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2CAN101601

October 27, 2016

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

SUBJECT: License Amendment Request to Revise the National Fire Protection Association (NFPA) Standard 805 Modifications
Arkansas Nuclear One, Unit 2
Docket No. 50-368
License No. NPF-6

Dear Sir or Madam,

In accordance with 10 CFR 50.90, Entergy Operations, Inc. (Entergy) proposes to amend Renewed Facility Operating License No. NPF-6 for Arkansas Nuclear One, Unit 2 (ANO-2). Entergy requests NRC review and approval of revisions to the NFPA-805 modifications as previously approved by NRC in letter dated February 18, 2015 (Reference 1).

In accordance with NRC guidance provided by letter to NEI (Reference 2), this request follows Option B of the guidance. Option B is being used due to an analysis performed using the Fire Dynamic Simulator (FDS) computer code which was required to evaluate an impact on instrumentation that was not evaluated in the original NFPA-805 application. The changes to NFPA-805 related plant modifications have been evaluated using the accepted fire probabilistic risk assessment (FPRA) methods and approaches as summarized in the final safety evaluation accompanying the license amendment approving transition to NFPA 805 (Reference 1). As such, the following information is provided in attachments to this letter:

i. A summary of all changes to the modifications;

ii. A summary of all changes to the PRA models and explanation for each change;

iii. New, updated versions in their entirety of: the License Condition (Attachment M), list of plant modifications (Table S-1) and the summarizing area wide change-in-risk result tables (Tables W-1 and W-2);

iv. A statement that the defense-in-depth and safety margin evaluations associated with the original license amendment request (LAR) have been completed on the proposed changes;

v. A summary of all accepted PRA methods being used that weren't used in the NFPA 805 amendment request and a reference to the NRC document accepting the method (i.e., the method should have been previously accepted by NRR staff);

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

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

viii. A justification for the creating of new and/or removal of previously existing Variances from Deterministic Requirements (VFDRs) and Recovery Actions (RAs).

The above changes will require a change to the ANO-2 Operating License. Additional letter references are needed in the initial paragraph of the Fire Protection section of the Operating License and the second item listed in the Transition License Condition will need to reference this update letter.

During the June 2016 ANO Triennial Fire Inspection (Reference 3), the NRC identified two examples of a Severity Level IV non-cited violation of License Condition 2.C(3)(b), "Fire Protection," for the failure to properly implement the risk-informed fire protection program and accurately capture component ignition frequencies in the fire PRA. The inspectors noted that the ignition frequency for air compressors was approximately ten times lower than the generic fire frequency for air compressors outlined in NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities." In addition, exhaust fans of five horsepower or less were counted as ignition sources, contrary to the criteria established in NUREG/CR-6850 (including Supplement 1).

The ANO-2 request to transition to NFPA-805 and subsequently approved by the NRC provided initial risk quantifications related to fire events with final values provided in Entergy letter dated August 7, 2014 (Reference 4). Because the concerns identified in the aforementioned triennial fire inspection are related to risk quantifications, Attachment 1 of this letter provides additional information with respect to potential fire risk impacts.

While the focus of this submittal is on the modification changes that were submitted for Table S-1 of the original LAR, additional discussion of a dual unit Control Room abandonment scenario is included in the results to ensure that the ANO-1 and ANO-2 LAR submittals are consistent with regard to the assumptions relating to abandonment scenarios. Therefore, further information related to dual unit (i.e., ANO-1 and ANO-2) Control Room abandonment is also provided for review.

Additionally, a discussion related to a three-dimensional Computational Fluid Dynamics model (Fire Dynamics Simulator, Version 6.2) is included which was used to analyze the thermal response of an electrical cable associated with the Safety Parameter Display System that was identified after receipt of the NRC's approval of the ANO-2 transition to NFPA-805. This item and the use of the FDS computer code is the basis for this submittal following the format of Option B, rather than Option A, of the aforementioned NRC to NEI letter (Reference 2).

Entergy also requests confirmation of the acceptability to utilize performance-based methods to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features required by NFPA-805 as established by Electric Power Research Institute (EPRI) Technical Report TR-1006756, "Fire Protection Equipment Surveillance Optimization and Maintenance Guide, Final Report," July 2003. This request was originally stated in Entergy letter dated November 7, 2013 (Reference 5), but was not discussed in the NRC's approval of the ANO-2 transition to NFPA-805 (Reference 1).

Finally, a new recovery action is identified in Attachment 1 of this letter and the risk impacts are included in the revised Attachment W risk results included in Attachment 4 of this letter.

No new commitments have been identified in this letter.

In accordance with 10 CFR 50.91(b)(1), a copy of this application and the reasoned analysis about no significant hazards consideration is being provided to the designated Arkansas state official.

Entergy requests approval of the proposed license amendment by April 1, 2017, with the amendment being implemented within 60 days of approval. In accordance with the Operating License, ANO-2 cannot re-start the plant from the spring 2017 refueling outage until all stated NFPA-805 requirements have been met. The spring 2017 ANO-2 refueling outage is currently scheduled to begin in February 2017, and end in April 2017.

If you have any questions or require additional information, please contact Stephenie Pyle at 479-858-4704.

I declare under penalty of perjury that the foregoing is true and correct.
Executed on October 27, 2016.

Sincerely,

ORIGINAL SIGNED BY RICHARD L. ANDERSON

RLA/dbb

Attachments:

1. NFPA-805 Transition Changes
2. Updated Table S-1, Plant Modifications
3. Markup of Attachment W, Fire PRA Insights
4. Updated Attachment W, Fire PRA Insights
5. Markup of Operating License Pages
6. Clean (Revised) Operating License Pages

REFERENCES:

1. NRC letter dated February 18, 2015, *Arkansas Nuclear One, Unit 2 – Issuance of Amendment Regarding Transition to a Risk-Informed, Performance-Based Fire Protection Program In Accordance with 10 CFR 50.48(c),* (TAC No. MF0404) (2CNA021502) (ML14356A227)

2. NRC letter to NEI dated March 2, 2016, *Recommended Content for License Amendment Requests that Seek Changes to License Conditions that were Established in Amendments to Adopt National Fire Protection Association Standard 805 but have yet to be Fully Implemented*

3. NRC letter dated August 4, 2016, *Arkansas Nuclear One – NRC Triennial Fire Protection Inspection Report (05000313/2016009 and 05000368/2016009),* (0CNA081603) (ML16218A299)

4. Entergy letter dated August 7, 2014, *Response to Request for Additional Information – Adoption of National Fire Protection Association Standard NFPA-805*, (2CAN081401) (ML14219A635)

5. Entergy letter dated November 7, 2013, *Response to Request for Additional Information – Adoption of National Fire Protection Association Standard NFPA-805*, (2CAN111301) (ML13312A877)

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Attachment 1 to

2CAN101601

NFPA-805 Transition Changes

NFPA-805 TRANSITION CHANGES

1.0 SUMMARY DESCRIPTION

The proposed amendment would modify the Arkansas Nuclear One, Unit 2 (ANO-2) Renewed Operating License NPF-6 specific to requirements related to the adoption of National Fire Protection Association (NFPA) Standard 805. The current ANO-2 Operating License (OL) contains a license condition referencing specific correspondence associated with the NFPA-805 in the first paragraph of the Fire Protection license condition as well as a reference to the letter containing Table S-1, as submitted previously in Entergy Operations, Inc. (Entergy) letter dated August 7, 2014 (Reference 4). During the transition to NFPA-805, necessary changes have been identified relative to the types of modifications planned to resolve fire-risk significant issues listed in Table S-1. Therefore, a revised Table S-1 is included in this letter. The first paragraph of the Fire Protection license condition and Item 2 of the section entitled "Transition License Condition" contained in ANO-2 OL 2.C(3)(b) is subsequently revised as follows:

> Entergy Operations, Inc. shall implement and maintain in effect all provisions of the approved fire protection program that comply with 10 CFR 50.48(a) and 10 CFR 50.48(c), as specified in the license amendment request dated December 17, 2012, and supplements dated November 7, 2013, December 4, 2013, January 6, 2014, May 22, 2014, June 30, 2014, August 7, 2014, September 24, 2014, ~~and~~ December 9, 2014, and October 27, 2016, and as approved in ~~the~~ SEs dated February 18, 2015, and ______________. Except where NRC approval for changes or deviations is required by 10 CFR 50.48(c), and provided no other regulation, technical specification, license condition or requirement would require prior NRC approval, the licensee may make changes to the fire protection program without prior approval of the Commission if those changes satisfy the provisions set forth in 10 CFR 50.48(a) and 10 CFR 50.48(c), the change does not require a change to a technical specification or a license condition, and the criteria listed below are satisfied.
>
> 2. The licensee shall implement the modifications to its facility, as described in Table S-1, "Plant Modifications," Attachment ~~5~~2, of Entergy Operations, Inc. letter 2CAN101601~~081401~~, dated ~~August 7, 2014~~October 27, 2016, prior to startup from the second refueling outage following issuance of the Safety Evaluation. The licensee shall maintain appropriate compensatory measures in place until completion of the modifications.

Attachment 2 provides a revised copy of Table S-1. Attachment 5 provides markup pages of the existing ANO-2 OL to show the proposed change. Attachment 6 provides revised (clean) OL pages.

In addition to the above, a new recovery action is added to the previously submitted recovery actions listed in Attachment G of Entergy's August 7, 2014 (Reference 4) letter.

Entergy also requests confirmation of the acceptability to utilize performance-based methods to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features required by NFPA-805 as established by Electric Power Research Institute (EPRI) Technical Report TR-1006756, "Fire Protection Equipment Surveillance Optimization and Maintenance Guide, Final Report," July 2003. This request was originally stated in Entergy letter dated November 7, 2013 (Reference 7), but was not discussed in the NRC's approval of the ANO-2 transition to NFPA-805 (Reference 1).

For consistency with the ANO, Unit 1 (ANO-1) transition to NFPA-805, additional information and risk impacts associated with a potential dual unit Control Room abandonment scenario is included in this letter.

Information intended to address NRC concerns identified in the recent June 2016 Triennial Fire Inspection (Reference 3) is also included in this letter.

Additionally, a discussion related to a three-dimensional Computational Fluid Dynamics model (Fire Dynamics Simulator, Version 6.2) is included which was used to analyze the thermal response of an electrical cable associated with the power supply to the conditioning cabinet that sends the instrumentation signals to the Control Room and to the Safety Parameter Display System (SPDS). The potential vulnerability associated with this cable was identified after receipt of the NRC's approval of the ANO-2 transition to NFPA-805.

The above changes to ANO-2's transition to NFPA-805 require re-evaluation of station fire risk. Subsequently, the information contained in the final Attachment W submitted in Entergy letter dated August 7, 2014 (Reference 4), has been updated. A marked-up version of the Reference 4 Attachment W is provided in Attachment 3 of this letter, with a revised version provided in Attachment 4.

2.0 DETAILED DESCRIPTION

Plant Modifications

The following NFPA-805 related modifications are being revised. A markup of the "Proposed Modification" column wording from the Reference 4 letter is included below (replaced wording is struck-through and added wording is underlined):

S1-1 In Fire Area HH, a separation issue was identified on the Emergency Feedwater (EFW) valves 2CV-1026-2 and 2CV-1076-2.

ANO plans to relocate ~~interposing~~ relays ~~and affected cables~~ associated with 2CV-1026-2 and 2CV-1076-2 from Fire Area HH, Fire Zone 2096-M~~, to the adjacent room in Fire Area G, Fire Zone 2098-C. Circuits for 2CV-1026-2 and 2CV-1076-2 are currently routed through Fire Area G and no new impacts will be generated by this modification.~~ to Fire Area B-3, Fire Zone 2091–BB, where the motor control centers (MCCs) for the affected valves are located.

S1-2 In Fire Area JJ, a separation issue was identified that impacts the DC power cables control wiring on both trains. The planned modification of 2CV-4816 and 2CV-4817 is being revised.

2CV-4816 & 2CV-4817 – ~~A reroute of cable 2I016N is planned by using embedded conduit C4080 that is located between Fire Area G (cable spreading room) to Fire Area EE-L. Cable 2I016N is also planned to be separately fused in panel 2C-09 to prevent failure due to a loss of cable 2I016P. This eliminates circuit impacts in Fire Areas TT, JJ, and EE-U.~~The control circuit of these valves will be modified by replacing 2HS-4817 with a new four-position switch in the existing location in control room panel 2C09. The new switch configuration allows the operator to place the switch in the CLOSE position to isolate the transducer and its field cable from the controller, and bond the positive and negative conductors of the current loop to each other. This arrangement de-energizes the target cable eliminating intracable faults as a potential failure, prevents spurious operation of the controller from opening the valve, and provides protection from postulated intercable faults.

S1-4 In Fire Area TT, a separation issue was identified that impacts the power cables for EFW, chemical and volume control system (CVCS), and service water (SW) components. The planned modification of 2CV-4816 and 2CV-4817 is being revised.

2CV-4816 & 2CV-4817 – A reroute of cable 2I016N is planned by using embedded conduit C4080 that goes between Fire Area G (cable spreading room) to Fire Area EE-L. Cable 2I016N is also planned to be separately fused in panel 2C-09 to prevent failure due to a loss of cable 2I016P of cable. This eliminates circuit impacts in Fire Areas TT, JJ, and EE-U.The control circuit of these valves will be modified by replacing 2HS-4817 with a new four-position switch in the existing location in control room panel 2C09. The new switch configuration allows the operator to place the switch in the CLOSE position to isolate the transducer and its field cable from the controller, and bond the positive and negative conductors of the current loop to each other. This arrangement de-energizes the target cable eliminating intracable faults as a potential failure, prevents spurious operation of the controller from opening the valve, and provides protection from postulated intercable faults.

S1-7 In Fire Area G, MOVs will be modified to meet requirements per IN 92-18. The planned modification to 2CV-1075-1 and 2CV-1036-2 is being revised.

ANO plans to modify the control circuit for MOVs 2CV-1075-1 and 2CV-1036-2 to prevent fire induced spurious operation from the main control room, Fire Area G, which could result in failing the valves in an unrecoverable position. This will be accomplished by separating the cable conductors, inclusive of internal panel wiring, that can cause spurious valve operation and protecting them with suitable barriers to prevent inadvertent energizing of target conductors. This will prevent contact with potentially energized conductors from both intracable and intercable hot shorts.

MOV 2CV-1075-1 control cables R2B53J2C and R2B53J2N that enter panel 2C-17 or 2C-39 from floor penetrations have been identified as the cables of concern applicable to this modification.

MOV 2CV-1036-2 control cable G2B63H1E that enters panel 2C-40 from a floor penetration has been identified as the cable of concern applicable to this modification. This will be accomplished by the use of interposing relays to ensure hot shorts will not bypass the valve torque switches. The modification reduces the risk of fire induced valve circuit failures (hot shorts, open circuits, and short to ground) for EFW valves 2CV-1036-2 and 2CV-1075-1 control cables.

S1-8 In Fire Areas B-3 and G, spurious opening of MOV 2CV-4698-1 RCS Pressurizer Emergency Core Cooling Vent valve~~pressurizer low temperature – overpressure (LTOP) relief~~ can result from a fire in motor control center (MCC) 2D-27 and cabinet 2C-09.

~~ANO plans to modify the control circuit for 2CV-4698-1 to prevent fire induced spurious opening in Fire Areas B-3 and G. This will be accomplished by separating the cable conductors, inclusive of internal panel wiring, that can cause spurious opening and protecting the conductors with suitable barriers to prevent inadvertent energizing of target conductors. This will prevent contact with potentially energized conductors from both intracable and intercable hot shorts. Control cable R2D27A3J that enters MCC 2D-27 in Fire Area B-3 and the other end of cable that enters cabinet 2C-09 in Fire Area G from the floor penetrations have been identified as the cable of concern applicable to this modification.~~The control circuit of 2CV-4698-1 will be modified by installing an inhibit circuit to prevent spurious operation in the event of a fire-induced short circuit. The inhibit circuit utilizes an existing spare closed contact in the CLOSE-OPEN control switch to effectively ground the valve opening circuit except when the control switch is moved to the OPEN position. A fire-induced circuit failure will result in a short to ground through the closed contact. This will prevent a cable failure from causing spurious operation of the valve.

S1-9 RCS High Point Vent Valves 2SV-4670-2 and 2SV-4669-1.

~~ANO plans to modify the RCS vent solenoid valve control circuits with the installation of metallic sleeves and/or barriers as described to eliminate impacts in Fire Area G associated with the following components:~~

~~2SV-4670-2 - Control circuit in cabinet 2C-336-2 modification is planned to prevent conductor (wire P3) of cable G2SI122N from contacting energized conductors by installing a grounded metallic sleeve and/or barriers up to load side of hand-switch 2HS-4670-2.~~

~~2SV-4669-1 - Control circuit in cabinet 2C-336-1 modification is planned to prevent conductor (wire P3) of cable R2SI121N from contacting energized conductors by installing a grounded metallic sleeve and/or barriers up to load side of hand-switch 2HS-4669-1.~~The control circuits of 2SV-4670-2 and 2SV-4669-1 will be modified by installing an inhibit circuit in each to prevent spurious operation in the event of a fire-induced short circuit. The inhibit circuit will utilize an existing spare closed contact in the CLOSE-OPEN control switch to effectively ground the valve opening circuit except when the control switch is moved to the OPEN position. A fire-induced circuit failure will result in a short to ground through the closed contact. This will prevent a cable failure from causing spurious operation of the valve. The functional and performance characteristics of the two valves are not changed. The method of operating the valves will remain the same.

The S1-9 modification description was also included, although unnecessary, in the Problem Statement column of the table and is being deleted:

~~In Fire Area G, PRA determined that solenoid valves 2SV-4670-2 and 2SV-4669-1 control circuits shall be protected with metallic sleeves and/or barriers to prevent a spuriously opening of 2SV-4670-2 or 2SV-4669-1 due to a fire induced hot short circuit failure resulting in an uncontrolled RCS vent path release.~~

The S1-9 modification description in the Risk Informed Characteristics column of the table is likewise modified as follows:

The modification in Fire Area G to install <u>an inhibit</u>~~grounded metallic sleeves and/or barriers protects control~~ circuit ~~cable G2SI122E in cabinet 2C-336-2 and control circuit cable R2SI121E in cabinet 2C-336-1 to reduce~~<u>minimizes</u> the risk of fire induced circuit failures (such as spurious opening).

Because the plant modifications of Table S-1 are referred to in the ANO-2 OL, a revised Table S-1 containing all of the modifications, including the above changes, is provided in Attachment 2 of this letter.

<u>Recovery Actions</u>

The described plant modification changes eliminate the need for several previously submitted Recovery Actions (RAs) listed in Attachment G of Entergy letter dated August 7, 2014 (Reference 4). The plant modifications improve overall risk and effectively alleviate the need for a recovery action to resolve the associated variance from deterministic requirement (VFDR). The operator actions remain in the FPRA model as non-VFDR recovery actions to mitigate random failures. A new RA, however, is being added to the previous listing and incorporated into the FPRA. Shown in the table form previously submitted for Attachment G, the new RA reads as follows:

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

This also results in a change to Part b) of the associated VFDR Disposition contained in Attachment C of the original LAR (Reference 2), as follows:

b) <u>Recovery action to restore power to 2D32B.</u> No further actions required for ~~2D32B and~~ 2D32A.

Risk impacts associated with this new RA are discussed in Section 3.0 below.

Dual Unit Main Control Room (MCR) Abandonment

While the focus of this submittal is on the modification changes previously submitted in Table S-1 of Entergy letter dated August 7, 2014 (Reference 4), a dual unit MCR abandonment scenario has been added to the overall ANO-2 fire risk results to ensure that the ANO-1 and ANO-2 NFPA-805 LAR submittals are consistent in assumptions relating to MCR abandonment scenarios. Therefore, a description of dual unit (i.e., ANO-1 and ANO-2) control room abandonment is also provided in Section 3.0 below.

June 2016 ANO Triennial Fire Inspection

In the original LAR (Reference 2), a Bayesian statistical update was performed using the Bin 9 alpha term from NUREG/CR-6850, Supplement 1, in the ANO-2 Fire PRA Plant Partitioning and Fire Ignition Frequency Report (PRA-A2-05-013). However, NUREG/CR-6850, Supplement 1, footnotes the Bin 9 alpha terms as an error and thus should not be used for the Bayesian update. The NRC identified this error during the recent ANO-2 triennial fire inspection. In order to correct the analysis, the mean value for the Bin 9 ignition frequency from NUREG/CR-6850, Supplement 1, has now been incorporated (i.e., no Bayesian update performed) and the corrected ignition frequency was used to calculate the results depicted Section 3.0 of this letter.

Additionally, the NRC identified that some 5 horsepower (hp) motors were included in development of ignition frequencies, contrary to the criteria established in NUREG/CR-6850 (including Supplement 1). The impact of this inconsistency has not yet been documented for ANO-2 due to resource loading. However, a sensitivity analysis was performed in support of the ANO-1 transition to NFPA-805 and the results reflected that the removal of the scenarios associated with the inappropriate ignition sources more than offset the increase in risk for the revised ignition frequency. Therefore, this issue is not expected to impact the results in a significant manner.

Use of FDS Model

Version 6.2 of the Fire Dynamics Simulator (FDS), a three-dimensional Computational Fluid Dynamics model, was used to analyze the thermal response of an electrical cable associated with the power supply to the conditioning cabinet that sends the instrumentation signals to the Control Room and to the Safety Parameter Display System (SPDS). The potential vulnerability associated with this cable was identified after receipt of the NRC's approval of the ANO-2 transition to NFPA-805. Details of this model use are included in Section 3.0 below.

3.0 TECHNICAL EVALUATION

Plant Modifications

The fire risk effects associated with each of the following plant modification changes is addressed following discussion of all the NFPA-805 changes in aggregate. A discussion of defense-in-depth (DID) and safety margin is included immediately following each plant modification change description.

S1-1: EFW valves 2CV-1026-2 and 2CV-1076-2

The previously approved modification wording intended to relocate associated interposing relays and affected cables out of the affected fire area to Fire Area G. Entergy now plans to relocate the relays and cables to Fire Area B-3, Fire Zone 2091-BB, where the Motor Control Centers (MCCs) for the affected valves are located.

The originally planned modification to relocate the circuits for 2CV-1026-2 and 2CV-1076-2 to Fire Area G ensured feedwater via the Emergency Feedwater (EFW) system was available in the event of a fire in Fire Area HH, Fire Zone 2096-M. The revision to the modification continues to ensure the original intent of the modifications, reduces the risk impact originally credited for this modification, and has no impact on any of the DID echelons: 1) Prevent fires from starting; 2) Rapidly detect, control and extinguish promptly those fires that do occur thereby preventing fire damage; and 3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed.

Adequate safety margin is maintained because the codes and standards used have been accepted for use by the NRC and meet the acceptance criteria in NFPA 805. These codes and standards were applied in a manner which would provide FPRA results which contain and complement safety margin. The bases for the application of these FPRA codes and standards were not altered in support of this fire risk evaluation.

S1-2 and S1-4: CVCS Valves 2CV-4816 and 2CV-4817

The previously approved modification wording intended to separately fuse cable 2I016N in Control Room panel 2C09 to prevent failure due to a loss of cable 2I016P and to reroute cable 2I016N from Fire Area G to Fire Area EE-L. Entergy now plans to modify the control circuits for the subject valves by replacing 2HS-4817, which operates both valves, with a new four-position switch in the existing location in control room panel 2C09. The new switch configuration allows the operator to place the switch in the CLOSE position to isolate the transducer and its field cable from the controller, and bond the positive and negative conductors of the current loop to each other. This arrangement de-energizes the target cable eliminating intracable faults as a potential failure, prevents spurious operation of the controller from opening the valve, and provides protection from postulated intercable faults.

Control of air operated Chemical and Volume Control System (CVCS) Letdown throttle control valves 2CV-4816 and 2CV-4817 is by electric to pneumatic transducers that convert a 4-20mA (close to full open) signal into a proportional pneumatic output. The desired post-fire position for these valves is closed.

ANO-2 raceways are segregated by voltage service level and the target cables associated with these valves are routed exclusively in low-level instrumentation trays and conduits. Higher energy aggressor circuits are routed in separate control (125 VDC / 120 VAC) and power (480 VAC / 4160 VAC) level raceways. Spurious operation from an intercable fault requires the single twisted pair of ungrounded DC instrumentation cables with grounded shield to have two proper polarity hot shorts to another instrumentation cable. Instrument cables carry other types of signals besides 4-20 milliamps and the transducers require a compatible controlled current source with a proper direction flow of current to operate. The transducers have an overcurrent rating 100 milliamps; currents in excess of this value can result in failure of the electronics. The aggressor cable will also need to be free of other fire damage such as an intracable fault that could fail its power supply and render it unsuitable as a current source. Bonding of the positive and negative conductors to each other by closing 2HS-4817 places both at the same potential and should not allow the creation of a current flow in the event of the multiple proper polarity intercable hot short as described. Based upon the multiple failures required, the sensitivity of the transducer electronics to failure, and the bonding of target cable conductors by closing 2HS-4817 preventing a flow of current, fire induced spurious operation of the transducers that could open the valves is not credible.

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

Adequate safety margin is maintained because the codes and standards used have been accepted for use by the NRC and meet the acceptance criteria in NFPA 805. These codes and standards were applied in a manner which would provide FPRA results which contain and complement safety margin. The bases for the application of these FPRA codes and standards were not altered in support of this fire risk evaluation.

S1-7: EFW Valves 2CV-1075-1 and 2CV-1036-2

The previously approved modification wording intended to change the control circuits for the subject valves by separating the cable conductors, inclusive of internal panel wiring, that can cause spurious valve operation and protecting them with suitable barriers to prevent inadvertent energizing of target conductors. Entergy now plans to modify the control circuits for the subject valves by the use of interposing relays to ensure hot shorts will not bypass the valve torque switches. The modification reduces the risk of fire induced circuit failures (hot shorts, open circuits, and short-to-ground) for EFW valves 2CV-1036-2 and 2CV-1075-1 control cables. In conclusion, this modification prevents non-recoverable valve position failures for all fires except those in the vicinity of the interposing relays. Local operation of these valves is not credited for a fire in the vicinity of the interposing relays.

The originally planned modification to 2CV-1036-2 and 2CV-1075-1 prevented fire induced spurious operation from the MCR, Fire Area G. The revision to the modification continues to ensure the original intent of the modifications, reduces the risk impact below that originally credited for this modification, and has no impact on any of the DID echelons: 1) Prevent fires from starting; 2) Rapidly detect, control and extinguish promptly those fires that do occur thereby preventing fire damage; and 3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed.

Adequate safety margin is maintained because the codes and standards used have been accepted for use by the NRC and meet the acceptance criteria in NFPA 805. These codes and standards were applied in a manner which would provide FPRA results which contain and complement safety margin. The bases for the application of these FPRA codes and standards were not altered in support of this fire risk evaluation.

S1-8: RCS Vent Valve 2CV-4698-1

The previously approved modification wording intended to change the control circuit for the subject valve by separating the cable conductors, inclusive of internal panel wiring, that can cause spurious opening and protecting the conductors with suitable barriers to prevent inadvertent energizing of target conductors. Entergy now plans to modify the control circuit by installing an inhibit circuit to prevent spurious operation in the event of a fire-induced short circuit. The inhibit circuit utilizes an existing spare closed contact in the CLOSE-OPEN control switch to effectively ground the valve opening circuit except when the control switch is moved to the OPEN position. The failure of this inhibit switch circuit is quantified in the same manner as that addressed in the ANO-1 NFPA 805 application, including associated responses to NRC requests for additional information (RAIs).

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

Adequate safety margin is maintained because the codes and standards used have been accepted for use by the NRC and meet the acceptance criteria in NFPA 805. These codes and standards were applied in a manner which would provide FPRA results which contain and complement safety margin. The bases for the application of these FPRA codes and standards were not altered in support of this fire risk evaluation.

S1-9: RCS High Point Vent Valves 2SV-4670-2 and 2SV-4669-1

The previously approved modification wording intended to eliminate adverse impacts on the subject solenoid valves for a fire in Fire Area G by installing a grounded metallic sleeve and/or barriers up to the load side of the valve's handswitch. Entergy now plans to modify the valves by installing an inhibit circuit in each to prevent spurious operation in the event of a fire-induced short circuit. The inhibit circuit will utilize a (currently) spare closed contact in the CLOSE-OPEN control switch to effectively ground the valve opening circuit except when the control switch is moved to the OPEN position. The failure of this inhibit switch circuit is quantified in the same manner as that addressed in the ANO-1 NFPA 805 application, including associated responses to NRC (RAIs).

The originally planned modification to the RCS vent solenoid valve control circuits was to eliminate impacts in Fire Area G. The revision to the modification continues to ensure the original intent of the modification, has no more than minimal risk impact with respect to that originally credited for this modification, and has no impact on any of the DID echelons: 1) Prevent fires from starting; 2) Rapidly detect, control and extinguish promptly those fires that do occur thereby preventing fire damage; and 3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed.

Adequate safety margin is maintained because the codes and standards used have been accepted for use by the NRC and meet the acceptance criteria in NFPA 805. These codes and standards were applied in a manner which would provide FPRA results which contain and complement safety margin. The bases for the application of these FPRA codes and standards were not altered in support of this fire risk evaluation.

New Recovery Action

ANO condition report CR-ANO-C-2015-4976 identified a potential concern related to the Safety Parameter Display System (SPDS) instrumentation. Specifically, both ANO units credited the past Appendix R efforts to deterministically address the post-fire safe shutdown strategy. However, the Appendix R, or deterministic basis, has been previously found to be inadequate and existing fire watches have been established to offset fire risks in the interim. This issue was not previously identified in the ANO-2 NFPA-805 transition process. Further evaluation has concluded that a new recovery action is required.

For ANO-2, panel 2C384 contains the signal processing for safe shutdown instrumentation and provides isolation to indications in the MCR. Green train inverters 2Y-22 and 2Y-2224 are located in the north electrical equipment room (Fire Area B-3, Fire Zone 2091-BB) and provide power to 2C384. Vital station battery 2D-12 or battery charger 2D-32B, via 125 VDC bus 2D-02, normally provides the input power to the inverters. In the event DC power is lost, the inverters will automatically switch to an AC power source (MCC 2B-61). A fire in Fire Zone 2109-U challenges the DC power source for inverters 2Y-22 and 2Y-2224 as well as the green train AC power source. If both the AC and battery charger power sources to the inverters were lost, then 2C384 will fail following depletion of the station battery, rendering SPDS instrumentation unavailable. However, 2D-02 can be reenergized from battery charger 2D-32B by aligning the charger's AC input to red train MCC 2B-54 using manual transfer switch 2S-22 located in Fire Zone 2100-Z. This in turn provides continuous DC power to inverters 2Y-22 and 2Y-2224, assuring instrumentation using SPDS remains available.

The proposed recovery action ensures instrumentation is available in the event of a fire in Fire Zone 2109-U and therefore, there is no impact on any of the DID echelons: 1) Prevent fires from starting; 2) Rapidly detect, control and extinguish promptly those fires that do occur thereby preventing fire damage; and 3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed.

Adequate safety margin is maintained because the codes and standards used have been accepted for use by the NRC and meet the acceptance criteria in NFPA 805. These codes and standards were applied in a manner which would provide FPRA results which contain and complement safety margin. The bases for the application of these FPRA codes and standards were not altered in support of this fire risk evaluation.

Dual Unit MCR Abandonment

The potential for dual unit MCR abandonment and a hot gas layer reaching sensitive electronic damage thresholds from a fire originating in the opposite unit Control Room (ANO-1) has been evaluated for its impacts on the ANO-2 analysis, consistent with the evaluation performed for the ANO-1 transition to NFPA-805 documented in Entergy letter dated March 25, 2016 (Reference 6). The results of this evaluation are included in the Risk Summary sub-section below.

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Bin 9 Ignition Frequencies

In the original LAR (Reference 2), a Bayesian statistical update was performed using the Bin 9 alpha term from NUREG/CR-6850 Supplement 1 in the ANO Fire PRA Plant Partitioning and Fire Ignition Frequency Report. However, NUREG/CR-6850, Supplement 1, footnotes the Bin 9 alpha term as an error and thus should not be used for the Bayesian update. In order to correct the analysis, the mean value for the Bin 9 ignition frequency from NUREG/CR-6850, Supplement 1, has now been applied (i.e., no Bayesian update performed) and the corrected ignition frequency was used to calculate the results depicted in this letter.

The update to the Bin 9 alpha term results in a small increase in risk; however, this has no impact on any of the DID echelons: 1) Prevent fires from starting; 2) Rapidly detect, control and extinguish promptly those fires that do occur thereby preventing fire damage; and 3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed.

Adequate safety margin is maintained with the use of the mean value for the Bin 9 ignition frequency because the codes and standards used have been accepted for use by the NRC and meet the acceptance criteria in NFPA 805. These codes and standards were applied in a manner which would provide FPRA results which contain and complement safety margin. The bases for the application of these FPRA codes and standards were not altered in support of this fire risk evaluation.

Inclusion of 5 hp Motors

The NRC identified a concern associated with the inclusion of motors having a horsepower rating of 5 hp has not yet been documented for ANO-2 due to resource loading. This concern is currently being evaluated to include a full extent of condition review and necessary changes incorporated in the development of the self-approval FPRA model. The inclusion of 5 hp motors in the fire ignition frequency calculation acts to dilute the overall frequency for each remaining ignition source within the same bin. The impact on CDF/LERF is typically inconsequential given that the risk reduction from removing the corresponding ignition source scenario should reduce the overall plant risk calculated in the ANO-2 model. The necessary changes are being tracked by condition report ANO-C-2016-2600 and are planned to be performed as part of the FPRA self-approval model. In addition to the expected inconsequential impact to fire risk based on the current dilution of fire frequencies due to the inclusion of additional motor ignition sources, a recent sensitivity analysis performed in support of the ANO-1 transition to NFPA-805 determined that 1) the overall change in CDF and LERF risk for ANO-1 decreased when compared to the assumptions in the approved model of record, and 2) no new Variances from Deterministic Requirements or recovery actions were needed to address the issue (see Entergy letter dated August 29, 2016 (Reference 5)). It is anticipated that the results for ANO-2 will be similar. Based on the above, the Risk Summary sub-section included below does not address risk values for this subject matter.

<u>Fire Dynamic Simulator (FDS) Modeling of Conduit in Fire Zone 2109-U</u>

The ANO-2 FPRA considers instrumentation availability when crediting operator actions. The availability of instrumentation was previously considered in 10 CFR 50, Appendix R, and documented in procedure OP-2203.049, "Fires in Areas Affecting Safe Shutdown". This procedure contains instruction steps to be performed when the associated conditional requirement is met and available instrumentation tables which provide a discrete list of reliable instrumentation.

During a review of instrumentation cables, it was identified that Fire Zone 2109-U contained a potential vulnerability for a loss of instrumentation via a fire that might affect approximately 5' of conduit EC2018 (feed from 125 VDC bus to 2D-02), which is located in this fire zone. This potential vulnerability was documented in condition report CR-ANO-C-2015-4976.

The conduit is located in a small corridor of the fire zone behind a concrete lintel. In order to determine the effects of a fire in Fire Zone 2109-U on this conduit, a fire modeling analysis of Fire Zone 2109-U was performed to calculate the time varying exposure of the conduit to the most adverse fire scenario that could impact the conduit. The analysis focused on calculating the conduit response to the elevated temperatures from the combustion products, using a three-dimensional Computational Fluid Dynamics (CFD) model, FDS, Version 6.2. The analysis considered the thermal response of the electrical cable target routed in conduit EC2018 to establish the likelihood that the target would fail if exposed to fires in Fire Zone 2109-U.

The evaluation includes conservative fire scenarios that may lead to heating and/or damage of the cable target routed in EC2018 under current installed conditions. All potential ignition source and corresponding secondary combustible configurations were considered in the space, and the most adverse scenario was evaluated in detail. Given that the objective is to determine worst-case conditions for the cable damage, the most conservative conditions were obtained with the largest fire sizes (heat release rates) and the nearest possible location of the fire relative to the target. In this case, the ignition source evaluated was a Battery Charger (2D-36), which is capable of igniting overhead cable trays. The normal ventilation conditions and as-built geometric configuration are assumed. It was shown that this ignition source, the secondary combustible configuration, and the ventilation condition assumptions were either bounding or that the expected results would be risk neutral.

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

Model Results

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

PRA Methods not used in the ANO-2 NFPA 805 Amendment Request

Only one PRA method that was not used in the ANO-2 NFPA 805 amendment request was applied in the fire model analysis of conduit EC2108 in Fire Zone 2109-U: the fire modeling computer code FDS, Version 6.2. This fire model is an acceptable tool for evaluating fire conditions in nuclear power plants per NUREG 1934, "Nuclear Power Plant Fire Modeling Analysis Guidelines." FDS in particular is the highest resolution model typically applied to model fire scenarios in nuclear plants and has the greatest versatility and applicability among the tools available.

Fire Model Selection

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

- Conduit EC2018 is shielded by a concrete lintel. This shielding was a key factor in illustrating that the postulated fire scenarios do not damage this target. Alternative models do not have the capacity to model the time-dependent exposure from fire in this configuration, while this consideration is within the capabilities of the FDS.
- The ventilation conditions and associated fire dampers in the space is a configuration which other available fire models cannot accurately predict, but can be modeled in the FDS.
- Geometric features such as cable trays, the concrete lintel, and the penetration opening in the concrete lintel and other types of obstructions, are not easily incorporated into alternative fire models. These features can play an important role in the detailed performance on the thermal evaluation developed, and can be modeled in the FDS.
- Unlike other models, FDS, Version 6.2, has the capability to model the time varying exposure to the cable inside the conduit using the THIEF approach, which in this case is identical to the approach taken in the FDS validation guide for the CAROLFIRE (NUREG-6931, Volume 3) cases.

FDS Verification Basis

The FDS verification basis is documented in Appendix A.4 of Entergy calculation CALC-ANO2-FP-09-00038. The verification follows the instructions provided in NIST-SP-1019 and NIST-SP-1018-2. The verification basis involves completing a benchmark installation procedure, which provides confirmation that the FDS model produces the same results within a specified tolerance as the versions used to verify FDS.

FDS Validation Basis

The FDS, Version 6.2, validation basis for the Fire Zone 2109-U application is documented in Appendix A.3 of CALC-ANO2-FP-09-00038. The validation basis follows the guidance in NUREG-1934 using the NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," V&V assessment for the FDS model (Volume 7). The approach involves comparing seven non-dimensional parameters in the model application to the range considered in NUREG-1824. These parameters consist of the following:

- Fire Froude Number, a measure of the buoyancy of the fire plume and thus, an indicator of the plume shape and flame height
- Flame length ratio, a measure of the degree to which the flames impinge on the ceiling
- Ceiling jet radius, a measure of the position of a target or point of interest along the ceiling from the centerline of the fire
- Equivalence ratio, a measure of the relative supply of oxygen to the fire
- Compartment aspect ratios (length to height and width to height), a measure of the compartment shape
- Target distance ratio, a measure of the relative distance from the fire a target or point of interest is located and for which radiant heating is the exposure mechanism

Appendix A.3 of CALC-ANO2-FP-09-0028 identifies that the FDS, Version 6.2, application in Fire Zone 2109-U falls within the NUREG-1824 validation range for all non-dimensional parameters except for the length-to-height ratio. The maximum length-to-height ratio considered in the test data in NUREG-1824 was 5.7. The maximum compartment aspect ratio in Fire Zone 2109-U is 9.6, a consequence of the corridor like shape of the space. Although this value exceeds the NUREG-1824 validation range for the aspect ratio parameter, the enclosure shape does not exceed any limitation on the FDS model. Unlike simpler modeling tools, such as one-zone or two-zone models, the model assumptions of FDS do not break down for enclosures having a large aspect ratio, or in this case a high length-to-height ratio. FDS, Version 6.2, inherently accounts for transport delays of the smoke products along the length as well as the heat losses to the boundaries. The FDS has a pedigree for use in tunnels (e.g., NISTIR-6902), which have length-to-height ratios far in excess of those involved in the Fire Zone 2109-U evaluation. In addition, the length to height and width to height ratio ranges have been expanded in NUREG-1824, Supplement 1, to 8.3, which is close to the maximum value used to model Fire Zone 2109-U. As such, the FDS application in Fire Zone 2109-U is considered acceptable and the validation basis provided in NUREG-1824 remains applicable.

Summary of FDS Selection and Use

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

Focused Scope Peer Review

A focused-scope peer review of the ANO-2 FPRA against the requirements of Section 4 of the American Society of Mechanical Engineers (ASME)/American Nuclear Society (ANS) PRA Standard and any Clarifications and Qualifications provided in the NRC endorsement of the Standard contained in Revision 2 to RG 1.200, “An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities,” was performed using the process defined in Nuclear Energy Institute (NEI) 07-12, “Fire Probabilistic Risk Assessment (FPRA) Peer Review Process Guidelines.” The scope of this focused scope peer review was limited to the evaluation of a FDS analysis performed for evaluation of impact on the specific conduit of concern in Fire Zone 2109-U.

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

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

Summary of Results of the Peer Review

Section 4 of the ASME/ANS combined PRA Standard contains a total of 183 SRs under 13 technical elements, and configuration control from Section 1.5. Of these 183 SRs, 29 were within the scope of this focused-scope peer review. Table 2 provides a summary of the SRs that were reviewed and their assessed Capability Category. A revision to the FDS calculation to clarify the basis for an assumption was prompted by the peer review. No findings or observations were identified as a result of the peer review once this assumption was clarified.

Table 2: Focused Scope Peer Review Assessment Summary

SR ID	Supporting Requirements		MET / NOT MET (Category II/III)	Focused Peer Review Assessment
	Category II	Category III		
FSS-C1	For each selected fire scenario, ASSIGN characteristics to the ignition source using a two-point fire intensity model that encompass low likelihood, but potentially risk contributing, fire events in the context of both fire intensity and duration given the nature of the fire ignition sources present.	For each selected fire scenario, ASSIGN characteristics to the ignition source that reflect a range of fire intensities and durations and that encompass low likelihood, but potentially risk contributing, fire events given the nature of the fire ignition sources present.	MET Cat II	Per Section 5.4 the analysis utilized legacy 98^{th} percentile HRR values for electrical equipment from NUREG/CR 6850 to represent a bounding case.
FSS-C2	For those scenarios that represent significant contributors to a physical analysis unit's fire risk, CHARACTERIZE ignition source intensity using a time-dependent fire growth profile (i.e., a time-dependent heat release rate) as appropriate to the ignition source.		MET Cat II	Per Section 5.4 the ignition source was modeled with a transient HRR based on guidance from NUREG/CR 6850 and secondary combustibles (cable trays) were modeled with a transient HRR based on the FLASH-CAT approach from NUREG/CR 7010.
FSS-C3	JUSTIFY the selected time to peak heat release rate and decay profile.		MET Cat II	While the ignition source underwent a decay period per guidance from NUREG/CR 6850, the cable tray fire continuously grew in size over the length of the simulation as seen in Figure 9 in Section 5.4. There was no overall decay of the fire scenario during the time simulated.
FSS-C4	If a severity factor is credited in the analysis, ENSURE that (a) the severity factor remains independent of other quantification factors (b) the severity factor reflects the fire event set used to estimate fire frequency (c) the severity factor reflects the conditions and assumptions of the specific fire scenarios under analysis, and (d) a technical basis supporting the severity factor's determination is provided	If a severity factor is credited in the analysis, ESTABLISH a direct relationship between the severity factor and the fire characteristics assumed in the analysis and ENSURE that (a) the severity factor remains independent of other quantification factors (b) the severity factor reflects the fire event set used to estimate fire frequency (c) the severity factor reflects the conditions and assumptions of the specific fire scenarios under analysis, and (d) a technical basis supporting the severity factor's determination is provided.	N/A	Severity factors were not credited in the analysis.

Table 2: Focused Scope Peer Review Assessment Summary

SR ID	Supporting Requirements		MET / NOT MET (Category II/III)	Focused Peer Review Assessment
	Category II	Category III		
FSS-C5	JUSTIFY that the damage criteria used in the Fire PRA are representative of the damage targets associated with each fire scenario.	JUSTIFY that the damage criteria used in the Fire PRA are representative of the damage targets associated with each fire scenario and reflect the damage criteria of plant-specific damage targets, where available.	MET Cat III	Assumption 11 identifies the specific makeup of the target cable as an IEEE-383 qualified thermoset cable. Damage criteria for the cable are then taken from NUREG/CR-6850 guidance.
FSS-C6	ASSUME target damage occurs when the exposure environment exceeds the damage threshold.	ANALYZE target damage times based on the thermal response of the damage target.	MET Cat III	Per Section 5.2.5 the analysis uses the THIEF approach validated in both the CAROLFIRE report and in the FDS validation guide. This approach performs time-dependent heat transfer calculations through conduit into the cable accounting for the specific diameter and construction of the target cable.
FSS-C7	If multiple suppression paths are credited, EVALUATE and PROPERLY MODEL dependencies among the credited paths including dependencies associated with recovery of a failed fire suppression system, if such recovery is credited.		N/A	No credit taken for assumption
FSS-C8	If raceway fire wraps are credited: (a) ESTABLISH a technical basis for their fire-resistance rating, and (b) CONFIRM that the fire wrap will not be subject to either mechanical damage or direct flame impingement from a high-hazard ignition source unless the wrap has been subject to qualification or other proof of performance testing under these conditions.		N/A	No credit taken for fire wraps
FSS-D1	SELECT appropriate fire modeling tools for estimating fire growth and damage behavior considering the physical behaviors relevant to the selected fire scenarios.		MET Cat II	Section 5.1 discusses that the model selected was FDS and provides an appropriate rationale for its selection over other modeling approaches.
FSS-D2	USE fire models that have sufficient capability to model the conditions of interest and only within known limits of applicability.		MET Cat II	Appendix A documents that the application of FDS was within its validation limits

Table 2: Focused Scope Peer Review Assessment Summary

SR ID	Supporting Requirements		MET / NOT MET (Category II/III)	Focused Peer Review Assessment
	Category II	Category III		
FSS-D3	For any physical analysis unit that represents a significant contributor to fire risk, SELECT and APPLY fire modeling tools such that the scenario analysis provides reasonable assurance that the fire risk contribution of each unscreened physical analysis unit can be either bounded or accurately characterized.	For any physical analysis unit that represents a significant contributor to fire risk, SELECT and APPLY fire modeling tools such that the scenario analysis provides reasonable assurance that the fire risk contribution of each unscreened physical analysis unit can be either bounded or accurately characterized and such that the risk contributions can be correlated to specific ignition sources and locations within the physical analysis unit.	N/A	The FDS analysis was focused on a single risk contributing cable within a single compartment.
FSS-D4	ESTABLISH a technical basis for fire modeling tool input values used in the analysis given the context of the fire scenarios being analyzed.		MET Cat II	The assumptions in Section 3 and the model input discussion in Section 5.2, 5.4, and 5.6 provides a detailed basis for the input values used for geometry, material properties, target exposure, and fire growth.
FSS-D5	ESTABLISH a technical basis for any applied statistical models in the context of the fire scenarios being analyzed.	ESTABLISH a technical basis for any applied statistical models in the context of the fire scenarios being analyzed and INCLUDE plant-specific updates to generic statistical models when (a) appropriate data are available to support the update and (b) updating of the statistical model might impact the quantification of one or more significant contributors to fire risk.	N/A	No applied statistical models used.
FSS-D6	ESTABLISH a technical basis for any applied empirical models in the context of the fire scenarios being analyzed.		MET Cat II	The FLASH-CAT approach was utilized in developing the heat release rate and NUREG/CR-7010 Is referenced in Section 2.2 as the technical basis.

Table 2: Focused Scope Peer Review Assessment Summary

SR ID	Supporting Requirements: Category II	Supporting Requirements: Category III	MET / NOT MET (Category II/III)	Focused Peer Review Assessment
FSS-D7	In crediting fire detection and suppression systems, USE generic estimates of total system unavailability provided that (a) the credited system is installed and maintained in accordance with applicable codes and standards, (b) the credited system is in a fully operable state during plant operation, and (c) the system has not experienced outlier behavior relative to system unavailability.	In crediting fire detection and suppression systems, USE plant-specific information, where available, to quantify total unavailability factors.	N/A	While Appendix D does discuss the expected timeline of detection and suppression for the compartment that was modeled, no credit was taken in the model for either suppression or detection.
FSS-D8	INCLUDE an assessment of fire detection and suppression systems effectiveness in the context of each fire scenario analyzed.		N/A	While Appendix D does discuss the expected timeline of detection and suppression for the compartment that was modeled, no credit was taken in the model for either suppression or detection. Model results demonstrate that the single target being analyzed did not see damage even in the absence of suppression.
FSS-D9	EVALUATE the potential for smoke damage to FPRA equipment on a qualitative basis and INCORPORATE the results of this assessment into the definition of fire scenario target sets.		N/A	The scope of the FDS calculation was limited to a single cable enclosed in a conduit where smoke damage is not a failure mechanism of concern.
FSS-D10	CONDUCT walkdowns to confirm that the combinations of fire sources and target sets that were selected per SR FSS-A5 appropriately represent the as-built plant conditions.		MET Cat II	A walkdown was performed and discussed throughout Section 5 as model inputs are discussed and developed.
FSS-D11	CONDUCT WALKDOWNS to verify that other aspects of the selected fire scenarios not covered by SR FSS-D10 have been characterized appropriately for each analyzed fire scenario.		N/A	The scope of the FDS calculation was limited to a single target.

Table 2: Focused Scope Peer Review Assessment Summary

SR ID	Supporting Requirements		MET / NOT MET (Category II/III)	Focused Peer Review Assessment
	Category II	Category III		
FSS-H1	For each fire scenario analyzed, DOCUMENT a) the nature and characteristics of the ignition source, b) the nature and characteristics of the damage target set, c) any applied severity factors, and d) the calculated non-suppression probability; all in a manner that facilitates Fire PRA applications, upgrades, and peer review.		MET Cat II	a) This item is documented in Section 5.4 including Table 5-4 and Appendix C. b) This item is documented in Assumptions 9,10,11&12 and Section 5.2.5. c) N/A – severity factors not used. d) N/A – suppression not credited.
FSS-H2	DOCUMENT a basis for target damage mechanisms and thresholds used in the analysis including references for any plant-specific or target-specific performance criteria applied in the analysis.		MET Cat II	This item is documented in Assumptions 7&9 and Section 5.3.
FSS-H3	DOCUMENT a basis for the selection of the applied fire modeling tools.		MET Cat II	The model selection is documented in Section 5.1 and its application space is provided in Appendix A.
FSS-H4	DOCUMENT the fire modeling tool input values used in the analysis of each fire scenario.		MET Cat II	The assumptions and Section 3.1 and the model input discussions in Sections 5.2, 5.5, and 5.6 provide justification for the model inputs. In the original version of the calculation Assumption 6 (that all cables in secondary targets are thermoset, a critical assumption in the severity of the fire growth timeline) lacked a reference to plant documentation or specifications to justify this assumption. ANO provided references as noted in the documents reviewed section to justify this assumption which were added to the calculation's assumption and enabled this SR to be deemed MET.

Table 2: Focused Scope Peer Review Assessment Summary

SR ID	Supporting Requirements		MET / NOT MET (Category II/III)	Focused Peer Review Assessment
	Category II	Category III		
FSS-H5	DOCUMENT fire modeling output results for each analyzed fire scenario, including the results of parameter uncertainty evaluations (as performed) in a manner that facilitates Fire PRA applications, upgrades, and peer review.	DOCUMENT fire modeling output results for each analyzed fire scenario, including the results of parameter uncertainty evaluations (as performed) in a manner that facilitates Fire PRA applications, upgrades, and peer review and DISCUSS insights related to the impact of uncertainties for key input parameters in the context of the resulting fire risk estimates.	MET Cat II	Results of the analysis including target temperature, target exposure temperature, and room hot gas layer are provided along with analysis in Section 6 and Appendix D for an alternative scenario.
FSS-H6	DOCUMENT (a) a technical basis for any statistical models applied in the analysis, including applicability (b) a technical basis for any plant-specific updates applied to generic statistical models, and (c) the plant-specific data applied in any plant-specific updates		N/A	No statistical models were applied in the analysis.
FSS-H7	DOCUMENT the assumptions made related to credited firefighting activities including fire detection, fire suppression systems, and any credit given to manual suppression efforts.		N/A	While Appendix D does discuss the expected timeline of detection and suppression for the compartment that was modeled, no credit was taken in the model for either suppression or detection. Model results demonstrate that the single target being analyzed did not see damage even in the absence of suppression.
FSS-H8	DOCUMENT the methodology used to select potentially risk-significant multicompartment fire scenarios, the results of the multicompartment fire scenario analysis including the applied screening criteria; results of the screening analysis; the identification of any multicompartment fire scenarios identified as potentially risk significant; and the quantitative results for any scenarios analyzed quantitatively in a manner that facilitates Fire PRA applications, upgrades, and peer review.		N/A	The scope of the analysis was limited to a single compartment.

SR ID	Supporting Requirements		MET / NOT MET (Category II/III)	Focused Peer Review Assessment
	Category II	Category III		
FSS-H9	DOCUMENT key sources of uncertainty for the FSS technical element.		MET Cat II	Uncertainty is addressed through the results of the analysis in Sections 6 and 7. The resulting cable temperature rise in the analysis is approximately 10 % of the rise needed for damage. It is observed that this margin eliminates the possibility that input uncertainty would result in a change in the conclusions.
FSS-H10	DOCUMENT the walkdown process and results.		MET Cat II	The walkdown is documented in Section 2.2 and throughout the model development discussion in Section 5.2, 5.4, and 5.5.

Table 2: Focused Scope Peer Review Assessment Summary

Risk Summary

Two modification changes require additional discussion prior to establishing the overall risk impacts. Table S-1, modifications S1-8 and S1-9, involve use of an inhibit circuit. Consistent with other NFPA-805 plant modifications that incorporate an inhibit circuit, a 1E-03 failure probability assumption has been applied in the risk evaluation of Items S1-8 and S1-9. This failure probability was previously presented in Entergy letter dated January 15, 2016, supporting the ANO-1 transition to NFPA-805 (Reference 8) and later approved by the NRC in the ANO-1 NFPA-805 NRC SE (Reference 9).

With respect to modification S1-8 (RCS vent valve 2CV-4698-1), the modeling of the inhibit switch uses the methodology agreed upon for ANO-1 in the response to RAI SSA 11.01 (Reference 8) as stated above. For this risk impact determination, no evaluation was performed to identify which route points contain DC cables fused with fuses greater than 10 amps; therefore, all scenarios impacting the protected circuit assumed some potential for an arcing fault. A failure probability of 1E-03 was applied to reasonably address the probability of the spurious operation. The NRC accepted the Browns Ferry application of the 1E-03 inhibit circuit failure probability in NRC SE dated October 28, 2015 (ML15212A796) and the similar ANO-1 application in the Reference 9 NRC SE. A probability of 1E-03 is proposed to model the likelihood that a cable containing shorting switch conductors is located next to a DC circuit cable capable of generating an arc that causes collateral damage and potential open circuit of the shorting switch conductors. Although there is uncertainty associated with this probability, it bounds the likelihood that the cable containing shorting switch conductors is located next to a cable capable of generating the arc, that the arc would be generated when the cable is affected by a fire and results in an open circuit of the shorting conductors, and that after the open circuit occurs, a fire-induced short causes a spurious operation. Note that for a fire in the cabinet containing the inhibit switch, the fire scenario only credits NUREG-7150 hot short probabilities with no credit for the inhibit circuit. In conclusion, the change in design for modification S1-8 resulted in a change in risk that is considered insignificant to the overall risk.

The discussion of the 1E-03 failure probability above also applies to modification S1-9, associated with the Reactor Coolant System (RCS) high point vent valves 2SV-4670-2 and 2SV-4669-1. The modification change involved shifting from a cable protection method to installation of an inhibit circuit. To address the potential failure of the inhibit circuit, it must first be noted that multiple valves are required to meet the criteria for a small break LOCA. To allow a flow via both the two orifices (2FO-4668 and 2FO-4675) associated with these vent paths as listed in the Multiple Spurious Operation (MSO) Report, the following three combinations for each orifice path is required:

- Flow via orifice 2FO-4675 through either block valve 2SV-4636-1 or 2SV-4636-2,
- Flow via orifice 2FO-4668 through either block valve 2SV-4668-1 or 2SV-4668-2, AND
- A pathway through one of the RCS vent valves 2SV-4669-1 or 2SV-4670-2.

The associated MSO report has been revised to include each of these flow paths. Each vent valve listed above is a normally de-energized DC operated valve. For a hot short to occur, a ground fault equivalent hot short or an inter-cable hot short could cause the valve to energize. Therefore, for this MSO to be possible, multiple ground fault equivalent hot shorts are required with a parallel path doubling the probability, and the duration of the hot short must last longer than 7 minutes. Using this information concludes that for a fire in the cabinet, the probability of failure for these valves is projected to be 4.67E-07. For scenarios outside the cabinets (2C336-1 or 2C336-2) a hot short probability of 1E-03 is credited in accordance with the assumptions previously discussed for the above S1-8 modification. For these scenarios, the probability for a hot short is below the 1E-7/yr screening threshold for potentially high consequence equipment, as defined by Section 2.5.6 of NUREG/CR-6850. Since fires external to the cabinets have screened, the only cases considered are the scenarios where the inhibit switch is physically damaged by fire. The inhibit switch is located at panels 2C336-1 and 2C336-2 inside the MCR, having an ignition frequency of 4.28E-05. Without the consideration of any non-suppression probabilities, severity factors, or conditional core damage probabilities, the combination of ignition frequencies and hot short probabilities results in very low frequency events that have a negligible impact on CDF/LERF. In conclusion, the change in design for modification S1-9 resulted in a no more than minimal change in risk.

With respect to the aforementioned dual unit MCR abandonment scenario, the updated FPRA quantification incorporates a control room fire scenario associated with a fire in the ANO-1 Control Room which creates the potential for impacting sensitive electronics in the ANO-2 Control Room via hot gases spreading from ANO-1 to ANO-2. In this scenario (identified as scenario 129-F-A/A in the FPRA), the potential exists for the need to abandon both Control Rooms. Given that the operator minimum staffing for both Control Rooms does not support dual unit alternate shutdown, the impact of this case on ANO-2 is conservatively modeled as core damage. The frequency for such a scenario has been quantified as 2.34E-06 (ANO-1 MCR fires that result in sensitive electronics hot gas layer damage in ANO-2). The calculated CDF for this scenario, conservatively assuming a conditional core damage probability (CCDP) of 1.0, is 2.34E-06/rx-yr. The corresponding conditional large early release probability (CLERP) contribution is 3.46E-02 resulting in the total ANO-2 LERF (8.08E-08/rx-yr). This conservative analysis, assuming a CCDP of 1.0 due to the potential for inadequate staffing for dual unit fire damage shutdown, is reflected in the total ANO-2 fire risk presented in the updated Attachment W tables (see Attachment 4 of this letter).

Since the dual unit MCR abandonment scenario is not a change to the plant, but a revision to the analysis to ensure completeness in the assumptions used to calculate risk, the results are not depicted as a change in risk. However, the results of the dual unit MCR abandonment scenario are conservatively included in the cumulative risk results provided below.

The Attachment W baseline values provided previously (Reference 4) and approved in the ANO-2 SE (Reference 1) are provided in Table 1 below. The overall risk impact associated with these modifications was evaluated against these risk values. Table 2 contains the results of each modification compared to the baseline values.

Table 3 contains the Fire Risk Evaluation (FRE) delta CDF/LERF between the compliant configuration and the revised post transition baseline model. The cumulative CDF and LERF results are provided in Table 4.

Table 5 includes the cumulative FRE delta CDF/LERF between the compliant configuration and the revised (cumulative effects) post transition baseline model. The final total plant fire CDF is 7.67E-05 and LERF is 1.76E-06. The total plant fire CDF was derived using the NUREG/CR-6850 methodology for FPRA development and is useful in identifying the areas of the plant where fire risk is greatest. See revised Attachment W tables included in Attachment 4 of this letter.

Table 1 – Baseline Values

CDF	LERF	∆CDF	∆LERF
7.54E-05	1.72E-06	-1.29E-04	-4.72E-06

Table 2 – Individual Results of Changes

Item	Baseline CDF	Updated CDF	Difference	Baseline LERF	Updated LERF	Difference
S1-1, 2CV-1026-2 & 2CV-1076-2	7.54E-05	7.48E-05	-6.10E-07	1.72E-06	1.69E-06	-2.94E-08
S1-2 and S1-4, 2CV-4816 & 2CV-4817	7.54E-05	7.50E-05	-4.23E-07	1.72E-06	1.72E-06	-5.32E-09
S1-7, 2CV-1036-2 & 2CV-1075-1	7.54E-05	7.37E-05	-1.79E-06	1.72E-06	1.66E-06	-6.87E-08
S1-8, 2CV-4698-1	7.54E-05	7.59E-05	4.70E-07	1.72E-06	1.73E-06	6.60E-09
S1-9: 2SV-4670-2 & 2SV-4669-1	7.54E-05	Note 1	Note 1	1.72E-06	Note 1	Note 1
New Recovery Action- Availability of Instrumentation in Fire Area JJ	7.54E-05	7.60E-05	5.53E-07	1.72E-06	1.74E-06	1.68E-08
Bin 9	7.54E-05	7.56E-05	1.34E-07	1.72E-06	1.73E-06	2.89E-09

Note 1: Risk impacts described in Section 3.0 above are considered no more than minimal.

Table 3 – FRE ∆CDF/∆LERF
(between compliant and revised post-transition model)

Item	Baseline ∆CDF	Updated ∆CDF	Difference	Baseline ∆LERF	Updated ∆LERF	Difference
S1-1, 2CV-1026-2 & 2CV-1076-2	-1.29E-04	-1.29E-04	-5.58E-07	-4.72E-06	-4.74E-06	-2.44E-08
S1-2 and S1-4, 2CV-4816 & 2CV-4817	-1.29E-04	-1.29E-04	-2.69E-07	-4.72E-06	-4.72E-06	-3.49E-09
S1-7, 2CV-1036-2 & 2CV-1075-1	-1.29E-04	-1.29E-04	-4.55E-08	-4.72E-06	-4.72E-06	-6.74E-09
S1-8, 2CV-4698-1	-1.29E-04	-1.28E-04	7.08E-07	-4.72E-06	-4.70E-06	1.18E-08
S1-9: 2SV-4670-2 & 2SV-4669-1	-1.29E-04	Note 1	Note 1	-4.72E-06	Note 1	Note 1
New Recovery Action- Availability of Instrumentation in Fire Area JJ	-1.29E-04	-1.28E-04	4.75E-07	-4.72E-06	-4.70E-06	1.57E-08
Bin 9	-1.29E-04	-1.29E-04	-1.22E-07	-4.72E-06	-4.72E-06	-4.00E-09

Note 1: Risk impacts described in Section 3.0 above are considered no more than minimal.

Table 4 – Cumulative CDF and LERF Results

Baseline CDF	Updated CDF	Difference	Baseline LERF	Updated LERF	Difference
7.54E-05	7.67E-05	1.25E-06	1.72E-06	1.76E-06	3.09E-08

Table 5 – Cumulative Delta CDF and Delta LERF Results

Baseline FRE Delta CDF	Updated FRE Delta CDF	Difference	Baseline FRE Delta LERF	Updated FRE Delta LERF	Difference
-1.29E-04	-8.14E-05	4.75E-05	-4.72E-06	-3.13E-06	1.59E-06

The final FPRA quantification results are included in a revised Attachment W provided in Attachment 4 of this letter. The results meet the acceptance guidelines of Regulatory Guide (RG) 1.174, “An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis.”

Additional Entergy Request

By letter to the NRC dated November 7, 2013 (Reference 7), Entergy requested the flexibility to utilize performance-based methods to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features required by NFPA-805. Performance-based inspection, testing, and maintenance frequencies guidance is established in Electric Power Research Institute (EPRI) Technical Report TR-1006756, Fire Protection Equipment Surveillance Optimization and Maintenance Guide, Final Report, July 2003. The request was not in the original LAR, but was included in the Reference 7 Entergy response to an NRC request for additional information associated with ANO-2 adoption of NFPA-805. This allowance was not discussed in the NRC NFPA-805 SE for ANO-2 (Reference 1). Entergy requests the allowance to use this method be docketed for ANO-2, consistent with that included in Section 3.1.4.1 of the NRC NFPA-805 SE for ANO-1, issued in October 7, 2016 (Reference 9).

Summary

When considering the information provided above in aggregate, Entergy requests NRC approval of the planned changes to Table S-1 modifications and, subsequently, the ANO-1 Operating License which references the table. Other changes described herein are provided in support of the modification changes, or act to inform the NRC of non-modification revisions necessary for consistency, completeness, resolving newly identified NFPA-805 related issues, or to address NRC findings associated with the ANO-2 June 2016 triennial fire inspection.

The changes, in aggregate, result in changes to the final risk results provided previously in Entergy letter dated August 7, 2014 (Reference 4) and subsequently approved by the NRC in letter dated February 18, 2015 (Reference 1). Therefore, NRC acceptance of the final risk values provided in Attachment 4 of this letter is also necessary.

Finally, Entergy request NRC approval to apply the flexibility to utilize performance-based methods to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features required by NFPA-805 in accordance with the guidance of EPRI Technical Report TR-1006756 (July 2003).

4.0 REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements/Criteria

This letter, in its entirety, supports the continued transition of ANO-2 to NFPA-805, “Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants (2001 Edition),” and complies with the requirements in fire protection regulation 10 CFR 50.48(a), 10 CFR 50.48(c), and the guidance in Regulatory Guide (RG) 1.205, “Risk-Informed Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants.”

4.2 No Significant Hazards Consideration Determination

Entergy Operations, Inc. (Entergy) has evaluated the proposed changes using the criteria in 10 CFR 50.92 and has determined that the proposed changes do not involve a significant hazards consideration.

Entergy proposes a change to the Arkansas Nuclear One, Unit 2 (ANO-2) Operating License that effectively updates the methods employed to complete required NFPA-805 related plant modifications. Entergy has included the risk impacts of these changes and has also included risk impacts associated with new items identified since NRC approval of the ANO-2 transition to NFPA-805 (reference NRC Safety Evaluation dated February 18, 2018, ADAMS Accession No. ML14356A227).

Basis for no significant hazards consideration determination: As required by 10 CFR 50.91(a), Entergy analysis of the issue of no significant hazards consideration is presented below.

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No

   The purpose of this amendment is to provide updated information associated with the modifications that were described and committed to the ANO-2 license amendment request that was submitted and subsequently approved by the NRC to adopt a new risk-informed, performance-based fire protection licensing basis that complies with the requirements in 10 CFR 50.48(a) and 10 CFR 50.48(c), as well as the guidance contained in Regulatory Guide (RG) 1.205. The amendment also provides updated information related to ignition frequencies, recovery actions, use of an NRC-approved fire modeling tool not previously recognized as being used by ANO, and dual unit control room abandonment. The NRC considers that NFPA 805 provides an acceptable methodology and performance criteria for licensees to identify fire protection requirements that are an acceptable alternative to the 10 CFR Part 50, Appendix R, fire protection features (69 FR 33536; June 16, 2004).

   Operation of ANO-2 in accordance with the proposed amendment does not result in a significant increase in the probability or consequences of accidents previously evaluated. The proposed amendment does not affect accident initiators or precursors as described in the ANO-2 Safety Analysis Report (SAR), nor does it adversely alter design assumptions, conditions, or configurations of the facility, and it does not adversely impact the ability of structures, systems, or components (SSCs) to perform their intended function to mitigate the consequences of accidents described and evaluated in the SAR. The proposed amendment does not adversely alter safety-related systems nor affect the way in which safety-related systems perform their functions as required by the accident analysis. The SSCs required to safely shut down the reactor and to maintain it in a safe shutdown condition will remain capable of performing the associated design functions.

   Therefore, this change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No

   Implementation of the new risk-informed, performance-based fire protection licensing basis, with the revised modifications, recovery actions, application of an NRC-approved fire modeling method for ANO, and ignition frequencies, along with the demonstration of the risk impact of dual unit abandonment, complies with the requirements in 10 CFR 50.48(a) and 10 CFR 50.48(c), as well as the guidance contained in RG 1.205, and will not result in new or different kinds of accidents. The requirements in NFPA 805 address only fire protection. The impacts of fire effects on the plant have been evaluated. The proposed amendment does not involve new failure mechanisms or malfunctions that could initiate a new or different kind of accident beyond those already analyzed in the SAR.

   Therefore, this change does not create the possibility of a new or different kind of accident from an accident previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

   Response: No

   The proposed amendment has been evaluated to ensure that risk and safety margins are maintained within acceptable limits. The risk evaluations for plant changes in relation to the potential for reducing a safety margin, were measured quantitatively for acceptability using the delta risk (i.e., change in core damage frequency and change in large early release frequency) criteria from Section 5.3.5, "Acceptance Criteria," of NEI 04-02, "Guidance for Implementing a Risk-Informed, Performance-based Fire Protection Program under 10 CFR 50.48(c)," as well as the guidance contained in RG 1.205. Engineering analyses, which may include engineering evaluations, probabilistic safety assessments, and fire modeling calculations, have been performed to demonstrate that the performance-based methods of NFPA-805 do not result in a significant reduction in the margin of safety.

   Therefore, this change does not involve a significant reduction in a margin of safety.

Based upon the reasoning presented above, Entergy concludes that the requested change involves no significant hazards consideration, as set forth in 10 CFR 50.92(c), "Issuance of Amendment."

4.3 Conclusions

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

5.0 ENVIRONMENTAL CONSIDERATION

The proposed change would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR Part 20, and would change an inspection or surveillance requirement. However, the proposed change does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed change meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed change.

6.0 REFERENCES

1. NRC letter dated February 18, 2015, *Arkansas Nuclear One, Unit 2 – Issuance of Amendment Regarding Transition to a Risk-Informed, Performance-Based Fire Protection Program In Accordance with 10 CFR 50.48(c),* (TAC No. MF0404) (2CNA021502) (ML14356A227)

2. Entergy letter dated December 17, 2012, *License Amendment Request to Adopt NFPA-805 Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants (2001 Edition)*, (2CAN121202) (ML12353A041)

3. NRC letter dated August 4, 2016, *Arkansas Nuclear One – NRC Triennial Fire Protection Inspection Report (05000313/2016009 and 05000368/2016009),* (0CNA081603) (ML16218A299)

4. Entergy letter dated August 7, 2014, *Response to Request for Additional Information – Adoption of National Fire Protection Association Standard NFPA-805*, (2CAN081401) (ML14219A635)

5. Entergy letter dated August 29, 2016, *General Updates – Adoption of National Fire Protection Association Standard NFPA-805*, (1CAN081605) (ML16243A127)

6. Entergy letter dated March 25, 2016, *Response to PRA RAI 03 – Adoption of National Fire Protection Association Standard NFPA 805*, (1CAN031602) (ML16088A299)

7. Entergy letter dated November 7, 2013, *Response to Request for Additional Information – Adoption of National Fire Protection Association Standard NFPA-805*, (2CAN111301) (ML13312A877)

8. Entergy letter dated January 15, 2016, *Response to Round 3 Request for Additional Information – Adoption of National Fire Protection Association Standard NFPA-805*, (1CAN011601) (ML16015A421)

9. NRC letter dated October 7, 2016, *Arkansas Nuclear One, Unit 1 – Issuance of Amendment Regarding Transition to a Risk-Informed, Performance-Based Fire Protection Program in accordance with 10 CFR 50.48(c)* (CAC No. MF3419) (1CAN011601) (ML16223A481)

Attachment 2 to

2CAN101601

Updated Table S-1

Plant Modifications

S. Plant Modifications and Items to be Completed During Implementation

Table S-1, Plant Modifications, provided below includes a description of the modifications along with the following information:

- A problem statement,
- Risk ranking of the modification,
- An indication if the modification is currently included in the FPRA,
- Compensatory measure in place, and
- A risk-informed characterization of the modification and compensatory measure.

The following ranking legend should be used when reviewing the table:

- High = Modification which would have an impact on FPRA and affect multiple Fire Areas.
- Med = Modification which would have an impact on FPRA and affect individual Fire Areas, or include IN 92-18 modifications.
- Low = Modification which would have no or insignificant impact on risk.

Table S-1 Plant Modifications

Item	Rank	Unit	Problem Statement	Proposed Modification	In FPRA	Comp Measure	Risk Informed Characterization
S1-1	Med (PRA)	2	In Fire Area HH, a separation issue was identified on the EFW valves 2CV-1026-2 and 2CV-1076-2. During a fire induced circuit failure the feedwater valves may be impacted by a fire in Fire Zone 2096-M. LAR Source: Attachment C	ANO plans to relocate relays associated with 2CV-1026-2 and 2CV-1076-2 from Fire Area HH, Fire Zone 2096-M, to Fire Area B-3, Fire Zone 2091-BB, where the motor control centers (MCCs) for the affected valves are located.	Yes	Yes	This modification is specifically credited from a PRA perspective. Modification reduces the risk in Fire Area HH of a fire induced circuit failure for EFW valves 2CV-1026-2 and 2CV-1076-2 in Fire Zone 2096-M. In accordance with station directives, compensatory measures per OP-1003.014 have been established as appropriate.

Table S-1 Plant Modifications

Item	Rank	Unit	Problem Statement	Proposed Modification	In FPRA	Comp Measure	Risk Informed Characterization
S1-2	High (PRA)	2	In Fire Area JJ, a separation issue was identified that impacts the DC power cables control wiring on both trains. If a fire event occurred, this could result in the loss of equipment that would otherwise be available. Additional considerations are potential spurious operations at switchgear 2A-3 that may result in a loss of power to the safety bus. LAR Source: Attachment C	ANO plans to modify the circuits as described to eliminate impacts in Fire Area JJ associated with these components. 2A-3, 2A-308, 2A-309, and 2A-310 – The red train 125V DC panel 2D-23 that supplies control power for 2A-3 and 2B-5 is planned for relocation to Fire Area MM from Fire Area JJ. Control power cables are planned to be rerouted using embedded conduits from Fire Area MM to Fire Area II to avoid Fire Areas JJ and SS. This allows post-fire control of 2A-3 bus from the control room. 2CV-1036-2 – Auxiliary relays 2CR1036A, B, C, and D are currently installed in MCC 2B-61 and are planned to be relocated to MCC 2B-63. This would eliminate cables that are routed through Fire Area JJ associated with this valve. This eliminates a loss of 2CV-1036-2 due to a fire in Fire Area JJ. *(continued)*	Yes	Yes	This modification is specifically credited from a PRA perspective and affects multiple fire areas. The modification limits the risk of a potential spurious operation and a loss of DC power to safety bus for switchgear 2A-3 due to a fire induced circuit failure. In accordance with station directives, compensatory measures per OP-1003.014 have been established as appropriate.

Table S-1 Plant Modifications

Item	Rank	Unit	Problem Statement	Proposed Modification	In FPRA	Comp Measure	Risk Informed Characterization
S1-2				2CV-1075-1 – The reroute of DC control power to bus 2A-3 and load-center 2B-5 listed above assures MCC 2B-53 remains available to power this valve. Control cables from 2C-17 to MCC 2B-53 are planned to be rerouted using an embedded conduit between Fire Area G and II to avoid Fire Areas JJ, SS, and TT. New dedicated fuses are planned to be installed in 2C-17 for 2CV-1075-1 control relays so that failure of cables in scheme 2S113 will not impact 2CV-1075-1. 2B-6 – Cables are planned to be rerouted to control room panel 2C33-2 from 2B-6 using an embedded conduit between Fire Zone 2100-Z to the cable spreading room Fire Area G. This eliminates an impact in Fire Area JJ. 2CV-4816 & 2CV-4817 – The control circuit of these valves will be modified by replacing 2HS-4817 with a new four-position switch in the existing location in control room panel 2C09. The new switch configuration allows the operator to place the switch in the CLOSE position to isolate the transducer and its field cable from the controller, and bond the positive and negative conductors of the current loop to each other. This arrangement de-energizes the target cable eliminating intracable faults as a potential failure, prevents spurious operation of the controller from opening the valve, and provides protection from postulated intercable faults.			

Table S-1 Plant Modifications

Item	Rank	Unit	Problem Statement	Proposed Modification	In FPRA	Comp Measure	Risk Informed Characterization
S1-3	High (PRA)	2	In Fire Area MM, fire induced circuit failure could impact DC power cables feeding circuit breakers at switchgear 2A-1, 2A-2, 2H-1, and 2H-2. The failure of 2A-1 and 2A-2 could prevent alignment to an offsite power source. The failure of 2H-1 and 2H-2 could prevent tripping the reactor coolant pumps (RCPs) from the control room. LAR Source: Attachment C	ANO plans to install backup DC control power to switchgear 2A-1, 2A-2, 2H-1 and 2H-2 with automatic transfer capability in the event the normal DC control power source is lost. The new backup DC power source will be located completely within Fire Area B-2 in proximity to the switchgear either on elevation 372' or below at elevation 354'. This eliminates impacts to switchgear DC control power due to a fire in any other ANO-2 fire area and allows tripping of the RCPs in those areas. Inclusive in this modification will be changes to the control power circuits for switchgear 2H-1 and 2H-2 to allow tripping the RCPs in a scenario where a fire originates internally to a switchgear cubicle. This design will prevent fire damage to a load cubicle from disabling the ability to trip the line breakers and remove power to the RCPs. The opposite scenario where fire damages the line breakers would not prevent the RCP load breakers from being tripped. This modification will require the line and load breakers to be separately fused and fed as described: *(continued)*	Yes	Yes	This modification is specifically credited from a PRA perspective and affects multiple fire areas. Modification to install an alternate DC power source reduces the risk of a fire induced circuit failure to the DC power cables feeding RCP circuit breakers 2H-1 and 2H-2 which could prevent tripping the RCPs from the control room. In accordance with station directives, compensatory measures per OP-1003.014 have been established as appropriate.

Table S-1 Plant Modifications

Item	Rank	Unit	Problem Statement	Proposed Modification	In FPRA	Comp Measure	Risk Informed Characterization
S1-3				2H-1 – Internal DC control wiring jumpers will be removed to isolate the line and load cubicles. The DC control power for line breakers 2H-13, 2H-14, and 2H-15 will be isolated from the DC control power for the load breakers 2H-10, 2H-11, and 2H-12. 2H-2 – Internal DC control wiring jumpers will be removed to isolate the line and load cubicles. The DC control power for line breakers 2H-23, 2H-24, and 2H-25 will be isolated from the DC control power for the load breakers 2H-20, 2H-21, and 2H-22.			
S1-4	High (PRA)	2	In Fire Area TT, a separation issue was identified that impacts the power cables for EFW, chemical and volume control system (CVCS), and service water (SW) components. LAR Source: Attachment C	ANO plans to modify the circuits as described to eliminate impacts in Fire Area TT associated with these components. 2CV-1036-2 – Auxiliary relays 2CR1036A, B, C, and D are currently installed in MCC 2B-61 and are planned to be relocated to MCC 2B-63. This would also eliminate cables that are routed through Fire Area TT associated with this valve. This eliminates a loss of 2CV-1036-2 due to a fire in Fire Area TT. *(continued)*	Yes	Yes	This modification is specifically credited from a PRA perspective and affects multiple fire areas. The modification reduces the risk of a fire induced circuit failure for EFW/CVCS/SW components and power cables (2B-5, 2CV-0789-1, 2CV-1036-2, 2CV-1075-1, 2CV-4816, 2CV-4817, and 2P-7B) in Fire Area TT. In accordance with station directives, compensatory measures per OP-1003.014 have been established as appropriate.

Table S-1 Plant Modifications

Item	Rank	Unit	Problem Statement	Proposed Modification	In FPRA	Comp Measure	Risk Informed Characterization
S1-4				2CV-1075-1 – Cables for this valve between panels 2C-39 to 2C-17 that are currently routed through Fire Area TT are planned to be rerouted to remain exclusively in the cable spreading room. Control cables from 2C-17 to MCC 2B-53 are planned to be rerouted using an embedded conduit between Fire Area G and II to avoid Fire Areas JJ, SS, and TT. New dedicated fuses are planned for installation in 2C-17 for 2CV-1075-1 control relays so that failure of cables in scheme 2S113 will not impact 2CV-1075-1. 2P-7B – Cables for this pump between panels 2C-39 to 2C-17 that are currently routed through Fire Area TT are planned to be rerouted to remain exclusively in the cable spreading room. New conduits are also planned to be installed. 2CV-0789-1 – Cables for this valve between panels 2C-39 to 2C-17 that are currently routed through Fire Area TT are planned to be rerouted to remain exclusively in the cable spreading room. Control cables from 2C-17 to MCC 2B-53 are planned to be rerouted using an embedded conduit between Fire Area G and II to avoid Fire Areas JJ and SS. *(continued)*			2B-5 – Cables for this load center between panels 2C-39 to 2C-33-1 that are currently routed through Fire Area TT are planned to be rerouted to remain exclusively in the cable spreading room.

Table S-1 Plant Modifications

Item	Rank	Unit	Problem Statement	Proposed Modification	In FPRA	Comp Measure	Risk Informed Characterization
S1-4				2CV-4816 & 2CV-4817 – The control circuit of these valves will be modified by replacing 2HS-4817 with a new four-position switch in the existing location in control room panel 2C09. The new switch configuration allows the operator to place the switch in the CLOSE position to isolate the transducer and its field cable from the controller, and bond the positive and negative conductors of the current loop to each other. This arrangement de-energizes the target cable eliminating intracable faults as a potential failure, prevents spurious operation of the controller from opening the valve, and provides protection from postulated intercable faults. 2B-5 – Cables for this load center between panels 2C-39 to 2C-33-1 that are currently routed through Fire Area TT are planned to be rerouted to remain exclusively in the cable spreading room.			

Table S-1 Plant Modifications

Item	Rank	Unit	Problem Statement	Proposed Modification	In FPRA	Comp Measure	Risk Informed Characterization
S1-5	High (PRA)	2	In Fire Area SS, a fire induced circuit failure could impact the DC power on both trains resulting in the loss of the various components. LAR Source: Attachment C	ANO plans to modify the circuits as described to eliminate impacts in Fire Area SS associated with these components. 2A-3 and 2A-310 – The red train 125V DC panel 2D-23 that supplies control power for 2A-3 and 2B-5 is planned to be relocated from Fire Area JJ to Fire Area MM. Control power cables are planned to be rerouted using embedded conduits from Fire Area MM to Fire Area II to avoid Fire Areas JJ and SS. This allows post-fire control of 2A-3 bus from the control room. 2A-4, 2A-409, & 2B-6 – Cables are planned to be rerouted to control room panel 2C33-2 from 2A-4 and 2B-6 using an embedded conduit between Fire Zone 2100-Z to the cable spreading room Fire Area G. This eliminates an impact in Fire Zone 2097-X and Fire Area JJ. The 125V DC control power from 2D-24 to 2A-4 is planned to be rerouted using a new conduit to avoid an impact against cables G2D2404A and B in Fire Zone 2097-X. 2CV-0789-1 & 2PIS-0789-1 – The power cable for 2PIS-0789-1 (for 2CV-0789-1) is planned to be re-routed using an embedded conduit from Fire Area G to Fire Area II to avoid Fire Area SS. *(continued)*	Yes	Yes	This modification is specifically credited from a PRA perspective and affects multiple fire areas. The modification reduces the risk of a fire induced circuit failure that could result in the loss of DC power for both trains. In accordance with station directives, compensatory measures per OP-1003.014 have been established as appropriate.

Table S-1 Plant Modifications

Item	Rank	Unit	Problem Statement	Proposed Modification	In FPRA	Comp Measure	Risk Informed Characterization
S1-5				2CV-1040-1 – This valve is not directly impacted but is failed due to a loss of AC. The red train 125V DC panel 2D-23 that supplies control power for 2A-3 and 2B-5 is planned to be relocated from Fire Area JJ to Fire Area MM. Control power cables are planned to be routed using embedded conduits from Fire Area MM to Fire Area II to avoid Fire Areas JJ and SS. This assures 2CV-1040-1 will have a source of power and eliminates an impact in Fire Area SS. 2A-308, 2A-309, 2D-27, 2K-4A, 2P-16A, 2P-36A, 2SV-0724-1, 2SV-2809-1, 2SV-2810-1, and 2SV-2811 – The cables associated with these components are planned to be re-routed to avoid Fire Area SS by using embedded conduits and as required the installation of a new raceway in Fire Area B-2 directly under Fire Area SS on elevation 372'. The new raceway in Fire Area B-2 is planned to be installed above the vertical zone of influence for any postulated fire source. This eliminates impacts for 2A-308, 2A-309, 2D-27, 2K-4A, 2P-16A, 2P-36A, 2SV-0724-1, 2SV-2809-1, 2SV-2810-1, and 2SV-2811 in Fire Area SS.			

Table S-1 Plant Modifications

Item	Rank	Unit	Problem Statement	Proposed Modification	In FPRA	Comp Measure	Risk Informed Characterization
S1-6	Med (92-18)	2	Motor Operated Valves (MOVs) will be modified to meet requirements per IN 92-18. The NPO assessment determined that any one of the RCS drop line valves can fail in a closed and unrecoverable position resulting in a loss of SDC. LAR Source: Attachment D NPO-RCS-SDC	ANO plans to modify the control circuit for 2CV-5038-1 to prevent spurious closure. This is planned to be similar to the inhibit circuit modification on CV-1275 for ANO-1. Procedural controls to secure power by opening breakers are planned to be implemented for 2CV-5084-1 and 2CV-5086-2.	No	Yes	The NPO modification reduces the risk of fire induced MOV circuit failures (hot shorts, open circuits and short to ground). This MOV modification can prevent a non-recoverable position failure resulting in the loss of shutdown cooling. In accordance with station directives, compensatory measures per OP-1003.014 have been established as appropriate.
S1-7	Med (PRA)	2	In Fire Area G, MOVs will be modified to meet requirements per IN 92-18. Four EFW discharge valves can fail in an unrecoverable position. LAR Source: Attachment C	ANO plans to modify the control circuit for MOVs 2CV-1075-1 and 2CV-1036-2 to prevent fire induced spurious operation from the main control room, Fire Area G, which could result in failing the valves in an unrecoverable position. This will be accomplished by the use of interposing relays to ensure hot shorts will not bypass the valve torque switches. The modification reduces the risk of fire induced valve circuit failures (hot shorts, open circuits, and short to ground) for EFW valves 2CV-1036-2 and 2CV-1075-1 control cables.	Yes	Yes	This modification is specifically credited from a PRA perspective. The modification reduces the risk of fire induced MOV circuit failures (hot shorts, open circuits and short to ground). This MOV modification can prevent a non-recoverable position failure. In accordance with station directives, compensatory measures per OP-1003.014 have been established as appropriate.

Table S-1 Plant Modifications

Item	Rank	Unit	Problem Statement	Proposed Modification	In FPRA	Comp Measure	Risk Informed Characterization
S1-8	High (PRA)	2	In Fire Areas B-3 and G, spurious opening of MOV 2CV-4698-1 RCS Pressurizer Emergency Core Cooling Vent valve can result from a fire in motor control center (MCC) 2D-27 and cabinet 2C-09. LAR Source: Attachment C	The control circuit of 2CV-4698-1 will be modified by installing an inhibit circuit to prevent spurious operation in the event of a fire-induced short circuit. The inhibit circuit utilizes an existing spare closed contact in the CLOSE-OPEN control switch to effectively ground the valve opening circuit except when the control switch is moved to the OPEN position. A fire-induced circuit failure will result in a short to ground through the closed contact. This will prevent a cable failure from causing spurious operation of the valve.	Yes	Yes	This modification is specifically credited from a PRA perspective. The modification in Fire Areas B-3 and G protects the valve control cable in MCC 2D-27 and cabinet 2C-09 which reduces the risk of fire induced circuit failures (such as spurious opening). This modification can prevent a non-recoverable position failure. In accordance with station directives, compensatory measures per OP-1003.014 have been established as appropriate.
S1-9	High (PRA)	2	RCS High Point Vent Valves 2SV-4670-2 and 2SV-4669-1: Solenoid valves are provided in the RCS system for a means of venting. These “energize to open” solenoids provide a vent path from the top of the pressurizer. The final two, in parallel, solenoids determine the vent path, either to the containment atmosphere (2SV-4670-2) or the quench tank (2SV-4669-1). LAR Source: Attachment C	The control circuits of 2SV-4670-2 and 2SV-4669-1 will be modified by installing an inhibit circuit in each to prevent spurious operation in the event of a fire-induced short circuit. The inhibit circuit will utilize an existing spare closed contact in the CLOSE-OPEN control switch to effectively ground the valve opening circuit except when the control switch is moved to the OPEN position. A fire-induced circuit failure will result in a short to ground through the closed contact. This will prevent a cable failure from causing spurious operation of the valve. The functional and performance characteristics of the two valves are not changed. The method of operating the valves will remain the same.	Yes	Yes	This modification is specifically credited from a PRA perspective. The modification in Fire Area G to install an inhibit circuit minimizes the risk of fire induced circuit failures (such as spurious opening). In accordance with station directives, compensatory measures per OP-1003.014 have been established as appropriate.

Table S-1 Plant Modifications

Item	Rank	Unit	Problem Statement	Proposed Modification	In FPRA	Comp Measure	Risk Informed Characterization
S1-10	Med (PRA)	2	In Fire Area B-4 an incipient fire detection system is not installed in control element drive mechanism (CEDM) room panels 2C-70, 2C-71, 2C-72, 2C-73, 2C-75, 2C-80, and 2C-409. However an early warning fire detection system in accordance with NFPA 72, Fire Alarm Detection Code, is required by the PRA in accordance with FRE CALC-09-E-0008-05. LAR Source: Attachment C	ANO plans to provide a modification in the CEDM room in Fire Area B-4 to install incipient detection in cabinets 2C-70, 2C-71, 2C-72, 2C-73, 2C-75, 2C-80, and 2C-409. Fire detection signal cable is planned to be routed from each air sampling detector to the control room fire panel 2C-343-3.	Yes	Yes	This modification is specifically credited from a PRA perspective. The early warning fire detection system modification in Fire Area B-4 reduces the risk of a fire induced circuit and equipment failures that could result in the loss of CEDM room panels 2C-70, 2C-71, 2C-72, 2C-73, 2C-75, 2C-80, and 2C-409. In accordance with station directives, compensatory measures per OP-1003.014 have been established as appropriate.
S1-11	High (PRA)	2	At ANO the availability of feedwater to ANO-2 SGs was identified as an issue by PRA. Also identified by PRA was ANO's inability to perform high risk and time sensitive actions, such as control of auxiliary feedwater (AFW), outside of the ANO-2 Control Room. LAR Source: Attachment C (listed globally in multiple Fire Areas for new AFW pump in Risk Summaries)	ANO plans to install a new AFW pump capable of feeding either of the ANO-2 SGs. The AFW would be designed to meet or exceed the flow requirements of ANO-2 Emergency Feedwater (EFW) Pump 2P-7B (380 gpm @ 1100 psig). The new pump, controls and motor operated valves would be designed to be installed in a manner that protects the assumptions in the PRA. The preferred source of suction for the new pump is planned to be from an available source (i.e., Condensate Storage Tank). *(continued)*	Yes	Yes	The AFW modification is specifically credited from a PRA perspective to provide a reliable additional source of feedwater. The local control panel modification is specifically credited from a PRA perspective to provide an alternate means to perform required actions outside the ANO-2 Control Room. This modification reduces the risk of not being able to perform necessary operator actions to shutdown the plant, if either Control Room can't be manned. *(continued)*

Table S-1 Plant Modifications

Item	Rank	Unit	Problem Statement	Proposed Modification	In FPRA	Comp Measure	Risk Informed Characterization
S1-11				The discharge piping is planned to be routed through the Turbine Building to ANO-2 Auxiliary Building Rooms 2081 and 2084 for the tie-ins to the EFW System piping. The AFW tie-ins are planned to discharge into the ANO-2 EFW downstream of all EFW injection valves to ensure a single area fire does not disable AFW. The AFW pump would be designed to have the capability to be operated from the ANO-2 Control Room and also locally. The design will ensure electrical isolation from Control Room functions to prevent a fire in the ANO-2 Control Room from affecting local control of AFW components. The AFW pump and associated motor operated valves would be designed to be powered by diverse non-safety related power sources to prevent a single failure from disabling equipment operation. The AFW pump would be designed to include controls and monitoring instrumentation to ensure proper water flow to the SGs. The local controls and monitoring instrumentation are planned to be located and powered with redundant power supplies in a manner that protects the assumptions in the PRA.			Also, the local control panel modification reduces the risk of availability issue with of feedwater supply to the ANO-2 SGs. Manual actions are credited in fire areas that contain redundant safe shutdown equipment. These actions have been demonstrated feasible and are therefore considered adequate compensatory measures until compliance can be achieved by transitioning to a 10 CFR 50.48(c) licensing basis.

Table S-1 Plant Modifications

Item	Rank	Unit	Problem Statement	Proposed Modification	In FPRA	Comp Measure	Risk Informed Characterization
S1-12	Med (PRA)	2	In Fire Area B-3, excessive temperatures have been identified in Fire Zone 2091-BB following a loss of ventilation. LAR Source: Attachment C	ANO plans to modify the control wiring for fans 2VEF-63 and 2VEF-64 to isolate the control room and allow the local controls to override a “stop” signal generated from within Fire Area G, either from handswitch positioning or fire-induced circuit damage. This eliminates fire impacts in Fire Area G and assures either 2VEF-63 or 2VEF-64 will remain available except for a fire in Fire Area B-3, Fire Zone 2091-BB.	Yes	No	This modification supports a basic assumption from a PRA perspective.
S1-13	Med (PRA)	2	In Fire Area MM, excessive temperatures have been identified in Fire Zone 2099-W following a loss of ventilation. LAR Source: Attachment C	ANO plans to provide a modification to fire door DR 265 to allow normally open positioning with automatic closure features in the event of a fire. This allows natural circulation to prevent long term room overheating impact on equipment located in Fire Zone 2099-W, West DC Equipment Room, by allowing an opening to Fire Zone 2109-U, Corridor, in Fire Area JJ.	Yes	No	This modification supports a basic assumption from a PRA perspective.

Table S-1 Plant Modifications

Item	Rank	Unit	Problem Statement	Proposed Modification	In FPRA	Comp Measure	Risk Informed Characterization
S1-14	Low (Code)	C	With regard to NFPA 50A, Gaseous Hydrogen Systems, code non-compliance issues were identified in the Hydrogen Gas Bottle Storage Room related to inadequate vent piping and room ventilation. The hydrogen storage room light switch was identified as not meeting Article 501 for Class I, Division 2 locations of the National Electric Code (NEC). LAR Source: Attachment A, Section 3.3.7.1	ANO plans to modify the ventilation for the Hydrogen Bottle Storage area to ensure compliance with NFPA 50A. In addition, electrical equipment and wiring changes will be made to meet the requirements of NFPA 70 (NEC), Article 501 for Class I, Division 2.	No	No	The subject hydrogen gas system bottle storage area is not credited by the PRA. This modification will be completed to meet NFPA 805 code requirements.

Table S-1 Plant Modifications

Item	Rank	Unit	Problem Statement	Proposed Modification	In FPRA	Comp Measure	Risk Informed Characterization
S1-15	Med (PRA)	C	NFPA 805 non-compliance issues were encountered when smaller fire areas were defined such that multiple walls, dampers, penetration seals, and doors were credited and used in the PRA model as rated fire barriers in the NRC regulatory basis for NFPA 805. Multiple walls and doors barriers will require upgrading to comply with NFPA 805. LAR Source: Attachment A, Section 3.11.2	ANO plans to provide an adequate-for-the-hazard evaluation and if necessary a modification to upgrade fire barrier walls, dampers, penetration seals, and doors to rated barriers for those barriers credited for deterministic compliance and subsequently credited in the Fire PRA analysis. These barriers have been previously identified as NRC regulatory basis to ensure compliance with NFPA 805 and have compensatory measures established. The barriers to be addressed as identified by EC-1956 are 2005-2, 2005-3, 2067-4, 2082-3, 2091-1, 2091-2, 2091-3, 2091-4, 2107-4, 2110-2, 2110-4, 2110-7, 2112-2, 2112-8, 2112-10, 2133-5, 2133-6, 2147-8, 2148-4, 2148-5, 2149-5, 2152-2, 2154-2, 2154-3, 2154-5, 2158-10, 2224-2, 2224-3, 2228-10, 2239-4, 2239-5, 2256-4, 2256-5, 2256-6, 2256-8, 2134-1, and 2155-1.	Yes	Yes	This modification will be completed to meet NFPA 805 code requirements. In accordance with station directives, compensatory measures per OP-1003.014 have been established as appropriate.

Table S-1 Plant Modifications

Item	Rank	Unit	Problem Statement	Proposed Modification	In FPRA	Comp Measure	Risk Informed Characterization
S1-16	Low (Code)	C	NFPA 10 non-compliance issues (such as incorrect number of fire extinguishers for travel distance, incorrect type and size for the hazard area) were identified with ANO portable fire extinguishers. LAR Source: Attachment A, Section 3.7	ANO plans to provide a modification to resolve the NFPA 10 code deficiencies identified in CALC-ANOC-FP-09-00009. In general, this modification would involve portable fire extinguisher physical relocation, substitution of existing extinguishers, and documentation updates to reflect these plant changes. The results will ensure the proper number of fire extinguishers to meet travel distance requirements in coverage areas, adequately sized fire extinguishers, and the correct type of extinguisher that is rated for the fire hazard in each area.	No	No	The subject fire extinguishers are not credited in the FPRA. This modification will be completed to meet NFPA 805 code requirements.

Attachment 3 to

2CAN101601

Markup of Attachment W

Fire PRA Insights

W. Fire PRA Insights

W.1 Fire PRA Overall Risk Insights

Risk insights were documented as part of the development of the FPRA. The total plant fire CDF/LERF was derived using the NUREG/CR-6850 methodology for FPRA development and is useful in identifying the areas of the plant where fire risk is greatest. The risk insights generated were useful in identifying areas where specific contributors might be mitigated via modification. A detailed description of significant risk sequences associated with the fire initiating events that contribute above 1% of the calculated fire risk for the plant was prepared for the purposes of gaining these insights and an understanding of the risk significance of MSO combinations. These insights are provided in Table W-1.

Fire Scenario Selection

Fire scenarios were selected based on the definition of 'significant accident sequence' from RG 1.200, Revision 2:

> *Significant accident sequence: A significant sequence is one of the set of sequences, defined at the functional or systemic level that, when ranked, compose 95% of the CDF or the LERF/LRF, or that individually contribute more than ~1% to the CDF or LERF/LRF.*

There are 80~~2~~ fire scenarios comprising 90% of the cumulative fire CDF and 113~~9~~ fire scenarios comprising 95% of the cumulative fire CDF. Of these, 24 scenarios contribute 1% or greater on an individual basis. These 24 scenarios (all scenarios contributing 1% or greater on an individual basis) are presented in Table W-1. There is a strong correlation between CDF and LERF. There are five~~six~~ scenarios that contribute 1% or more to the total CDF, but do not similarly contribute to LERF. An additional two~~three~~ scenarios contribute 1% or more to the LERF total, but do not similarly contribute to CDF. These two~~three~~ scenarios have been added to Table W-1.

Modifications

Several modifications were identified in the FREs that contributed to reducing ΔCDF and ΔLERF to within the acceptable criteria. The risk benefits of these proposed modifications are reflected in the ΔCDF and ΔLERF risk values presented in Table W-2.

See Table~~Attachment~~ S-1 for a complete list of all modifications including additional details of each.

Recovery Actions

Recovery actions were reviewed for adverse impact on the FPRA. Each human action credited in the FPRA model was evaluated in the ANO-2 Fire PRA Human Reliability Analysis Notebook (PRA-A2-05-007, Revision 1). None of the modeled actions was found to have an adverse impact on the FPRA. Recovery actions were not credited given a fire in the room in which the action occurs, or through which the operators must pass to perform the action. Also, for the main control room, recovery actions were not credited given a fire in a panel needed to complete the action.

Safe Shutdown Analysis actions were also reviewed in developing the Variances from Deterministic Requirements (VFDRs) to be used for assessing actions adverse to risk.

The risk associated with each VFDR was evaluated in the FRE process. The potential risk of each recovery action is bounded by the ΔCDF and ΔLERF provided in Table W-2. Also, the additional risk of recovery actions for an area was conservatively determined and is provided in Table W-2.

See Attachment G for the recovery actions credited in each area.

W.2 Risk Change Due to NFPA 805 Transition

In accordance with the guidance in Regulatory Position 2.2.4.2 of RG 1.205, Revision 1:

"The total increase or decrease in risk associated with the implementation of NFPA 805 for the overall plant should be calculated by summing the risk increases and decreases for each fire area (including any risk increases resulting from previously approved recovery actions). The total risk increase should be consistent with the acceptance guidelines in Regulatory Guide 1.174. Note that the acceptance guidelines of Regulatory Guide 1.174 may require the total CDF, LERF, or both, to evaluate changes where the risk impact exceeds specific guidelines. If the additional risk associated with previously approved recovery actions is greater than the acceptance guidelines in Regulatory Guide 1.174, then the net change in total plant risk incurred by any proposed alternatives to the deterministic criteria in NFPA 805, Chapter 4 (other than the previously approved recovery actions), should be risk-neutral or represent a risk decrease."

The change in CDF and LERF for each fire area is provided in Table W-2.

W.2.1 Methods Used to Determine Changes in Risk

Variances from Deterministic Requirements (VFDRs)

For a fire area that is not deterministically compliant under NFPA 805, Section 4.2.3.2, deterministic compliance strategies were identified as compensatory measures for the variances from the deterministic requirements (VFDRs). These strategies include NRC-granted exemptions, evaluations that determine specific equipment is free of fire damage (see discussion of embedded conduit below), application of electrical raceway fire barrier systems (wrap), or manual manipulations of controls and equipment in the control room and power block. The VFDRs are lack-of-separation issues and span the NFPA 805 nuclear safety performance criteria: reactivity control, inventory and pressure control, decay heat removal, vital auxiliaries, and process monitoring. The compensatory measures already in place for the VFDRs mitigate the risk of the associated failures, thereby ensuring that the risk from fire damage prior to transition to NFPA 805, although not quantified, is acceptable.

For the transition to NFPA 805, the risk from fire damage is quantified. Each fire area that is not deterministically compliant under NFPA 805, Section 4.2.3.2, is evaluated in the risk-informed, performance-based approach under NFPA 805, Section 4.2.4.2, by the Fire Probabilistic Risk Assessment (FPRA). The FPRA provides a current state-of-the-art fire PRA analysis performed using accepted methods.

The aggregate change in risk associated with the VFDRs in a given fire area is evaluated by comparing all fire scenarios in the given fire area against two distinct plant models within the FPRA:

- the compliant plant model, and
- the post-transition plant model

Compliant Case Analysis for a Fire Area

The compliant case for an area represents the existing as-built, as-operated plant if all of the VFDRs in the area were eliminated; in other words, if the area was deterministically compliant. Thus, the compliant case for each area was analyzed as follows.

The FPRA scenarios for the area were reviewed to determine which VFDR related components are modeled and for those modeled, which VFDR related components are failed by each specific fire scenario. VFDR related components not modeled within the FPRA (e.g., those involving HVAC systems not required to meet PRA success criteria) were determined to have no impact on the safety functions modeled in the FPRA and thus, no contribution to core damage frequency (CDF) or large early release frequency (LERF).

For each scenario, the specific VFDR related components, which if protected would eliminate the VFDR, were set to their random failure probability instead of to "failed by the fire." Setting these components to their random failure probability provides an estimate of the fire risk if individual modifications were made to protect or reroute the components, thereby eliminating the VFDRs. The other components in the FPRA model that are impacted by the fire scenario are set to "failed by the fire."

Recovery actions (outside control room manual actions to mitigate the direct failure of VFDRs listed in Attachment G) were not credited in the compliant case. Non-recovery actions (manual actions to mitigate non-VFDR failures) were credited in the compliant case. This ensures that the compliant case represents the as-built, as-operated plant except for the eliminated VFDRs in the area, allowing for direct comparison with the post-transition plant model, which credits recovery actions.

As a rule, proposed modifications (listed in Attachment S) were not credited in the compliant case. This ensures that the compliant case represents the as-built, as-operated plant, except for the eliminated VFDRs in the area, allowing for direct comparison with the post-transition plant model, which credits the modifications. One noted exception is Modification S1-3, "Backup DC control power to switchgear 2A-1, 2A-2, 2H-1 and 2H-2," which is conservatively credited in both the compliant plant model and the post transition plant model.

Post Transition Case Analysis for a Fire Area

The post transition case for a fire area represents the plant if the recoveries listed in Attachment G and the modifications listed in Attachment S are used to protect the plant from core damage, mitigating the risk imposed by the VFDRs.

For each scenario, the specific VFDR related components and other components in the FPRA model that are impacted by the fire scenario were set to "failed by the fire." Some examples of the methods used in the post transition case are provided below.

- VFDR components with 1-hour fire wrap; specifically, Service Water pump cables in Fire Areas OO and B-6 and charging pump cables in Fire Area DD were set to "failed by the fire." Since these wrapped components were set to "failed by the fire" in the post transition model, but not in the compliant model, they are included in the Δ risk calculations. Also, since the resulting risk meets the acceptance criteria, the fire wrap does not need to be maintained. See VFDRs B6-01, DD-03 and OO-01 in Attachment C.
- VFDR related components with NRC-granted exemptions were set to "failed by the fire." Since these components were set to "failed by the fire" in the post transition model and the resulting risk meets the acceptance criteria, the NRC-granted exemptions for these components do not need to be maintained in the post transition licensing basis. See Licensing Actions sections of Attachment C for details.
- VFDR related components in embedded conduits were not set to "failed by the fire" since they were determined to be protected from fire damage as documented in Attachment J. Thus, they have no impact on the Δ risk calculations.

Recovery actions (outside control room manual actions to mitigate the direct failure of VFDRs listed in Attachment G) were credited in the post transition case. Non-recovery actions (manual actions to mitigate non-VFDR failures) were also credited in the post transition case.

The proposed modifications (listed in Attachment S) were credited in the post transition case. This ensures that the post transition case represents the plant following transition to NFPA 805 and allows comparison, with the compliant case which does not credit the modifications. The exception is Modification S1-3, "Backup DC control power to switchgear 2A-1, 2A-2, 2H-1 and 2H-2," which is conservatively credited in both the compliant plant model and the post transition plant model.

FPRA model changes to incorporate the proposed modifications (listed in Attachment S) and recovery actions (listed in Attachment G) were made using accepted methods. FPRA peer reviews were performed to assess the adequacy of the FPRA model and the results of the peer reviews are described in Attachment V and in Entergy letter dated October 27, 2016 (2CAN101601), Section 3.

To confirm the availability of operator cues for the recovery actions, the actions were correlated to fire safe shutdown analysis instrumentation. Since one train of fire safe shutdown analysis instrumentation is demonstrated to be available via the conservative deterministic post-fire analysis, these cues will remain available post-fire. Current fire procedures provide guidance to the operators for use of the fire safe shutdown analysis instrumentation as cues for evaluation of the need to perform actions. Confirmation of the availability of operator cues is documented in the ANO-2 Fire PRA Human Reliability Analysis calculations (PRA-A2-05-007, PRA-A2-05-020, and PRA-A2-05-002).

Change in Risk for a Fire Area

Each scenario for a fire area is evaluated as described above, with the following exceptions.

- If a scenario does not impact VFDR related components, no analysis was performed since the post transition case is equivalent to the compliant case, and the ΔCDF and ΔLERF for that scenario are zero.
- If a scenario contains a VFDR and is low risk (< 1E-08 CDF, < 1E-09 LERF), the scenario ΔCDF and ΔLERF are conservatively approximated by assuming the CDF/LERF for the compliant case is equal to zero. Therefore, the delta risk is bounded by assuming the delta risk is equal to the total risk of the post transition case results for that scenario.

The change in risk for a fire area is computed as the sum of the post-transition plant scenario results minus the sum of the compliant plant scenario results.

ANO-2 Control Room Analysis

ANO-2 does not have a Primary Control Station outside the Control Room. Therefore, if Control Room abandonment is required, the current Alternate Shutdown Procedure for Control Room abandonment requires Operations personnel to control the plant via local control of components. Plant monitoring is performed from the Technical Support Center using the Safety Parameter Display System (SPDS).

Post transition to NFPA-805, the plant response to a fire in Fire Area G will differ from the current response. The primary differences are due to the proposed modifications and the insights gained from the fire scenarios analyzed as part of the transition to NFPA-805. Incorporating the proposed modifications into the Fire PRA analysis allows for analyzing the risk impact of maintaining Reactor Coolant System (RCS) integrity and providing primary-to-secondary heat removal.

The ANO-2 Control Room is one of several fire zones included in Fire Area G. In order to support the transition to NFPA-805, the ANO-2 Control Room abandonment scenario, the non-abandonment scenarios, and additional scenarios associated with other fire zones within Fire Area G have been analyzed to determine the delta risk for the compliant cases vs. post transition cases. The information provided in the previous sections describing the process used for delta risk determination also applies to the methodology used for Fire Area G. The VFDRs for Fire Area G are provided in Attachment C.

In order to calculate the compliant cases for Fire Area G, the pertinent VFDRs were identified that would be affected in each of the scenarios (i.e., both abandonment and non-abandonment). This process allowed for a compliant case to be developed and analyzed for each of the Fire Area G scenarios similar to other fire areas.

The Post Transition case was analyzed by failing the components affected by the fire and using the Fire PRA model with modifications and recoveries as necessary to determine the risk.

In addition to the proposed modifications and recoveries identified as part of the risk analysis, additional Defense in Depth actions, which are listed in Attachment G, have been identified to enhance plant control and reduce the likelihood that additional equipment is damaged due to spurious operation.

Additional Risk of Recovery Actions

In the fire area risk evaluations, credit was taken for plant modifications in addition to the credited recovery actions to meet the acceptance criteria. These proposed modifications were developed and scoped to reduce risk. One modification in particular, the newly proposed Auxiliary Feedwater (AFW) pump, is a significant modification and has been developed to be implemented with more reliable and redundant power supplies. Additionally, this proposed modification will have fewer dependencies than the currently configured Emergency Feedwater (EFW) pumps. The design of the AFW pump will be developed to be more reliable than the existing configuration for the EFW systems when mitigating a post-fire transient. The risk reduction, after implementing the AFW pump in the PRA, results in a significant decrease in plant risk. This large decrease in risk enveloped the positive risk increase of the recovery actions and resulted in an overall negative delta CDF and LERF.

Regulation Guide 1.205, Section 2.2.4.1 (Revision 1), requires that the risk increase associated with the recovery actions be reported to the NRC as part of the license amendment request (LAR). Therefore, the risk increase from crediting the identified recovery actions, which is enveloped in the overall negative delta CDF/LERF of the fire risk evaluations, was determined as described below.

The additional risk of recovery actions for an area was conservatively determined by calculating the difference in CDF and LERF using the post transition case model (with modifications incorporated into the model) in accordance with the guidance in FAQ 07-0030 “Establishing Recovery Actions.” The difference between the two cases of the same scenario (one recovery set to its nominal HEP values, and the other set to zero failure probability) provides an estimated, yet bounding, evaluation of the change in risk of the recovery actions in the area. By starting with the post-transition model, the modifications are credited in both cases of the risk of recovery analysis. This method of analysis removes the modification offset reported in the fire risk evaluation ΔCDF and ΔLERF in Table W-2.

W.2.2 Risk Acceptance Criteria

The change in CDF and LERF for each fire area is provided in Table W-2.

Total Change in CDF and LERF

The total change in CDF for this application is calculated to be -8.14E-05~~1.29E-04~~/yr (the sum of the calculated delta risk from Table W-2) and the total change in LERF is calculated to be -3.13~~4.72~~E-06/yr. These values include credited recovery actions and plant modifications (documented in Attachments G and S, respectively). These changes in the plant CDF and LERF meet the RG 1.174 criteria as the total change in risk associated with the transition to NFPA 805 results are well within the acceptance criteria and the total plant fire risk is below 1E-04/yr for CDF and 1E-05/yr for LERF.

<u>Site Risk from Internal Events</u>

Although RG 1.174 does not require calculation of total CDF and LERF, if the increases are below the delta CDF and delta LERF of 1E-06/yr and 1E-07/yr respectively, it does recommend that if there is an indication that the CDF is 'considerably higher' than 1E- 04/yr or if LERF is 'considerably higher' than 1E-05/yr, then the focus should be on finding ways to decrease CDF or LERF.

The total CDF including Fire and Internal events has a value of 7.89~~7~~E-05/yr (Internal Events CDF (1.41E-06~~9.5E-7~~/year) + Internal Floods (8.0E-07/yr) + Fire CDF (7.67~~5~~E-05)), and the total LERF has a value of 1.86~~9~~E-06/yr (Internal Events LERF (4.45E-08~~1.1E-07~~/year) + Internal Floods (5.6E-08/yr) + Fire LERF (1.76E-06/yr)). Both values are below the RG 1.174 criteria of 1E-04/yr (CDF) and 1E-05/yr (LERF).

The aforementioned total CDF and LERF values do not include contribution from external events. Therefore, the contribution to risk from external events is captured below.

<u>Site Risk from External Events</u>

Seismic – ~~The Operating Basis Earthquake for ANO is 0.1g and the Design Basis Earthquake for ANO is 0.2g. As part of the IPEEE submittal, ANO-2 performed a Seismic Margin Analysis (SMA). The results of the walkdowns that were performed as part of the SMA verified that the equipment, tanks, distribution systems, structures, and relays are able to withstand the 0.3g Review Level Earthquake at the plant and still provide for its safe shutdown. Based on an updated seismic hazard curve provided by EPRI, the likelihood of a seismic event exceeding 0.3 g peak ground acceleration is 9.28E-06/yr. Given the low seismic frequency with no seismic design outliers, the seismic CDF is estimated to be well below 1E-5/yr and LERF is estimated to be well below 1E-6/yr.~~An NRC report ("Generic Issue 199 (GI-199) – Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants," Appendix D, August 2010) provides Seismic CDF estimates for many of the nuclear facilities in the United States. The study uses information from the site Individual Plant Examination of External Events (IPEEE) along with 2008 United States Geological Survey (USGS) Seismic Hazard Curves to estimate the CDF due to seismic events. This document estimates the worst case ANO-2 Seismic CDF to be 4.1E-6.

<u>Flooding and other External Events</u> – High winds, floods, or off-site industry facility accidents do not contribute significantly to ANO-2 site risk. For the external events the CDF is also estimated to be less than 1E-6/yr. This is consistent with the discussions of the events in Sections 2.3 through 2.11 of NUREG-1407.

A bounding estimate of the overall CDF risk due to external events (including seismic, external flooding, and off-site industry facility accidents) is estimated to be less than 1E-5/yr. A total bounding estimate for LERF external events is assumed to be 0.1 of the total CDF, which is less than 1E-6/yr.

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2199-G/A	Post Transition Baseline Case	16.03~~44~~%	16.03~~44~~%	Fire scenario 2199-G/A is the control room abandonment scenario. This scenario assumes fire damage to all cable targets in the control room. No in-control room actions are credited. Top cutsets are associated with the ex-control room actions to trip the reactor coolant pumps (RCPs), isolate letdown, and start the new AFW pump at the local control station. The local control station for the AFW pump will include local Steam Generator (SG) instrumentation to assist the operators in shutting down the plant following an abandonment scenario.	8.20E-05	1.50~~1~~E-01	1.234E-05	1.54~~5~~E-07
2099-W/HGL	Base scenario - Severe Fire	3.88~~95~~%	19.92~~20.39~~ %	Fire scenario 2099-W/HGL is a base scenario representing a severe fire in the West DC Equipment room, which impacts all targets in the room. Both the turbine-driven and motor-driven EFW pumps are unavailable. The new DC modification is credited to provide the DC power needed to trip the RCPs from the control room. The top cutsets are associated with random failure to trip RCPs in the control room resulting in an RCP seal Loss of Coolant Accident (LOCA) due to the Engineered Safety Feature (ESF) signal induced isolation of Component Cooling Water (CCW) to the RCP seals. High Pressure Safety Injection (HPSI) is unavailable due to spurious Recirculation Actuation Signal (RAS) prior to sufficient inventory in the containment sump and is not available for LOCA mitigation or feed and bleed. The top cutsets also include random failure of the new AFW pump and the existing AFW pump (2P-75) to provide cooling to the SGs.	4.99~~8~~E-04	5.98E-03	2.98E-06	7.40E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2101-AA/HGL	Base scenario	3.1~~2~~9%	23.11~~67~~%	Fire scenario 2101-AA/HGL represents the severe fire contribution for all fires in the North Switchgear room. This fire scenario is assumed to impact all targets in the zone, which results in failure of vital 4 kV bus 2A-3 (red train power) and components fed by that bus. Both the turbine-driven EFW pump (2P-7A) and the new AFW pump are available for secondary heat removal.	6.44E-04	3.80~~5~~E-03	2.45~~8~~E-06	8.11~~5~~E-08
2199-G-AJ/A	2C33, 2C33-1, 2C33-2	3.08~~14~~%	26.20~~81~~%	Fire scenario 2199-G-AJ/A is a fire impacting the Service Water (SW) and Boron Management vertical board panel 2C33-1 and 2C33-2 in the Main Control Room (MCR). No divisional separation is credited for a fire in this panel. Failure of breaker interlocks can result in a loss of offsite power and loss of Emergency Diesel Generators (EDGs). The new AFW pump has an independent power supply and is available to provide feed to the SGs. Reactor Coolant System (RCS) integrity is maintained following an in-control room trip of the RCPs before seal damage occurs. HPSI is unavailable due to SW (for HPSI pump room cooler) and power supply failures.	1.38E-04	1.72E-02	2.37E-06	5.67E-08
129-F-A/A	Dual Unit Abandonment	3.05%	29.24%	Fire scenario 129-F-A/A is a low probability, high consequence scenario that results in damage to the ANO-2 sensitive electronics located within the ANO-2 MCR resulting from a hot gas layer forming from a fire in the ANO-1 MCR. This scenario would require a challenging dual unit shutdown and was conservatively assigned a CCDP of 1.0.	2.34E-06	1.0E+00	2.34E-06	8.08E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2150-C/A	Base scenario - Severe Fire	2.904%	32.1429.76 %	Fire scenario 2150-C/A is a base scenario in which all components in the Core Protection Calculator (CPC) room are impacted. The primary failures in this scenario are associated with failure of ESF Actuation System (ESFAS) due to fire-induced failure of the SG level and pressure instrumentation. HPSI is unavailable due to the potential for a spurious RAS resulting from fire-induced failure of the Refueling Water Tank (RWT) level instrumentation and the power supply to the Plant Protection System (PPS). The resulting top cutsets are associated with random failure to trip RCPs in the control room resulting in an RCP seal LOCA due to assumed loss of CCW. HPSI is unavailable due to fire related effects and is not available for LOCA mitigation. The new AFW pump is available and the EFW pumps are available with an action for EFAS override.	3.96E-04	5.61E-03	2.22E-06	5.44E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2109-U-B1/A	2109-U-B State 1 (Source), 2D35	2.8576%	34.9935.40 %	Fire scenario 2109-U-B1/A is a fire starting in battery eliminator (charger) 2D-35 which damages conduits and targets up to, and including, the nearest tray target above the panel. This scenario results in loss of 2P-7A discharge motor-operated valves (MOVs) (IN 92-18) without the ability to reposition. The motor-driven EFW pump (2P-7B) and existing AFW pump (2P-75) are failed due to air operated valve (AOV) 2CV-0714-1 (flow diversion valve to startup and blow-down demineralizer system). 2CV-0714-1 can be isolated from the control room, but this recovery action has conservatively not been credited. Therefore, the scenario relies on the new AFW pump to provide secondary heat removal. The RCS integrity is maintained with HPSI available to provide RCS inventory loss mitigation.	1.88E-04	1.161E-02	2.1908E-06	7.306.96 E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2136-I-TN/A	Transient Base Scenario DSA Area Wide	2.8~~49~~%	37.83~~32.65~~ %	Fire scenario 2136-I-TN/A is a very large transient fire due to the potential for a large amount of intervening combustible material to be stored within this health physics and corridor zone. The entire zone is considered a designated storage area in which the combustible material could exceed the NUREG/CR-6850 317 kW fire. As a result, conservative fire modeling assumes instantaneous full zone burnout. Both the turbine-driven and motor-driven EFW pumps are unavailable. Offsite power and diesel generators are impacted in this fire area. The new DC modification is credited to provide the DC power needed to trip the RCPs from the control room. The top cutsets are associated with random failure to trip RCPs in the control room resulting in an RCP seal LOCA due to assumed loss of CCW. HPSI is unavailable due to fire related effects and is not available for LOCA mitigation or feed and bleed. The new AFW pump is the only source of feedwater credited in the scenario.	1.90E-04	1.14E-02	2.18E-06	7.48E-08
2199-G-B/A	2C04 (incl. 2C01, 2C02, 2C03, 2C09) and adj panels 2C100	2.62~~1.40~~%	40.45~~51.95~~ %	Fire Scenario 2199-G-B/A is the Main Control Board (MCB) fire in the MCR. An Appendix L factor is credited using a zero distance from Figure L-1 in NUREG/CR-6850. The top cutsets are associated with the ex-control room actions to trip the RCPs and to isolate letdown, as well as with the in-control room action to use the new AFW pump and random failures of the new AFW pump.	7.03E-06	2.85~~1.50~~ E-01	2.01~~1.06~~ E-06	2.52~~1.32~~ E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2199-G-O/A	2C17	2.45~~9~~%	42~~37~~.90%	Fire scenario 2199-G-O/A is a fire impacting ESF and PPS vertical board panel 2C17 in the MCR. The new AFW pump provides the main source of feedwater and the existing AFW pump is available via manual action. The EFW flow path is available via a recovery action for the AC operated EFW valve that is being modified to remove the IN 92-18 concerns (Attachment S, Modification S1-7). RCS integrity is maintained following an in-control room trip of the RCPs before seal damage occurs. HPSI is unavailable due to failure of the cold leg injection path from headers A and B.	1.42E-04	1.32E-02	1.88E-06	4.01E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution % of Total	Contribution Cumulative	Risk Insights	IGF (rx/yr)	CCDP	CDF	LERF
2100-Z/HGL	Base Scenario	2.31~~5~~%	45.21~~42.67~~ %	Fire scenario 2100-Z/HGL represents the severe fire contribution for all fires in the South Switchgear room. This fire scenario is assumed to impact all targets in the zone, which results in failure of vital 4 kV bus 2A-4 (green train power) and components fed by that bus. Also, cables impacted in 2100-Z could result in loss of red train SW. Red train service water could be lost due to a spurious hot short causing the red train sluice gate (2CV-1470-1) to transfer closed or loss of control of the Auxiliary Cooling Water (ACW) isolation valves causing a flow diversion. Loss of red train service water SW would subsequently result in failure of the red train EDG. The new AFW pump is unaffected as it has an independent power supply, and the motor-driven EFW pump (2P-7B) is available, but manual action to open the green train powered isolation MOV may be required if that valve is closed at the time green train power is lost. RCS integrity is maintained following an in-control room trip of the RCPs before seal damage occurs. HPSI is available for HPSI recirc mode with action to mitigate SW failures.	6.84~~2~~E-04	2.59E-03	1.77E-06	4.71E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2091-BB/HGL	Base scenario - Severe Fire	1.77~~80~~%	46.97~~44.47~~ %	Fire Scenario 2091-BB/HGL is a severe fire contribution in the North Electrical Equipment room. In this scenario, all cable targets in 2091-BB are damaged. The motor-driven EFW pump (2P-7B) and the new AFW pump are available to provide feed to the SG. 2P-7B is available with operator action to open the EFW discharge MOVs after a fire-induced loss of power. The top risk contributing cutsets include random failures of the new AFW pump and the motor-driven EFW system. RCP seal LOCA is a concern since CCW is assumed lost, but HPSI is available for LOCA mitigation.	4.41E-04	3.07~~9~~E-03	1.35~~6~~E-06	4.47~~8~~E-08
2137-I-TN1/A	Transient – DSA Electrical Penetration Room~~Base Scenario~~	1.74~~2.43~~%	48.71~~40.32~~ %	Fire scenario 2137-I-TN1/A is a designated storage area (DSA) fire that burns out the entire compartment in the Upper South Electrical Penetration (USEP) room. The fire modeling is consistent with the approach described in scenario 2136-I-TN/A. The new AFW pump is the only pump available to provide secondary heat removal. The top cutsets are associated with random failure to trip RCPs in the control room resulting in an RCP seal LOCA due to assumed loss of CCW. HPSI is unavailable due to fire related effects and is not available for LOCA mitigation or feed and bleed.	1.56E-04	8.56~~1.17~~ E-03~~2~~	1.34~~83~~E-06	3.72~~6.19~~ E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2076-HH/A	Base scenario	1.65~~8~~%	50.36~~46.15~~%	Fire scenario 2076-HH/A is the Severe Fire contribution for all ignition sources in electrical equipment room 2076-HH resulting in all targets being damaged within the fire zone. The motor-driven EFW pump and the new AFW pump are available to provide secondary heat removal. Top cutsets are associated with failure of the manual control room action to trip the RCPs since CCW is assumed lost. HPSI is available for feed and bleed and LOCA mitigation.	2.44E-03	5.19~~20~~E-04	1.26~~7~~E-06	4.08~~9~~E-08
2068-DD/A	Base scenario	1.52~~47~~%	51.88~~49.12~~%	Fire scenario 2068-DD/A is a full zone burn out of the Hot Machine Shop conservatively impacting all cables in the fire zone, many of which are routed in the overhead. The motor-driven EFW pump (2P-7B) and the new AFW pump are available to provide secondary heat removal. Top cutsets are associated with failure of the manual control room action to trip the RCPs since CCW is assumed lost. Fire-induced failures also result in loss of HPSI for LOCA mitigation.	5.03~~4.80~~E-04	2.31E-03	1.16~~1~~E-06	1.32~~27~~E-08
2108-S/HGL	Base scenario	1.47~~50~~%	53.35~~47.65~~%	Fire scenario 2108-S/HGL is the Severe Fire contribution for all ignition sources in electrical equipment room 2108-S resulting in all targets being damaged in Fire Zone 2108-S. The existing AFW pump (2P-75) and the new AFW pump are credited to provide secondary heat removal. The DC modification is credited to provide DC power to trip the RCPs from the control room since CCW is assumed lost. Fire-induced failures result in loss of HPSI for LOCA mitigation.	3.09E-04	3.66E-03	1.13E-06	2.23E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2073-DD-F/A	2B-62	1.4~~02~~%	54.75~~50.54~~ %	Fire Scenario 2073-DD-F/A is a fire in motor control center (MCC) 2B-62. The EFW, existing AFW and new AFW pumps are available to provide secondary heat removal. Top cutsets are associated with failure of the manual control room action to trip the RCPs since CCW is assumed lost. Fire-induced failures result in loss of HPSI injection valves for LOCA mitigation.	4.71E-04	2.28E-03	1.07E-06	1.18E-08
2200-MM-CW/A	2A-1, 2A-2 (60 min duration)	1.2~~46~~%	55.99~~54.47~~ %	Fire scenario 2200-MM-CW/A is a fire at switchgear 2A1 and 2A2 in the turbine building. This scenario results in a fire-induced Loss of Offsite Power (LOSP) and credits the diesel generators for providing power to the vital red and green train 4kV switchgear (2A3 and 2A4). The new DC modification will provide trip capability of the RCPs if this fire precludes access to 6.9 kV switchgear 2H-1 and 2H-2. The EFW, existing AFW and new AFW pumps are available for feedwater. Also, the redundant power supply to the new AFW pump is independent of the EDGs and unaffected by fire impact to the offsite power source from 2A-1. Top cutsets are associated with failure of the manual control room action to trip the RCPs since CCW is assumed lost. HPSI is available provided the emergency diesel generators load properly.	1.30E-03	7.32E-04	9.51E-07	2.39E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2111-T/HGL	Base scenario	1.2~~35~~%	57.22~~55.72~~ %	Fire scenario 2111-T/HGL is the Severe Fire contribution for all ignition sources in the Lower South Electrical Penetration (LSEP) room resulting in all targets being damaged within the fire zone. The new AFW pump and existing AFW pump are credited for secondary heat removal. The motor-driven and turbine-driven EFW pumps are failed due to fire-induced failures. Top cutsets are associated with failure of the manual control room action to trip the RCPs since CCW is assumed lost. HPSI is available via EDG power.	1.94E-04	4.87E-03	9.44E-07	2.15E-08
~~2109-U-H/A~~	~~2B-51~~	~~1.26%~~	~~53.21%~~	~~Fire scenario 2109-U-H/A is a fire in MCC 2B-51. The motor-driven EFW and new AFW pumps are available to provide secondary heat removal. Top cutsets are associated with failure of the manual control room action to trip the RCPs since CCW is assumed lost. Fire-induced hot short failures could result in loss of HPSI for LOCA mitigation.~~	~~5.56E-04~~	~~1.71E-03~~	~~9.52E-07~~	~~3.15E-08~~
2199-G-N/A	2C16	1.20~~2~~%	58.43~~56.94~~ %	Fire scenario 2199-G-N/A is a fire impacting ESF and PPS vertical board panel 2C16 in the MCR. The new AFW pump provides the main source of feedwater but the existing AFW pump is available with manual action. The AFW flow path is through the AC operated EFW discharge lines that are being modified to remove the IN 92-18 concerns (see Attachment S, Modification S1-7). RCS integrity is maintained following an in-control room trip of the RCPs before seal damage occurs. HPSI is unavailable due to failure of the cold leg injection and suction paths from headers A and B.	9.49E-05	9.73E-03	9.23E-07	1.54E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2040-JJ-Y/A	2B-52	1.14~~6~~%	59.57~~29~~%	Fire scenario 2040-JJ-/AY is a fire in MCC 2B-52. The EFW, existing AFW, and new AFW pumps are available to provide secondary heat removal. Top cutsets are associated with failure of the manual control room action to trip the RCPs since CCW is assumed lost. Fire-induced failures result in loss of HPSI injection valves for LOCA mitigation.	3.85E-04	2.28E-03	8.76E-07	9.61E-09
2098-C/HGL	Base scenario - Severe Fire	1.14~~8~~%	60.70~~58.13~~ %	Fire scenario 2098-C/HGL is the Severe Fire contribution for all ignition sources in the CPC room resulting in all targets being damaged within the fire zone. The HALON suppression system is credited for the CPC panel fire and this scenario represents the failure of the HALON system to actuate before additional cable target damage. In this scenario, only the new AFW pump is available to provide secondary heat removal. Actions to trip the RCPs and isolate letdown are credited to maintain RCS integrity and HPSI is unavailable due to fire-induced failures.	7.63~~2~~E-05	1.14~~7~~E-02	8.71~~93~~E-07	2.99~~3.02~~ E-08
2101-AA-H-NS/A	2A3	1.09~~11~~%	61.80~~60.40~~ %	Fire scenario 2101-AA-H-NS/A represents a fire at the 4 kV vital bus 2A-3. The risk insights are the same as in 2101-AA/HGL described above.	2.19E-04	3.83E-03	8.39E-07	2.76E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2199-G-M/A	2C14	1.02~~3~~%	62.82~~61.43~~ %	Fire scenario 2199-G-M/A is a fire impacting the Plant Auxiliary Systems vertical board panel 2C14 in the main control room. The new AFW pump provides the main source of feedwater, but EFW and the existing AFW pumps are available with manual override following a spurious Main Steam Isolation Signal (MSIS) signal. RCS integrity is maintained following an in-control room trip of the RCPs before seal damage occurs. HPSI is unavailable due to a spurious RAS signal.	9.49E-05	8.23E-03	7.80E-07	1.05E-08
2073-DD-TN5/A[1]	Transient Base Scenario	0.92~~4~~%	63.74~~62.37~~ %	Fire scenario 2073-DD-TN5/A is a designated storage area transient fire in Fire Zone 2073-DD. This scenario burns the entire compartment. The new AFW pump is the only pump available for secondary heat removal. Top cutsets are associated with failure of the manual control room action to trip the RCPs since CCW is assumed lost.	5.53E-05	1.28E-02	7.08E-07	2.43E-08
2033-K/A[1]	Base scenario	0.81~~2~~%	64.54~~63.19~~ %	Fire scenario 2033-K/A represents a large fire within containment, North Side. No walk-downs were performed for the scenario development and the high risk targets were identified from drawing references. The primary failures include failures to SG and RCS instrumentation. The new AFW pump remains available for feedwater injection and HPSI is available with a manual override of a spurious Safety Injection Actuation Signal (SIAS) signal.	2.40E-03	2.57E-04	6.17~~8~~E-07	2.05E-08

(1) – Sequences included due to LERF contribution. These sequences contribute less than 1% of CDF, but account for 1% or more of the LERF total.

CCDP – Conditional Core Damage Probability

IGF – Ignition Frequency (includes severity factor and probability of non-suppression, where applicable)

Table W-2 ANO-2 Fire Area Risk Summary

Fire Area	Area Description	NFPA 805 Basis	Fire Area CDF	Fire Area LERF	VFDR (Yes/No)	RAs	Fire Risk Eval. ΔCDF	Fire Risk Eval. ΔLERF	Additional Risk of RAs (CDF/LERF)
2MH01E	concrete manhole east	4.2.4.2	9.62E-09	1.42E-10	Yes	No	9.62E-09	1.42E-10	N/A
2MH02E	concrete manhole east	4.2.4.2	9.62E-09	1.42E-10	Yes	No	9.62E-09	1.42E-10	N/A
2MH03E	concrete manhole east	4.2.4.2	3.13E-07	9.76E-09	Yes	No	-5.05E-06	-1.69E-07	N/A
2MH01W	concrete manhole west	4.2.3.2	2.95E-08	7.47E-10	No	N/A	N/A	N/A	N/A
2MH02W	concrete manhole west	4.2.3.2	2.95E-08	7.47E-10	No	N/A	N/A	N/A	N/A
2MH03W	concrete manhole west	4.2.3.2	2.95E-08	7.47E-10	No	N/A	N/A	N/A	N/A
AA	Fire Zone 2007-LL ("B" HPSI, LPSI, and Containment Spray Pump room and gallery)	4.2.4.2	4.50~~49~~E-07	5.21E-09	Yes	No	-1.29E-07	-1.38E-08	N/A
AAC	Fire Zones SBOD and 2MH12 (alternate AC diesel and nearby manhole)	4.2.3.2	3.50E-08	7.78E-10	No	N/A	N/A	N/A	N/A
Admin	administration building	4.2.3.2	n/a	n/a	No	N/A	N/A	N/A	N/A
B-2	miscellaneous turbine building fire compartments	4.2.4.2	3.86~~4~~E-06	9.53~~49~~E-08	Yes	Yes	-2.94E-05	-1.01E-06	7.71~~3~~E-07 / 1.16~~5~~E-08
B-3	Fire Zones 2091-BB, 2112-BB and 2183-J (electrical penetration rooms)	4.2.4.2	1.44~~7~~E-06	4.73~~7~~E-08	Yes	Yes	5.~~8~~70E-07	1.87~~9~~E-08	4.79~~90~~E-07 / 1.62~~4~~E-08
B-4	Fire Zone 2154-E (CEDM equipment room)	4.2.4.2	2.89E-07	4.30E-09	Yes	No	-8.39E-06	-2.48E-07	N/A

Table W-2 ANO-2 Fire Area Risk Summary

Fire Area	Area Description	NFPA 805 Basis	Fire Area CDF	Fire Area LERF	VFDR (Yes/No)	RAs	Fire Risk Eval. ΔCDF	Fire Risk Eval. ΔLERF	Additional Risk of RAs (CDF/LERF)
B-5	Fire Zones 2149-B and 2158-F (stairwells 2001 and 2055)	4.2.3.2	3.56~~4.14~~E-09	1.07~~13~~E-10	No	N/A	N/A	N/A	N/A
B-6	Fire Zones 2006-LL, 2010-LL, 2011-LL, and 2014-LL (general access, C HPSI pump room, tendon gallery access, and A HPSI, LPSI and Containment Spray Pump room)	4.2.4.2	2.86~~5~~E-07	3.54E-09	Yes	No	-4.50~~1~~E-08	-1.59E-09	N/A
CC	Fire Zone 2024-JJ (turbine-driven emergency feedwater pump room)	4.2.3.2	3.21E-09	9.63E-11	No	N/A	N/A	N/A	N/A
DD	Fire Zones 2019-JJ, 2032-JJ, 2040-JJ, and 2068-DD (boric acid condensate tank room, spent resin storage tank room, corridor, and hot machine shop)	4.2.4.2	2.~~4~~50E-06	3.18~~3~~E-08	Yes	No	-1.92~~84~~E-06	-6.99~~72~~E-08	N/A
EE-L	Fire Zones 2055-JJ and 2084-DD (piping penetration rooms)	4.2.4.2	4.94~~5~~E-07	1.24E-08	Yes	No	-6.83E-08	-2.18E-09	N/A
EE-U	Fire Zone 2111-T (lower south electrical penetration room)	4.2.4.2	9.48~~9~~E-07	2.16~~7~~E-08	Yes	No	-1.82E-06	-6.11E-08	N/A
FF	Fire Zone 2025-JJ (motor-driven emergency feedwater pump room)	4.2.3.2	1.62E-07	5.37E-09	No	N/A	N/A	N/A	N/A
G	Fire Zones 2199-G, 2119-H, 2136-I, 2137-I, 2150-C, 2098-C, 2098-L, 129-F, and 97-R (control room and other alternate shutdown areas)	4.2.4.2	4.07~~3.88~~E-05	8.24~~7.74~~E-07	Yes	Yes	~~-~~4.29~~3.92~~E-06~~5~~	-2.10~~1.66~~E-07~~6~~	1.47~~6~~E-05 / 1.91~~2.88~~E-07

Table W-2 ANO-2 Fire Area Risk Summary

Fire Area	Area Description	NFPA 805 Basis	Fire Area CDF	Fire Area LERF	VFDR (Yes/No)	RAs	Fire Risk Eval. ΔCDF	Fire Risk Eval. ΔLERF	Additional Risk of RAs (CDF/LERF)
GG	Fire Zones 2076-HH and 2081-HH (electrical equipment room and upper north and lower north piping penetration room)	4.2.4.2	1.64~~5~~E-06	4.51~~2~~E-08	Yes	Yes	-3.87E-06	-1.37E-07	1.14~~5~~E-06 / 3.78~~9~~E-08
HH	Fire Zones 2063-DD, 2072-R, 2073-DD, 2096-M, 2106-R, and 2107-N (sample room, VCT room, 2B-62 room, 2B-63 room, degasifier vacuum pump room, and corridor)	4.2.4.2	3.87~~60~~E-06	9.49~~8.62~~E-08	Yes	No	-1.~~0~~13E-06	-2.97~~59~~E-08	N/A
II	Fire Zone 2101-AA (north switchgear 2A-3 room)	4.2.4.2	3.90~~3~~E-06	1.29E-07	Yes	No	-2.12E-05	-7.17E-07	N/A
JJ	Fire Zone 2109-U (corridor)	4.2.4.2	3.654~~.57~~E-06	1.09~~36~~E-07	Yes	Yes	-7.50~~1.31~~E-07~~6~~	-2.824~~.22~~E-08	2.20~~9.97~~E-07 / 5.333~~.31~~E-09~~8~~
K	Fire Zones 16-Y and 2020-JJ (clean waste receiver tank room and boron holdup tank vault)	4.2.3.2	6.14~~3~~E-10	1.45E-11	No	N/A	N/A	N/A	N/A
KK	Fire Zones 2093-P, 2114-I, and 2115-I (south EDG room, EDG air intake room, and boric acid makeup tank room)	4.2.4.2	9.63~~4~~E-08	2.93E-09	Yes	No	ε	ε	N/A
L	Fire Zone TKVLT (diesel fuel storage vault)	4.2.3.2	2.70E-08	6.69E-10	No	N/A	N/A	N/A	N/A
MM	Fire Zones 2099-W and 2103-V (west DC equipment room and west battery room)	4.2.4.2	3.01~~2~~E-06	7.48~~9~~E-08	Yes	No	-1.76E-06	-8.40E-08	N/A

Table W-2 ANO-2 Fire Area Risk Summary

Fire Area	Area Description	NFPA 805 Basis	Fire Area CDF	Fire Area LERF	VFDR (Yes/No)	RAs	Fire Risk Eval. ΔCDF	Fire Risk Eval. ΔLERF	Additional Risk of RAs (CDF/LERF)
NN	Fire Zones 2032-K and 2033-K (containment building south side and containment building north side)	4.2.4.2	1.50~~3~~E-06	4.30~~4~~E-08	Yes	No	ε	ε	N/A
OO	Intake Structure	4.2.4.2	3.01E-07	3.76E-09	Yes	Yes	2.61E-07	2.48E-09	7.80E-09 / 1.64E-10
QQ	Fire Zones 2094-Q and 2114-I (north EDG room and EDG air intake room)	4.2.3.2	1.98~~9~~E-07	6.30~~1~~E-09	No	N/A	N/A	N/A	N/A
SS	Fire Zones 2097-X, 2100-Z and 2102-Y (east DC equipment room, south switchgear room and east battery room)	4.2.4.2	2.79~~83~~E-06	8.03~~7~~E-08	Yes	Yes	-9.84E-06	-3.41E-07	2.64E-06 / 7.60E-08
TT	Fire Zone 2108-S (electrical equipment room)	4.2.4.2	1.16~~7~~E-06	2.28~~30~~E-08	Yes	Yes	-2.60~~4.70~~E-06	-8.68~~1.58~~E-08~~7~~	4.02E-07 / 1.36~~7~~E-08
YD	YARD	4.2.3.2	2.02E-06	5.78E-08	No	N/A	N/A	N/A	N/A
Various	Unit 1 - specific fire areas[1]	4.2.3.2	9.17~~8.64~~E-07	2.13~~02~~E-08	No	N/A	N/A	N/A	N/A
TOTAL			**7.67~~54~~E-05**	**1.76~~2~~E-06**			**-8.14~~1.29~~E-054**	**-3.13~~4.72~~E-06**	**2.04~~41~~E-05 / 3.51~~4.77~~E-07**

ε Indicative of an immeasurable change in risk from the impact of the VFDR on Fire PRA model.

[1] ANO-1-specific fire areas were conservatively assessed to contribute to ANO-2 CDF/LERF. Fires in these areas typically do not impact circuits for ANO-2 components and are not expected to cause, or require, an ANO-2 plant trip. (Fires in the ANO-1 control room and cable spreading room are not included in this value since they are included in the Fire Area G results.)

[2] The Fire PRA quantification results for CDF, LERF, ΔCDF/ΔLERF are documented in PRA-A2-05-025~~1~~.

References

1. Echelon Calculation PRA-A2-05-002, Rev. 0, “ANO-2 Fire PRA New Human Failure Events,” October 2011.
2. Echelon Calculation PRA-A2-05-007, Rev. 1, “ANO-2 Fire Probabilistic Risk Assessment Human Reliability Analysis (HRA) Notebook,” July 2014.
3. Echelon Calculation PRA-A2-05-020, Rev. 0, “Detailed Fire Human Reliability Analysis (HRA) for Selected ANO-2 Human Failure Events (HFE),” July 2014.
4. PRA-A2-05-021, Rev. 0, “Fire PRA Quantification Changes to Support Attachment W of the License Amendment Request (LAR).”
5. Echelon Calculation PRA-A2-05-025, Rev. 0, “ANO-2 FPRA Quantification in Support of LAR Submittal Relating to Mod Changes,” September 2016.

Attachment 4 to

2CAN101601

Updated Attachment W

Fire PRA Insights

W. Fire PRA Insights

W.1 Fire PRA Overall Risk Insights

Risk insights were documented as part of the development of the FPRA. The total plant fire CDF/LERF was derived using the NUREG/CR-6850 methodology for FPRA development and is useful in identifying the areas of the plant where fire risk is greatest. The risk insights generated were useful in identifying areas where specific contributors might be mitigated via modification. A detailed description of significant risk sequences associated with the fire initiating events that contribute above 1% of the calculated fire risk for the plant was prepared for the purposes of gaining these insights and an understanding of the risk significance of MSO combinations. These insights are provided in Table W-1.

<u>Fire Scenario Selection</u>

Fire scenarios were selected based on the definition of 'significant accident sequence' from RG 1.200, Revision 2:

> *Significant accident sequence: A significant sequence is one of the set of sequences, defined at the functional or systemic level that, when ranked, compose 95% of the CDF or the LERF/LRF, or that individually contribute more than ~1% to the CDF or LERF/LRF.*

There are 80 fire scenarios comprising 90% of the cumulative fire CDF and 113 fire scenarios comprising 95% of the cumulative fire CDF. Of these, 24 scenarios contribute 1% or greater on an individual basis. These 24 scenarios (all scenarios contributing 1% or greater on an individual basis) are presented in Table W-1. There is a strong correlation between CDF and LERF. There are five scenarios that contribute 1% or more to the total CDF, but do not similarly contribute to LERF. An additional two scenarios contribute 1% or more to the LERF total, but do not similarly contribute to CDF. These two scenarios have been added to Table W-1.

<u>Modifications</u>

Several modifications were identified in the FREs that contributed to reducing ΔCDF and ΔLERF to within the acceptable criteria. The risk benefits of these proposed modifications are reflected in the ΔCDF and ΔLERF risk values presented in Table W-2.

See Table S-1 for a complete list of all modifications including additional details of each.

<u>Recovery Actions</u>

Recovery actions were reviewed for adverse impact on the FPRA. Each human action credited in the FPRA model was evaluated in the ANO-2 Fire PRA Human Reliability Analysis Notebook (PRA-A2-05-007, Revision 1). None of the modeled actions was found to have an adverse impact on the FPRA. Recovery actions were not credited given a fire in the room in which the action occurs, or through which the operators must pass to perform the action. Also, for the main control room, recovery actions were not credited given a fire in a panel needed to complete the action.

Safe Shutdown Analysis actions were also reviewed in developing the Variances from Deterministic Requirements (VFDRs) to be used for assessing actions adverse to risk.

The risk associated with each VFDR was evaluated in the FRE process. The potential risk of each recovery action is bounded by the ΔCDF and ΔLERF provided in Table W-2. Also, the additional risk of recovery actions for an area was conservatively determined and is provided in Table W-2.

See Attachment G for the recovery actions credited in each area.

W.2 Risk Change Due to NFPA 805 Transition

In accordance with the guidance in Regulatory Position 2.2.4.2 of RG 1.205, Revision 1:

> *"The total increase or decrease in risk associated with the implementation of NFPA 805 for the overall plant should be calculated by summing the risk increases and decreases for each fire area (including any risk increases resulting from previously approved recovery actions). The total risk increase should be consistent with the acceptance guidelines in Regulatory Guide 1.174. Note that the acceptance guidelines of Regulatory Guide 1.174 may require the total CDF, LERF, or both, to evaluate changes where the risk impact exceeds specific guidelines. If the additional risk associated with previously approved recovery actions is greater than the acceptance guidelines in Regulatory Guide 1.174, then the net change in total plant risk incurred by any proposed alternatives to the deterministic criteria in NFPA 805, Chapter 4 (other than the previously approved recovery actions), should be risk-neutral or represent a risk decrease."*

The change in CDF and LERF for each fire area is provided in Table W-2.

W.2.1 Methods Used to Determine Changes in Risk

<u>Variances from Deterministic Requirements (VFDRs)</u>

For a fire area that is not deterministically compliant under NFPA 805, Section 4.2.3.2, deterministic compliance strategies were identified as compensatory measures for the variances from the deterministic requirements (VFDRs). These strategies include NRC-granted exemptions, evaluations that determine specific equipment is free of fire damage (see discussion of embedded conduit below), application of electrical raceway fire barrier systems (wrap), or manual manipulations of controls and equipment in the control room and power block. The VFDRs are lack-of-separation issues and span the NFPA 805 nuclear safety performance criteria: reactivity control, inventory and pressure control, decay heat removal, vital auxiliaries, and process monitoring. The compensatory measures already in place for the VFDRs mitigate the risk of the associated failures, thereby ensuring that the risk from fire damage prior to transition to NFPA 805, although not quantified, is acceptable.

For the transition to NFPA 805, the risk from fire damage is quantified. Each fire area that is not deterministically compliant under NFPA 805, Section 4.2.3.2, is evaluated in the risk-informed, performance-based approach under NFPA 805, Section 4.2.4.2, by the Fire Probabilistic Risk Assessment (FPRA). The FPRA provides a current state-of-the-art fire PRA analysis performed using accepted methods.

The aggregate change in risk associated with the VFDRs in a given fire area is evaluated by comparing all fire scenarios in the given fire area against two distinct plant models within the FPRA:

- the compliant plant model, and
- the post-transition plant model

Compliant Case Analysis for a Fire Area

The compliant case for an area represents the existing as-built, as-operated plant if all of the VFDRs in the area were eliminated; in other words, if the area was deterministically compliant. Thus, the compliant case for each area was analyzed as follows.

The FPRA scenarios for the area were reviewed to determine which VFDR related components are modeled and for those modeled, which VFDR related components are failed by each specific fire scenario. VFDR related components not modeled within the FPRA (e.g., those involving HVAC systems not required to meet PRA success criteria) were determined to have no impact on the safety functions modeled in the FPRA and thus, no contribution to core damage frequency (CDF) or large early release frequency (LERF).

For each scenario, the specific VFDR related components, which if protected would eliminate the VFDR, were set to their random failure probability instead of to "failed by the fire." Setting these components to their random failure probability provides an estimate of the fire risk if individual modifications were made to protect or reroute the components, thereby eliminating the VFDRs. The other components in the FPRA model that are impacted by the fire scenario are set to "failed by the fire."

Recovery actions (outside control room manual actions to mitigate the direct failure of VFDRs listed in Attachment G) were not credited in the compliant case. Non-recovery actions (manual actions to mitigate non-VFDR failures) were credited in the compliant case. This ensures that the compliant case represents the as-built, as-operated plant except for the eliminated VFDRs in the area, allowing for direct comparison with the post-transition plant model, which credits recovery actions.

As a rule, proposed modifications (listed in Attachment S) were not credited in the compliant case. This ensures that the compliant case represents the as-built, as-operated plant, except for the eliminated VFDRs in the area, allowing for direct comparison with the post-transition plant model, which credits the modifications. One noted exception is Modification S1-3, "Backup DC control power to switchgear 2A-1, 2A-2, 2H-1 and 2H-2," which is conservatively credited in both the compliant plant model and the post transition plant model.

Post Transition Case Analysis for a Fire Area

The post transition case for a fire area represents the plant if the recoveries listed in Attachment G and the modifications listed in Attachment S are used to protect the plant from core damage, mitigating the risk imposed by the VFDRs.

For each scenario, the specific VFDR related components and other components in the FPRA model that are impacted by the fire scenario were set to "failed by the fire." Some examples of the methods used in the post transition case are provided below.

- VFDR components with 1-hour fire wrap; specifically, Service Water pump cables in Fire Areas OO and B-6 and charging pump cables in Fire Area DD were set to "failed by the fire." Since these wrapped components were set to "failed by the fire" in the post transition model, but not in the compliant model, they are included in the Δ risk calculations. Also, since the resulting risk meets the acceptance criteria, the fire wrap does not need to be maintained. See VFDRs B6-01, DD-03 and OO-01 in Attachment C.
- VFDR related components with NRC-granted exemptions were set to "failed by the fire." Since these components were set to "failed by the fire" in the post transition model and the resulting risk meets the acceptance criteria, the NRC-granted exemptions for these components do not need to be maintained in the post transition licensing basis. See Licensing Actions sections of Attachment C for details.
- VFDR related components in embedded conduits were not set to "failed by the fire" since they were determined to be protected from fire damage as documented in Attachment J. Thus, they have no impact on the Δ risk calculations.

Recovery actions (outside control room manual actions to mitigate the direct failure of VFDRs listed in Attachment G) were credited in the post transition case. Non-recovery actions (manual actions to mitigate non-VFDR failures) were also credited in the post transition case.

The proposed modifications (listed in Attachment S) were credited in the post transition case. This ensures that the post transition case represents the plant following transition to NFPA 805 and allows comparison, with the compliant case which does not credit the modifications. The exception is Modification S1-3, "Backup DC control power to switchgear 2A-1, 2A-2, 2H-1 and 2H-2," which is conservatively credited in both the compliant plant model and the post transition plant model.

FPRA model changes to incorporate the proposed modifications (listed in Attachment S) and recovery actions (listed in Attachment G) were made using accepted methods. FPRA peer reviews were performed to assess the adequacy of the FPRA model and the results of the peer reviews are described in Attachment V and in Entergy letter dated October 27, 2016 (2CAN101601), Section 3.

To confirm the availability of operator cues for the recovery actions, the actions were correlated to fire safe shutdown analysis instrumentation. Since one train of fire safe shutdown analysis instrumentation is demonstrated to be available via the conservative deterministic post-fire analysis, these cues will remain available post-fire. Current fire procedures provide guidance to the operators for use of the fire safe shutdown analysis instrumentation as cues for evaluation of the need to perform actions. Confirmation of the availability of operator cues is documented in the ANO-2 Fire PRA Human Reliability Analysis calculations (PRA-A2-05-007, PRA-A2-05-020, and PRA-A2-05-002).

<u>Change in Risk for a Fire Area</u>

Each scenario for a fire area is evaluated as described above, with the following exceptions.

- If a scenario does not impact VFDR related components, no analysis was performed since the post transition case is equivalent to the compliant case, and the ΔCDF and ΔLERF for that scenario are zero.
- If a scenario contains a VFDR and is low risk (< 1E-08 CDF, < 1E-09 LERF), the scenario ΔCDF and ΔLERF are conservatively approximated by assuming the CDF/LERF for the compliant case is equal to zero. Therefore, the delta risk is bounded by assuming the delta risk is equal to the total risk of the post transition case results for that scenario.

The change in risk for a fire area is computed as the sum of the post-transition plant scenario results minus the sum of the compliant plant scenario results.

<u>ANO-2 Control Room Analysis</u>

ANO-2 does not have a Primary Control Station outside the Control Room. Therefore, if Control Room abandonment is required, the current Alternate Shutdown Procedure for Control Room abandonment requires Operations personnel to control the plant via local control of components. Plant monitoring is performed from the Technical Support Center using the Safety Parameter Display System (SPDS).

Post transition to NFPA-805, the plant response to a fire in Fire Area G will differ from the current response. The primary differences are due to the proposed modifications and the insights gained from the fire scenarios analyzed as part of the transition to NFPA-805. Incorporating the proposed modifications into the Fire PRA analysis allows for analyzing the risk impact of maintaining Reactor Coolant System (RCS) integrity and providing primary-to-secondary heat removal.

The ANO-2 Control Room is one of several fire zones included in Fire Area G. In order to support the transition to NFPA-805, the ANO-2 Control Room abandonment scenario, the non-abandonment scenarios, and additional scenarios associated with other fire zones within Fire Area G have been analyzed to determine the delta risk for the compliant cases vs. post transition cases. The information provided in the previous sections describing the process used for delta risk determination also applies to the methodology used for Fire Area G. The VFDRs for Fire Area G are provided in Attachment C.

In order to calculate the compliant cases for Fire Area G, the pertinent VFDRs were identified that would be affected in each of the scenarios (i.e., both abandonment and non-abandonment). This process allowed for a compliant case to be developed and analyzed for each of the Fire Area G scenarios similar to other fire areas.

The Post Transition case was analyzed by failing the components affected by the fire and using the Fire PRA model with modifications and recoveries as necessary to determine the risk.

In addition to the proposed modifications and recoveries identified as part of the risk analysis, additional Defense in Depth actions, which are listed in Attachment G, have been identified to enhance plant control and reduce the likelihood that additional equipment is damaged due to spurious operation.

Additional Risk of Recovery Actions

In the fire area risk evaluations, credit was taken for plant modifications in addition to the credited recovery actions to meet the acceptance criteria. These proposed modifications were developed and scoped to reduce risk. One modification in particular, the newly proposed Auxiliary Feedwater (AFW) pump, is a significant modification and has been developed to be implemented with more reliable and redundant power supplies. Additionally, this proposed modification will have fewer dependencies than the currently configured Emergency Feedwater (EFW) pumps. The design of the AFW pump will be developed to be more reliable than the existing configuration for the EFW systems when mitigating a post-fire transient. The risk reduction, after implementing the AFW pump in the PRA, results in a significant decrease in plant risk. This large decrease in risk enveloped the positive risk increase of the recovery actions and resulted in an overall negative delta CDF and LERF.

Regulation Guide 1.205, Section 2.2.4.1 (Revision 1), requires that the risk increase associated with the recovery actions be reported to the NRC as part of the license amendment request (LAR). Therefore, the risk increase from crediting the identified recovery actions, which is enveloped in the overall negative delta CDF/LERF of the fire risk evaluations, was determined as described below.

The additional risk of recovery actions for an area was conservatively determined by calculating the difference in CDF and LERF using the post transition case model (with modifications incorporated into the model) in accordance with the guidance in FAQ 07-0030 "Establishing Recovery Actions." The difference between the two cases of the same scenario (one recovery set to its nominal HEP values, and the other set to zero failure probability) provides an estimated, yet bounding, evaluation of the change in risk of the recovery actions in the area. By starting with the post-transition model, the modifications are credited in both cases of the risk of recovery analysis. This method of analysis removes the modification offset reported in the fire risk evaluation ΔCDF and ΔLERF in Table W-2.

W.2.2 Risk Acceptance Criteria

The change in CDF and LERF for each fire area is provided in Table W-2.

Total Change in CDF and LERF

The total change in CDF for this application is calculated to be -8.14E-05/yr (the sum of the calculated delta risk from Table W-2) and the total change in LERF is calculated to be -3.13E-06/yr. These values include credited recovery actions and plant modifications (documented in Attachments G and S, respectively). These changes in the plant CDF and LERF meet the RG 1.174 criteria as the total change in risk associated with the transition to NFPA 805 results are well within the acceptance criteria and the total plant fire risk is below 1E-04/yr for CDF and 1E-05/yr for LERF.

Site Risk from Internal Events

Although RG 1.174 does not require calculation of total CDF and LERF, if the increases are below the delta CDF and delta LERF of 1E-06/yr and 1E-07/yr respectively, it does recommend that if there is an indication that the CDF is 'considerably higher' than 1E- 04/yr or if LERF is 'considerably higher' than 1E-05/yr, then the focus should be on finding ways to decrease CDF or LERF.

The total CDF including Fire and Internal events has a value of 7.89E-05/yr (Internal Events CDF (1.41E-06/year) + Internal Floods (8.0E-07/yr) + Fire CDF (7.67E-05)), and the total LERF has a value of 1.86E-06/yr (Internal Events LERF (4.45E-08/year) + Internal Floods (5.6E-08/yr) + Fire LERF (1.76E-06/yr)). Both values are below the RG 1.174 criteria of 1E-04/yr (CDF) and 1E-05/yr (LERF).

The aforementioned total CDF and LERF values do not include contribution from external events. Therefore, the contribution to risk from external events is captured below.

Site Risk from External Events

Seismic – An NRC report ("Generic Issue 199 (GI-199) – Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants," Appendix D, August 2010) provides Seismic CDF estimates for many of the nuclear facilities in the United States. The study uses information from the site Individual Plant Examination of External Events (IPEEE) along with 2008 United States Geological Survey (USGS) Seismic Hazard Curves to estimate the CDF due to seismic events. This document estimates the worst case ANO-2 Seismic CDF to be 4.1E-6.

Flooding and other External Events – High winds, floods, or off-site industry facility accidents do not contribute significantly to ANO-2 site risk. For the external events the CDF is also estimated to be less than 1E-6/yr. This is consistent with the discussions of the events in Sections 2.3 through 2.11 of NUREG-1407.

A bounding estimate of the overall CDF risk due to external events (including seismic, external flooding, and off-site industry facility accidents) is estimated to be less than 1E-5/yr. A total bounding estimate for LERF external events is assumed to be 0.1 of the total CDF, which is less than 1E-6/yr.

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2199-G/A	Post Transition Baseline Case	16.03%	16.03%	Fire scenario 2199-G/A is the control room abandonment scenario. This scenario assumes fire damage to all cable targets in the control room. No in-control room actions are credited. Top cutsets are associated with the ex-control room actions to trip the reactor coolant pumps (RCPs), isolate letdown, and start the new AFW pump at the local control station. The local control station for the AFW pump will include local Steam Generator (SG) instrumentation to assist the operators in shutting down the plant following an abandonment scenario.	8.20E-05	1.50E-01	1.23E-05	1.54E-07
2099-W/HGL	Base scenario - Severe Fire	3.88%	19.92%	Fire scenario 2099-W/HGL is a base scenario representing a severe fire in the West DC Equipment room, which impacts all targets in the room. Both the turbine-driven and motor-driven EFW pumps are unavailable. The new DC modification is credited to provide the DC power needed to trip the RCPs from the control room. The top cutsets are associated with random failure to trip RCPs in the control room resulting in an RCP seal Loss of Coolant Accident (LOCA) due to the Engineered Safety Feature (ESF) signal induced isolation of Component Cooling Water (CCW) to the RCP seals. High Pressure Safety Injection (HPSI) is unavailable due to spurious Recirculation Actuation Signal (RAS) prior to sufficient inventory in the containment sump and is not available for LOCA mitigation or feed and bleed. The top cutsets also include random failure of the new AFW pump and the existing AFW pump (2P-75) to provide cooling to the SGs.	4.99E-04	5.98E-03	2.98E-06	7.40E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2101-AA/HGL	Base scenario	3.19%	23.11%	Fire scenario 2101-AA/HGL represents the severe fire contribution for all fires in the North Switchgear room. This fire scenario is assumed to impact all targets in the zone, which results in failure of vital 4 kV bus 2A-3 (red train power) and components fed by that bus. Both the turbine-driven EFW pump (2P-7A) and the new AFW pump are available for secondary heat removal.	6.44E-04	3.80E-03	2.45E-06	8.11E-08
2199-G-AJ/A	2C33, 2C33-1, 2C33-2	3.08%	26.20%	Fire scenario 2199-G-AJ/A is a fire impacting the Service Water (SW) and Boron Management vertical board panel 2C33-1 and 2C33-2 in the Main Control Room (MCR). No divisional separation is credited for a fire in this panel. Failure of breaker interlocks can result in a loss of offsite power and loss of Emergency Diesel Generators (EDGs). The new AFW pump has an independent power supply and is available to provide feed to the SGs. Reactor Coolant System (RCS) integrity is maintained following an in-control room trip of the RCPs before seal damage occurs. HPSI is unavailable due to SW (for HPSI pump room cooler) and power supply failures.	1.38E-04	1.72E-02	2.37E-06	5.67E-08
129-F-A/A	Dual Unit Abandonment	3.05%	29.24%	Fire scenario 129-F-A/A is a low probability, high consequence scenario that results in damage to the ANO-2 sensitive electronics located within the ANO-2 MCR resulting from a hot gas layer forming from a fire in the ANO-1 MCR. This scenario would require a challenging dual unit shutdown and was conservatively assigned a CCDP of 1.0.	2.34E-06	1.0E+00	2.34E-06	8.08E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2150-C/A	Base scenario - Severe Fire	2.90%	32.14%	Fire scenario 2150-C/A is a base scenario in which all components in the Core Protection Calculator (CPC) room are impacted. The primary failures in this scenario are associated with failure of ESF Actuation System (ESFAS) due to fire-induced failure of the SG level and pressure instrumentation. HPSI is unavailable due to the potential for a spurious RAS resulting from fire-induced failure of the Refueling Water Tank (RWT) level instrumentation and the power supply to the Plant Protection System (PPS). The resulting top cutsets are associated with random failure to trip RCPs in the control room resulting in an RCP seal LOCA due to assumed loss of CCW. HPSI is unavailable due to fire related effects and is not available for LOCA mitigation. The new AFW pump is available and the EFW pumps are available with an action for EFAS override.	3.96E-04	5.61E-03	2.22E-06	5.44E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2109-U-B1/A	2109-U-B State 1 (Source), 2D35	2.85%	34.99%	Fire scenario 2109-U-B1/A is a fire starting in battery eliminator (charger) 2D-35 which damages conduits and targets up to, and including, the nearest tray target above the panel. This scenario results in loss of 2P-7A discharge motor-operated valves (MOVs) (IN 92-18) without the ability to reposition. The motor-driven EFW pump (2P-7B) and existing AFW pump (2P-75) are failed due to air operated valve (AOV) 2CV-0714-1 (flow diversion valve to startup and blow-down demineralizer system). 2CV-0714-1 can be isolated from the control room, but this recovery action has conservatively not been credited. Therefore, the scenario relies on the new AFW pump to provide secondary heat removal. The RCS integrity is maintained with HPSI available to provide RCS inventory loss mitigation.	1.88E-04	1.16E-02	2.19E-06	7.30E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2136-I-TN/A	Transient Base Scenario DSA Area Wide	2.84%	37.83%	Fire scenario 2136-I-TN/A is a very large transient fire due to the potential for a large amount of intervening combustible material to be stored within this health physics and corridor zone. The entire zone is considered a designated storage area in which the combustible material could exceed the NUREG/CR-6850 317 kW fire. As a result, conservative fire modeling assumes instantaneous full zone burnout. Both the turbine-driven and motor-driven EFW pumps are unavailable. Offsite power and diesel generators are impacted in this fire area. The new DC modification is credited to provide the DC power needed to trip the RCPs from the control room. The top cutsets are associated with random failure to trip RCPs in the control room resulting in an RCP seal LOCA due to assumed loss of CCW. HPSI is unavailable due to fire related effects and is not available for LOCA mitigation or feed and bleed. The new AFW pump is the only source of feedwater credited in the scenario.	1.90E-04	1.14E-02	2.18E-06	7.48E-08
2199-G-B/A	2C04 (incl. 2C01, 2C02, 2C03, 2C09) and adj panels 2C100	2.62%	40.45%	Fire Scenario 2199-G-B/A is the Main Control Board (MCB) fire in the MCR. An Appendix L factor is credited using a zero distance from Figure L-1 in NUREG/CR-6850. The top cutsets are associated with the ex-control room actions to trip the RCPs and to isolate letdown, as well as with the in-control room action to use the new AFW pump and random failures of the new AFW pump.	7.03E-06	2.85E-01	2.01E-06	2.52E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2199-G-O/A	2C17	2.45%	42.90%	Fire scenario 2199-G-O/A is a fire impacting ESF and PPS vertical board panel 2C17 in the MCR. The new AFW pump provides the main source of feedwater and the existing AFW pump is available via manual action. The EFW flow path is available via a recovery action for the AC operated EFW valve that is being modified to remove the IN 92-18 concerns (Attachment S, Modification S1-7). RCS integrity is maintained following an in-control room trip of the RCPs before seal damage occurs. HPSI is unavailable due to failure of the cold leg injection path from headers A and B.	1.42E-04	1.32E-02	1.88E-06	4.01E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2100-Z/HGL	Base Scenario	2.31%	45.21%	Fire scenario 2100-Z/HGL represents the severe fire contribution for all fires in the South Switchgear room. This fire scenario is assumed to impact all targets in the zone, which results in failure of vital 4 kV bus 2A-4 (green train power) and components fed by that bus. Also, cables impacted in 2100-Z could result in loss of red train SW. Red train service water could be lost due to a spurious hot short causing the red train sluice gate (2CV-1470-1) to transfer closed or loss of control of the Auxiliary Cooling Water (ACW) isolation valves causing a flow diversion. Loss of red train service water SW would subsequently result in failure of the red train EDG. The new AFW pump is unaffected as it has an independent power supply, and the motor-driven EFW pump (2P-7B) is available, but manual action to open the green train powered isolation MOV may be required if that valve is closed at the time green train power is lost. RCS integrity is maintained following an in-control room trip of the RCPs before seal damage occurs. HPSI is available for HPSI recirc mode with action to mitigate SW failures.	6.84E-04	2.59E-03	1.77E-06	4.71E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2091-BB/HGL	Base scenario - Severe Fire	1.77%	46.97%	Fire Scenario 2091-BB/HGL is a severe fire contribution in the North Electrical Equipment room. In this scenario, all cable targets in 2091-BB are damaged. The motor-driven EFW pump (2P-7B) and the new AFW pump are available to provide feed to the SG. 2P-7B is available with operator action to open the EFW discharge MOVs after a fire-induced loss of power. The top risk contributing cutsets include random failures of the new AFW pump and the motor-driven EFW system. RCP seal LOCA is a concern since CCW is assumed lost, but HPSI is available for LOCA mitigation.	4.41E-04	3.07E-03	1.35E-06	4.47E-08
2137-I-TN1/A	Transient – DSA Electrical Penetration Room	1.74%	48.71%	Fire scenario 2137-I-TN1/A is a designated storage area (DSA) fire that burns out the entire compartment in the Upper South Electrical Penetration (USEP) room. The fire modeling is consistent with the approach described in scenario 2136-I-TN/A. The new AFW pump is the only pump available to provide secondary heat removal. The top cutsets are associated with random failure to trip RCPs in the control room resulting in an RCP seal LOCA due to assumed loss of CCW. HPSI is unavailable due to fire related effects and is not available for LOCA mitigation or feed and bleed.	1.56E-04	8.56E-03	1.34E-06	3.72E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2076-HH/A	Base scenario	1.65%	50.36%	Fire scenario 2076-HH/A is the Severe Fire contribution for all ignition sources in electrical equipment room 2076-HH resulting in all targets being damaged within the fire zone. The motor-driven EFW pump and the new AFW pump are available to provide secondary heat removal. Top cutsets are associated with failure of the manual control room action to trip the RCPs since CCW is assumed lost. HPSI is available for feed and bleed and LOCA mitigation.	2.44E-03	5.19E-04	1.26E-06	4.08E-08
2068-DD/A	Base scenario	1.52%	51.88%	Fire scenario 2068-DD/A is a full zone burn out of the Hot Machine Shop conservatively impacting all cables in the fire zone, many of which are routed in the overhead. The motor-driven EFW pump (2P-7B) and the new AFW pump are available to provide secondary heat removal. Top cutsets are associated with failure of the manual control room action to trip the RCPs since CCW is assumed lost. Fire-induced failures also result in loss of HPSI for LOCA mitigation.	5.03E-04	2.31E-03	1.16E-06	1.32E-08
2108-S/HGL	Base scenario	1.47%	53.35%	Fire scenario 2108-S/HGL is the Severe Fire contribution for all ignition sources in electrical equipment room 2108-S resulting in all targets being damaged in Fire Zone 2108-S. The existing AFW pump (2P-75) and the new AFW pump are credited to provide secondary heat removal. The DC modification is credited to provide DC power to trip the RCPs from the control room since CCW is assumed lost. Fire-induced failures result in loss of HPSI for LOCA mitigation.	3.09E-04	3.66E-03	1.13E-06	2.23E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2073-DD-F/A	2B-62	1.40%	54.75%	Fire Scenario 2073-DD-F/A is a fire in motor control center (MCC) 2B-62. The EFW, existing AFW and new AFW pumps are available to provide secondary heat removal. Top cutsets are associated with failure of the manual control room action to trip the RCPs since CCW is assumed lost. Fire-induced failures result in loss of HPSI injection valves for LOCA mitigation.	4.71E-04	2.28E-03	1.07E-06	1.18E-08
2200-MM-CW/A	2A-1, 2A-2 (60 min duration)	1.24%	55.99%	Fire scenario 2200-MM-CW/A is a fire at switchgear 2A1 and 2A2 in the turbine building. This scenario results in a fire-induced Loss of Offsite Power (LOSP) and credits the diesel generators for providing power to the vital red and green train 4kV switchgear (2A3 and 2A4). The new DC modification will provide trip capability of the RCPs if this fire precludes access to 6.9 kV switchgear 2H-1 and 2H-2. The EFW, existing AFW and new AFW pumps are available for feedwater. Also, the redundant power supply to the new AFW pump is independent of the EDGs and unaffected by fire impact to the offsite power source from 2A-1. Top cutsets are associated with failure of the manual control room action to trip the RCPs since CCW is assumed lost. HPSI is available provided the emergency diesel generators load properly.	1.30E-03	7.32E-04	9.51E-07	2.39E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2111-T/HGL	Base scenario	1.23%	57.22%	Fire scenario 2111-T/HGL is the Severe Fire contribution for all ignition sources in the Lower South Electrical Penetration (LSEP) room resulting in all targets being damaged within the fire zone. The new AFW pump and existing AFW pump are credited for secondary heat removal. The motor-driven and turbine-driven EFW pumps are failed due to fire-induced failures. Top cutsets are associated with failure of the manual control room action to trip the RCPs since CCW is assumed lost. HPSI is available via EDG power.	1.94E-04	4.87E-03	9.44E-07	2.15E-08
2199-G-N/A	2C16	1.20%	58.43%	Fire scenario 2199-G-N/A is a fire impacting ESF and PPS vertical board panel 2C16 in the MCR. The new AFW pump provides the main source of feedwater but the existing AFW pump is available with manual action. The AFW flow path is through the AC operated EFW discharge lines that are being modified to remove the IN 92-18 concerns (see Attachment S, Modification S1-7). RCS integrity is maintained following an in-control room trip of the RCPs before seal damage occurs. HPSI is unavailable due to failure of the cold leg injection and suction paths from headers A and B.	9.49E-05	9.73E-03	9.23E-07	1.54E-08
2040-JJ-Y/A	2B-52	1.14%	59.57%	Fire scenario 2040-JJ-/AY is a fire in MCC 2B-52. The EFW, existing AFW, and new AFW pumps are available to provide secondary heat removal. Top cutsets are associated with failure of the manual control room action to trip the RCPs since CCW is assumed lost. Fire-induced failures result in loss of HPSI injection valves for LOCA mitigation.	3.85E-04	2.28E-03	8.76E-07	9.61E-09

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2098-C/HGL	Base scenario - Severe Fire	1.14%	60.70%	Fire scenario 2098-C/HGL is the Severe Fire contribution for all ignition sources in the CPC room resulting in all targets being damaged within the fire zone. The HALON suppression system is credited for the CPC panel fire and this scenario represents the failure of the HALON system to actuate before additional cable target damage. In this scenario, only the new AFW pump is available to provide secondary heat removal. Actions to trip the RCPs and isolate letdown are credited to maintain RCS integrity and HPSI is unavailable due to fire-induced failures.	7.63E-05	1.14E-02	8.71E-07	2.99E-08
2101-AA-H-NS/A	2A3	1.09%	61.80%	Fire scenario 2101-AA-H-NS/A represents a fire at the 4 kV vital bus 2A-3. The risk insights are the same as in 2101-AA/HGL described above.	2.19E-04	3.83E-03	8.39E-07	2.76E-08
2199-G-M/A	2C14	1.02%	62.82%	Fire scenario 2199-G-M/A is a fire impacting the Plant Auxiliary Systems vertical board panel 2C14 in the main control room. The new AFW pump provides the main source of feedwater, but EFW and the existing AFW pumps are available with manual override following a spurious Main Steam Isolation Signal (MSIS) signal. RCS integrity is maintained following an in-control room trip of the RCPs before seal damage occurs. HPSI is unavailable due to a spurious RAS signal.	9.49E-05	8.23E-03	7.80E-07	1.05E-08
2073-DD-TN5/A[1]	Transient Base Scenario	0.92%	63.74%	Fire scenario 2073-DD-TN5/A is a designated storage area transient fire in Fire Zone 2073-DD. This scenario burns the entire compartment. The new AFW pump is the only pump available for secondary heat removal. Top cutsets are associated with failure of the manual control room action to trip the RCPs since CCW is assumed lost.	5.53E-05	1.28E-02	7.08E-07	2.43E-08

Table W-1 Fire PRA CDF & LERF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF)

Scenario	Description	Contribution		Risk Insights	IGF	CCDP	CDF	LERF
		% of Total	Cumulative		(rx/yr)			
2033-K/A[1]	Base scenario	0.81%	64.54%	Fire scenario 2033-K/A represents a large fire within containment, North Side. No walk-downs were performed for the scenario development and the high risk targets were identified from drawing references. The primary failures include failures to SG and RCS instrumentation. The new AFW pump remains available for feedwater injection and HPSI is available with a manual override of a spurious Safety Injection Actuation Signal (SIAS) signal.	2.40E-03	2.57E-04	6.17E-07	2.05E-08

(1) – Sequences included due to LERF contribution. These sequences contribute less than 1% of CDF, but account for 1% or more of the LERF total.

CCDP – Conditional Core Damage Probability IGF – Ignition Frequency (includes severity factor and probability of non-suppression, where applicable)

Table W-2 ANO-2 Fire Area Risk Summary

Fire Area	Area Description	NFPA 805 Basis	Fire Area CDF	Fire Area LERF	VFDR (Yes/No)	RAs	Fire Risk Eval. ΔCDF	Fire Risk Eval. ΔLERF	Additional Risk of RAs (CDF/LERF)
2MH01E	concrete manhole east	4.2.4.2	9.62E-09	1.42E-10	Yes	No	9.62E-09	1.42E-10	N/A
2MH02E	concrete manhole east	4.2.4.2	9.62E-09	1.42E-10	Yes	No	9.62E-09	1.42E-10	N/A
2MH03E	concrete manhole east	4.2.4.2	3.13E-07	9.76E-09	Yes	No	-5.05E-06	-1.69E-07	N/A
2MH01W	concrete manhole west	4.2.3.2	2.95E-08	7.47E-10	No	N/A	N/A	N/A	N/A
2MH02W	concrete manhole west	4.2.3.2	2.95E-08	7.47E-10	No	N/A	N/A	N/A	N/A
2MH03W	concrete manhole west	4.2.3.2	2.95E-08	7.47E-10	No	N/A	N/A	N/A	N/A
AA	Fire Zone 2007-LL (“B” HPSI, LPSI, and Containment Spray Pump room and gallery)	4.2.4.2	4.50E-07	5.21E-09	Yes	No	-1.29E-07	-1.38E-08	N/A
AAC	Fire Zones SBOD and 2MH12 (alternate AC diesel and nearby manhole)	4.2.3.2	3.50E-08	7.78E-10	No	N/A	N/A	N/A	N/A
Admin	administration building	4.2.3.2	n/a	n/a	No	N/A	N/A	N/A	N/A
B-2	miscellaneous turbine building fire compartments	4.2.4.2	3.86E-06	9.53E-08	Yes	Yes	-2.94E-05	-1.01E-06	7.71E-07 / 1.16E-08
B-3	Fire Zones 2091-BB, 2112-BB and 2183-J (electrical penetration rooms)	4.2.4.2	1.44E-06	4.73E-08	Yes	Yes	5.70E-07	1.87E-08	4.79E-07 / 1.62E-08
B-4	Fire Zone 2154-E (CEDM equipment room)	4.2.4.2	2.89E-07	4.30E-09	Yes	No	-8.39E-06	-2.48E-07	N/A
B-5	Fire Zones 2149-B and 2158-F (stairwells 2001 and 2055)	4.2.3.2	3.56E-09	1.07E-10	No	N/A	N/A	N/A	N/A

Table W-2 ANO-2 Fire Area Risk Summary

Fire Area	Area Description	NFPA 805 Basis	Fire Area CDF	Fire Area LERF	VFDR (Yes/No)	RAs	Fire Risk Eval. ΔCDF	Fire Risk Eval. ΔLERF	Additional Risk of RAs (CDF/LERF)
B-6	Fire Zones 2006-LL, 2010-LL, 2011-LL, and 2014-LL (general access, C HPSI pump room, tendon gallery access, and A HPSI, LPSI and Containment Spray Pump room)	4.2.4.2	2.86E-07	3.54E-09	Yes	No	-4.50E-08	-1.59E-09	N/A
CC	Fire Zone 2024-JJ (turbine-driven emergency feedwater pump room)	4.2.3.2	3.21E-09	9.63E-11	No	N/A	N/A	N/A	N/A
DD	Fire Zones 2019-JJ, 2032-JJ, 2040-JJ, and 2068-DD (boric acid condensate tank room, spent resin storage tank room, corridor, and hot machine shop)	4.2.4.2	2.50E-06	3.18E-08	Yes	No	-1.92E-06	-6.99E-08	N/A
EE-L	Fire Zones 2055-JJ and 2084-DD (piping penetration rooms)	4.2.4.2	4.94E-07	1.24E-08	Yes	No	-6.83E-08	-2.18E-09	N/A
EE-U	Fire Zone 2111-T (lower south electrical penetration room)	4.2.4.2	9.48E-07	2.16E-08	Yes	No	-1.82E-06	-6.11E-08	N/A
FF	Fire Zone 2025-JJ (motor-driven emergency feedwater pump room)	4.2.3.2	1.62E-07	5.37E-09	No	N/A	N/A	N/A	N/A
G	Fire Zones 2199-G, 2119-H, 2136-I, 2137-I, 2150-C, 2098-C, 2098-L, 129-F, and 97-R (control room and other alternate shutdown areas)	4.2.4.2	4.07E-05	8.24E-07	Yes	Yes	4.29E-06	-2.10E-07	1.47E-05 / 1.91E-07

Table W-2 ANO-2 Fire Area Risk Summary

Fire Area	Area Description	NFPA 805 Basis	Fire Area CDF	Fire Area LERF	VFDR (Yes/No)	RAs	Fire Risk Eval. ΔCDF	Fire Risk Eval. ΔLERF	Additional Risk of RAs (CDF/LERF)
GG	Fire Zones 2076-HH and 2081-HH (electrical equipment room and upper north and lower north piping penetration room)	4.2.4.2	1.64E-06	4.51E-08	Yes	Yes	-3.87E-06	-1.37E-07	1.14E-06 / 3.78E-08
HH	Fire Zones 2063-DD, 2072-R, 2073-DD, 2096-M, 2106-R, and 2107-N (sample room, VCT room, 2B-62 room, 2B-63 room, degasifier vacuum pump room, and corridor)	4.2.4.2	3.87E-06	9.49E-08	Yes	No	-1.13E-06	-2.97E-08	N/A
II	Fire Zone 2101-AA (north switchgear 2A-3 room)	4.2.4.2	3.90E-06	1.29E-07	Yes	No	-2.12E-05	-7.17E-07	N/A
JJ	Fire Zone 2109-U (corridor)	4.2.4.2	3.65E-06	1.09E-07	Yes	Yes	7.50E-07	2.82E-08	2.20E-07 / 5.33E-09
K	Fire Zones 16-Y and 2020-JJ (clean waste receiver tank room and boron holdup tank vault)	4.2.3.2	6.14E-10	1.45E-11	No	N/A	N/A	N/A	N/A
KK	Fire Zones 2093-P, 2114-I, and 2115-I (south EDG room, EDG air intake room, and boric acid makeup tank room)	4.2.4.2	9.63E-08	2.93E-09	Yes	No	ε	ε	N/A
L	Fire Zone TKVLT (diesel fuel storage vault)	4.2.3.2	2.70E-08	6.69E-10	No	N/A	N/A	N/A	N/A
MM	Fire Zones 2099-W and 2103-V (west DC equipment room and west battery room)	4.2.4.2	3.01E-06	7.48E-08	Yes	No	-1.76E-06	-8.40E-08	N/A

Table W-2 ANO-2 Fire Area Risk Summary

Fire Area	Area Description	NFPA 805 Basis	Fire Area CDF	Fire Area LERF	VFDR (Yes/No)	RAs	Fire Risk Eval. ΔCDF	Fire Risk Eval. ΔLERF	Additional Risk of RAs (CDF/LERF)
NN	Fire Zones 2032-K and 2033-K (containment building south side and containment building north side)	4.2.4.2	1.50E-06	4.30E-08	Yes	No	ε	ε	N/A
OO	Intake Structure	4.2.4.2	3.01E-07	3.76E-09	Yes	Yes	2.61E-07	2.48E-09	7.80E-09 / 1.64E-10
QQ	Fire Zones 2094-Q and 2114-I (north EDG room and EDG air intake room)	4.2.3.2	1.98E-07	6.30E-09	No	N/A	N/A	N/A	N/A
SS	Fire Zones 2097-X, 2100-Z and 2102-Y (east DC equipment room, south switchgear room and east battery room)	4.2.4.2	2.79E-06	8.03E-08	Yes	Yes	-9.84E-06	-3.41E-07	2.64E-06 / 7.60E-08
TT	Fire Zone 2108-S (electrical equipment room)	4.2.4.2	1.16E-06	2.28E-08	Yes	Yes	-2.60E-06	-8.68E-08	4.02E-07 / 1.36E-08
YD	YARD	4.2.3.2	2.02E-06	5.78E-08	No	N/A	N/A	N/A	N/A
Various	Unit 1 - specific fire areas[1]	4.2.3.2	9.17E-07	2.13E-08	No	N/A	N/A	N/A	N/A
TOTAL			**7.67E-05**	**1.76E-06**			**-8.14E-05**	**-3.13E-06**	**2.04E-05 / 3.51E-07**

ε Indicative of an immeasurable change in risk from the impact of the VFDR on Fire PRA model.

[1] ANO-1-specific fire areas were conservatively assessed to contribute to ANO-2 CDF/LERF. Fires in these areas typically do not impact circuits for ANO-2 components and are not expected to cause, or require, an ANO-2 plant trip. (Fires in the ANO-1 control room and cable spreading room are not included in this value since they are included in the Fire Area G results.)

[2] The Fire PRA quantification results for CDF, LERF, ΔCDF/ΔLERF are documented in PRA-A2-05-025.

<u>References</u>

1. Echelon Calculation PRA-A2-05-002, Rev. 0, “ANO-2 Fire PRA New Human Failure Events,” October 2011.
2. Echelon Calculation PRA-A2-05-007, Rev. 1, “ANO-2 Fire Probabilistic Risk Assessment Human Reliability Analysis (HRA) Notebook,” July 2014.
3. Echelon Calculation PRA-A2-05-020, Rev. 0, “Detailed Fire Human Reliability Analysis (HRA) for Selected ANO-2 Human Failure Events (HFE),” July 2014.
4. PRA-A2-05-021, Rev. 0, “Fire PRA Quantification Changes to Support Attachment W of the License Amendment Request (LAR).”
5. Echelon Calculation PRA-A2-05-025, Rev. 0, “ANO-2 FPRA Quantification in Support of LAR Submittal Relating to Mod Changes,” September 2016.

Attachment 5 to

2CAN101601

Markup of Operating License Pages

(b) Fire Protection

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

Risk-Informed Changes that may be Made Without Prior NRC Approval

A risk assessment of the change must demonstrate that the acceptance criteria below are met. The risk assessment approach, methods, and data shall be acceptable to the NRC and shall be appropriate for the nature and scope of the change being evaluated; be based on the as-built, as-operated, and maintained plant; and reflect the operating experience at ANO-2. Acceptable methods to assess the risk of the change may include methods that have been used in the peer-reviewed fire PRA model, methods that have been approved by NRC through a plant-specific license amendment or NRC approval of generic methods specifically for use in NFPA 805 risk assessments, or methods that have been demonstrated to bound the risk impact.

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

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

Transition License Conditions

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

2. The licensee shall implement the modifications to its facility, as described in Table S-1, "Plant Modifications," Attachment ~~5~~2, of Entergy Operations, Inc. letter 2CAN101601~~081401~~, dated ~~August 7, 2014~~October 27, 2016, prior to startup from the second refueling outage following issuance of the Safety Evaluation. The licensee shall maintain appropriate compensatory measures in place until completion of the modifications.

3. The licensee shall complete the implementation items as listed in Table S-2, "Implementation Items," Attachment, of Entergy Operations, Inc. letter 2CAN091402, dated September 24, 2014, within six months after issuance of the Safety Evaluation.

(c) Less Than Four Reactor Coolant Pump Operation

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

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

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

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

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

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

(i) Containment Radiation Monitor

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

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

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

Attachment 6 to

2CAN101601

Clean (Revised) Operating License Pages

(b) Fire Protection

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