8.3 New Recovery Action

In its LAR to adopt NFPA 805, dated December 17, 2012, as supplemented by its letter dated August 7, 2014, the licensee included RAs in LAR Attachment G. The licensee stated that a new RA, shown in Table 1 below, is being added to the previous listing and incorporated into the FPRA.

Table 1

Fire Area	Component	Component Description	Actions	VFDR	RA/PCS
JJ	2C384	SPDS Instrumentation	Reenergize 2D-02 and 2C384 by using battery charger 2D-32B and aligning its alternating current input to red train MCC 2B-54 using manual transfer switch 2S-22 located in Fire Zone 2100-Z.	JJ-06	RA

The licensee also indicated a change to Part b) of the associated VFDR Disposition contained in LAR Attachment C (Reference 1), as follows:

b) RA to restore power to 2D32B. No further actions required for 2D32B and 2D32A.

In its letter dated December 2, 2016, the licensee explained that the ANO-2 FPRA model originally assumed instrumentation was available for the emergency diesel generator corridor in Fire Area JJ. However, the only power supply to the instrument bus is fed from the green train battery bank. As a result, absent an operator action to transfer the power supply to a red train source, the instrument bus would de-energize upon battery depletion.

The licensee further stated the analysis now accounts for operator action to transfer the power supply to the alternate red train source. The incorporation of this operator action to maintain power to the instrument bus increases the risk and adds an RA to mitigate this failure. In its letter dated February 21, 2017, the licensee stated that the process for evaluating the feasibility and quantification of this operator action was consistent with that used for calculating other RAs in the LAR and is in accordance with NUREG-1921, "EPRI/NRC-RES Fire Human Reliability Analysis Guidelines" (Reference 23), which was approved in the ANO-2 NFPA 805 SE. The NRC staff finds this change acceptable because the evaluation and quantification of this human action to the PRA model follows NUREG-1921, and was accepted in the Feb 2015 SE.

3.8.4 Dual Unit Main Control Room Abandonment

The licensee stated that it added a dual unit MCR abandonment scenario to the overall ANO-2 fire risk results to ensure that the ANO-1 and ANO-2 NFPA 805 LAR submittals are consistent in assumptions relating to MCR abandonment scenarios.

The licensee stated that the potential for dual unit MCR abandonment and a hot gas layer reaching sensitive electronic damage thresholds from a fire originating in the opposite unit control room (ANO-1) has been evaluated for its impacts on the ANO-2 analysis, consistent with the evaluation performed for the ANO-1 transition to NFPA 805 documented in its letter dated March 25, 2016 (Reference 24). As in the ANO-1 analysis, the licensee stated that the ANO-2

analysis conservatively assumes a conditional core damage probability of 1.0 for dual MCR abandonment due to the potential for inadequate manpower for dual unit fire damage shutdown. In the ANO-1 NFPA 805 SE dated October 7, 2016 (Reference 18), the NRC staff concluded that the licensee's MCR abandonment analysis resulted in consistency with plant conditions and the guidance contained in NUREG/CR-6850. Therefore, the NRC staff finds that its application to the ANO-2 analysis is acceptable.

As a part of the risk summary in the LAR, the licensee stated that dual unit MCR abandonment scenario does not contribute to the change-in-risk calculation, since the change is to the analysis and not to the plant. The NRC staff concludes that the addition of the dual unit MCR abandonment is not a change to the plant because the licensee is revising its analysis only and not making any physical plant modifications or operational changes. However, the RAs that are taken for MCR abandonment represent VFDRs and the additional risk from retaining these VFDRs provides an additional contribution to the change-in-risk. Because the additional risk associated with these VFDRs can be bounded by assuming the total risk from the dual unit MCR abandonment contributes to the change-in-risk, the NRC staff concludes that the licensee's MCR abandonment analysis results in consistency with plant conditions and the guidance contained in NUREG/CR-6850. Therefore, the NRC staff finds the analysis acceptable.

3.8.5 Use of Fire Dynamics Simulator Model

In its application dated October 27, 2016, the licensee stated that Version 6.2 of FDS, a three-dimensional computational fluid dynamics (CFD) model, was used to analyze the thermal response of an electrical cable associated with the power supply to the conditioning cabinet that sends the instrumentation signals to the control room and to the SPDS and that the potential vulnerability associated with this cable was identified after receipt of the NRC's approval of the ANO-2 transition to NFPA 805.

The licensee stated that the ANO-2 FPRA considers instrumentation availability when crediting operator actions and that the availability of instrumentation was previously considered in 10 CFR Part 50, Appendix R, and documented in a plant procedure. The licensee further indicated that its procedure contains instructions to be performed when the associated conditional requirement is met along with available instrumentation tables, which provide a discrete list of reliable instrumentation.

The licensee stated that during a review of instrumentation cables, it identified that Fire Zone 2109-U contained a potential vulnerability for a loss of instrumentation via a fire that might affect approximately 5 feet of conduit EC2018 (feed from 125 volts direct current bus to 2D-02), which is located in this fire zone. The licensee further stated that the conduit is located in a small corridor of the fire zone behind a concrete lintel and that in order to determine the effects of a fire in Fire Zone 2109-U on this conduit, an FM analysis of Fire Zone 2109-U was performed to calculate the time varying exposure of the conduit to the most adverse fire scenario that could impact the conduit. The licensee further stated that the analysis focused on calculating the conduit response to the elevated temperatures from the combustion products, using a three dimensional CFD model, FDS, Version 6.2. The licensee further stated that the analysis considered the thermal response of the electrical cable target routed in conduit EC2018 to establish the likelihood that the target would fail if exposed to fires in Fire Zone 2109-U.

The licensee stated that the evaluation includes conservative fire scenarios that may lead to heating and/or damage of the cable target routed in EC2018 under current installed conditions

and that all potential ignition source and corresponding secondary combustible configurations were considered in the space, and the most adverse scenario was evaluated in detail. The licensee further stated that given that the objective is to determine worst-case conditions for the cable damage, the most conservative conditions were obtained with the largest fire sizes (heat release rates) and the nearest possible location of the fire relative to the target, and that in this case, the ignition source evaluated was a battery charger (2D-36), which is capable of igniting overhead cable trays. The licensee also stated that normal ventilation conditions and as-built geometric configuration are assumed and that the ignition source, the secondary combustible configuration, and the ventilation condition assumptions were either bounding or that the expected results would be risk neutral.

The licensee stated that Fire Zone 2109-U is equipped with a partial-area deluge sprinkler system, a ceiling mounted smoke detector system (multiple ionization detectors), and an in-tray fire detection system (protectowire) and that the FM does not include any suppression effects within the 1-hour burning duration modeled, though the expected actuation times for these systems is evaluated for information purposes. The licensee further stated that the 1-hour burning duration is bounding because the DID fire brigade response is projected to occur well before that time as a backup for the partial area deluge system.

The licensee stated that the time varying exposure to conduit EC2018 was predicted by the FDS model for the course of 1-hour of exposure and that the results show that conduit EC2018 is exposed to a maximum temperature of 85 degrees Celsius (°C), well below the damage threshold of 330 °C. The licensee also stated that the temperature conditions in the general fire area are sufficiently hot to damage thermoset cables, especially in the general vicinity of the fire, however, most of the combustion occurs in the cable trays, which are elevated above the lintel base and as a result, the combustion energy tended to remain above the lintel base since there was not a driving force to push the energy below the fire base, and thus the lintel. The licensee further stated that as a result, there was not a significant flow of combustion energy into the area containing the target conduit and therefore, the licensee concluded that the cable inside the conduit will not experience a thermal exposure sufficient to cause failure in a conservatively severe fire scenario in Fire Zone 2109-U.

The licensee stated that only one PRA method that was not used in the ANO-2 NFPA 805 amendment request was applied in the fire model analysis of conduit EC2108 in Fire Zone 2109-U: the FM computer code FDS, Version 6.2. The licensee added that this fire model is an acceptable tool for evaluating fire conditions in nuclear power plants per NUREG-1934, "Nuclear Power Plant Fire Modeling Analysis Guidelines (NPP FIRE MAG)" (Reference 25). The licensee further stated that FDS, in particular, is the highest resolution model typically applied to model fire scenarios in nuclear plants and has the greatest versatility and applicability among the tools available.

The licensee stated that CFD model FDS, Version 6.2, was selected for predicting the time-varying exposure to conduit EC2018 in response to the fires generated in each of the scenarios considered, and that FDS computes the three-dimensional temperature and velocity distributions throughout a defined model domain and uses this information, combined with a radiation transport model, to compute the boundary conditions at a defined target location. The licensee further stated that FDS has the advantage of having a relatively broad nuclear power plant verification and validation (V&V) basis and that the primary input that drives the boundary conditions as computed in FDS is the fire ignition source geometry, fire location, and heat input into the model domain.

The licensee stated in its LAR dated October 27, 2016, that it selected FDS as the FM tool for this analysis because:

- Conduit EC2018 is shielded by a concrete lintel. This shielding was a key factor in illustrating that the postulated fire scenarios do not damage this target. Alternative models do not have the capacity to model the time-dependent exposure from fire in this configuration, while this consideration is within the capabilities of the FDS.

- The ventilation conditions and associated fire dampers in the space is a configuration which other available fire models cannot accurately predict, but can be modeled in the FDS.

- Geometric features such as cable trays, the concrete lintel, and the penetration opening in the concrete lintel and other types of obstructions, are not easily incorporated into alternative fire models. These features can play an important role in the detailed performance on the thermal evaluation developed, and can be modeled in the FDS.

- Unlike other models, FDS, Version 6.2, has the capability to model the time-varying exposure to the cable inside the conduit using the THIEF approach, which in this case is identical to the approach taken in the FDS validation guide for the CAROLFIRE (NUREG-6931, Volume 3) (Reference 26), cases.

The licensee stated that the FDS verification basis is documented in a calculation and follows the instructions provided in NIST-SP-1019 (Reference 27), and NIST-SP-1018-2 (Reference 28). The licensee also stated that the verification basis involves completing a benchmark installation procedure, which provides confirmation that the FDS model produces the same results within a specified tolerance as the versions used to verify FDS.

The licensee stated that the FDS, Version 6.2, validation basis for the Fire Zone 2109-U application is documented in its calculation and that the validation basis follows the guidance in NUREG-1934 using NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," V&V assessment for the FDS model (Volume 7), (Reference 29). The licensee further stated that the approach involves comparing seven non-dimensional parameters in the model application to the range considered in NUREG-1824 and that these parameters are:

- Fire Froude Number, a measure of the buoyancy of the fire plume and thus, an indicator of the plume shape and flame height.

- Flame length ratio, a measure of the degree to which the flames impinge on the ceiling.

- Ceiling jet radius, a measure of the position of a target or point of interest along the ceiling from the centerline of the fire.

- Equivalence ratio, a measure of the relative supply of oxygen to the fire.

- Compartment aspect ratios (length to height and width to height), a measure of the compartment shape.

- Target distance ratio, a measure of the relative distance from the fire a target or point of interest is located and for which radiant heating is the exposure mechanism.

The licensee stated that its calculation identifies that the FDS, Version 6.2, application in Fire Zone 2109-U falls within the NUREG-1824 validation range for all non-dimensional parameters except for the length-to-height ratio and that the maximum length-to-height ratio considered in the test data in NUREG-1824 was 5.7. The licensee stated that the maximum compartment aspect ratio in Fire Zone 2109-U is 9.6, a consequence of the corridor like shape of the space and that although this value exceeds the NUREG-1824 validation range for the aspect ratio parameter, the enclosure shape does not exceed any limitation on the FDS model. The licensee further stated that, unlike simpler modeling tools, such as one-zone or two-zone models, the model assumptions of FDS do not break down for enclosures having a large aspect ratio, or in this case a high length-to-height ratio and that FDS, Version 6.2, inherently accounts for transport delays of the smoke products along the length as well as the heat losses to the boundaries. The licensee stated that the FDS has a pedigree for use in tunnels (e.g. NISTIR-6902) (Reference 30), which have length-to-height ratios far in excess of those involved in the Fire Zone 2109-U evaluation and that the length to height and width to height ratio ranges have been expanded in NUREG-1824, Supplement 1, to 8.3, which is close to the maximum value used to model Fire Zone 2109-U and as such, the FDS application in Fire Zone 2109-U is acceptable and the validation basis provided in NUREG-1824 remains applicable.

The licensee stated that the V&V basis for the FDS, Version 6.2, application consists of National Institute of Standards and Technology (NIST) documentation and NUREG-1824, Volume 7 and that although the version of FDS assessed in NUREG-1824, Volume 7, is different from the version applied in Fire Zone 2109-U, all validation results for FDS are actively updated, and the software installation has been verified to match published expected analytical values. The licensee further stated that an assessment of each of these parameters indicates that this application is expected to produce a comparable or more conservative result than a configuration that falls within all non-dimensional parameter ranges.

The licensee stated that a focused-scope peer review of the ANO-2 FPRA against the requirements of Section 4 of the American Society of Mechanical Engineers (ASME)/American Nuclear Society (ANS) PRA Standard, Addenda to ASME/ANS RA-S-2008, for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," ASME/ANS RA-Sa-2009 (Reference 31), and any Clarifications and Qualifications provided in the NRC endorsement of the Standard contained in Revision 2 to RG 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities" (Reference 32), was performed using the process defined in Nuclear Energy Institute (NEI) 07-12, "Fire Probabilistic Risk Assessment (FPRA) Peer Review Process Guidelines" (Reference 33). The licensee further stated that the scope of this focused scope peer review was limited to the evaluation of a FDS analysis performed for evaluation of impact on the specific conduit of concern in Fire Zone 2109-U.

The licensee stated that the detailed scope of the focused-scope peer review covers high level requirements FSS-C, FSS-D, and FSS-H, which are applicable to the new FDS analysis and that the review was focused on assessing the FPRA against the specific Supporting Requirements (SRs) at a Capability Category of II or higher.

The licensee stated that the focused-scope peer review was conducted offsite during September 2016, and that the review was conducted by an individual who has not participated in the development or preparation of any portion of the ANO-2 FPRA and who is a recognized industry expert in the development and use of the FDS software.

The licensee stated that Section 4 of the ASME/ANS combined PRA Standard, ASME/ANS RA-Sa-2009, contains a total of 183 SRs under 13 technical elements, and configuration control from Section 1.5 of the PRA Standard, and that of these 183 SRs, 29 were within the scope of this focused-scope peer review. The licensee provided a summary of the SRs that were reviewed and their assessed Capability Category. The licensee stated that a revision to the FDS calculation to clarify the basis for an assumption was prompted by the peer review and that no findings or observations were identified as a result of the peer review once this assumption was clarified.

The NRC staff considers the licensee's use of FDS a change that utilizes a method and approach that has been used by other licensees to transition to NFPA 805 and has been accepted by the NRC staff in other SEs. The NRC staff concludes that the licensee's use of FDS to analyze the thermal exposure to electrical cable is acceptable because the licensee demonstrated the applicability of FDS for the specific plant configuration and conditions for which it is being applied, because: 1) the licensee used FDS within its limits of applicability, 2) the licensee's assumptions for model input are reasonable, and 3) the NRC staff considers FDS an acceptable tool for evaluating fire conditions in nuclear power plants.

3.8.6 Use of Electric Power Research Institute Technical Report TR-1006756, Fire Protection Equipment Surveillance and Optimization Guide

3.8.6.1 Background/Discussion

By letter to the NRC dated November 7, 2013 (Reference 34), the licensee requested the flexibility to utilize a PB method to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features required by NFPA 805. The licensee further stated that PB inspection, testing, and maintenance frequencies guidance is established in Electric Power Research Institute (EPRI) Technical Report TR-1006756, "Fire Protection Equipment Surveillance Optimization and Maintenance Guide for Fire Protection Systems and Features," Final Report, July 2003 (Reference 35). This request was not in the licensee's original NFPA 805 LAR dated December 17, 2012, but was added in its letter dated November 7, 2013, in response to an NRC RAI associated with the ANO-2 adoption of NFPA 805. Because the Feb 2015 SE did not evaluate and approve this method, the licensee requested approval to use this method for ANO-2, consistent with that included in Section 3.1.4.1 of the NRC NFPA 805 SE for ANO-1, issued on October 7, 2016 (Reference 18).

By letter dated November 7, 2013, the licensee requested NRC staff approval of a PB method to demonstrate an equivalent level of fire protection for the NFPA 805 Section 3.2.3(1) requirement to establish procedures for inspection, testing, and maintenance of fire protection systems and features credited by the FPP. Specifically, the licensee stated that it desires the flexibility to utilize a PB method to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features required by NFPA 805. The licensee further stated that PB inspection, testing, and maintenance frequencies guidance is established in EPRI TR-1006756.

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

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

(B) Maintains safety margins; and

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

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

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

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

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

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

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

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

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

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

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

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

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

In its NFPA 805 application dated November 7, 2013, the licensee stated that NFPA 805, Section 2.6, "Monitoring," requires that "A monitoring program shall be established to ensure that the availability and reliability of the fire protection systems and features are maintained and to assess the performance of the fire protection program in meeting the performance criteria. Monitoring shall ensure that the assumptions in the engineering analysis remain valid."

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

The licensee stated that NFPA 805 Section 2.6.2, "Monitoring Availability, Reliability, and Performance," requires that "Methods to monitor availability, reliability, and performance shall be

established. The methods shall consider the plant operating experience and industry operating experience."

The licensee stated that the scope and frequency of the inspection, testing, and maintenance activities for fire protection systems and features required in the FPP have been established based on the previously approved TSs/licensing basis documents and appropriate NFPA codes and standards. The licensee stated that the scope of the aforementioned activities is determined by the required systems review identified in Table 4-3, "Summary of NFPA 805 Compliance Basis and Required Fire Protection Systems and Features," of the LAR dated December 17, 2012 (Reference 1). The licensee further stated that this approval request is specific to the use of EPRI TR-1006756 to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features credited by the FPP. The licensee indicated that EPRI TR-1006756, Section 10.1, states, "The goal of a performance-based surveillance program is to adjust test and inspection frequencies commensurate with equipment performance and desired reliability." The licensee stated that this goal is consistent with the stated requirements of NFPA 805, Section 2.6, "Monitoring," and EPRI TR-1006756 provides an accepted method to establish appropriate inspection, testing, and maintenance frequencies, which ensure the required NFPA 805 availability, reliability, and performance goals are maintained.

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

The licensee stated that the use of PB test frequencies established in accordance with EPRI TR-1006756 combined with the NFPA 805, Section 2.6, monitoring program will ensure that the availability and reliability of the fire protection systems and features are maintained at levels assumed in the NFPA 805 engineering analysis; and, therefore, the use of EPRI TR-1006756 does not result in an adverse impact to the nuclear safety performance criteria.

The licensee stated that the radiological release performance criteria are satisfied based on the determination of the limiting radioactive release and fire protection systems and features are credited as part of the subject evaluation. The licensee further stated that the development of PB test frequencies in accordance with EPRI TR-1006756 combined with NFPA 805, Section 2.6, will ensure that the availability and reliability of the fire protection systems and features are maintained at the levels assumed in the NFPA 805 engineering analysis, including assumptions supporting the radioactive release performance criteria. Therefore, there is no adverse impact to radioactive release performance criteria.

The licensee stated that for Echelon 1, fire prevention is not affected by the use of EPRI TR-1006756. The licensee stated that for Echelons 2 and 3, the use of PB test frequencies established in accordance with EPRI TR-1006756 combined with NFPA 805,

Section 2.6, will ensure that the availability and reliability of the fire protection systems and features credited for DID are maintained at the levels assumed in the NFPA 805 engineering analysis; and, therefore, there is no adverse impact to Echelons 2 and 3 for the DID.

3.8.6.2 Risk Evaluation

The regulation, 10 CFR 50.48(c)(2)(vii), does not require a risk evaluation for approval of a PB method.

3.8.6.3 Defense-in-Depth/Safety Margins

The licensee stated that the use of PB test frequencies established per EPRI TR-1006756 combined with NFPA 805, Section 2.6, will ensure that the availability and reliability of the fire protection systems and features are maintained at the levels assumed in the NFPA 805 engineering analysis, including those assumptions supporting the FRE safety margin discussions. The licensee further stated that this method does not invalidate the inherent safety margins contained in the codes and standards used for design and maintenance of fire protection systems and features; and, therefore, the safety margin inherent and credited in the analysis has been preserved.

The licensee stated that the three echelons of DID are: 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 stated that Echelon 1 is not affected by the use of EPRI TR-1006756. The NRC staff found this acceptable because the licensee's use of EPRI TR-1006756 is only for fire protection systems and equipment, not administrative controls such as control of combustibles or hotwork. The licensee stated that use of PB test frequencies established in accordance with EPRI TR-1006756 combined with the NFPA 805, Section 2.6, monitoring program, will ensure that the availability and reliability of the fire protection systems and features credited for DID are maintained at the levels assumed in the NFPA 805 engineering analysis. The licensee also stated that failure criterion will be established based on the required fire protection systems and features credited functions and will ensure those functions are maintained, and therefore, there is no adverse impact to Echelons 2 and 3 for the DID.

3.8.6.4 NRC Staff Evaluation

The NRC staff reviewed the information provided by the licensee in its LAR dated October 27, 2016 (Reference 4), as supplemented, which included discussions of the impact of the proposed change on the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release, DID, and safety margins as required by 10 CFR 50.48(c)(2)(vii).

The NRC staff confirmed that the proposed change has no apparent impact on any of the DID echelons because the use of EPRI TR-1006756 is not considered a method for preventing fires from starting, or detecting, controlling, or extinguishing fires. In addition, the level of fire protection that will be provided so that a fire will not prevent essential safety functions from being performed is not changed because the use of EPRI TR-1006756 combined with the

NFPA 805 monitoring program ensures the availability and reliability of fire protection systems and features.

The NRC staff also confirmed that the proposed change continues to maintain adequate safety margins, in part, because the change does not impact any codes and standards, or their alternatives accepted for use by the NRC, and the change does not impact any safety analysis acceptance criteria used in the licensing basis.

3.8.6.5 Conclusion for Section 3.8.6

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

3.9 Technical Evaluation Summary and Conclusion

The NRC staff reviewed the licensee's application to revise six plant modifications, add an RA, add a dual unit control room abandonment scenario, revise the ignition frequency analysis, use FDS, and use a PB method for inspection, testing, and maintenance of fire protection systems and equipment, with respect to the RI/PB FPP in accordance with the requirements of 10 CFR 50.48(c) and NFPA 805. The licensee's application identified revisions to the ANO-2 license condition as required by 10 CFR 50.48(c)(3)(i). The changes proposed by the licensee included a review of risk, DID, and safety margins, as required by NFPA 805, Section 4.2.4.2. The NRC staff concludes that the licensee's application identified the appropriate license condition that needs revision as a result of the proposed changes, and concluded that the revisions are adequate to authorize the proposed FPP changes, thereby satisfying the requirements of 10 CFR 50.48(c)(3)(i). In addition, the NRC staff finds that the licensee evaluated the changes to the FPP and the additional changes and corrections to the PRA, using acceptable methods and, therefore, the risk results can be used to update the change-in-risk evaluation. The NRC staff concludes that the licensee included its assessment of risk, DID, and safety margin for the proposed changes, thereby meeting the requirements of NFPA 805, Section 4.2.4.2.

The licensee provided updated estimates of total risk and change-in-risk in its letter dated February 21, 2017, to account for the correction in the ignition frequency quantification and the resulting removal of fire scenarios discussed. The risk estimates included both the changes to the modifications and the changes to the PRA methods as described in the LAR and subsequently evaluated in this SE. The total change in fire CDF and fire LERF for this LAR, as well as for the original LAR, are both negative. Between the original LAR and this LAR, the change in fire CDF increased slightly from -8.14E-05/year to -7.88E-05/year, and the total change in fire LERF increased slightly from -3.13E-06/year to -3.03E-06/year. The additional risk in RAs corresponding to this final total risk and change-in-risk was not provided; however, the additional risk of RAs will remain relatively close to the values reported in Attachment W of the licensee's LAR dated October 27, 2017, since the risk from this LAR didn't change substantially due to the ignition frequency correction provided in the licensee's letter dated February 21, 2017.

The NRC staff calculated the CDF and LERF from the dual MCR abandonment scenario as 2.34E-06 and 8.08E-08, respectively. Conservatively assuming that the entire CDF and LERF from this scenario contributes to the change-in-risk, the change-in-risk for the LAR would be affected slightly yet remain negative; the change in fire CDF would rise to -7.64E-05 and the change in fire LERF would rise to -2.95E-06.

The NRC staff finds the various changes consistent with the reported modifications and the highly integrated effects of changes in a PRA. The final values, with the exception of the additional risk of RA, are all less than the acceptance guidelines in RG 1.205 and therefore acceptable. RG 1.205 states that, when the additional risk of RAs exceed the acceptance guidelines, the NRC staff would not normally approve a net increase in risk. However, given that the change in both the fire CDF and fire LERF associated with the LAR is negative, the NRC staff concludes that the additional CDF of RAs, which exceeds RG 1.174 (Reference 12) acceptance guidelines is acceptable.

The NRC staff concludes that the results of the licensee's evaluation in regard to risk, DID, and safety margin is acceptable because: (1) the changes when evaluated together do not challenge the RG 1.174 risk acceptance guidelines; (2) the licensee's process and result is consistent with the guidance approved by the NRC staff in the Feb 2015 SE; and (3) the results of the changes are consistent with the guidance in NEI 04-02, Revision 2; RG 1.205, Revision 1; and RG 1.174, Revision 2.

Implementation of the RI/PB FPP under 10 CFR 50.48(c) must be in accordance with the fire protection license condition, which references the list of modifications and implementation items that must be completed in order to support the NRC staff's conclusion and establishes a date by which full compliance with 10 CFR 50.48(c) must 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.

4.0 FIRE PROTECTION LICENSE CONDITION

On February 18, 2015 (Reference 2), the NRC issued Amendment No. 300 to RFOL License No. NPF-6 for ANO-2, which revised the existing fire protection license condition to one that addresses the transition to an RI/PB FPP under NFPA 805 in accordance with 10 CFR 50.48(c)(3)(i). The new license condition adopted 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 plant-specific FPP license condition is consistent with the standard fire protection license condition and incorporated all of the relevant features of the transition to NFPA 805 at ANO-2.

In its letter dated October 27, 2016 (Reference 4), the licensee requested a license amendment to modify Fire Protection License Condition 2.C.(3)(b). The licensee proposed that the license condition be revised to add the licensee's October 27, 2016, LAR and December 2, 2016, and February 21, 2017, supplements, and add the issuance date of this SE to the first paragraph under 2.C.(3)(b) and replace the reference to Table S-1 submitted by letter dated August 7, 2014, with a reference to Table S-1 submitted by letter dated October 27, 2016. No other changes to the license condition were requested by the licensee or identified by the NRC staff. As described in Section 3.9 of this SE, the NRC staff reviewed the application and supplements for this LAR and concludes in this SE that the proposed changes are acceptable. Therefore, the

NRC staff concludes that the revision of the license conditions, identifying the associated submittal and SE dates, is appropriate and acceptable.

As revised, the first paragraph of the Fire Protection license condition and paragraph "2" of the Transition License Conditions of ANO, Unit 2, RFOL No. NPF-6 Condition 2.C(3)(b) will read as shown below (in bold):

> 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**s** dated December 17, 2012, **and October 27, 2016,** and supplements dated November 7, 2013, December 4, 2013, January 6, 2014, May 22, 2014, June 30, 2014, August 7, 2014 September 24, 2014, December 9, 2014, **December 2, 2016, and February 21, 2017**, and as approved in the SEs dated February 18, 2015 and **May 12, 2017**. Except where NRC approval for changes or deviations is required by 10 CFR 50.48(c), and provided no other regulation, technical specification, license condition or requirement would require prior NRC approval, the licensee may make changes to the fire protection program without prior approval of the Commission if those changes satisfy the provisions set forth in 10 CFR 50.48(a) and 10 CFR 50.48(c), the change does not require a change to a technical specification or a license condition, and the criteria listed below are satisfied.
>
> * * *
>
> Transition License Conditions
>
> * * *
>
> 2. The licensee shall implement the modifications to its facility, as described in Table S-1, "Plant Modifications," Attachment **2**, of Entergy Operations, Inc. letter **2CAN101601, dated October 27, 2016,** prior to startup from the second refueling outage following issuance of the Safety Evaluation. The licensee shall maintain appropriate compensatory measures in place until completion of the modifications.

5.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Arkansas State official was notified of the proposed issuance of the amendment on April 6, 2017. The State official had no comments.

6.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component 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 January 31, 2017 (82 FR 8869). 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.

7.0 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.

8.0 REFERENCES

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Date: May 12, 2017

SUBJECT: ARKANSAS NUCLEAR ONE, UNIT 2 - ISSUANCE OF AMENDMENT RE: REQUEST TO REVISE THE NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) STANDARD 805 MODIFICATIONS (CAC NO. MF8691) DATED MAY 12, 2017

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