Lent, Susan

From:	Wilkins, Lynnea
Sent:	Friday, February 22, 2013 10:28 AM
To:	LIPPY, DONNA L
Cc:	HANSHER, BILL R; EDWARDS, MICHAEL L; Sebrosky, Joseph; Robinson, Jay; Fields, Leslie; Lent, Susan; Burkhardt, Janet
Subject:	DRAFT: Fort Calhoun NFPA 805, Second Round RAIs (ME7244)
Attachments:	ME7244 2nd Round RAIs Email.docx

Donna,

By letter dated September 28, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML 112760660), as supplemented by letters dated December 19 and 22, 2011, and March 20, 2012 (ADAMS Accession Nos. ML 113540334, ML 11363A077, and ML 12083A147, respectively), Omaha Public Power District, (the Licensee), submitted a license amendment request (LAR) to transition their fire protection licensing basis at the Fort Calhoun Station, Unit 1, 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).

A review team, consisting of U.S. Nuclear Regulatory Commission (NRC) staff and contractors from Pacific Northwest National Laboratory (PNNL) and the Center for Nuclear Waste Regulatory Analyses (CNWRA) participated in a regulatory audit of Fort Calhoun in Blair, NE from March 5 - 9, 2012. By letter dated April 26, 2012, (ADAMs Accession No. ML12198A406) the NRC issued requests for additional information (RAIs). By letters dated July 24, 2012 (ADAMs Accession No. ML12208A131), August 24, 2012 (ADAMs Accession No. ML12240A151), and September 27, 2012 (ADAMS Accession No. ML12276A046) the licensee provided responses to the RAIs.

The NRC staff has have reviewed the information provided by the licensee and determined that additional information specified in the attached RAI is needed for the staff to complete its evaluation.

The staff is proposing a 60 calendar day response time from the date of draft issuance (this email). Though identified as draft items subject to the need for clarification, they are firm relative to the information being requested.

In addition, please note that review efforts on this LAR are being continued and additional RAIs may be forthcoming. Please contact me or Joe Sebrosky if a clarifying teleconference is needed for the RAI.

Thanks

Lynnea Wilkins, Project Manager
Fort Calhoun Station, Unit 1
Cooper Nuclear Station
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation
US Nuclear Regulatory Commission
Phone: 301-415-1377

Fire Modeling RAI 04.01

By letter dated July 24, 2012, the licensee responded to Fire Modeling RAI 04b.

Please provide additional details regarding the processes and procedures in place to ensure that personnel and contractors who will perform fire modeling during and after the transition to National Fire Protection Association Standard 805 (NFPA 805), "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," have the necessary qualifications.

Fire Modeling RAI 06

a. The responses to PRA RAI 01.c.ii in the July 24, 2012 letter and to Fire Modeling RAI 01.c in the August 24, 2012 letter (ADAMS Accession no. ML12240A151) discuss modeling of cable tray fires. The response to PRA RAI 01.c.ii indicates that fire is propagated from the ignition source to the overhead cables, indicating that fire is propagated vertically. Additionally, the response states that the fire growth profile of the ignition source and ignited cable tray configuration are summed to obtain the overall fire growth profile. However, the response to Fire Modeling RAI 01.c does not address how the combined HRR was addressed nor how the higher HRR impacts the ZOI. Please explain how the effect of the increased HRR due to vertical propagation to cable trays on the ZOI (in all aspects), and the resulting targets selected for damage in the PRA, were determined.

b. The response to FM RAI 01.c (Part 2) states that the rate of horizontal flame spread along the cable tray is conservatively not credited because the entire characteristic length is modeled to ignite instantaneously. This is consistent with the guidelines in Section R.4.2.1 of NUREG/CR-6850. However, a characteristic length of 1 ft was assumed which deviates from Section R.4.2.1 of NUREG/CR-6850. Please quantify the effect on the ZOI, hot gas layer (HGL) development and risk (CDF, LERF, delta (Δ)CDF and ΔLERF) of using a) The width of the vertical section of origin for fires in cabinets that have vertical barriers (switchgear, MCCs, control panels in relay rooms, auxiliary control rooms, etc.) or, b) The width of the cabinet if it is a single cabinet with no vertical barriers, as the characteristic length for calculating fire propagation in and HRR of horizontal cable trays.

Fire Protection Engineering RAI 10.01

By letter dated July 24, 2012, the licensee responded to Fire Protection Engineering RAI 10c and indicated that the manual suppression equipment for the yard transformers are located in nearby hose houses that contain "adjustable spray-solid stream nozzles." However, this response does not provide full compliance with NFPA 805, specifically with regards to maintaining "listed electrically safe fixed fog nozzles" for "locations where high-voltage shock hazards exist" as required by NFPA 805, Section 3.6.3. Please provide further justification for the acceptability of the use of non-electrically safe nozzles capable of providing a solid stream in areas containing high voltage equipment (for example, the yard). In addition, for any non-electrically safe nozzles co-located with electrically safe nozzles in areas of high voltage equipment, please describe how the different nozzles are labeled such that brigade members can identify which nozzle type is which.

Fire Protection Engineering RAI 12.01

By letter dated July 24, 2012, (ADAMS Accession No. ML12208A131) the licensee responded to Fire Protection Engineering RAI 12 and removed the missing implementation item and changed the compliance statement from "Complies with Required Action" to "Complies" and "Complies with Use of EEEEs." However, no existing engineering equivalency evaluation (EEEE) was identified in the response, instead it stated that the license amendment request (LAR) will be updated to provide the referenced document. Please please identify and provide a short description of the new EEEE referred to in the original response.

Fire Protection Engineering RAI 16.01

a. LAR Attachment L, Request 3, states that "most of the wiring and cabling that is installed above the suspended or dropped ceilings is in conduit and/or is IEEE-383 qualified." Attachment L, Request 3 further states under "Basis for Request" that "only a minimal amount of wiring installed above suspended ceilings...is not rated for plenum use or wrapped in conduit." The "Basis for Request" goes on to state that "identified cabling is routed in conduit or raceway and/or is IEEE-383 qualified." Attachment L, Request 3 appears inconsistent as to the actual qualification or rating of existing wires above suspended ceiling.

   Further, it appears an institute of electrical and electronics engineers (IEEE)-383 qualification is equated to a plenum-use rating which is incorrect. NFPA 805 Section 3.3.5.1 requires cables above suspended ceilings to be plenum-rated, routed in armored cable, routed in metallic conduits, or routed in cable trays with solid metal top and bottom covers. NFPA 805 does not list IEEE-383 as satisfying this requirement. IEEE-383 is a flame spread characteristic whereas the term "plenum-rated" characterizes flame spread and damage threshold. Therefore, the IEEE-383 qualification alone does not meet the requirements of NFPA 805 Section 3.3.5.1. Re-evaluate the cables located above suspended ceilings with regards to NFPA 805 Section 3.3.5.1. Please provide clear descriptions to separate between those that do and do not meet NFPA 805 Section 3.3.5.1 requirements. Revise Attachment L, Request 3 and Table B-1, Section 3.3.5.1 compliance statement, as necessary.

b. Cabling introduces both a combustible load and potential ignition source to an area, to varying degrees. Attachment L, Request 3 is requesting that certain cables remain in these concealed spaces without the protection required by NFPA 805 which is a potential

reduction in the defense-in-depth (DID) and/or safety margin. The DID discussion should be revised to describe how each layer of DID is adequate and/or compliments the other layers.

Please clarify the following in Attachment L Request 3:

i. What voltage the cables carry.
ii. Whether a fire detection system is installed above the suspended ceiling(s) in the control room (CR) area.
iii. Whether the Gai-tronics cables, fire detection circuits, and lighting/power circuit cables are relied upon to perform any required safe shutdown or fire protection duties.
iv. That if a fire event were to damage these unprotected cables, whether or not the plant would remain capable of performing its safe shutdown and fire protection functions as required.
v. Whether fire damage to these cables (e.g. fire detection, Gai-tronics, etc) would adversely impact the radiological release performance criteria with regards to fire suppression run-off and smoke effluents.
vi. Whether the presence of air handling unit VA-67 in fire area 19 presents a hazard with regards to these non-rated and non wrapped cables.
vii. Whether the cables compromise fire protection for systems and structures.

Fire Protection Engineering RAI 18.01

By letter dated July 24, 2012, the licensee responded to Fire Protection Engineering RAI 18.

a. The letter indicated that Approval #7 would be deleted as compliance with NFPA 805 section 3.11.5, is being met through Exception #2. The licensee stated that these electrical fire barrier raceway system (ERFBS) assemblies being installed prior to issuance of Generic Letter 86-10, Supplement 1, "Fire Endurance Test Acceptance Criteria For Fire Barrier Systems Used To Separate Redundant Safe Shutdown Trains Within The Same Fire Area," were tested against the end point temperature requirements similar to the acceptance criteria of NFPA 251, "Standard Methods of Tests of Fire Resistance of Building Construction and Materials." Please provide a detailed description of the ERFBS testing performed, including the end point temperatures reached and the acceptance criteria used.

b. Please describe whether the ERFBS enclosure protecting cable tray 54S (formerly separating fire area 36C from 36B) should also be listed under Table B-1, Section 3.11.5, Exception #2.

c. During the site audit walk down of fire area 36A (east switchgear room), the NRC staff noticed the horizontal Pyrocrete assembly intersected with a non-protected cable tray (approximately mid-room). The Pyrocrete configuration at this intersection did not appear to match the normal Pyrocrete assembly, nor the description contained in Attachment L, Approval #7, page L-14. Please clarify whether the configuration at this intersection is acceptable and meets the analyzed configuration. Please provide the basis for the conclusion and any reference to the engineering analysis and testing. Identify the non-protected cables intersecting this Pyrocrete assembly (e.g. division, equipment/system).

Fire Protection Engineering RAI 21

Regarding LAR Attachment L, Request 1 and Table B-1, Section 3.3.1.2(1):

a. Please identify what other equipment, besides hand tools, is meant by "commonly available equipment".

b. For "commonly available equipment" other than hand tools:

   i. Please clarify whether and how all untreated wood is administered under the combustible control program.
   ii. Please clarify whether and how quantities will be within the transient and in-situ fire loads calculated in the fire hazards analysis (FHA), the fire probabilistic risk assessment (FPRA), and any associated fire modeling calculations.
   iii. Please clarify whether and how any loading that exceeds the permissible loadings will be reviewed by a fire protection engineer to identify and implement any special precautions or limitations.
   iv. Please provide justification on the acceptability of any untreated wood in close proximity of ignition sources or equipment important to safety.
   v. Please clarify whether and how this performance-based method does not change the assumptions and limitations of the analytical methods used in the development of the FPRA.
   vi. Please clarify whether and how untreated wood within the power block will directly compromise fire protection for systems and structures, or post-fire safe shutdown capability.

Fire Protection Engineering RAI 22

Attachment L, Request 2 states that "a significant portion of transient combustible material at FCS consists of temporary scaffolding that is constructed in place or combustible equipment/supplies that are not easily relocated due to size, weight or bulk."

a. Please identify the "combustible equipment/supplies that are not easily relocated due to size, weight or bulk." Provide several examples of equipment/supplies that fall into this category.

b. Please clarify what limitations and administrative controls are in place to:

   i. Limit the combustible load/quantity.
   ii. Limit the type of combustible material.
   iii. Limit the total time present within the power block.

c. The request makes the statement that an hourly fire watch would be an appropriate compensatory measure to address these additional combustibles. The staff notes that from a risk perspective, periodic fire watch patrols (hourly) do not provide a significant risk reduction as a compensatory measure. Please provide a quantitative analysis that demonstrates that an hourly fire watch patrol would adequately compensate for the increased fire risk of a substantial increase in combustible fuel load.

d. From a combustible loading standpoint, treated wood used in temporary scaffolding constructed in place does not present a major fire risk. The staff sees the request to be

exempted from the requirement to remove this combustible material at the end of the shift as reasonable. However, the request and its associated acceptance criteria evaluation must be revised to address the limited scope of this request. Other aspects of scaffolding need to be evaluated and addressed as necessary on a case-by-case basis. The NRC staff cannot make a blanket approval of scaffolding installations since numerous other considerations must be addressed.

For instance, the installation of substantial quantities of scaffolding can adversely impact fire detection and both automatic and manual fire suppression functions. Please provide justification for the statement that the introduction of temporary scaffolding that is constructed in place does not impact fire protection defense-in-depth. The installation of scaffolding can have a significant impact on fire detection and suppression systems due to obstruction of air flow and to manual suppression due to physical access to fight fires. Scaffolding can also have an adverse impact on safety margins. Scaffolding can result in significant degradation of detection and suppression system effectiveness, resulting in response substantially below assumptions in approved codes and standards. Please provide justification for the statement that following the introduction of temporary scaffolding... "the safety margin inherent in the analysis of the fire event has been preserved."

e. As presently written, the request discusses "combustible equipment/supplies that are not easily relocated due to size, weight or bulk" with no discussion of limitations and/or controls with regard to combustible loading. Significant increases in combustible loading can have an adverse impact on safety margins since the increase could result in fire size exceeding the capability of installed suppression systems to control and extinguish the fire. In addition, additional combustible loading can result in fuel loading outside the assumptions used in designing the systems in accordance with NFPA codes and standards (NFPA 13, 15, etc.). Please provide additional justification for the statement that this performance-based change will preserve the safety margin in the fire protection program.

Fire Protection Engineering RAI 23

In EA-FC-95-022, the referenced EEEE code compliance for NFPA 51B, "Standard for Fire Prevention During Welding, Cutting, and Other Hot Work," refers to (Implementation Item) REC-033 regarding a conflict meeting Section 3-1(b) of NFPA 51B. However, REC-033 is not identified in the LAR. This appears to be an oversight. If not, please provide justification for not including REC-033 in the list of items needing to be completed during NFPA 805 implementation in Attachment S-3.

Fire Protection Engineering RAI 24

In Table B-1, Section 3.3.1.3.1, the referenced procedure, SO-M-9, allows roving hot work fire watches. This does not meet the requirements or intent of NFPA 51B nor branch technical position (BTP) 9.5-1, "Guidelines For Fire Protection For Nuclear Power Plants," requirements. Based on the staff's review of SO-M-9, the document should be revised to be compliant with the requirements of NFPA 51B, or NRC approval should be requested. If the licensee desires to include roving hot work fire watches in the performance-based NFPA 805 fire protection program, please submit a request in accordance with 10 CFR 50.48(c)(2)(vii) and provide justification that the change meets the requirements for risk, DID and safety margins.

Fire Protection Engineering RAI 25

In regards to Table B-1, Section 3.3.1.3.4, implementation Item REC-004 will update plant procedure FCSG-15-11 to include "prohibit[ing] the use of portable fuel-fired heaters in safety related areas..." NFPA 805 Section 3.3.1.3.4 states that portable fuel-fired heaters shall not be permitted in plant areas containing equipment important to nuclear safety. Please provide justification that prohibiting fuel fired heaters in only safety related areas will encompass all plant areas containing equipment important to nuclear safety.

Fire Protection Engineering RAI 26

Attachment L Request 4 is not clear as to exactly what is requested. Table B-1 Sections 3.5.3 & 3.5.6 indicates the request is only for the remote stopping of fire pumps. In contrast, only the acceptance criteria evaluation section of Attachment L Request 4 mentions the ability to remotely stop the fire pump (FP-1A). The main body, including the basis for request and conclusion sections, indeterminately present various code requirements beyond the remote stopping requirement in a way that generates confusion as to what exactly is being requested.

a. NFPA 805 does not contain a specific requirement regarding remote stop features; however, NFPA 20, "Standard for the Installation of Stationary Fire Pumps for Fire Protection," Section 7-5.2.3 does prohibit such features. Please identify, clearly and concisely, the exact request(s) asked for and include the associated code requirement(s). Clarify the purpose and the intended scenarios regarding the use of this remote stop switch.

b. The request addresses the function of the PULLOUT switch under normal circumstances. The request does not address the impact on the fire protection program (FPP) of a fire in the MCR. Please describe the possible failure modes of the PULLOUT switch and their impact on the fire protection water supply. Please identify if there are any fire-induced failure modes that can either prevent the automatic starting of pump P1A or stop P1A once automatically or manually started. If fire-induced damage can stop the operation of P1A, provide justification for the acceptability of this condition.

c. In addition, Attachment L Request 4 describes the FP-1A remote stop switch as an existing pullout switch which also overrides the pump's automatic start capability when in the PULLOUT position. This preventing or overriding the automatic start of a fire pump is not in compliance with NFPA 805 Section 3.5.6; however, Attachment L, Request 4 does not appear to include this as a specific request. Please clarify whether a request is needed for the pullout switch's ability to override the automatic start function. Please clarify the purpose and the intended scenarios regarding the use of this remote pullout switch.

d. As necessary, the Attachment L Request 4 discussions on safety margin and DID should be revised to account for all its identified requests (e.g. automatic start override, remote stop, etc).

Fire Protection Engineering RAI 27

NFPA 805 Section 3.6.1 states all power block buildings shall have a Class III standpipe and hose system installed in accordance with NFPA 14, "Standard for the Installation of Standpipes

and Hose Systems." Table B-1 Section 3.6.1 indicates "Submit for NRC Approval" via Attachment L, Request 6 for use of hose lengths greater than allowed by NFPA 14. The Attachment L, Request 6 introduction mentions the cable spreading room (CSR) and containment; however, the discussions only include the CSR. In addition, LIC-77-0103 (9-27-77), and respective NRC letter dated 10-17-77, appear to grant previous NRC approval for lack of hose stations inside containment which is not claimed. Please clarify whether previous approval, if valid, will be claimed for lack of hose stations inside containment. If claimed, revise Table B-1, Section 3.6.1 to include the appropriate compliance statement. Please reference any applicable documentation.

Fire Protection Engineering RAI 28

LAR Table 4-3 and Table B-3, for Fire Area 47, credits the transformer deluge water spray system as required for risk significance; however, Table B-1, Section 3.9.1(2), regarding compliance with NFPA 15, "Standard for Water Spray Fixed Systems for Fire Protection," states there are no water spray systems credited for NFPA 805. Please clarify the correct compliance statement. Revise Tables 4-3, B-1, and B-3 as applicable to reflect correct compliance and credit.

Safe Shutdown RAI 12.01

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 association with a potential HEAF, and subsequently reduce the risk calculated for fire areas 36A and 36B.

Please provide complete design and construction information for the HEAF barriers and supporting structures including dimensions, materials, construction types, etc. In addition, describe how the zone of influence (ZOI) was translated into the physical dimensions of the HEAF barrier, and also how the HEAF barrier will be tested to ensure it will mitigate a HEAF. Please include in the response pictures, drawings or renditions of the 4 kv switchgear and related equipment and bus ducts for Fire Areas 36A and 36B.

Safe Shutdown RAI 14

LAR Attachment T Clarifications to Approved Exemptions – For the requests for approval regarding the previously approved exemptions, provide clarifications as follows:

a. Prior Approval Clarification Request 1 (page T-2): For steam generator (SG) level and pressure instrumentation, reactor coolant system (RCS) temperature instrumentation, and source range monitoring in the containment, cable routing is provided in the original exemption. Because instrument sensing line tubing was not addressed in the original exemption, Attachment T requests that this tubing be included in the exemption as well.

   The original SER identifies acceptable separation criteria for cables in various areas of the containment. The LAR clarification states, "The instrument sensing line routings meet these criteria and therefore are considered to be covered under this exemption. Based on this assumption, the instrument sensing lines have adequate separation to support NFPA 805 safe shutdown requirements for providing at least one channel of reliable indication for process monitoring of pressurizer level and pressure, and steam generator level and pressure."

   Please provide a more detailed description of the instrument sensing line separation.

b. Prior Approval Request 1: For SG level and pressure instrumentation, and RCS temperature instrumentation describe the redundant channel availability for fires in the containment. The background/basis describes the separation for redundant trains of safe shutdown components in this area including steam generator pressure and level transmitters, reactor coolant hot and cold leg temperature instrumentation, and neutron flux indication and all associated cables. It states that at least one channel of each will remain free of fire damage.

   Please provide clarification as to whether "free of fire damage" is for both RCS/SG loops or just one loop. If only one RCS/SG loop of instrumentation is available, justify why this is sufficient for safe shutdown.

c. Prior Approval Requests 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10, identify that because of "conservative re-quantification and additional assumed transient combustible material" the reported amount of combustibles in the original exemption(s) have increased but are still

considered low. Please provide a more detailed description of "re-quantification" and "additional transients". Describe whether a major source of combustible loading growth is attributed to additional cable(s) or modification(s) in the areas of concern. Please describe whether there have there been cables added in deference to the exemption granted in 1985, or does re-quantification make the analysis more accurate for the current cable loading. Describe how combustible loading "creep" will be controlled in the post-transition plant.

d. The separation schemes In Attachment 'T' and exemptions of Attachment K describe clarification of the previously approved exemption requests of the current licensing basis of Appendix R. NFPA 805 requires more equipment to be evaluated than just traditional Appendix R safe shutdown equipment. Please describe how the following elements of the FPRA are addressed specifically with regard to the other categories of equipment in:

   i. Containment isolation (LERF)
   ii. Internal Events PRA (IEPRA) equipment (CDF and LERF)
   iii. Spurious equipment that could affect the success of the mitigating safety functions credited in the FPRA
   iv. Equipment whose fire-induced failure will cause an initiating event to be modeled in the FPRA Model

   Because equipment lists for the FPRA consist of more than just traditional Appendix R analysis, please describe how the separation scheme described in Attachment T and K is used in NFPA 805. Describe whether there are separation schemes similarly applied to other components and systems added to the NFPA 805 FPRA where separation is credited.

Safe Shutdown RAI 15

LAR Attachment S, identifies the proposed plant modifications REC-119 (Train A 125VDC power), and REC-120 (Train B 125VDC power) for additional electrical isolation. The LAR for modification REC-119 states "this proposed modification will maintain DC Control power for Train A breaker and diesel generator control with no reliance upon operator manual actions for fire area 37 [battery room #1]". The LAR for modification REC-120 states the same for Train B breaker control in fire area 38 [battery room #2].

Apparently, the current design could result in the loss of EE-8F / EE-8G (DC distribution panel(s)) because of a fire in its' respective battery room. Relocating/additional fuses to provide isolation of the DC distribution panel(s) from their respective batteries is the proposed resolution.

Please provide a more detailed description of these modifications (how the manual disconnect will be modified), and breaker/fuse coordination curves to achieve the continued availability of DC distribution panels EE-8F and EE-8G. Explain how the modifications will eliminate reliance on the operator manual actions.

Safe Shutdown RAI 16

LAR Attachment S for the proposed plant modification REC-112 states "the purpose of these modifications is to ensure that the breakers will remain functional to trip on demand for automatic load shed, overcurrent, and manual control from the main control room. These modifications generally involve wiring changes within the switchgear cubicles, installation of additional

coordinated DC control power fuses within the switchgear cubicles, and/or installation of interposing relays within the switchgear cubicles." The applicable breakers are: 1A1-0 (FP-1A); 1A1-1 (FW-5A); 1A1-2 (FW-4A); 1A1-3 (FW-2A); 1A1-4 (CW-1A); 1A2-6 (CW-1B); 1A2-7 (FW-2B); 1A2-8 (FW-4B); 1A2-9 (FW-5B); 1A4-3 (CW-1C); 1A4-4 (FW-5C); 1A4-5 (FW-4C); and 1A4-6 (FW-2C).

The LAR for REC-112 also states "this proposed modification addresses issues associated with loss of overcurrent trip capability for load breakers (trip and lockout of credited switchgear and secondary fires). The proposed modification will maintain breaker manual trip capability from the main control room, protective trip, automatic load shed trip and accident signal trip for fire areas 31, 46, and 47."

Please provide a more detailed description of the modifications for various breakers (typical(s) for various breakers), including fuse coordination curves with the upstream protective devices.

Safe Shutdown RAI 17

LAR Attachment S for the proposed plant modification REC-117 states, "Modification to change the normal operating alignment for 480 V load center tie breakers BT-1B4A, BT-1B3B, and BT-1B4C from normally open and racked-in, to normally racked-out (or otherwise disabled from spuriously closing due to fire damage to DC breaker control circuits in the opposite Train 4kV switchgear room, main control room, or cable spreading room). This modification addresses the issue associated with electrical failure resulting from spurious connection of out-of-synch power sources (offsite power to diesel generator, diesel generator to diesel generator).

The LAR for REC-117 also states, "The proposed modification will maintain breaker manual trip capability from main control room, protective trip, automatic load shed trip and accident signal trip for fire areas 36A, 36B, 41 and 42."

According to NRC Special Inspection Report dated March 12, 2012 (ADAMS Accession No ML12072A128), there are interconnecting control wires (operated at 125 V DC) between 480V tie breakers in Electrical Switchgear Fire Areas 36A (East Switchgear) and 36B (West Switchgear) (typical - between breakers BT-1B3A and BT-1B4A). These wires are used in the control circuitry of the breakers. A fire in these breakers in either Switchgear Fire Area 36A or 36B can cause damage to the control wires (such as shorts to ground) in the opposite area breakers.

Considering the fire scenario explained in the above inspection report (fire across an open tie breaker BT-1B4A), explain how modification REC-117 will eliminate the damage to the interconnecting control wires between any two tie-breakers located in opposite fire areas, and thus potentially adversely impacting the operation of the opposite area/train tie-breaker. Please provide a schematic diagram for each of these breakers (typical) having interconnecting wires between the fire areas 36A and 36B. Also, provide time-overcurrent coordinating curves of the control fuses of these breakers and the next upstream protective devices.

Probabilistic Risk Assessment RAI 01.c.01

Components of an analysis of hot work induced cable fires have been provided through the response to RAI 01.c.ii in a letter dated July 24, 2012 (ADAMS Accession No. ML12208A131). Also, through the NRC staffs review, it has been established that only qualified cable is installed in the plant. A frequently asked question (FAQ 13-0005) is expected to be released for evaluating hot work induced cable fires, and self ignited cable fires in the FPRA. Among the differences from your approach for hot work induced cable fires, no suppression credit is given prior to damage of the cable tray in which the fire initiates. Also qualified cables must be evaluated for self ignited cable fires, if these cables are located in an under-ventilated area.

As a result, perform a sensitivity analysis on hot work induced cable fires, and self ignited cable fires addressing the above differences. Please provide the impact on CDF, LERF, ΔCDF, and ΔLERF as a result of this change.

Probabilistic Risk Assessment RAI 01.d.01

By letter dated July 24, 2012, the licensee responded to Probabilistic Risk Assessment RAI 01.d that the root cause of the peer reviewer-identified errors were "challenges reading the cable and raceway layout drawings...." This does not appear to be the cause of the specific error identified by the peer reviewer, who noted that four highly risk significant cable trays were not included as targets for ignition source FC36A-IS13 even though these cable trays were correctly identified in both the initial walkdowns and data verification walkdowns. In this case, the error appears to be due to incorrect transposition of the targets identified on the walkdown data sheets into the FPRA FSS database. Please explain how the sampling study, and other plant processes if applicable, addressed the potential for walkdown sheets-to-FSS database transposition errors. Indicate how these processes provide confidence that these types of errors were addressed.

Probabilistic Risk Assessment RAI 01.e.01

By letter dated July 24, 2012, the licensee responded to Probabilistic Risk Assessment RAI 01.e stating that the review of the Halon system operating history did not identify any "repeated patterns of system unavailability" and discussed the use of a continuous fire watch when the Halon system is declared inoperable. A continuous fire watch is an acceptable DID measure for an inoperable Halon system, but is not as reliable as an operating automatic Halon fire suppression system. As a result, please discuss whether the review of the Halon system operating history identified any outlier behavior such as any periods of extended unavailability and, if so, discuss how this behavior was included in the PRA. (e.g., inclusion of a basic event representing out of service unavailability due to failures, test, and maintenance).

To credit the continuous fire watch when the Halon system is inoperable, the detection and suppression must be discussed for fires associated with all the different types of ignition sources in the rooms containing the Halon system. In the case of transient fires, the full discussion needed for crediting manual suppression in the case of a continuous fire watch is described in PRA RAI 07.01. For electrical cabinet fires, a continuous fire watch may provide prompt detection. In order to credit manual suppression for a continuous fire watch in the case of an electrical cabinet fire, several considerations must be addressed in the quantitative analysis as follows: 1) Please discuss whether the fire watch is instructed to open the cabinet door and fight the fire upon its initiation or does he/she simply relay the occurrence of the fire to the MCR, 2) Please discuss the fire brigade response time if they must be summoned to the area to fight

the fire after the fire watch reports the fire, 3) Please discuss how much time prior to cable damage in the overhead is available after fire suppression activities have started, and 4) Please discuss fire suppression equipment staging and access to that equipment. If crediting the continuous fire watch when the Halon system is inoperable, provide a discussion of both detection and suppression for both electrical cabinet fires and transient fires, and related these elements directly to the quantification provided in the PRA.

Probabilistic Risk Assessment RAI 01.g.01

By letter dated July 24, 2012, the licensee responded to Probabilistic Risk Assessment RAI 01.g which does not provide sufficient justification for the conclusion that the cable routing assumptions described in response to Safe Shutdown RAI 03 is judged to negligibly impact the FPRA results and conclusions. Specifically, the table provided in response to "Assumption "c" of SSD RAI 03 identifies numerous scenarios where fire-induced failures of cables have not been included in the FPRA and are excluded without assessing the potential for fire damage. Thus failure of these cables could impact the FPRA results. The specific cables are as follows:

- Cables EA4220A-D, EA42222A-D – "there is minimal fire impact on AFW...."
- Cables EB4257C-D, EB4256C-D – "there is a relatively low frequency of fire..."
- Cable EB12191G – "This cable will be walked down..."
- Cable B1641B – "the cables will be walked down..."
- Cable B1655A – "the cables will be walked down..."
- Cables 7700A-B – "modeling the exact routing of the relevant cables is not expected to appreciably increase..."
- Cables 5022C-M – "there is minimal potential fire impact..."

The treatment of these cables in the FPRA is non-conservative and is contrary to the PRA standard (i.e., supporting requirement (SR) CS-A11, Note 11: "the Fire PRA should assume that those cables fail for any fire scenario that has a damaging effect on any raceway or location where the subject cable might reasonably exist"). For each of these cables please either provide further justification that they are not failed by a fire or provide an assessment of the impact on CDF, LERF, ΔCDF, and ΔLERF from appropriately considering their fire-induced failure. Please provide appropriate justification for any fire scenarios that are either qualitatively or quantitatively screened. Furthermore, provide an assessment of whether the FPRA meets SR FSS-E4. If this SR is not met, provide justification for why this is acceptable for the application or revise the FPRA as appropriate to meet SR FSS-E4.

Probabilistic Risk Assessment RAI 01.h.01

By letter dated August 24, 2012, (ADAMS Accession No. ML12240A151) the licensee responded to Probabilistic Risk Assessment RAI 01.h and stated "automatic suppression (if present in the exposed compartment) is credited to prevent fire propagation into the exposed compartment." Please discuss if this includes exposed compartments that rely on gaseous suppression systems (e.g., Fire Areas 36A, 36B, 41, 42, and 46). Gaseous suppression systems should not be relied upon to prevent fire propagation to the exposed compartment since failure of the barrier may degrade its ability to retain the concentration of the suppressant. If relevant, identify the fire areas where this assumption was made and assess the impact on the risk results of not crediting the gaseous suppression systems in the multi-compartment analysis.

Probabilistic Risk Assessment RAI 01.h.02

By letter dated August 24, 2012, the licensee responded to Probabilistic Risk Assessment RAI 01.h.ii and described what time available for manual fire suppression was assumed in the multi-compartment analysis for rated fire barriers. Discuss and justify how this time was determined and how the analysis was performed for non-rated fire barriers and barriers with non-rated propagation pathways (e.g., fire dampers, doors, penetrations, etc.).

Probabilistic Risk Assessment RAI 01.i.01

By letter dated July 24, 2012, the licensee responded to Probabilistic Risk Assessment RAI 01.i. Please address the following issues identified in the response to PRA RAI 01.i:

a. The sensitivity case ΔCDF for FC 20-1 and FC 34B-1 are substantially lower than the corresponding values for the base case, whereas the ignition frequencies generally increased as did the ΔLERF values. Please explain this anomalous result.

b. The sensitivity case ΔCDF and ΔLERF for the CSR, FC 41, is substantially lower than the corresponding values for the base case, whereas the ignition frequencies generally increased. Based on Note 4, this appears to be due to different modeling assumptions between the two cases. Also, Note 4 states that the ΔCDF and ΔLERF values for the CSR may be modified as a result of analysis performed in response to PRA RAI 01j. Please provide the revised results for CDF/LERF/ΔCDF/ΔLERF for the CSR (FC41) based on these issues.

Probabilistic Risk Assessment RAI 01.j.01

By letter dated July 24, 2012, the licensee responded to Probabilistic Risk Assessment RAI 01.j. Please address the following issues identified in the response to PRA RAI 01.j:

a. The response to RAI 01.j.iii justifies the use of a CCDP of 0.1 and conditional large early release probability (CLERP) of 0.01 where this failure probability represents both failures of equipment and operator actions. The justification for these CCDP and CLERP values is based on a qualitative feasibility assessment of the operator actions, which consists of a qualitative argument that the actions have been determined to be feasible. It may be acceptable to take the position that operator actions are dominant in the CCDP and CLERP. However, no quantitative assessment of failure of alternate shutdown was provided to verify the CCDP of 0.1 and CLERP of 0.01, given the operator actions dominate. Despite feasibility considerations being addressed, it is not obvious that a CCDP value of 0.1 (and CLERP of 0.01) represents the failure probability of an action of this complexity. Please provide further justification for the 0.1 and 0.01 by providing the results of the human failure event (HFE) quantification process described in Section 5 of NUREG-1921, "Fire Human Reliability Analysis Guidelines – Final Report", considering the following:

   i. The feasibility assessment of the operator action(s) associated with the HFEs, specifically addressing each of the criteria discussed in Section 4.3 of NUREG-1921.
   ii. The results of the process in Section 5.2.7 of NUREG-1921 for assigning scoping human error probabilities (HEPs) to actions associated with switchover of control to

an alternate shutdown location. Please address the bases for the answers to each of the questions asked in the Figure 5-4.

iii. The process in Section 5.2.8 of NUREG-1921 for assigning scoping HEPs to actions for performing alternate shutdown once switchover is accomplished. Please address the bases for the answers to each of the questions asked in the Figure 5-5.

iv. The results of a detailed human reliability analysis (HRA) quantification, per Section 5.3 of NUREG-1921 in place of items 2 and 3 if a CCDP as low as 0.1 (and CLERP as low as 0.01) is not attainable through the scoping approach. For the detailed study, please quantify the contribution via the evaluation of different scenarios upon MCR evacuation, including the sum of those scenarios in the results for the CCDP and CLERP.

b. Please provide justification for the assumption in response to RAI 01.j.iv that a fire must spread at least 0.5 meters on the main control board (MCB) to threaten abandonment. Furthermore, revise the response to this RAI to incorporate the results of (i.) above, as applicable.

Probabilistic Risk Assessment RAI 03.01

By letter dated July 24, 2012, the licensee responded to Probabilistic Risk Assessment RAI 03. The peer review determined SR PP-B4 to be met, however, the response to PRA RAI 03 states that the FPRA credits the pyrocrete enclosure in FC36C as a fire compartment boundary. SR PP-B4 specifically does not allow credit for raceway fire barriers, thermal wraps, fire-retardant coatings, radiant energy shields, or any other localized cable or equipment protection feature as partitioning elements in defining physical analysis units. Please provide the updated CDF/LERF/Delta CDF/Delta LERF from the impact of not crediting the pyrocrete barrier as a plant partitioning feature.

Probabilistic Risk Assessment RAI 07.01

By letter dated September 27, 2012 (ADAMS Accession No. ML12276A046), the licensee responded to Probabilistic Risk Assessment RAI 07. The sensitivity analysis provided in response to PRA RAI 07 for transient fires in FC28, FC32, and FC41 makes three key assumptions:

a. The sensitivity analysis credits the suppression curve for welding and cutting based on continuous fire watches 1) anytime combustibles are stored on the roof of Room 18 in FC32, 2) when greater than five pounds of combustibles are stored in FC41, and 3) anytime combustibles are stored in FC28. A continuous fire watch generally provides detection, but not necessarily suppression. To take prompt detection credit for a continuous fire watch, the combustibles must be observable at all times and the fire watch's line of sight must be unencumbered such that he/she can easily see the entire area being surveilled. [Note that the NRC staff does not consider the roving fire watches described in FCS procedures SO-M-9 and FCSG-15-35 to be equivalent to continuous fire watches because these procedures allow for the fire watch to check on hot work activity every five minutes rather than continuously.] Should the fire watch be credited for suppression with the welding and cutting suppression curve, other criteria besides those related to prompt detection must be met. In addition to the criteria for prompt detection, 1) one of the fire watch's purposes must be to extinguish the fire; 2) an extinguisher must be readily available for this action, including being located in the

vicinity being surveilled; and 3) the fire watch must have undergone adequate training in the use of extinguishers. A more capable suppressant system (i.e. fire hose) can be used in place of an extinguisher to qualify for this credit given proper training, and given that the prompt detection criteria are met. However, a discussion of the staging and rapidity with which the suppressant can be applied must be provided to demonstrate that the hose stream can be applied as rapidly as the fire watch would apply an extinguisher. The credit for suppression via the use of continuous fire watches credited in the sensitivity analysis should be discussed and justified in light of the criteria for both prompt detection and for suppression.

The estimate of the non-suppression factor must be justified based on detection and suppression times. If this type of non-suppression credit is used elsewhere in the fire PRA, please identify and discuss along similar lines, ensuring that the PAU/fire area in which it is used is identified. Absent a complete response that demonstrates that all the fire watches are continuous fire watches and meet the criteria for prompt detection and suppression, apply the transient fire suppression curve where the criteria are not met, and provide an assessment of the impact on the PRA results (CDF, LERF, ΔCDF, ΔLERF).

b. The sensitivity analysis credits the HRR probability density function from "Motors" from NUREG/CR-6850 for transient fires, rather than the transient combustibles HRR probability density function. The 98th percentile HRR is 69 kW for "motors," rather than 317 kW for transient fires.

No basis is provided for why postulated transient combustible fires in FC32 and FC41 have an HRR distribution similar to that of the electrical motor fires included in the NUREG/CR-6850 distribution for "Motors." Furthermore, with regard to the five pound combustible limitation in FC41, Table G-7 of NUREG/CR-6850 provides numerous fire test examples where combustible quantities of five pounds and less yielded transient fires having peak HRRs greater than 69 kW. Please provide justification that the 69 kW HRR distribution for electrical motor fires bounds the postulated transient fires in FC32 and FC41. In the response, address the full range of types and quantities of combustibles that are expected to be located in each location. If adequate justification cannot be provided that the 69 kW HRR distribution is bounding, provide a revised sensitivity analysis that either uses the normal transient HRR distribution from NUREG/CR-6850 or an appropriately justified alternate HRR distribution. Please provide a description of the revised sensitivity analysis and the impact on the PRA results (CDF, LERF, ΔCDF, ΔLERF).

c. The sensitivity analysis did not address the additional risk from combustible control violations where the allowed transient combustible quantities are exceeded and no continuous fire watch is present (i.e., more than five pounds of transient combustibles are stored in FC41, more than zero pounds of transient combustibles are stored in FC28 and FC32). Please provide an assessment of the impact of this effect on the PRA results (CDF, LERF, ΔCDF, ΔLERF). The transient fires suppression curve from NUREG/CR-6850 should be used for these postulated fires. Also, the HRR assigned to the modeled violation should reflect those HRRs for the transient combustibles which may exist in the room, considering the equipment and required maintenance, storage, and occupancy. Also, the HRR for the modeled violation should consider any actual violations of administrative combustible controls which have occurred in the room or comparable locations of the plant, and exceed those HRRs identified in the previous

sentence. The HRR for the modeled violation should be discussed and justified in light of these considerations.

d. The sensitivity analysis did not address the additional risk of transient fires in FC41 during normal plant operations when less than five pounds of transient combustibles are being stored and no continuous fire watch is called for by procedures. Please provide an assessment of the impact of both of these effects on the PRA results (CDF, LERF, ΔCDF, ΔLERF). The normal transient suppression curve from NUREG/CR-6850 should be used for these postulated fires. Please provide justification for the HRR distribution used for these transient combustibles.

Probabilistic Risk Assessment RAI 11.01

By letter dated July 24, 2012, the licensee responded to Probabilistic Risk Assessment RAI 11. The response to PRA RAI 11 describes the PRA modeling strategy for assessing variance from deterministic requirement (VFDR) risk as consisting of modeling each individual VFDR explicitly in the FPRA model (with the exception of those not considered risk-relevant or addressed using an alternative bounding approach). Calculation FC07883 (Fire Risk Assessment of FCS Variances from Deterministic Requirements of NFPA 805) describes a case on page A6-5 for Fire Compartment 34A in which the VFDR risk is stated to be bounded by conservatism in the Plant Response Model (PRM) which does not credit ability to isolate a steam generator using the main steam isolation valve (MSIV) or MSIV bypass valves. No risk for this VFDR is calculated and the risk for Fire Compartment 3A is reported to be zero CDF and LERF. In light of this, please provide the following:

a. An explanation of how conservatism in the PRM related to inadvertent opening of condenser steam dump and bypass valves can bound the fire-induced spurious opening of the MSIV and MSIV bypass valves. In the response, please, specifically, address the frequency of the fire-induced scenarios relative to the quantitative impact of not crediting successful closure of the MSIV and MSIV bypass valves.

b. An assessment of the impact of this and similar conservatisms in the FPRA modeling on the determination of VFDR risk. If VFDR risk (i.e., Δ CDF and Δ LERF) is under-estimated please provide risk estimates without these conservatisms.

Probabilistic Risk Assessment RAI 14.01

By letter dated July 24, 2012, the licensee responded to Probabilistic Risk Assessment RAI 14 and stated that "In order to demonstrate compliance with RG 1.200, Rev 2, the Enclosure 1 of the LAR supplement dated December 22, 2011, (LIC-11-0136), has been revised". Table 6-3 of that enclosure, which includes justification of SRs previously assessed less than Capability Category II or not previously assigned a grade, has been considerably expanded. In light of the fact that this revised document presents information key to demonstrating compliance to american society of mechanical engineers/american nuclear society (ASME/ANS) "Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Application," RA-Sa-2009, as clarified by RG 1.200, "An Approach For Determining The Technical Adequacy Of Probabilistic Risk Assessment Results For Risk-Informed Activities," Rev. 2, please provide this revised document as part of the RAI response.

Probabilistic Risk Assessment RAI 15.g.01

By letter dated July 24, 2012, the licensee responded to Probabilistic Risk Assessment RAI 15. The response, related to impact on the PRA from model uncertainty and assumptions, explains that plant specific analysis was performed to identify and characterize sources of generic modeling uncertainty. This included identifying model assumptions, putting them into a database, and characterizing them in terms of importance (i.e., Important, Medium, and Non-Important). According to the RAI response assumptions and uncertainties were reviewed using this new approach and an additional key assumption was identified for which a sensitivity study was performed and presented. In light of the fact that this approach appears to hinge on assigning of "Important, Medium, and Non-Importance" significance levels, please discuss the process for assigning these levels and the specific criteria involved.

Probabilistic Risk Assessment RAI 18.01

By letter dated July 24, 2012, the licensee responded to Probabilistic Risk Assessment (PRA) RAIs 17, 18a and 18b acknowledging that the last peer review of the internal events PRA (IEPRA) was performed in 1999 and that certain model changes performed since then warrant a peer review (i.e., the HRA, internal flooding, loss of off-site power (LOOP), recovery actions (RAs), and the update of the LERF model). In light of this, please perform a focused scope peer review of the internal events HRA and two of the PRA elements (i.e. LOOP recovery actions, and update of the LERF model) identified in response to PRA RAI 18.a and b. Please provide the findings from these peer reviews and the resolutions to these findings. If the resolutions to the peer review findings require changes to the FPRA, provide the CDF, LERF, ΔCDF, and ΔLERF for each fire area and the total based on the updated PRA model. In addition, if these resolutions impact the sensitivity studies performed, please provide revised sensitivity studies results.

Probabilistic Risk Assessment RAI 19

Transient fires should at a minimum be placed in locations within the plant PAUs where conditional core damage probabilities (CCDPs) are highest for that PAU, i.e., at "pinch points." Pinch points include locations of redundant trains or the vicinity of other potentially risk-relevant equipment, including the cabling associated with each. Transient fires should be placed at all appropriate locations in a PAU where they can threaten pinch points. Hot work should be assumed to occur in locations where hot work is a possibility, even if improbable (but not impossible), keeping in mind the same philosophy. Please describe how transient and hot work fires are distributed within the PAUs. In particular, identify the criteria for your plant which determines where an ignition source is placed within the PAUs. Also, if you have areas within a PAU where no transient or hot work fires are located since those areas are considered inaccessible, please define the criteria used to define "inaccessible." Note that an inaccessible area is not the same as a location where fire is simply unlikely, even if highly improbable.

Probabilistic Risk Assessment RAI 20

Please identify if any 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 FPRA including assumptions and insights on how the PRA modeling of these cables contributes to the VFDR delta-risk evaluations.

Probabilistic Risk Assessment RAI 21

F&O PRM-B9-01: Per Calculation FC07819 and FC07826 the MCR heating ventilation and air conditioning (HVAC) is qualitatively screened from the FPRA. One of the reasons for the screening cited in the plant disposition is that there is a low frequency of fires with the potential to damage both HVAC trains, VA-46A and VA-46B. Please indicate if the cables for these trains were traced and describe how the frequency for damage to both of these trains was established. Please discuss if a fire in other locations can result in loss of MCR HVAC and how this was considered in the fire PRA. If the cables were not traced, discuss how the feasibility of implementing AOP-13 is ensured. Provide a quantitative assessment for the failure of MCR HVAC and other forms of room cooling as identified in the plant response to the F&O and, if significant, evaluate the MCR CDF/LERF given loss of MCR HVAC.

Probabilistic Risk Assessment RAI 22

Calculation FC07821 describes the fire ignition frequency development methodology and results. Relative to this report, please provide the following:

Section 5.2 states that a Bayesian update was not performed. SR IGN-A4 requires that a Bayesian update be performed to meet this SR. Table 5-1 shows that the plant has experienced two "potentially challenging" fires, one dated 12/19/2001 and another dated 11/29/1997. An update should be performed for the 2001 event which is not a part of the generic database. An update should be performed for the 1997 event if it is not a part of the generic database. In addition, the June 2011 Switchgear Room fire may also be classified as a "potentially challenging" fire. Please provide an assessment of the impact on CDF, LERF, ΔCDF, and ΔLERF of a Bayesian update of the fire ignition frequencies considering these plant-specific fires.

Probabilistic Risk Assessment RAI 23

HRA-C1-01: Calculation FC07825 describes the post-fire human reliability analysis methodology and results. Please indicate if Set 1, Set 2, Set 3, or Set 4 criteria from Chapter 12 of NUREG/CR-6850 were used to characterize the human error failure probabilities. Summarize your use of Set 1, Set 2, Set 3, and Set 4 criteria to characterize the failure probabilities associated with your HRA analysis. In particular, for the application of Set 2, please state if the Set 1 criteria were incorporated in the Set 2 definition. Please identify any deviations from the applied criteria from Chapter 12 of NUREG/CR-6850.