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
FORT CALHOUN STATION, UNIT 1
(TAC NO. ME7244)

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

Fire Modeling RAI 01

National Fire Protection Association Standard 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," 2001 Edition, (NFPA 805), Section 2.4.3.3, states: "The PSA approach, methods, and data shall be acceptable to the AHJ…" The staff noted that fire modeling comprised the following:

-- Fire Dynamics Simulator (FDS) was used to assess the main control room (MCR) habitability and to model an air compressor oil fire scenario in Fire Area FC32 (also referred to as Room 19).

-- The algebraic equations implemented in FDTs and Fire Induced Vulnerability Evaluation, Rev. 1 (FIVE) were used to characterize flame radiation (heat flux), flame height, plume temperature, ceiling jet temperature, and hot gas layer (HGL) temperature for various ignition source types and heat release rates (HRRs).

Section 4.5.1.2, "FPRA Quality" of the Transition Report states that fire modeling was performed as part of the Fire Probabilistic Risk Assessment (FPRA) development (NFPA 805 Section 4.2.4.2). Reference is made to Attachment J, "Fire Modeling V&V," for a discussion of the acceptability of the fire models that were used. Regarding the acceptability of the Probabilistic Risk Assessment (PRA) approach, methods, and data:

a. In regard to fire location corner and wall proximity effects, which can affect air entrainment and flame height, as well as Zone of Influence (ZOI) and target impacts.

   The Location Factor was not applied in the ZOI calculations for ignition sources that are at a distance of 6 in. or greater from a wall or corner. The justification is provided in the Fire Scenario Selection Report (FSSR) (FC07823 and CN-RAM-10-013), and refers to data published by Zukoski et al., for a 55 kW circular pool fire. Please explain why the conclusions of Zukoski's work are valid for larger fires that involve solid combustibles and that are rectangular in shape (e.g., 317 kW transient fires).

b. During the walk down of the compressor area (Fire Area FC32/Room 19) during the audit, the staff observed two raw water pipes with a type of neoprene rubber insulation. The rubber insulation was not considered as an intervening combustible in the ZOI calculations and FDS analysis for this area. The staff is also concerned about the possibility that non-cable intervening combustibles were missed in other areas of the

plant. Please provide information how non-cable intervening combustibles were accounted for in the fire modeling analyses.

c. Explain in detail how the HRR of cable tray fires was calculated. Please provide justification for the use of a "characteristic length" of one foot instead of the cabinet length as specified in NUREG/CR-6850, "EPRI/NRC-RES, Fire PRA Methodology for Nuclear Power Facilities," page R-9, and perform a sensitivity study to obtain a quantitative measure of the effect of this discrepancy on the ZOI and HGL calculations and target damage assessment. In addition, provide a justification for the fact that the effect of the cable tray fire on the radius of the ZOI was not considered.

d. In the Method of McCaffrey, Quintiere, and Harkleroad (MQH) correlation (NUREG-1805, "Fire Dynamics Tools (FDT^s) Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program") a vent opening area of $1m^2$ and vent height of 1m were used in all compartment fire modeling calculations. Changing the vent area to $0.5m^2$ and the vent height to 0.5m, everything else being equal, would increase the MQH HGL temperature results by 41%. This indicates that the HGL temperature results are very sensitive to the compartment ventilation openings. In addition, the staff questions the applicability of the MQH correlations for vents of this size that may be located in the upper part of a wall or in the ceiling of the compartment.

    i. Please provide justification for the use of the MQH correlation for compartment vents of the order of 0.5m to $1m^2$ in size.
    ii. Please perform a sensitivity study to assess the effect of the vent opening area and height on the HGL temperature results.
    iii. Please compare the results with the HGL temperature results for closed compartments based on Beyler's correlation in NUREG-1805.
    iv. Please justify why Beyler's correlation for closed compartments was not used.

e. It is stated in the FSSR (Assumption 3 on page 53) that all cabinets are assumed to contain qualified cable, although some cabinets may contain non-qualified cable. This is justified on the basis that the 98th percentile HRR of cabinets with qualified cable in Table G-1 of NUREG/CR-6850, is higher than that of cabinets with non-qualified cable and closed doors. However, the 98th percentile HRR is higher for cabinets with non-qualified cable and open doors. Provide justification for not considering the possibility of cabinets with open doors.

f. Regarding the use of FDS:

    i. Provide the input files in electronic format (*.fds) for all FDS runs that were conducted (15 in the MCR and 1 in the air compressor area (Fire Area FC32/Room 19)).
    ii. Justify the grid spacing in the MCR and air compressor area (Fire Area FC32/Room 19) fire simulations based on a Characteristic Fire Diameter (D*) analysis. Please describe the size and location of the compartment vent(s) to the outside that is (are) specified in the FDS input files for the MCR and air compressor area (Fire Area FC32/Room 19) fire simulations.

iii. FAQ 08-0052 “Transient Fires - Growth Rates and Control Room Non-suppression” specifies a time to peak heat release rate of 2 min and 8 min for MCR trash bags and trash cans, respectively. Please justify why a time to peak heat release rate of 5 min was used for transient fires in the MCR.

iv. Please justify why scenarios with an ignition source in the kitchen, computer room and other areas connected to the MCR were not considered.

v. Regarding the FDS simulation of the Fire Area FC32/Room 19:

   a. Please justify why the potential contribution from raw water pipe insulation to the HRR was not considered. Determine whether the insulation would be involved in the compressor oil scenario, and, if so, rerun FDS for this scenario accounting for the contribution of the pipe neoprene rubber insulation.
   b. Please explain for the compressor oil fire scenario why the heat flux threshold for cables was ignored and only the temperature threshold was considered.
   c. Please demonstrate how a turbine-driven aux feedwater pump oil fire, including the potential contribution of the raw water pipe insulation in the vicinity of the pump would not result in further propagation or damage to additional targets. Provide a summary description, assumption and basis, of the fire modeling conducted, and if FDS was used, provide the input files in electronic format (*.fds).

Fire Modeling RAI 02

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.

Assumption 1 in Section 4.4 on page 53 of the FSSR (FC07823 and CN-RAM-10-013) states that, “All PRA targets are assumed to have a radiant heat flux damage threshold of 11 kW/m^2 and a temperature damage threshold of 330°C. These damage thresholds are consistent with those for electrical cables with thermoset insulation.”

Please 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 threshold as described in NUREG/CR-6850. Provide a statement regarding the extent of installed thermoset cable insulation.

b. If thermoplastic cabling is present, discuss the additional targets created/identified using the lower critical temperature damage threshold and/or critical heat flux damage threshold 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 please describe the impact 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 03

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, "FPRA Quality" of the Transition Report states that fire modeling was performed as part of the FPRA development (NFPA 805, Section 4.2.4.2). Reference is made to Attachment J, "Fire Modeling V&V," for a discussion of the verification and validation (V&V) of the fire models that were used. Furthermore it is stated in Section 4.7.3 "Compliance with Quality Requirements in Section 2.7.3 of NFPA 805" of the Transition Report that "Calculational models and numerical methods used in support of compliance with 10 CFR 50.48(c) were verified and validated as required by Section 2.7.3.2 of NFPA 805."

Regarding the V&V of fire models:

a. Attachment J of the Transition Report states that the algebraic equations implemented in FDTs and FIVE, Rev. 1, were used to characterize flame radiation, flame height, plume temperature, ceiling jet temperature, HGL temperature for various ignition source types and HRRs. However, the FDT^s and/or FIVE, Rev. 1, spreadsheets were not used to perform the calculations, but selected algebraic models from NUREG-1805 and FIVE, Rev. 1, were used in a new spreadsheet (or set of spreadsheets). Please describe how this new spreadsheet (or set of spreadsheets) was verified, (i.e., how was it ensured that the empirical equations/correlations were coded correctly and that the solutions are identical to those that would be obtained with the corresponding chapters in NUREG-1805 or FIVE, Rev. 1.

b. For V&V of the aforementioned algebraic models reference is made to NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications". Please provide technical details to demonstrate that the algebraic models have been applied within the validated range of input parameters, or to justify the application of the equations outside the validated range reported in NUREG-1824.

c. Attachment J of the Transition Report states that National Institute of Standards and Technology (NIST) FDS Version 5 was used to assess MCR habitability:

    i. For V&V, reference is made to NUREG-1824. However, NUREG-1824 provides V&V of FDS Version 4, while FDS Version 5 was used. Please explain why the V&V reports developed by NIST for FDS Version 5 were not included in the V&V basis described in Attachment J of the Transition Report.
    ii. Please provide technical details to demonstrate that FDS has been applied within the validated range of input parameters, or to justify the application of the model outside the validated range reported in NUREG-1824 and the aforementioned NIST reports.

d. FDS was also used to model an instrument air compressor oil fire scenario in Fire Area FC32/Room 19. This is not mentioned in Attachment J of the Transition Report. Please provide technical details for this scenario to demonstrate that FDS has been applied within the validated range of input parameters, or to justify the application of the model outside the validated range reported in NUREG-1824 and the aforementioned NIST reports.

Fire Modeling RAI 04

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 FPRA development (NFPA 805, Section 4.2.4.2). This requires that qualified fire modeling and PRA personnel work together. Furthermore it is stated in Section 4.7.3 "Compliance with Quality Requirements in Section 2.7.3 of NFPA 805" of the Transition Report that "For personnel performing fire modeling or FPRA development and evaluation, OPPD develops and maintains qualification requirements for individuals assigned various tasks. Position specific training will be developed to identify and document required training and mentoring to ensure individuals are appropriately qualified per the requirements of NFPA 805 Section 2.7.3.4 to perform assigned work."

Regarding qualifications of users of engineering analyses and numerical models:

a. Please describe what constitutes the appropriate qualifications for the Omaha Public Power District (OPPD) staff and consulting engineers to use and apply the methods and fire modeling tools included in the engineering analyses and numerical models.

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

c. Please explain how the necessary communication and exchange of information between fire modeling analysts and FPRA personnel was accomplished.

Fire Modeling RAI 05

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."

It is stated in Section 4.7.3 "Compliance with Quality Requirements in Section 2.7.3 of NFPA 805" of the Transition Report that "Uncertainty analyses were performed as required by Section 2.7.3.5 of NFPA 805 and the results were considered in the context of the application. This is of particular interest in fire modeling and FPRA development."

Regarding the uncertainty analysis:

a. Please explain in detail the uncertainty analyses for fire modeling that was performed. Describe how the uncertainties of the input parameters (compartment geometry, HRR, radiative fraction, etc.) were determined. In addition, please substantiate the statement

in Appendix J of the Transition Report that states, "…the predictions are deemed to be within the bounds of experimental uncertainty…"

b. Cables are the primary target in FPRA. The FPRA peer review team raised the question of uncertainty due to these target's thermophysical properties, and their importance to FPRA results. Please provide technical justification for the statement in the FSSR (FC07823 and CN-RAM-10-013) that "thermophysical property uncertainty is not expected to significantly affect the PRA results". In addition, provide a quantitative assessment of the impact of this uncertainty on the FPRA results.

c. The NRC staff is concerned about the fact that in many cases the most conservative model input parameter values were not used Two specific examples are described below.

    i. The soot yield in the FDS analysis for MCR habitability study was assumed to be 0.06 while higher values are reported in the fire protection literature for the same type of cables. Please perform a quantitative assessment and provide a summary report of the impact of the uncertainty of the soot yield on the Fire PRA results.
    ii. A HRR per unit area (HRRPUA) of 328 kW/m2 was used to calculate the HRR of cable tray fires in FDS analysis to model an air compressor oil fire scenario in Fire Area FC32/Room 19. This value is the average of all values for thermoset cables listed in Table R-1 of NUREG/CR-6850. However, the exact composition of the cables in each tray is not known and a tray might be filled with cables that have a higher HRRPUA. In addition, the licensee assumed that each tray contained 50 cables and that the weight of insulation and jacket is 0.02 lb/ft. In the walkdowns during the onsite audit the staff found numerous trays that had more than 50 cables. The cables in these trays appeared to contain more insulation than what was assumed. Please perform a quantitative assessment and provide a summary report of the impact of the uncertainty of the HRRPUA and combustible loading of the cables on the Fire PRA results.

d. Please provide justification for the assumption that in the Fire Area FC32/Room 19 compressor area (only) 10% of the compressor oil fires result in failure of the overhead cable trays while, based on the FDS calculations, the overhead cable trays in 90% of the fires are not damaged.

e. During the audit, the NRC staff reviewed Attachment 14 to the FSSR (FC07823 and CN-RAM-10-013). The staff noted that cable tray obstructions were omitted in the FDS fire modeling analysis for Fire Area FC32/Room 19. Please justify why cable tray obstructions could be omitted in the FDS fire modeling analysis for Fire Area FC32/Room 19.

Fire Protection Engineering RAI 01

License Amendment Request (LAR) Table 4.3 and the fire hazards analysis (FHA) include fire area “50” (“outdoor gas storage”) within their scope but the LAR Table I-1 (power block definition) does not. The NRC staff understands that NEI 04-02, "Guidance for Implementing A Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c)", Rev. 2, Attachment K, was used, however, provide justification for not having the outdoor gas storage area included within the power block definition under Attachment I.

Fire Protection Engineering RAI 02

Please provide further justification detailing why substation 1251 control building should not be considered within the power block since the 161 KV switchyard supplies the plant with offsite power.

Fire Protection Engineering RAI 03

Please provide further justification detailing why the 345 KV switchyard should not be considered within the power block since this switchyard carries the power output of the main generator as well as provides a portion of the supply to the plant for offsite power.

Fire Protection Engineering RAI 04

The FHA, design basis document (DBD), and code compliance analysis (EC-FA-95-022) are missing reference codes that are in the LAR Table B-1, or missing the code edition as stated in the LAR. It is not clear if the LAR contains the complete list of reference codes required. It is not clear why there is a difference in codes referenced between the LAR and the other documents. Please clarify whether or not the LAR, Table B-1, and Section 6.0 contain a complete and accurate list of required codes. Also, please clarify why there is a difference between the LAR Section 6.1, LAR Table B-1, DBD, and EA-FC-95-022.

Fire Protection Engineering RAI 05

LAR Table B-1, Section 3.3.1.2, currently states “N/A”; however, NFPA 805 contains an overall requirement in this section. Provide the appropriate compliance statement for Section 3.3.1.2 of Table B-1. In addition, please ensure Table B-1, for other instances, where an overall requirement is contained within a high level item description, is provided with the appropriate compliance statement.

Fire Protection Engineering RAI 06

Table B-1, Section 3.2.3(1) Inspection, Testing, and Maintenance: the compliance basis for element 3.2.3(1) of Attachment A to the Transition Report (page A-4) states “complies”. During the audit, the plans to use EPRI TR1006756, "Fire Protection Equipment Surveillance Optimization and Maintenance Guide" at a future date (post-LAR) were discussed. If using performance-based methods in lieu of the deterministic requirements of NFPA 805, Chapter 3, this must be identified and approved by the NRC via a license amendment. In addition, if performance-based methods are used, a discussion on how performance based surveillance frequencies will be established and monitored in the future needs to be provided. In this regard please provide the following:

a. Please state whether EPRI TR1006756 will be followed. If not, state which guidance will be followed.

b. Please describe how EPRI TR1006756, or other committed guidance, will be utilized to establish performance-based surveillance frequencies. Specifically discuss how the initial surveillance frequencies will be established; discuss the plant program for obtaining/using performance monitoring information to revise surveillance frequencies post-transition, and discuss the fire protection systems/features to be included in this program.

c. Please describe the changes to be made to inspection, testing, and maintenance procedures during the transition period to implement performance-based surveillance frequencies, including identifying the procedures to be changed or developed. Specifically please discuss the elements of EPRI TR1006756, or other committed guidance, that will be implemented, including identifying the applicable fire protection systems.

d. If performance-based procedure changes are/will be made, please clarify which implementation item in Table S-2 applies to these procedure changes/developments.

Fire Protection Engineering RAI 07

Table B-1, Section 3.3.8 Bulk Storage: the compliance basis statement does not specifically address the prohibition on bulk storage in certain areas of the plant as stated in the first sentence of NFPA 805, Section 3.3.8. Please provide further justification for how this requirement is met.

Fire Protection Engineering RAI 08

Table B-1, Section 3.4.1(c): during the audit, it was stated that the fire brigade will be reorganized to contain a fire brigade leader and at least two brigade members that will have "sufficient training and knowledge" of nuclear safety systems. Please clarify what is meant by "sufficient". Describe the level of training and knowledge these three members receive. Describe any operations training the members will receive. For example, please describe whether these members will be licensed or non-licensed operator.

Fire Protection Engineering RAI 09

Table B-1, Sections 3.4.2.1, 3.4.2.4, 3.4.3(a)(2) & 3.4.3(c)(2) indicate "complies" without any required action. Please clarify that the Radiation Release implementation items from Attachment E have been incorporated into the fire brigade pre-plans, training, and drills.

Fire Protection Engineering RAI 10

Table B-1, Section 3.6.3 Hose Nozzle Clarification. NFPA 805, Section 3.6.3, states the requirements for hose nozzles supplied to each power block area. The compliance statement in the Transition Report, Table B-1, Section 3.6.3, states "complies with EEEE"; however, the compliance basis only mentions a few nozzles and only the Auxiliary and Turbine buildings. It is unclear if the rest of the plant complies with this requirement. Please provide clarification for the following:

a. Whether or not these are the only nozzles used throughout the plant.

b. The compliance statement for the other power block fire areas.

c. Compliance regarding the prohibition of use of straight stream nozzle capability in high voltage settings. For example describe if the 250,000 volt criteria listed, will satisfy all power block areas and applicable transformers.

d. Describe the meaning of "consistent with other listed nozzles" and why is this acceptable per NFPA 805.

Fire Protection Engineering RAI 11

Table B-1, Sections 3.10.1 & 3.10.3, reference engineering analysis document EA-FC-93-047, "Halon System Operability Evaluation." However, Section 3.10.1 refers to revision 3 while Section 3.10.3 refers to revision 4, and LAR Section 6.139 references revision 3. Please provide justification for allowing two different revisions to be referenced within LAR or clarify the correct revision.

Fire Protection Engineering RAI 12

Table B-1, Section 3.4.4: The compliance basis points to an implementation item; however, there is no implementation item listed in Section 3.4.4. Please provide a new implementation item or provide clarification of which implementation item is part of this compliance basis.

Fire Protection Engineering RAI 13

Table B-1, Section 3.3.12: Provide the missing reference to OPPD Letter [LIC-88-1066] which requested NRC-88-0457. Please clarify whether LIC-97-0073 (dated 9-30-1997) should be referenced in Table B-1, Section 3.3.12.

Fire Protection Engineering RAI 14

Table B-1, Section 3.3.9, requires implementation item REC-039 which requires inspection of transformer oil collection basins to ensure the basins are free of debris. If applicable:

a. Please provide the frequency used and the justification for the basis of this frequency of inspections.

b. Please indicate how this frequency is related to the fire protection system inspection frequencies.

c. Please provide any plans on how frequency changes to the inspection frequency will be monitored (if frequency changes are planned/expected).

Fire Protection Engineering RAI 15

Table B-1, Sections 3.3.7 & 3.3.8, discuss storage requirements for flammable gas and flammable and combustible liquids including requirements to meet NFPA 30, "Flammable and Combustible Liquids Code", and NFPA 50A, "Standard for Gaseous Hydrogen Systems at Consumer Sites", respectively. Please clarify if there are non-hydrogen flammable gas or

combustible liquids stored on site (e.g. acetylene, propane, etc.) and whether the compliance basis statements include these non-hydrogen materials. Also, please clarify if these materials are controlled under the combustible control program and meet the requirements of NFPA 30 and/or NFPA 50A.

Fire Protection Engineering RAI 16

Table B-1, Item 3.3.5.1, indicates a reliance on implementation item REC-050 to modify SO-G-21; however, SO-G-21 is not listed in the referenced document's column. Please clarify why SO-G-21 is not referenced and clarify whether SO-G-21 and the FHA will include any restrictions to ensure cabling is kept to a minimum regardless of the type/classification of loading.

Fire Protection Engineering RAI 17

Table 4-3 and the appropriate section of Table B-3 for Fire Area 36B: Page L-15, Attachment L Approval #7, refers to an overhead horizontal cable chase (i.e. fire area 36C) in room 56W (west switchgear room) that was previously approved as a radiant energy shield. Note: this Pyrocrete shield is not the same feature which seeks approval under Attachment L, Approval #7, but is in reference as similar in construction to the room 56E (east switchgear room) new approval submitted feature. Table 4-3 and the appropriate section of Table B-3 do not reflect this feature for Fire Area 36B (room 56W, west switchgear room). Please provide justification for not including this credited feature in Table 4-3 and the appropriate section of Table B-3.

In addition, Table 4-3 states "Pyrocrete enclosures protecting vertical cable trays and horizontal conduit bank" are required electrical raceway fire barrier systems (ERFBS) features for fire area 36A (east switchgear room). However, Table 4-3, Table B-1, and Table B-3 do not clearly identify which ERFBS are credited for fire area 36A. Specifically, please identify by location and configuration type, all ERFBS features to be credited within Fire Area 36A. In addition, clarify if the two vertical Pyrocrete ERFBS features inside fire area 36A between column lines 6d and 7a are credited for the NFPA 805 Fire Protection Program (FPP) and are accounted for within the Table 4-3 (fire area 36A) statement "Pyrocrete enclosures protecting vertical cable trays …".

Fire Protection Engineering RAI 18

Attachment L, Approval #7: Please provide further details for why the ERFBS does not meet GL 86-10, Supplement 1. During the audit, it was discussed that this ERFBS does not meet any specific fire tests under Supplement 1, and the use of NFPA 805, Section 3.11.5, was also discussed. Clarify if the intention is to comply with NFPA 805, Exception 2 to Section 3.11.5, or to seek a new approval under Attachment L.

a. If seeking Exception 2 from Section 3.11.5, then please provide the basis for the conclusion for successfully meeting the pre-GL-86-10 letter and the limiting end point temperature requirements as specified by the NRC at the time of acceptance. Include a summary of the testing, the limiting end point temperature used, and any reference to the engineering analysis and testing. Also, please include any similar configurations that have received similar pre-GL-86-10 approval.

b. If seeking a new approval, then please provide the basis for the conclusion of equivalency to GL 86-10, Supplement 1. Include a summary of any testing performed, a

figure depicting the as-installed & as-tested/analyzed configuration, a description of the materials utilized, and a reference to the engineering analysis document(s).

Fire Protection Engineering RAI 19

Table B-1, Item 3.5.14(b), and Attachment L, Approval #6: Please discuss receiving approval for certain curb valves within the fire water main loop which do not meet the locked or supervised requirements stated in NFPA 805, Section 3.5.14.

Fire Protection Engineering RAI 20

Attachment K: Please clarify the need to rely on the exemption regarding no suppression within the MCR in order to meet the NFPA 805 FPP requirements.

Monitoring Program RAI 01

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” and 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.”

In addition, Section 4.6, “Monitoring Program” of the Transition Report states that the NFPA 805 monitoring program will be implemented “after the safety evaluation issuance as part of the fire protection program transition to NFPA 805” (Table S-3, Implementation Items, item 11-805-089 of the Transition Report).

Furthermore, the licensee has committed to comply with Frequently Asked Question (FAQ) 10-0059. The NRC staff noted that the information provided in Section 4.6, “Monitoring Program” of the Transition Report is insufficient for the staff to complete its review of the monitoring program. Please provide the following additional information for the NRC staff to complete its review:

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 the approach to be applied to any fire protection SSCs that are already included within the scope of the Maintenance Rule 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 monitoring program including the approach to be applied to any SSCs for which availability, reliability, and performance goals are not readily quantified.

c. A demonstration of how the 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 controls programs).

d. A description of how the monitoring program will address fundamental fire protection program elements.

e. A description of how the guidance in EPRI Technical Report 1006756, “Fire Protection Equipment Surveillance Optimization and Maintenance Guide” if used, will be integrated into the monitoring program.

f. 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.

g. Section 4.6.2 of LAR describes an overview of the post transition NFPA monitoring program to be implemented after safety evaluation issuance. Phase 2, in section 4.6.2 is titled "Establishing Risk Criteria." FAQ 10-0059 identifies this phase as "Screening Using Risk Criteria." Please describe the changes that are being proposed in regards to the NFPA 805 monitoring program compared to the monitoring program described in FAQ 10-0059.

h. The discussion of phases 2, 3, and 4 of the proposed NFPA 805 monitoring program discussed in Section 4.6 of the LAR omits Nuclear Safety Capability Assessment (NSCA) equipment. Please describe how the NFPA 805 monitoring program will address NSCA equipment.

i. Please describe the requirements for periodic NFPA 805 assessments (audits) of the fire protection program under the existing Fire Protection Quality Assurance Program. If these assessments are not conducted under the existing Fire Protection Quality Assurance Program, please describe the program and process that will be used to conduct them.

Programmatic RAI 01

NFPA 805 Section 2.7.1.1 states that “the analyses performed to demonstrate compliance with this standard shall be documented for each nuclear power plant (NPP). The intent of the documentation is that the assumptions be clearly defined and that the results be easily understood, that results be clearly and consistently described, and that sufficient detail be provided to allow future review of the entire analyses. Documentation shall be maintained for the life of the plant and be organized carefully so that it can be checked for adequacy and accuracy either by an independent reviewer or by the AHJ.”

NFPA 805 Section 2.4.3.3 states that “the PSA approach, methods, and data shall be acceptable to the AHJ. They shall be appropriate for the nature and scope of the change being evaluated, be based on the as-built and as-operated and maintained plant, and reflect the operating experience at the plant.”

NFPA 805 Section 3.3.1.2 states that “procedures for the control of general housekeeping practices and the control of transient combustibles shall be developed and implemented.” FPRA analyses assume combustible loading will be maintained at or below certain values. Please provide a description of how the combustible controls program will be administered to ensure that FPRA assumptions regarding combustible loading will be met.

Safe Shutdown Analysis RAI 01

Table B-2, NEI 00-01, Rev. 1 Alignment Basis: Regulatory Guide 1.205, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants", Rev. 1, identifies NEI 00-01, "Guidance for Post-Fire Safe Shutdown Circuit Analysis", Rev. 2, Chapter 3, as the guidance document to be used to ensure alignment with current NRC guidance for the application of NFPA 805. LAR Table B-2 identifies a comparison with NEI 00-01, Rev. 1. Please provide a gap analysis of differences between the alignments using NEI 00-01, Rev. 2, as the basis for transitioning compared to NEI 00-01, Rev. 1.

Safe Shutdown Analysis RAI 02

Safe and Stable: LAR Section 4.2.1.2 describes the capability for achieving and maintaining safe and stable conditions. The licensing basis is to achieve and maintain hot shutdown (Mode 3) conditions with the minimum plant operating shift staff "to demonstrate that FCS can achieve and maintain Mode 3 (Hot Shutdown Condition), … for a coping time of 24 hours." LAR Table B-2, Section 3.1.1.9 Criteria/Assumptions states that the 24-hour coping time has been selected based on the design capacity for the backup nitrogen supply that is relied upon to maintain positive remote control over the turbine driven auxiliary feedwater pump, and based on the ability of the Emergency Response Organization (ERO) to respond to the event with adequate time allowed for the ERO personnel to muster, assess the extent of fire damage, and assist the plant operating staff with implementation of the required actions to sustain Mode 3 (Hot Shutdown Condition), beyond 24 hours, or to assess the extent of fire damage, and assist the plant operating staff with implementation of cold shutdown actions and/or cold shutdown repairs for the plant to transition to, and enter, Mode 4 (Cold Shutdown Condition).

Actions required to sustain Mode 3 (Hot Shutdown Condition) are included in the results part of Section 4.2.1.2 of the LAR including reference to appropriate procedures.

Please provide a description of the risk impact(s) of any of these actions including the nature of the actions (i.e.; routine, abnormal, or repair) that may be required to maintain safe and stable.

Safe Shutdown Analysis RAI 03

Nuclear Safety Capability Analysis (NSCA), Safe Shutdown and Circuit Analysis, and Table B-3 Cable Routing for Fire PRA: the following are the cable routing assumptions (EA-10-0037) (R2008-007-003) for cables where no routing information was available:

a. Cables that transition from one numbered tray to another through an "un-numbered" vertical riser the cable path was assumed to include the riser.

b. Short runs of cable from a numbered tray to an end device, where the fire area location for both the tray and the end device are known, and where both are located in the same fire area or two adjacent fire areas, but the connecting conduit/air drop could not be identified from the plant conduit and raceway layout drawings, the cable is assumed to be located in the same fire area or the two adjacent fire areas.

c. Short runs of cable from one end device to another end device, where the fire area location for both are known and both are located in the same fire area or two adjacent areas the cable is assumed to be located in the fire area(s).

d. Cables of short length (20 feet or less) where the fire area location for only one of the end devices are known, the fire area location for the other end device is assumed to be located in the same fire area (typically valve junction boxes connecting to valve operators, solenoids, and or limit switches).

e. Cables from one end device in the Containment to another end device in the Containment are assumed to be contained entirely within the Containment.

f. Cables from one end device in the Intake Structure to another end device in the Intake Structure are assumed to be contained entirely within the Intake Structure.

g. Cables connecting panels between the MCR (for cables that could not be traced) are assumed to route from the MCR to the Cable Spread Room (CSR) and then back to the MCR. They are assumed to be exclusively in the MCR and CSR.

Please indicate the number of cables/circuits that do not have routing information where these assumptions were applied.

In target selection, ZOI were established above each ignition source. Please indicate how targets without cable routing information were selected to be included in the ZOI for each ignition source.

Please indicate whether or not this routing was factored into the field walk downs for ZOI. In addition, also indicate what specifically was done to account for this uncertainty in the analysis.

The analysis (EA-10-0037) (R2008-007-003) identifies that raceway and conduit layout drawings, architectural drawings, and fire area boundary drawings were used to locate equipment, raceways, and cables within the plant fire areas and fire zones. Please describe any field verification done to determine the suitability of the above assumptions.

Safe Shutdown Analysis RAI 04

Table 4.3, Summary of Compliance Bases: LAR Table 4.3 and LAR Attachment C, lists "NFPA 805 Regulatory Basis" for each fire area listed. For the Containment (FA 30) the basis is listed as 4.2.3.2 which does not align with the separation description used in the Containment of Table B-3 and supporting documents. Section 4.2.3.2 of NFPA 805 states that: "One success path of required cables and equipment shall be located in a separate area having boundaries consisting of fire barriers with a minimum fire resistance rating of 3 hours." This does not appear to apply to the Containment.

a. Please clarify this discrepancy in Table 4.3 and Attachment C regulatory compliance.

b. Please indicate whether or not there are any other fire areas that should be modified regarding this compliance column.

Safe Shutdown Analysis RAI 05

Table B-3: LAR Table B-3, Fire Area 31 (Intake Structure), variance from deterministic requirement (VFDR) 31-001, describes local manipulation of HCV-2805A and/or RW-144 and local pressure indication from PI-2805A-1/2 are required to manually rotate and backwash strainer AC-12A. AC-12A is required to function in order to support train 'A' raw water system

operation, which in turn supports refill of the emergency feedwater storage tank (EFWST), to maintain reactor coolant system (RCS) core decay heat removal for long term safe and stable post-fire safe shutdown. It also describes in VFDR 31-002 the same for the Train B strainer.

Please provide the following additional information:

a. Indicate how often the strainers need to be backwashed.

b. Indicate whether or not the need for backwashing the strainers changes seasonally or with different weather related events.

c. Indicate how often the strainers need to be manually backwashed.

d. Indicate whether or not the operators ever backwashed the strainers manually.

e. Indicate whether or not the strainer has a bypass.

f. Describe the compliance strategy for these VFDR's and if these actions will be included in the fire emergency procedure(s) even though the risk of their failure has been determined to be acceptably low.

g. Indicate how these actions are reviewed for feasibility.

Safe Shutdown Analysis RAI 06

LAR Table B-3, Fire Area 34B-1 (Electrical Penetration Area Ground and Intermediate Levels), utilizes the fire risk evaluation performance-based approach in accordance with NFPA 805, Section 4.2.4.2, with 17 VFDR's and 5 recovery actions (RAs) which indicates both trains might be affected by fire in the compartment. However, the suppression effects description indicates, "Fire area 34B is not considered to contain redundant safe shutdown equipment or cables." Please clarify this discrepancy.

Safe Shutdown Analysis RAI 07

LAR Table B-3, Attachment I, Power Block, Structure excluded from the power block: Attachment I of the Transition Report states that "The service building (NFPA 805 fire area 45; the combination of legacy fire areas 45, 48, and 49 as identified for the service building in EA-FC-97-001) is excluded from the power block on the basis that it contains only the fuel oil transfer pump (and its associated power cable) for diesel driven AFW pump, FW-54."

Based on the use of FW-54 in the NFPA 805 analysis, it would appear that FW-54 and all required supporting systems, structures, and components are "required for plant operation" since these structures, systems and components (SSCs) are credited as a means of meeting the nuclear safety performance criteria and should therefore be included within the structures considered within the "Power Block."

Please justify why this fire area (FA45) would not be considered part of the power block.

Safe Shutdown Analysis RAI 08

Table S-3 Implementation item (REC-140) to perform a supporting analysis for diesel driven auxiliary feedwater (AFW) pump, FW-54 states: "The analysis will document that FW-54 can supply adequate feedwater flow to the steam generators through the auxiliary feedwater flow path in support of the NFPA 805 safe and stable definition (i.e., achieve and maintain hot shutdown for a 24-hour coping time, with steam rejection through the spring relief mode of the main steam safety relief valves). The supporting analysis shall assume that the flow path from FW-54 to the main feedwater header remains un-isolated, and shall account for any flow diversion from FW-54 to the main feedwater header and/or the main feedwater pumps. The supporting analysis will be incorporated into a revised engineering analysis, or will be documented in a new engineering analysis. Implementation item associated with the NFPA 805 area-by-area review, EA10-044."

a. Please describe the current licensing basis for FW-54 and indicate whether or not it differs from that being proposed under NFPA 805.

b. Please describe the outcome or preliminary outcome of these results. In the event this is not feasible, describe any contingency established to accommodate feedwater for safe and stable operation and indicate how the FPRA analysis will be revised.

c. If this analysis will support only a 24 hour safe and stable period, please describe the alternative means of achieving the nuclear safety performance goals and objectives.

Safe Shutdown Analysis RAI 09

The MCR abandonment analysis CN-RAM-10-014 (FC07824), Section 4.3.4, identifies revisions required to AOP-06 "Fire Emergency" for habitability criteria. It also states that these will be added to changes required for "significant loss of plant control".

a. Please describe the change(s) that will be made to the procedure for significant loss of plant control.

b. Please indicate whether or not the MCR evacuation from loss of control is modeled in the FPRA. If not, describe why not.

c. Please clarify if fire scenarios initiated outside the MCR that may affect habitability in the MCR were considered (e.g.; heating, ventilation and air conditioning (HVAC) supply area(s)). If not, describe why not.

d. Please identify any deviations from the guidance in NUREG/CR-6850, MCR evacuation following both loss of control room function and loss of habitability.

Safe Shutdown Analysis RAI 10

AOP-17, "Loss of Instrument Air," has a 4 hour action time to isolate flow through condensate makeup control valve, LCV-1190, to prevent condensate storage tank (CST) drain down into the hotwell for NFPA 805. The NRC staff is of the understanding that the isolation action is only necessary when the CST is used and the diesel driven AFW pump is credited (page 21 of the AOP). Please confirm that this is correct, and if not, provide further discussion related to when this action is required.

Safe Shutdown Analysis RAI 11

Table B-3, Table C-94, Fire Area 06-08, Heat Exchanger and Pump Area is one of many examples of flooding. Flooding to adjacent areas is possible and has been analyzed. The adjacent areas affected by flood water include: corridor 4, the open stairwell next to fire area 06-3 and possibly room 23 which is located at the bottom of the stairwell. Since no safe shutdown equipment is in any of these areas, flooding to adjacent areas is not a concern. With regard to the flooding analysis used to address the suppression effects of this fire area.

a. Please indicate whether or not the flooding analysis credits the operation of sump pumps in the lower elevation areas.

b. If yes, please indicate whether or not the control and power cables of the sump pumps have been included in the NSCA. Provide justification if not included.

Safe Shutdown Analysis RAI 12

Attachment S, Table S-2, Committed Modifications Item REC-111 of the LAR indicates that High Energy Arcing Fault (HEAF) barriers will be installed around/near the 4 KV switchgear and bus ducts in the 4KV Switchgear Rooms. These barriers are intended to reduce the local damage associated with a potential HEAF, and subsequently reduce the risk calculated for Fire Areas 36A and 36B.

a. Please provide the criteria being used to design and build these barriers.

b. Please indicate to what standard these barriers will be installed.

c. If there is no standard to address the installation of HEAF barriers, please indicate how they will be tested to ensure suitable design and operational criteria are met.

Safe Shutdown Analysis RAI 13

Please indicate whether or not there are any locations in the plant where a fire could cause the mechanical failure of flexible hoses/expansion joints such that the fire could result in either piping system failure or potential significant flooding concerns (i.e., condenser water box inlet and outlet expansion joints, diesel generator cooling water flexible joints, condensate pump suction flexible joints, etc.). If there are such locations, please provide a list of them and an assessment of the input to the NSCA for NFPA 805 compliance.

Radioactive Release RAI 01

For liquid releases, Column 7 of Attachment E indicates the Fire Areas where floor drains are routed to the monitored Radioactive Waste Disposal System (RWDS). The liquids are collected in spent regenerate tanks via the floor drain header and sump pumps (pumped from lower elevations). For each area where credit for these engineering controls is taken, please provide clarification that the system is capable of handling and containing the estimated amount of water to be generated.

Radioactive Release RAI 02

For Fire Area 30, Containment, Refueling Pool, Column 7 of Attachment E states that during non-power operations, floor drains as described in Radioactive Release RAI 01 (above) remain present. It also states that "in the unlikely event that liquid effluents do escape containment, provisions are in place to contain liquid effluents and divert contaminated runoff away from the river." For this area, please provide clarification that the steps taken to contain liquid effluents comply with effluent requirements.

Radioactive Release RAI 03

The Original Steam Generator Storage Facility (OSGSF) (page E-15 of Attachment E) has been identified to be of no consequence and does not require a specific radiological calculation. Calculation FC07865 is referenced as the basis for this conclusion. Please provide justification for screening out this area.

Radioactive Release RAI 04

For liquid releases from fires involving sea-land containers, two cases are discussed in Column 7 of Attachment E. If the sea-land containers are located within the "screened in" protected areas identified in the table, the engineering controls discussed for their respective areas can safely handle liquid effluents. However, for sea-land containers located outside of the "screened in" areas, the table states that provisions are in place to "commence communication between the Fire Brigade and Radiation Protection and to contain liquid effluents for the purpose of diverting contaminated liquid flow away from the river." Please describe the provisions that are in place for the purpose of controlling liquid effluent releases for this situation or provide a bounding analysis, quantitative analysis, qualitative analysis, or other analysis that demonstrates that the limitations for instantaneous release of liquid radioactive effluents specified in the Technical Specifications (TS) are met (FAQ Number 09-0056.)

Radioactive Release RAI 05

A similar explanation as discussed in Radioactive Release RAI 04 (above) is offered for sea-land containers or other radiological sources located in the temporary Maintenance Shop Lower Expansion (Lower Mezz.) and the Old Warehouse. The table also states provisions are in place to "commence communication between the Fire Brigade and Radiation Protection and to contain liquid effluents within the area and away from the river." Please describe the provisions that are in place for the purpose of controlling liquid effluent releases for this situation or provide a bounding analysis, quantitative analysis, qualitative analysis, or other analysis that demonstrates that the limitations for instantaneous release of liquid radioactive effluents specified in the TS are met.

Radioactive Release RAI 06

Column 8 of Attachment E indicates that “if normal ventilation is not available, smoke will be removed using manual ventilation to the outside or to an area where normal ventilation will remove the smoke.” It also states that prior to any release, the radiological hazards associated with releasing contaminated smoke from the building will be considered and direct communication between the Fire Brigade and Radiation Protection will be initiated. Please clarify the method used for “manual ventilation” and provide methods for directing smoke to areas where “normal ventilation will remove the smoke” and clarify the specific actions/methods needed to minimize and/or monitor the release of the contaminated gaseous effluent.

Radioactive Release RAI 07

For radioactive sources in the Maintenance Shop Lower Expansion, page E-16 of Attachment E indicates that any fire involving radioactive sources in this area would never exceed the dose consequences from the combustion of the sea-land container and therefore the 10 CFR dose limits would never be exceeded from burning radioactive sources in this area. Please provide a qualitative response relating the amount of the activity contained in the radioactive sources relative to that of the amount assumed in the sea-land container.

Probabilistic Risk Assessment RAI 01

The Fire PRA (FPRA) peer review findings and observations (F&Os) are provided in Attachment V of the LAR. Please clarify the dispositions to the following F&Os:

a. F&O PP-B2-01: Enclosure 1 to the LAR supplement dated December 22, 2011 (ADAMS Accession No. ML11363A077) indicates for SR PP-B3 that manual suppression capability was used to help define compartment boundaries. Manual suppression is not allowed as criteria to define a compartment in NUREG/CR-6850. Therefore, remove this definition of compartment boundaries and modify your model if necessary, or identify this as a deviation from NUREG/CR-5860 and justify the deviation. In addition, indicate if spatial separation is used to define any compartment boundaries and, if used, describe the criteria used to identify and accept the spatial separation boundaries.

   In addition, please define and justify the criteria to establish the water curtain as a boundary between FC6-3 and FC 20-1. Clarify if water curtains were used as a boundary for any other fire compartments and, if so, define and justify the criteria used.

b. F&Os PRM-A3-01 and FQ-A1-01: LAR Table V1 shows SR PRM-A3 as "met." However, the "Summary" of the F&O in LAR Table V2 states that SR PRM-A3 is "NOT MET." Clarify this Discrepancy. In addition, describe the extent to which hot short probabilities are applied in the FPRA model. Please identify the components to which these hot short probabilities are applied and the basis for determining which components/cables were selected for application of circuit failure probabilities.

c. F&O FSS-A2-01: Based on discussions during the audit, the ZOI for various ignition sources is defined by a column above the ignition source. However, targets beyond those identified using this columnar ZOI could be damaged if a fire propagates to trays above the ignition source due to the 35° spread of fire in a cable tray stack (see Appendix R of NUREG/CR-6850).

   i. Please confirm whether cable trays exist in the region defined by the vertical column and the 35° angle, yet lie outside of the columnar ZOI. Provide an assessment of the importance of the cable trays lying within this region.
   ii. Please describe how the evaluation includes the possible increase in HRR caused by the spread of a fire from the ignition source to other combustibles.

d. F&O FSS-A4-01: In response to this F&O a subset of plant components (the most risk significant) were examined and 153 cases were corrected where the target set was insufficient. It is not clear what shortcoming in the original approach produced these omissions. Please explain this oversight and its root cause. Also, please provide the extent of the sample process in context of the full FPRA, including describing what percentage of the PRA components were sampled. If further examination of components is warranted, describe what needs to be done and the results of the additional examination.

e. F&O FSS-D8-01: A determination of no outlier behavior is required to meet CC-II of the corresponding SR. Please evaluate plant history and determine if the Halon system has revealed outlier behavior relative to system availability. Also, if outlier behavior relative to system unavailability exists include this behavior in your PRA or show how the fire watch and backup suppression is as effective and reliable as the Halon system.

f. F&O FSS-E1-01: Please discuss the difference in CDF, LERF, ΔCDF, and ΔLERF of using the draft of FAQ 08-50 rather than the final version as documented in NUREG/CR-6850 Supplement 1.

g. F&O FSS-E4-01: The LAR describes several cable routing assumptions that were made. Please explain how these assumed routings were treated on a fire scenario basis. For example, a cable known to be in two different trays in the same physical analysis unit (PAU) or in adjacent PAUs is assumed to traverse between the two trays. Explain how this cable is treated in the PRA model for the different ignition sources present in the PAU since the path of the cable between the trays is unknown.

h. F&O FSS-H8-01: The multi-compartment analysis (MCA) assumes 30 minutes is available for manual suppression credit prior to the fire propagating into the neighboring compartment.

   i. Please summarize how fire suppression is generally included in your evaluation.
   ii. Please discuss the basis for the 30-minute assumption, including the rating of barriers defining fire compartments.
   iii. Please provide justification for the use of the manual suppression failure probability of 0.074 using the methods described in FAQ 08-0050 or otherwise justify the estimate. Describe the results of the MCA for areas where spatial separation is credited.

i. F&O IGN-B5-01: The generic fire ignition frequencies used in the FPRA are taken from NUREG/CR-6850 Supplement 1. Section 10 of NUREG/CR-6850 Supplement 1 states that a sensitivity analysis should be performed when using these fire ignition frequencies rather than the fire ignition frequencies provided in Table 6-1 of NUREG/CR-6850. Please provide a sensitivity analysis of the impact on using the Supplement 1 frequencies instead of the Table 6-1 frequencies on CDF, LERF, ΔCDF, and ΔLERF for all of those bins that are characterized by an alpha that is less than or equal to one.

j. F&O HRA-A1-01: Calculations FC07826 and FC07824 state that the abandonment criteria currently in AOP-06 will be revised to reflect the assumption in the fire PRA that operators will evacuate only when it becomes uninhabitable due to heat and/or smoke or a significant loss of control has occurred. This procedure change is implementation item REC-096 in Table S-2 of the LAR. Please address the following with regard to how MCR abandonment was modeled in the fire PRA:

   i. Please state if any fires outside of the MCR cause MRC abandonment due to a significant loss of control. If so, please state how many.
   ii. While the FPRA models MCR abandonment due to uninhabitability, loss of control is not modeled. Please provide justification for not modeling MCR abandonment due to loss of control.
   iii. Assumption 1 of Calculation FC07824 states that a conditional core damage probability (CCDP) of 0.1 is assumed for scenarios that cause MCR abandonment and use the alternate shutdown panel. A conditional large early release probability (CLERP) of 0.01 is also assumed. Please confirm that these conditional probabilities include all failures of the operators and of mitigating equipment. Please provide justification that the CCDP of 0.1 and CLERP of 0.01 are appropriate in light of the multitude of recovery actions needed to implement plant shutdown via the alternate shutdown panel.

iv. Section 4.3.3 of Calculation FC07824 states that control room abandonment due to main control board (MCB) fires is not postulated (i.e., NSP = 0.0) and a qualitative justification is given for this assumption. Please provide a quantitative justification for not postulating MCR abandonment due to MCB fires.

k. SR HRA-A4: There is no F&O against this supporting requirement and the peer review team assessed this SR to meet only CC-I. SR HRA-A4 requires a talk-through with plant operations and training personnel to confirm interpretation of relevant procedures. The justification for not performing a talk-through is that the human failure events (HFEs) modeled in the FPRA are already modeled in the Internal Events (IEPRA) and have already received significant operator, training, and PRA input. Appendix G of the LAR indicates, however, that there are new operator actions that have been added to the fire PRA. Also, operator performance and reliability for performing actions corresponding to HFEs in general is potentially impacted when performed in response to a fire. In light of this, a talk-through with plant operations and training personnel is necessary to meet the requirements of SR HRA-A4. Please conduct this talk-through and provide a summary of the results.

l. SR HRA-B3: There is no F&O against this supporting requirement and the peer review team assessed this SR to meet only CC-I. SR HRA-B3 requires the completion of human failure event definitions. Table V3 of the LAR states that the HFE definitions are generally performed and defined in the FCS HRA Calculator. Please provide further justification that this SR meets CC-II by addressing how the FPRA meets each of the requirements of the SR for CC-II, or provide a justification that CC-I is acceptable for this application.

Probabilistic Risk Assessment RAI 02

Calculation FC07821 describes the fire ignition frequency development methodology and results. The second footnote to Table 4-2 provides the severity factors that were applied for main feedwater pump oil fires and states that these are in accordance with FAQ 08-44. However, these severity factors are not consistent with this FAQ, as described in Section 9 of NUREG/CR-6850, Supplement 1. Please provide an assessment of the impact on CDF, LERF, ΔCDF, and ΔLERF of applying the NUREG/CR-6850, Supplement 1 severity factors.

Probabilistic Risk Assessment RAI 03

Section V of the LAR (FPRA Quality), Table V1, “Peer Review Team Assessment of Capability Categories for all SRs in ASME/ANS RA-Sa-2009 Part 4,” indicates that Supporting Requirements (SRs) FSS-C8, PRM-B13, PRM-B15, HRA-A2 and HRA-B2, are not applicable to the FPRA. Please provide justification for this conclusion for each of these SRs.

Probabilistic Risk Assessment RAI 04

Attachment A of Regulatory Guide 1.200, “An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities”, Revision 2, (RG 1.200) provides the NRC staff clarifications and qualifications on each of the FPRA SRs in the ASME/ANS RA-Sa-2009 PRA Standard. Please clarify how the clarifications and qualifications were addressed during the Peer Review of the FPRA. If the peer review did not address the RG 1.200, Rev.2 clarifications and qualifications, develop and provide that assessment.

Probabilistic Risk Assessment RAI 05

According to Calculation FC07819, p35-36, those actions included in the Fire Response Procedures that could be adverse to plant risk are not modeled. Please provide justification for the exclusion of these actions from the FPRA. The justification should summarize the type and number of actions that could be adverse to plant risk and why the actions are not expected to be taken. In the response explain if these particular actions have been discussed with operators who might potentially perform such actions and whether such actions were considered during the human reliability analysis (HRA).

Probabilistic Risk Assessment RAI 06

Four deviations from NUREG/CR-6850 are identified in one-sentence descriptions in Section 4.5.1.2 of the LAR. A sensitivity study of these four deviations that calculate the aggregate CDF and LERF when these deviations are replaced by methods aligned with NUREG/CR- 6850 is provided in Attachment W of the LAR. Please describe each of these deviations from NUREG/CR 6850 in more detail. Include in this description, identification of what values were changed, which Fire Areas were impacted for each deviation, and a description of the analyses leading to the PRA results. In addition, please discuss the intentions regarding the treatment of each of these deviations in the FPRA post-transition.

Probabilistic Risk Assessment RAI 07

Deviations from NUREG/CR 6850 beyond the four identified in Section 4.5.1.2 of LAR were noted. Regarding these deviations, please address the following:

a. The first of these deviations is crediting a hot work procedural non-compliance factor of 0.01 for Compressor Area Room 19 (FC32), Switchgear Room FC36A, and Switchgear Room FC36B. This deviation is the subject of Item #3 in the supplement to the LAR dated December 19, 2011 (ADAMS Accession No. ML113540334). For this deviation, the non-compliance factor should be removed since this factor is implicitly included in the hot work fire frequency. Please indicate any other physical analysis units/fire areas in which this factor is applied. For all cases, indicate the effect of removing this factor on CDF, LERF, ΔCDF, and ΔLERF.

b. The second deviation is crediting a continuous fire watch on storage of combustibles through a non-suppression factor of 0.01. In the case of the roof of FC32, this fire watch credit is applied for all combustible loading; in the case of the Cable Spreading Room (FC41), this fire watch credit is applied for combustibles above 5 lbs. The use of the non-suppression factor must be justified, keeping in mind that the continuous fire watch generally provides detection, but not necessarily suppression. The scenario for the roof should take into account the full range of combustibles that are expected to be located on the roof, as well as the possible locations of those combustibles on the roof. Should the fire watch perform a suppression function, it should be confirmed that one of the fire watch's purposes is to extinguish the fire, that an extinguisher will be readily available, and that the fire watch will have undergone adequate training in the use of extinguishers. Also, the time over which the combustibles are to be placed in each location must be described. Please provide the effect of the second deviation on CDF. LERF, ΔCDF, and ΔLERF. For the justification of non-suppression, address the detection and suppression

timing, the combustible storage limit, and any other key assumptions. If this type of non-suppression credit is used elsewhere in the fire PRA, identify and discuss along similar lines, ensuring that the physical analysis unit/fire area in which it is used is identified.

c. Please identify and describe any other deviation from NUREG/CR-6850 not already identified and described in this RAI or in Section 4.5.1.2 of the LAR (the subject of another RAI). Provide a sensitivity analysis of each of these other deviations from NUREG/CR-6850. Provide the composite impact on CDF, LERF, ΔCDF, and ΔLERF from the sensitivity studies applied upon removal of all deviations identified in this RAI and the four deviations identified in the LAR.

Probabilistic Risk Assessment RAI 08

Calculation EA10-039 identified approximately 50 valves and instruments where failure likelihood was evaluated using option 1 (Table values 10-1 thru 10-5) of NUREG/CR-6850 Chapter 10. It was recently stated at the industry fire forum that the Phenomena Identification and Ranking Table Panel being conducted for the circuit failure tests from the DESIREE-FIRE and CAROL-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, Vol. 2, as being invalid 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 on CDF, LERF, ΔCDF, and ΔLERF.

Probabilistic Risk Assessment RAI 09

Describe the methodology that was used to evaluate defense-in-depth. The description should include what was evaluated, how the evaluation was performed, and what, if any, actions or changes to the plant or procedures were taken to maintain the philosophy of defense-in-depth.

Probabilistic Risk Assessment RAI 10

Please describe the methodology used to evaluate safety margins.

Probabilistic Risk Assessment RAI 11

While Attachment W of the LAR provides the ΔCDF and ΔLERF for the VFDRs for each of the fire areas, the LAR does not describe either generically or specifically how ΔCDF and ΔLERF were calculated. Please describe the method(s) used to determine the changes in risk reported in the Tables in Appendix W. Include in the description discussion of specific PRA model additions or modifications needed to determine the changes.

Probabilistic Risk Assessment RAI 12

Please describe any PRA methods used for the plant modifications identified in LAR Attachment S, and for other plant modifications, that were not included in the PRA at the time of the FPRA peer review. Include a discussion of any basic events or models added to the PRA to address these modifications.

Probabilistic Risk Assessment RAI 13

There are several implementation items in LAR Attachment S that have not been completed but which have been credited directly or indirectly in the change-in-risk estimates provided in Attachment W. When an implementation item has been included in the PRA but not yet implemented, the models and values used in the PRA are necessarily estimates based on current plans. The as-built facility after implementation is completed may be different than the plans. Please add an implementation item that, upon completion of all PRA credited modifications (including procedural modifications), verify the change-in-risk estimate reported in the LAR. This implementation item should include your plan of action should the as-built change-in-risk exceed the estimates reported in the LAR.

Probabilistic Risk Assessment RAI 14

It is not clear that the quality of the IEPRA against the requirements of RG 1.200, Rev. 2 is established. Based on the LAR and clarifications in a LAR supplement dated December 22, 2011 (ADAMS Accession No. ML11363A077), the most current full peer review was performed in 1999 well prior to when the ASME PRA standards were first issued. The only full gap assessment against the PRA standards was performed in 2003 against a draft version of RA-Sa-2003. There were a number of changes in the internal events SRs between the draft RA-Sa-2003 and the RA-Sb-2005, and a few minor changes between RA-Sb-2005 and RA-Sa-2009, the current version of the standard (as endorsed by RG 1.200). A handful of focused scope reviews and self assessments were performed after the 2003 gap assessment. Notable was a 2006 focused scope self assessment in which 41 SRs from a ASME RA-Sb-2005 draft standard applying to Mitigating Systems Performance Indicators (MSPI) were assessed and for which it is stated that "the remaining SRs were also reviewed but to a lesser degree of scrutiny." The LAR supplement provides a roadmap of the different PRA reviews performed since the 1999 peer review and attempts to make the case that review against the RA-Sa-2009 version of the PRA standards and RG 1.200, Rev. 1 is established. However, the differences between all the SRs in the draft ASME RA-Sa-2003 standard used in the 2003 gap assessment and the RA-Sa-2009 version have not been identified and dispositioned as being addressed in the intervening assessments. Please explain how the quality of the IEPRA meets the requirements of RG 1.200 given the changes between the ASME standard which your PRA was peer reviewed against and the current version of the standard as endorsed by RG 1.200, Rev. 2.

Probabilistic Risk Assessment RAI 15

Please clarify the following dispositions to IEPRA peer review findings identified in Attachment U of the LAR, Table 6-2 of LTR-RAM-II-10-046, Revision 1, and from the 2007 PRA Self Assessment (SA-07-48) that appear to have the potential to noticeably impact the fire PRA results but which do not seem to be fully resolved.

a. The disposition to SR IE-A8 on page 10 of the 2007 PRA Self Assessment Report (SA-07-48) acknowledges that no interviews were specifically performed to meet this SR. (This SR is also identified in Attachment U, Table U-2 of the LAR). Please summarize efforts that contribute to ensuring comprehensive identification of initiating events, describe how sensitive this process is to possible incompleteness in the internal initiating event models, and, based on these summaries, explain why interviews are not needed to provide confidence that the IE's have been appropriately characterized.

b. LAR Attachment U, Table U-2 indicates that SR SY-A4 is met at only CC-I. In light of this, please describe what efforts were made during the systems analysis to correctly reflect the as-built, as-operated plant. Include in this explanation: identification of walk

downs or interviews performed in support of the PRA, the scope and extent of those efforts, and who performed them (e.g., PRA staff, engineering, plant operations, etc.).

c. F&O SY-01-GA identified in LAR Attachment U, Table U-1 (originating from the 2006 gap self assessment) finds that component boundaries used in the PRA models were not matched to component boundary definitions of the component failure data. Please explain what impact inconsistent boundaries definitions might have on the FPRA. Clarify, whether review of component boundary definitions has been completed, and if so provide a sensitivity analysis to determine the impact to the FPRA CDF and LERF, and Δ CDF and Δ LERF. Also, please justify that any inconsistent boundaries (e.g., placement of isolation breakers) does not mask identification of dependencies or insights important to the FPRA.

d. F&O QU-02-GA identified in LAR Attachment U, Table U-1 (originating from the Internal Events GAP Review) found that state-of-knowledge correlations between event probabilities were not performed for the IEPRA. This SR remains unresolved. Please explain how state-of-knowledge correlations were addressed for the FPRA, both those in the internal events models' events, and those added by the fire events. If state-of-knowledge correlations were not addressed, please provide an estimate of the impact of not considering state-of-knowledge correlations including impact to the FPRA CDF and LERF, and ΔCDF and ΔLERF.

e. LAR, Table V1, indicates that SRs LE-C9, LE-C11, and LE-C13 are not met. The 2007 PRA Self Assessment points out that Level 2 modeling is conservative because no credit was taken in the Containment Event Tree (CET) for system operation or human actions under adverse environments or after containment failure. The 2007 self assessment also states that no credit was taken for "scrubbing". Please clarify what credit was taken in the CET supporting the fire PRA. Justify that the lack of modeling detail in the CET does not mask important insights or dependencies for the FPRA.

f. F&O DA-01-GA is identified in the 2007 PRA Self Assessment report (SA-07-48) as Not Met. This F&O is not identified in LAR Attachment U, Table U-2 nor is it identified or dispositioned in the LAR, Table V1. Please explain how coincident maintenance on redundant equipment (both intrasystem as well as intersystem) was addressed for the IEPRA and how it impacted the FPRA. If it was not addressed or only partly addressed please provide the quantitative impact to the FPRA CDF and LERF, and Δ CDF and Δ LERF.

g. The 2007 PRA Self Assessment SA-07-48 identifies SR QU-E4 as Not Met against the 2005 version of the American Society of Mechanical Engineers (ASME) PRA standard, but it is not identified in LAR Attachment U-2 nor is it identified or dispositioned in LAR Table V1, so there appears to be no F&O against this SR. Complicating this omission is the fact that the content and wording for SR QU-E4 changed between the 2005 and 2009 versions of the ASME PRA standard. In light of this and consistent with the 2009 version of the standard, please identify how the IEPRA is affected by important model uncertainty and assumptions and the impact of this on the FPRA. If a finding exists against this SR, provide the finding and corresponding resolution.

Probabilistic Risk Assessment RAI 16

The 1999 Westinghouse and Combustion Engineering Owners Group (CEOG) peer review is the last full peer review of the IEPRA. A number of F&Os resulting from this peer review (based on the supplement to the LAR dated December 19, 2011, ADAMS Accession No. ML113540334) are not resolved or there was not enough information in the F&O disposition to understand if they were resolved. The following appear to have the potential to noticeably impact the fire PRA results.

a. The 1999 peer review found that isolation of Component Cooling Water (CCW) to the Spent Fuel Pool (SFP) heat exchangers on a containment isolation signal was not modeled in the PRA (see F&O SY-11). The disposition for this F&O indicates that potential flow diversion is not considered to be significant, and so this flow diversion remains "not modeled". Please provide the impact on the fire CDF and LERF, and on Δ CDF and Δ LERF, if any, of not modeling this flow diversion.

b. The 1999 peer review found that the AFW system model should include an additional demand for FW-10 (the secured pump) to start given the failure to run of an operating pump (see F&O SY-21). The disposition to this F&O indicates that this failure combination was not modeled in the PRA. Please provide the impact on the fire CDF and LERF, and on Δ CDF and Δ LERF, if any, of not modeling this failure combination.

Probabilistic Risk Assessment RAI 17

The 1999 peer review of IEPRA and the FPRA peer review found several cases where dependency analysis had not been performed in the HRA for cut sets containing multiple operator errors (see DA-7 and FQ-A-01). Additional issues were identified that the HRA documentation was limited and that the process of obtaining operator review or input was not provided (see F&O HR-3 and HR-4). It appears that the HRA evaluations migrated to the EPRI HRA Calculator after the 1999 peer review. Migration of the HRA to the EPRI HRA Calculator would appear to be a PRA upgrade that would warrant a Focused Scope Peer Review per ASME/ANS-SA-Ra-2009, as endorsed by RG 1.200. Instead of a focused scope Peer Review, this upgrade was reviewed as part of the 2007 PRA Self Assessment. Please explain how the self assessment, as applied to the HRA element, meets the RG 1.200 endorsed ASME/ANS-SA-Ra-2009 PRA standard and industry peer review guidance that requires focused scope peer reviews for PRA upgrades. If it is determined that this self assessment does not meet the RG 1.200 endorsed standard and guidance as a focused scope peer review, please identify what actions will be taken to address this review deficiency.

Probabilistic Risk Assessment RAI 18

The LAR indicates that a full peer review was performed in 1999 for the IEPRA and in 2010 for the FRPA and gap or self assessments have been performed periodically since these peer reviews. The LAR also indicates that the PRA model has been revised periodically and some of these revisions included changes to address findings from these past peer reviews and self assessments. Please identify any changes made to the IEPRA or FPRA since the last full-scope peer review of each of these PRA models, that are consistent with the definition of a "PRA upgrade" in ASME/ANS-RA-Sa-2009, as endorsed by RG 1.200. Also, please address the following:

a. If any changes are characterized as a PRA upgrade, identify if a focused-scope peer review was performed for these changes consistent with the guidance in ASME/ANS-RA-Sa-2009, as endorsed by Regulatory Guide 1.200, and describe any findings from that focused-scope peer review and the resolution of these findings for this application.

b. If a focused-scope peer review has not been performed for changes characterized as a PRA upgrade, describe what actions will be implemented to address this deficiency.