



Entergy Operations, Inc.
1448 S.R. 333
Russellville, AR 72802
Tel 479-858-3110

Richard L. Anderson
ANO Site Vice President

2CAN121602

December 2, 2016

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

SUBJECT: Supplemental Information
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

REFERENCES: 1. Entergy letter dated October 27, 2016, *License Amendment Request to Revise the National Fire Protection Association (NFPA) Standard 805 Modifications - Arkansas Nuclear One, Unit 2* (2CAN101601) (ML16302A227)

2. NRC letter dated November 29, 2016, *Arkansas Nuclear One, Unit 2 - Supplemental Information Needed for Acceptance of Requested License Action RE: Amendment Request to Revise the National Fire Protection Association (NFPA) Standard 805 Modifications* (CAC MF8691) (2CNA111602) (ML16333A307)

3. 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)

Dear Sir or Madam:

By letter dated October 27, 2016 (Reference 1), and pursuant to 10 CFR 50.90, Entergy Operations, Inc. (Entergy) submitted a request (Reference 1) to amend the Renewed Facility Operating License No. NPF-6 for Arkansas Nuclear One, Unit 2 (ANO-2). The proposed change, in part, would revise the NFPA-805 modifications as previously approved by NRC in letter dated February 18, 2015 (Reference 3).

During the course of review, the NRC determined that supplemental information is required to support continued review of the Reference 1 request. The request was communicated to Entergy via Reference 2. The attachment to this letter contains the requested supplemental information.

Entergy has determined that the attached supplemental information does not affect or invalidate the No Significant Hazards Determination present in the Reference 1 original request.

In accordance with 10 CFR 50.91, a copy of this application, with attachments, is being provided to the designated Arkansas state official.

No new commitments have been identified in this letter.

I declare under penalty of perjury that the foregoing is true and correct. Executed on December 2, 2016.

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

Sincerely,

ORIGINAL SIGNED BY RICHARD L. ANDERSON

RLA/dbb

Attachment: Supplemental Information – ANO-2 NFPA-805 Revisions

cc: Mr. Kriss M. Kennedy
Regional Administrator
U. S. Nuclear Regulatory Commission
RGN-IV
1600 East Lamar Boulevard
Arlington, TX 76011-4511

NRC Senior Resident Inspector
Arkansas Nuclear One
P. O. Box 310
London, AR 72847

U. S. Nuclear Regulatory Commission
Attn: Mr. Thomas Wengert
MS O-08B1
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

Mr. Bernard R. Bevil
Arkansas Department of Health
Radiation Control Section
4815 West Markham Street
Slot #30
Little Rock, AR 72205

Attachment to

2CAN121602

Supplemental Information – ANO-2 NFPA-805 Revisions

Supplemental Information – ANO-2 NFPA-805 Revisions

By letter dated October 27, 2016 (Reference 1), and pursuant to 10 CFR 50.90, Entergy Operations, Inc. (Entergy) submitted a request (Reference 1) to amend the Renewed Facility Operating License No. NPF-6 for Arkansas Nuclear One, Unit 2 (ANO-2). The proposed change, in part, would revise the NFPA-805 modifications as previously approved by NRC in letter dated February 18, 2015 (Reference 3).

During the course of review, the NRC determined that supplemental information is required to support continued review of the Reference 1 request. The request was communicated to Entergy via Reference 2. The attachment to this letter contains the requested supplemental information.

The following includes the information request presented in the NRC's letter (Reference 2) followed by Entergy's response. Following the response, a summary listing of all subject matter included in Entergy's Reference 1 letter is provided, along with an explanation of why Entergy believes NRC review of the subject matter is required.

Request

Most of the proposed modifications in Section 2.0 of the LAR replace cable rerouting with alternative electronic modification. Cable rerouting would eliminate the possibility for fire-induced failure while alternative electronic modifications will only reduce the possibility of fire induced failures. Contrary to this observation, Tables 1 and 2 on Page 25 of 30 of Attachment 1 of the LAR indicate that several alternative electronic modifications result in lower plant risk compared to the cable rerouting option. Provide supplemental information explaining why the risk decreases in some of the modifications summarized in Table 2 and increases for other modifications.

RESPONSE

The following information describes the plant modifications, assumptions, inputs, and risk impact for each of the modifications listed in Attachment 1, Table 2, of the subject Reference 1 license amendment request (LAR).

Modification S1-1 (2CV-1026-2 and 2CV-1076-2) – No inhibit switch credited in this modification, cable routing change only.

As described in the detailed description of Section 2.0 of the Reference 1 LAR, Entergy plans to relocate the relays associated with Emergency Feedwater (EFW) motor operated valves (MOVs) 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.

The original modification described in Attachment S of Entergy letter dated August 7, 2014 (Reference 4), relocated the relays from Fire Zone 2096-M to the adjacent Fire Zone 2098-C. The original design concept removed the fire induced impact for those circuits in Fire Zone 2096-M only by moving the relays to an adjacent zone. The proposed design revision

described in the Reference 1 letter relocates the relays to Fire Zone 2091-BB, which contains the MCCs for the affected valves. Since the MCC is located within Fire Zone 2091-BB, the fire induced impacts of this specific conductor are completely contained within the same fire zone and, therefore, removed the fire induced impact between Fire Zones 2096-M and 2091-BB. As a result, a reduction in risk has been calculated from that determined for the original modification design that was approved in Attachment W risk results for ANO-2 (Reference 4).

Additionally, the relocation of the relays for 2CV-1026-2 and 2CV-1076-2 had risk reduction benefits beyond the original scope of the modification described in Attachment S, Table S-1, Modification S1-1 of Reference 4, due to sharing of an EFW auxiliary relay with the circuits for EFW valves 2CV-0340-2, 2CV-0205-2, and 2CV-0795-2. The MCC associated with these MOVs is also located in Fire Zone 2091-BB and a contribution to risk reduction was achieved for the same reason described above for 2CV-1026-2 and 2CV-1076-2.

Modification S1-2 and S1-4 (2CV-4816 and 2CV-4817) – No inhibit switch credited in this modification, although circuit modification has been employed.

As described in Attachment S, Table S-1, for Modifications S1-2 and S1-4 (Reference 4), the original modification for Letdown valves 2CV-4816 and 2CV-4817 rerouted cable 2I016N by using embedded conduit C4080, which is located between Fire Area G (cable spreading room) and Fire Area EE-L. Cable 2I016N was also planned to be separately fused in Main Control Room (MCR) panel 2C-09 to prevent failure due to a loss of cable 2I016P. This modification would eliminate circuit impacts in Fire Areas TT, JJ, and EE-U.

The proposed change in this modification was described in the Reference 1 letter as a replacement of handswitch 2HS-4817 with a new four-position switch in the existing location in panel 2C-09. 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 eliminates intracable faults as a potential failure, prevents spurious operation of the controller from opening the valve, and provides protection from postulated intercable faults. A detailed discussion of this circuit and its failure modes is provided in the Reference 1 request.

As a result of this revised modification, the spurious failures of 2CV-4816 and 2CV-4817 were removed from the scenarios which were previously assumed to fail. The removal of the spurious failures in these fire zones resulted in a lower calculated plant risk than that determined for the original modification design that was approved in Attachment W risk results for ANO-2 (Reference 4).

Modification S1-7 (2CV-1036-2 and 2CV-1075-1) – No inhibit switch credited in this modification; circuit modification is employed in lieu of separation/protection.

The original design described in Attachment S, Table S-1, for Modification S1-7 (Reference 4), would change the control circuits for the subject EFW valves by separating the cable conductors, inclusive of internal panel wiring, that can cause spurious valve operation, and protecting the conductors with suitable barriers to prevent inadvertent energizing of target conductors in the MCR.

The revised modification uses interposing relays to ensure hot shorts will not bypass the valve torque switches. Therefore, the cables to and from the MCR (where the interposing relays are located) no longer maintain a fire induced adverse impact. This information was incorporated into the Fire Probabilistic Risk Assessment (FPRA) model and provided in the update to Attachment W (Reference 1) to assess the impact of the changes. The result of the change was a decrease in calculated plant risk.

Modification S1-8 (2CV-4698-1) – Inhibit switch credited in this modification.

The original modification design described in Attachment S, Table S-1, for Modification S1-8 (Reference 4) proposed to separate the cable conductors and protect the cables with suitable barriers to prevent inadvertent energizing of the conductors. The proposed revision to the design modifies the control circuit of the Emergency Core Cooling System (ECCS) vent valve 2CV-4698-1 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.

The risk value associated with the new modification design was calculated using the same methodology as that used in the ANO, Unit 1 (ANO-1) request for additional information (RAI) response for inhibit circuits and approved in the associated NRC Safety Evaluation for ANO-1 (Reference 5). Consistent with the ANO-1 analysis, fires outside the cabinet that impact cabling associated with the inhibit circuits assumed a hot short failure probability of 1E-03 in the event DC power cables (fused greater than 10 amps) are routed in the same cable trays. Fires inside the cabinet were assumed to cause spurious operation using the NUREG-7150 hot short probability.

The revision to the design associated with 2CV-4698-1 increased the calculated plant risk due to the probability of failure associated with the inhibit switch. Since the original design assumed no spurious operation where the conductors were separated and protected with metallic shielding, this change in the modification has increased the risk as depicted in Table 2 of the Reference 1 letter.

Modification S1-9 (2SV-4670-2 and 2SV-4669-1) – Inhibit switch credited in this modification; however, the change in risk due to this modification change is listed in Table 2 as “no more than minimal” because the change results in an insignificant change in risk.

The original modification design described in Attachment S, Table S-1, for Modification S1-9 (Reference 4), was intended to eliminate adverse impacts on the subject Reactor Coolant System (RCS) vent 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. The revision to the design, described in the Reference 1 letter, modifies the control circuits of 2SV-4670-2 and 2SV-4669-1 by installing an inhibit circuit for each switch 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

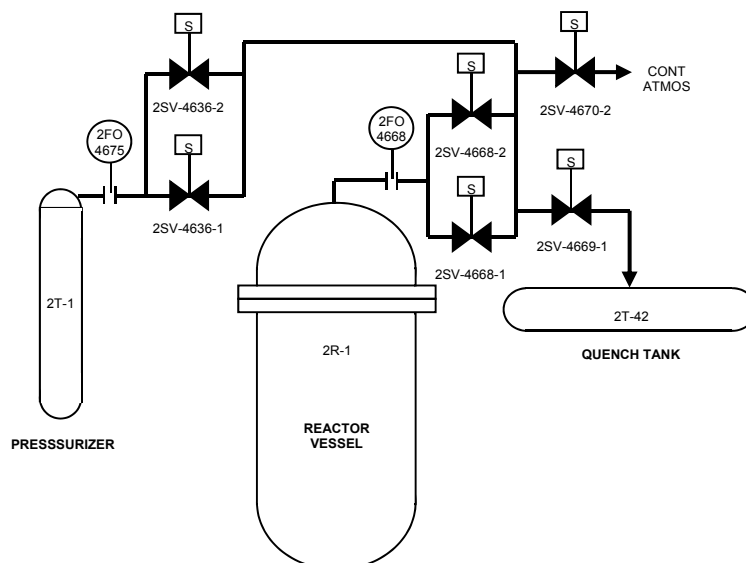
to ground through the closed contact. This will prevent a cable failure from causing spurious operation of the valve. The functional and performance characteristics of the two valves are not changed. The method of operating the valves will remain the same.

The original risk analysis considered the probability of a spurious operation to be zero. Implementation of this design change and the zero spurious operation probability assumed were determined to be unfeasible. Ultimately, the design change to include the use of the inhibit switch resulted in a non-zero spurious operation probability. The risk of the new modification was calculated using the same methodology as that used in the ANO-1 RAI response for inhibit circuits and approved in the associated Safety Evaluation (Reference 5). Consistent with the ANO-1 FPRA analysis, fires outside the cabinet that impact cabling associated with the inhibit circuits assumed a hot short failure probability of $1\text{E-}03$ in the event DC power cables (fused greater than 10 amps) are routed in the same cable trays. Fires inside the cabinet were assumed to cause a spurious operation based upon the hot short probability from NUREG-7150.

To address the potential failure of the inhibit circuit for this modification, it should be noted that multiple valves are required to fail in order to meet the criteria for a small break loss of coolant accident (SBLOCA). The hot short probability used also considers the hot short duration terms provided in NUREG-7150. The following combinations of spurious operations are required for each flow path:

1. Through flow orifice 2FO-4675 spurious operation of either RCS vent valve 2SV-4636-1 or 2SV-4636-2,
AND
2. Through flow orifice 2FO-4668 spurious operation of either RCS vent valve 2SV-4668-1 or 2SV-4668-2,
AND
3. Through one of the RCS vent valves 2SV-4669-1 or 2SV-4670-2.

The simplified diagram below depicts the flow paths described above:



From NUREG-7150, the hot short probability is 1.763E-01 and the hot short probability for scenarios lasting greater than 7 minutes is 2.20E-03.

For the configuration above, the probability of an RCS leak as defined in the multi-spurious operation (MSO) report is $([2 \times (1.763\text{E-}01 \times 2.20\text{E-}02)]^2) \times [2 \times 1.763\text{E-}01 \times 2.20\text{E-}02] = 4.67\text{E-}07$. When this probability is combined with the frequency of a fire inside the cabinets in the MCR (4.28E-05/yr), the impact on the core damage frequency (CDF) is considered negligible in relation to the overall CDF as depicted in Table 2 of the Reference 1 letter.

For scenarios outside the cabinets, a hot short probability of 1E-03 is applied to credit the inhibit circuit in addition to the duration term from NUREG-7150. Therefore, a fire affecting the cabling outside the MCR is essentially the same order of magnitude as that for a fire inside the MCR and is considered negligible in relation to the overall CDF. Given the multiple paths required, the frequency of creating a SBLOCA is considered insignificant in relation to its risk impact on CDF and the large early release frequency (LERF).

The following three items are not modifications, but were included in the updated Attachment W results provided in the Reference 1 request. These items were specifically identified to provide full explanation for the additional changes incorporated into the analysis that were included in the revised Attachment W.

Bin 9 Update

For Bin 9 (IA compressors), the Bayesian update of the data was removed and the value changed to reflect the generic frequency from Supplement 1 of NUREG/CR-6850 of 4.65E-03. This corrected frequency is a factor of 10 higher than that used in the original ANO-2 LAR analysis. The results for incorporating the revised frequency for instrument air compressors increases the CDF as depicted in Table 2 of the Reference 1 letter.

Availability of instrumentation for Fire Are JJ

The ANO-2 FPRA model originally assumed instrumentation was available for the Emergency Diesel Generator (EDG) corridor in Fire Area JJ. However, the only power supply to the instrument bus is fed from the green train battery bank. As a result, absent an operator action to transfer the power supply to a red train source, the instrument bus would de-energize upon battery depletion.

The current analysis now accounts for operator action to transfer the power supply to the alternate red train source. The incorporation of this operator action to maintain power to the instrument bus increases the risk and adds a recovery action to mitigate this failure.

Dual Unit MCR Abandonment – This item was not depicted in Table 2; however, the impact on risk has been included in the Attachment W update included in the Reference 1 letter.

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. The dual unit MCR abandonment scenario is a low probability, high consequence scenario that results in damage to the ANO-2 sensitive

electronics located within the MCR, caused by 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 conditional core damage probability (CCDP) of 1.0. The CDF associated with this scenario is 2.34E-06/rx-yr. The ANO-2 MCR is contained in Fire Area G and this new scenario contributes only a small percentage of the overall risk for Fire Area G (4.07E-05/rx-yr). This change in risk is included in the overall risk results provided in the updated Attachment W included in the Reference 1 request.

The ANO-2 evaluation depicted in the Reference 1 letter is consistent with the evaluation performed for the ANO-1 transition to NFPA-805 documented in Entergy letter dated March 25, 2016 (Reference 6).

Summary

The above information provides the basis for both reductions and increases in fire-related risk associated with the ANO-2 transition to NFPA 805. Below is a summary list of changes depicted in the Reference 1 letter and the basis for Entergy's request for NRC review and approval of each.

Modification Changes

Because the method of each modification is specifically referenced in the ANO-2 Operating License (tied to the Reference 4 letter), the OL must be updated to reference the letter containing the revised modification descriptions (Reference 1). Therefore, NRC review and approval is required for the modification changes.

Bin 9 Update

The application of the correct ignition frequency for air compressors resulted in an increase in overall risk; therefore, NRC review and approval is requested.

Availability of instrumentation for Fire Are JJ

A new operator action has been identified resulting in an increase in overall risk; therefore, NRC review and approval is requested.

Dual Unit MCR Abandonment

Revising the MCR abandonment scenario to be consistent with that previously approved in the ANO-1 transition to NFPA 805 (Reference 5) resulted in an increase in overall risk; therefore, NRC review and approval is requested.

Fire Dynamics Simulator

A three-dimensional Computational Fluid Dynamics model (Fire Dynamics Simulator, Version 6.2) was used to analyze the thermal response of an electrical cable associated with the Safety Parameter Display System which was not previously reviewed and approved by the NRC for ANO-2; therefore, NRC review and approval is requested.

EPRI Technical Report TR-1006756

Entergy also requested 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 3). The NRC approved use of the EPRI report for ANO-1 in the Reference 5 Safety Evaluation.

References

1. Entergy letter dated October 27, 2016, *License Amendment Request to Revise the National Fire Protection Association (NFPA) Standard 805 Modifications - Arkansas Nuclear One, Unit 2* (2CAN101601) (ML16302A227)
2. NRC letter dated November 29, 2016, *Arkansas Nuclear One, Unit 2 - Supplemental Information Needed for Acceptance of Requested License Action RE: Amendment Request to Revise the National Fire Protection Association (NFPA) Standard 805 Modifications* (CAC MF8691) (2CNA111602) (ML16333A307)
3. 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)
4. NRC letter dated August 7, 2014, *Response to Request for Additional Information – Adoption of National Fire Protection Association Standard NFPA-805 – Arkansas Nuclear One, Unit 2*, (2CAN081401) (ML14219A635)
5. 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) (1CAN101601) (ML16223A481)
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)