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

June 9, 2014

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

SUBJECT: ARKANSAS NUCLEAR ONE, UNIT 2 – REQUEST FOR ADDITIONAL INFORMATION REGARDING LICENSE AMENDMENT REQUEST PROPOSING THE ADOPTION OF NATIONAL FIRE PROTECTION STANDARD 805 (TAC NO. MF0404)

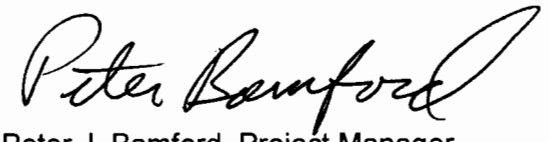
Dear Sir or Madam:

By letter dated December 17, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12353A041), Entergy Operations, Inc. (Entergy, the licensee), submitted a license amendment request (LAR) proposing to revise Renewed Facility Operating License No. NPF-6 for Arkansas Nuclear One, Unit 2. The proposed changes would modify the license to incorporate a transition to National Fire Protection Association Standard 805.

The U.S. Nuclear Regulatory Commission staff has been reviewing the LAR and has determined that additional information is needed to complete its review. The specific questions are found in the enclosed request for additional information (RAI). The questions were sent in draft form via electronic transmission on May 9, 2014, to Mr. David Bice, of your staff. The draft questions were discussed in a teleconference with your staff on May 27, 2014. In that teleconference, one question was eliminated and Question 16.01 was modified. The NRC requests that a response to this RAI be submitted by July 9, 2014, except for Questions 01.e.01 and 21, for which responses are requested by August 11, 2014. If responses are not provided by those dates, the license amendment request will be subject to denial, pursuant to Title 10 of the *Code of Federal Regulations,* Section 2.108, "Denial of application for failure to supply information."

If you have any questions, please contact me at (301) 415-2833 or by e-mail at Peter.Bamford@nrc.gov.

Sincerely,



Peter J. Bamford, Project Manager
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-368

Enclosure:
Request for Additional Information

cc w/encl: Distribution via Listserv

REQUEST FOR ADDITIONAL INFORMATION

LICENSE AMENDMENT REQUEST TO ADOPT

NATIONAL FIRE PROTECTION ASSOCIATION STANDARD 805

ENTERGY OPERATIONS, INC.

ARKANSAS NUCLEAR ONE, UNIT 2

DOCKET NO. 50-368

By letter dated December 17, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12353A041), Entergy Operations, Inc. (Entergy, the licensee), submitted a license amendment request (LAR) proposing to revise Renewed Facility Operating License No. NPF-6 for Arkansas Nuclear One, Unit 2 (ANO-2). The proposed changes would modify the license to incorporate a transition to National Fire Protection Association Standard 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," 2001 Edition" (NFPA 805). By letters dated November 7, 2013, December 4, 2013, January 6, 2014, and May 22, 2014 (ADAMS Accession Nos. ML13312A877, ML13338A432, ML14006A315, and ML14142A410, respectively), Entergy responded to previous requests for additional information (RAIs) from the U.S. Nuclear Regulatory Commission (NRC) staff. The NRC staff continues to review the submittal, as supplemented, and has determined that additional information is needed to complete its review.

Probabilistic Risk Assessment (PRA) RAI 01.e.01

By letter dated November 7, 2013, the licensee responded to PRA RAI 01.e, and noted the use of a single conditional core damage probability (CCDP) estimate of 6.97E-2 for failing to successfully shut down the reactor following a main control room (MCR) abandonment scenario. The response to PRA RAI 15a in the same letter further states:

> The control room abandonment compliant case represents the existing as-built, as operated plant if all of the fire area variances from deterministic requirements (VFDRs) in the control room were eliminated; in other words, if the control room was deterministically compliant...
>
> For the control room abandonment scenario, all of 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 Fire Probabilistic Risk Assessment (FPRA) model that are impacted by the fire scenario were set to "failed by the fire."

The second paragraph above indicates that VFDRs in the MCR room are known and that their removal could be modeled by setting the related components to their random failure probability

instead of failed by fire. Using the random failure probability instead of failed by fire is one acceptable method of estimating the compliant plant risk for use in estimating the change in risk associated with retaining VFDRs. However, in a letter dated January 6, 2014, the licensee responded to PRA RAI 16b and stated:

> Full room burn-up scenarios in the Cable Spreading Room (CSR) and the MCR have the highest (and the same) compliant case CCDP in Fire Area G. Though a few scenarios in Fire Area G have a higher Core Damage Frequency (CDF) than the MCR full room burn-up scenario because of varying ignition frequencies and non-suppression probabilities, those scenarios are bounded by the CCDP of the MCR and CSR full room burn-up fires. The MCR full room burn-up scenario is also known as the MCR abandonment scenario.

The paragraph above indicates that the full room burn-up scenario is the only scenario included in the compliant plant MCR abandonment scenario. In contrast to the full room-burn up scenario, the response to PRA RAI 1.d.i in the letter dated December 4, 2013, indicates that full room burn-up is not the only MCR fire scenario that can cause loss of habitability. The licensee stated:

> Abandonment times were calculated based on the limiting habitability condition of either smoke (visibility) or heat. The various configurations, the output from the CFAST runs, and the resultant abandonment times are documented in CALC-ANO2-FP-09-00013, "ANO-2 Control Room Abandonment Times." This calculation includes an evaluation of impact of a fire initiating in the ANO-2 MCR, as well as a fire initiating in the ANO-1 MCR, and the transfer of heat and smoke to the ANO-2 MCR.

a) Please explain how the CCDPs and conditional large early release probabilities (CLERPs) are estimated for fires that lead to MCR abandonment, in both the post-transition and the compliant case. Provide the range of CCDPs and CLERPS that have been developed and explain how the process and the range of estimates eventually developed address the types of MCR abandonment scenarios that the NRC staff has identified as appropriately characterizing such fires. These types of scenarios are:

   i. Scenarios where the fire fails few functions aside from forcing MCR abandonment and successful shutdown is straightforward.

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

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

b) Using the frequency for full room burn-up with the relatively low Human Error Probabilities (HEP) of 0.0697 seems inconsistent. It would appear that the scenario

following full room burn-out would be the most complex and confusing and that the highest HEP should be assigned because the greatest fire damage possible is achieved. Please describe the types of spurious operations and instrumentation failures and access issues that are associated with full MCR burn-up and how these have been evaluated and included in the HEP.

c) Please describe the total frequency of fires that initiate in the MCR and the total frequency of fires that lead to MCR abandonment.

PRA RAI 01.f.01

In a letter dated November 7, 2013, the licensee responded to PRA RAI 01.f stating that the combustible controls procedure will specify "levels of control" but only identifies one level (i.e., Level 1 – Continuous fire watch for unattended transient combustibles). Requiring a continuous fire watch allows crediting rapid detection and suppression but does not justify a reduction in the expected heat release rate (HRR) of a transient fire.

It is also not clear from the response if the 69 kilowatt (kW) transient fires are assumed only for the listed locations which all have Level 1 control, and the 317 kW transient fires are assumed for all other locations with other control levels. Please describe the controls that the control of combustibles procedure (EN-DC-161) will implement and how will these controls specifically address the types and locations of existing and potential transient combustibles in the areas where a reduced heat release rate is credited.

PRA RAI 06.01

In a letter dated November 7, 2013, the licensee responded to PRA RAI 06 and stated that fire ignition frequencies were updated from the NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities," frequencies (as part of the compensation for removing control power transformers (CPT) credit) to frequencies provided in Supplement 1 to NUREG/CR-6850 (frequently asked question (FAQ) 08-0048). Please indicate whether or not the guidance in FAQ 08-0048 is being followed. The NRC staff notes that if following FAQ 08-0048, a sensitivity study using the mean of the fire frequency for those fire frequency bins with an alpha value less than or equal to one should be performed and, if the acceptance guidelines are exceeded, possible defense-in-depth actions should be considered. Address the possibility that the acceptance guidelines could be exceeded in the sensitivity study and, if this is the case, identify any applicable defense-in-depth actions.

PRA RAI 06.02

In a letter dated November 7, 2013, the licensee responded to PRA RAI 06.b and stated that non-suppression probabilities were updated and were applied to scenarios 2109-U-B/C/D/E/F and G, based on additional fire modeling. The staff notes that these appear to be changes related to additional modelling discussed in the response to PRA RAI 01.g.ii. The staff notes that the response does not refer to the discussion in LAR Section V.2.3 that states that non-suppression probabilities of "0" were used for manual suppression times greater than 60 minutes, contrary to the NUREG/CR-6850 guidelines of a minimum value of 1E-3. Please

confirm that minimum non-suppression probabilities of 1E-3 are used in the PRA and will be used unless replaced by an alternative method acceptable to the NRC Staff.

PRA RAI 8.01

In a letter dated December 4, 2013, the licensee responded to PRA RAI 08.c and stated that the calculation of the control room abandonment frequency assumes that half of the control room panel fires will be single cable bundle fires and the other half will be multiple cable bundle fires. The licensee further states that this assumption is considered appropriate and provides a more realistic yet conservative result. The licensee further stated that it is highly implausible for a fire to start in multiple cable bundles, rather, it will first start as a single cable bundle fire with the potential to grow to involve multiple cable bundles and that since the control room is continuously manned, the rapid response to the fire will suppress most fires during the initial, single cable bundle stage and the fire will not become a multiple cable bundle fire. The NRC staff notes that without supporting fire modeling or event data, it is not clear what the opportunity for suppression is before multiple cables in a multiple bundle are involved in a fire, and whether the assumption is conservative compared to, for example, identifying single and multiple cable cabinets and modelling suppression. The NRC staff also notes that this assumption is a deviation from NUREG/CR-6850, which treats individual electrical panels as either a single cable bundle or a multiple cable bundle. Please provide updated risk results as part of the integrated analysis requested in PRA RAI 21, modeling all panels in the MCR as multiple bundle cable fires, or provide further justification that the assumption is conservative based on characterization of the actual cable bundle configurations in the MCR cabinets.

PRA RAI 08.02

In a letter dated December 4, 2013, the licensee responded to PRA RAI 08.a and stated that two main control board (MCB) scenarios were evaluated: one in which the fire impacted Panels 2C01, 2C02, 2C03, 2C04, and 2C100, and one in which the fire impacted Panel 2C09. The licensee's analysis indicates that NUREG/CR-6850 Appendix L was used to develop a non-suppression probability for the MCB fire scenarios and that the MCB (Bin 4) fire frequency was apportioned between these scenarios. According to NUREG/CR-6850 Appendix L, if Figure L-1 is used then each MCB cabinet scenario should have the entire MCB frequency assigned to it since the Appendix L method assumes that the single 60' by 10' MCB cabinet represents the entire frequency of all MCB cabinets [alternatively, if the MCB (Bin 4) frequency is apportioned to individual MCB cabinets, then Figure L-1 should be re-calculated for each cabinet to use the actual dimensions of each cabinet]. Please provide updated risk results as part of the integrated analysis requested in PRA RAI 21 appropriately applying NUREG/CR-6850 Appendix L, or fully define and justify an alternative method.

PRA RAI 09.01

In a letter dated November 7, 2013, the licensee responded to PRA RAI 09 and explained how the licensee's "multiplier approach" was applied to internal events HEPs to calculate the increased probability of fire related Human Failure Events (HFEs). The licensee also presented an evaluation of how this treatment aligns with NUREG-1921, "EPRI/NRC-RES Fire Human Reliability Analysis Guidelines," showing the licensee's "multiplier approach" cannot be

considered consistent with or conservative in respect to approaches defined in NUREG-1921. In the response to PRA RAI 09, under Section 4.0, "Implementation in NFPA-805 Model," the licensee indicates that HFE evaluations will be supplemented by significance determination, reanalysis of significant HFE, and a sensitivity study using these reanalyzed HEPs as part of transition – but that the current "multiplier approach" will be retained if the risk profile is unaffected. The NRC staff notes that if the risk profile is unaffected for transition, it does not necessarily follow that the risk profile will be unaffected for self-approval which will evaluate as yet unknown changes and for which the acceptance guidelines are relatively small. Please provide additional information about possible impact's from retaining the method in the base line model for use in self-approval evaluations and whether the sensitivity study will be retained for self-approval.

PRA RAI 16.01

In a letter dated November 7, 2013, the licensee responded to PRA RAI 15.c and stated that, "due to lack of cable routing information, some components are assumed to be failed in all fire scenarios, unless credited by exclusion." The response to PRA RAI 02 states that "credit by exclusion" was used to remove just 2,757 failures from a total population of 451,276 cable failure events.

The assumption that numerous systems and/or functions always fail with every fire because the routing of the cables is not known is not necessarily a conservative assumption with respect to the change in risk estimate. Risk reduction modifications that reduce the risk of scenarios with conservatory high risk estimates will overestimate the magnitude of the actual risk reduction that will be achieved.

The NRC staff notes that there are several substantive risk reduction modifications being implemented as part of the transition to NFPA-805 and recognizes that such modifications are a real safety benefit while tracing cables is not. In a letter dated January 6, 2014, several sensitivity results reported in the response to PRA RAI 16 indicate that the effects of the assumption of system and/or function failures based on lack of knowledge about cable routing may be investigated instead of tracing cables. This investigation would need to support a conclusion that any increase in risk is smaller than the acceptance guidelines.

Please provide quantitative results (i.e., CDF, LERF, ΔCDF, and ΔLERF values) of an assessment that demonstrate that the magnitude of the risk reduction from the improvements being implemented to reduce risk is greater than the magnitude of the risk of the retained VFDRs. This assessment should explicitly investigate and account for the overestimation in risk associated with the assumption that cables with unknown routing fail in all fire scenarios. The impact of the assumption on the additional risk of recovery actions should also be addressed.

PRA RAI 17.a.01

In a letter dated January 6, 2014, the licensee responded to PRA RAI 17.a and stated that modifications may directly or indirectly correct a VFDR. The use of the term "indirectly" is confusing. A modification (or assumed modification) that protects or moves a cable directly resolves a VFDR and the lack of such a modification is modeled by removing fire affect failures

from the compliant plant. If a modification provides an alternative redundant train, this may be called an indirect correction; but if categorized as related to a VFDR, the new train should be modeled in both the compliant plant and the post-transition plant. If categorized as a risk reducing modification, it may be modeled in only the post-transition plant. Please clarify what "indirect" means and how such modifications are reflected in the change in risk calculations.

PRA RAI 20

The LAR, Section 4.5.1.1, states that a peer review against Regulatory Guide (RG) 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk- Informed Activities," Revision 1, was performed on the Internal Events PRA model used for the Fire PRA. Please clarify when this peer review was performed. Also, given that the peer review was performed against an earlier version of the American Society of Mechanical Engineers/American Nuclear Society (ASME/ANS) PRA Standard than recognized by RG 1.200 Revision 2, please explain how the change in Supporting Requirements (SRs) between the PRA standard used in the peer review and the 2009 version of the ASME/ANS PRA Standard and SR clarifications in RG 1.200 are reconciled.

PRA RAI 21

Section 2.4.3.3 of the NFPA 805 standard incorporated by reference into 50.48(c) states that the probabilistic safety assessment (PSA) (PSA is also referred to as PRA) approach, methods, and data shall be acceptable to the authority having jurisdiction (AHJ), which is the NRC.

a) For each method (i.e., each bullet) below, please indicate how the issue will be addressed in: (i) the final composite analysis results provided in support of the LAR and (ii) the PRA that will be used at the beginning of the self-approval of post-transition changes. Please note that the licensee may replace any of these methods and weaknesses with a method or model previously accepted by the NRC by modifying the FPRA.

- PRA RAI 01.g regarding removal of the electric panel factors and additional credit for suppression and detection.
- PRA RAI 01.k regarding state of knowledge correlations (SOKC) associated with parametric data propagation for fire ignition frequency bins, spurious operations, non-suppression probabilities, HFEs, and internal events.
- PRA RAI 03 regarding removal of credit for incipient detection in the control element drive mechanism (CEDM) room cabinets to limit cable damage within a cabinet.
- PRA RAI 06 Regarding removal credit of CPT credit in assessment of circuit failure probabilities.
- PRA RAI 06.02 regarding minimum non-suppression probabilities of 1E-3 (RAI 6.02 requests clarification of the values used, not justification for any proposed deviation).

- FM RAI 01.b use of 10 minutes propagation time between MCR cabinets in lieu of 15 minutes.
- FM RAI 01.c MCR transient fire growth rates changed to be consistent with NUREG/CR-6850.

  Additionally, please explain the statement "Because the revised transient growth rates are consistent with the current NUREG guidance, it is not necessary to compute the impact on fire risk results."
- FM RAI 01.d updated MCR abandonment calculation that no longer uses the hot gas layer smoke concentration and temperature modifications.
- FM RAI 01.f new transient zone of influence (ZOI) tables.
- FM RAI 01.g and FM RAI 04 new cable ignition ZOIs and hot gas layers (HGLs).
- PRA RAI 01.e.01 regarding MCR abandonment CCDP/CLERP estimates.
- PRA RAI 01.f.01 regarding using 69 kW instead of 317 kW heat release rates (HRRs) for transient fires.
- PRA RAI 08.01 regarding treatment of electrical cabinet fires in the MCR abandonment analysis.
- PRA RAI 08.02 regarding treatment of MCB fires.
- PRA RAI 09.01 regarding evaluation of non-significant HFEs using guidance in NUREG-1921 opposed the licensee's multiplier approach.
- PRA RAI 15.01 regarding modelling of the failure of cables with unknown locations.

b) In a letter dated November 7, 2013, the licensee responded to RAI 01.h and indicated that the PRA will be revised under implementation item S2-9 to address all modifications and implementation items, including the procedure changes in implementation item S2-6. The response does not indicate when this model will be available and how the model will be consistent with the response to a) above. Please provide a method to assure that all changes will be made and that a focused-scope peer review will be performed on changes that are PRA upgrades as defined in the PRA standard, and that any findings will be resolved before self-approval of post-transition changes (For example, a license condition).

c) Please provide final risk estimates (CDF, LERF, ΔCDF, ΔLERF, and additional risk of recovery actions) based on a PRA that uses only acceptable methods for any method that impacts the transition change in risk estimates. Discuss the likelihood that the risk increase in any individual fire area would exceed the acceptance guidelines and, if so, why exceeding the guidelines is acceptable.

If you have any questions, please contact me at (301) 415-2833 or by e-mail at Peter.Bamford@nrc.gov.

Sincerely,

/RA/

Peter J. Bamford, Project Manager
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-368

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Request for Additional Information

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