



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

June 26, 2013

Vice President, Operations
Entergy Operations, Inc.
Waterford Steam Electric Station, Unit 3
17265 River Road
Killona, LA 70057-3093

SUBJECT: WATERFORD STEAM ELECTRIC STATION, UNIT 3 – REQUEST FOR
ADDITIONAL INFORMATION – NATIONAL FIRE PROTECTION ASSOCIATION
STANDARD NFPA 805 (TAC NO. ME7602)

Dear Sir or Madam:

By letter dated November 17, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML113220230), Entergy Operations, Inc. (Entergy, the licensee), submitted a license amendment request (LAR) to transition its fire protection licensing basis at the Waterford Steam Electric Station, Unit 3, from paragraph 50.48(b) of Title 10 of the *Code of Federal Regulations* (10 CFR) to 10 CFR 50.48(c), National Fire Protection Association Standard NFPA 805 (NFPA 805).

A review team, consisting of U.S. Nuclear Regulatory Commission (NRC) staff and contractors from Pacific Northwest National Laboratory (PNNL) and the Center for Nuclear Waste Regulatory Analyses (CNWRA) participated in a regulatory audit at Waterford in Killona, Louisiana, from May 7 - 11, 2012. By letter dated July 18, 2012 (ADAMS Accession No. ML12185A212), the NRC staff issued requests for additional information (RAIs). By letters dated September 27 and October 16, 2012 (ADAMS Accession Nos. ML12272A099 and ML12290A215, respectively), the licensee provided its responses to the RAIs. By letter dated March 22, 2013 (ADAMS Accession No. ML13072A063), the NRC issued a second set of RAIs. By letter dated May 16, 2013 (ADAMS Accession No. ML13137A128), the licensee provided its response to this second set of RAIs. The NRC staff is continuing its review of the RAI responses received in the licensee's letter dated May 16, 2013, and those RAIs and responses are unrelated to the RAI request enclosed to his letter, since they are related to different review areas.

The NRC staff has reviewed the information provided by the licensee and determined that additional information is needed to complete the review. Please note that review efforts on this task (TAC No. ME7602) are continuing and additional RAIs may be forthcoming.

On May 22, 2013, during a telephone call between the Entergy staff and the NRC staff, it was agreed that:

1. At the earliest following the call, the NRC staff would, send a draft version of the enclosed RAIs via email to the licensee followed by a formal issuance of the RAIs, as draft, on the public docket.

2. The NRC staff will not start the review until the licensee provides a letter detailing the schedule.
3. The focused Fire PRA Peer Review will now be reviewed by NRC staff.
4. The NRC staff believes that the enclosed RAIs discuss the gaps and shortcomings with the licensee's submittals, as identified by the NRC staff. While the NRC staff does not expect a specific response to the enclosed RAIs, the staff expects the discussed concerns be addressed in the final LAR submittals planned submittal. Also, this RAI does not preclude future RAIs.
5. The NRC staff's LAR submittal schedules and interim milestone request, documented in the NRC staff's letter dated May 10, 2013 (ADAMS Accession No. ML13129A150), is hereby withdrawn. The licensee is requested to provide a new schedule for the submittal of the supplement within 2 weeks from the date of this letter.

If you have any questions, please contact me at 301-415-1480 or via e-mail at kaly.kalyanam@nrc.gov.

Sincerely,



N. Kalyanam, Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-382

Enclosure:
As stated

cc w/encl: Distribution via Listserv

REQUEST FOR ADDITIONAL INFORMATION
LICENSE AMENDMENT REQUEST TO ADOPT
NATIONAL FIRE PROTECTION ASSOCIATION STANDARD 805
PERFORMANCE-BASED STANDARD FOR FIRE PROTECTION FOR
LIGHT WATER REACTOR GENERATING PLANTS
WATERFORD STEAM ELECTRIC STATION, UNIT 3
DOCKET NO. 50-382

By letter dated November 17, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML113220230), Entergy Operations, Inc. (Entergy, the licensee), submitted a license amendment request (LAR) to transition its fire protection licensing basis at the Waterford Steam Electric Station, Unit 3, from paragraph 50.48(b) of Title 10 of the *Code of Federal Regulations* (10 CFR) to 10 CFR 50.48(c), National Fire Protection Association Standard NFPA 805 (NFPA 805).

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The NRC staff has reviewed the information provided by the licensee and determined that additional information is needed to complete the review.

Probabilistic Risk Assessment (PRA) RAI 01.01

During the audit, it was explained that, when addressing fire spread along cables or to cables in nearby trays from an ignition source or other already ignited cables, the zone of influence (ZOI) associated with the heat release rate (HRR) from only the ignition source was assumed to envelope any fire spread beyond the characteristic 35-degree vertical "cone" described in Appendix R of Electric Power Research Institute (EPRI) 1011989 / NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities," Volume 1: Summary and Overview," September 2005 (ADAMS Accession No. ML052580075), and Volume 2: Detailed Methodology," September 2005 (ADAMS Accession No. ML052580118). By letter dated

Enclosure

October 16, 2012, the licensee responded to PRA RAI 1 and stated that additional plausible secondary ignition targets were identified in only two physical access units (PAUs).

- a. Please explain how “plausible secondary ignition sources” are defined. For example, please describe whether the ZOI approach summarized above was applied or was some modified approach used.
- b. If the ZOI approach was applied, please explain how, even after considering the flame spread rate of 0.3 mm/sec recommended for thermoset cables (XLPE) in Appendix R of NUREG/CR-6850 (0.9 mm/sec for thermoplastic [PVC], if applicable), the assumed ZOI continues to bound any expansion beyond the cone until the fire is suppressed.
- c. The RAI response stated that “Suppression was not included in the baseline analysis.” If this is the case, please describe whether the fire is assumed to spread until all possible targets within the ZOI, including subsequent fire propagation, are damaged.
- d. By letter dated September 27, 2012, the licensee responded to PRA RAI 21 and stated, “For the IEEE-383 qualified thermoset cables at Waterford, the fire spread is considered to be limited to those raceways within the cable damage ZOI; spread of a fire beyond the ZOI due to a secondary (i.e., target) fire was not evaluated.” Please describe whether this means that fire was allowed to spread throughout a cable tray where at least part of it was within the ZOI or if no spread along that tray beyond the ZOI was assumed. If the former, describe whether vertical propagation to upper trays as a result of horizontal propagation along a given tray was assumed. If the latter, provide a basis for what would appear to be a non-conservative assumption, given that, even for qualified, thermoset cables, fire spread rates of 0.3 mm/sec are cited in NUREG/CR-6850 and retained as a result of cable fire tests in the FLASH-CAT [Flame Spread over Horizontal Cable Trays] model recommended by NUREG/CR-7010, “Cable Heat Release, Ignition, and Spread in Tray Installations during Fire (CHRISTIFIRE), Phase 1: Horizontal Trays,” July 2012 (ADAMS Accession No. ML12213A056).
- e. One possible basis suggested by your staff during the May 2012 audit was that the assumed ZOI extended far enough beyond the nominal 35-degree cone and that, based on timing and suppression considerations, the probability of fire spreading beyond the extended ZOI was shown to be negligible. If so, please explain. Regardless, provide explanation and, as appropriate, a confirmatory calculation incorporating fire phenomenological considerations.

PRA RAI 04.01

By letter dated September 27, 2012, the licensee responded to PRA RAI 4 and stated that the Fire Risk Evaluation (FRE) considered the risk profile of each area based on the ignition frequency (IF), conditional core damage probability (CCDP) and high-risk scenarios in each area, and determined if additional defense-in-depth (DID) was warranted. The response also stated that, if deficiencies were discovered that did not allow the DID goal to be met, a change

would be considered. Please describe the methodology that was applied to address the three elements identified in National Fire Protection Association Standard 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," 2001 Edition, (NFPA 805) Section 1.2 and the associated DID goals. The description should clarify how ignition frequency and CDDP are considered together with other aspects of the fire scenario, such as propagation, detection, and suppression.

PRA RAI 10.01

When subjecting unprotected cables to direct fire damage for delta-risk evaluations of variances from deterministic requirements (VFDRs) (non-compliant case), please describe whether any of the deviations from NUREG/CR-6850 were used as the basis for evaluating the risk in the non-compliant case. If so, please indicate whether a sensitivity analysis was performed removing such credit and recalculating the delta-risk, and if so, provide the sensitivity analysis results (e.g., use of a reduction factor for fire damage outside an electrical cabinet, or extensions of resolved analysis methods where the justification has been questioned, such as limiting transient combustible HRR to lower than the NUREG/CR-6850 default profile for trash fires).

PRA RAI 16.01

Regarding the low likelihood of damage to sensitive electronics in "non-adjacent cabinets," your letter dated October 16, 2012 (Page 7 of 48), states that "Any potential damage that could propagate to a non-adjacent panel would also be mitigated by room cooling (if functional) and any active fire suppression (which is more likely given the time required to reach damage in non-adjacent equipment)." However, by letter dated October 16, 2012, in response to PRA RAI 1, you stated that "Suppression was not included in the baseline analysis." Appendix S of NUREG/CR-6850 suggests delaying damage to sensitive electronics in "adjacent cabinets" with double walls and an air gap by 10 minutes. The RAI response credits the additional air gap between non-adjacent, well-sealed cabinets as a "significant" contributor to delayed damage. Please describe whether the conclusion still holds if no suppression is credited and whether these "well-sealed" cabinets satisfy the criteria in NUREG/CR-6850, Supplement 1 "Fire Probabilistic Risk Assessment Methods Enhancements," September 2010 (ADAMS Accession No. ML103090242). Also, see Frequently Asked Question (FAQ)-08-0042, Fire Propagation from Electrical Cabinets, located in ADAMS Accession No. ML092110537.

PRA RAI 25.01

One of the bases for assuming a time of 15 minutes for the manual non-suppression probability is "listed time to damage for secondary cable targets of 19 minutes" from NUREG/CR-6850. Specifically, please clarify the source of this reference within the document (i.e., cite the corresponding table, figure, and/or section). The other basis for the 15-minute assumption is the sensitivity study for sensitive electronics. Please explain how this estimate was calculated.

PRA RAI 29.01

- a. For actual plant conditions, which do not meet the assumed generic PAU ceiling heights of 7 or 12 feet (ft), or the assumed cabinet height of 7 ft, please describe how the generic methodology is applied to ensure the results bound the actual

conditions, including the apparent assumption of 12 ft for all transient fire scenarios based on assuming their location at floor level. Describe how the potential for transient fires located above the floor level is accommodated by the generic approach. Also, given that the use of the ignition frequency correction factor for electrical cabinet fire damage beyond the source has not been accepted, please describe the alternative (e.g., sensitivity analysis) that is provided to address conditions where this was applied but may not be properly characterized by the generic approach.

- b. Reference is made in your letter dated September 27, 2012, to two groupings for HRRs, 69 kilowatt (kW) and 702 kW. It is unclear where these groupings arise, although it is possible they are meant to characterize Cases 1 and 2 from Table E-1 of NUREG/CR-6850 for the minimum (75th percentile) and maximum (98th percentile) listed HRRs for those two groups (69 kW at the 75th percentile for Case 1 and 702 kW at the 98th percentile for Case 2). Table E-1 of NUREG/CR-6850 also cites an "intermediate" HRR of 211 kW as the 98th percentile for Case 1 and the 75th percentile for Case 2. Please describe whether this HRR was also examined. Also cited are scenarios at 1000 kW and 1750 kW, respectively, presumably for Cases 1 and 2. Please provide a discussion of the selection of these higher HRRs, which include secondary ignitions.
- c. With regard to the 69 kW HRR grouping discussed in (b), there is a statement in your letter dated September 27, 2012, that the 69 kW HRR may have initially limited the selection for hot gas layer screening for transient scenarios. This seems to suggest that Case 7 in Table E-1 of NUREG/CR-6850, where 69 kW represents the 98th percentile HRR, rather than Case 1, where it represents the 75th percentile, may have been the corresponding Case for "Group 1." Please provide clarification.

PRA RAI 43.01

By letter dated September 27, 2012, the licensee responded to PRA RAI 43 and in RAI response 43.a stated that the items in S-1 are not in the PRA model and that the items in S-2 are in the PRA model. However, LAR Attachment S, Table S-1, identifies that items S1-3, S1-4, and S1-5 are included in the PRA model. Please explain the discrepancy between the RAI response and LAR Attachment S, Table S-1.

PRA RAI 44.01

- a. By letter dated September 27, 2012, the licensee responded to PRA RAI 44b, which did not address the equivalency of the counting method of using plant computer data versus reviewing surveillance test procedures, and therefore does not provide justification as to why the approach is acceptable in place of reviewing surveillance test data. Please evaluate the two different counting methods and clarify why the results are expected to be equivalent or provide an evaluation of the fire probability risk assessment (FPRA) results that illustrates the effect of any potential correction to the random failure data in the PRA.

- b. By letter dated September 27, 2012, the licensee responded to PRA RAI 44d and stated that, after reducing the time available to perform the action to 1 hour, the impact on the human error probability (HEP) for fire is not impacted by the assumption change per the HRA Screening Figure 5.2.1-1 in PRA-W3-05-003. The NRC staff noted that if the time available is at least 1 hour but less than 2, the HEP should be doubled (or set to 0.01 if undeveloped), at least for screening purposes. Please provide an explanation of why there is no impact.
- c. By letter dated September 27, 2012, the licensee responded to PRA RAI 44e and stated that the assumed HEP value for EHFMANTR (the PRA human error event code for Failure to transfer loads to the Startup Transformers (SUTs) when auto transfer fails--no DC power) has no impact on the FPRA results since the event does not appear in a single cutset. Please describe whether this refers to the internal events PRA (IEPRA) or FPRA cutsets. If the former, indicate whether it was excluded (e.g., truncated) prior to increasing its HEP by a factor of six. If it was excluded before increasing its value, describe whether it still could have appeared in the FPRA cutsets.
- d. By letter dated September 27, 2012, the licensee responded to PRA RAI 44f and recognized that the cooling tower models have not been updated since the power uprate. Since the wet cooling towers (WCT) and dry cooling towers (DCT) provide important, credited functions in the FPRA, the success criteria should be modeled for the as-designed, as-operated plant. To meet this supporting requirement (SR), please update the success criteria in the FPRA.
- e. By letter dated September 27, 2012, the licensee responded to PRA RAI 44, describing the modeling of the battery, but did not provide sufficient information for the NRC staff to complete its review. Please provide the information requested in PRA RAI 44h (see the NRC staff's letter dated July 18, 2012).
- f. For Fact and Observation (F&O) SY-A12b-01, please describe whether the potential for a loss of significant inventory over a period of time was also considered for inclusion of diversion flowpaths in the FPRA.

PRA RAI 53.01

By letter dated September 27, 2012, the licensee responded to part c of PRA RAI 53 and stated that if the solenoid operated valve (SOV) fails closed following a loss of power and the only PRA function is for the SOV to close, then power dependency would not be modeled for the valve. However, a hot short may have the potential to maintain a SOV energized until it is cleared. Please provide a discussion regarding how hot shorts for SOVs were considered for inclusion in the FPRA, and explain why they may not have been included, as appears to be the case, given that no power dependency was logically tied to the SOVs. Provide this discussion for SOVs in the FPRA, as well as for SOVs within the boundary of an AOV in the FPRA. If hot short modeling for SOVs were included by means other than model logic, please explain how this was done and how it can be used for FREs, which may require the assessment of power dependency to SOVs.

PRA RAI 58.01

- a. By letter dated September 27, 2012, the licensee responded to PRA RAI 58 and stated that, "the non-compliant case includes basic events that no credit can be given to when compliant with NFPA 805. These basic events are items such as modifications to the plant or operator action that reduce the risk of fire leading to an undesirable state." Please clarify this statement, provide examples, and relate it, as applicable, to the modifications and operator actions in the LAR or otherwise in the FPRA.
- b. By letter dated September 27, 2012, the licensee responded to various PRA RAIs and used the value of "TRUE," which is confusing. The response to RAI PRA 10 states that "In the delta risk evaluations, all components/cables with associated VFDRs are assumed protected (set to TRUE) in the compliant case and not protected, subject to direct fire damage or random failure in the non-compliant case (whether a current fire wrap exists or not)." While the response to RAI PRA 39 states "In the FPRA quantification (using FRANC) fire impacts are modeled by setting FPRA basic events associated with fire-failed components and cables to True in the FPRA fault tree and then quantifying the model." In one case, TRUE represents the protected components/cables and in the other case TRUE represents the basic components associated with fire-failed components and cables. Please describe how the value of TRUE can represent a decrease in risk (response to RAI PRA 10) and also an increase in risk (response to RAI PRA 39). Describe why a value of FALSE is not used for basic events which are assumed to be successful (e.g., assumed successful for the compliant case). Provide examples in your explanation.
- c. By letter dated September 27, 2012, the licensee responded to PRA RAI 47, and provided an example that stated that setting the basic event for SI-405B to a value of TRUE removes the cutset which contains SI-405B and SI-401B. The NRC notes that setting a basic event to a value of TRUE would be expected to retain the basic event's cutset. Please explain why the cutset is removed and not retained (without the basic event that was set to a value of TRUE).
- d. The above observations above imply a two-step "TRUE" setting approach. A compliant case sets the compliant basic events value to TRUE, and then the non-compliant case sets the non-compliant cases value to TRUE. Please clarify the "TRUE" approach and provide a general discussion on how the FRE compliant and non-compliant cases are used with the software.
- e. By letter dated September 27, 2012, the licensee responded to PRA RAI 58 and stated that every VFDR entry in the B-3 table with "open" status is associated with a modification and that for every open case the B-3 disposition identifies an Attachment S implementation item. In addition, the response stated that for all of these cases, the risk measurement for the corresponding VFDR for the fire area (delta (Δ) CDF and Δ LERF) is provided in the FRE calculations identified for each fire area. The NRC staff noted that risk measures for the VFDRs of open status were not found to be provided in the LAR. If an FRE had been performed

for such VFDRs, please provide the risk associated with each open VFDR (Δ CDF and Δ LERF) for the fire areas.

PRA RAI 60

The NRC staff noted that if any HEP is set to a value of TRUE, then the joint human error probability (JHEP) is set to 0. Please explain why the JHEP is apparently removed from the FPRA if any of its HEPs are set to a value of TRUE.

PRA RAI 61

- a. The NRC staff noted that a JHEP basic event, ZHF-C2-014, involves an action of failure to isolate component cooling water (CCW) cross-connections after the safety injection actuation system (SIAS) fails. Given the importance of CCW, please discuss how this condition of failing to isolate CCW cross-connections arises for the FPRA and its impact on CCW success criteria. Describe whether fire events have the potential to preclude isolating the CCW cross-connects, and if so, discuss how this was this considered in the FPRA.
- b. In addition, with respect to CCW success criteria, the CCW makeup system is not included in the FPRA according to Table B-3 of the LAR. Please describe what assurance there is that CCW makeup will not be necessary for fire scenarios considered for the NFPA 805 application. Describe whether the VFDRs related to the CCW surge tank level control and indications have the potential to result in opening a surge tank relief valve leading to the need for CCW makeup.

2. The NRC staff will not start the review until the licensee provides a letter detailing the schedule.
3. The focused Fire PRA Peer Review will now be reviewed by NRC staff.
4. The NRC staff believes that the enclosed RAIs discuss the gaps and shortcomings with the licensee's submittals, as identified by the NRC staff. While the NRC staff does not expect a specific response to the enclosed RAIs, the staff expects the discussed concerns be addressed in the final LAR submittals planned submittal. Also, this RAI does not preclude future RAIs.
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If you have any questions, please contact me at 301-415-1480 or via e-mail at kaly.kalyanam@nrc.gov.

Sincerely,

/RA/

N. Kalyanam, Project Manager
 Plant Licensing Branch IV
 Division of Operating Reactor Licensing
 Office of Nuclear Reactor Regulation

Docket No. 50-382

Enclosure:
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ADAMS Accession No. ML13157A062

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