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

May 5, 2015

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

SUBJECT: ARKANSAS NUCLEAR ONE, UNIT NO. 1 - REQUEST FOR ADDITIONAL INFORMATION REGARDING LICENSE AMENDMENT REQUEST TO ADOPT NATIONAL FIRE PROTECTION ASSOCIATION STANDARD 805 (TAC NO. MF3419)

Dear Sir or Madam:

By letter dated January 29, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14029A438), Entergy Operations, Inc. (the licensee), submitted a license amendment request to change the Arkansas Nuclear One, Unit 1 (ANO-1), fire protection program to one based on the National Fire Protection Association Standard 805 (NFPA 805), "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," 2001 Edition, as incorporated into Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.48(c). To complete its review, the Nuclear Regulatory Commission staff requests a response to the requests for additional information (RAIs), included as Enclosure 1.

The draft RAIs were sent to Mr. David Bice on April 1, 2015, of your staff, to ensure that the questions were understandable, the regulatory basis for the questions was clear, and to determine if the information was previously docketed. Please respond to the enclosed questions appropriately, as indicated on Enclosure 2, Timetable for Request for Additional Information Response.

If you have any questions, please contact me at (301) 415-1081 or by e-mail at Andrea.George@nrc.gov.

Sincerely,

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

Docket No. 50-313

Enclosures:
1. Request for Additional Information
2. Timetable for Request for Additional Information Response

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
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REQUEST FOR ADDITIONAL INFORMATION

REGARDING LICENSE AMENDMENT REQUEST TO ADOPT

NATIONAL FIRE PROTECTION ASSOCIATION STANDARD 805

PERFORMANCE-BASED STANDARD FOR FIRE PROTECTION

FOR LIGHT WATER REACTOR GENERATING PLANTS

ENTERGY OPERATIONS, INC.

ARKANSAS NUCLEAR ONE, UNIT 1

DOCKET NO. 50-313

By letter dated January 29, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14029A438), Entergy Operations, Inc. (the licensee), submitted a license amendment request (LAR) to change the Arkansas Nuclear One, Unit 1 (ANO-1), fire protection program to one based on the National Fire Protection Association Standard 805 (NFPA 805), "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," 2001 Edition, as incorporated into Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.48(c). In the course of its review, the U.S. Nuclear Regulatory Commission (NRC) staff has determined that additional information is required in order to complete its evaluation, as detailed below.

Fire Protection Engineering (FPE) RAI 01

The LAR Attachment A, cites previous NRC approval as the compliance strategy for several elements of Chapter 3 of NFPA 805. The compliance basis statements for these previously approved elements do not clearly state that the basis for the previous approval remains valid per the guidance in Section 2.3.1 of Regulatory Guide (RG) 1.205, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants," December 2009 (ADAMS Accession No. ML092730314) and Nuclear Energy Institute (NEI) 04-02, "Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c)," Revision 2, April 2008 (ADAMS Accession No. ML081130188).

Please confirm the continued validity of the bases for the previous approvals and include a discussion of any changes or modifications that have been made to the plant that may impact the bases for the previous approvals.

FPE RAI 02

NFPA 805 Section 3.4.1(c) requires that the fire brigade leader and at least two brigade members have sufficient training and knowledge of nuclear safety systems in order to understand the effects of fire and fire suppressants on nuclear safety performance criteria (NSPC). Section 1.6.4.1, "Qualifications," of RG 1.189, Revision 2, "Fire Protection for Nuclear

Power Plants," September 2009 (ADAMS Accession No. ML092580550), provides one acceptable approach for implementing the requirements for qualification of the fire brigade leader:

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

In LAR Attachment A, the licensee stated that it complies with the requirements of Section 3.4.1(c), and references station procedures, which state that the fire brigade chief and at least two fire brigade members shall be operations personnel who have sufficient knowledge of safety-related systems to understand the effects of a fire and fire suppressants on the safe shutdown of the unit.

Please provide additional detail regarding the training that is provided to the fire brigade leader and members that addresses their training on plant systems and ability to understand and assess the effects of fire and fire suppressants on NSPC.

FPE RAI 03

NFPA 805 Section 3.3.12 states, in part:

> The oil collection system for each reactor coolant pump shall be capable of collecting lubricating oil from all potential pressurized and nonpressurized leakage sites in each reactor coolant pump oil system.

In short, it requires that any leakage from the reactor coolant pump oil collection system be safely contained for off-normal conditions. In LAR Attachment L, the licensee requested NRC approval for oil mist resulting from normal operation of the reactor coolant pump oil collection system.

Please provide additional technical justification addressing the following items:

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

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

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

d) The licensee stated that the three echelons of defense-in-depth 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, recovery actions). Provide clear bases for concluding that the approval request does not adversely affect the nuclear safety performance criteria (for example, discuss how the location of the oil mist does not affect the function of equipment credited to meet each nuclear safety performance criteria).

Provide clear bases for concluding that there is no impact on the three elements of defense-in-depth.

FPE RAI 04

LAR Section 4.1.1, "Overview of Evaluation Process" states, in part:

> Each section and subsection of NFPA 805 Chapter 3 was reviewed against the current fire protection program. Upon completion of the activities associated with the review, the following compliance statement(s) was used:
>
> - Complies – For those sections/subsections determined to meet the specific requirements of NFPA 805.
>
> - Complies with use of Existing Engineering Equivalency Evaluations (EEEEs) – For those sections/subsections determined to be equivalent to the NFPA 805 Chapter 3 requirements as documented by engineering analysis.

In LAR Attachment A, the compliance statement for certain NFPA 805, Chapter 3 sections (for example, 3.4.3(c)), is "Complies" and the Compliance Basis states, for example, "This requirement was evaluated by NFPA 600 Code Compliance Evaluation." For other NFPA 805 Chapter 3 sections (for example, 3.5.10), the compliance statement is "Complies with EEEE," and the Compliance Basis states, for example, "This requirement was evaluated by NFPA 24 Code Compliance Evaluation."

Please confirm that those elements associated with the "Complies" statements, and that describe the compliance basis as a Code Evaluation, have been determined to meet all applicable codes or compliance standards as determined by the referenced code evaluation.

FPE RAI 05

NFPA 805 Section 3.5.14 requires that all fire protection water supply and fire suppression system control valves be under a periodic inspection program and supervised. LAR Attachment A, Element 3.5.14 states that ANO-1 "Complies by previous NRC approval." The citation in the Compliance Basis that supports the previous approval determination refers to an NRC safety evaluation, which states that the plant Technical Specifications (TS) require the periodic inspection of fire water system valve position that are not locked, sealed, electronically supervised, or otherwise secured in position to assure that values are maintained in the open position.

Please confirm that this requirement remains in the TS or identify how this requirement is currently controlled and maintained.

FPE RAI 06

LAR Section 4.1.1, "Overview of Evaluation Process," states, in part:

> Each section and subsection of NFPA 805 Chapter 3 was reviewed against the current fire protection program. Upon completion of the activities associated with the review, the following compliance statement(s) was used:
>
> - Complies by previous NRC approval – For those sections/subsections where the specific NFPA 805 Chapter 3 requirements are not met but previous NRC approval of the configuration exists.
>
> - Complies with use of Existing Engineering Equivalency Evaluations (EEEEs) – For those sections/subsections determined to be equivalent to the NFPA 805 Chapter 3 requirements as documented by engineering analysis.

In LAR Attachment A, the compliance statements for NFPA 805 Sections 3.9.5, 3.11.2, and 3.11.4 is "Complies with EEEE," but the Compliance Basis includes a citation or discussion of previous NRC approval and references the original Safety Evaluation Report dated August 22, 1978 (ADAMS Accession No. ML021210569).

Please clarify the compliance strategy for these elements of NFPA 805 Chapter 3, including what portion, if any, is based on previous NRC approval.

FPE RAI 07

The regulations at 10 CFR 50.48(c)(2)(vii) state, in part, that licensees who wish to use performance-based methods for fire protection program (FPP) elements and minimum design requirements of NFPA 805 Chapter 3, shall submit a request that: (a) Satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release; (b) Maintains safety margins; and (c) Maintains fire protection defense-in-depth (DID) (fire prevention, fire detection, fire suppression, mitigation, and post-fire safe shutdown capability). Attachment L of the LAR contains Entergy's requests for approval of performance-based methods utilized to satisfy certain requirements in NFPA 805 Chapter 3.

a) For all the LAR Attachment L performance-based method approval requests, the licensee described the three echelons of DID as: 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 levels of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed (fire barriers, fire-rated cable,

success path remains free of fire damage, recovery actions). Please discuss how DID is maintained with respect to the items described for each echelon.

b) In LAR Attachment L, pages L-1 through L-5, the licensee requested approval for deviation from the prescriptive requirements of NFPA 805, Section 3.2.3(1) to use the performance-based method contained in Electric Power Research Institute (EPRI) Technical Report TR-1006756, Fire Protection Surveillance Optimization and Maintenance Guide, Final Report, July 2003, to establish inspection, testing, and maintenance frequencies for fire protection systems and features required by NFPA 805 for ANO-1. Please clarify the scope of the approval request to identify the specific fire protection systems and features that are applicable (e.g., existing fire protection systems, components, and features such as fire detection systems, gaseous fire suppression systems, water-based fire suppression systems, fire pumps, water supply tanks and fire water distribution systems, fire walls, fire extinguishers, etc.) and indicate whether the application of the approval request will apply to any new fire protection systems, components, or features not yet constructed or installed.

c) In LAR Attachment L, pages L-8 to L-9, the licensee requested the approval for deviation from the requirement of NFPA 805, Section 3.3.5.1, that "Where installed, electrical wiring shall be listed for plenum use, routed in armored cable, routed in metallic conduit, or routed in cable trays with solid metal top and bottom covers." ANO-1 has installed electrical wiring above suspended ceilings which is not listed for plenum use, routed in armored cable, routed in metallic conduit, or routed in cable trays with solid metal top and bottom covers. In the basis for request, please describe any fire protection features (e.g., barriers, detection and suppression systems) available above the suspended ceiling and clarify that the existing administrative controls will ensure that the requirements of NFPA 805, Section 3.3.5.1 are met for future installations above suspended ceilings.

d) In LAR Attachment L, pages L-11 to L-12, the licensee requested the approval for deviation from the requirement of NFPA 805, Section 3.3.5.2, which states that "only metal tray and metal conduits shall be used for electrical raceways." The licensee stated that by procedure, "Underground concrete encased conduits, sizes three (3) inches and larger shall be of an approved heavywall ABS or Schedule 40 PVC [polyvinyl chloride]," and that "Slab and wall embedded conduits three (3) inches and larger shall be Schedule 40 PVC or rigid steel..." Please clarify that this approval request is limited to the existing PVC conduits that are currently installed and that administrative controls will ensure that the requirements of NFPA 805, Section 3.3.5.2 will be met for future installations.

e) In LAR Attachment L, pages L-16 to L-20, the licensee requested the approval for deviation from the requirement of NFPA 805, Section 3.5.3 to allow the use of 4160 Volts alternating current (VAC) electric fire pump motor and 4160 VAC electric fire pump controller (Fire Pump P-6A), which are not Underwriters Laboratories, Inc. (UL) listed for fire protection. The licensee also requested the approval for the diesel engine fire pump (Fire Pump P-6B), which does not list or

identify a certification for the batteries and the battery charger discharge rate of the lead acid batteries. Please provide the following information:

i. For Pump P-6B, describe what "certified by the vendor for fire pump services" (page L-18 of the LAR) for Pump P-6B controller sub-component means with respect to: (a) assuring that the sub-component will perform its intended functions; (b) any impact of using unlisted sub-component on achieving automatic sequenced start functions of the fire pump; and (c) any impact of the unlisted sub-component(s) on the performance of the fire pump to start in the event of failure of the lead pump or that the sub-component will not prevent subsequent pump from starting.

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

f) In LAR Attachment L, pages L-21 to L-23, the licensee requested the approval for deviation from the requirement of NFPA 805, Section 3.5.16 for the use of the ANO-1 fire protection water supply system for purposes other than fire protection water supply. Exception No. 1 to NFPA 805 Section 3.5.16 states that fire protection water supply systems shall be permitted to be used to provide backup to nuclear safety systems, provided the fire protection water supply systems are designed and maintained to deliver the combined fire and nuclear safety flow demands for the duration specified by the applicable analysis. NFPA 805, Section 3.5.10, states that an underground yard fire main loop, designed and installed in accordance with NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, shall be installed to furnish anticipated water requirements, which domestic service (non-fire protection) use is prohibited.

i. Please clarify if the approval request should also include a deviation from the requirements of NFPA 805 Section 3.5.10, which states that the underground yard fire main loop is designed and installed in accordance with NFPA 24.

ii. Please describe the design and licensing bases to demonstrate that the configuration and system interfaces of using the temporary pump will not degrade or impact reliability and availability of the fire water supply system for fire protection, including the following:

1. Please describe the temporary pump design capacity (e.g., rated flow and pressure – 2000 gallons per minute (gpm) at 125 pounds per square inch (psi)), required flow and pressure for auxiliary

cooling, any system operating limits (i.e., maximum operating pump pressure), and anticipated maximum duration for using the temporary pump;

2. Please describe how the combined fire and auxiliary cooling demand, flow and pressure, are within the performance of the fire pumps P-6A and P-6B;

3. Please describe how the temporary pump design, performance, and system configuration will affect the intended performance of fire pumps P-6A and P-6B, including whether the fire pumps will automatically start upon actuation of a water-based fire suppression system(s);

4. Please clarify whether the temporary pump (not listed for fire protection), when in-use, will serve as the primary pump for the fire water supply system to meet the fire protection supply requirements because fire flows and pressures of the water-base fire suppression systems could be met by temporary pump in lieu of the fire pumps.

iii. Please discuss how the use of the temporary pump, which is not listed for fire protection use, will affect compliance with other sections of NFPA 805 Chapter 3, which require the use of a listed fire pump (for example, in LAR Attachment A, Section 3.5.2, the licensee stated that fire water is supplied by two fire pumps located in the intake structure), and determine if other deviations from NFPA 805 Chapter 3 will be needed when this temporary pump is in-use.

FPE RAI 08

In LAR Attachment A, Section 3.4.1, "Onsite Fire Fighting Capability," the licensee stated that the Fire Brigade Leader (Unit 1) and three other members (Unit 2) are from the Operations Department. Please discuss how the use of three members from Unit 2 will affect the minimum shift crew staffing contained in the TS and Emergency Plan for Unit 2.

Safe Shutdown Analysis (SSA) RAI 01

In LAR Section 4.2.1.2, the licensee described the methodology for establishing safe and stable conditions for the plant, which is based on the NFPA 805 Nuclear Safety Capability Assessment (NSCA) methodology described in LAR Attachment B. The licensee stated, in part, that

> The 'At Power' safe shutdown analysis postulates a single fire occurring at 100% power and provides a listing of conflicts that may impact the assured success path to meet a particular nuclear safety performance goal.

Please describe what is meant by "a listing of conflicts that may impact the assured success path to meet a particular nuclear safety performance goal" and how these conflicts were addressed in meeting the requirements of NFPA 805 Chapter 4.

SSA RAI 02

NFPA 805, Section 2.4.2.2.1 states, in part:

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

In LAR Section 4.2.1.4 and LAR Attachment F, the licensee described the process for reviewing and evaluating fire-induced multiple spurious operations (MSOs). Please provide the following additional information:

a) In Step 1 of the process, the licensee stated that a Pressurized-Water Reactor (PWR) Owners Group generic list of MSOs was not yet available at the time of the expert panel meeting in 2005, and that the list of PWR generic MSOs from Revision 2 of NEI 00-01, "Guidance for Post-Fire Safe Shutdown Circuit Analysis," May 2009 (ADAMS Accession No. ML091770265), was subsequently evaluated to ensure that applicable MSOs from this list were included in the NSCA and Fire Probabilistic Risk Assessment (FPRA) model. The licensee did not discuss how the list of PWR generic MSOs in Revision 2 of NEI 00-01 was evaluated, such as by reconvening the expert panel or licensee staff. Please describe the process and expertise used to perform the review the list of PWR generic MSOs.

b) In Step 2 of the process, the licensee stated that the Expert Panel "focused on identifying those spurious actuations and combinations thereof that could be risk significant," and that an initial screening was performed by the panel based on the function affected, the potential consequences, and the time available to mitigate the potential transient, such that "spurious actuations and combinations of spurious actuations that did not require a mitigating action in the first hour after the reactor trip were identified." Please describe how spurious actuations required to be mitigated within the first hour after reactor trip, if any, were evaluated in the MSO review.

SSA RAI 03

In LAR Attachment G, the licensee included the results of evaluating the feasibility of recovery actions (Step 4) and stated that implementation items resulting from the feasibility evaluation include development/revision of procedures and revisions to the training program to reflect the procedure changes.

LAR Attachment S, Table S-2, Implementation Item S2-5 involves revising operator manual action (OMA) procedures/documents to include feasibility criteria in Frequently Asked Question

(FAQ) 07-0030, "Establishing Recovery Actions," dated February 4, 2011 (ADAMS Accession No. ML110070485) for recovery actions listed in LAR Attachment G, Table G-1, "Recovery Action Transition." This implementation item does not discuss the need to revise the training program to reflect procedure changes.

a) Please clarify if LAR Attachment S, Table S-2, Implementation Item S2-5 includes the post-transition action to revise the training program, or identify the correct implementation item for the training program revisions.

b) Please clarify whether or not the training program described in LAR Attachment G includes the performance of periodic drills as described in Table B-TBD in FAQ 07-0030.

SSA RAI 04

NFPA 805 Section 2.4.2.2.1 states, in part:

> Circuits required for the nuclear safety functions shall be identified. This includes circuits that are required for operation, that could prevent the operation, or that result in the maloperation of the equipment identified in 2.4.2.1.

NFPA 805 Section 2.4.2, "Nuclear Safety Capability Assessment," requires licensees to perform an NSCA. RG 1.205 endorsed the guidance in NEI 00-01 Chapter 3 as one acceptable approach to perform an NSCA.

In LAR Attachment B, the licensee stated in its Alignment Basis for Attribute 3.3.3.1 that all cables including those from interlocks, instruments, and power supplies that could adversely impact the desired operation of a piece of safe shutdown equipment are listed as safe shutdown cables. This includes cables external to the component control circuit if any cable fault could adversely impact the required state of the component, unless the cable is included with another piece of safe shutdown equipment.

Please provide the following additional information:

a) The licensee stated that "in some special cases, the circuit analysis was completed based on components being skid mounted." Please clarify the intent of the statement.

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

c) In the alignment bases for Attribute 3.3.1.2 regarding failure of a single cable that could impact more than one piece of safe shutdown equipment, the licensee

stated that "where a cable may affect several SSEs, these cables are assigned to those SSE's circuit analysis." The methodology alignment for Attribute 3.3.1.2 appears to contradict the statement for Attribute 3.3.1.1 where the licensee states that "cables are listed as safe shutdown cables...., unless the cable is included with another piece of safe shutdown equipment." Please provide an explanation of the intent of these two statements that appear to contradict each other.

SSA RAI 05

NFPA 805 Section 2.4.2, "Nuclear Safety Capability Assessment," requires licensees to perform an NSCA. RG 1.205 endorsed the guidance in NEI 00-01 Chapter 3 as one acceptable approach to perform an NSCA.

In LAR Attachment B, the licensee stated in the Alignment Basis for Attribute 3.1.1.11 that ANO-1 and ANO-2 do not share resources required to meet performance goals for control of reactivity, inventory, pressure, and decay heat removal. However, in LAR Attachment C for fire area I-2 North Switchgear Room, the licensee stated in the "Method of Accomplishment" for meeting the performance goals for Vital Auxiliaries (e.g., HVAC) that ANO-1 shares a common control room envelope with ANO-2. The licensee further stated that ANO-2 condensing units (2VE-1A and 2VE-1B), and the control room emergency recirculation units (2VUC-27A and 2VUC-27B) are available. Also, in LAR Section 4.2.1.2, the licensee stated that safe and stable conditions in Mode 3 may continue long term by transferring water between the non-qualified Condensate Storage Tanks maintained in ANO-2 to ANO-1 by manipulation of valves and that fuel oil supplies can be cross-connected between ANO-1 and ANO-2, if needed.

Please clarify the discrepancy between the alignment bases for NEI 00-01 Attribute 3.1.1.11 and the Unit 2 equipment credited in LAR Attachment C for fire area I-2.

SSA RAI 06

NFPA 805 Section 2.4.2.4, requires that

> An engineering analysis shall be performed in accordance with the requirements of Section [2.4] for each fire area to determine the effects of fire or fire suppression activities on the ability to achieve the NSPC of Section 1.5....

RG 1.205, Revision 1, dated December 2009 (ADAMS Accession No. ML092730342), endorsed NEI 04-02, Revision 2, as one acceptable approach to performing and documenting the engineering analyses required to transition to a risk-informed, performance-based FPP in accordance with 10 CFR 50.48(c) and NFPA 805. On a fire area basis, NEI 04-02 requires that the licensee document how the NSPC are met. The guidance in NEI 04-02 recommends that this information be presented in LAR Attachment C, Table B-3, "Fire Area Transition." In LAR Section 4.2.4, "Overview of the Evaluation Process," Step 5 – Final Disposition, the licensee stated that the final disposition of variances from deterministic requirements (VFDRs) is documented in LAR Attachment C (NEI 04-02 Table B-3).

In LAR Attachment C, VFDRs B173-03, B8SEPR-04, and I3-04 state that fire damage to cables associated with the power supply to battery charger D-03B, D-03A, and D-04A, respectively, would require a local manual transfer for the redundant battery charger, if it is not aligned. The disposition of the VFDRs and their associated fire risk evaluation state that no further action is required for the fire-affected battery charger, but does not discuss if the local manual transfer to the non-affected redundant battery charger is credited in the fire risk evaluation.

Please clarify whether the local manual transfer for the non-affected redundant battery charger is credited in the fire risk evaluations, and if so, discuss how the local manual transfer is modeled with respect to risk-related recovery actions.

SSA RAI 07

NFPA 805 Section 2.2.4 requires, in part, that the NSPC be evaluated on a fire area basis, and NFPA 805 Section 2.7.1.2 requires, in part, that the NSCA be documented on a fire area basis.

LAR Attachment C includes a summary of the NSCA for each fire area; LAR Table 4-3 includes a summary of the required fire protection systems and features; and LAR Attachment W, Table W-2 includes a summary of the fire area risks for each fire area. There are several fire area designations in these attachments and tables that are different. Please provide the following clarifications:

a) LAR Attachment C includes the NSCA summary for Fire Area ADMIN – Administration Building, and although LAR Attachment C includes a summary table for required fire protection systems and features, there is no corresponding entry in LAR Table 4-3 and LAR Attachment W, Table W-2 does not include this fire area in the Fire Area Risk Summary. Please clarify the reason for the difference between the LAR Attachment C, Table 4-3, and LAR Attachment W.

b) LAR Attachment W, Table W-2 includes the risk summary for Fire Area AAC, "SBOD [Station Blackout Diesel] Alternate Diesel Building," but there are no results for the NSCA for this fire area in LAR Attachment C. Please clarify the reason for the difference between the LAR Attachments C and W. If an NSCA was performed for this fire area, please provide the NSCA results for this fire area in an updated LAR Attachment C.

SSA RAI 08

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 1.4.1, 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.

In LAR Section 4.3.2, the licensee provided the results of the evaluation process for Non-Power Operations (NPO) analysis. Please provide the following information pertaining to NPO discussions provided in the results discussion in LAR Section 4.3 and LAR Attachment D:

a) LAR Section 4.3.2 and LAR Attachment D stated that additional equipment identified as being needed for NPO, but not previously evaluated, was evaluated and added as necessary to Plant Data Monitoring Systems (PDMS) and, where added, flagged accordingly as being only required for NPO. Please provide a list of the additional components and a list of those at-power components that have a different functional requirement for NPO. Describe the difference between the at-power safe shutdown function and the NPO function. Include with this list a general description by system indicating why components would be selected for NPO and not be included in the at-power analysis.

b) LAR Attachment D states the licensee followed the guidance of FAQ 07-0040, "Non-Power Operations Clarifications," dated August 11, 2008 (ADAMS Accession No. ML082200528). Please provide a list of key safety functions (KSF) pinch points by fire area that were identified in the NPO fire area reviews using FAQ 07-0040 guidance including a summary level identification of unavailable paths in each fire area. Describe how these locations will be identified to the plant staff for implementation.

c) During NPO modes, spurious actuation of valves can have a significant impact on the ability to maintain decay heat removal and inventory control. Please provide a description of any actions being credited to minimize the impact of fire-induced spurious actuations on power operated valves (e.g., air-operated valves and motor-operated valves) during NPO (e.g., pre-fire rack-out, actuation of pinning valves, and isolation of air supplies).

d) During normal outage evolutions, certain NPO credited equipment will have to be removed from service. Please describe the types of compensatory actions that will be used during such equipment down-time.

e) The description of the NPO review in the LAR does not identify locations where KSFs are achieved via recovery actions or for which instrumentation not already included in the at-power analysis is needed to support recovery actions required to maintain safe and stable conditions. Please identify those recovery actions and instrumentation relied upon in the NPO, and describe how recovery action feasibility is evaluated. Include in the description whether these variables have been or will be factored into operator procedures supporting these actions.

SSA RAI 09

RG 1.205 Section 2.4, states, in part, that:

> NFPA 805, Section 4.2.3.1, identifies recovery actions for which the additional risk must be evaluated, as required by NFPA 805, Section 4.2.4. These "success path" recovery actions are operator actions that, if not successful, would lead to the fire-induced failure of the "one success path of required cables and equipment to achieve and maintain the nuclear safety performance criteria." Other operator actions that do not involve the success path may be credited in plant procedures or the fire PRA [probabilistic risk assessment] to overcome a combination of fire-induced and random failures may also be recovery actions, but licensees do not need to evaluate the additional risk of their use.

LAR Attachment G identified a number of "Defense-in-Depth Recovery Actions." Please provide additional information to clarify how these recovery actions are evaluated in the NSCA. Specifically, provide the following information:

a) Describe the methodology for identifying DID recovery actions and how they were credited, if at all, in the risk determination for the fire area.

b) Clarify if the NFPA 805 nuclear safety and radioactive release performance goals, objectives and criteria, including the risk acceptance guidelines, are met without these actions and provide the bases for this conclusion.

c) In LAR Attachments C and G, DID recovery actions are credited in Fire Area G to resolve VFDRs that involve spurious operation of valves, such as CV-1227, CV-1228, CV-1408, CV-1274, and CV-3807, that may be affected by hot short issues described in Information Notice (IN) 92-18, "Potential for Loss of Remote Shutdown Capability During a Control Room Fire," dated February 28, 1992 (ADAMS Accession No. ML031200481). In LAR Attachment G, Step 4, the licensee stated that the recovery actions are evaluated against the feasibility criteria of NEI 04-02; FAQ 07-0030, Revision 5; and RG 1.205. Please discuss how the feasibility of performing these specific DID recovery actions for spuriously operated valves are met if its' respective circuit(s) are damaged as described in IN 92-18.

SSA RAI 10

NFPA 805 Section 4.2.1 states that one success path necessary to achieve and maintain the nuclear safety performance criteria shall be maintained free of fire damage by a single fire. NFPA 805 Section 4.2.3.1 states that use of recovery actions to demonstrate availability of a success path for the nuclear safety performance criteria automatically shall imply use of the performance-based approach as outlined in Section 4.2.4. NFPA 805 Section 4.2.4 states that when the use of recovery actions has resulted in the use of [the performance-based] approach, the additional risk presented by their use shall be evaluated. NFPA 805 Section 1.6.52 defines a recovery action as activities to achieve the nuclear safety performance criteria that take place outside of the main control room (MCR) or outside the primary control station(s) for the equipment being operated, including the replacement or modification of components.

In LAR Attachment C, for a fire in Fire Area G, "Control Room," and associated fire zones, the licensee stated in the "Method of Accomplishment" for the process monitoring performance goal that instrumentation is available in the TSC (Technical Support Center) to monitor neutron flux, pressurizer level, reactor coolant system (RCS) pressure, RCS temperature, and credited steam generator (SG) level and pressure using Safety Parameter Display System (SPDS). This activity is performed outside the MCR and is a recovery action as defined in NFPA 805 Section 1.6.52. LAR Attachment G, Table G-1 identifies the recovery actions and activities credited in the nuclear safety capability assessment (NSCA), and the recovery action to monitor instrumentation at the TSC is not identified.

a) Please clarify that the process monitoring function performed at the SPDS is maintained free of fire damage by a fire in Fire Area G, as required by Section 4.2.1, including the power source and instrumentation input data to the SPDS.

b) In LAR Attachment G, Step 4, the licensee stated that the recovery actions are evaluated against the feasibility criteria of NEI 04-02, FAQ 07-0030, Revision 5, and RG 1.205. Please discuss how each of the feasibility criteria of FAQ 07-0030 will be met for performing the process monitoring function at the SPDS, including the method of communications between operators at the SPDS and other operators performing recovery actions in other areas of the plant.

c) Please confirm that all recovery actions that are credited in the NSCA are described in LAR Attachment G, such as monitoring instruments at the SPDS and breaker actions to de-energize a valve prior to locally operating a valve, are evaluated for risk as required by NFPA 805 Section 4.2.4.

SSA RAI 11

NFPA 805 Section 2.4.2.2.1 states that circuits required for the nuclear safety functions shall consider fire-induced failure modes such as hot shorts (external and internal), open circuits, and shorts to ground.

In LAR Attachment C and Attachment S, Table S-1, "Plant Modifications," the licensee identified modifications on valves (e.g., CV-1221, CV-1405, CV-1406, SG-1, SG-2, SG-3, and SG-5) that

will be credited to meet the requirements of IN 92-18, and stated that the modification will add an "inhibit" circuit which will preclude spurious opening of the MOV due to intercable or intracable hot shorts.

a) Please clarify if these modifications are credited to meet deterministic approach of NFPA 805 Section 4.2.3

b) Please describe the details of the modification, including the details of the "inhibit" circuit.

c) For each fire area that credits these modifications, please discuss how the effects of hot shorts (external and internal), open circuits, and shorts to ground were evaluated to ensure that the desired nuclear safety function of the valves will not adversely affect the ability to achieve the nuclear safety performance criteria credited in the fire areas that credit these modifications. As part of this discussion, address the potential for "collateral damage" as a result of the energetic failure of other circuits in the same raceway/wireway as the shorting portion of the circuit. In NUREG/CR-7100, "Direct Current Electrical Shorting in Response to Exposure Fire (DESIREE- Fire): Test Results," Final Report, April 2012 (ADAMS Accession No. ML121460107), an NRC-sponsored fire test, it was concluded that open circuits in adjacent cables resulting from energetic faulting will not occur as long as the fusing used is 10 amps or less. For circuits fused greater than this, testing showed that the fuses may not clear on a fault, thereby causing the dc cable to open circuit, resulting in repeated arcing of conductors. This repeated arcing could result in an open circuit in an adjacent cable.

d) During the NFPA 805 audit performed the week of April 20-23, 2015, the licensee described that a new "shorting switch" will be installed in the control room as part of this modification. Please describe how fire damage to the new "shorting switch" will not affect the desired nuclear safety function required to achieve the nuclear safety performance criteria.

Fire Modeling (FM) RAI 01

NFPA 805 Section 2.4.3.3, states that:

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

The NRC staff noted that the ANO-1 fire modeling comprised the following:

- The Consolidated Fire Growth and Smoke Transport (CFAST) model was used to calculate MCR abandonment times and to evaluate development and timing of hot gas layer conditions in selected fire zones.

- The Generic Fire Modeling Treatments (GFMTs) approach was used to determine the zone of influence (ZOI) in all fire areas throughout the plant.

- FLASH-CAT was used for calculating fire propagation in stacks of more than two horizontal cable trays.

- HEATING 7.3 was used in the assessment of the fire resistance of conduit embedded in concrete.

- As described in NUREG-1805, "Fire Dynamics Tools (FDTS): Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program," December 2004 (ADAMS Accession No. ML043290075), the Point Source Model and the Solid Flame Model were used to determine whether there is adequate separation between the Administration Building and the ANO-1 Turbine Building.

LAR Section 4.5.1.2, "Fire PRA," states that fire modeling was performed as part of the Fire PRA development (NFPA 805 Section 4.2.4.2). Reference is made to LAR Attachment J, "Fire Modeling V&V [verification and validation]," for a discussion of the acceptability of the fire models that were used to develop the FPRA.

Regarding the acceptability of the PRA approach, methods, and data, please provide the following information:

a) Please identify any applications of fire modeling tools and methods used in the development of the LAR that are not discussed in LAR Attachment J.

b) Please describe how non-cable secondary combustibles were identified and accounted for in the fire modeling analyses and the fire risk evaluations.

c) Regarding fire propagation in cable trays:

   (i) Please explain how the expansion of the ZOI of an ignition source due to the heat release rate (HRR) of secondary combustibles (cable trays) was accounted for.

   (ii) In any fire area, please explain how cable tray covers, fire-resistant coatings, and fire wraps were credited in terms of delaying or preventing ignition and subsequent flame spread of cables. In addition, explain how holes in cable tray covers were treated in regard to the fire modeling damage criteria.

d) Regarding high energy arcing fault (HEAF) generated fires, please describe the criteria used to decide whether a cable tray in the vicinity of an electrical cabinet will ignite following a HEAF event in the cabinet. Explain how the ignited area was determined and subsequent fire propagation was calculated. If applicable, describe and justify the effect of tray covers and fire-resistant wraps on HEAF-induced cable tray ignition and subsequent fire propagation.

e) Provide justification for the assumed fire areas and elevations that were used in the transient fire modeling analyses. Explain how the model assumptions in terms of location and HRR of transient combustibles in a fire area or zone will not be violated during and post-transition.

Regarding the acceptability of the GFMTs approach, please provide the following information:

f) Explain how the modification to the critical heat flux for a target that is immersed in a thermal plume was used in the ZOI determination.

g) Explain how wall and corner effects were accounted for in the ZOI calculations for transient fires.

h) Describe how transient combustibles in an actual plant setting are characterized in terms of the three fuel package groupings in Supplement 3, "Transient Ignition Source Strength," of the GFMT. Identify areas, if any, where the NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities, Volume 1: Summary and Overview," September 2005 (ADAMS Accession No. ML052580075), transient combustible HRR characterization (probability distribution and test data) may not encompass typical plant configurations. Finally, explain how any administrative action will be used to control the type of transient combustibles in a fire area.

Regarding the development and timing of the Hot Gas Layer (HGL) calculations, please provide the following information:

i) Explain when and how wall and corner effects were accounted for in the HGL timing calculations. Describe the process for selecting alternate scenarios that have characteristics that are consistent with the "image" method adjustments, as described at the end of the first paragraph on page J-4 of the LAR Attachment J.

j) Explain how the time to ignition of the lowest tray was determined in the FLASH-CAT cable tray fire propagation calculations.

Regarding the acceptability of CFAST for the MCR abandonment time calculations, please provide the following information:

k) During the onsite regulatory audit from April 20-23, 2015, the NRC staff noted that the licensee has completely revised the MCR abandonment calculations. Please explain the differences between the original and the revised analyses, and, in particular, provide an explanation regarding the assumptions that were made and the scenarios that were modeled. In addition, please provide technical justification for substantive, potentially non-conservative changes that were made in the assumptions for the calculations (e.g., increase of the effective volume of the MCR in CFAST, reduction of the peak HRR of the workstation fire, etc.).

l) Please provide the basis for the assumption that the fire brigade is expected to arrive within 15 minutes. In addition, describe the uncertainty associated with

this assumption, discuss possible adverse effects of not meeting this assumption on the results of the FPRA, and explain how possible adverse effects will be mitigated.

m) LAR Attachment H, Table H-1, "NFPA 805 Frequently Asked Question Summary Table," credits FAQ 08-0052, "Transient Fires - Growth Rates and Control Room Non-Suppression," dated August 4, 2009 (ADAMS Accession No. ML092120501). Please provide justification for using the transient fire growth rates that differ from those specified in FAQ 08-0052, and discuss the effect of these deviations on the risk results (i.e., core damage frequency (CDF), large early release frequency (LERF), ΔCDF, and ΔLERF).

n) Please provide the technical justification for the assumption that fire spreads to adjacent cabinets in 15 minutes, and not in 10 minutes as recommended in Appendix S of NUREG/CR-6850 for the case when cables in the adjacent cabinet are in direct contact with the separating wall.

o) During a plant walkdown as part of the onsite regulatory audit held from April 20-23, 2015, the NRC staff noted that several electrical cabinets in the electrical equipment area have plexiglass doors, and observed plastic cases with self-contained breathing apparatus and a partially covered vertical cable tray in the southwest corner of the electrical equipment area. Please provide technical justification for not explicitly considering fire scenarios that involve these combustibles in the MCR abandonment time calculations.

p) Regarding the sensitivity analysis:

   (i) A baseline fire scenario is considered insensitive if the change in the total probability of control room abandonment remains less than 15 percent. Please provide technical justification for the 15 percent criterion.

   (ii) The sensitivity analysis appears to indicate that raising the fire base to 1.2 m or 2.4 m significantly reduces the abandonment times for scenarios without operating HVAC. Please explain why the baseline scenarios were not updated to include the higher fire elevations.

FM RAI 02

LAR Section 4.5.1 states, in part, that

> In accordance with the guidance in RG 1.205, a Fire PRA (FPRA) model was developed for ANO-1 in compliance with the requirements of Part 4 "Requirements for Fires at Power Probabilistic Risk Assessment Requirements," of the American Society of Mechanical Engineers (ASME) and American Nuclear Society (ANS) combined PRA Standard, ASME/ANS RA-Sa-2009, 'Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Application,'..."

ASME/ANS Standard RA-Sa-0009, Part 4, requires damage thresholds be established to support the FPRA. The standard further states that thermal impact(s) must be considered in determining the potential for thermal damage of systems, structures, and components (SSCs) and appropriate temperature and critical heat flux criteria must be used in the analysis.

Please provide the following information:

a) Describe how the installed cabling in the power block was characterized, specifically with regard to the critical damage threshold temperatures and critical heat fluxes for thermoset and thermoplastic cables as described in NUREG/CR-6850.

b) In any fire area, explain how cable tray covers, fire-resistant coatings, and fire wraps were credited in terms of delaying or preventing damage of cables. In addition, explain how holes in cable tray covers were treated in regard to the fire modeling damage criteria.

c) Explain how the damage thresholds for non-cable components (i.e., pumps, valves, electrical cabinets, etc.) were determined. Identify any non-cable components that were assigned damage thresholds different from those for thermoset and thermoplastic cables, and provide a technical justification for these damage thresholds.

d) Describe the damage criteria that were used for exposed temperature-sensitive electronic equipment. Explain how temperature-sensitive equipment inside an enclosure was treated, and provide a technical justification for these damage criteria.

FM RAI 03

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

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

LAR Section 4.5.1.2, "Fire PRA," states, in part, that:

> Fire modeling was performed as part of the Fire PRA development (NFPA 805 Section 4.2.4.2).

Reference is made to LAR Attachment J, "Fire Modeling V&V," for a discussion of the V&V of the fire models that were used.

Furthermore, LAR Section 4.7.3, "Compliance with Quality Requirements in Section 2.7.3 of NFPA 805," states, in part, that:

> Calculational models and numerical methods used in support of compliance with 10 CFR 50.48(c) were verified and validated as required by Section 2.7.3.2 of NFPA 805.

Regarding the V&V of fire models, for any fire modeling tool or method that was in the development of the LAR or that is identified in the response to FM RAI 01(a) above, provide the V&V basis if not already explicitly provided in the LAR (e.g., in LAR Attachment J).

FM RAI 04

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

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

LAR Section 4.7.3, "Compliance with Quality Requirements in Section 2.7.3 of NFPA 805," states, in part, that:

> Engineering methods and numerical models used in support of compliance with 10 CFR 50.48(c) were used appropriately and will continue to be used as required by Section 2.7.3.3 of NFPA 805.

Regarding the limitations of use, please identify the use, if any, of the GFMTs approach (including the GFMTs supplements), outside the limits of applicability of the method. For those cases, explain how the use of the GFMTs approach was justified.

FM RAI 05

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

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

LAR Section 4.5.1.2, "Fire PRA," states that fire modeling was performed as part of the Fire PRA development (NFPA 805 Section 4.2.4.2). This requires that qualified fire modeling and PRA personnel work together. Furthermore, LAR Section 4.7.3, "Compliance with Quality Requirements in Section 2.7.3 of NFPA 805," states:

> Cognizant personnel who use and apply engineering analysis and numerical methods in support of compliance with 10 CFR 50.48(c) are competent and experienced as required by Section 2.7.3.4 of NFPA 805.

> During the transition to 10 CFR 50.48(c), work was performed in accordance with the quality requirements of Section 2.7.3 of NFPA 805. Personnel who used and applied engineering analysis and numerical methods (e.g. fire modeling) in support of compliance with 10 CFR 50.48(c) are competent and experienced as required by NFPA 805 Section 2.7.3.4.
>
> Post-transition, for personnel performing fire modeling or FPRA development and evaluation, Entergy will develop and maintain qualification requirements for individuals assigned various tasks. Position Specific Guides will be developed to identify and document required training and mentoring to ensure individuals are appropriately qualified per the requirements of NFPA 805, Section 2.7.3.4, to perform assigned work (see Attachment S).

Regarding qualifications of users of engineering analyses and numerical models, please provide the following information:

- Describe what constitutes the appropriate qualifications for the staff and consulting engineers to use and apply the methods and fire modeling tools included in the engineering analyses and numerical models.
- Describe the process for ensuring the adequacy of the appropriate qualifications of the engineers and personnel performing the fire analyses and modeling activities.
- Explain the communication process between the fire modeling analysts, PRA personnel, consulting engineers, and operations personnel to exchange the necessary information, and any measures taken to assure fire modeling was performed adequately and will continue to be performed adequately during post-transition.

FM RAI 06

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

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

LAR Section 4.7.3, "Compliance with Quality Requirements in Section 2.7.3 of NFPA 805," states, in part, that:

> Uncertainty analyses were performed as required by Section 2.7.3.5 of NFPA 805 and the results were considered in the context of the application. This is of particular interest in fire modeling and FPRA development.

Regarding the uncertainty analysis for fire modeling, please provide the following information:

a. Describe how the uncertainty associated with the input parameters (compartment geometry, radiative fraction, thermophysical properties, etc.) were addressed and accounted for in the fire modeling analyses.

b. Describe how the "model" and "completeness" uncertainties were accounted for in the fire modeling analyses.

Radioactive Release RAI 01

NFPA 805, Section 1.3.2, states, in part, that:

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

For areas where engineered containment is not provided to contain radioactive effluent, please describe manual actions or temporary measures that may be taken to contain or limit potential liquid and gaseous effluent releases (storm drain covers, dikes, eductors, etc.).

Probabilistic Risk Assessment (PRA) RAI 01 - Fire PRA Facts and Observations

Section 2.4.3.3 of NFPA 805 states that the probabilistic safety assessment (PSA) (PSA is also referred to as PRA) approach, methods, and data shall be acceptable to the AHJ, which is the NRC. RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting a FPRA and endorses, with exceptions and clarifications, NEI 04-02 Revision 2, "Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c)," April 2008 (ADAMS Accession No. ML081130188), as providing methods acceptable to the staff for adopting a fire protection program consistent with NFPA-805. RG 1.200, Revision 2, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-informed Activities," March 2009 (ADAMS Accession No. ML090410014), describes a peer review process utilizing an associated ASME/ANS standard (ASME/ANS-RA-Sa-2009) as one acceptable approach for determining the technical adequacy of the PRA once acceptable consensus approaches or models have been established for evaluations that could influence the regulatory decision. The primary result of a peer review are the Facts and Observations (F&Os) recorded by the peer review team and the subsequent resolution of these F&Os.

Please clarify the following dispositions to the ANO-1 FPRA F&Os and Supporting Requirements (SRs) assessment identified in LAR Attachment V that have the potential to impact the Fire PRA results and do not appear to be fully resolved:

a) PP-B3-01 (Credit for Spatial Separation)

The disposition to this F&O states, in part, that: "No fires were judged to credibly breach the spatial separation and no hot gas layer potential exists." While it appears clear from this statement that there is no potential for formation of a HGL

in areas where spatial separation was credited, it is not apparent what the statement "no fires were judged to credibly breach the spatial separation" means. Guidance in Section 1.5.2 of NUREG/CR-6850 allows use of partial separation of 20 feet given this space is absent of combustibles and fire ignition sources and there is no potential for formation of a HGL.

i. Designate the distance used to define spatial separation and describe the basis for justifying that this space is absent of combustibles and fire ignition sources.

ii. If the approach to modeling spatial separation is not consistent with guidance in NUREG/CR-6850 then replace the current approach with an acceptable approach in the integrated analysis provided in response to PRA RAI 03.

b) PP-B5-01, FSS-G4-01, and FSS-G5-01 (Credit for Fire Barriers)

The dispositions for F&Os PP-B5-01, FSS-G4-01, and FSS-G5-01 explain that failure of fire barriers, including active fire barriers, is evaluated in the Multiple-Compartment Analysis (MCA) by assigning a generic failure probability of 0.0074 from NUREG/CR-6850 based on the probability of fire door failure. It is not clear how this limited consideration of barrier failure reflects all the types of barriers present between Physical Analysis Units (PAUs), including active barriers such as water curtains and fusible link actuated dampers.

i. Please justify why the failure probability for a passive component can be used as the failure probability for active fire barriers given that failure probabilities of passive components are typically lower than active components.

ii. Please explain how the impact of fire on cables associated with active fire barriers was considered. If the current treatment of active barriers cannot be justified, then please provide an acceptable method in the integrated analysis provided in response to PRA RAI 03.

iii. Please update risk results as part of the integrated analysis provided in response to PRA RAI 03, postulating at least one propagation scenario summing the generic barrier probabilities for each type of barrier present between PAUs, consistent with NUREG/CR-6850 guidance.

c) FSS-C1-01 (Panel Factors)

The disposition for this F&O states that a "Conditional Probability of Propagating Fire factors" method was used for vented panels based on split fraction specifying the "fraction of the fires impacting only the ignition source panel versus those fires which impact targets within the zone of influence of the panels." The fire scenario analysis appears to indicate that an alternate method that considers

rate of target damage is used instead to make the distinction between "non-severe" and "severe" fires.

i. Please explain which modeling approach was used to model fire spread to another target to meet the requirements of SR FSS-C1 to have a two-point fire intensity model.

ii. If the cited method is the "panel factors" approach not accepted by NRC, as stated in the letter from Joseph Giitter of the NRC to Biff Bradley of the NEI, dated June 21, 2012 (ADAMS Accession No. ML12171A583), then please explain why this method was not removed from the integrated analysis provided in response to PRA RAI 3.

iii. Please describe how target damage sets are developed for both "non-severe" and "severe" scenarios in the FPRA, considering circumstances where there is a HGL and where there is not.

iv. If the cited method is the not the "panel factors" approach, then please provide a brief description of the method used at ANO-1, and justify that it is consistent with accepted methods.

d) FSS-G2-01 (Distributed HGL growth rates)

The disposition to this F&O explains that distributed manual suppression probabilities based on 20-, 30-, and 60-minute HGL growth rates were used. The NRC staff reviewed the Multi-Compartment and HGL analyses report and notes that a convolution process was used involving nine HRR/Severity Factor bins, time to a HGL, and non-suppression probabilities for different volumes. However, the NRC staff did not fully understand how 20-, 30-, and 60-minute HGL growth rates were used as explained in the disposition. Describe how the use of 20-, 30-, and 60-minute HGL growth rates were incorporated into the analyses.

e) CF-A1-01 (Updated guidance on circuit failure mode likelihood analysis in NUREG/CR-7150)

New guidance on using conditional probabilities of spurious operation for control circuits is contained in a letter dated April 23, 2014, from Joseph Giitter, NRC, to Michael Tschiltz, NEI, "Supplemental Interim Technical Guidance on Fire-Induced Circuit Failure Mode Likelihood Analysis" (ADAMS Package Accession No. ML14111A366), and in Section 7 of NUREG/CR-7150, "Joint Assessment of Cable Damage and Quantification of Effects from Fire (JACQUE-FIRE)," Volume 2: Expert Elicitation Exercise for Nuclear Power Plant Fire-Induced Electrical Circuit Failure, Final Report, May 2014 (ADAMS Accession No. ML14141A129). This guidance includes: a) replacement of the conditional hot short probability tables in NUREG/CR-6850 for Option #1 (including removal of credit for CPTs and conduit) with new circuit failure probabilities for single-break and double-break control circuits (Option #2 in

NUREG/CR-6850 is no longer an adequate method and should not be used); b) replacement of the probability of spurious operation duration figure in FAQ 08-0051 (NUREG/CR-6850 Supplement 1) for alternating current (AC) control circuits and additional guidance to address duration for direct current (DC) control circuits; c) a method for incorporation of the uncertainty values for the circuit failure probabilities and spurious operation duration in the state-of-knowledge correlation (SOKC) for developing the mean CDF/LERF; and, d) recommendations on the hot short probabilities to use for other cable configurations, including panel wiring, trunk cables, and instrument cables.

Please provide an assessment of the assumptions used in the FPRA relative to the updated guidance in NUREG/CR-7150, Volume 2, specifically addressing each of the items a) through d) above. If the FPRA assumptions are not bounded by the new guidance, please provide a justification for each difference or provide updated risk results as part of the integrated analysis requested in PRA RAI 03, utilizing the guidance in NUREG/CR-7150, Volume 2.

f) HRA-A3-01 and ES-C2-01 (Undesirable operator actions caused by spurious actuations)

F&Os HRA-A3-01 and ES-C2-01 questioned how spurious indications that could result in undesirable operator actions were evaluated. The disposition to the F&Os discusses instrument failures but does not clarify how operator actions resulting from spurious indications are addressed by the analysis.

Given that fire can create spurious indications, please clarify how spurious instrument indications were treated in the FPRA. Please include explanation of how scenario specific spurious indications were either modeled in the FPRA, or discounted as not impacting the fire scenario.

g) HRA-B3-01 and HRA-E1-01 (New HFEs Credited in the Fire PRA)

F&O HRA-B3-01 states that new HFEs for operator actions which are used in current procedures but not modeled in the internal events PRA have not been evaluated for viability and have not been peer reviewed against the Human Reliability Analysis (HRA) PRA Standard. The disposition explains that the HRA was performed for these events in the same manner (i.e., detailed modeling) as for HFEs modeled in the Internal Events PRA. Fire related HFEs should be evaluated using guidance in NUREG 1921, "EPRI/NRC-RES Fire Human Reliability Analysis Guidelines," July 2012 (ADAMS Accession No. ML12216A104)). Please confirm that this guidance was used for the new HFE evaluations and that the evaluations were peer reviewed.

h) F&Os FQ-A4-01 and UNC-A1-01 (SOKC)

The dispositions to F&Os FQ-A4-01 and UNC-A1-01 indicate that quantitative analysis of uncertainty intervals was performed. Section W.1 of the LAR further explains that parametric uncertainty analysis was performed for ignition

frequencies, circuit failure probabilities, non-suppression probabilities, HRA, and internal event PRA failure data. PRA Standard SR QU-A3 (referenced by Fire PRA SR FQ-A4) requires that the mean CDF be estimated accounting for the SOKC between event probabilities. It is not apparent from the uncertainty analysis whether SOKC was considered.

Please explain whether SOKC was taken into account for the uncertainty parameters cited in Section W.1 of the LAR. If CDF and LERF were estimated without accounting for the SOKC for these parameters, then please account for SOKC in the integrated analysis performed in response to PRA RAI 3.

i) FSS-G3-06 (Insufficient technical justification)

F&O FSS-G3-06 states that there are a number of statements in the licensee's HGL and MCA analysis documentation which appear to lack technical justification and identifies six examples. The disposition to this F&O does not explicitly address the six examples provided in the F&O, nor does it explain how elimination of "Table 3-1" of the cited documentation resolves the F&O. Please explain how all issues discussed in Table 3-1 have been resolved.

PRA RAI 02 - Internal Events PRA F&Os

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting a Fire PRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the staff for adopting a fire protection program consistent with NFPA-805. RG 1.200 describes a peer review process utilizing an associated ASME/ANS standard (currently ASME/ANS-RA-Sa-2009) as one acceptable approach for determining the technical adequacy of the PRA once acceptable consensus approaches or models have been established. The primary results of a peer review are the F&Os recorded by the peer review and the subsequent resolution of these F&Os.

Please clarify the following dispositions to Internal Events F&Os and SRs assessment identified in the LAR Attachment U that have the potential to impact the Fire PRA results and do not appear to be fully resolved:

a) SY-B14, SY-A22, and AS-B3 (Phenomenological conditions associated with each accident sequence)

SR SY-B14 stipulates that SSCs that need to operate in conditions beyond their environmental qualifications should be identified. SR SY-A22 states that credit for component operability can be taken only if analysis exists to demonstrate rated design capabilities are not exceeded. Though the disposition states that this F&O is only a documentation issue, it is not clear how it can be concluded that not meeting these F&Os has no impact on the FPRA. The NRC staff reviewed the Internal Events PRA notebooks and could not determine whether such assessment had been performed.

i. Please explain whether phenomenological conditions associated with each accident sequence were assessed to determine impact on the successful credited function of SSCs.

ii. If this assessment was not performed or if the results were not applied to the FPRA, please address these impacts in the integrated analysis provided in response to PRA RAI 3.

b) LE-G5 (LERF analysis limitations)

The F&O disposition states that LERF quantifications were performed with qualified computer codes. However, the F&O and SR LE-G5 (i.e., identify limitations in the LERF analysis that would impact applications) are applicable to more than software limitations. Please explain how LERF modeling limitations were assessed and explain the impact of these limitations on the FPRA.

c) LE-A4, LE-E1, LE-C7 (HFE modeling for LERF)

The F&O disposition states that no dependency analysis was performed for LERF HFEs because of the "relatively long" time internal between Level 1 and Level 2 events and because the cues for Level 1 and Level 2 operator actions are different.

Please describe and justify the treatment of these and other possible dependency elements discussed in NUREG-1921 such as common crew, common instrumentation (cognitive), and stress using the guidance for dependency analysis in NUREG-1921.

d) DA-C10 (Data – counting operational demands)

Based on the NRC staff's review of the F&O disposition for DA-C10, it appears that surveillance tests were not fully evaluated to adjust the demand count of component failures based on what failure modes are evaluated in the tests. Given that the potential impact from this evaluation is unknown and several component failure rates could be affected, it is not apparent how it can be

concluded that resolution of this finding would have only a "very small impact" on the FPRA results.

Please provide further justification for not fully evaluating surveillance tests and adjusting the failure rates used in the FPRA for post-transition change evaluation (i.e., when the PRA results are compared against the self-approval guidance for post transition change evaluation).

e) DA-C4, DA-E2 (Data – counting failures)

Based on the NRC staff's review of the F&O disposition for DA-C4/DA-E2, it appears that consideration of plant-specific component data for the FPRA was limited to the data in the Maintenance Rule Database. Given that the potential impact from evaluating these additional failures from data sources outside the Maintenance Rule Database is unknown and that a number of failure rates could be affected, it is not clear how it can be concluded that resolution of this finding would have only a "very small impact" on the FPRA results.

Please provide further justification for not considering plant-specific component failure data beyond the data in the Maintenance Rule Database in the FPRA for post-transition change evaluation (i.e., when the PRA results are compared against the self-approval guidance for post-transition change evaluation).

PRA RAI 03 – Integrated Analysis

Section 2.4.4.1 of NFPA-805 states that the change in public health risk arising from transition from the current fire protection program to an NFPA-805 based program, and all future plant changes to the program, shall be acceptable to the NRC. RG 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," Revision 2, dated May 2011 (ADAMS Accession No. ML100910006), provides quantitative guidelines on CDF and LERF, and identifies acceptable changes to these frequencies that result from proposed changes to the plant's licensing basis and describes a general framework to determine the acceptability of risk-informed changes. The NRC staff review of the information in the LAR has identified additional information that is required to fully characterize the risk estimates.

The PRA methods currently under review in the LAR include:

- PRA RAI 1.a regarding spatial separation
- PRA RAI 1.b regarding fire barriers
- PRA RAI 1.d regarding fire propagation from electrical cabinets
- PRA RAI 1.h regarding circuit failure likelihood analysis
- PRA RAI 1.j regarding modeling new fire Human Error Events
- PRA RAI 1.k regarding state of knowledge correlation (SOKC)
- PRA RAI 2.a regarding impact of phenomenological conditions
- PRA RAI 2.d regarding counting operational demands
- PRA RAI 2.e regarding counting failures
- PRA RAI 4 regarding reduced transient HRRs

- PRA RAI 5 regarding treatment of sensitive electronics
- PRA RAI 7 regarding propagation of fire from >440 V electrical cabinets
- PRA RAI 8 regarding use of the transient frequency adjustment factors
- PRA RAI 9 regarding fire propagation in the MCR
- PRA RAI 11 regarding crediting MCR abandonment
- PRA RAI 12 regarding multiple versus single cables
- PRA RAI 14 regarding large reduction credit for modifications
- FM RAI 1.k regarding evaluation of MCR abandonment times

Please provide the following information:

a) Results of an aggregate analysis that provides the integrated impact on the fire risk (i.e., the total transition CDF, LERF, ΔCDF, ΔLERF) of replacing specific methods identified above with alternative methods which are acceptable to the NRC. In this aggregate analysis, for those cases where the individual issues have a synergistic impact on the results, a simultaneous analysis must be performed. For those cases where no synergy exists, a one-at-a-time analysis may be done. For those cases that have a negligible impact, a qualitative evaluation may be done. It should be noted that this list may expand depending on NRC's review of the responses to other RAIs in this document.

b) For each method (i.e., each bullet) above, please explain how the issue will be addressed in 1) the final aggregate analysis results provided in support of the LAR, and 2) the PRA that will be used at the beginning of the self-approval of post-transition changes. In addition, provide a method to ensure that all changes will be made, that a focused-scope peer review will be performed on changes that are PRA upgrades as defined in the PRA standard, and that any findings will be resolved before self-approval of post-transition changes.

c) In the response, explain how the RG 1.205 risk acceptance guidelines are satisfied for the aggregate analysis. If applicable, include a description of any new modifications or operator actions being credited to reduce delta risk as well as a discussion of the associated impacts to the fire protection program.

d) If any unacceptable methods or weaknesses will be retained in the PRA that will be used to estimate the change in risk of post-transition changes to support self-approval, explain how the quantification results for each future change will account for the use of these unacceptable methods or weaknesses.

PRA RAI 04 – Reduced Transient Heat Release Rates

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting a fire PRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the NRC staff for adopting a fire protection program consistent with NFPA-805. By letter to NEI dated July 12, 2006 (ADAMS Accession No. ML061660105), the NRC established the ongoing FAQ process where official agency positions regarding acceptable methods can be documented until they can be included in

revisions to RG 1.205 or NEI 04-02. Methods that have not been determined to be acceptable by the NRC staff require additional justification to allow the NRC staff to complete its review of the proposed method.

The fire scenario analysis appears to indicate that reductions below the 98th-percentile NUREG/CR-6850 HRR of 317 Kilowatts (kW) for transient fires may have been credited in detailed fire modeling in support of the FPRA. The licensee's analysis indicates that though a bounding 98 percent HRR of 317 kW from NUREG/CR-6850 was typically used, reduced transient fire HRRs were applied for some fire compartments. Please discuss the key factors used to justify the reduced rate below 317 kW per the guidance endorsed by the June 21, 2012, memorandum from Joseph Giitter, NRC, to Biff Bradley, NEI, "Recent Fire PRA Methods Review Panel Decisions and EPRI 1022993, 'Evaluation of Peak Heat Release Rates in Electrical Cabinets Fires'" (ADAMS Accession No. ML12171A583). Include in this discussion:

a) Identification of the fire areas where reduced HRR transient fires are credited.

b) For each location where a reduced HRR is credited, a description of the administrative controls that justify the reduced HRR including how location-specific attributes and considerations are addressed.

c) A discussion of required maintenance for ignition sources in each location, and types/quantities of combustibles needed to perform that maintenance.

d) A discussion of the personnel traffic that would be expected through each location.

e) The results of a review of records related to violations of the transient combustible and hot work controls.

PRA RAI 05 – Sensitive Electronics

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting a fire PRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the staff for adopting a fire protection program consistent with NFPA-805. By letter to NEI dated July 12, 2006, the NRC established the ongoing FAQ process where official agency positions regarding acceptable methods can be documented until they can be included in revisions to RG 1.205 or NEI 04-02. Methods that have not been determined to be acceptable by the NRC staff or acceptable methods that appear to have been applied differently than described require additional justification to allow the NRC staff to complete its review of the proposed method.

The fire scenario analysis appears to indicate that consideration of the impact of sensitive electronics is only considered for cabinets "touching or nearly touching" and was not considered "in areas such as the MCR where the fire would be expected to be extinguished quickly." Neither of these assumptions is consistent with the most recent guidance for performing assessment of sensitive electronics (i.e., FAQ 13-0004, "Clarifications on Treatment of Sensitive Electronics," dated December 3, 2013 (ADAMS Accession No. ML13322A085)).

Please describe the treatment of sensitive electronics for the FPRA and explain whether it is consistent with the guidance in FAQ 13-0004, including the caveats about configurations that can invalidate the approach (i.e., sensitive electronic mounted on the surface of cabinets and the presence of louver or vents). If the approach is not consistent with FAQ 13-0004, justify the approach or replace the current approach with an acceptable approach into the integrated analysis performed in response to PRA RAI 3.

PRA RAI 06 – Transient Fire Placement at Pinch Points

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting a fire PRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the staff for adopting a fire protection program consistent with NFPA-805. By letter to NEI dated July 12, 2006, the NRC established the ongoing FAQ process where official agency positions regarding acceptable methods can be documented until they can be included in revisions to RG 1.205 or NEI 04-02. Methods that have not been determined to be acceptable by the NRC staff or acceptable methods that appear to have been applied differently than described require additional justification to allow the NRC staff to complete its review of the proposed method.

The fire scenario analysis description provided in the LAR states that transient walkdowns were conducted to identify specific general transient locations where a transient combustible fire could impact trays, conduits, or risers. It is not clear from the analysis how "pinch points" were modeled for transient fires. Per the guidance provided in NUREG/CR-6850, Section 11.5.1.6, transient fires should at a minimum be placed in locations within the plant physical analysis units (PAUs) where conditional core damage probabilities (CCDPs) are highest for that PAU (i.e., at "pinch points"). The NRC staff notes that pinch points include locations of redundant trains or the vicinity of other potentially risk-relevant equipment. The NRC staff notes that transient fires due to hot work should be assumed to occur in locations where hot work is a possibility, even if improbable. Please provide the following information:

a) If different methods were used in different areas, provide an explanation for b), c), and d) for each method.

b) Explain how "pinch points" were identified and modeled for transient fires.

c) Include description of how transient fires and transient fires due to hot work are distributed within the PAUs and the criteria used to determine where such ignition sources are placed within the PAUs.

d) Include explanation of how ignition frequency for transient fires is allocated to specific fire scenarios.

PRA RAI 07 – Fire Propagation from Electrical Cabinets

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting a fire PRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the staff for adopting a fire protection program consistent with NFPA-805. By letter to NEI July 12, 2006, the NRC established the ongoing FAQ process where official agency positions regarding acceptable methods can be documented until they can be included in revisions to RG 1.205 or NEI 04-02. Methods that have not been determined to be acceptable by the NRC staff require additional justification to allow the NRC staff to complete its review of the proposed method.

The fire scenario analysis indicates that the contribution of "sealed panels" was excluded from fire modeling. It is not clear from the analysis how "sealed panels" are defined or how fire propagation from "sealed panels" versus "unsealed" panels were modeled. Nor is it clear from the ignition frequency assessment how "sealed panels" were counted. Please provide the following information:

a) Per Section 6.5.6 of NUREG/CR-6850, fires originating from within "well-sealed electrical cabinets that have robustly secured doors (and/or access panels) and that house only circuits below 440V," do not meet the definition of potentially challenging fires and, therefore, should be excluded from the counting process for Bin 15. By counting these cabinets as ignition sources within Bin 15, the frequencies applied to other cabinets may be inappropriately reduced.

   Please discuss how many Bin 15 cabinets are identified and how many of these are well-sealed less than 440 Volt (V) cabinets and the impact of this deviation from NUREG/CR-6850 on the transition and post-transition risk estimates.

b) Please clarify if the criteria used to evaluate whether electrical cabinets below 440 V are "well sealed" is consistent with guidance in Chapter 8 of Supplement 1 of NUREG/CR-6850. If not, please explain how the current approach is an acceptable approach in accordance with the integrated analysis performed in response to PRA RAI 03.

c) All cabinets having circuits of 440 V or greater should be counted for purposes of Bin 15 frequency apportionment based on the guidance in Section 6.5.6 of NUREG/CR-6850.

   Please clarify that this guidance is being applied. If not, please explain how the current approach is an acceptable approach in accordance with the integrated analysis performed in response to PRA RAI 03.

d) For those cabinets that house circuits of 440 V or greater, propagation of fire outside the ignition source should be evaluated based on guidance in Chapter 6 of NUREG/CR-6850, which states that "an arcing fault could compromise panel integrity (an arcing fault could burn through the panel sides, but this should not be confused with the high energy arcing fault type fires)."

Please describe how fire propagation outside of well-sealed cabinets greater than 440 V is evaluated. If propagation is not evaluated, please explain how the current approach is an acceptable approach in accordance with the integrated analysis performed in response to PRA RAI 03.

PRA RAI 08 – Transient Frequency Adjustment Factor

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting a fire PRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the staff for adopting a fire protection program consistent with NFPA-805. By letter to NEI dated July 12, 2006, the NRC established the ongoing FAQ process where official agency positions regarding acceptable methods can be documented until they can be included in revisions to RG 1.205 or NEI 04-02. Methods that have not been determined to be acceptable by the NRC staff require additional justification to allow the NRC staff to complete its review of the proposed method.

The fire scenario PRA analysis appears to indicate that a "Transient Frequency Adjustment Factor" of 0.1 was used to represent the fraction of time transient combustibles are allowed in the Cable Spreading Room. Section 6.5.7.2 of NUREG/CR-6850 states: "It is assumed that transient fires may occur at all areas of a plant unless precluded by design and/or operation, such as inside a BWR [boiling-water reactor] drywell or torus during power operation. Administrative controls significantly impact the characteristics and likelihood of transient fires, but do not preclude their occurrence, since there is industry evidence of failure to follow administrative control procedures."

Please remove credit for use of the Transient Frequency Adjustment Factor in the integrated analysis provided in response to PRA RAI 03, or replace it with an acceptable credit such as use of influencing factors per guidance in FAQ 12-0064, "Hot Work/Transient Fire Frequency – Influence Factors."

PRA RAI 09 – Modeling of Fire Propagation in the MCR

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting a fire PRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the NRC staff for adopting a fire protection program consistent with NFPA-805. By letter to NEI dated July 12, 2006, the NRC established the ongoing FAQ process where official agency positions regarding acceptable methods can be documented until they can be included in revisions to RG 1.205 or NEI 04-02. Methods that have not been determined to be acceptable by the NRC staff require additional justification to allow the NRC staff to complete its review of the proposed method.

The fire scenario analysis states "[f]or electrical panel fires inside the control room the fire is expected to be contained within the panel due to early fire detection and suppression by operations personnel." This statement appears to be inconsistent with guidance for addressing the potential for fire propagation between adjacent electrical panels/cabinets in

NUREG/CR-6850. It is not clear from the analysis how the potential for fire propagation between adjacent electrical panels/cabinets in the MCR was addressed.

a) Please describe the approach used to model fire propagation between adjacent Bin 15 electrical panels in the MCR and between segments of the Bin 4 Main Control Board.

b) If the potential for fire propagation between adjacent electrical panels/cabinets has not been evaluated or is not consistent with NRC guidance, please justify the approach or use an acceptable approach in the integrated analysis provided in response to PRA RAI 3.

PRA RAI 10 – MCR Abandonment Scenarios due to Loss of Habitability

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting a Fire PRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the staff for adopting a fire protection program consistent with NFPA-805. By letter to NEI dated July 12, 2006, the NRC established the ongoing FAQ process where official agency positions regarding acceptable methods can be documented until they can be included in revisions to RG 1.205 or NEI 04-02. Methods that have not been determined to be acceptable by the NRC staff or acceptable methods that appear to have been applied differently than described require additional justification to allow the NRC staff to complete its review of the proposed method.

The fire scenario analysis indicates that MCR abandonment due to loss of habitability (LOH) in the MCR was credited in the Fire PRA. However, beyond presenting the times to abandonment due to LOH for different fire scenarios, the analysis does not indicate how these scenarios were modeled. Table W-1a of the LAR appears to indicate that a single scenario (i.e., 129-F/A) was used to model MCR abandonment due to LOH based on an aggregation of the frequency of abandonment into a single frequency representing multiple fire sources in the MCR. There appears to be just five HFEs in the HRA designated as MCR abandonment actions which is in contrast to the large number of actions identified in the MCR abandonment procedure. Accordingly, it is not completely clear how MCR abandonment was modeled in the Fire PRA or how the range of potential fire-induced failures resulting from fires leading to MCR abandonment were addressed. In light of these observations, please provide the following information:

a) Please describe how MCR abandonment was modeled for LOH. Include an explanation of how the CCDPs and conditional large early release probabilities (CLERPs) were estimated. Include identification of the actions required to execute safe alternate shutdown and how they are modeled in the Fire PRA, including actions that must be performed before leaving the MCR.

b) Please explain how the CCDPs and CLERPs that were estimated for fires which lead to abandonment due to LOH address various possible fire-induced failures and provide the range of CCDPs for MCR abandonment due to LOH. Specifically include in this explanation, a discussion of how the following scenarios are addressed:

   i. Scenarios where fire fails only a few functions aside from forcing MCR abandonment and successful alternate shutdown is straightforward;

   ii. Scenarios where fire could cause some recoverable functional failures or spurious operations that complicate the shutdown, but successful alternate shutdown is likely; and,

   iii. Scenarios where the fire-induced failures cause great difficulty for shutdown by failing multiple functions and/or complex spurious operations that make successful shutdown unlikely.

c) Please provide the frequency of MCR abandonment for LOH for the variant case and the compliant case.

d) Please provide the CCDP(s) and CLERP(s) for the variant case and the compliant case.

PRA RAI 11 – Credit for MCR Abandonment for Loss of Control Scenarios

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting a fire PRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the staff for adopting a fire protection program consistent with NFPA-805. By letter to NEI dated July 12, 2006, the NRC established the ongoing FAQ process where official agency positions regarding acceptable methods can be documented until they can be included in revisions to RG 1.205 or NEI 04-02. Methods that have not been determined to be acceptable by the NRC staff or acceptable methods that appear to have been applied differently than described require additional justification to allow the NRC staff to complete its review of the proposed method.

The LAR does not indicate whether MCR abandonment (i.e., "evacuation" in procedure 1203.002) due to loss of control (LOC) (i.e. use of "Alternative Shutdown") is modeled or credited in the Fire PRA. Please clarify whether MCR abandonment due to LOC is credited in the Fire PRA analysis. If it was credited, then provide the following information:

a) Please explain how the variant plant PRA models scenarios which threaten "immediate damage to major portions of vital controls" or "immediate damage to a significant number of cables."

b) Please explain how the compliant plant PRA models scenarios which threaten "immediate damage to major portions of vital controls" or "immediate damage to a significant number of cables."

c) Please describe how the human error probabilities (HEPs) are developed for the scenarios in a) and b) above and confirm that the timing associated with the cues to implement alternate shutdown and the times available to perform alternate shutdown have been evaluated.

d) Please explain how the CCDPs/CLERPs are estimated for scenarios in a) and b) above.

e) Please provide your range of CCDPs/CLERPs for the scenarios in a) and b) above.

PRA RAI 12 – Single vs Multiple Bundle Cables in MCR Analysis

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting a fire PRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the staff for adopting a fire protection program consistent with NFPA-805. By letter to NEI dated July 12, 2006, the NRC established the ongoing FAQ process where official agency positions regarding acceptable methods can be documented until they can be included in revisions to RG 1.205 or NEI 04-02. Methods that have not been determined to be acceptable by the NRC staff or acceptable methods that appear to have been applied differently than described require additional justification to allow the NRC staff to complete its review of the proposed method.

The fire scenario analysis for determining MCR abandonment times indicates that it was assumed that "half of the panels will involve a single cable bundle and the other half will be multiple bundle cables," and that because of "rapid detection of fires in the control room significantly more than 50% of the fires are likely to be detected and suppressed before progressing to multiple cable bundle fires." These assumptions appear to be made without supporting fire modeling or event data and so it is not clear what the opportunity for suppression is before cables in multiple bundles are involved in a fire, and whether this assumption is conservative compared to, for example, specifically identifying and modeling single and multiple cable bundles based on a walkdown. The NRC staff also notes that this assumption is a deviation from NUREG/CR-6850 guidance, which treats individual electrical panels as containing either a single cable bundle or multiple cable bundles.

Please provide further justification that the assumption is conservative based on characterization of the actual cable bundle configurations in the MCR cabinets, or update risk results as part of the integrated analysis requested in PRA RAI 03.

PRA RAI 13 - Calculation of VFDR ΔCDF and ΔLERF

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. Section 2.4.4.1 of NFPA-805 further states that the change in public health risk arising from transition from the current FPP to an NFPA-805 based program, and all future plant changes to the program, shall be acceptable to the NRC. RG 1.174 provides quantitative guidelines on CDF and LERF, and identifies acceptable changes to these

frequencies that result from proposed changes to the plant's licensing basis and describes a general framework to determine the acceptability of risk-informed changes. The NRC staff review of the information in the LAR has identified the following information that is required to fully characterize the risk estimates.

Attachment W of the LAR, Section W.2, "Risk Change due to NFPA 805 Transition," provides a description of how the change-in-risk associated with VFDRs is determined but not enough detail to make the approach completely understood. Please provide the following information:

a) A detailed definition of both the post-transition and compliant plant models used to calculate the reported change-in-risk due to the NFPA 805 transition. Include a description of the model adjustments made to remove VFDRs from the compliant plant model, such as adding events or logic, or use of surrogate events. Also, include an explanation of how VFDR and non-VFDR modifications are addressed for both the post-transition and compliant plant models. Include an explanation of whether the approach is consistent with guidance in FAQ 08-0054, "Demonstrating Compliance with Chapter 4 of NFPA 805."

b) A separate description of how the change-in-risk was determined for 1) MCR abandonment due to loss of habitability and 2) MCR abandonment due to loss of control. Include a discussion of how the CCDPs/CLERPs were determined for both the variant plant and the compliant plant models for each of these types of scenarios. Note that an overestimate of the compliant plant risk, unless offset with a similar overestimate in the variant plant risk, results in a non-conservative analysis of the delta risk. If the methods apply different assumptions to the variant and the compliant plant risk estimates, an indeterminate but non-conservative impact on the change-in-risk estimate may result. Based on the modeling of the compliant and the variant plant, discuss whether the change-in-risk estimate is realistic, potentially conservative or potentially non-conservative.

c) An explanation of any major changes made to the Fire PRA model or data for the purpose of evaluating VFDRs.

d) A description of the type of VFDRs identified, and discussion whether and how the VFDRs identified, but not modeled in the Fire PRA, impact the risk estimates. Note 1 to Table W-2 of the LAR provides qualitative rationale for excluding VFDRs from the change-in-risk calculations associated with HVAC systems and equipment required to transition to cold shutdown. Identify and describe any other types of VFDRs excluded from the change-in-risk calculations.

PRA RAI 14 – Additional Risk of Recovery Actions

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. Section 2.4.4.1 of NFPA-805 further states that the change in public health risk arising from transition from the current FPP to an NFPA-805 based program, and all future plant changes to the program, shall be acceptable to the NRC. RG 1.174 provides quantitative guidelines on CDF and LERF, and identifies acceptable changes to these

frequencies that result from proposed changes to the plant's licensing basis and describes a general framework to determine the acceptability of risk-informed changes. The NRC staff review of the information in the LAR has identified the following information that is required to fully characterize the risk estimates.

Attachment W of the LAR, Section W.1, cites the licensee's analysis on calculation of additional risk of recovery actions risk associated with VFDRs, but does not provide a description of this calculation in the LAR. The NRC staff notes that per Attachment G of the LAR, recovery actions are only credited in two fire areas, Fire G and B-1@BOFZ. Please describe how the additional risk of recovery actions is calculated for these two areas. Please include an explanation of whether the approach is consistent with guidance in FAQ 07-0030, "Establishing Recovery Actions."

PRA RAI 15 – Large Reduction Credit for Modifications

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. Section 2.4.4.1 of NFPA-805 further states that the change in public health risk arising from transition from the current FPP to an NFPA-805 based program, and all future plant changes to the program, shall be acceptable to the NRC. RG 1.174 provides quantitative guidelines on CDF and LERF, and identifies acceptable changes to these frequencies that result from proposed changes to the plant's licensing basis and describes a general framework to determine the acceptability of risk-informed changes. The NRC staff review of the information in the LAR has identified the following information that is required to fully characterize the risk estimates.

Appreciable risk reduction credit is presented in Attachment W of the LAR for non-VFDR risk reduction modifications, judging by the large negative total change-in-risk. Section 3.2.5 of RG 1.205 states that risk decreases may be combined with risk increases for the purposes of evaluating combined changes in accordance with regulatory positions presented in Sections 1.1 and 1.2 of RG 1.174, Revision 2, but that the total increase and total decrease in the ΔCDF and ΔLERF should be provided. Table W-1a of the LAR reports the net change-in-risk values for each fire area after the risk increase associated with unresolved VFDRs is offset with the risk decrease associated with modifications, but does not present the total increase associated with unresolved VFDRs and the total decrease associated with modifications.

The NRC staff notes that conservative calculation of the compliant plant CDF and LERF can lead to a non-conservative calculation of the ΔCDF and ΔLERF. The NRC staff observes that the dominant scenario listed in Table W-1a of the LAR (i.e., 100-N/A) involves a scenario in which all targets in the fire zone are damaged which seems to imply the scenario was conservatively modeled. Dispositions to Fire PRA F&Os indicate that modeling conservatisms exist such as limited credit for suppression and detection systems and simplified modeling for high risk areas. The NRC staff acknowledges that installation of a new auxiliary feedwater (AFW) pump, redundant DC control power to switchgear, and other modifications represent significant risk reduction. However, given the significance of the risk reduction credited for modifications, and the fact that a conservative calculation of the compliant plant CDF and LERF

can lead to a non-conservative calculation of the ΔCDF and ΔLERF, please provide the following information:

a) Please provide (or point out if already provided) the total risk increase associated with unresolved VFDRs and the total decrease associated with non-VFDR modifications.

b) Please summarize the risk significant scenarios for fire areas in the compliant plant model which are most significantly impacted by risk reduction from modifications, and discuss the contribution of fire-induced failures for those scenarios.

c) Please discuss the impact of any important modeling assumptions contributing to the risk significant scenarios for fire areas in the compliant plant model. Specifically address conservative modeling assumptions made in the compliant plant model that may artificially reduce the calculated change-risk-risk (or result in overestimating the risk offset).

d) If conservative modeling of the compliant plant contributes to the under estimation of the total change in risk, then demonstrate that the total risk increase associated with unresolved VFDRs is offset by the total risk decrease associated with risk reduction modifications even when the conservative modeling is removed. Alternatively, demonstrate that the conservative modeling does not significantly impact the change in risk or replace the conservative modeling with realistic modeling that does not underestimate the total change-in-risk in the integrated analysis provided in response to PRA RAI 3.

PRA RAI 16 – Defense in Depth and Safety Margin

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. Section 2.4.4.1 of NFPA-805 further states that the change in public health risk arising from transition from the current fire protection program to an NFPA-805 based program, and all future plant changes to the program, shall be acceptable to the NRC. RG 1.174 provides quantitative guidelines on CDF and LERF, and identifies acceptable changes to these frequencies that result from proposed changes to the plant's licensing basis and describes a general framework to determine the acceptability of risk-informed changes. The NRC staff review of the information in the LAR has identified the following information that is required to fully characterize the risk estimates.

LAR Section 4.5.2.2 provides a high-level description of how transition to NFPA 805 impacts DID and safety margin.

a) Please provide further explanation of the method used to determine when a substantial imbalance between DID echelons existed in the Fire Risk Evaluations (FREs), and identify the types of plant improvements made in response to this assessment.

b) Please provide further discussion of the approach in applying the NEI 04-02, Revision 2 criteria for assessing safety margin in the FREs.

PRA RAI 17 – Focused Scope Reviews and Model Changes after the Full Peer Review

NFPA 805 Section 2.4.3.3 states that the PRA approach, methods, and data shall be acceptable to the NRC. RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting a fire PRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the staff for adopting a fire protection program consistent with NFPA-805. RG 1.200 (currently Revision 2) describes a peer review process utilizing an associated ASME/ANS standard (currently ASME/ANS-RA-Sa-2009) as one acceptable approach for determining the technical adequacy of the PRA once acceptable consensus approaches or models have been established.

Attachment U of the LAR states that a "Regulatory Guide (RG) 1.200, Revision 1 Peer Review against the American Society of Mechanical Engineers (ASME)/American Nuclear Society (ANS) PRA Standard requirements" was performed on the ANO-1 Internal Events PRA in August 2009. Revision 2 of RG 1.200 was issued in March 2009, and is the version of the regulatory guide that should be used to support risk-informed applications submitted after March 2010, including the ANO-1 NFPA-805 LAR. The NRC staff also notes that a number of revisions and updates were made in response to the reported peer review F&Os.

a) Clarify how the review of the ANO-1 PRA complies with Revision 2 of RG 1.200 and provide any additional F&Os or related findings summarizing the assessment of the ANO-1 Internal Events PRA against Revision 2.

b) If any changes made to the Internal Event PRA or Fire PRA since the last full-scope peer review are consistent with the definition of a PRA upgrade in ASME/ANS-RA-Sa-2009, confirm whether a focused-scope peer review was performed for these changes. Provide any findings from that focused-scope peer review and the resolution of these findings, unless they were already provided in the LAR.

c) Confirm that all focused-scope peer reviews were performed consistent with RG 1.200 endorsed methods.

PRA RAI 18 – Minimum Joint HEP Values

Confirm that each joint HEP value used in the Fire PRA below 1.0E-05 includes its own justification that demonstrates the inapplicability of the NUREG-1792 lower value guideline. Provide an estimate of the number of these joint HEPs below 1.0E-05 and at least two different examples of the justification.

Timetable for Request for Additional Information Response

Request for Additional Information	Response Date
FPE 02, 03, 05, 08 SSA 01, 03, 04, 05 RR 01	05/26/2015 (*30 days)
FPE 01, 04, 06 SSA 02, 06, 08 FM 05 PRA 01.a, .b, .d, .f, .j, .k, .l, 02.b, 04, 06, 12, 14	06/22/2015 (*60 days)
FPE 07 SSA 07, 09, 10 FM 01, 02, 03, 04, 06 PRA 01.h, .i, 02.a, .c, .d, .e, 05, 07, 08, 09, 16	07/22/2015 (*90 days)
SSA 11 PRA 03**, 10, 11, 13, 15, 17**, 18	08/21/2015 (*120 days)

*From conclusion of audit on April 23, 2015
**Final risk quantification information will be provided after the approaches outlined in all RAI responses that impact final risk quantification are acceptable to the NRC.

Abbreviation Key:
FPE - Fire Protection Engineering
SSA - Safe Shutdown Analysis
FM - Fire Modeling
PRA - Probabilistic Risk Assessment
RR - Radioactive Release

If you have any questions, please contact me at (301) 415-1081 or by e-mail at Andrea.George@nrc.gov.

Sincerely,

/RA/

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

Docket No. 50-313

Enclosures:
1. Request for Additional Information
2. Timetable for Request for Additional Information Response

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