NRR-PMDAPEm Resource

From: Feintuch, Karl
Sent: Tuesday, January 31, 2012 7:03 AM
To: 'Swenzinski, Laura'; 'Browning, Tony'
Cc: Fields, Leslie; Lain, Paul; Klein, Alex; Harrison, Donnie; Robinson, Jay; Pickett, Douglas
Subject: ME6818 - DAEC Adoption of NFPA-805 - AFPB, IHPB, APLA Request for Additional Information (RAI)
Attachments: ME6818 DAEC AFPB IHPB RAIs NFPA 805 LAR.docx; ME6818 DAEC PRA RAIs NFPA 805 LAR.docx

By letter dated August 5, 2011, Nextera Energy Duane Arnold, LLC, (the Licensee), submitted a license amendment request (LAR) to transition their fire protection licensing basis at the Duane Arnold Energy Center (DAEC), from Title 10 of the Code of Federal Regulations (CFR), Section 50.48(b), to 10CFR50.48(c), National Fire Protection Association Standard NFPA 805 (NFPA 805).

The Fire Protection (AFPB), Health Physics & Human Performance (IHPB), and Probabilistic Risk Assessment Licensing (APLA) Branches have reviewed the information provided by the licensee and determined that additional information is needed to complete the review. Attached are the requests for additional information (RAI) items from AFPB, IHPB and APLA in two files. Please note that review efforts on this task (TAC No. ME6818) continue and additional RAI items may be forthcoming.

AFPB and IHPB are proposing a **60 calendar day** response time for their RAIs **with the exception of** the following RAIs:

- Safe Shutdown Analysis RAI 1 and Safe Shutdown Analysis RAI 6 for which a **90 calendar day** response time in proposed.

The RAI items from AFPB and IHPB are grouped into 5 technical review areas with a total of 29 RAIs as follows:

Fire Protection Engineering RAIs – 10
Monitoring Program RAIs – 1
Fire Modeling RAIs – 6
Safe Shutdown Analysis RAIs – 9
Radioactive Release RAIs - 3

The APLA is proposing a **60 calendar day** response time for its RAI items (RAIs) **with the exception of**:

- Probablistic Risk Assessment (PRA) - RAIs 1, 5, 7, 8, 12, 14, 15, 19, 20, 23, 27, 29, 51 for which a **90 calendar day** response time is proposed.

If you have any questions concerning the content of these RAIs, need any additional clarifying information concerning these RAIs, or wish to schedule clarification conference call(s) to discuss any of these items, please contact Leslie Fields (301-415-1186 or leslie.fields@nrc.gov).

Please contact me with any questions concerning this message.

Karl Feintuch
USNRC
301-415-3079

Docket No: 50-331
Two files of RAI items are attached: AFPB and IHPB items in one file and APLA items in a second file, as named

Hearing Identifier: NRR_PMDA
Email Number: 253

Mail Envelope Properties (26E42474DB238C408C94990815A02F0968B91F5F32)

Subject: ME6818 - DAEC Adoption of NFPA-805 - AFPB, IHPB, APLA Request for Additional Information (RAI)
Sent Date: 1/31/2012 7:02:34 AM
Received Date: 1/31/2012 7:02:00 AM
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Post Office: HQCLSTR01.nrc.gov

Files	**Size**	**Date & Time**
MESSAGE	2239	1/31/2012 7:02:00 AM
ME6818 DAEC AFPB IHPB RAIs NFPA 805 LAR.docx	44537	
ME6818 DAEC PRA RAIs NFPA 805 LAR.docx	47078	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

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
DUANE ARNOLD ENERGY CENTER
(TAC NO. ME6818)

Office of Nuclear Reactor Regulation
Division of Risk Assessment
Fire Protection Branch
Health Physics and Human Performance Branch

Fire Protection Engineering RAI 1

Fire Area PH1 is described as meeting the deterministic requirements of National Fire Protection Association (NFPA) Standard 805, Section 4.2.3.3(b), which requires 20-feet of separation with detection and suppression throughout the area. Engineering Evaluation (EE) FPE-S06-004, Table 6.2, Paragraph 1-6, references an exemption from 10 CFR 50, Appendix R requirements for full coverage by automatic suppression systems, but there is no discussion of this previous exemption request for partial system coverage in license amendment request (LAR) Section 4.2.3 or Attachment K. Clarify the applicability of the exemption request referenced in FPE-S06-004.

Fire Protection Engineering RAI 2

The compliance statement for LAR Table B-1, Element 3.2.3(1) is “complies with clarification.” The apparent clarification is to allow modification of surveillance frequencies in accordance with the methodology in Electric Power Research Institute (EPRI) Technical Report (TR) 1006756, “Fire Protection Surveillance Optimization and Maintenance Guide for Fire Protection Systems and Features.” The proposed future use of the EPRI methodology is not a clarification to current compliance as these methods are not currently incorporated in the surveillance program and there is no associated implementation item in Attachment S of the LAR. Discuss the planned application and incorporation of the EPRI methodologies at Duane Arnold Energy Center (DAEC).

Fire Protection Engineering RAI 3

LAR, Attachment L, Approval Request 1, references previous evaluations of epoxy floor coatings that were performed in response to an unresolved item from an NRC inspection report. Resolution of the unresolved item included evaluation of the potential for fire propagation across barriers and for those areas crediting spatial separation of redundant safe shutdown equipment. The Approval Request states the combustible contribution of the epoxy does not present a challenge to the plant fire barriers, but does not specifically address the potential for propagation between redundant success paths for achieving the nuclear safety performance criteria. Clarify how epoxy coatings will not propagate fire between spatially separated nuclear safety capability systems or components.

Fire Protection Engineering RAI 4

The safety margin discussions in Approval Requests 1, 2, and 3 in Attachment L of the LAR contain the following statements, respectively:

> These precautions and limitations on the use of these materials have been defined by the limitations of the analytical methods used in the development of the Fire Probabilistic Risk Assessment (FPRA). Therefore, the inherent safety margin and conservatisms in these methods remain unchanged.
>
> The use of these materials has been defined by the limitations of the analytical methods used in the development of the FPRA. Therefore, the inherent safety margin and conservatisms in these methods remain unchanged.
>
> The use of these systems has been defined by the limitations of the analytical methods used in the development of the FPRA. Therefore, the inherent safety margin and conservatisms in these methods remain unchanged.

Clarify these statements and describe how safety margins are met for the individual approvals that are requested.

Fire Protection Engineering RAI 5

NFPA 805, Paragraph 3.3.8 states that bulk storage of flammable and combustible liquids is not permitted in structures containing systems or components important to nuclear safety. The compliance basis statements in LAR Table B-1, Element 3.3.8 do not address this prohibition on bulk storage in certain areas of the plant, which is independent of the NFPA 30 code citation in Table B-1. Describe how DAEC complies with the first sentence of 3.3.8 of NFPA 805 for storage of bulk flammable and combustible liquids.

Fire Protection Engineering RAI 6

Implementation Item No. 14 (Attachment S, Table S-2,) states: “Implement the results of the Radioactive Release Analysis,” but is not specific to the actions to be completed. Provide additional discussion of the actions to be implemented to address the analysis results for radioactive release.

Fire Protection Engineering RAI 7

LAR Attachment L, Approval Request 3, requests approval for fire water supply system designs that do not provide separate water supply connections for fixed fire suppression systems and fire hose stations provided for manual backup. The approval request states that an alternative source for manual suppression can be provided from yard fire hydrants. Provide additional discussion of the actions necessary to provide backup suppression to the Standby Filter Unit location, including the approximate distance and any elevation change from the nearest fire hydrant(s) and other alternatives available (e.g., local hose stations) in the proximity. Also, with regard to the Pump House system design, clarify if Sprinkler System 21 that protects the 747-ft elevation should be included in the scope of the approval request. Lastly, the approval request identifies the fixed systems served by a common source but does not identify the associated hose stations. Describe both the fixed and manual systems associated with this request.

Fire Protection Engineering RAI 8

LAR Attachment A, Table B-1, Element 3.5.16 contains requirements regarding shared use of fire water supply and storage for nuclear safety functions (i.e., Exceptions 1 and 2). The LAR states that DAEC utilizes both of the exceptions.

a. With regard to Exception 1 on use of fire water supply system to provide a means of make up to the reactor vessel or spent fuel pool, describe the availability of both fire pumps for all fire areas where a fire pump is credited to support the nuclear safety function.

b. With regard to Exception 2, describe how sufficient water volume is provided to supply both the fire water suppression demand as well as the demand of other plant systems when a fire pump is used to supply these systems. If river or well pumps are credited for makeup to the wet pit, describe how these pumps are protected from fire damage.

Fire Protection Engineering RAI 9

LAR Attachment A, Table B-1, Element 3.6.4, states compliance with previous approval. The compliance basis for this element does not address the provision of this element to provide manual fire suppression in areas containing systems and components needed to perform nuclear safety functions following a safe-shutdown earthquake (SSE). Describe how DAEC will provide manual fire suppression protection of nuclear safety functions following a SSE.

Fire Protection Engineering RAI 10

LAR Attachment E, describes the radioactive release transition evaluation and describes using plant filter, off-gas, and drain collection systems to manage airborne and liquid effluents. Clarify the following:

a. For the Low Level Radwaste Processing Facility, the “Smoke and By Products of Combustion – Airborne Effluent Evaluation,” states that any signal from a smoke detector will align dampers to purge the facility through particulate filters. Clarify how these filters are capable of functioning with exposure to, or loading associated with, products of combustion.

b. For the Offgas Retention Building, the “Smoke and By Products of Combustion – Airborne Effluent Evaluation,” states that smoke can be monitored but does not provide means to mitigate smoke release. Discuss the actions if monitoring detects radioactive release.

c. For the Offgas Retention Building, the “Fire Suppressant Run Off – Liquid Effluent Evaluation,” describes collection of runoff in the Floor Drain Collector Tank. What is the volume of this tank and describe the evaluation of this volume relative to expected fire flow?

d. For the Reactor Building, the “Smoke and By Products of Combustion – Airborne Effluent Evaluation,” states that a high radiation alarm on the exhaust ventilation will

result in alignment of the exhaust to the standby gas treatment system. Discuss how this system is designed to handle products of combustion.

Monitoring Program RAI 1

NFPA 805, Section 2.6, “Monitoring,” states that: "A monitoring program shall be established to ensure that the availability and reliability of the fire protection systems and features are maintained and to assess the performance of the fire protection program in meeting the performance criteria." It also states that "Monitoring shall ensure that the assumptions in the engineering analysis remain valid."

Specifically, NFPA 805, Section 2.6, states that: (2.6.1) "Acceptable levels of availability, reliability, and performance shall be established." (2.6.2) "Methods to monitor availability, reliability, and performance shall be established. The methods shall consider the plant operating experience and industry operating experience." (2.6.3) "If the established levels of availability, reliability, or performance are not met, appropriate corrective actions to return to the established levels shall be implemented. Monitoring shall be continued to ensure that the corrective actions are effective."

Section 4.6 of the DAEC NFPA 805 Transition Report states that the DAEC NFPA 805 monitoring program will be implemented as part of the fire program transition to NFPA 805 (Attachment S, Table S-2, Implementation Items, Item 2 of the DAEC NFPA 805 Transition Report) after the safety evaluation is issued. Furthermore, the licensee has indicated that the monitoring program will be developed in accordance with, Frequently Asked Question (FAQ) 10-0059. The staff noted that the information provided in Section 4.6, “Monitoring Program,” of the DAEP NFPA 805 Transition Report, is insufficient for the staff to complete its review of the monitoring program and as such is requesting that the following additional information be provided:

a. A description of the process by which systems, structures, and components (SSCs) will be identified for inclusion in the NFPA 805 monitoring program including an explanation of how SSCs that are already included within the scope of the DAEC Maintenance Rule program will be addressed with respect to the NFPA 805 monitoring program.

b. A description of the process that will be used to assign availability, reliability, and performance goals to SSCs within the scope of the DAEC NFPA 805 monitoring program including the approach to be applied to any SSCs for which availability, reliability, and performance goals are not readily quantified.

c. A description of the procedures that will be employed to address SSCs that fail to meet assigned availability, reliability, or performance goals.

d. A description of how the DAEC NFPA 805 monitoring program will address response to programmatic or training elements that fail to meet performance goals (examples include fire brigade response or performance standards and discrepancies in programmatic areas such as combustible control programs).

e. A description of how the DAEC NFPA 805 monitoring program will address fundamental fire protection program elements.

f. A description of how the guidance in EPRI Technical Report 1006756 will be integrated into the DAEC NFPA 805 monitoring program.

g. A description of how periodic assessments of the monitoring program will be performed taking into account, where practical, industry wide operating experience including whether this process will include both internal and external assessments and the frequency at which these assessments will be performed.

Fire Modeling RAI 1

NFPA 805, Section 2.4.3.3 requires that the PRA approach, methods, and data shall be acceptable to the Authority Having Jurisdiction (AHJ).

Section 4.5.1.2, "Fire PRA," of the DAEC NFPA 805 Transition Report states that fire modeling was performed as part of the Fire PRA development (NFPA 805 Section 4.2.4.2). Section 4.5.1.2, "Fire PRA," of the DAEC NFPA 805 Transition Report refers to Attachment J, "Fire Modeling V&V," for a discussion of the acceptability of the models that were used.

Regarding the acceptability of the PRA approach, methods, and data:

a. Of specific concern are fire location corner and wall proximity effects, which can affect entrainment and flame height, as well as Zone of Influence (ZOI) and target impacts. During the audit the staff discussed the issue of fire location and it was not clear how this concern was addressed.

   The staff requests the licensee describe how the effects of fires located near corners and walls were accounted for in the fire modeling analyses; specifically for:

   1. Fires that affect Main Control Room (MCR) abandonment.
   2. Transient, small liquid fuel spill fires.
   3. Open electronic equipment (closed vented cabinet) fires throughout the plant.

   In addition, the staff requests the licensee describe the data collection method for specific ignition sources identified as being in close proximity to walls and/or corners.

b. During the audit, the staff noted that fire modeling comprised the following:

   - The Consolidated Fire Growth and Smoke Transport (CFAST) model was used to calculate abandonment times in the main control room (MCR).

   - The Generic Fire Modeling Treatments approach was used to determine the ZOI in all fire areas throughout plant.

   Explain if and how the modification to the critical heat flux for a target that is immersed in a thermal plume described in Section 2.4 of the Generic Fire Modeling Treatments document was used in the analyses to support the transition to NFPA 805. In addition, provide the title and describe the supplements to the Generic Fire Modeling Treatments that were developed and explain how these supplements were used in the analyses to support the transition to NFPA 805. Also provide a description of the specific CFAST input parameters and provide the CFAST input files and a summary of the results for the MCR abandonment study.

c. During the audit, the staff observed that Section 8.7 of the FPRA Quantification Report, 493080001.04 (supporting documentation for the transition to NFPA 805), discusses essential switchgear room hot gas layer (HGL) refinements. The first part of this discussion explains how the HGL tables from the Generic Fire Modeling Treatments document were applied to these specific fire areas. The second part of this discussion explains how new generic HGL results were developed in Generic

Fire Modeling Treatments document, based on specific heat release rates (HRR), including fire growth.

Provide clarification on the second part of this discussion and explain which documents were used for the HGL refinements and the process for applying the refined HGL tables. Provide the information that was obtained during the walk downs of the essential switchgear rooms (i.e. copies of the walk down sheets) together with any additional information needed to determine the ZOI in these rooms (e.g. geometry, type and location of the ignition sources and secondary combustibles, etc.)

Fire Modeling RAI 2

NFPA 805 Section 2.5 requires damage thresholds be established to support the performance-based approach. Thermal impact(s) must be considered in determining the potential for thermal damage of structures, systems, or components. Appropriate temperature and critical heat flux criteria must be used in the analysis.

Section 4.5.1.2, "Fire PRA," of the Transition Report states that fire modeling was performed as part of the FPRA development (NFPA 805 Section 4.2.4.2). FPRA Fire Scenario Report Revision 2, Section 1.3 Assumptions and Limitations #8 states "DAEC has Institute of Electrical and Electronic Engineers (IEEE)-383 cables. Damage criteria for thermoset cables are assumed." Section 2.3 Damage Criteria states "Based on NUREG/CR-6850, EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities, April 2005, cable damage thresholds are generally assumed to be the limiting vulnerability. Cable damage threshold limits are dependent on the type of cables at DAEC. The DAEC UFSAR (Section 8.3) states that DAEC has IEEE-383 equivalent cables. Therefore, the damage criteria associated with IEEE-383 cables was used." However, Table B-1 of the LAR Section 3.3.5.3 electrical cable construction is described not as compliant with IEEE-383, but based on an earlier Insulated Power Cable Engineers Association (IPCEA) Standard S-19-81, and previously approved by NRC Safety Evaluation Report dated June 1, 1978 (Section 4.8).

Additionally, Section 5.1.4.5 Self Ignited Cable/Junction Box Fires states: "DAEC has IEEE-383 cables; therefore, self-ignited cable fires are not postulated per NUREG/CR-6850, Appendix R. Junction box fires are not considered given the lack of an ignition source."

During the audit, the staff noted that fire modeling in support of the transition to NFPA 805 involved the use of the Generic Fire Modeling Treatments approach to determine the ZOI in all fire areas throughout plant. The Generic Fire Modeling Treatments approach constitutes an implicit use of fire modeling.

The staff also noted that the ZOI in all fire areas with cable targets was determined on the basis of the tables in the Generic Fire Modeling treatments document for, "IEEE-383 Qualified Cable Target". The tables for "non-IEEE-383 Qualified Cable Target," were not used in the ZOI determination.

Section 2.0 of the Generic Fire Modeling Treatments document provides a discussion of damage criteria for different types of targets. Section 2.1 of the Generic Fire Modeling Treatments document states: "Damage to IEEE-383 qualified cables is quantified as either an imposed incident heat flux of 11.4 kW/m2 (1 Btu/s-ft2) or an immersion temperature of 329°C (625°F) per Nuclear Regulatory Guidance [NRC, 2005, NUREG 6850, 2005]." Section 2.2 of

the Generic Fire Modeling Treatments document states: “Damage to non-IEEE-383 qualified cables is quantified as either an imposed incident heat flux of 5.7 kW/m2 (0.5 Btu/s-ft2) or an immersion temperature of 204°C (400°F) per Nuclear Regulatory Guidance [NRC, 2005, NUREG 6850, 2005].”

The above statements from Generic Fire Modeling Treatments document imply that in the Generic Fire Modeling Treatments document, IEEE-383 qualified cables are assumed to be equivalent in terms of damage thresholds to “thermoset” cables as defined in Table 8-2 of NUREG/CR-6850. In addition, non-IEEE-383 qualified cables are assumed to be equivalent to “thermoplastic” cables as defined in Table 8-2 of NUREG/CR 6850. These assumptions may or may not be correct. An IEEE-383 qualified cable may or may not meet the criteria for a “thermoset cable” as defined in NUREG/CR-6850. It is also possible that a non-IEEE-383 qualified cable actually meets the NUREG/CR-6850 criteria for a “thermoset” cable.

The staff requests the licensee provide substantiation for the exclusive use of the ZOI tables for “IEEE-383 Qualified Cable Target” in the Generic Fire Modeling Treatments. Further, the staff does not consider these two flame test standards (IPCEA S-19-81 and IEEE-383) alone, as qualifying criteria for the as installed cable critical damage temperature and self-ignition to be used in the Fire PRA. The staff requests the licensee provide the following information:

a. Characterize the installed thermoset and thermoplastic cabling in the power block specifically with regard to the critical damage threshold temperatures and critical heat flux as described in NUREG/CR-6850.

b. If thermoplastic cabling is present, discuss the additional targets created/identified using the lower critical temperature and/or heat flux criteria of NUREG/CR-6850.

c. If thermoplastic cabling is present, discuss impact on ZOI size due to increased HRR and fire propagation.

d. If thermoplastic cabling is present, discuss self-ignited cables and their impact to additional targets created.

e. If more targets are identified what would the impact be to core damage frequency (CDF) and large early release frequency (LERF), as well as ΔCDF and ΔLERF for those fire areas affected.

Fire Modeling RAI 3

NFPA 805, Section 2.7.3.2, “Verification and Validation,” states:

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

Section 4.5.1.2 of the Transition Report states that fire modeling was performed as part of the FPRA development (NFPA 805, Section 4.2.4.2). Details pertaining to the verification and validation of the fire models that were used are provided in Attachment J.

Regarding the verification and validation of fire models:

a. Describe how the empirical equations/correlations in the Generic Fire Modeling Treatments document and supplements were verified, (i.e., how was it ensured that the empirical equations/correlations were coded correctly).

b. Describe the verification and validation of the empirical equations and correlations identified in the supplements to the Generic Fire Modeling Treatments document and provide assurance that these equations/correlations were applied within their appropriate range of applicability.

Fire Modeling RAI 4

NFPA 805, Section 2.7.3.3, "Limitations of Use," states:

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

Section 4.5.1.2 of the Transition Report states that fire modeling was performed as part of the F PRA development (NFPA 805, Section 4.2.4.2). Details pertaining to the limitations of use of fire models are provided in Attachment J.

Identify uses of the Generic Fire Modeling Treatments outside the limits of applicability of the method and for those cases explain how the use of the Generic Fire Modeling Treatments approach was justified.

Fire Modeling RAI 5

NFPA 805, Section 2.7.3.4, "Qualification of Users," states:

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

Section 4.5.1.2 of the Transition Report states that fire modeling was performed as part of the F PRA development (NFPA 805, Section 4.2.4.2). This requires that qualified fire modeling and PRA personnel work together.

Regarding qualifications of users of engineering analyses and numerical models:

a. Describe what constitutes the appropriate qualifications for the staff and consulting engineers to use and apply the methods and fire modeling tools included in the engineering analyses and numerical models.

b. Describe the process/procedures for ensuring adequate qualification of the engineers/personnel performing the fire analyses and modeling activities.

c. Explain how the necessary communication and exchange of information between fire modeling analysts and PRA personnel was accomplished.

Fire Modeling RAI 6

NFPA 805, Section 2.7.3.5, “Uncertainty Analysis,” states:

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

The MCR abandonment fire modeling report and the Generic Fire Modeling Treatments document and supplements include a discussion of the sensitivity of the calculations to variations in the input parameter values.

Regarding the uncertainty analysis:

a. The staff requests an explanation regarding if and how the results of these sensitivity analyses were used in satisfying the requirements of NFPA 805 Section 2.7.3.5.

b. In cases where the results of the sensitivity analyses were not used for this purpose (see a. above), explain how the requirements of NFPA Section 2.7.3.5 were met.

c. If necessary, revise elements 6 and 7 in Section 1.3.1 of the FPRA Fire Scenario Report (Report No. 049308001.003, Rev. 2).

Safe Shutdown Analysis RAI 1

Incipient Detection - In LAR Attachment S, Table S-1, an incipient detection system is identified as a committed modification to 12 Control Room Panels.

a. Because of the various vendor types of incipient detection systems, provide a description of the incipient detection system being installed/considered. If the system has not yet been designed or installed, provide the specified design features for the proposed system along with a comparison of these specified design features to their role in satisfying or supporting the risk reduction features being credited in FAQ 08-0046. Include in this description the installation testing criteria to be met prior to operation.

b. Describe the physical separation of the cabinets in which incipient detection is being installed. Describe the process for estimating the conditional probability of damage to a set of target items as defined in Appendix L, Main Control Board Fires of NUREG/CR-6850. Justify any deviations from the methods described in NUREG/CR-6850.

c. Describe how each cabinet will be addressable by the detection system.

d. Provide the codes of record for the design/installation.

e. Based on the operator recognizing the impacted cabinet(s) fire location sufficiently early, describe what operator actions are necessary to limit fire impact and allow safe shutdown of the plant from the control room? Describe how will the operator be made aware of what must be done to remain in the control room for plant shutdown.

Safe Shutdown Analysis RAI 2

Table B-2 NEI 00-01 Revision 1 Alignment Basis - Regulatory Guide 1.205, “Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants, Revision 1, December 2009,” identifies NEI 00-01, Guidance for Post-Fire Safe Shutdown Circuit Analysis Revision 2, Chapter 3, as the guidance document to be used to ensure alignment with current NRC guidance for application of NFPA 805. LAR Table B-2 identifies a comparison with NEI 00-01 Revision 1.

Provide a gap analysis on the differences between the alignments using NEI 00-01, Revision 2, as the basis for transitioning, compared to NEI 00-01, Revision 1.

Safe Shutdown Analysis RAI 3

Instrument Tubing - The LAR instrument tubing guidance of NEI 00-01 Sections 3.2.1.2, 3.2.1.7, and 3.4.1.8 refers to referenced calculation NSCA-FPLDA013-PR-007 Revision 0 and R98-0001 Revision 3. The alignment basis for tubing failure indicates “Instrument tubing credited for safe shutdown indication and bi-stable actuation that could adversely affect safe shutdown at DAEC was identified and evaluated. Conclusions of the evaluation are incorporated into DAEC fire area compliance assessments”.

Provide the instrument tubing failure modes that were considered in the analysis. Describe what method(s) of plant review were conducted to determine that certain tubing materials would not be affected by fire?

Safe Shutdown Analysis RAI 4

Safe and Stable - LAR Section 4.2.1.2 describes the capability for achieving and maintaining safe and stable conditions and the licensing basis is to achieve and maintain hot shutdown (Mode 3) conditions. The licensee described "following stabilization at hot shutdown, a long term strategy for reactivity control, decay heat removal, and inventory/ pressure control would be determined based on the extent of equipment damage."

Provide a qualitative description of the risk impact(s) of any "long term actions" required to maintain safe and stable conditions including resource availability and the "routine" nature of the actions that may be required to maintain safe and stable (such as water inventory control and diesel fuel management).

Safe Shutdown Analysis RAI 5

Implementation Items - NEI 04-02, "Guidance for Implementing a Risk-informed, Performance Based Fire Protection Program Under 10 CFR 50.48(c)," Section 4.6 indicates that the LAR should contain a "discussion of the changes to Updated Final Safety Analysis Report (UFSAR) necessitated by the license amendment and a statement that the changes will be made in accordance with 10 CFR 50.71(e)." Figure 4-8 of the LAR indicates that a revised UFSAR will be developed as a post-transition document representing the revised license condition. However, there appears to be no implementation item to update the UFSAR, nor is there a description of the changes that need to be made to the current UFSAR.

Provide this description and indicate its implementation in Attachment S or justify why this is not necessary.

Safe Shutdown Analysis RAI 6

Non-Power Operations - Provide the following pertaining to non-power operations (NPO) discussions provided in Section 4.3 and Attachment D of the LAR:

a. LAR Section 4.3.2 states that incorporation of the recommendations from the Key Safety Functions (KSF) pinch point evaluations into appropriate plant procedures prior to implementation will be done to ensure the requirements of NFPA 805 are met.

   Identify and describe the changes to outage management procedures, risk management tools, and any other document resulting from incorporation of KSF identified as part of NFPA 805 transition. Include changes to any administrative procedures such as "Control of Combustibles".

b. LAR Section 4.3.2 states that for those components which had not previously been analyzed in support of the at-power analysis or whose functional requirements may have been different for the non-power analysis, cable selection was performed in accordance with approved project procedures.

Provide a list of the additional components and a list of those at-power components that have a different functional requirement for NPO. Describe the difference between the at-power safe shutdown function and the NPO function.

c. Provide a list of KSF pinch points by fire area that were identified in the NPO fire area reviews using FAQ 07-0040 guidance including a summary level identification of unavailable paths in each fire area. Describe how these locations will be identified to the plant staff for implementation.

d. During NPO modes, spurious actuation of valves can have a significant impact on the ability to maintain decay heat removal and inventory control.

   Provide a description of any actions, including pre-fire staging actions, being credited to minimize the impact of fire-induced spurious actuations on power operated valves (e.g., air operated valves (AOVs) and motor operated valves (MOVs)) during NPO (e.g., pre-fire rack-out, "pinning" valves, or isolation of air supply).

e. During normal outage evolutions certain NPO credited equipment will have to be removed from service.

   Describe the types of compensatory actions that will be used during such equipment down-time.

f. The description of the NPO review for the LAR does not identify locations where KSFs are achieved via recovery actions or for which instrumentation not already included in the at-power analysis is needed to support recovery actions required to maintain safe and stable conditions.

   Identify those recovery actions and instrumentation relied upon in NPO by physical analysis unit and describe how recovery action feasibility is evaluated. Include in the description whether these have been or will be factored into operator procedures supporting these actions.

Safe Shutdown Analysis RAI 7

LAR Attachment S, Table S-2, item #13, identifies the need to implement the results of the Non-Power Operational Modes Analysis. This description is very general, and will be difficult to ensure all aspects are completed prior to transition.

Provide a description of what those changes entail and where will they be incorporated.

Safe Shutdown Analysis RAI 8

LAR Table B-3, Fire Area CB1, under "Required Fire Protection Systems" states that fire brigade response "could be challenging" as the reason for requiring fire detection systems as "Defense-in-Depth". This phrase is used in numerous entries of numerous fire areas.

Clarify the meaning of "could be challenging" and identify the criteria for making this determination.

Safe Shutdown Analysis RAI 9

Recovery Actions - LAR Attachment G, Recovery Actions, (page G-5, Table G-1) identifies for fire area CB1, two recovery actions for the 1A Switchgear Room Air Supply and Exhaust Fans which are to block open doors and dampers and energize fans in the 1A4 switchgear room.

Identify the dampers and describe the process of blocking open fire dampers.

Radioactive Release RAI 1

For those compartments in LAR Attachment E – Radioactive Release Transition, that are identified as areas where gaseous radioactive effluents (caused by fire fighting activities - excluding the fire itself) would not be contained (areas without provision for radiation monitor detection capability with automatic closure to isolate the gaseous effluent), or where liquid effluents would be generated, provide a bounding analysis, qualitative analysis, quantitative analysis, or other analysis that demonstrates that the amount of radioactive effluent from the fire fighting activities will meet the gaseous effluent dose rate limits and the liquid effluent concentration limits specified in the plant's Technical Specifications (TS).

a. If a qualitative analysis is being performed, provide information on:

    i. Type of fire most likely to occur in that fire area (e.g., electrical, transient combustibles, fuel)

    ii. Type and amount of radioactive contamination in the fire area (e.g., particulate, gas, iodine)

    iii. Type of fire suppression (e.g., water, foam, halon , CO2)

    iv. Duration of anticipated fire fighting activities

    v. Anticipated amount of water to be generated

    vi. Capability of sumps and tanks to contain the estimated amount of water to be generated

    vii. Potential use of smoke educators and the impact of the exhaust as a new release path to the environment

b. For a bounding analyses or a quantitative analysis, estimate the effluent concentrations discharged to the unrestricted area and demonstrate the doses rate limits of the TS are met.

Radioactive Release RAI 2

Liquid Effluents - For those areas where containment is not specifically engineered (e.g., concrete floors, walls, sumps, tanks), describe other methods in the fire pre-plans that are used to provide containment (e.g., spill control kits, temporary dikes, storm drain covers, settling ponds etc.).

Radioactive Release RAI 3

For those compartments in LAR Attachment E – Radioactive Release Transition, that make a conclusion that the radioactive release will not exceed the limits of NFPA 805, provide justification as to how the release will also not exceed the instantaneous release rate limits in the plant's TS (reference FAQ-09-0056).

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
DUANE ARNOLD ENERGY CENTER
(TAC NO. ME6818)

Office of Nuclear Reactor Regulation
Division of Risk Assessment
PRA Licensing Branch

Probabilistic Risk Assessment RAI 1

Numerous Facts and Observations (F&Os) (5-1, 5-2, 5-3, 5-4, 5-5, 5-6 and 5-15) discuss the lack of documentation of the review of cutsets and other outputs of the Fire Probabilistic Risk Analysis (FPRA) model to provide assurance that the FPRA logic model is accurate and producing the intended results. The dispositions for these F&Os state that Sections 5.2 and 5.3 of the Fire Quantification Report have been updated to document these reviews. During the audit, the licensee informed the staff that two non-logical cutsets had been discovered in the top core damage frequency (CDF) cutsets and that their elimination (along with other similar cutsets) would result in a significant reduction in both total core damage frequency (CDF) and large early release frequency (LERF). It was stated that these erroneous cutsets occurred as the unintended consequence of a logic transfer in the FPRA. Address the following:

a. Provide further information on this issue and its cause.

b. Review the license amendment request (LAR) submittal and provide updated LAR information impacted or changed by the corrected FPRA model. Discuss what had changed in the model to result in the revised LAR information.

c. Address the broader implication of this discovery in terms of quality of the review of FPRA results and steps taken, such as new reviews of important and non-important cutsets, sequences and other results, to provide assurance that other similar errors do not exist in the current model.

d. Confirm that RAI responses which utilize the FPRA model used the corrected model.

Probabilistic Risk Assessment RAI 2

Confirm that FPRA modeling changes, cable selection analyses, and evaluations which were not complete at the time of the June 1010, FPRA peer review (e.g., F&Os 2-9, 2-3, 2-7, 2-8, 4-17, 5-28), were completed for the LAR FPRA model. In addition, confirm that the final results reported in the LAR are based on a FPRA that is built upon the internal events models that was reviewed in March 2011 including the resolution of the internal events F&Os reported in Appendix U. Insofar as not clarified in the PRA timeline requested in another RAI, provide a summary of how the results of the 2011 internal events review were incorporated into the FPRA that was reviewed in 2010.

Probabilistic Risk Assessment RAI 3

Provide a comprehensive timeline showing the development of the full power internal events (FPIE) PRA and the FPRA for the NFPA 805 application, including the PRA model versions and reviews.

Probabilistic Risk Assessment RAI 4

F&O 4-34. Describe the process for dividing up the transient frequency within physical analysis units (PAUs). Discuss the use of the area weighting factor in evaluating the importance of transients to a PAU. Define localized transients and describe how the area weighting factors were applied to both generalized and localized transients. Clarify if the area weighting factor was applied to incorporate the entire length of cable trays and any other targets not limited to a single location and, if not, provide justification for not doing so. Also clarify the use of 100 square feet as an area factor and its application to only localized transients.

Probabilistic Risk Assessment RAI 5

F&O 3-7. For multi-element rated barriers, the probability of failure used in the multi-compartment analysis (MCA) was for the most bounding element in the barrier. Provide revised total/delta risk estimates that include all elements (see Table 11-3 of NUREG/CR-6850) providing pathways from one compartment to another or a justification that including the failure probability of all elements will not significantly impact the results.

Probabilistic Risk Assessment RAI 6

F&O 3-10. For PAU 02E and 02B, Table C-4 of the MCA justifies screening of PAU 02E and 02B by stating that "App N of NUREG/CR-6850 indicates only 1 (~1%) event caused structural damage beyond blowing doors open." Explain how this statement can be derived from Appendix N and, based on this derivation, provide further justification for screening this scenario.

Probabilistic Risk Assessment RAI 7

The MCA for diesel generator (DG) room fires (e.g., Exposing PAU 08H to Exposed PAU 08D) in Table C-4 of the Fire Scenario Report used a Severity Factor (SF) of 0.01 based on a review of the Fire Events Database (FEDB) which indicates that no DG fires damaged equipment beyond the DG room (0.5/49.5 = 0.01). This SF was applied to a calculated CDF that already credited a Type 1 barrier (3 hour door) having a NUREG/CR-6850 recommended failure probability of 7.4E-03 (from Table C-3 of the Fire Scenario Report). Application of this SF in these scenarios appears to be double-counting credit already given for the barrier failure probability. Provide revised total/delta risk results in which the SF of 0.01 is removed for those scenarios where this double-counting is applied. Describe the revised analysis and assumptions for these scenarios and, if applicable, provide justification for the use of change in risk results based on a SF/NSP less than one and/or subsequent qualitative screening.

Fire Probabilistic Assessment RAI 8

The results of the MCA were not included in the quantified CDF and LERF reported in the LAR. Provide revised total/delta CDF/LERF results by incorporating the MCA results consistent with the quantification as required by Supporting Requirement (SR) FSS-G6 Capability Category (CC)-II/III.

Fire Probabilistic Assessment RAI 9

F&O 3-8 stated that an assessment of the effectiveness, reliability, and availability of credited passive fire barriers was not performed. The response states that the, "[f]ire protection program provides the assessment." Clarify how the fire protection program assess the effectiveness, reliability, and availability of credited passive fire barriers.

Probabilistic Risk Assessment RAI 10

F&O 4-35. SR FSS-D7, regarding credited fire suppression systems, has three elements that must be addressed for CC-II. Relative to these elements, address the following:

a. Confirm that 1) the credited systems are installed and maintained in accordance with applicable codes and standards and 2) the credited systems are in a fully operable state during plant operation or provide justification why such confirmation is not necessary.

b. Provide a discussion of the basis for your statement that "DAEC have not experienced outlier behavior in the past."

Probabilistic Risk Assessment RAI 11

F&O 2-14. For postulated oil fires in the Turbine Building that result in damage to structural integrity address the following:

a. Section 5.1.8.4 and Appendix A of the Fire Scenario Report (FSR) are inconsistent in how the Turbine Building catastrophic fire analysis (i.e., scenario TBO01) is described. Clarify the assumptions and results for this analysis.

b. This evaluation to satisfy SR FSS-F1 means that SR FSS-F3 is now applicable. Accordingly, update the self-rating for this SR in LAR Table V-1, "DAEC Fire PRA Quality Summary," or provide justification for why SR FSS-F1 and F3 are not applicable to DAEC. If the self-rating is CC-I, provide justification for why CC-I is adequate for the NFPA 805 LAR.

Probabilistic Risk Assessment RAI 12

It was recently stated at the industry fire forum that the Phenomena Identification and Ranking Table (PIRT) Panel being conducted for the circuit failure tests from the DESIREE-FIRE tests may be eliminating the credit for Control Power Transformer (CPT) (about a factor 2 reduction) currently allowed by Tables 10-1 and 10-3 of NUREG/CR-6850 when estimating alternating current (AC) circuit failure probabilities. Provide a sensitivity analysis that removes this CPT credit from the PRA and provide new results that show the impact of this potential change for CDF, LERF, Δ CDF, and Δ LERF.

Probabilistic Risk Assessment RAI 13

a. F&O 6-3. Table 2.2-2 of the "Plant Partitioning and Fire Ignition Frequency Development" report identifies credited spatial separation areas and provides justification based on hot gas layer (HGL) formation and postulated combustibles. Expand the justification to address all of the criteria in Section 1.5.2 of NUREG/CR-6850, including the potential presence of ignition sources and the potential for damage or fire spread from flame height and plume effects.

b. F&O 6-4. Section 2.2 of the "Plant Partitioning and Fire Ignition Frequency Development" report states that non-rated walls, ceilings, and floors were credited for several PAUs. Describe the evaluation used to justify the use of partitioning elements lacking fire resentence rating.

Probabilistic Risk Assessment RAI 14

F&O 2-20 and 5-29 appear to identify the following two deviations from NUREG/CR-6850 that have been applied in the cable spreading room (CSR). Provide a sensitivity analysis for the CSR that applies the guidance in NUREG/CR-6850 with no deviations.

a. The analysis of the CSR applied a hot work pre-initiator factor of 0.01, which is an Unreviewed Analysis Method (UAM) or deviation from NUREG/CR-6850.

b. The LAR Supplement apportions transient fire frequency in the CSR using a "Very Low" transient fire influencing factor for maintenance which is a deviation from NUREG/CR-6850.

Probabilistic Risk Assessment RAI 15

F&O 4-21. Section 5.2.1 of the FSR explains that the main control room (MCR) non-abandonment analysis credited an internal fire barrier or single metal wall (separating redundant divisions) for electrical cabinets 1C06, 1C08, and 1C31 (essentially treating each of these cabinets as two different panels). The analysis assumed that a fire in one panel would not result in damage to components in the adjacent panel until 10 minutes after the peak heat release rate (HRR). This assumption is non-conservative since the 10 minutes is the guidance in Appendix S of NUREG/CR-6850 for damage to sensitive electronics when such equipment is protected from a cabinet fire with double walls with an air gap. Provide an estimate of the change in risk results either assuming no credit for the single metal wall, or justify any time delay that was used based on crediting the single metal wall.

Probabilistic Risk Assessment RAI 16

Table 3.3-1 of the Fire Model Development Report describes the cues for operator action "D250DCENOPCB4023HE" as 1) loss of DC power on indicating lights and 2) reactor pressure vessel (RPV) level given high pressure core injection (HPCI) fail to start. Regarding this operator action address the following:

a. F&O 5-37. The second cue was added in response to the peer review finding on the first cue that it was inadequate since it would only occur when the batteries are depleted. Regarding the "RPV level given loss of HPCI" cue, explain the timing for the human

failure event (HFE), describe how the operator knows to respond appropriately to this cue, and clarify why this cue is adequate for this operator action.

b. F&O 5-38. Clarify how the "RPV level given loss of HPCI" cue addresses the peer review finding that the four hour timeline plus the additional10 minutes access delay (for ex-control room actions) is inadequate for station blackout (SBO) and loss of offsite power (LOOP) sequences when the battery charger is not available.

Probabilistic Risk Assessment RAI 17

F&Os 5-39 and 5-42. The resolutions to these F&Os do not completely address the peer review finding to assign dependency levels for recoveries of both cognitive and execution errors no lower than the minimum recommended by the Human Reliability Analysis (HRA) Calculator. Provide a description of the dependency analysis and how dependency values were established. If necessary provide justification for using dependency levels lower than the minimum recommended by the HRA Calculator.

Probabilistic Risk Assessment RAI 18

F&O HR-C1-01A. It was concluded that the impact of evaluating pre-initiators at the system level instead of the train level was judged to have little or no impact on the results of the LAR. However, fire often consequentially fails one train, increasing the sensitivity of the results on the remaining train's availability. Provide an assessment of the impact of using train level unavailability where ever system level values are currently used on the total/delta risk estimates developed for the LAR. It is noted that draft NUREG-1921, "EPRI/NRC-RES Fire Human Reliability Analysis Guidelines", dated November 2009, states that existing internal events PRA pre-initiators do not need to be re-analyzed for the fire PRA. However, this presumes there are no unresolved F&Os on the issue. Appropriate resolution of this internal event PRA F&O is relevant to the NFPA 805 application since use of the system level HFE values could yield non-conservative results.

Probabilistic Risk Assessment RAI 19

According to discussions during the audit, there are procedures for a fire in the CSR that leads to Control Room (CR) evacuation upon equipment damage leading to loss of control from the CR. However, it was stated that CR evacuation from loss of control was not modeled in the fire PRA. There may be other fires outside of the CR that lead to CR evacuation because of loss of control or loss of habitability.

a. Is CR evacuation from loss of control modeled in the FPRA. If not, why not?

b. Clarify if fire scenarios initiated outside the MCR that may impact habitability in the CR were considered. If not, why not?

c. Identify any deviation from the guidance in NUREG/CR-6850 CR evacuation following both loss of control room function and loss of habitability.

Probabilistic Risk Assessment RAI 20

No transient combustible was postulated in the corner of the Division 2 CSR which contains Division 1 and Division 2 equipment cabling. It is recognized that access to that portion of the room is difficult, however the consequences of a fire in this location may be severe. Provide a discussion of the analysis, assumptions, and risk (ignition frequency and conditional core damage probability (CCDP) and conditional large early release probability (CLERP) of a fire in this location).

Probabilistic Risk Assessment RAI 21

According to the disposition of F&O 4-32, an unreviewed method using a severity factor of 0.08 was removed for transient fire scenarios. Is this evaluation now consistent with NUREG/CR-6850? If not, but, instead, another alternate approach or factor was used, describe that approach. If there remains a deviation from NUREG/CR-6850, perform a sensitivity study using NUREG/CR-6850 or NRC-endorsed frequently asked questions (FAQs).

Probabilistic Risk Assessment RAI 22

With respect to F&Os 3-4 and 4-43 concerning the screening of fire events, fire event action request (AR) number 00306845 was listed as a non-potentially challenging fire for purposes of the update of the generic fire frequency. This fire occurred near the exhaust line by the turbocharger associated with the emergency diesel generator (EDG). Lube oil was absorbed by the insulation and, according to the report, 60 to 80 % of the over piston oil leaked past the gasket onto the floor of the room with a good probability. According to plant personnel, a few gallons of oil could have leaked on the floor. The report also states that the fire was of sufficient size to consume the lube oil absorbed by the insulation. The AR report describes an operator extinguishing the fire with water mist, but later states the fire self-extinguished. The following additional information is necessary to understand the screening of this event as non-challenging (in the response to each, be clear with respect to whether the factors are being judged solely on the basis of the event description in the AR Report, from other records, or discussions with personnel familiar with the event):

a. Provide a specific discussion of this event relative to the NUREG/CR-6850 criteria for potentially challenging and undetermined events to determine if this fire should be counted in the Bayesian update from DAEC experience. In this regard, describe whether this fire caused damage to equipment or cables in the EDG room, ignited secondary combustibles, or affected the function of the EDG. Also, indicate if any fixed suppression system was actuated as a result of this fire, or if the fire brigade contributed to the suppression of the fire. Also, indicate if more than one portable extinguisher was used to extinguish the fire. In summary, this analysis should address the objective classification criteria identified in Section C.3.3 of NUREG/CR-6850.

b. To support the more subjective criteria of Section C.3.3., further assessment should be done. Provide confirmation regarding the amount of oil that could have leaked on the floor. Also, to determine if such a fire would be extinguished regularly, indicate if this event could have occurred during a normal automatic start and load of the generator when an operator may not be present to immediately extinguish the fire. Indicate whether this operator is trained in the use of a fire extinguisher and describe his/her other duties besides monitoring the situation for a fire. In summary, the ability to

regularly extinguish a fire of the type cited in the event is important to establishing whether the fire is potentially challenging.

Furthermore, NUREG/CR-6850 credits prompt suppression by plant personnel via the fire suppression curves which include short duration fires such as this event. Except for cases involving a designated fire watch, fire duration was not a factor in determining whether or not an event was potentially challenging. Hence, if such a fire could have occurred without the presence of an operator trained in the use of a fire extinguisher (i.e., having equivalent qualifications to a fire watch) and having no significant distractions from identifying and extinguishing the fire, describe the potential extent of fire propagation or damage in the absence of the operator (no prompt suppression). Indicate if the oil pool described in the incident report could have caught fire, and potential damage and fire fighting and systems response under those conditions. It should be noted that a fire would not be potentially challenging if it can be established that the fire would not have propagated beyond the EDG or caused substantial damage to the EDG (e.g., prevents the EDG from operating) in the absence of an operator. If the fire could have caused substantial damage to the EDG, become more involved through igniting the oil pool, or propagated beyond the EDG through some other means, this fire would have been potentially challenging.

c. Provide an evaluation of each of the other EDG fires which occurred during the period of the Bayesian update in light of the considerations discussed above, and characterize each as either potentially challenging, not challenging, or undetermined. Clarify that those characterized as potentially challenging or undetermined were appropriately included in the update.

Probabilistic Risk Assessment RAI 23

According to Table V-1 of the LAR, F&O FSS-C8 on raceway fire wraps is listed as “NA” by the peer review and DAEC. Provide justification that this supporting requirement is not applicable to the fire PRA. Identify if any variance from deterministic requirement (VFDRs) in the LAR involved performance-based evaluations of wrapped or embedded cables. If applicable, describe how wrapped or embedded cables were modeled in the Fire PRA including assumptions and insights on how the PRA modeling of these cables contributes to the VFDR delta-risk evaluations.

Probabilistic Risk Assessment RAI 24

F&O 1-7 concerned the counting of fixed ignition sources for determining the fire ignition frequency (FIF) and noted several potential discrepancies between the PAU ignition source data sheet (ISDS) and items observed in the peer review walkdown. The disposition refers to PI 07-06, in addition to NUREG/CR-6850 and FAQ 06-0016, as the basis for screening various items when counting fixed ignition sources. This document includes in Section 2.3.2.2 the instruction that all motor operated valves (MOVs) and all transformer rates less than 45 kVA are non-countable items. FAQ 07-0031 Section 6.2.1 provides limitations on the exclusion of MOVs while Section 6.2.3 provides limitations on the exclusion of transformers that are not reflected in PI 07-006. Provide a comparison of the criteria for inclusion or exclusion of various fixed ignition sources with the criteria in NUREG/CR-6850 and approved FAQs and justify any differences.

Probabilistic Risk Assessment RAI 25

F&O 4-16 concerns the apparent lack of modeling the fire induced opening of all 6 safety relief valves (SRVs) and that this scenario can be more limiting than 2 SRVs or atmospheric depressurization system (ADS), due to the thermal transient that results and this could result in a change to the success criteria, accident sequences, etc. that are presently modeled in the FPRA. The disposition states that spurious opening of all SRVs treatment is consistent with the FPIE PRA. As discussed during the audit, the opening of multiple SRVs (up to 4 for spurious ADS) are all modeled in the FPIE PRA as large steamline failures in containment. It was also stated during the audit that the worst case fire induced multiple-spurious operation (MSO) would lead to spurious opening of 5 SRVs. Document the maximum number of SRVs open due to MSO and provide a justification that the opening of this number of SRVs does not change the success criteria.

Probabilistic Risk Assessment RAI 26

F&O 5-16 states that the sources of LERF model uncertainty and related assumptions have not been identified or documented. The disposition states that "[t]he quantification and summary report is updated to document the sources of LERF model uncertainty and assumptions." The resolution refers to two internal documents: DEAC-PSA-L2-15 and DAEC-PSA-QU-14. Provide a summary of the methodology used and the identified sources of LERF model uncertainty and assumptions described in these reports.

Probabilistic Risk Assessment RAI 27

In response to F&Os 1-5, 2-12, 4-14, 4-28, 5-18 and 5-36 a discussion of uncertainty and assumptions for the technical elements was added to each of the FPRA development documents. These are generally large lists of issues of a range of importance. Provide a consolidated discussion of the key uncertainties and assumptions for this application. Include those important for the CDF and LERF baseline model, and any sensitivity analyses performed for them.

Probabilistic Risk Assessment RAI 28

Finding SY-C2-02 (SR SY-C2) of the focused peer review of the internal events PRA notes the lack of evidence that the system level cutsets were reviewed to validate the completeness and accuracy of the system models. The F&O states that based on DAEC discussions the cut sets were reviewed but the review was not documented. The disposition states that, "[g]iven the conservatism of the Fire PRA model and the reviews performed in the process of developing the Fire PRA model, the system cutset review is not expected to identify modeling issues that would impact this LAR submittal." A general reference to conservative models does not resolve the issue. Provide confirmation that the system level cutsets were reviewed and provide a summary of the review of the system models performed in the process of developing the FPRA.

Probabilistic Risk Assessment RAI 29

Finding DA-D4-01A (SR DA-D4) of the focused peer review of the internal events PRA concerns the lack of a discussion of reasonableness of posterior distributions. While the disposition indicates there will be an enhancement to documentation, no assurance is provided that unreasonable distributions do not adversely impact the results used for the LAR. A review of

the FPIE data notebook during the audit identified 5 component types (ARCR FR, ARCR FS, AS1K FR, DFCV FC, and DFCV FO including the 1 identified in the finding) where the posterior distributions differ significantly from the prior distributions. Capability Category II for SR DA-D4 requires a check that the posterior distribution is reasonable given the weight of evidence provided by the prior and the plant specific data. Provide an assessment about the potential impact of differences in these distributions on the change in risk results used to support the submittal. If the change in risk could be significant, provide an assessment of the reasonableness of the plant specific data distributions and the impact on FPRA results for any structure, system, and component (SSC) where the posterior distributions are found unreasonable.

Probabilistic Risk Assessment RAI 30

The fire transition LAR utilizes a number of probabilistic computer codes in performing the risk assessment. Different codes were used for different purposes and the results sometime vary where they would be expected to agree. For total CDF and LERF the result on page W-4 of Attachment W of the LAR indicate that FRANC gives the highest value compared to XINITS. The benchmarking of XINITS in Appendix K of the Fire Risk Quantification Report indicates that the CCDP and CLERP for XINITS are higher than XINITS results on a scenario by scenario basis in Appendices L and M of the Fire Risk Quantification Report indicates that XINITS may give higher results for one scenario while FRANC may give higher results for another scenario. Provide a discussion of these differences in results, their cause and the impact of the differences on the FPRA results relative to the risk measures used for the NFPA 805 transition. Provide a discussion of the limitations of the software and their use and the use of the results from them. Clarify which software results were presented in the LAR for transition to NFPA 805, and which software is (are) planned to be used post-transition.

Probabilistic Risk Assessment RAI 31

F&O 1-1 cites Appendix G of the Fire Model Development Report for the disposition of MSOs. For several MSOs (4b thru 4e) the resolution given is that containment overpressure was removed from the SSA and not required for the PRA. During the audit this was described as not requiring containment overpressure to insure that emergency core cooling system (ECCS) pumps taking suction from the torus had adequate net positive suction head (NPSH). Further it was stated that the internal events PRA did not take credit for the ECCS pumps for situations where containment over pressure is lost such as after containment venting. Provide a discussion of this inconsistency between the safe shutdown analysis (SSA) and the PRA and the potential impact on the results of the FPRA used for the transition. Also, describe the meaning of N/A in this appendix and the basis for it.

Probabilistic Risk Assessment RAI 32

Attachment G of the Fire Scenario Report identifies a recovery action (RA) to locally close cross-tie manual valve, V19-0048. The discussion in Section 6.2 of the Fire Quantification Report (p. 84/491) states that the cross-tie manual valve, V19-0048, is closed to isolate spuriously operating valves that could result in flow diversion and while this action (to close the valve) would prevent use of the cross tie which is credited in the PRA, it is not considered an adverse action as it would isolate flow diversion. Table E-3 of the FSR states that MO-2010 (a valve that also isolates the cross-tie line) is assumed closed in the FPRA for fire areas RB1 and RB3 so as to not credit the cross-tie. Discuss further the modeling associated with this cross-

tie, its being credited or not in the FPRA, and how the operator closing the manual valve does not adversely impact the sequences where credit is taken for the cross-tie.

Probabilistic Risk Assessment RAI 33

F&O 4-12 concerns the impact of fire on the Level 2 model. The disposition states that events in the Level 2 model are generally conditional events, phenomenon events, and long term human actions and that none of these events would be considered impacted by a fire as discussed in the review. Provide the definition of "long term" and the basis for saying that long term human actions would not be impacted by a fire considering, in particular, the loss of instrumentation that might occur.

Probabilistic Risk Assessment RAI 34

F&O 4-7 states that the logic under gate HPCI-MSL-FLD appears to be incorrect, as developed, both a HPCI valve failure and Level 8 Failure are required and even if level 8 occurs, the valve failure can result in overfeed continuing. The disposition states that the logic has been corrected and the requirement for Level 8 failure removed. A review of the fire PRA Computer Aided Fault Tree Analysis (CAFTA) model during the audit showed that this gate did not include a valve failure but did include other failures that are expected to be less important than a valve failure. Explain this modeling and its relevance to the FPRA. Also, explain the correction and the technical basis for it.

Probabilistic Risk Assessment RAI 35

Section 6 of the Fire Quantification Report describes the development and application of a 0.02 failure probability for incipient detection in modeling several CR panels based on guidance in FAQ 08-0046. The methodology in FAQ 08-0046 was developed for implementing incipient detection in electrical cabinets in rooms that are not constantly manned, contrary to the CR. Provide justification for the risk reduction credit obtained from implementing incipient detection. Discuss any deviations in the incipient detection risk analysis from NUREG/CR-6850 or the FAQ.

Probabilistic Risk Assessment RAI 36

Confirm that the potential impact on the FPRA results of (a) all known outstanding plant changes that would require a change to the FPRA model and (b) all planned plant changes that would significantly impact the FPRA model are included in the change-in-risk results.

Probabilistic Risk Assessment RAI 37

FPIE finding DA-C10-01A (SR DA-C10) indicates that no evidence of failure mode information is provided. The DAEC disposition states that every basic event is coded to identify that it is tested and that this implicitly implies that the testing procedures have been reviewed to determine that the test covers the failure mode. Provide the following:

a. Discuss where this coding is documented and how this indicates that the review of test procedures to verify the failure mode is properly tested.

b. It is noted that for two important component failure types (a circuit breaker fails to open or close and an air operated valve fails to open or close) the data notebook gives the

same number of demands for the normally open fail to close and the normally closed fail to open failure modes. Verify that the testing program (procedures, practices and plant population) for these components gives the same number of demands regardless of failure mode and that this determination meets the standard or other guidance requirements.

Probabilistic Risk Assessment RAI 38

F&O 2-6 noted that the Revision 6 FPIE model used for the FPRA model had not been approved and that there were draft system notebooks that had a section for fire impact that needed updating. While two FPIE system notebooks reviewed were approved, a third one (HPCI notebook, DAEC-PSA-SY-05.05, Rev. 3) had not been approved. Confirm that the FPIE model on which the FPRA is based and the supporting documentation was fully approved.

Probabilistic Risk Assessment RAI 39

The resolution to F&O 5-41 does not completely address the peer review finding to use upper bound cognitive error probabilities, rather than nominal or lower bound, where appropriate. Describe how the FPRA HRA results were reanalyzed for appropriateness and the results of this review. Specifically discuss whether human error probability (HEP) values were changed as a result of this review, including whether upper bound HEPs were used.

Probabilistic Risk Assessment RAI 40

Clarify if protective relaying cables 1X3 and 1X4 were considered in multi-compartment analyses for the FPRA. If not, discuss why not.

Probabilistic Risk Assessment RAI 41

Describe how the failure of fire dampers, including potential smoke propagation, were considered in the FPRA and the Fire Risk Evaluations for multicompartment analyses involving risk-significant fire areas.

Probabilistic Risk Assessment RAI 42

Clarify if anticipated transient without scram (ATWS) sequences were screened out or not in the FPRA. Provide justification for doing so if ATWS sequences were screened out.

Probabilistic Risk Assessment RAI 43

The LAR Table W-1, “DAEC Fire PRA CDF Significant Fire Initiating Events (Individually Representing > 1% of the Calculated CDF),” describes fire scenarios involving failure of HPCI and reactor core isolation cooling (RCIC). Respond to the following:

a. Why are the HPCI and RCIC systems both failed in these fire scenarios? Is the ability to depressurize the reactor modeled for these fire scenarios, including dependencies on DC power and operator actions?

b. Are both systems failed by the same fire(s)? If so, is it (are they) associated with VFDR(s)?

c. Were operator actions, recovery actions (RAs), or other actions to address risk, defense-in-depth, or safety margins, considered or modeled for these fire scenarios? For the corresponding fire areas, Table B-3 states that Fire Risk Evaluations determined no further action was determined to be necessary. Discuss the rationale for this conclusion.

Probabilistic Risk Assessment RAI 44

F&O 3-9 for SR FSS-D6 is related to a transient heat release rate approach, and the disposition of this F&O is noted to be deferred. This approach is also identified as an unreviewed analysis method in Attachment V of the LAR. In response to a staff request for clarification on this method, sensitivity analysis results were documented in the letter from Peter Wells, NextEra Energy Duane Arnold, LLC, to the U.S. Nuclear Regulatory Commission, "Clarification of Information Contained in License Amendment Request (TSCR-128): Transition to 10 CFR 50.48(c) - NFPA 805 Performance-Based Standard for Fire Protection for Light Water Reactor Generating Plants (2001 Edition) (TSCR-128) ," dated October 14, 2011, (ML1128702452). With respect to the delta risk calculations referred to in response to the question, it was noted that there was no impact on delta-risk for many fire areas since the increased risk contribution influenced both the variant and compliant case. Explain this statement.

Probabilistic Risk Assessment RAI 45

For Finding HR-A1-01A and HR-A2-02A in Attachment U of the LAR, clarify the identified deviation from the standard, and specify which standard was deviated from. Clarify what is meant by "the approached used" noted in the dispositions.

Probabilistic Risk Assessment RAI 46

F&O 2-15 states that the FPRA HRA does not consider the operator access route and therefore the impact of timing for ex-control room operator actions in response to a fire event. Explain how this was addressed for operator actions and/or RAs in the FPRA.

Probabilistic Risk Assessment RAI 47

According to the Fire Model Development Report, some equipment in the FPRA is credited by exclusion in cases when cables could not be traced, and includes systems and signals which are containment-related. Discuss the extent (e.g., in terms of fire zones) that these containment-related systems and signals are credited by exclusion in the FPRA. For fire scenarios which involve potential impact on these containment-related systems and signals, describe what failure modes were considered when using credit for exclusion for containment isolation valves (CIVs), e.g., multiple spurious operation and containment isolation signals including low reactor pressure vessel water level or high drywell pressure.

Probabilistic Risk Assessment RAI 48

Monitoring suppression pool level is mentioned in the LAR section "Process Monitoring" for alternate shutdown capability instrumentation, but is not listed in the Final Safety Analysis Report (FSAR) section 7.4, "Systems Required for Safe Shutdown," as being required for safe shutdown. Is process monitoring of suppression pool level necessary for the alternate shutdown capability? If so, is suppression pool level monitoring modeled in the Fire PRA?

Probabilistic Risk Assessment RAI 49

The following FAQs were not included in Table H-1, "NEI 04-02 FAQs Utilized in the LAR Submittal": FAQ 08-0047, Spurious Operation Probability, and FAQ 08-0048, Fire Ignition Frequency. Discuss the guidance and methodology used in the LAR submittal in place of these FAQs.

Probabilistic Risk Assessment RAI 50

As shown in Table W-3, explain why the Δ LERF is greater than the Δ CDF for Fire Area CB3.

Probabilistic Risk Assessment RAI 51

Table S-1, "Plant Modifications Committed" of the LAR identifies a modification to pump circuitry to correct a VFDR to result in a deterministically compliant condition and to assist in a reduction in cumulative Δ LERF to support meeting Regulatory Guide (R.G.) 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis, Revision 1, November 2002", criteria. Address the following for this modification:

a. The entry in Table S1 states that this modification will "assist in a reduction in cumulative Δ LERF to support meeting R.G. 1.174 criteria." Explain what this means.

b. Correcting the FPRA model error discussed during the NRC audit could change the results. Re-evaluate the reduction in LERF as a result of the modification for the applicable fire area, the reduction of cumulative Δ LERF, and the cumulative Δ CDF.

c. For the FPRA developed for this modification, confirm that the evaluations were done using peer reviewed methods for the FPRA and the supporting FPIE PRA.

d. Verify that fire(s) relevant to the modification, for the associated fire area noted in Table S-1, do not result in a scenario that should deterministically assume the loss of offsite power. Explain whether or not the conditional probability of loss of offsite power given a plant trip is included in the probabilistic evaluations. If not, why not?

Probabilistic Risk Assessment RAI 52

Confirm or clarify that the RAs identified in the LAR are new and are not previously approved RAs.

Probabilistic Risk Assessment RAI 53

Some VFDRs in fire area CB1 are the same or similar to those in other fire areas, yet no RA is assigned to them. Some examples are VFDR-SSA—CB1-12 and VFDR-SSA-RB1-03 in fire area RB1, as well as VFDR-SSA-CB11 and VFDR-SSA-RB1-04 in fire area RB1. Explain why RAs are not assigned to such VFDRs in fire areas other than CB1.

Probabilistic Risk Assessment RAI 54

Attachment G of the LAR, "Recovery Actions Transition," Table G-1, "Recovery Actions and Activities Occurring at the Primary Control Station(s)," identifies six RAs. For these RAs:

a. Explain why there are RAs identified with the 1A4 switchgear in the LAR, but not with the 1A3 switchgear.

b. The RA for "B EDG" states "If Bus 1A4 is de-energized, Then start diesel generator 1G21 locally …. " Explain why the diesel generator does not start automatically if bus 1A4 is de-energized.

Probabilistic Risk Assessment RAI 55

In Attachment W of the LAR, the discussion under "Recovery Actions" notes that an HRA was performed for RAs required in the short term. Clarify what is "short term" and why an HRA is not needed for actions required after "short term." Clarify whether this refers to only fire scenarios involving main control room abandonment and how it relates to the RAs provided in Table G-1.

Probabilistic Risk Assessment RAI 56

Clarify if the operator actions occurring at the primary control stations given in LAR Table G-1 are modeled in the FPRA.

Probabilistic Risk Assessment RAI 57

F&Os 4-12 and 4-15 contain specific peer review comments which do not appear to have been addressed or their evaluation documented. The dispositions of these F&Os mention that the Fire Model Development (FMD) report was updated to include a detailed LERF model review; however, very little technical justification was provided in the FMD report. The document PSA-L2-15, Appendix C, contains a discussion of the Level 2 modeling. The discussion in Appendix C does not appear to have been updated for fire-related impacts, but appears to be related to Internal Events PRA random failures. Address all the specific comments from the peer review for these F&Os and provide detailed technical justification for the conclusions in the disposition of these F&Os. Include a discussion on how Appendix C of PSA-L2-15 is impacted by fire scenarios.

Probabilistic Risk Assessment RAI 58

Describe the administrative controls and processes for maintaining the FPRA quality for the NFPA 805 application, including updates based on changes to the Internal Events PRA. Describe your schedule with respect to NFPA 805 transition and post-transition to align and to continue to update the alignment of the Internal Events PRA with the FPRA used to support the LAR.

Probabilistic Risk Assessment RAI 59

The licensee procedure for Fire Risk Evaluations provides guidance for transition to NFPA 805 for evaluating variations from deterministic requirements. Provide a discussion of your procedure(s)/process(es) for plant change evaluations post-transition. Include a discussion on how post-transition guidance for plant change evaluations addresses key uncertainties, assumptions, sensitivity analyses, and peer review F&Os (e.g., unaddressed F&Os).

Probabilistic Risk Assessment RAI 60

Summarize how a Fire Risk Evaluation PRA analysis is preformed for a VFDR, including how operator actions are, or are not, included. Are all retained VFDR's modeled in the PRA? If not, explain the guidelines used to decide not to model individual VFDRs in the PRA. If an individual VFDR does not receive a delta-risk quantification per your fire risk evaluation procedure, explain how is it treated in the Fire Risk Evaluation of the fire area.

Probabilistic Risk Assessment RAI 61

As indicated by F&O 4-42, as the PRA model evolved HFEs may have been added and the HRA dependency analysis needs to consider all of the multiple HFEs that appear in the final model. Confirm that the dependency analysis appropriately considered all of the final models' multiple HFEs.