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10 CFR 50.90

March 11, 2015

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2
Renewed Facility Operating License Nos. DPR-53 and DPR-69
NRC Docket Nos. 50-317 and 50-318

Subject: Request for Additional Information Regarding the National Fire Protection Association Standard 805 License Amendment Request

References:
1. Letter from G. H. Gellrich (CCNPP) to Document Control Desk (NRC), dated September 24, 2013, License Amendment Request re: Transition to 10 CFR 50.48(c) - NFPA 805 Performance Based Standard for Fire Protection
2. Letter from N. S. Morgan (NRR) to G. H. Gellrich (CCNPP), dated January 12, 2015, Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 – Request for Additional Information Regarding the National Fire Protection Association Standard 805 License Amendment Request (TAC Nos. MF2993 and MF2994)

In Reference 1, Calvert Cliffs Nuclear Power Plant, LLC submitted a license amendment request to transition to 10 CFR 50.48(c) – NFPA 805 Performance Based Standard for Fire Protection. In Reference 2 the NRC staff requested additional information regarding this amendment request. Attachment (1) and the Enclosure provide the response to the request for additional information. The schedule for providing responses to individual questions was provided in Reference 2. Enclosure 1 contains markups of the original license amendment package pages and supersedes the previously provided pages.

Note that a change was made to Attachment O to conform to Attachment K. The marked up page is provided in Enclosure 1.

The Attachment C and S pages in Enclosure 1 contain security-related information and are requested to be withheld from public disclosure under 10 CFR 2.390.

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NRR

This additional information does not change the No Significant Hazards Determination provided in Reference 1. No regulatory commitments are contained in this letter.

Should you have questions regarding this matter, please contact Mr. Michael J. Fick at (410) 495-6731.

I declare under penalty of perjury that the foregoing is true and correct. Executed on March 11, 2015.

Respectfully,

George H. Gellrich
Site Vice President

GHG/PSF/bjm

Attachment: (1) Request for Additional Information Regarding the National Fire Protection Association Standard 805

Enclosure 1 Updated pages

cc: NRC Project Manager, Calvert Cliffs
NRC Regional Administrator, Region I
NRC Resident Inspector, Calvert Cliffs
S. Gray, MD-DNR

ATTACHMENT (1)

REQUEST FOR ADDITIONAL INFORMATION REGARDING THE NATIONAL FIRE PROTECTION ASSOCIATION STANDARD 805

By letter dated September 24, 2013 Calvert Cliffs Nuclear Power Plant, LLC (CCNPP), submitted a license amendment request (LAR) for Calvert Cliffs Nuclear Power Plant, Units 1 and 2 (Calvert Cliffs) to transition its fire protection licensing basis from Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.48(b) to 10 CFR 50.48(c), National Fire Protection Association Standard (NFPA) 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," 2001 Edition. The Nuclear Regulatory Commission (NRC) staff is reviewing the application and has determined that the following additional information is needed to complete the review of the LAR:

Fire Protection Engineering (FPE) Request for Additional Information (RAI) 01:

Section 3.3.4 of NFPA 805, 2001 Edition, requires that thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials be noncombustible or limited combustible. In Attachment A, "NEI [Nuclear Energy Institute] 04-02 Table B-1 - Transition of Fundamental Fire Protection Program & Design Elements," of the LAR, the licensee stated that the plant "Complies with Clarification" on the basis that the referenced procedures, specifications, and the Combustible Loading Analysis Database control and account for the use of thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials. The licensee does not state whether these materials are specified in the documents to be noncombustible or limited combustible. Provide the following information:

a. *Clarify that the procedure(s), specifications, and database specify that thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials shall be noncombustible or limited combustible.*

b. *Clarify in the compliance bases whether thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials that are either permanently or temporarily installed in the plant are noncombustible or limited combustible.*

c. *If installed materials are not noncombustible or limited combustible, describe how these materials are accounted for and managed in the fire protection program.*

CCNPP RESPONSE FPE RAI 01:

a. Fleet administrative procedures and specifications specify that thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials shall be noncombustible, limited combustible, or shall have a flame spread rating of less than 25 when tested in accordance with ASTM E84. Administrative procedures identify that the fire protection engineer approves thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials. Thermal insulation materials, radiation shielding materials, ventilation duct materials, or soundproofing materials that cannot be classified as noncombustible or limited combustible are treated the same as any other combustible material located within the plant and are administratively controlled. Refer to subpart c for details. The compliance basis for license amendment request (LAR) Attachment A, Section 3.3.4 has been revised to include this clarification.

b. Thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials that are either permanently or temporarily installed in the plant are noncombustible or limited combustible, with some exceptions. Thermal insulation materials, radiation shielding materials, ventilation duct materials, or soundproofing materials that cannot be classified as noncombustible or limited combustible are treated the same as any other combustible material located within the plant and are administratively controlled. Refer to subpart c for details. The compliance basis for LAR Attachment A, Section 3.3.4 has been revised to include this clarification.

c. If installed materials are not noncombustible or limited combustible, the materials are administratively tracked by the site combustible loading database and evaluated and approved by the site fire protection engineer. The site fire protection engineer ensures that the installed materials will not impact the ability of the plant to achieve and maintain the nuclear safety and radioactive release performance criteria of NFPA 805. The compliance basis for LAR Attachment A, Section 3.3.4 has been revised to include the information on these controls.

FPE RAI 02:

Section 3.4.1(c) of NFPA 805 requires that the fire brigade leader and at least two brigade members have sufficient training and knowledge of nuclear safety systems to understand the effects of fire and fire suppressants on nuclear safety performance criteria (NSPC). In Section 1.6.4.1, "Qualifications," of NRC Regulatory Guide (RG) 1.189, "Fire Protection for Nuclear Power Plants," Revision 2, September 2009 (ADAMS Accession No. ML092580550), the NRC staff has acknowledged the following example for the fire brigade leader as sufficient:

> *The brigade leader should be competent to assess the potential safety consequences of a fire and advise control room personnel. Such competence by the brigade leader may be evidenced by possession of an operator's license or equivalent knowledge of plant systems.*

In Attachment A, the licensee stated that it complies and references Procedure SA-1-105, Fire Brigade Training, Section 4.4.A.1, which includes the NFPA 805, Section 3.4.1(c) requirement as a responsibility for the shift manager to assure the fire brigade members have the requisite training and knowledge. Provide additional detail regarding the training that is provided to the fire brigade leader and members that addresses their ability to assess the effects of fire and fire suppressants on NSPC.

CCNPP RESPONSE FPE RAI 02:

Response provided in Reference 1.

FPE RAI 03:

In the compliance bases in Attachment A for NFPA 805, Sections 3.10.1(2) and 3.10.3, the licensee refers to a required action in Attachment S, Table S-2, Item 18 of the LAR. Attachment S, Table S-2 does not include an Item 18; however, Attachment S, Table S-2, Item 17 appears to address these elements. Confirm that Attachment S, Table S-2, Item 17 is the correct reference for the implementation item or provide the correct implementation item for the Halon system actions identified in the LAR.

CCNPP RESPONSE FPE RAI 03:

Response provided in Reference 1.

FPE RAI 04:

Section 3.11.3(2), "Fire Barrier Penetrations," of NFPA 805 requires that fire dampers comply with NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems." In Attachment A, the licensee requested NRC approval for the use of a performance-based methodology described in Electric Power Research Institute (EPRI) TR-1006756, "Fire Protection Surveillance Optimization and Maintenance Guide for Fire Protection Systems and Features," to change the surveillance frequencies for fire dampers. Attachment L of the LAR, Approval Request 1, which is related to the use of performance-based methodology described in EPRI TR-1006756, only includes NFPA 805, Section 3.2.3(1), as the NFPA 805 requirement that is applicable.

Clarify if Attachment L, Approval Request 1, is also applicable to NFPA 805, Section 3.11.3(2), and revise Approval Request 1 as necessary to accommodate the additional section.

CCNPP RESPONSE FPE RAI 04:

Response provided in Reference 1.

FPE RAI 05:

In Attachment L, Approval Request 2, the licensee proposed a performance-based approach to evaluate the acceptability of unprotected cables located above the suspended ceilings for compliance with the requirements of NFPA 805, Section 3.3.5.1. Provide the following information:

a. Provide further details that describe the extent of use of extension cords that are located above the suspended ceilings, such as number, length, size, use (e.g., types of electrical loads), and if the extension cords are for permanent or temporary use.

b. Describe the administrative controls that are (or will be) in place to maintain the technical bases for the request (e.g., prevent/limit future placement of ignition sources and combustible materials, periodic surveillance above the ceiling, etc.).

c. Clarify the following:

i. If the Nuclear Safety Capability Assessment (NSCA) credited cables that are routed in metal conduit above the suspended ceiling need to be free from fire damage in order to support a nuclear safety function or fire risk evaluation (FRE) for a fire in the fire areas described in this request.

ii. The NSPC discussion implies fire damage will not occur because, in part, the cables are protected in metal conduit or in metal covered trays. Metal conduit and metal trays are not generally sufficient to protect cables from exposure fire damage. Provide additional discussion and/or details that provide assurance that NSCA credited cables are not susceptible to damage from extension cords or other potential fire hazards in the area above the ceiling.

d. The licensee appears to conclude that because defense-in-depth (DID) Echelon 1 is satisfied, that Echelons 2 and 3 are also satisfied. The NRC staff notes that DID is based on a balance of the three echelons. Provide additional details related to how Echelons 2 (fire detection and suppression) and 3 (safe shutdown) of the DID concept are maintained.

CCNPP RESPONSE FPE RAI 05:

05a – Response to be provided 4/13/15.

05b – Fleet administrative configuration control procedures limit the future installation of additional cabling above suspended ceilings and require that all future installations comply with the requirements of NFPA 805, Section 3.3.5.1. Fleet administrative configuration control procedures require that any new combustible materials and/or ignition sources are reviewed to ensure that the bases of an approved deviation from the requirements of NFPA 805 are not compromised.

05c – Response provided in Reference 1.

05d – Response to be provided 4/13/15.

FPE RAI 06:

In Attachment L, Approval Request 3, the licensee requested the use of procedural guidance that will allow performance of welding, cutting and other hot work in sprinklered fire areas while the suppression system is impaired, as an acceptable performance-based approach to comply with NFPA 805, Section 3.3.1.3.1. Provide the following information:

a. *In the bases for the request, the licensee stated that this request is applicable to any fire area containing a sprinkler system, as identified in Attachment C, Table C-2. Discuss the bases for limiting this hot work procedure request to only fire areas that contain required fire sprinkler systems identified in Attachment C, Table C-2.*
b. *Describe the hot work administrative controls for the fire areas that contain a suppression system that is not identified as a required suppression system in Attachment C, Table C-2, and whether the administrative controls are different than those for fire areas with required fire suppression systems.*
c. *In the bases for the request, the licensee stated that permanent combustibles located within 35 feet of the work area that cannot be removed must be covered with the appropriate style of blanket. Clarify if the "appropriate style of blanket" is a listed or approved welding curtain, welding blanket, welding pad, or equivalent, as required by NFPA 51B, "Standard for Fire Prevention During Welding, Cutting, and Other Hot Work."*
d. *Describe any additional actions/controls to be used when hot work is performed in fire areas/zones where one or more sprinkler systems are impaired above and beyond those taken for any other hot work activity conducted when sprinklers are in service.*

CCNPP RESPONSE FPE RAI 06:

Response provided in Reference 1.

FPE RAI 07:

NRC endorsed guidance NEI 04-02, "Guidance for Implementing a Risk-Informed, Performance-Based Program Under 10 CFR 50.48(c)," states that, where used in Chapter 3, "power block" and "plant" refer to structures that have equipment required for nuclear plant operations, such as containment, auxiliary building, service building, control building, fuel *building, radiological waste, water treatment, turbine building, and intake structure, or structures that are identified in the facility's pre-transition licensing basis.*

Section 4.1.3 and Attachment I, Table I-1, "Definition of Power Block," of the LAR state that buildings that are required for nuclear plant operations (i.e., required to meet the nuclear safety or radioactive release (RAD) performance criteria identified in Sections 1.5.1 and 1.5.2 of NFPA 805) are considered within the power block. The licensee reviewed the plant for compliance with the RAD performance criteria, and the results are documented in Attachment E, which includes the following compartments as screened in for RAD review, but are not described as part of the power block in Attachment I, Table I-1:

- *Interim Resin Storage Facility (Lake Davies)*
- *Material Processing Facility*
- *Office and Training Facility*
- *Original Steam Generator Storage Facility*
- *Pre-Assembly Facility (Upper Laydown Area)*
- *Sewage Treatment Plant*
- *Unit 1 Butler Building*
- *Unit 2 Butler Building*
- *Warehouse No. 3*
- *West Road Cage*

Describe the basis for excluding these structures from the power block, based on the criteria stated in Section 4.1.3, " ... those that contain equipment required to meet the nuclear safety and RAD criteria ... ," and consequently, exclusion from the NFPA 805, Chapter 3 elements that apply to the power block.

CCNPP RESPONSE FPE RAI 07:

There are areas which Calvert Cliffs reviewed for compliance with the radioactive release (RAD) performance criteria in Attachment E that are not described as part of the power block in Attachment I, Table I-1. Section 4.1.3 of the LAR states, "*power block structures are limited to structures that contain equipment required to meet the nuclear safety and radioactive release criteria described in Section 1.5 of NFPA 805.*" The Interim Resin Storage Facility (Lake Davies), Material Processing Facility, Office and Training Facility, Original Steam Generator Storage Facility, Pre-Assembly Facility Upper Laydown Area, Sewage Treatment Plant, Unit 1 Butler Building, Unit 2 Butler Building, Warehouse No. 3, and West Road Cage do not contain NSCA or Fire PRA-credited components. The radioactive release review, which is documented in LAR Attachment E, "screened-in" all plant areas that had radiological sources. An area that was "screened in" to the RAD review (see Attachment E) means that area has some radiological source(s) that must be evaluated. "Screened in" does not mean that the area has equipment required to meet the radioactive release criteria of NFPA 805.

The following compartments were qualitatively assessed in the RAD review that a release of the involved radioactive materials from these compartments due to fire will not challenge the applicable 10 CFR 20 limits (see Attachment E). No fixed equipment contained in these areas is required in order to meet the radioactive release criteria of NFPA 805.

- Material Processing Facility
- Unit 1 Butler Building
- Unit 2 Butler Building

A calculation demonstrates that instantaneous radioactive releases are below applicable 10 CFR Part 20 limits without relying on equipment within the compartments to meet the radioactive release criteria of NFPA 805:

- Interim Resin Storage Facility (Lake Davies)
- Original Steam Generator Storage Facility
- Pre-Assembly Facility Upper Laydown Area
- Sewage Treatment Plant
- Warehouse No. 3
- West Road Cage

The acceptability of the radioactive sources in the Office and Training Facility credited in part, the sprinkler system in the building. Radioactive source(s) will be removed, as necessary, to ensure that the radioactive release performance criteria of NFPA 805 can be met without relying on fixed fire suppression in non-power block buildings. Implementation item IMP-17 has been added to Attachment S. Refer to the attached marked up pages of Attachment S.

FPE RAI 08:

Section 3.11.1 of NFPA 805 requires that each major building within the power block be separated from the others by barriers having a designated fire resistance rating of 3 hours or by open space of at least 50 feet or space that meets the requirements of NFPA 80A, "Recommended Practice for Protection of Buildings from Exterior Fire Exposures." In Attachment A, the licensee stated that it "Complies with Clarification" and described that the North Service Building and Turbine Building are analyzed as one fire area in the NFPA 805 NSCA, and are, therefore, treated as one building from a building separation perspective. The licensee also stated that it "Complies with Use of EEEE's" with respect to excluding the 45'-0" elevation of the North Service Building from the power block. The licensee did not discuss the basis for excluding this specific elevation from the power block in Attachment I.

Provide the basis for excluding the 45'-0" elevation of the North Service Building from the power block.

CCNPP RESPONSE FPE RAI 08:

Response provided in Reference 1.

FPE RAI 09:

Section 3.4.1(a) of NFPA 805 requires that a fully staffed, trained, and equipped fire-fighting force be available at all times to control and extinguish all fires on site. In Attachment A, the licensee stated that in Section 5.5.B of Procedure SA-1-101, "If there are less than 5 brigade members notify the Control Room."

Current NRC guidance, Frequently Asked Question (FAQ) 12-0063, "Fire Brigade Make-Up" (ADAMS Accession No. ML121980572), discusses conditions where fire brigade complement may be less than the minimum for a period of time, in order to accommodate unexpected absence of on-duty shift members. Further, licensees may claim prior approval if their current technical specifications or fire protection safety evaluation addresses the issue. If prior approval has not been granted, then the licensee should seek NRC approval in the NFPA 805 LAR.

Provide additional detail on the compliance bases related to conditions when there are less than 5 fire brigade members onsite.

CCNPP RESPONSE FPE RAI 09:

Response to be provided 4/13/15.

FPE RAI 10:

Section 3.11.5 of NFPA 805 requires that Electrical Raceway Fire Barrier Systems (ERFBS) that are required by NFPA 805, Chapter 4, be capable of resisting the fire effects of the hazards in the area. In Attachment A, the licensee stated that there are no ERFBS credited for compliance with Chapter 4, and, therefore, there is no compliance applicable to NFPA 805, Section 3.11.5. However, in Attachment B (Attributes 3.4.1.3, 3.4.1.5, 3.4.2.2, and 3.4.2.3) the licensee described that one of the means of addressing cable impacts of fire damage is to protect the cables by an ERFBS.

a. *Clarify if there were any cable resolutions in the NSCA that credit an ERFBS to protect the affected cables to meet NFPA 805, Chapter 4. If yes, then clarify if the ERFBS are in compliance with NFPA 805, Section 3.11.5.*

CCNPP RESPONSE FPE RAI 10:

Response provided in Reference 1.

Safe Shutdown Analysis (SSA) RAI 01:

Attribute 3.2.1.2 of NEI 00-01, Revision 2, includes the assumption that exposure fire damage to manual valves and piping does not adversely impact their ability to perform their pressure boundary or safe shutdown function, and that any post-fire operation of a rising stem valve located in the fire area of concern should be well justified using an engineering evaluation. In Attachment B, the alignment bases for NEI 00-01, Attribute 3.2.1.2, states that manual valves that are repositioned for credited NFPA 805 recovery actions (RAs) are included in the NFPA 805 NSPC equipment list and are subject to assessment of feasibility.

Provide the following information:

a. *Clarify if any rising stem valves involved in an RA are subjected to fire damage.*
b. *If any of the valves in the fire area of concern being repositioned by an RA are rising stem valves, then clarify if an engineering evaluation was performed to evaluate the exposure fire damage to manual valves and piping to determine if the exposure to fire would adversely impact their ability to perform their pressure boundary or safe shutdown function. If used, describe the method and results obtained from the engineering evaluation.*

CCNPP RESPONSE SSA RAI 01:

Response provided in Reference 1.

SSA RAI 02:

Attribute 3.3.1.1.4 of NEI 00-01, Revision 2, includes criteria and assumptions for evaluating power cables for breaker coordination concerns and includes safe shutdown cables and those *non-safe shutdown cables that can impact safe shutdown. In Attachment B of the LAR, the alignment bases for NEI 00-01, Attribute 3.3.1.1.4, states that the NSCA circuit identification and analysis should utilize a "building block" approach and include only, as applicable, the power cable from the NSCA component to the upstream electrical power source.*

Provide the following information:

a. *Clarify if cables that supply loads not required to meet the NSPC off of the nuclear safety buses are classified as "required" cables. If non-nuclear safety cables are not included, then provide the justification for not considering the failure of non-nuclear safety cables in meeting the breaker coordination criteria for protection.*

b. *The alignment basis states that plant modifications have been identified to achieve selective coordination of breakers/fuses and identified as implementation items in Attachment S, Table S-2. Identify the specific modifications that are required to achieve the selective coordination of breakers/fuses.*

CCNPP RESPONSE SSA RAI 02:

Attachment B, Table B-2, Attribute 3.3.1.1.4 has been revised. The term "building block" has been removed and explained using logic relations between components and cables in the NSCA database.

a. Cables that supply loads, not required to meet NSPC, are required to meet breaker coordination criteria for protection. Power cables and their associated power supplies were analyzed for common power and common enclosure requirements. Common power requirements were considered for power supplies supplying loads required to meet NSPC. Common enclosure requirements were considered for all electrical power supplies supplying loads in the power block by evaluating the adequacy of overcurrent protection for power cables. Modifications required to ensure coordination and protection to meet NSPC are included in table S-2. In summary, power supplies are properly coordinated and cables are adequately protected such that NSPC are met.

b. Modifications required to achieve selective coordination, specifically common enclosure requirements for the protection of power cables or transformers, are listed in S-2 as follows:

   - Item 14 which modifies the listed power cables such that short circuit withstand current temperature limits will not be exceeded or thermal overload temperature limits are adequately protected.
   - Item 15 which installs transformer secondary winding overcurrent protection such that transformer thermal overload limits are not exceeded.
   - Item 18 (new) which installs fusing to protect 250 VDC control cables such that short circuit withstand temperature limits are not exceeded.

A revised S-2 is provided with this response and includes additions, deletions, and changes in scope based on design requirements and approved engineering processes.

SSA RAI 03:

Attribute 3.5.1.3 of NEI 00-01, Revision 2, includes an assumption that circuit contacts are initially positioned (i.e., open or closed) consistent with the normal mode/position of the *"required for hot shutdown" equipment, and that the analyst must consider the position of the "required for hot shutdown" equipment for each specific shutdown scenario when determining the impact that fire damage to a particular circuit may have on the operation of the equipment. In LAR Attachment B, the alignment basis for Attribute 3.5.1.3 states that the circuit analysis may discount spurious operation based on a fire affected cable being routed in a dedicated conduit and the cable being protected from external sources of voltage (also taking into consideration the potential impact from ground equivalent hot shorts).*

For multi-conductor cables routed in dedicated conduit, provide a description if intra-cable hot shorts (wire-to-wire shorts) are considered as a potential impact of fire damage on required position of the NSCA equipment (i.e., the function of the initial position of circuit contacts are not affected by intra-cable hot shorts).

CCNPP RESPONSE SSA RAI 03:

Intra-cable hot shorts (wire-to-wire shorts) were considered as a potential fire impact for circuits without regard to a cable's pathway (whether through a conduit, raceway, wireway, or tray).

SSA RAI 04:

The nuclear safety goal described in NFPA 805, Section 1.3.1, is to provide reasonable assurance that a fire during any operational mode and plant configuration will not prevent the plant from achieving and maintaining the fuel in a safe and stable condition. In Section 4.2.1.2, the licensee stated that the NSCA will demonstrate that the plant can achieve and maintain safe and stable conditions for at least 12 hours with the minimum shift operating staff. After 12 hours, the Emergency Response Organization (ERO) will be available to support "safe and stable" actions to extend hot standby conditions.

a. *In Section 4.2.1.2, subsection "Methods to Maintain 'Safe and Stable' and Extend Hot Standby Conditions," of the LAR, local manual actions are described to align various systems and functions. In Item No. 8, the licensee stated that should alternating current (AC) charging sources be lost, local manual operator action may be required, and that station batteries are capable of providing a minimum of 4 hours of 125 V direct current power to their respective loads during a station blackout without AC charging sources. The licensee further stated that this time allowance credits securing 1INV1T11 in the cable spreading room (CSR) within 45 minutes. Clarify if this local manual action is credited as an RA in any fire area.*
b. *In Section 4.2.1.2, subsection "Assessment of Risk," the licensee stated that the ERO provides sufficient resources for assessment of fire damage and completion of repairs to equipment necessary to maintain hot standby for an extended period, transition to cold shutdown, or return to power operations as dictated by the plant fire event. Describe if any repair activities are necessary to maintain hot standby for an extended period (safe and stable conditions), including a detailed description of the specific repairs that would be needed, the success path(s) being restored, and the time frame required to complete the repair.*

CCNPP RESPONSE SSA RAI 04:

a. Securing of 1INV1T11 has not been credited as a recovery action in any fire area. Alternating current power is required to support other functions to achieve safe and stable and is restored to the charger before the battery is discharged.

b. No repair activities are necessary to maintain hot standby for an extended period (safe and stable conditions). License Amendment Request Section 4.2.1.2, subsection "Methods to Maintain 'Safe and Stable' and Extend Hot Standby Conditions" identifies those systems which are required to maintain hot standby for an extended period. Post fire assessments would include evaluation of impacted equipment and compensatory measures to restore needed plant equipment to support RCS cool down in a safe and controlled manner.

SSA RAI 05:

Section 2.4 of RG 1.205, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants," Revision 1, dated December 2009 (ADAMS Accession No. ML092730314) describes the treatment of RAs supplemented by guidance provided in NEI 04-02 and FAQ 07-0030, "Establishing Recovery Actions" (ADAMS Accession No. ML110070485). In RG 1.205, the NRC staff clarifies that operation of alternative or dedicated shutdown controls while the main control room (MCR) remains the command and control location would primarily be considered an RA because, for such scenarios, the dedicated or alternative controls are not considered primary. Attachment G of the LAR describes the primary control stations (PCS) and identifies RAs performed at the PCS in Fire Area 16 (Unit 1 CSR and 1C cable chase) and Fire Area 17 (Unit 2 CSR and 2C cable chase). Provide the following information:

a. Clarify if the control room remains the command and control location for a fire in Fire Areas 16 and 17, and if so, discuss how the RAs at the PCS are evaluated for compliance with NFPA 805, Section 4.2.4.

b. In Fire Areas 16 and 17, there are RAs at the PCS that are not associated with a variance from deterministic requirement (VFDR).

- *For Fire Area 16, the RAs are:*

  6ICHECKRXSD1; 16ICONSERVE1; 16ISECHTR11_13; 16IADV1C43; 16I1C43CONTROL; and 16IRCSTEMP1.

- *For Fire Area 17, the RAs are:*

  17ICHECKRXSD2; 17ICONSERVE2; 17ISECHTR21_23; 17IADV2C43; 17I2C43CONTROL; and 17IRCSTEMP2.

  Clarify the purpose of performing these RAs, and whether the actions are required to meet the NSPC required by NFPA 805, Section 1.5.1.

c. In Attachment G, Table G-1 of the LAR, disposition of VFDR 16-19-1 credits RAs at the PCS to energize pressurizer backup heater banks 11 and 13; however, another non-VFDR related RA (16ISECHTR11_13) is credited to secure the pressurizer backup heater banks 11 and 13. Discuss how the contradicting RAs are evaluated in the NSCA.

d. In LAR Attachment G, Table G-1, RAs are credited to disposition VFDRs 16-27-1 and 17-25-2 to control atmospheric dump valve (ADV) hand valves to support control of the ADVs at the PCS locations 1C43 and 2C43, respectively. However, the RAs (16IADV1C43 and 17IADV2C43) to control the ADVs at the PCS location do not have a VFDR associated with them. Discuss the method for crediting RAs to support the VFDR disposition without crediting the RA at the PCS.

CCNPP RESPONSE SSA RAI 05:

a. For a fire in Fire Area 16 the Control Room remains the command and control location for Unit 2 only. A severe fire in Fire Area 16 would require the Unit 1 operating personnel to use an alternate shutdown strategy in accordance with procedure AOP-9B-1. This procedure uses the Unit 1 Alternate Shutdown Panel as the command and control location to achieve a safe and stable condition for Unit 1. The actions that are completed at this panel are not considered a VFDR because the panel is considered the primary control station (PCS) for Unit 1 in this fire scenario. All other failures that cannot be resolved with actions at the PCS for Unit 1 in this fire scenario are documented with a VFDR and evaluated in accordance with NFPA 805, Section 4.2.4.2. All Unit 2 failures that cannot be mitigated by actions taken inside of the Control Room are documented with a VFDR and evaluated in accordance with NFPA 805, Section 4.2.4.2 for a fire in Fire Area 16.

   For a fire in Fire Area 17 the Control Room remains the command and control location for Unit 1 only. A severe fire in Fire Area 17 would require the Unit 2 operating personnel to use an alternate shutdown strategy in accordance with procedure AOP-9B-2. This procedure uses the Unit 2 Alternate Shutdown Panel as the command and control location to achieve a safe and stable condition for Unit 2. The actions that are completed at this panel are not considered a VFDR because the panel is considered the PCS for Unit 2 in this fire scenario. All other failures that cannot be resolved with actions at the PCS for Unit 2 in this fire scenario are documented with a VFDR and evaluated in accordance with NFPA 805, Section 4.2.4.2. All Unit 1 failures that cannot be mitigated by actions taken inside of the Control Room are documented with a VFDR and evaluated in accordance with NFPA 805, Section 4.2.4.2 for a fire in Fire Area 17.

   In summary, for a fire in Fire Area 16 the Unit 1 Alternate Shutdown Panel is the PCS for Unit 1 and the Control Room is the PCS for Unit 2. For a fire in Fire Area 17 the Unit 2 Alternate Shutdown Panel is the PCS for Unit 2 and the Control Room is the PCS for Unit 1. All actions not taken at the specified PCS for the fire area / unit combination are documented with a VFDR and evaluated in accordance with NFPA 805, Section 4.2.4.2.

b. Actions 16|CHECKRXSD1, 16|CONSERVE1, 16|SECHTR11_13, 16|ADV1C43; 16|1C43CONTROL and 16|RCSTEMP1 are not recovery actions. These actions are taken at the PCS (Unit 1 Alternate Shutdown Panel) to support a safe and stable condition of Unit 1 for a severe fire that occurs in Fire Area 16. The Unit 1 Alternate Shutdown Panel is the command and control location for Unit 1 for a fire occurring in Fire Area 16. Therefore, actions 16|CHECKRXSD1, 16|CONSERVE1, 16|SECHTR11_13, 16|ADV1C43; 16|1C43CONTROL and 16|RCSTEMP1 do not need to be documented with a VFDR and evaluated in accordance with NFPA 805, Section 4.2.4.2. These actions are required to meet the NSPC criteria as defined by NFPA 805, Section 1.5.1.

   Actions 17|CHECKRXSD2, 17|CONSERVE2, 17|SECHTR21_23, 17|ADV2C43; 17|2C43CONTROL and 17|RCSTEMP2 are not recovery actions. These actions are taken at the PCS (Unit 2 Alternate Shutdown Panel) to support a safe and stable condition of Unit 2 for a severe fire that occurs in Fire Area 17. The Unit 2 Alternate Shutdown Panel is the command and control location for Unit 2 for a fire occurring in Fire Area 17. Therefore, actions 17|CHECKRXSD2, 17|CONSERVE2, 17|SECHTR21_23, 17|ADV2C43; 17|2C43CONTROL and 17|RCSTEMP2 do not need to be documented with a VFDR and evaluated in accordance with NFPA 805, Section 4.2.4.2. These actions are required to meet the NSPC criteria as defined by NFPA 805, Section 1.5.1.

c. The non-VFDR action (16ISECHTR11_13) is to secure the pressurizer heaters to ensure spurious operation does not occur. This action is not a VFDR for Fire Area 16 because control room abandonment has been credited for Unit 1 in this fire scenario and this action is completed at the Alternate Shutdown Panel, 1C43. The Alternate Shutdown Panel is the PCS for Unit 1 in this fire scenario, therefore this action does not need to be documented with a VFDR and evaluated in accordance with NFPA 85, Section 4.2.4.2.

   The recovery action credited for VFDR 16-19-1 is to re-energize 1MCC111PH which powers Pressurizer Backup Heater Bank 13 (1UH1). Backup pressurizer heater 13 is required to be operable in this fire area to maintain pressure control due to the possibility of spurious operation of the Pressurizer PORV and Block Valves. This recovery action does not occur at the PCS and is therefore documented with a VFDR and evaluated in accordance with NFPA 805, Section 4.2.4.2.

d. The Unit 1 Alternate Shutdown Panel is the PCS for Unit 1 during a severe fire in Fire Area 16. In order to gain control of the ADVs at the Alternate Shutdown Panel two actions are required. One action occurs at the PSC and the other is in the field. The action that occurs at the PCS is 16|ADV1C43. This action does not need to be documented with a VFDR and evaluated in accordance with NFPA 805, Section 4.2.4.2 because it is occurring at the PSC for Unit 1 for this fire scenario. The recovery action associated with VFDR 16-27-1 occurs in the field and thus is required to be documented with a VFDR and evaluated in accordance with NFPA 805, Section 4.2.4.2.

   The Unit 2 Alternate Shutdown Panel is the PCS for Unit 2 during a severe fire in Fire Area 17. In order to gain control of the ADVs at the Alternate Shutdown Panel two actions are required. One action occurs at the PSC and the other is in the field. The action that occurs at the PCS is 17|ADV2C43. This action does not need to be documented with a VFDR and evaluated in accordance with NFPA 805, Section 4.2.4.2 because it is occurring at the PSC for Unit 2 for this fire scenario. The recovery action associated with VFDR 17-25-2 occurs in the field and thus is required to be documented with a VFDR and evaluated in accordance with NFPA 805, Section 4.2.4.2.

SSA RAI 06:

Attachment W Tables W-6 and W-7 of the LAR appear to conflict with information described in Attachment C, Table C-1, and Attachment G, Table G-2. Clarify the following discrepancies:

a. *In Attachment C, Table C-1, Fire Area 34 is identified as transitioning deterministically in Unit 2 (Section 4.2.3.2 of NFPA 805) with no VFDRs identified. However, in Attachment W, Table W-7, Fire Area 34 is identified as transitioning using performance-based methods (Section 4.2.4.2 of NFPA 805), VFDRs are identified, RAs are credited, and the risk of the RA was calculated. Clarify the correct nuclear safety compliance strategy for Fire Area 34.*

b. *In Attachment C, Table C-1, the following fire areas are identified as transitioning deterministically with no VFDRs identified. However, Attachment W, Table W-6 (for*

Unit 1) and Attachment W, W-7 (for Unit 2) identify that these fire areas have VFDRs identified. Further, an FRE was performed that calculated a delta core damage frequency (CDF) and delta large early release frequency (LERF) value as follows:

Unit 1: 2, 8, 13, 18, 18A, 22, 23, 25, 26, 27, 28, 31, 38, 40, and 2CNMT
Unit 2: 3, 4, 6, 14, 15, 19, 19A, 21, 30, 33, 39, and 1CNMT

For each of these fire areas, clarify the correct nuclear safety compliance strategy, and justify the bases for performing an FRE that is not discussed in the NSCA in LAR Attachment C, Table C-1, and the bases for crediting RAs that are not included in LAR Attachment G, Table G-1.

c. *In Attachment C, Table C-1, the following fire areas are identified as transitioning using performance-based methods (FRE) to meet the NSPC, and no RAs were credited (either for risk or DID). However, Attachment W, Table W-6 (for Unit 1) and Attachment W, W-7 (for Unit 2) identify these fire areas as crediting RAs and the risk of the RA was calculated:*

   Unit 1: 12, 14, 15, 19A, 21, 30, 32, 33, 35, 36, 39, 1 CNMT, and IS
   Unit 2: 12, 13, 18A, 20, 26, 27, 28, 32, 34, 35, 36, 40, 2CNMT and IS

   For each of these fire areas, clarify the correct nuclear safety compliance strategy for these fire areas and the bases for crediting RAs that are not included in Attachment G, Table G-1.

d. *In Attachment C, Table C-1, the following fire areas are identified as transitioning using deterministic methods to meet the NSPC, and no RAs were credited (either for risk or DID). However, Attachment W, Table W-6 (for Unit 1) and Attachment W, W-7 (for Unit 2) identifies these fire areas as crediting RAs and the risk of the RA was calculated:*

   Unit 1: 13, 18, 18A, 22, 23, 25, 26, 27, 28, and 2CNMT
   Unit 2: 14, 15, 19, 19A, 21, 30, 33, 39 and 1CNMT

   For each of these fire areas, clarify the correct nuclear safety compliance strategy and justify the bases for not including these RAs in Attachment G, Table G-1, if these RAs are actually credited in the NSCA.

CCNPP RESPONSE SSA RAI 06:

Response to be provided 4/13/15.

SSA RAI 07:

Modifications were identified in Attachment S, Table S-2, that appear to resolve certain VFDR issues. However, the disposition of the certain VFDRs as summarized in Attachment C, Table C-1, do not describe whether the modification was credited or not. Provide clarification on how the modifications described below were addressed in the disposition of the VFDRs listed:

a. *Attachment S, Table S-2, Item 7, involves modifying control circuits for the Pressurizer Power Operated Relief Valves (PORVs), 1(2)ERV402 and 1 (2)ERV404, to prevent the PORVs from spuriously opening. However, VFDRs 16-46-1, 24-26-1, 16-47-1, 24-27-1, 17-41-2, 24-63-2, 17-42-2, and 24-64-2 involve fire damage to cables which could result in spurious opening of the Pressurizer PORV, and the VFDR dispositions credits an RA for DID.*

b. *Attachment S, Table S-2, Item 8, involves modifying the control circuits for the auxiliary feed water (AFW) steam admission valves 1(2)CV4070 and 1(2)CV4071 to ensure adequate separation such that one set of valves will be available during a fire in either the CSR or switchgear rooms. However, VFDRs (16-22-1, 17-16-2, 16-26-1, and 17-26-2) involve fire damage to cables that could cause the loss of control and/or spurious operation of 1(2)CV4070 and 1(2)4071, and the VFDR dispositions credit an RA either to reduce risk (VFDRs 16-22-1 and 17-16-2) or for DID (VFDRs 16-26-1 and 17-26-2).*

c. *Attachment S, Table S-2, Item 11, involves modifying control circuits for the Main Steam Isolation Valves (MSIVs), 1(2)CV4043OP and 1(2)CV4048OP, to ensure at least one solenoid dump valve can be energized to close the MSIVs. However, VFDRs 16-31-1, 16-32-1, 17-23-2, and 17-24-2 involve fire damage to cables that could cause a loss of control and/or spurious operation of the associated MSIV, and the VFDR dispositions credit an RA for DID (VFDRs 16-31-1, 16-32-1, 17-23-2, and 17-24-2).*

<u>CCNPP RESPONSE SSA RAI 07</u>:

Response to be provided 4/13/15.

<u>SSA RAI 08</u>:

In Attachment K, Licensing Action 5, the licensee requested that a previously approved exemption, related to dedicated water curtains as being adequate to maintain the 3-hour fire rating of barriers, be transitioned to the NFPA 805 program. The licensee described the sprinkler systems located in Room 216A and Room 106 as supplying the sprinkler heads for the dedicated water curtains. In the summary of the exemption approved by the NRC in a letter dated March 15, 1984 (ADAMS Accession No. ML010430325), the licensee stated that on the Corridor No. 110 side of the hatch, a dedicated sprinkler head will be supplied from the Room No. 116 sprinkler system. However, in the Baltimore Gas & Electric Company submittal dated November 21, 1983 (ADAMS Accession No. 8311290159), the licensee stated that on the corridor No. 110 side of the hatch, a dedicated sprinkler head will be supplied from the Room No. 106 sprinkler system. The NRC staff also noted that Attachment C, Table C-1, refers to room numbers in the "Required Fire Protection System and Features," and Attachment C, Table C-2, refers to fire zones. The NRC staff also noted in the discussion for Licensing Action 1 that room numbers at the plant may have changed over time. Provide the following information:

a. *Describe if the fire zone numbers listed in Attachment C, Table C-2, are the same as the room numbers listed in the fire area summary in Attachment C, Table C-1. Describe if the room numbers in Attachment C correspond with the room numbers cited in the previous licensing actions in Attachment K.*

b. *Provide a description of the water curtain arrangement, including the sprinkler systems that supply the required sprinkler heads using the current terminology for rooms, fire areas, and/or fire zones such that the staff can fully understand the installation and how the installation is represented in the various tables in the submittal and the previous licensing actions.*

<u>CCNPP RESPONSE SSA RAI 08</u>:

Response provided in Reference 1.

SSA RAI 09:

In Attachment C, Table C-1, under the heading "Fire Suppression Effects on Nuclear Safety Performance Criteria," the majority of the fire areas contain the concluding statement, "Fire suppression in this fire area will not impact the ability to achieve the NSPC in accordance with NFPA 805, Sections 4.2.1 and 4.2.4.1.5." NFPA 805, Section 4.2.4.1.5, is associated with the fire modeling performance-based approach, which the licensee stated it did not use in Section 4.5.2.1 of the LAR. In addition, the suppression effects sections for several other fire areas (e.g., 18A, 20, 21, 22, 23, 35, and 36) contain the statement, "There is no suppression effect concern for this fire area as the fire area does not contain NSCA equipment," yet the fire area contains VFDRs. Address the following:

a. *Clarify the basis for discussing the fire suppression effects for a fire modeling performance-based approach when the fire areas used a risk evaluation performance-based approach.*
b. *Provide additional discussion for those fire areas where VFDRs are identified, but the suppression effects discussion states there is no NSCA equipment in the fire area.*

CCNPP RESPONSE SSA RAI 09:

a. The fire modeling performance-based approach (NFPA 805 Section 4.2.4.1.5) was not used at Calvert Cliffs. NFPA 805 Section 4.2.4.1.5 was inadvertently listed in Attachment C, Table C-1 of the LAR. License Amendment Request Attachment C, Table C-1 has been revised to remove the reference to NFPA 805 Section 4.2.4.1.5.

b. Fire Areas 18A, 20, 22, 21, 23, 35 and 36 do not contain any NSCA equipment. The VFDRs are the result of cable failures within the fire areas. The following statement will be added to the suppression effects section for these fire areas, "The VFDRs associated with this Fire Area are the result of cable damage."

SSA RAI 10:

In Section 4.5.2.2, the licensee stated that there are no VFDRs that involved performance-based evaluations related to wrapped or embedded cables. However, in Attachment C, Table C-1, Fire Areas 18, 19, 35, 36, and TB/NSB/ACA are performance-based fire areas and credit EEEE, "ECP-13-000359 - "Generic Letter (GL) 86-10 Evaluation of Embedded Conduit in the Turbine Building and Barrier Thickness of the Floor/Ceiling Barrier between AB-4/AB-5 and 517/518," which justifies the acceptability of conduits embedded in the Turbine Building floor slab (elevation 27'), the floor/ceiling slab between stairwells AB-4 and AB-5, and the horizontal cable chases (Rooms 517 and 518). Clarify if the disposition of the VFDRs in Fire Areas 18, 19, 35, 36, and TB/NSB/ACA credit the embedment as evaluated in the EEEE.

CCNPP RESPONSE SSA RAI 10:

ECP-13-000359 – "Generic Letter (GL) 86-10 Evaluation of Embedded Conduit in the Turbine Building and Barrier Thickness of the Floor/Ceiling Barrier between stairwells AB-4/AB-5 and 517/518," includes an evaluation of the acceptability of the embedment depth of the conduits routed in the barriers of Fire Areas 18, 19 and TB/NSB/ACA to ensure cable damage will not occur due to fire. The depth of the embedment of these conduits does not meet the required depth of 6.2 inches to achieve a 3 hour fire rating in siliceous concrete. The evaluation concludes that the embedded configuration of these conduits will provide sufficient fire resistance capability to withstand the hazards in the areas and therefore not adversely impact the ability to achieve and maintain the nuclear safety performance goals.

This evaluation was credited and referenced in Attachment C for Fire Areas 18, 19 and TB/NSB/ACA. The cables routed in these conduits were excluded from the analysis for Fire Areas 18, 19 and TB/NSB/ACA unless they specifically exited the barrier into the area. Cables within these conduits will therefore not contribute to a VFDR and embedment is not utilized in the disposition of a VFDR.

The evaluation is referenced in Attachment C for Fire Areas 35 and 36 due to fire area barriers analyzed within the evaluation. There are no embedded conduits analyzed in these areas and no embedded conduits are utilized in the disposition of a VFDR.

SSA RAI 11:

In Attachment C, Table C-1, the licensee identified Marinite boards as fire protection features that are credited for "S" (required for Chapter 4 separation criteria) and "R" (required for risk significance) to protect cables for a fire in Fire Area 1CNMT (Unit 1 Containment) and 2CNMT (Unit 2 Containment). Provide the following information:

a. *Describe the extent that Marinite boards are credited for Chapter 4 separation ("S") and for risk significance ("R") in the Unit 1 and Unit 2 Containments. In addition, describe the design and plant configuration of the Marinite boards and the nuclear safety functions that the passive fire protection features are protecting.*
b. *Provide previous NRR staff approval (if any) for the use of Marinite boards in containment to demonstrate meeting the requirements of Appendix R, Section III.G.2, which can be credited to meet the requirements of NFPA 805, Section 4.2.3.4, or evaluate acceptability using a performance-based analysis approach in accordance with NFPA 805, Section 4.2.4.*

CCNPP RESPONSE SSA RAI 11:

Response to be provided 4/13/15.

SSA RAI 12:

In Attachment C, Table C-2, the licensee makes reference to "Unit 1 Containment (App-R Purposes Only)" and "Unit 2 Containment (App-R Purposes Only)," for fire protection systems and features. The fire protection systems and features are identified as required for "S" (Required for Chapter 4 Separation Criteria), "R" (Required for Risk Significance), and/or "D" (maintain an adequate balance of DID in a change evaluation or FRE).

Clarify the meaning of "Appendix-R Purposes Only" and if these fire protection systems and features are credited with respect to compliance with NFPA 805, Chapter 4.

CCNPP RESPONSE SSA RAI 12:

Response provided in Reference 1.

SSA RAI 13:

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

a. *Section 4.3.2 and Attachment D state that incorporation of the recommendations from the "KSF [key safety function] pinch point" evaluations into appropriate plant procedures prior to implementation will be done to ensure the requirements of NFPA 805 are met. Identify and describe the changes to outage management procedures, risk management tools, and any other document resulting from incorporation of KSFs identified as part of NFPA 805 transition. Include changes to any administrative procedures such as "Control of Combustibles."*

b. *For those components that had not previously been analyzed in support of the at-power analysis or whose functional requirements may have been different for the non-power analysis, cable selection was performed in accordance with approved project procedures. Provide a list of the additional components and a list of those at-power components that have a different functional requirement for NPO. Describe the difference between the at-power safe shutdown function and the NPO function. Include with this list a general description by system indicating why components would be selected for NPO and not be included in the at-power analysis.*

c. *Section 4.3.1 and Attachments D and H state that the NPO analysis was performed in accordance with FAQ 07-0040, "Non-Power Operations Clarifications (ADAMS Accession No. ML082200528). However, the LAR did not provide the results of the KSF pinch point analysis. Provide a list of KSF pinch points by fire area that were identified in the NPO fire area reviews using FAQ 07-0040, including a summary level identification of unavailable paths in each fire area. Describe how these locations will be identified to the plant staff for implementation.*

d. *During NPO modes, spurious actuation of valves can have a significant impact on the ability to maintain decay heat removal and inventory control. Provide a description of any actions being credited to minimize the impact of fire-induced spurious actuations on power operated valves (e.g., air-operated valves and motor-operated valves) during NPO (e.g., pre-fire rack-out, actuation of or pinning of valves, and isolation of air supplies).*

e. *During normal outage evolutions, certain NPO credited equipment will have to be removed from service. Describe the types of compensatory actions that will be used during such equipment down-time.*

f. *The description of the NPO review for the LAR does not identify locations where KSFs are achieved via RAs or for which instrumentation not already included in the at-power analysis is needed to support RAs required to maintain safe and stable conditions. Identify those RAs and instrumentation relied upon in NPO and describe how RA feasibility is evaluated. Include in the description whether these variables have been or will be factored into operator procedures supporting these actions.*

CCNPP RESPONSE SSA RAI 13:

13a – Response provided in Reference 1.

13b – Response provided in Reference 1.

13c – Response provided in Reference 1.

13d – The NPO Modes Transition Review, NFPA-805-00008, does not specifically credit any actions to prevent spurious actuations during NPO. However, pre-positioning has not been excluded as a method of mitigating fire impact to KSFs. Report NFPA-805-00008 identifies plant configuration changes (e.g., removing power from valves) as an option to reduce fire risk and this report will be used as a reference document in support of site procedure updates, as discussed in LAR Attachment S, Table S-3 IMP-4.

13e – Updates to procedures such as NO-1-103, Conduct of Lower Mode Operations, will ensure that NPO credited equipment is not removed from service during High Risk Evolutions (HRE) without adequate compensatory measures. Plant procedures provide guidelines and identify compensatory actions that can be taken when fire safe shutdown components are out of service. These procedures will be evaluated for updates during NFPA 805 implementation, but the following types of compensatory actions are expected to be maintained for fire risk mitigation: Hot Work Restrictions, Transient Combustible Controls, Access Limitations, Automatic Detection and Suppression Systems, Fire Watch Patrols, etc.. Additionally, Report NFPA-805-00008 identifies locations where only one success path may remain available to support a KSF in the event of a fire. When NPO credited equipment is removed from service this report can be used as a reference to develop adequate compensatory measures.

13f – Response provided in Reference 1.

SSA RAI 14:

Describe if any RAs require the cross-tie of Unit 1 and Unit 2 systems to achieve the NSPC. Provide the following information:

a. *Describe whether these cross-connecting RAs require staff from both units. If so, describe how the feasibility analysis reflects the Unit 1 and Unit 2 staffing, communication, and operational interface.*
b. *Describe the operational impacts (by fire), if any, on the unaffected unit created by cross-tying these systems. Describe whether Technical Specification 3.0.3 is entered once the cross-tie with the opposite unit has been completed for fire safe shutdown.*

CCNPP RESPONSE SSA RAI 14:

Response provided in Reference 1.

SSA RAI 15:

In Attachment B of the LAR, the alignment basis discussion for Attribute 3.2.1.2 provides the following statement on possible fire damage to instrument air tubing that includes copper tubing with soldered joints that are susceptible to separation during a fire and could cause the loss of instrument air to components:

> *These affects were evaluated on an area basis to determine if the instrument air system pressure could be maintained. Calculation CA07971 demonstrates that the instrument air system can maintain system pressure with a 1 inch line pipe rupture.*

Calculation CA07971 states, "Evaluation of Maximum Air Line Break Size in Which Nominal Instrument Air Pressure Can Be Maintained at 50 psig." The NRC staff noted apparent *discrepancies in the use and recovery of instrument air as described in Attachment C. Provide the following:*

a. Provide justification that 50 psig of instrument air pressure will not prevent instrument air operated valves from changing position.

b. Provide justification for limiting the size of the line to 1" soldered joints being susceptible to separation during a fire. Describe the soldered joints used in the plant instrument air system. For any soldered joints larger than 1", describe how they were treated in the NSCA and Fire Probabilistic Risk Assessment (PRA).

c. For several fire areas in Attachment C (such as Fire Areas 18, 19, 20, 21, and 22), the licensee stated in the method of accomplishment for the vital auxiliaries performance goal that instrument air may be recoverable from the opposite unit plant air system. However, the VFDRs associated with the fire areas (such as VFDRs 18-16-2, 19-01-1, 20-02-1, 21-02-1, and 22-05-2) state that plant air from the opposite unit cannot be used because of failure of 1CV2061 or 2CV2061, and the VFDR disposition credits an RA that involves aligning backup nitrogen to the affected unit control valves. Clarify the discrepancy between the method described in the subject fire areas for achieving the performance goal, the VFDRs that state this method is not available, and the RAs cited in LAR Attachment G for resolution of the VFDRs.

d. In Attachment C, the discussion of fire suppression effects on the NSPC for Fire Areas 39 and 40 addresses the impact of suppression damage to redundant instrument air compressors and the saltwater air system, and states that the AFW air accumulators can be charged from the nitrogen system with an RA. However, the disposition of VFDRs 39-01-1 and 40-01-2, which address fire damage to the respective unit's instrument air system, stated that the VFDR has been evaluated with no further action required. In addition, the RA to align the nitrogen system to the AFW air accumulators is not discussed in LAR Attachment G for these fire areas. Clarify the apparent discrepancy between the effects of fire damage and suppression damage on the instrument air system and salt water air compressors (SWAC) with regard to the need for an RA. If an RA is necessary to mitigate the suppression effects on the instrument air compressors and SWAC, then describe the feasibility and additional risk of the RA.

CCNPP RESPONSE SSA RAI 15:

15a – Response to be provided 4/13/15.

15b – Response provided in Reference 1.

15c – Response to be provided 4/13/15.

15d – Response to be provided 4/13/15.

SSA RAI 16:

In Attachment C, the licensee stated in the summary of vital auxiliaries for Fire Area 17B that the control room and CSR heating, ventilating, and air conditioning (HVAC) is not available without an RA and referenced VFDR 17B-01-0. However, the disposition discussion for VFDR 17B-01-0 states that no further actions are required based on the performance-based analysis for the VFDR, and no RAs required for risk or DID were identified in Attachment G. Clarify the *bases for the discrepancy between the description of the vital auxiliaries' discussion and the VFDR disposition.*

CCNPP RESPONSE SSA RAI 16:

Response provided in Reference 1.

SSA RAI 17:

In Attachment G, there are numerous RAs to provide portable fans for temporary cooling of switchgear rooms for Unit 1 Fire Areas 11, 16, 17, 18, and 20, and for Unit 2 Fire Areas 22, 25, 34, and yard. Plant procedures indicate the use of portable generators to power the fans if normal power is not available. Provide the following additional information:

a. Describe the location of the portable generators and the location of NSCA structures, systems, and components (SSCs), if any, in the vicinity of these location(s). In your description, include a summary of the procedure guidance for the use of portable gas generators and how the RA aligns with each of the feasibility criteria of FAQ 07-0030 (i.e., training, procedures, drills, etc.).

b. Describe the type of fuel and quantity associated with the portable generators and the availability and the location(s) of sufficient fuel sources to support maintaining safe and stable conditions for the time period required.

c. Provide justification that refueling the generators does not present a fire exposure hazard to NSCA SSCs.

d. Describe the installation of temporary power cables, connections to distribution panels, and any disruptions to fire area boundaries.

e. Describe the method (e.g., the analyzed ventilation path configuration) of providing temporary cooling when portable fans are used for these RAs.

CCNPP RESPONSE SSA RAI 17:

Response to be provided 4/13/15.

RAD RAI 01:

The radioactive material (RAM) described in the CENG [Constellation Energy Nuclear Group] Calculation No. CA07953 provides a quantification of the maximum amount of RAM that may be stored in various areas. Provide information, if any, on site procedures that are (or will be) established to limit the amount of RAM in storage containers to the levels identified in the analyses (e.g., West Road Cage area, Warehouse #3, Pre-Assembly Facility, and Upper Laydown Area).

CCNPP RESPONSE RAD RAI 01:

For areas that calculation CA07953 justifies the acceptability of radioactive materials, site procedure(s) will be developed to document the maximum amount of radioactive materials that may be stored in the area. The areas will be verified to be within compliance of the procedure on a routine basis. Implementation item IMP-18 has been added to Attachment S. Refer to the attached marked up pages of Attachment S.

RAD RAI 02:

Provide information, if any, on site procedures that establish operational controls to restrict the opening of storage containers in open, uncontained areas (e.g., West Road Cage area, Warehouse #3, Pre-Assembly Facility, and Upper Laydown Area).

CCNPP RESPONSE RAD RAI 02:

Site Radiation Protection Control procedures provide guidance for the opening and inspection of any outdoor container with a bottom door gasket/sealing surface. Measures are put in place prior to the opening of the container to prevent any liquid that may spill during the opening from contacting/reaching the ground.

RAD RAI 03:

In the Upper Laydown Area, there are "sealed" Sealand containers, casks, and other containers. Describe what is meant by "sealed" (e.g., are the containers locked and access is not allowed, and do site procedures prevent the opening of these containers?). Also, describe how potential effluent will be contained based on the "sealing" of containers and concluding that there will be negligible RAD.

CCNPP RESPONSE RAD RAI 03:

The Sealand containers, casks, and other containers that are stored in the Upper Laydown Area are either secured to prohibit access by a lock or require specific/special plant equipment to facilitate access. The keys and equipment are controlled by the Radiation Protection organization. Should the container require an inspection while outside, site procedures establish the requirements for opening the container. Measures are put in place prior to the opening of the container to prevent any effluent that may spill during the opening from contacting/reaching the ground, therefore the potential for radioactive release is qualitatively assessed to be negligible.

RAD RAI 04:

Describe any compensatory actions that may be taken during fire suppression activities to minimize RAD (e.g., diking of liquid effluent, use of storm drain covers, radioactive monitoring, or use of other gaseous effluent controls (e.g., use of eductors, effluent filtration)).

CCNPP RESPONSE RAD RAI 04:

The fire fighting strategies manuals provide the compensatory actions to be taken regarding the effluent from fire suppression activities. The compensatory measures that may be taken during fire suppression activities to minimize radioactive release are to contain and/or monitor smoke and water runoff to minimize external contamination using standard industry techniques such as temporary dikes, and absorbent materials. The Fire Brigade is also required to notify Radiation Protection before using an unmonitored liquid release path.

Fire fighting strategies manuals for areas within the owner controlled areas that have the potential for radioactive release will be updated, as necessary, to contain guidance for minimizing radioactive release due to suppression activities. Implementation item IMP-19 has been added to Attachment S. Refer to the attached marked up pages of Attachment S.

Fire Modeling (FM) RAI 01:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. The NRC staff noted that fire modeling comprised the following:

- *The algebraic equations implemented in Fire Dynamics Tools (FDTs) were used to characterize flame radiation (heat flux), flame height, plume temperature, ceiling jet temperature, and hot gas layer (HGL) temperature, and the latter in the multi-compartment analysis (MCA).*
- *Fire Dynamics Simulator (FDS) was used to assess MCR habitability, to calculate temperatures and heat fluxes for damage assessment to critical targets in selected compartments, calculate the flame height and how that affected certain targets, and calculate temperature rise for the purposes of estimating smoke detector activation.*
- *The Thermally-Induced Electrical Failure model, as part of FDS, was used as a secondary check on the temperature and heat flux calculations using FDS for zone of influence (ZOI) purposes.*

Section 4.5.1.2, "Fire PRA" of the LAR states that fire modeling was performed as part of the Fire PRA (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 PRA approach, methods, and data:

a. *Identify whether any fire modeling tools and methods have been used in the development of the LAR that are not discussed in Attachment J. In addition, identify any fire modeling tools and methods that are discussed in Attachment J that were not used in the fire modeling analyses performed at the plant.*
b. *It is discussed in the detailed fire modeling analysis that, "the FDTs are not setup for secondary ignition or for the effects of suppression systems on a fire scenario." This implies that secondary combustibles were not considered for any fire modeling analysis at the plant, except those using FDS.*
c. *Provide justification for ignoring the effects of flame spread and fire propagation in secondary combustibles (for example, cable trays) and the corresponding heat release rate (HRR) on the calculated ZOI and HGL temperature.*
d. *Provide information on how non-cable intervening combustibles were identified and accounted for in the fire modeling analyses.*
e. *Typically, during maintenance or measurement activities in the plant, electrical cabinet doors are opened for a certain period of time. Explain what administrative controls are in place to minimize the likelihood of fires involving such a cabinet, and describe how cabinets with temporary open doors were treated in the fire modeling analyses.*
f. *Describe the criteria that were used to decide whether a cable tray in the vicinity of an electrical cabinet will ignite following a high energy arcing fault (HEAF) event in the cabinet. Explain how the ignited area was determined and subsequent fire propagation was calculated. If applicable, describe the effect of tray covers and fire-resistant wraps on HEAF-induced cable tray ignition and subsequent fire propagation.*
g. *Provide justification for the assumed fire areas and elevations that were used in the transient ZOI calculations. Explain how the model assumptions in terms of location and*

HRR of transient combustibles in a fire area or zone will not be violated during and post-transition.

h. *Explain how wall and corner effects were accounted for in the fire modeling calculations, or provide justification if these effects were not considered.*

i. *Specifically regarding the use of FDS in the MCR abandonment calculations:*

   i. *It appears that the ceiling height of the MCR used in the calculations is rather high (~ 17ft.). Explain how the MCR dimensions specified in the FDS input files were established, and confirm that they are consistent with the actual dimensions of the control room. In addition, if a false ceiling is present to separate the interstitial space above the operator and back panel areas, provide justification for ignoring it in the control room abandonment calculations.*

   ii. *Explain if the doors of the MCR were assumed to be closed or open at all times, or were assumed to be open at a specified time. Discuss the impact of this assumption on the calculated abandonment times. Describe the additional leakage paths that were specified in the FDS input files, and provide the technical basis for the assumed natural vent areas.*

   iii. *The abandonment calculations consider two mechanical ventilation modes: HVAC inoperative and HVAC in smoke purge mode. Explain why the normal HVAC mode was not considered in the analysis, and why the two modes that were considered are bounding.*

   iv. *The MCR abandonment calculations for a specified ignition source appear to include FDS runs for 10 HRR bins. Appendix-E of NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities: Volume 1: Summary and Overview," September 2005 (ADAMS Accession No. ML052580075) uses a 15-bin discretization. Explain why only 10 bins were used, and describe how the 10-bin discretization was established.*

   v. *Describe the technical basis for choosing the location of the ignition source in the electrical cabinet and transient fire scenarios that were modeled in FDS, and confirm that locations in the operator area and the back panel area were considered for both types of ignition sources. Provide technical justification for not considering fire scenarios with the ignition source against a wall or in a corner.*

   vi. *Explain how the area and elevation of electrical cabinet and transient fires were determined, and demonstrate that the assumed areas and elevations are consistent with plant conditions or lead to conservative estimates of the abandonment times.*

   vii. *Provide justification for not considering scenarios that involve secondary combustibles in the MCR abandonment calculations.*

   viii. *Explain how the HRRs for electrical cabinets were determined and whether the values are consistent with the type(s) of cabinets present in the MCR at the plant.*

   ix. *Provide technical justification for not considering electrical cabinet fires that propagate to adjacent cabinets.*

   x. *Provide the technical basis for the material properties that were specified in FDS for the cables inside the cabinets in the MCR. Provide confirmation that the assumed soot yield and heat of combustion values (the latter either explicitly or implicitly* *through the specified fuel composition) lead to conservative estimates of the soot generation rate.*

xi. *Describe the transient fire growth rate(s) used in the control room abandonment calculations and provide the technical basis for the assumed time(s) to peak HRR.*

xii. *Provide the technical basis for the material properties that were specified in FDS for the transient combustibles in the MCR. Provide confirmation that the assumed soot yield and heat of combustion values (the latter either explicitly or implicitly through the specified fuel composition) lead to conservative estimates of the soot generation rate.*

xiii. *Describe the habitability conditions that were used to determine the time to MCR abandonment. FDS "devices" (temperature and optical density) were placed at a height of 6 feet and at four different locations in the MCR. Describe the basis for choosing these locations and demonstrate that these locations are either representative of where operators are expected to be, or lead to conservative abandonment time estimates. Confirm that heat flux sensors were not specified and, if so, provide technical justification for using temperature sensors as a surrogate for heat flux sensors.*

xiv. *Variations in the input parameters such as ambient temperature, soot yield of the fuel, fire base height, etc., affect the output of FDS calculations. The abandonment analyses for the MCR were performed using a single set of input parameters for each scenario. Demonstrate that the FDS calculations obtained using this set of input parameters provide conservative or bounding results. Alternatively, demonstrate that the abandonment times for a given scenario are not sensitive to variations within the uncertainty of the input parameters.*

xv. *Explain how the results of the MCR abandonment time calculations were used in the FPRA.*

j. *Specifically regarding the MCA:*

i. *Describe the criteria that were used to screen multi-compartment scenarios based on the size of the exposing and exposed compartments.*

ii. *Explain how the methods described in Chapter 2 of NUREG-1805, "Fire Dynamics Tools (FDTs): Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program," December 2004 (ADAMS Accession No. ML043290075) were used in the calculations to screen an ignition source based on insufficient HRR to generate a HGL condition in the exposing compartment. In addition, clarify which FDTs were used for the HGL calculations.*

iii. *In the MCA scenario analysis, explain the technical basis of modeling the ZOI as a vertical cylinder with the radius equal to 0.2 times the ceiling height in scenarios where the fire occurs near the opening between the two compartments and damages items on both sides within its ZOI.*

iv. *Some of the FDT calculations make the following assumption: "It is assumed that the forced ventilation of air flow rate is distributed among the interconnected compartments, especially corridors, based on the volume of the compartments." Provide technical justification for this assumption.*

v. *The screening process based on the ZOI specifies that if there are cable trays, conduits, or targets on the exposed side of the barrier within the ZOI, which may not be the same as those inside the exposing compartment, the scenario should be analyzed further. Provide details about this additional analysis.*

k. *Specifically regarding the use of FDS in the CSR (physical analysis units (PAUs) 306 and 302) calculations:*

i. *It is stated that engineering judgment is used to assess that the delay in smoke detector activation, which is associated with cross-train logic that is not possible to incorporate in FDS, would be in the range of 2 to 10 seconds. Provide technical justification for this estimate.*

ii. *The FDS "devices" (temperature and heat flux) were placed at different locations around the switchgear rooms. Describe the basis for choosing these locations.*

iii. *The analysis highlights the location of possible electrical cabinet fires that were considered. Provide technical justification for selecting these specific fire locations or demonstrate that these locations lead to bounding or conservative estimates.*

iv. *A number of transient fires were postulated in the CSRs, but the documentation indicates that the walkdown identified no transient combustibles and there were no storage areas for more permanent combustibles in the fire areas. Provide justification for selection of the transient fire areas and indicate if this selection is dependent on any administrative controls of transient combustibles in the CSRs.*

v. *The HRR used for the cabinet fires indicates that the cabinet doors were assumed to be closed. Provide justification for this assumption (e.g., on the basis of the actual plant configuration or operational condition).*

vi. *As stated in FM RAI 1.b, it is expected that secondary combustibles (ignition, flame spread, and cable tray fire propagation) would be part of the FDS analysis for the CSRs. Clarify how secondary combustibles were considered in the FDS analysis of the CSRs, and if they were not considered, provide justification for their omission.*

l. *During the walkdown of the MCR, several observations were made, which require additional information:*

i. *The main horseshoe and back panel cabinet configurations consist of open cabinets with a steel mesh open top with the open sides facing each other across a narrow aisle. The FDS analysis utilizes an HRR case from Appendix G of NUREG-CR 6850, which assumes closed cabinets. Provide justification for not using an HRR case applicable to open cabinets or update the analysis with the appropriate HRR.*

ii. *During the discussion about the open cabinets, it was also discussed that the current analysis does not consider the potential for fire spread across the aisle (i.e., within the horseshoe) from the front to back or vice versa. Provide justification for not considering this potential fire spread or update the analysis to include this scenario.*

iii. *During the walkdown of the MCR, several combustible items, which could be considered transient fire sources, were observed that could potentially have an HRR of greater than 317 kW. Examples include the kitchen area, the upholstered furniture in the shift manager's office and space below the shift manager's office, and photocopiers. Provide additional information that can justify that the transient fire source selected in the FDS analysis is conservative and bounding.*

CCNPP RESPONSE FM RAI 01:

Remaining responses to be provided 4/13/15.

01l.i – Calvert Cliffs will update the Main Control Room (MCR) Fire Dynamics Simulator (FDS) analysis to use the heat release rate (HRR) probability distribution from NUREG/CR-6850 Table G-1 for an open cabinet with unqualified cable, fire in more than one cable bundle. There is no HRR value in NUREG/CR-6850 Table G-1 for an open cabinet with qualified cable. The main control board (MCB) (i.e., main horseshoe and back panel cabinets) is predominately qualified cable, and this HRR value may be inappropriate and would produce overly conservative risk estimates. Therefore, Calvert Cliffs will review the MCB contents and cable types, and for certain MCB vertical sections, the NUREG/CR-6850 recommended HRR may be refined and a more appropriate peak HRR for the MCB will be estimated using the following approach:

- Estimate the surface area of exposed cabling (both vertically and horizontally oriented cables) in each vertical section, and use this to calculate the HRR of cable using the heat release rate per unit area values recommended in NUREG/CR-7010 ("CHRISTIFIRE") for thermoset (150 kW/m^2) and thermoplastic (250 kW/m^2) cable types, as appropriate. If specific HRRs can be determined for cable types, then this may be used instead of the generic values, using NUREG-1805.1, Chapter 7, "Estimating the full-scale heat release rate of a cable tray fire". A mass-weighted ratio of the HRRs will be applied based on the percentage of each cable type, which is consistent with the recommendations of NUREG/CR-7010 for when there is a mixture of cable types. In lieu of a specific HRR estimate for each vertical section, a generic estimate may be applied, provided that the generic estimate is appropriate and bounding for that vertical section.
- The fire growth profile will follow NUREG/CR-6850, Section G.3.1, for electrical cabinet fires.
- The heat release rate probability distribution will be determined using the value calculated above as the 98^{th} percentile HRR as follows:
    - o The alpha value for the HRR gamma distribution will be based on the existing value in NUREG/CR-6850 Table G-1 (and Table E-1) for "Vertical cabinets with unqualified cable, fire in more than one cable bundle and open doors" (i.e., Case 5 in table E-1).
    - o The beta value will be calculated based on the peak HRR of the cabinet section and the alpha value chosen above. Conservatively, the largest calculated HRR value may be used to determine the HRR Bin distribution which will bound the remaining sources.
- Spread to adjacent vertical cabinet sections, where applicable, will be modeled to occur at 10 minutes, per guidance in NUREG/CR-6850, Appendix S.

Updates to MCR fire modeling analysis to incorporate appropriate HRRs for the MCB main horseshoe and back panel cabinets will be reflected in the updated fire risk results that will be provided to the NRC after the Calvert Cliffs Fire PRA is updated and additional quantification is performed in response to PRA RAI 03.

FM RAI 02:

The ASME/ANS Standard RA-Sa-2009, "Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," Part 4, requires damage thresholds be established to support the FPRA. Thermal impact(s) must be considered in determining the potential for thermal damage of SSCs and appropriate temperature and critical heat flux criteria must be used in the analysis.

a. *Describe how the installed cabling in the power block was characterized, specifically with regard to the critical damage threshold temperatures and critical heat fluxes for thermoset and thermoplastic cables as described in NUREG/CR-6850. If thermoplastic cables are present, explain how raceways with a mixture of thermoset and thermoplastic cables were treated in terms of damage thresholds.*
b. *Explain how the damage thresholds for non-cable components (i.e., pumps, valves, electrical cabinets, etc.) were determined. Identify any non-cable components that were assigned damage thresholds different from those for thermoset and thermoplastic cables, and provide a technical justification for these damage thresholds.*
c. *Explain how exposed temperature-sensitive equipment was treated, and provide a technical justification for the damage criteria that were used.*

CCNPP RESPONSE FM RAI 02:

02a – Response to be provided 4/13/15.

02b – The damage threshold for non-cable components was determined using the guidance of NUREG/CR-6850 Appendix H:

- Active, non-combustible components (e.g., pumps, motors, valve bodies, etc.) were characterized based on review of the supporting cables (power, control, or instrument wiring) for the component.
- Passive, non-combustible components (e.g., check valves, tanks, pipes, etc.) were considered invulnerable to fire as recommended in Appendix H of NUREG 6850.
- Components, such as electrical cabinets, that have the potential to contain temperature sensitive equipment were evaluated for an alternative damage criteria. Components containing temperature sensitive equipment will be discussed in the response to part c of this RAI.

Since the characterization of target damage follows the guidance of NUREG/CR-6850 Appendix H, except for sensitive electronics discussed in part c to this RAI, no further justification is required.

02c – Response to be provided 4/13/15.

FM RAI 03:

Section 2.7.3.2 of NFPA 805 states that each calculational model or numerical method used shall be verified and validated through comparison to test results or comparison to other acceptable models.

Section 4.5.1.2 of the LAR 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 for a discussion of the verification and validation (V&V) of the fire models that were used. Furthermore, Section 4.7.3 of the LAR states that "Calculation 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."

For any tool or method identified in the response to FM RAI 1.a above, provide the V&V basis if not already explicitly provided in the LAR (for example, in Attachment J). Provide technical details to demonstrate that these models were applied within the validated range of input parameters, or justify the application of the model outside the validated range in the V&V basis documents.

CCNPP RESPONSE FM RAI 03:

There will be nine tools or methods added to Attachment J as identified in the response to FM RAI 01.a:

1. Plume Radius (Method of Heskestad);
2. Ceiling Jet (Method of Alpert);
3. Smoke Detection Activation Correlation;
4. Sprinkler Activation Correlation;
5. Plume / Hot Gas Layer Interaction Study using Fire Dynamics Simulator (FDS);
6. Temperature Sensitive Equipment Hot Gas Layer Study using Consolidated Model of Fire and Smoke Transport (CFAST);
7. Correlation for Flame Spread over Horizontal Cable Trays (FLASH-CAT);
8. PyroSim software package for generating FDS input files; and,
9. Engineering Planning and Management (EPM) Fire Modeling Workbook (FMWB).

The verification and validation (V&V) bases for these tools are discussed below.

Plume Radius (Method of Heskestad)

The plume radius correlation is documented in an authoritative publication of the Society of Fire Protection Engineers (SFPE) Handbook. Page 2-7 of the 4th edition of the SFPE Handbook of Fire Protection Engineering states that the value calculated by this correlation is the point where the temperature has declined to half of the centerline plume temperature. The Heskestad centerline plume correlation was verified and validated in NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," including Draft Supplement 1.

The plume radius correlation is used to approximate when to apply the vertical fire plume zone of influence (ZOI), versus the horizontal heat flux based ZOI. The plume radius is not used as the sole basis for any target failures, nor is it used to estimate target temperature. In other words, targets located within the plume radius are considered to be exposed to the centerline temperatures of the plume, while targets located beyond the plume radius are considered to be exposed to the heat flux as determined by the point source model. Although the plume radius is calculated for the critical plume height above the base of the fire, the plume radius distance is conservatively used for the entire height of the fire plume.

Based on how the plume radius was applied, and since the plume radius correlation is a derivative of the Heskestad centerline plume temperature correlation, which was verified and validated by NUREG-1824, the plume radius correlation is subject to the same validated ranges as the plume centerline correlation.

All calculations utilizing this correlation will be performed within the validated range of NUREG 1934 and NUREG-1824, including Draft Supplement 1, for the Heskestad centerline plume temperature correlation, or justified as acceptable. The results of these calculations will be included as part of PRA RAI 03.

Ceiling Jet (Method of Alpert)

The Alpert ceiling jet correlation is used to calculate target damage as well as detection and suppression application in some models. This correlation assumes that no walls exist to channel the flow of gases or cause the formation of a hot gas layer. The presence of walls or a hot gas layer will always increase the temperature of the ceiling jet flow. The correlation should also only be used to predict the flow of hot gases under flat, unobstructed ceilings, and the correlation is not intended to model the ceiling jet temperature in compartments with a well-developed hot gas layer. Alpert's ceiling jet correlation was verified and validated in NUREG-1824.

The approach of adding the hot gas layer temperature to the ceiling jet temperature is not used. The primary application of the ceiling jet correlation was the determination of detection and suppression timing, in which the ceiling jet velocity is a sub-model in the analysis. Including the effects of a hot gas layer would result in shorter detection and suppression times, and therefore the use of the ceiling jet correlation is considered conservative.

All calculations utilizing this correlation will be performed within the validated range of NUREG-1934 and NUREG-1824, including Draft Supplement 1, or justified as acceptable. The results of these calculations will be included as part of PRA RAI 03.

Smoke Detection Activation Correlation

Heskestad and Delichatsios determined that an increase in temperature of 10°C (18°F) above ambient temperature corresponded to a significant enough increase in optical density to cause smoke detector activation. The method of Alpert is used to determine the temperature within the ceiling jet and the limitations of the Alpert ceiling jet correlation are applicable. The temperature to smoke obscuration correlation is discussed and detailed within Chapter 4-1 of the 4th edition of the SFPE Handbook of Fire Protection Engineering and Chapter 11 of NUREG-1805, "Fire Dynamics Tools (FDTs) Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program," and is subject to the following assumptions and limitations:

- The fire is steady state;
- The forced ventilation system is off. As ventilation is increased, detector response times increase;
- Both flaming and non-flaming fire sources can be used;

- Caution should be exercised with this method when the overhead area is highly obstructed; and,
- The detectors are located at or very near to ceiling. Very near to ceiling would include code compliant detectors mounted on the bottom flange of structural steel beams. This method is not applicable to detectors mounted well below the ceiling in free air.

Heskestad and Delichatsios correlated a smoke temperature change of 10°C (18°F) based upon typical fire fuels. The materials tested to develop the Heskestad and Delichatsios smoke detector correlation are representative of the fuels modeled for smoke detector activation. The tested materials include various plastics, foams, and paper, possessing smoke properties similar to the fires modeled at CCNPP. Additionally, when implementing the Heskestad and Delichatsios Smoke Detection Actuation Correlation (i.e., FDT10), the 10°C (18°F) ceiling jet temperature rise from ambient temperature is preserved by adjusting the activation temperature of the smoke detector accordingly.

Since the correlation is documented in an authoritative publication of the SFPE Handbook and in NUREG-1805, the correlation is acceptable for use, provided that it is applied within the limits of its applicability. The smoke detection correlation will only be applied to fuels, configurations, and environmental conditions consistent with those described in Chapter 4-1 of the SFPE Handbook and NUREG-1805.

All calculations utilizing this correlation will be performed subject to the assumptions and limitations described above, and within the validated range for the Alpert ceiling jet correlation of NUREG-1934 and NUREG-1824, including Draft Supplement 1. The results of these calculations will be included as part of PRA RAI 03.

Sprinkler Activation Correlation

The sprinkler activation correlation uses the Alpert Ceiling Jet Correlation to determine sprinkler activation. The method of Alpert is used to determine the temperature within the ceiling jet and the limitations of the Alpert Ceiling Jet Correlation are applicable. The correlation is documented in an authoritative publication of the NFPA Fire Protection Handbook and the correlation V&V is documented in NUREG-1824, including Draft Supplement 1.

All calculations utilizing this correlation will be performed subject to the assumptions and limitations described above, and within the validated range for the Alpert ceiling jet correlation of NUREG 1934 and NUREG-1824, including Draft Supplement 1. The results of these calculations will be included as part of PRA RAI 03.

Plume / Hot Gas Layer Interaction Study using FDS

The plume / hot gas layer (HGL) study was performed by EPM using FDS to determine the point at which the HGL and plume interact and establish limits for plume temperature application. V&V of FDS is documented in National Institute of Standards and Technology (NIST) Special Publication 1018-5, "Fire Dynamics Simulator (Version 5) Technical Reference Guide." The V&V of FDS specifically for nuclear power plant applications is documented in NUREG-1824.

The study has been reviewed to ensure the parameters are within the validated range of NUREG 1934 and NUREG-1824, including Draft Supplement 1 or are justified as acceptable. Application of this study to the CCNPP Fire PRA will be included as part of PRA RAI 03.

Temperature Sensitive Equipment Hot Gas Layer Study using CFAST

The objective of this study is to determine whether hot gas layer conditions may develop in a room that would lead to damage of temperature sensitive plant equipment (e.g., equipment containing solid state components). The study investigates a range of room geometries, fire sizes and durations to identify scenarios where these lower layer temperature conditions can be expected to develop. For each room geometry and fire size analyzed, a recommendation for the treatment of hot gas layer impacts to temperature sensitive equipment is provided.

For this study, the Consolidated Model of Fire and Smoke Transport (CFAST) was used to analyze varying room configurations and fire scenarios that can typically be expected at CCNPP and those that serve to bound the expected fires.

The output files from the CFAST runs were analyzed to determine the maximum upper gas layer and lower gas layer temperatures, as well as the lowest gas layer height from the floor. Potential damage to temperature sensitive equipment was analyzed based on the CFAST data for the upper and lower gas layer temperatures, as well as the interface layer height.

The V&V of the CFAST code is documented in NIST Special Publication 1086, "CFAST – Consolidated Model of Fire Growth and Smoke Transport (Version 6) Software Development and Model Evaluation Guide." The specific use of CFAST for nuclear power plant applications has been documented in NUREG-1824.

The study has been reviewed to ensure the parameters are within the validated range of NUREG 1934 and NUREG-1824, including Draft Supplement 1 or are justified as acceptable. Application of this study to the CCNPP Fire PRA will be included as part of PRA RAI 03.

Flame Spread over Horizontal Cable Trays (FLASH-CAT)

FLASH-CAT is a relatively simple model for predicting the growth and spread of a fire within a vertical stack of horizontal cable trays. The correlation is recommended by NUREG/CR-7010, "Cable Heat Release, Ignition, and Spread in Tray Installations During Fire (CHRISTIFIRE)," and follows guidance set forth in EPRI 1011989 / NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities." The FLASH-CAT model is validated in Section 9.2.3 of NUREG/CR-7010 through experimentally measured heat release rates (HRRs) compared with the predictions of the FLASH-CAT model.

The FLASH-CAT correlation will be applied to configurations similar to those reported by NUREG/CR-7010 or will be justified as acceptable by quantitative analysis.

PyroSim

PyroSim is a software package that was used to generate the FDS files used in fire modeling calculations.

The developers of PyroSim (Thunderhead Engineering) confirmed that PyroSim is verified to build the input file correctly. A multi-level process is used to do this, including testing during development and running example problems through the software to ensure the correct input data is written and results obtained. Selected examples from Volume 7 of NUREG-1824 are used for some of these example problems to ensure the input is written correctly. In addition, PyroSim has been utilized by hundreds of users since 2006 and any discrepancies identified by these users are addressed in subsequent releases of the software.

Engineering Planning and Management (EPM) Fire Modeling Workbook (FMWB)

The EPM FMWB is a collection of fire modeling correlations that are already documented in NUREG-1805 and Fire Induced Vulnerability Evaluation (FIVE), "EPRI Fire Induced Vulnerability Evaluation Methodology," Revision 1, referenced by EPRI Report 1002981, 2002. The V&V basis for these correlations are addressed individually within Attachment J of the LAR or within this RAI response.

The fire modeling correlations within the EPM FMWB have been verified, by "black box" testing, to ensure that the results were identical to the verified and validated models. "Black box" testing (or functional testing) is testing that ignores the internal mechanism of a system or component and focuses solely on the outputs generated in response to selected inputs and execution conditions.

The results from the EPM FMWB were compared to those produced by the NUREG-1805 FDTs and FIVE Revision 1, when identical inputs were entered into both. Since the correlations from NUREG-1805 FDTs and FIVE Revision 1, were verified and validated in NUREG-1824 and the results match the results produced by the EPM FMWB, the EPM FMWB is verified and validated with respect to NUREG-1824.

All calculations utilizing the EPM FMWB will be performed within the validated range of NUREG 1934 and NUREG-1824, including Draft Supplement 1, or justified as acceptable. The results of these calculations will be included as part of PRA RAI 03.

Attachment J, Table J-1 of the LAR is revised as shown in the Enclosure.

FM RAI 04:

Section 2.7.3.3 of NFPA 805 states that acceptable engineering methods and numerical models shall only be used for applications to the extent these methods have been subject to verifications and validation. These engineering methods shall only be applied within the scope, limitations, and assumptions prescribed for that method.

Section 4.7.3 of the LAR states that, "Engineering methods and numerical models used in support of compliance with 10 CFR 50.48(c) were applied appropriately as required by Section 2.7.3.3 of NFPA 805."

Regarding the limitations of use, the NRC staff notes that algebraic models cannot be used outside the range of conditions covered by the experiments on which the model is based. NUREG-1805 includes a section on assumptions and limitations that provides guidance to the user in terms of proper and improper use for each FDT.

Identify uses, if any, of FDS and the FDTs outside the limits of applicability of the model, and for those cases, explain how the use of FDS and the FDTs was justified.

CCNPP RESPONSE FM RAI 04:

Response to be provided 4/13/15.

FM RAI 05:

Section 4.5.1.2 of the LAR states that fire modeling was performed as part of the FPRA development (NFPA 805, Section 4.2.4.2). The NRC staff notes this requires that qualified fire modeling and PRA personnel work together. Furthermore, Section 4.7.3 of the LAR states the following:

> *Cognizant personnel who use and apply engineering analysis and numerical methods in support of compliance with 10 CFR 50.48(c) are competent and experienced as required by Section 2.7.3.4 of NFPA 805.*
>
> *For personnel performing fire modeling for FPRA development and evaluation, CCNPP [Calvert Cliffs Nuclear Power Plant] develops and maintains qualification requirements for individuals assigned various tasks. Position specific guides were 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.*
>
> *Qualification cards provide evidence that Design Engineering and PRA personnel have the appropriate training and technical expertise to perform assigned work, including the use of engineering analyses and numerical models.*
>
> *Qualification requirements are contained in procedure CNG-TR-1.01-1014 (Reference 6.47). CCNPP will maintain qualification requirements for the performance of NFPA 805 related tasks. Position specific qualification cards identify and document required training and mentoring to ensure cognizant individuals are appropriately qualified to perform assigned work per the requirements of NFPA 805, Section 2.7.3.4.*

Regarding qualifications of users of engineering analyses and numerical models (i.e., fire modeling techniques):

a. *Describe the requirements to qualify personnel for performing fire modeling calculations in the NFPA 805 transition.*
b. *Describe the process for ensuring that fire modeling personnel have the appropriate qualifications not only before the transition, but also during and following the transition.*
c. *When fire modeling is performed in support of the FPRA, describe how proper communication between the fire modeling and FPRA personnel is ensured.*

CCNPP RESPONSE FM RAI 05:

05a – Response provided in Reference 1.

05b – In the case of the initial fire modeling, the vendor provided the credentials of the fire modelers, which were reviewed and approved by Calvert Cliffs Engineering supervision per Constellation procedures. During and following the transition to Exelon procedures, the Exelon engineering staff will continue to be knowledgeable in fire modeling techniques, including interpreting and maintaining the fire modeling database. If new fire modeling personnel are needed in the future, their credentials will also be reviewed and approved by Exelon PRA Engineering Management. Exelon Engineering Managers have procedural responsibility for verifying all required qualifications in the Exelon training database prior to assigning personnel to perform work. Exelon personnel assigned to perform work have procedural responsibility for verifying their own required qualifications prior to commencing the assigned work.

05c – Throughout the development of the Calvert Cliffs Fire PRA, fire modeling personnel and the PRA engineers maintained frequent communications. Responsibility for the fire modeling and Fire PRA model rests with the Fire PRA Exelon manager. Periodic meetings with the Fire PRA and fire modeling personnel were performed as necessary to ensure proper communication. The fire scenario frequencies and target sets were electronically transmitted to the PRA engineers, who performed the quantification. Fire modeling personnel and PRA engineers participated in the cutset review meetings during the development of the Calvert Cliffs Fire PRA. Going forward, the fire PRA will continue to be maintained with oversight from the Fire PRA Exelon manager who will continue to have responsibility for the fire modeling personnel and the PRA engineers.

FM RAI 06:

Section 4.7.3 of the LAR states 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 for fire modeling:

a. Describe how the uncertainty associated with the fire model input parameters was accounted for in the fire modeling analyses.

b. Describe how the "model" and "completeness" uncertainties were accounted for in the fire modeling analyses.

CCNPP RESPONSE FM RAI 06:

Response to be provided 4/13/15.

PRA RAI 01 - Fire Event Facts and Observations:

Section 2.4.3.3 of NFPA 805 states that the probabilistic safety assessment (also referred to as PRA) approach, methods, and data shall be acceptable to the authority having jurisdiction, which is the NRC. RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting an FPRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the NRC staff for adopting a fire protection program consistent with NFPA 805. RG 1.200 describes a peer review process utilizing an associated ASME/ANS standard (currently ASME/ANS-RA-Sa-2009) as one acceptable approach for determining the technical adequacy of the PRA, once acceptable consensus approaches or models have been established for evaluations that could influence the regulatory decision. The primary result of a peer review are the facts and observations (F&Os) recorded by the peer review and the subsequent resolution of these F&Os.

Clarify the following dispositions to fire F&Os and Supporting Requirement (SR) assessments identified in Attachment V of the LAR that have the potential to impact the FPRA results and do not appear to be fully resolved:

a) *PRM-83-01: The disposition to F&O PRM-83-01 appears to indicate that the FPRA was updated to address events involving a fire induced loss of MCR HVAC, which the peer review suggests has a conditional core damage probability (CCDP) of 1.0, by increasing the likelihood of functional failures in lieu of assuming their occurrence. Justify the functional failures modeled by the FPRA to address this loss of MCR HVAC. In addition, explain how the FPRA evaluates the degradation of equipment due to elevated temperatures caused by loss of HVAC as an increase in equipment failure rates, and provide a technical basis for doing so.*

b) *FSS-A5-01: This F&O states that some PAUs are further divided into "sub-PAUs" and appears to indicate that there is no explicit process for evaluating the fire spread across sub-PAU boundaries, which, as the peer review noted, are not defined by physical barriers. The disposition to this F&O, however, does not discuss such a process, and by referencing a sensitivity analysis limited to a number of "representative" PAUs, suggests that this apparent deviation from acceptable methods has not been fully addressed for all PAUs for which sub-PAUs have been defined. Explain how the fire effects across non-physical sub-PAU boundaries are identified and evaluated. Discuss how this approach is consistent with or conservatively bounds acceptable methods.*

c) *FSS-G4-01: The disposition to this F&O indicates that the MCA did not postulate a propagation scenario if doing so would require failure of a penetration seal. The licensee's analysis (C0-FSS-08) suggests that a similar approach may have also been followed for other barrier types (e.g., walls). As a result, identify each barrier type for which propagation scenarios were not postulated, and provide quantitative justification (e.g., an evaluation demonstrating that MCA scenarios involving barrier failure are low risk, even considering the risk associated with the multi-compartment fire) for not addressing propagation. As an alternative, provide updated risk results as part of the integrated analysis requested in PRA RAI 03, summing the generic barrier failure probabilities for each type of barrier present between communicating compartments, consistent with NUREG/CR-6850.*

d) *FSS-G5-01: The disposition to this F&O indicates that unreliability values were applied to all normally open, self-closing dampers and doors; however, the disposition neither provides a basis for the values applied nor mentions active elements discussed elsewhere (e.g., water curtains in F&O PP-B5-01). Summarize the types of active fire barrier elements credited in the FPRA, and provide quantitative justification for their unreliability and unavailability.*

e) *HRA-B2-01: The disposition to this F&O indicates that "adverse" operator actions, which include actions to de-energize electrical busses as a means to address spurious operations, are modeled in the FPRA by assuming all equipment disabled by the action is failed (i.e., the action is successful). Although the licensee's analysis (Section 2.2 of C0-HRA-001) indicates that this assumption is conservative, the basis for this conclusion is unclear if the action is taken to reduce risk. In light of this:*

   i. *Provide justification for the assumption that modeling "adverse" actions as successful is conservative. Note that guidance in NUREG-1921 offers considerations for evaluating fault clearing strategies in the FPRA human reliability analysis (HRA).*

   ii. *Clarify how "adverse" actions are addressed by the FPRA HRA dependency analysis, given that these actions are modeled by failing associated equipment directly within the PRA logic model.*

iii. *Explain the statement in Attachment G that "[n]one of the recovery actions were found to have an adverse impact on the FPRA." In doing so, clarify how "adverse" risk impact was defined. Note that FAQ 07-0030 states that "[i]f activities (recovery actions or other actions in the post-fire operational guidance) are determined to have an adverse risk impact, they should be resolved during NFPA 805 implementation via an alternate strategy that eliminates the need for the action in the NSCA."*

f) *CS-B1-01: The licensee's analysis (Appendix F of ECP-13-000321, "Common Power Supply and Common Enclosure Study") identifies several MCC 208/120 Volts alternating current load breakers that were not coordinated with their respective feed breakers. The disposition to this F&O indicates that these 120V panel breaker coordination issues are to be addressed by plant modification; however, Attachment S does not appear to contain such a modification. Identify the Attachment S modification(s) being credited to resolve the 120V panel breaker coordination issues identified in the disposition to this F&O.*

CCNPP RESPONSE PRA RAI 01:

01a – Response provided in Reference 1.

01b - Response to be provided 4/13/15.

01c – Response to be provided 4/13/15.

01d – Response provided in Reference 1.

01e – Response provided in Reference 1.

01f – Response provided in Reference 1.

PRA RAI 02 - Internal Event F&Os:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting an FPRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the staff for adopting a fire protection program consistent with NFPA 805. RG 1.200 describes a peer review process utilizing an associated ASME/ANS standard (currently ASME/ANS-RA-Sa-2009) as one acceptable approach for determining the technical adequacy of the PRA once acceptable consensus approaches or models have been established. The primary results of a peer review are the F&Os recorded by the peer review and the subsequent resolution of these F&Os.

Clarify the following dispositions to internal events F&Os and SR assessments identified in Attachment U of the LAR that have the potential to impact the FPRA results and do not appear to be fully resolved:

a) *4-5: This F&O indicates that the alignment strategy assumed by the PRA for the 0C diesel generator (DG) is not appropriately justified and may be non-conservative. While the disposition to this F&O clarifies how alignment of the 0C DG is modeled in the PRA, a justification for this treatment is not provided. Provide a technical and/or procedural basis for the alignment strategy assumed in the PRA for the 0C DG, and indicate whether any operator interviews were conducted to support the analysis.*

b) 6-23: This F&O indicates that some joint human error probabilities (HEPs) applied within the internal events PRA (IEPRA) may not accurately reflect the sequential timing of associated operator actions. While the disposition appears to address the specific example referenced by the F&O, it is not clear that the broader issue has been fully resolved in the fire PRA, particularly noting that the status of this F&O in Table U-1 is identified as "open."

i. Explain how the HRA methods used by the FPRA for developing HEP and joint HEP values are consistent with or conservatively bound NRC-accepted guidance in NUREG/CR-6850 or NUREG-1921. Alternatively, provide updated risk results as part of the aggregate change-in-risk analysis requested in PRAN RAI 03 applying HEP and joint HEP values developed using NRC-accepted guidance.

ii. NUREG-1921 indicates and NUREG-1792 (Table 2-1) states that joint HEP values should not be below 1.0E-05. Confirm that each joint HEP value used in the FPRA below 1.0E-05 includes its own justification that demonstrates the inapplicability of the NUREG-1792 lower value guideline. Provide an estimate of the number of these joint HEPs below 1.0E-05 and at least two different types of justification.

CCNPP RESPONSE PRA RAI 02:

Response provided in Reference 1.

PRA RAI 03 - Integrated Analysis:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. Section 2.4.4.1 of NFPA 805 further states that the change in public health risk arising from transition from the current fire protection program to an NFPA 805 based program, and all future plant changes to the program, shall be acceptable to the NRC. RG 1.174 provides quantitative guidelines on CDF and LERF, identifies acceptable changes to these frequencies that result from proposed changes to the plant's licensing basis, and describes a general framework to determine the acceptability of risk-informed changes. The NRC staff's review of the information in the LAR has identified additional information that is required to fully characterize the risk estimates.

The PRA methods currently under review in the LAR include:

- *PRA RAI 01.a regarding loss of MCR HVAC*
- *PRA RAI 01.b regarding division of PAUs into "sub-PAUs"*
- *PRA RAI 01.c regarding treatment of propagation in the MCA*
- *PRA RAI 01.d regarding unreliability and unavailability of active barriers*
- *PRA RAI 01.e regarding adverse operator actions*
- *PRA RAI 01.f regarding 120V panel breaker coordination issues*
- *PRA RAI 02.a regarding alignment of OC diesel generator*
- *PRA RAI 02.b regarding HRA methods, including sequential timing of operator actions*
- *PRA RAI 04 regarding placement of transient fires*
- *PRA RAI 05 regarding transient influence factors*
- *PRA RAI 06 regarding reduced transient HRR*
- *PRA RAI 07 regarding self-ignited cable fires and those caused by welding and cutting*
- *PRA RAI 08 regarding treatment of junction boxes*
- *PRA RAI 09 regarding treatment of sensitive electronics*
- *PRA RAI 10 regarding circuit failure probabilities*

- *PRA RAI 11 regarding counting and treatment of Bin 15 electrical cabinets*
- *PRA RAI 12 regarding treatment of HEAF*
- *PRA RAI 13 regarding MCR modeling*
- *PRA RAI 14 regarding credit for MCR abandonment actions*
- *PRA RAI 15 regarding MCR abandonment on loss of control*
- *PRA RAI 16 regarding application of the state-of-knowledge correlation (SOKC)*
- *PRA RAI 18 regarding ΔICDF, ΔLERF and additional risk of RAs*
- *PRA RAI 23 regarding other deviations from acceptable methods*

Provide the following:

a) *Results of an aggregate analysis that provide the integrated impact on the fire risk (i.e., the total transition CDF, LERF, ΔCDF, ΔLERF, and additional risk of RAs) of replacing specific methods identified above with alternative methods that are acceptable to the NRC. In this aggregate analysis, for those cases where the individual issues have a synergistic impact on the results, a simultaneous analysis must be performed. For those cases where no synergy exists, a one-at-a-time analysis may be done. For those cases that have a negligible impact, a qualitative evaluation may be done. It should be noted that this list may change depending on NRC's review of the responses to other RAIs in this document.*

b) *For each method (i.e., each bullet) above, explain how the issue will be addressed in 1) the final aggregate analysis results provided in support of the LAR, and 2) the PRA that will be used at the beginning of the self-approval of post-transition changes. In addition, provide a process to ensure that all changes will be made, that a focused-scope peer review will be performed on changes that are PRA upgrades as defined in the PRA standard, and that any findings will be resolved before self-approval of post-transition changes.*

c) *In the response, explain how RG 1.205 risk acceptance guidelines are satisfied for the aggregate analysis. Additionally, discuss the likelihood that the risk increase in any individual fire area would exceed the acceptance guidelines, and if so, why exceeding the guidelines should be acceptable. If applicable, include a description of any new modifications or operator actions being credited to reduce delta risk as well as a discussion of the associated impacts to the fire protection program.*

d) *If any unacceptable methods identified above will be retained in the PRA and will be used to estimate the change in risk of post-transition changes to support self-approval, explain how the quantification results for each future change will account for the use of these methods.*

CCNPP RESPONSE PRA RAI 03:

Response to be provided 4/13/15.

PRA RAI 04 - Transient Fire Placement at Pinch Points:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting an FPRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the staff for adopting a fire protection program consistent with NFPA 805. Methods that have not been determined to be acceptable by the

NRC staff, or acceptable methods that appear to have been applied differently than described, require additional justification to allow the NRC staff to complete its review of the proposed method.

The NRC staff could not identify in the LAR or licensee's analysis a description of how "pinch points" for transient fires were treated in the FPRA. Per NUREG/CR-6850, Section 11.5.1.6, transient fires should, at a minimum, be placed in locations within the plant PAUs where 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. Cable congestion is typical for areas like the CSR, so placement of transient fire at pinch points in those locations is important. Hot work should be assumed to occur in locations where hot work is possible, even if improbable, keeping in mind the same philosophy.

a) *Clarify how "pinch points" were identified and modeled for general transient fires and transient fires due to hot work.*

b) *Describe how general transient fires and transient fires due to hot work are distributed within the PAUs at Calvert Cliffs. In particular, identify the criteria used to determine where such ignition sources are placed within the PAUs.*

CCNPP RESPONSE PRA RAI 04:

Response to be provided 4/13/15.

PRA RAI 05 - Transient Influencing Factors:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. The 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting an FPRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the NRC staff for adopting a fire protection program consistent with NFPA 805. Methods that have not been determined to be acceptable by the NRC staff, or acceptable methods that appear to have been applied differently than described, require additional justification to allow the NRC staff to complete its review of the proposed method.

Appendix H of the LAR does not indicate that FAQ 12-0064, "Hot Work/Transient Fire Frequency Influence Factors," dated January 17, 2013 (ADAMS Accession No. ML12346A488), was used in preparation of the FPRA. According to this FAQ, transient influence factor may not be assigned a ranking value of 0, unless associated activities and/or entrance during power operation are precluded by design and/or operation. The licensee's analysis (Table C-2 of C0-IGN-001) indicates, however, that a large number of PAUs are assigned ranking values of 0 for one or more of the transient influence factors. As a result, clarify whether ranking values assigned to transient influencing factors were developed consistent with the guidance in NUREG/CR-6850 and FAQ 12-0064, in particular Section 6.5.7.2, and if not, provide justification. If justification cannot be provided, then provide treatment of transient influence factors consistent with NRC guidance in the integrated analysis provided in response to PRA RAI 03.

CCNPP RESPONSE PRA RAI 05:

Response to be provided 4/13/15.

PRA RAI 06 - Reduced Transient Heat Release Rates:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting an FPRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the NRC staff for adopting a fire protection program consistent with NFPA 805. Methods that have not been determined to be acceptable by the NRC staff, or acceptable methods that appear to have been applied differently than described require additional justification, to allow the NRC staff to complete its review of the proposed method.

It appears that reductions below the NUREG/CR-6850 98th percentile HRR of 317 kilowatt (kW) for transient fires may have been credited in the FPRA. In particular, the licensee's analysis (e.g., Section 6.5.4 of Addendum 1 to C0-FSS-004) indicates that a 142 kW (75th percentile) HRR transient fire was postulated in the switchgear rooms. As a result, discuss the key factors used to justify any reduced HRR below 317 kW, per the guidance endorsed by the June 21, 2012, memo from Joseph Giitter to Biff Bradley, "Recent Fire PRA Methods Review Panel Decisions and EPRI 1022993, 'Evaluation of Peak Heat Release Rates in Electrical Cabinet Fires'" (ADAMS Accession No. ML12171A583). In doing so:

a) Identify all PAUs for which a reduction in the HRR below 317 kW for transient fires is credited.

b) For each location where a reduced HRR is credited, describe the administrative controls that justify the reduced HRR, including how location-specific attributes and considerations are addressed.

c) Provide the results of a review of records related to violations of transient combustible and hot work controls, including how this review informs the development of administrative controls credited, in part, to justify an HRR lower than 317 kW.

CCNPP RESPONSE PRA RAI 06:

Response to be provided 4/13/15.

PRA RAI 07 - Self-Ignited and Caused by Welding and Cutting:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting an FPRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the NRC staff for adopting a fire protection program consistent with NFPA 805. In letter dated July 12, 2006, to NEI (ADAMS Accession No. ML061660105), the NRC established the ongoing FAQ process where official agency positions regarding acceptable methods can be documented until they can be included in revisions to RG 1.205 or NEI 04-02.

Appendix H of the LAR does not indicate that FAQ 13-0005, "Cable Fires Special Cases: Self-Ignited and Caused by Welding and Cutting," dated June 26, 2013 (ADAMS Accession No. ML13322B260), was used in preparation of the FPRA. Explain whether the treatment of self-ignited fires and fires caused by welding and cutting is consistent with FAQ 13-0005, and if not, provide justification. If justification cannot be provided, then provide treatment of self-ignited fires and fires caused by welding and cutting consistent with NRC guidance in the integrated analysis provided in response to PRA RAI 03.

CCNPP RESPONSE PRA RAI 07:

The fire ignition frequencies for both self-ignited cable fires and cable fires caused by welding and cutting were established in accordance with the method identified in NUREG/CR-6850. Specifically, self-ignited cable fires were established based on the quantity of cables within each PAU, as specified in Section 6.5.6 of NUREG/CR-6850, and cable fires caused by welding and cutting were evaluated using the guidance in Section 6.5.7.2.

Fire PRA FAQ 13-0005 states, "The current method for evaluating cable fire risk identified in NUREG/CR-6850 remains as an acceptable method."

The fire ignition frequencies for self-ignited cable fires and cable fires due to welding and cutting are included as part of the total transient fire ignition frequency at Calvert Cliffs. The combined cable fire and transient fire ignition frequency is apportioned to transient scenarios in a given PAU. The ZOI of any transient fire scenario results in damage to multiple Fire PRA targets (e.g., multiple conduits, or at least one cable tray) and therefore, the damage set is considered consistent with the recommended ZOI in Fire PRA FAQ 13-0005 (i.e., the tray of initiation) or is bounding.

Therefore, the Calvert Cliffs Fire PRA analysis is consistent with the guidance contained in Fire PRA FAQ 13-0005.

PRA RAI 08 - Junction Boxes:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting an FPRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the NRC staff for adopting a fire protection program consistent with NFPA 805. In letter dated July 12, 2006, to NEI from Sunil Weerakkody (ADAMS Accession No. ML061660105), the NRC established the ongoing FAQ process where official agency positions regarding acceptable methods can be documented until they can be included in revisions to RG 1.205 or NEI 04-02.

Appendix H of the LAR does not indicate that FAQ 13-0006, "Modeling Junction Box Scenarios in an Fire PRA," dated May 6, 2013 (ADAMS Accession No. ML13149A527), was used in preparation of the FPRA. Explain whether the treatment of junction box fires is consistent with FAQ 13-0006, and if not, provide justification. If justification cannot be provided, then provide treatment of junction box fires consistent with NRC guidance in the integrated analysis provided in response to PRA RAI 03.

CCNPP RESPONSE PRA RAI 08:

The Calvert Cliffs Fire PRA utilized the guidance of NUREG/CR-6850 and apportioned the frequency of junction box scenarios based on the quantity of cables within each PAU, as specified in Section 6.5.6 of NUREG/CR-6850. The NUREG/CR-6850 frequency methodology remains a valid approach, as specified in Section 3.1 of Fire PRA FAQ 13-0006.

The Calvert Cliffs Fire PRA ignition frequency for junction boxes is included as part of the total transient fire ignition frequency. The combined junction box and transient fire ignition frequency is apportioned to transient fire scenarios in a given PAU. The ZOI of transient fire scenarios results in damage to multiple Fire PRA targets (e.g., multiple conduits, or at least one cable tray) and, therefore, the damage set is considered consistent with the recommended ZOI in Fire PRA FAQ 13-0006 (i.e., junction box and terminating cables) or is bounding.

Therefore, the treatment of junction box fire scenarios in the Calvert Cliffs Fire PRA is consistent with the guidance contained in Fire PRA FAQ 13-0006.

PRA RAI 09 - Sensitive Electronics:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting an FPRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the NRC staff for adopting a fire protection program consistent with NFPA 805. Methods that have not been determined to be acceptable by the NRC staff, or acceptable methods that appear to have been applied differently than described, require additional justification to allow the NRC staff to complete its review of the proposed method.

The NRC staff could not identify in the LAR or licensee's analysis a description of how potential fire damage to sensitive electronics was modeled. Though the treatment of sensitive electronics may be consistent with recent guidance on the modeling of sensitive electronics, Appendix H of the LAR does not cite FAQ 13-0004, "Clarifications Regarding Treatment of Sensitive Electronics," dated December 3, 2013 (ADAMS Accession No. ML13322A085), as one of the FAQ guidance documents used to support the FPRA. Describe the treatment of sensitive electronics for the FPRA and explain whether it is consistent with the guidance in FAQ 13-0004, including the caveats about configurations that can invalidate the approach (i.e., sensitive electronic mounted on the surface of cabinets and the presence of louvers or vents). If the approach is not consistent with FAQ 13-0004, justify the approach, or replace the current approach with an acceptable approach in the integrated analysis performed in response to PRA RAI 03.

CCNPP RESPONSE PRA RAI 09:

Response to be provided 4/13/15.

PRA RAI 10 - Conditional Probabilities of Spurious Operations:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. Section 2.4.4.1 of NFPA 805 further states that the change in public health risk arising from transition from the current fire protection program to an NFPA 805 based program, and all future plant changes to the program, shall be acceptable to the NRC. RG 1.174 provides quantitative guidelines on CDF, LERF, and identifies acceptable changes to these frequencies that result from proposed changes to the plant's licensing basis and describes a general framework to determine the acceptability of risk-informed changes. The NRC staff's review of the information in the LAR has identified additional information that is required to fully characterize the risk estimates.

Attachment V of the LAR indicates that application of circuit failure probabilities was limited to circuits without control power transformers and further clarifies that the probabilities applied yield conservative risk and delta risk estimates relative to the July 1, 2013, interim guidance (ADAMS Accession No. ML13165A214). However, new guidance on using conditional *probabilities of spurious operation for control circuits was recently issued by the NRC in Section 7 of NUREG/CR-7150, Volume 2. This guidance included a) replacement of the conditional hot short probability tables in NUREG/CR-6850 for Option #1 with new circuit failure probabilities for single break and double break control circuits, b) Option #2 in NUREG/CR-6850 is not an adequate method and should not be used, c) replacement of the probability of spurious operation duration figure in FAQ 08-0051 for AC control circuits, d) aggregate values for circuit failure probabilities should be used unless it is demonstrated that a cable is only susceptible to a single failure mode, e) incorporation of the uncertainty values for the circuit failure probabilities and spurious operation duration in the SOKC for developing the mean CDF/LERF, and f) recommendations on the hot short probabilities to use for other cable configurations, including panel wiring, trunk cables, and instrument cables. Provide an assessment of the assumptions used in the Calvert Cliffs FPRA relative to the updated guidance in NUREG/CR-7150, Volume 2, specifically addressing each of the above items. If the FPRA assumptions are not bounded by the new guidance, provide a justification for each difference, or provide updated risk results as part of the aggregate change-in-risk analysis requested in PRA RAI 03, utilizing the guidance in NUREG/CR-7150.*

CCNPP RESPONSE PRA RAI 10:

Response to be provided 4/13/15.

PRA RAI 11 - Counting and Treatment of Bin 15 Electrical Cabinets:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting an FPRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the NRC staff for adopting a fire protection program consistent with NFPA 805. Methods that have not been determined to be acceptable by the NRC staff, or acceptable methods that appear to have been applied differently than described, require additional justification to allow the NRC staff to complete its review of the proposed method.

The licensee's analysis (Section 2.2.1 of C0-FSS-002) appears to indicate that the FPRA evaluates the potential for propagation of electrical cabinet fires based solely on the text in Appendix G (Section G.3.3) to NUREG/CR-6850; however, portions of this text were either clarified or disregarded in Chapter 8 of Supplement 1 of NUREG/CR-6850. In light of this observation, address the following:

a) Per Section 6.5.6 of NUREG/CR-6850, fires originating from within "well-sealed electrical cabinets that have robustly secured doors (and/or access panels) and that house only circuits below 440V" do not meet the definition of potentially challenging fires and, therefore, should be excluded from the counting process for Bin 15. By counting these cabinets as ignition sources within Bin 15, the frequencies applied to other cabinets are inappropriately reduced. Clarify that this guidance is being applied. If not, then address the impact as part of the integrated analysis performed in response to PRA RAI 03.

b) Clarify if the criteria used to evaluate whether electrical cabinets below 440V are "well sealed" are consistent with guidance in Chapter 8 of Supplement 1 of NUREG/CR-6850. If not, then address the impact as part of the integrated analysis performed in response to PRA RAI 03.

c) *All cabinets having circuits of 440V or greater should be counted for purposes of Bin 15 frequency apportionment based on the guidance in Section 6.5.6 of NUREG/CR-6850. Clarify that this guidance is being applied. If not, then address the impact as part of the integrated analysis performed in response to PRA RAI 03.*

d) *For those cabinets that house circuits of 440V or greater, propagation of fire outside the ignition source should be evaluated based on guidance in Chapter 6 of NUREG/CR-6850, which states that "an arcing fault could compromise panel integrity (an arcing fault could burn through the panel sides, but this should not be confused with the high energy arcing fault type fires)." Describe how fire propagation outside of cabinets greater than 440V is evaluated (including those that are considered "well-sealed"). If propagation is not evaluated, then address the impact as part of the integrated analysis performed in response to PRA RAI 03.*

CCNPP RESPONSE PRA RAI 11:

11a – Response to be provided 4/13/15.

11b – The guidance of Chapter 8 (*Fire Propagation from Electrical Cabinets / FAQ 08-0042*) of Supplement 1 of NUREG/CR-6850 has been utilized to determine whether electrical cabinets below 440V are "well sealed." Based on this guidance, electrical cabinets were screened as follows:

- Well-sealed electrical cabinets that have robustly secured doors (and/or access panels) and that house only circuits below 440VAC.
  - Cabinets with heavy gauge metal construction and doors which are reinforced with turned in edges which would prevent warping in the event of internal fire were considered well-sealed and robustly secured.
  - Panels with voltages of 440VAC or greater (e.g., MCCs) were not screened from the analysis.
- Small 120VAC distribution panels, lighting panels, and small control panels. These types of panels typically have a low combustible loading inside a relatively well-sealed cabinet (i.e., no openings, no unsealed penetrations, and no ventilation openings). The combustible materials (i.e., cables) inside the panel are normally separated internally from the breaker casings and therefore do not communicate directly with the breakers, which is the likely source of ignition. Based on these factors, the fire is expected to be substantially contained within the cabinet. These panels were screened from the ignition frequency so as not to dilute the frequency of other electrical cabinet fires due to the fact that they contain little combustible materials and would not be considered a potentially challenging fire.
- Small, wall-mounted (or mounted to columns or equipment) panels, housing less than four switches. These are located throughout the plant as local controllers for one or more pieces of equipment. They contain little combustibles and are screened as non-damaging ignition sources.

A confirmatory walkdown of electrical cabinets was performed. Any necessary ignition frequency updates will be reflected in the updated fire risk results that will be provided to the NRC after the Fire PRA is updated and additional quantification is performed in response to PRA RAI-03.

11c – Based on the guidance in Section 6.5.6 of NUREG/CR-6850, all cabinets that house circuits of 440VAC or greater have been counted for the purposes of apportioning Bin 15 frequency.

A confirmatory walkdown of electrical cabinets was performed. Any necessary ignition frequency updates will be reflected in the updated fire risk results that will be provided to the NRC after the Fire PRA is updated and additional quantification is performed in response to PRA RAI-03.

11d – For cabinets that house circuits of 440VAC or greater and that are not "well-sealed" and "robustly-secured", propagation of fire outside the ignition source has been evaluated based on guidance in NUREG/CR-6850.

For those cabinets that house circuits of 440VAC or greater and that are "well-sealed" and "robustly secured", propagation of fire outside the ignition source will be evaluated using the guidance in Fire PRA FAQ 14-0009, "Treatment of Well-Sealed MCC Electrical Panels Greater than 440V," Revision F. Calvert CLiffs will use the probability of breaching a well-sealed MCC from a MCC fire as 0.22, based on the "NRC Position on Probability of Breaching Well-Sealed MCCs of 440V or Greater," dated 1/23/2015 (ML15023A064).

Any updates to fire modeling associated with cabinets that house circuits of 440VAC or greater will be reflected in the updated fire risk results that will be provided to the NRC after the Fire PRA is updated and additional quantification is performed in response to PRA RAI-03.

PRA RAI 12 - High Energy Arcing Faults:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting an FPRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the NRC staff for adopting a fire protection program consistent with NFPA 805. Methods that have not been determined to be acceptable by the NRC staff, or acceptable methods that appear to have been applied differently than described, require additional justification to allow the NRC staff to complete its review of the proposed method.

The NRC staff could not identify in the LAR or licensee's analysis a description of how HEAF were modeled. The licensee's analysis (e.g., Appendix B to C0-FQ-001) appears to indicate that HEAF ignition sources are combined with other ignition sources (e.g., transients) to form fire scenarios. Per Appendix P of NUREG/CR-6850, however, HEAF events and other types of fires have different non-suppression probability curves. In addition, the NRC staff's interpretation of the NUREG/CR-6850 guidance is that the growth of a fire subsequent to a HEAF event, unlike other types of fires, instantaneously starts at a non-zero HRR because of the intensity of the initial heat release from the HEAF. As a result, provide a detailed justification of the FPRA's treatment of HEAF events and the ensuing fire that includes a discussion of conservatisms and non-conservatisms relative to the accepted methods and assesses the associated impacts on the fire total and delta risk results. Alternatively, replace the current approach with an acceptable approach in the integrated analysis performed in *response to PRA RAI 03. Note that the response should address the treatment of all HEAF scenarios, including in the HGL analysis and MCA.*

CCNPP RESPONSE PRA RAI 12:

Response to be provided 4/13/15.

PRA RAI 13 - MCR Modeling:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. Section 2.4.4.1 of NFPA 805 further states that the change in public health risk arising from transition from the current fire protection program to an NFPA 805 based program, and all future plant changes to the program, shall be acceptable to the NRC. RG 1.174 provides quantitative guidelines on CDF, LERF, and identifies acceptable changes to these frequencies that result from proposed changes to the plant's licensing basis and describes a general framework to determine the acceptability of risk-informed changes. The NRC staff's review of the information in the LAR has identified additional information that is required to fully characterize the risk estimates.

The licensee's analysis (Section 11.1 of CO-FSS-007) appears to assume that all of the wiring inside MCR control panels is qualified, even though unqualified wiring is known to be present as well. Describe how the presence of both qualified and unqualified wiring is incorporated into the NUREG/CR-6850 Appendix L evaluation. Alternatively, provide treatment of qualification that is consistent with or bounds the actual MCR configuration in the integrated analysis provided in response to PRA RAI 03.

CCNPP RESPONSE PRA RAI 13:

Response to be provided 4/13/15.

PRA RAI 14 - Credit for MCR Abandonment Actions:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. Section 2.4.4.1 of NFPA 805 further states that the change in public health risk arising from transition from the current fire protection program to an NFPA 805 based program, and all future plant changes to the program, shall be acceptable to the NRC. RG 1.174 provides quantitative guidelines on CDF, LERF, and identifies acceptable changes to these frequencies that result from proposed changes to the plant's licensing basis and describes a general framework to determine the acceptability of risk-informed changes. The NRC staff's review of the information in the LAR has identified additional information that is required to fully characterize the risk estimates.

Tables W-2 through W-5 of the LAR and the licensee's analysis (Section 9.0 of C0-FSS-007) appear to represent MCR abandonment on loss of habitability as a single scenario with unit specific CCDP and conditional large early release probability (CLERP) values. However, the NRC staff could not identify in the LAR or the licensee's analysis the method(s) used to obtain these values. In light of this:

a) *Describe how MCR abandonment was modeled for loss of habitability in both the post-transition and the compliant plant. Include identification of the actions required to execute safe alternate shutdown and how they are modeled in the FPRA, including actions that* *must be performed before leaving the MCR. Also, include an explanation of how the CCDPs and CLERPs are estimated for fires that lead to MCR abandonment.*

b) *Explain how the CCDPs and CLERPs estimated for fires that lead to abandonment due to loss of habitability address various possible fire-induced failures. Specifically, provide a discussion of how the following scenarios are addressed:*

   i. *Scenarios where fire fails only a few functions aside from forcing MCR abandonment and successful alternate shutdown is straightforward;*

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

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

c) *Explanation of the timing considerations (i.e., total time available, time until cues are reached, manipulation time, and time for decision-making) made to characterize scenarios in Part (b). Include in the explanation the basis for any assumptions made about timing.*

d) *Discussion of how the probability associated with failure to transfer control to the Auxiliary Shutdown Panel is taken into account in Part (b).*

CCNPP RESPONSE PRA RAI 14:

Response to be provided 4/13/15.

PRA RAI 15 - MCR Abandonment on Loss of Control:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. Section 2.4.4.1 of NFPA 805 further states that the change in public health risk arising from transition from the current fire protection program to an NFPA 805 based program, and all future plant changes to the program, shall be acceptable to the NRC. RG 1.174 provides quantitative guidelines on CDF, LERF, and identifies acceptable changes to these frequencies that result from proposed changes to the plant's licensing basis and describes a general framework to determine the acceptability of risk-informed changes. The NRC staff's review of the information in the LAR has identified additional information that is required to fully characterize the risk estimates.

LAR Table G-1 identifies several PCS actions for non-MCR fire areas (Fire Areas 16 and 17), which encompass, in part, the Unit 1 and Unit 2 CSRs. Additionally, the licensee's analysis (Table 6 of CO-HRA-001) appears to credit actions to transfer control from the MCR to the auxiliary shutdown panel for fires in the CSR. In light of this:

a) *Clarify whether the above fire areas (or other non-MCR areas) contain fire scenarios for which primary command and control is not retained in the MCR (i.e., the MCR is abandoned), and if so, explain how this decision was reached.*

b) *If primary command and control is retained in the MCR, then RG 1.205 states, "Operation of dedicated or alternative shutdown controls while the MCR remains the command and control location would normally be considered a recovery action." If actions taken at the PCS are not considered RAs for scenarios in which primary command and control are retained in the MCR, assess the impact of treating such actions consistent with RG 1.205* *on both the delta risk and additional risk of RAs as part of the integrated analysis performed in response to PRA RAI 03. Additionally, discuss the results of the feasibility and reliability evaluation of any new RAs in accordance with FAQ 07-0030.*

c) For scenarios in which primary command and control is not retained in the MCR and is instead transferred to the PCS, the actions taken at the PCS are not RAs, and the MCR is assumed to be abandoned on loss of control (or function). Describe these scenarios, discussing how actions taken prior to and after MCR abandonment are modeled in the FPRA and its HRA. Additionally, explain the cues that result in the decision to abandon and their timing, identify the instruments being relied upon to make the abandonment decision, discuss whether the identified instruments are protected, and discuss how failure to transfer control to the PCS is taken into account.

CCNPP RESPONSE PRA RAI 15:

Response to be provided 4/13/15.

PRA RAI 16 - State-of-Knowledge Correlation:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. Section 2.4.4.1 of NFPA 805 further states that the change in public health risk arising from transition from the current fire protection program to an NFPA 805 based program, and all future plant changes to the program, shall be acceptable to the NRC. RG 1.174 provides quantitative guidelines on CDF, LERF, and identifies acceptable changes to these frequencies that result from proposed changes to the plant's licensing basis and describes a general framework to determine the acceptability of risk-informed changes. The NRC staff's review of the information in the LAR has identified additional information that is required to fully characterize the risk estimates.

Section 4.7.3 of the LAR explains that the sources of uncertainty in the FPRA were identified, and specific parameters were analyzed, for sensitivity in support of the NFPA 805 FRE process. It is further explained that during the FRE process, the uncertainty and sensitivity associated with specific FPRA parameters were considerations in the evaluation of the change in risk relative to the applicable acceptance thresholds. Based on these explanations, it appears that the risk results presented in Attachment W of the LAR are point estimates and do not include parameter uncertainty. Explain how the SOKC was taken into account in the FPRA quantification, including fire ignition frequencies, circuit failure likelihood and hot short duration, and non-suppression probabilities. If the SOKC for these parameters was not addressed in the FPRA quantification, then include the impact of the SOKC for these parameters in the integrated analysis performed in response to PRA RAI 03.

CCNPP RESPONSE PRA RAI 16:

Response provided in Reference 1.

PRA RAI 17 - Sensitivity Analysis on FAQ 08-0048 Fire Bin Frequencies:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting an FPRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the NRC staff for adopting a fire protection program consistent with NFPA 805. Methods that have not been determined to be acceptable *by the NRC staff, or acceptable methods that appear to have been applied differently than described, require additional justification to allow the NRC staff to complete its review of the proposed method.*

The licensee's analysis appears to indicate that generic fire ignition frequencies were based upon those provided in Supplement 1 to NUREG/CR-6850. Chapter 10 of this supplement, however, states that a sensitivity analysis should be performed when using the fire ignition frequencies in the supplement instead of those provided in Table 6-1 of NUREG/CR-6850. As part of the response to PRA RAI 03, provide the results (i.e., CDF, LERF, ΔCDF and ΔLERF) of a sensitivity analysis that evaluates the impact of using the supplement frequencies, consistent with Chapter 10 of Supplement 1 to NUREG/CR-6850. If RG 1.17 4 risk acceptance guidelines are exceeded, (1) discuss which ones are exceeded, (2) describe the fire protection or related measures that will be taken to provide additional DID, and (3) discuss conservatisms in the analysis and the risk significance of these conservatisms.

CCNPP RESPONSE PRA RAI 17:

Response to be provided 4/13/15.

PRA RAI 18 - Calculation of VFDR ΔCDF and ΔLERF:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. Section 2.4.4.1 of NFPA 805 further states that the change in public health risk arising from transition from the current fire protection program to an NFPA 805 based program, and all future plant changes to the program, shall be acceptable to the NRC. RG 1.174 provides quantitative guidelines on CDF, LERF, and identifies acceptable changes to these frequencies that result from proposed changes to the plant's licensing basis and describes a general framework to determine the acceptability of risk-informed changes. The NRC staff's review of the information in the LAR has identified additional information that is required to fully characterize the risk estimates.

Section W.2.1 of the LAR provides some description of how the change-in-risk and the additional risk of RAs associated with VFDRs is determined, but not enough detail to make the approach completely understood. As a result, provide the following:

a) A detailed definition of both the post-transition and compliant plant models used to calculate the reported change-in-risk, including any special calculations for the MCR and other abandonment areas (if applicable). Include description of the model adjustments made to remove VFDRs from the compliant plant model, such as adding events or logic, or use of surrogate events. Also, provide an explanation of how VFDR- and non-VFDR-related modifications are addressed for both the post-transition and compliant plant models.

b) Justification for the assumption in the licensee's analysis (Section 8.0 of EPM Report R2215-008-024) that the risk associated with the post-transition plant model is considered equivalent to that of the compliant plant model for scenarios requiring MCR abandonment.

c) A description of how the reported additional risk of RAs was calculated, including any special calculations performed for the MCR and other abandonment areas (if applicable). If non-VFDR-related modifications are credited to reduce delta risk, equating the additional risk of RAs (as discussed in W.2.1) to the sum of the delta risks of the VFDRs that are resolved by crediting an RA may be non-conservative. In this case, the additional *risk of these RAs should be re-calculated consistent with FAQ 07-0030 as part of the integrated analysis performed in response to PRA RAI 03.*

d) A summary of the types of VFDRs that were identified but not modeled in the FPRA. Include any qualitative rationale for excluding these from the change-in-risk calculations.

e) A clarification of whether they DID RAs listed in Attachment G of the LAR are quantified in the FPRA. Also, explain whether credit for such DID RAs is necessary for the change-in-risk to be acceptable.

CCNPP RESPONSE PRA RAI 18:

18a – Response provided in Reference 1.

18b - Response to be provided 4/13/15.

18c – Response provided in Reference 1.

18d – Response provided in Reference 1.

18e – Response provided in Reference 1.

PRA RAI 19 - Attachment W Inconsistencies:

Several inconsistencies were noted within Attachment W as well as between its tables and those in Attachments C and G for particular fire areas. In light of this:

a) Provide clarification on the following inconsistencies, and discuss their significance to the risk results reported in Tables W-6 and W-7:

i. In Table W-6, Unit 1 Fire Areas 2, 8, 13, 18, 18A, 22, 23, 25, 26, 27, 28, 31, 38, 40, and 2CNMT are indicated as Deterministically Compliant (4.2.3.2); however, they are indicated as having VFDRs (i.e., there is a "Yes"' under the "VFDR" column and sometimes under the "RAs" column) as well as very small risk values (i.e., Fire Area 18) or epsilon for ΔCDF/ΔLERF. Similarly, in Table W-7, Unit 2 Fire Areas 3, 4, 6, 14, 15, 19, 19A, 21, 30, 33, 39, and 1CNMT are noted as Deterministically Compliant (4.2.3.2); however, they are indicated as having VFDRs and very small risk values (i.e., Fire Areas 19 and 30) or epsilon for ΔCDF/ΔLERF. Attachment C does not identify any of the above deterministic fire areas as having VFDRs. Furthermore, while for most of these fire areas the ΔCDF/ΔLERF and additional risk of RAs is reported to be epsilon, actual (very small) numerical values are reported for ΔCDF/ΔLERF for Unit 1 Fire Area 18 and for Unit 2 Fire Areas 19 and 30, and actual (very small) numerical values are reported for additional risk of RAs for Unit 1 Fire Area 23.

ii. In Table W-6, Unit 1 Fire Areas 12, 14, 15, 19A, 21, 30, 32, 33, 35, 36, 39, 1CNMT, and IS are indicated as Performance-Based (4.2.4.2) and as having an RA credited in the FPRA (i.e., there is a "Yes"' under the "RAs" column); however, no RAs are described in the VFDR dispositions presented in Attachment C or listed in Attachment G for these areas. Similarly, Unit 2 Fire Areas 12, 13, 18A, 20, 26, 27, 28, 32, 34, 35, 36, 40, 2CNMT, and IS are indicated as Performance-Based (4.2.4.2) and identify a "Yes"' under RA; however, no RAs were described in the VFDR dispositions *presented in Attachment C or listed in Attachment G for these areas. Furthermore, while for most of these fire areas the additional risk of RAs is reported to be epsilon, actual (very small) numerical values are reported for Unit 1 Fire Areas 21 and 36 and for Unit 2 Fire Area 13.*

iii. *The LERF (9.49E-08/year (yr) reported in Table W-4 for scenario PAU CC-1A-C (Complete Burn of Vertical Cable Chase 1A) is greater than the total LERF (4.04E-08/yr) reported in Table W-6 for Fire Area 20 (Cable Chase 1A). For two scenarios reported in Table W-4 (PAU 230E-C and PAU 230W-C), which represent fires in Unit 1 Containment, the summation of their LERF (1.99E-07/yr) is greater than the total LERF (1.91 E-07/yr) reported in Table W-6 for Fire Area 1CNMT (Unit 1 Containment). These inconsistencies also exist between Tables W-5 and W-7 for the same scenarios in Unit 2.*

iv. *The Table W-1 Unit 1 fire LERF of 3.2E-06/(chemical reactor (rx)-yr) does not match the corresponding value reported in Table W-6. Similarly, the Table W-1 Unit 2 fire LERF of 4.4E-06/(rx-yr) does not match the corresponding value reported in Table W-7.*

b) *Describe what is meant by the use of "ε," or epsilon, in columns for Fire Area CDF/LERF, ΔCDF/ΔLERF, and additional risk of RAs. Address if epsilon is defined by a specific cut-off value(s). Also, clarify how an actual value for LERF can be reported while epsilon is reported for the corresponding CDF (i.e., Unit 1 Fire Area 24 for additional risk of RAs, Unit 2 Fire Areas 8 and 10 for CDF/LERF and Δ CDF/LERF).*

c) *Describe what is meant by the use of "N/A" in columns for Fire Area CDF/LERF, ΔCDF/ΔLERF, and additional risk of RAs. In doing so, clarify the basis for not reporting Fire Area CDF/LERF values (or epsilon) for Unit 1 and Unit 2 Fire Areas 44, AB-1, AB-3, ABFL, DGB1, DGB2, and TBFL.*

d) *Tables W-6 and W-7 include a risk reduction credit for internal events that is described in a footnote to these tables as covering random failures and internal floods. This risk reduction credit is used to offset the increase in fire risk reported in these tables. Explain how the risk reduction from internal events reported in these tables is calculated.*

CCNPP RESPONSE PRA RAI 19:

19a – Response to be provided 4/13/15.

19b – Response provided in Reference 1.

19c – Response provided in Reference 1.

19d - Response to be provided 4/13/15.

PRA RAI 20 - Implementation Item Impact on Risk Estimates:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. Section 2.4.4.1 of NFPA 805 further states that the change in public health risk arising from transition from the current fire protection program to an NFPA 805 based program, and all future plant changes to the program, shall be acceptable to the NRC. RG 1.174 provides quantitative guidelines on CDF, LERF, and identifies acceptable changes to *these frequencies that result from proposed changes to the plant's licensing basis and describes a general framework to determine the acceptability of risk-informed changes. The NRC staff's review of the information in the LAR has identified additional information that is required to fully characterize the risk estimates.*

Table S-3, Implementation Item 12 of the LAR commits to updating the FPRA and verifying the risk results after "risk related" plant modifications have been incorporated. However, it is unclear to which modifications the implementation item refers. Update Implementation Item 12 to reflect completion of both the Table S-2 modifications and Table S-3 implementation items before this verification.

CCNPP RESPONSE PRA RAI 20:

Response provided in Reference 1.

PRA RAI 21 - Internal Events Peer Review:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. The RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting an FPRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the NRC staff for adopting a fire protection program consistent with NFPA 805. The RG 1.200 describes a peer review process utilizing an associated ASME/ANS standard (currently ASME/ANS-RA-Sa-2009) as one acceptable approach for determining the technical adequacy of the PRA once acceptable consensus approaches or models have been established.

Attachment U of the LAR indicates that the full-scope IEPRA peer review was performed against ASME/ANS PRA Standard, RA-S-2008a. In light of this observation, if RG 1.200, Revision 2, and ASME/ANS PRA Standard, RA-Sa-2009, were not used as the basis for the peer review of the IEPRA, then discuss whether any differences between SRs were evaluated and whether they had any impact on the application.

CCNPP RESPONSE PRA RAI 21:

Response provided in Reference 1.

PRA RAI 22 - PRA Upgrades:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. The RG 1.205 identifies NUREG/CR-6850 as documenting a methodology for conducting an FPRA and endorses, with exceptions and clarifications, NEI 04-02, Revision 2, as providing methods acceptable to the NRC staff for adopting a fire protection program consistent with NFPA 805. The RG 1.200 describes a peer review process utilizing an associated ASME/ANS standard (currently ASME/ANS-RA-Sa-2009) as one acceptable approach for determining the technical adequacy of the PRA, once acceptable consensus approaches or models have been established.

The LAR does not indicate whether any changes made to the IEPRA or FPRA since their most recent full-scope peer reviews are consistent with the definition of a "PRA upgrade" in ASME/ANS-RA-Sa-2009, "Standard for Level 1/Large Early Release Frequency for Nuclear Power Plant Applications," as endorsed by RG 1.200, Revision 2. In light of this, identify any such changes. If a focused-scope peer review has not been performed for the identified changes, describe what actions will be implemented to address this issue. If a focused-scope *peer review has been performed, confirm whether it was done consistent with the guidance in ASME/ANS-RA-Sa-2009, as endorsed by RG 1.200, and provide any findings and their resolutions.*

CCNPP RESPONSE PRA RAI 22:

Response provided in Reference 1.

PRA RAI 23 - Deviations from Acceptable Methods:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. Section 2.4.4.1 of NFPA 805 further states that the change in public health risk arising from transition from the current fire protection program to an NFPA 805 based program, and all future plant changes to the program, shall be acceptable to the NRC. The RG 1.174 provides quantitative guidelines on CDF, LERF, and identifies acceptable changes to these frequencies that result from proposed changes to the plant's licensing basis and describes a general framework to determine the acceptability of risk-informed changes. The NRC staff's review of the information in the LAR has identified additional information that is required to fully characterize the risk estimates.

Section 4.5.1.2 of the LAR states that the FPRA model uses "a methodology consistent with the guidance provided in NUREG/CR-6850 and subsequent clarifications documented in responses to NFPA 805 FAQs" and that "[n]o unreviewed methods or deviations from NUREG/CR-6850 were utilized in the FPRA model development." Indicate if any other methods were employed that deviate from other NRC-accepted guidance (e.g., subsequent clarifications documented in FAQs, interim guidance documents, etc.). If so, describe and justify any proposed method that deviates from NRC guidance, or replace the proposed method with an accepted method. Also, include the proposed method as a method "currently under review" as part of the integrated analysis in the response to PRA RAI 03.

CCNPP RESPONSE PRA RAI 23:

Response provided in Reference 1.

PRA RAI 24 - Defense-in-Depth and Safety Margin:

Section 2.4.3.3 of NFPA 805 states that the PRA approach, methods, and data shall be acceptable to the NRC. Section 2.4.4.1 of NFPA 805 further states that the change in public health risk arising from transition from the current fire protection program to an NFPA 805 based program, and all future plant changes to the program, shall be acceptable to the NRC. The RG 1.174 provides quantitative guidelines on CDF, LERF, and identifies acceptable changes to these frequencies that result from proposed changes to the plant's licensing basis and describes a general framework to determine the acceptability of risk-informed changes. The NRC staff's review of the information in the LAR has identified additional information that is required to fully characterize the risk estimates.

LAR Section 4.5.2.2 provides a high-level description of how the impact of transition to NFPA 805 impacts DID and safety margin was reviewed, including using the criteria from Section 5.3.5 of NEI 04-02 and from RG 1.205. However, no explanation is provided of how specifically the criteria in these documents were utilized and/or applied in these assessments.

a) *Provide further explanation of the method(s) or criteria used to determine when a substantial imbalance between DID echelons existed in the FREs, and identify the types of plant improvements made in response to this assessment.*

b) *Provide further discussion of the approach in applying the NEI 04-02, "Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c)," Revision 2 (ADAMS Accession No. ML081130188) criteria for assessing safety margin in the FREs.*

CCNPP RESPONSE PRA RAI 24:

Response provided in Reference 1.

REFERENCES

1. Letter from G. H. Gellrich (Exelon Generation) to Document Control Desk (NRC), dated February 9, 2015, Request for Additional Information Regarding the National Fire Protection Association Standard 805 License Amendment Request

ENCLOSURE 1

UPDATED PAGES

NFPA 805 Ch. 3 Ref.	Requirements/Guidance	Compliance Statement	Compliance Basis	Reference Document	
3.3.4 Insulation Materials.	Thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials shall be noncombustible or limited combustible.	Complies with Clarification	The referenced procedures~~,~~ and specifications, ~~and the Combustible Loading Analysis Database control and account for the use of thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials.~~ specify that thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials shall be noncombustible, limited combustible, or shall have a flame spread rating less than 25 when tested in accordance with ASTM E84. Administrative procedures identify that the fire protection engineer approves thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials. Thermal insulation materials, radiation shielding materials, ventilation duct materials, and soundproofing materials that are either permanently or temporarily installed in the plant are noncombustible or limited combustible, with some exceptions. Thermal insulation materials, radiation shielding materials, ventilation duct materials, or soundproofing materials that cannot be classified as noncombustible or limited combustible are treated the same as any other combustible located within the pant. These materials are administratively controlled and tracked by the site combustible loading database and evaluated and approved by the site fire protection engineer. The site fire protection engineer ensures that the installed materials will not impact the ability of the plant to achieve and maintain the nuclear safety and radioactive release performance criteria of NFPA 805.	Calculation CA02243, Combustible Loading Analysis Database Update, Rev. 0002 / All Procedure CNG-FES-007 (or Exelon equivalent), Preparation of Design Inputs and Change Impact Screen, Rev. 00017 / Section 5.4.16.A.14 Procedure CNG-FES-015 (or Exelon equivalent), Design Engineering and Configuration Management Forms, Rev. 00006 / Form 17 - Item A Procedure SA-1-100 (or Exelon equivalent), Fire Prevention, Rev. 01800 / Sections 4.9 and Attachment 1: Section I to PCR-13-02460 Specification C-0056, Specification for Furnishing, Detailing, Fabricating, and Delivery of Structural Steel for Neutron Shielding, Rev. 0003 / Section 9.1 Specification M-0196, Specification for Heating, Ventilating and Air Conditioning Ducts, Rev. 0004 / Section 5.2 Specification M-0196A, Specification for Heating, Ventilating, and Air Conditioning Ducts, Rev. 0002 / Section 5.2 Specification M-0198, Specification for Insulation of HVAC Systems, Rev. 0000 / Section 7.3 Specification M-0336, Specification for Reactor Coolant System and Steam Generators Insulation (Except Reactor Cavity), Rev. 0003 / Section 7.9.c	FPE RAI 01

NFPA 805 Section: 2.4.2.2 Nuclear Safety Capability Circuit Analysis

NEI 00-01 Ref	**NEI 00-01 Section 3 Guidance**
3.3.1.1.4 Criteria/Assumptions	For each circuit requiring power to perform its safe shutdown function, identify the cable supplying power to each safe shutdown and/or required interlock component. Initially, identify only the power cables from the immediate upstream power source for these interlocked circuits and components (i.e., the closest power supply, load center or motor control center). Review further the electrical distribution system to capture the remaining equipment from the electrical power distribution system necessary to support delivery of power from either the offsite power source or the emergency diesel generators (i.e., onsite power source) to the safe shutdown equipment. Add this equipment to the safe shutdown equipment list. The set of cables described above are classified as required safe shutdown cables. Evaluate the power cables for breaker coordination concerns. The non-safe shutdown cables off of the safe shutdown buses are classified as required for hot shutdown or as important to SSD based on the criteria contained in Appendix H.

Applicability	**Comments**
Applicable	None

Alignment Statement

Aligns

Alignment Basis

CENG Document NFPA-805-00006, Section 3.0, NSCA Criteria / Assumptions, lists criteria / assumptions pertaining to the NSCA model development and component selection. The criteria / assumptions listed in Section 3.3.1.5 [3.3.1.1.4] of NEI 00-01 are explicitly stated in the calculation.

Document NFPA-805-00006, Section 3.0, identifies the criteria / assumptions utilized in Document NFPA-805-00006, Section 7.0, NSCA Model Development and Component Selection, and Section 8.0, Circuit Identification and Analysis (component selection is also performed during the circuit identification and analysis activity).

CENG Document NFPA-805-00006, Section 7.0, identifies the overall process utilized to develop the NSCA model and select components required to satisfy each of the Nuclear Safety Performance Criteria (NSPC) from Section 1.5.1 of NFPA 805.

The NSCA model development and component selection process includes consideration for the following:

"• With respect to the convention for identifying and associating electrical distribution equipment to NSCA components, the NSCA model **shall be developed using logic dependencies between components in the NSCA database. That is each component would depend on (or logically tied to) its first upstream power supply being available. This approach is**~~development and component selection should utilize a "building block" approach~~ consistent with NEI 00-01 Criteria / Assumption 3.3.1.5 [3.3.1.1.4]. The boundary for NSCA model development and component selection (for each NSCA component) should include only, as applicable, the upstream electrical power source for each NSCA component."

SSA RAI 02

CENG Document NFPA-805-00006, Section 8.0, identifies the overall process utilized to identify and analyze circuits for the NSCA components identified as being required to satisfy each of the Nuclear Safety Performance Criteria (NSPC) from Section 1.5.1 of NFPA 805.

The circuit identification and analysis process includes consideration for the following:

"• With respect to the convention for associating power cables to NSCA components, the NSCA **model shall be developed using logic dependencies between components and cables in the NSCA database. That is each component would depend (or logically be ties to) the feeder cable(s) from the upstream power supply being available. This** ~~circuit identification and analysis should utilize a "building block"~~ approach consistent with NEI 00-01 Criteria / Assumption 3.3.1.5 [3.3.1.1.4]. The boundary for NSCA circuit identification and analysis (for each NSCA component) should include only, as applicable, the power cables from the NSCA component to the upstream electrical power source."

Application of NEI 00-01 Criteria / Assumption 3.3.1.5 [3.3.1.1.4] for the Calvert cliffs Plant NSCA is reflected in the final set of NSCA support components identified to support the

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required function of each NSCA supported component. These relationships are maintained utilizing an component-to-component logic success path relationship in the NSCA database. The NSCA component-to-component logic success path relationship is also provided in Calvert Cliffs Plant Document NFPA-805-00006, Attachment 7-4.

SSA RAI 02

From NFPA-805-00006 section 8.7:

"ECP-13-000321, "Common Power Supply and Common Enclosure Study", has analyzed all power supplies and power supply alignments modeled for the NSCA and the NPO Assessment. The analysis performed included cable for circuits on those power supplies regardless of if the cable was categorized as required or not required of the NSPC. The ECP has established that for each power supply (and power supply alignment) selective coordination is maintained, or will be achieved through plant modification, or has otherwise provided a justification for the lack of selective coordination as being acceptable with respect to the requirements of the NSCA and the NPO Assessment.

Plant modifications identified by ECP-13-000321, "Common Power Supply and Common Enclosure Study", to achieve selective coordination of breakers/fuses have been identified as Implementation Items in the CCNPP NFPA 805 License Amendment Request (LAR), Attachment S, Table S-2.

Furthermore, plant circuit breakers that require an external source of control power to perform their protective trip function have been identified and analyzed for common power supply and common enclosure concerns. This assessment has demonstrated that all load breakers on the credited switchgear will remain functional to isolate potentially fire affected (non-credited) loads, and that common enclosure fires due to failure of load and feed breakers for NOT credited switchgear will not be adverse to safe shutdown."

Note: Based on review of the section numbering of NEI 00-01 Rev. 2, EPM has determined that some sections have been incorrectly numbered. For these sections, EPM has provided the corrected section number followed by the current section number in brackets.

Reference Documents

Engineering Equivalency Evaluation ECP-13-000321, Common Power Supply and Common Enclosure Study

Report NFPA-805-00006, Nuclear Safety Capability Assessment (NSCA), Rev. 0 / Sections 3.0; 7.0 (Attachment 7-4); and 8.0

Table J-1 V & V Basis for Fire Models / Model Correlations Used

Calculation	Application	V & V Basis	Discussion
PyroSim	Used to create FDS input files.	• Calvert V&V Calculation	PyroSim software is a graphical interface used to create FDS input files. The developers of PyroSim (Thunderhead Engineering) confirmed that PyroSim is verified to build the input file correctly. A multi-level process is used to do this, including testing during development and running example problems through the software to ensure the correct input data is written and results obtained. The software is benchmarked against selected examples from NUREG-1824, "Verification & Validation of Selected Fire Models for Nuclear Power Plant Applications, Volume 7: Fire Dynamics Simulator," to ensure the input is written correctly. In addition, PyroSim has been widely used since 2006 and any discrepancies identified by users are addressed in subsequent releases of the software via a software maintenance agreement.

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Table J-2 V & V Basis for Fire Models / Model Correlations Used

Calculation	Application	V & V Basis	Discussion
Radiant Heat Flux (Radiant Flame Method)	Calculates the horizontal or radial separation distance to a target in order to determine the horizontal extent of the ZOI based on heat flux for oil fires.	• NUREG-1805, Chapter 5 • NUREG-1824, Volume 3 • SFPE Handbook, 4th Edition, Chapter 3 • NUREG/CR-6850, Appendix H	The correlation is used in the NUREG-1805 fire model, for which V&V was documented in NUREG-1824. The correlation is documented in an authoritative publication of the SFPE Handbook of Fire Protection Engineering. The correlation is used within the limits of its range of applicability. NUREG/CR-6850 generic screening damage criteria are used, which is considered conservative.
Plume Radius (Method of Heskestad)	Calculates the horizontal radius, based on temperature, of the plume at a given height. The correlation is derived from the Heskestad centerline plume correlation.	• FIVE – Revision 1, Referenced by EPRI Report 1002981, 2002 • NUREG-1824, Volume 4, 2007 • NUREG-1824, Supplement 1, Draft, 2014 • NUREG-1934, Chapter 2, 2012 • SFPE Handbook of Fire Protection Engineering, 4th Edition, Chapter 2-1, Heskestad, G., 2008	The correlation is contained in the FIVE-Rev1 fire model. The correlation is documented in an authoritative publication of the "SFPE Handbook of Fire Protection Engineering." Although not specifically verified and validated in NUREG-1824, Page 2-7 of the 4th Edition of the SFPE Handbook of Fire Protection Engineering states that the value calculated by this correlation is the point where the temperature has declined to half of the centerline plume temperature. The Heskestad centerline plume correlation is verified and validated in NUREG-1824, including the Supplement 1, Draft. The correlation will be applied within its limits of applicability and the validated range reported in NUREG-1934 and NUREG-1824 Supplement 1, Draft or, if applied outside the validated range, the model will be justified as acceptable, either by qualitative analysis, or by quantitative sensitivity analysis. The methodology for justifying application of the fire model outside the range is in accordance with methods documented in NUREG-1934.

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Table J-2 V & V Basis for Fire Models / Model Correlations Used

Calculation	Application	V & V Basis	Discussion
Correlation for Flame Spread over Horizontal Cable Trays (FLASH-	Predicts the growth and spread of a fire within a vertical stack of horizontal cable trays.	• NUREG/CR-7010, Section 9, 2012 • NUREG/CR-6850, Volume 2, Appendix R, 2005	The correlation is recommended by NUREG/CR-7010 and follows guidance set forth in NUREG/CR-6850. The FLASH-CAT model is validated in NUREG/CR-7010, Section 9.2.3, through experimentally measured HRRs compared with the predictions of the FLASH-CAT model. The correlation will be applied to configurations consistent with those reported in NUREG/CR-7010 or the correlation will be qualitatively justified as acceptable.
Engineering Planning and Management (EPM) Fire Modeling Workbook (FMWB)	Used to calculate the zone of influence associated with fire scenarios.	• Calvert V&V Calculation	The FMWB is a collection of fire modeling correlations that are already documented in NUREG-1805 FDTs, "Fire Dynamics Tools (FDTs),:Quantitative Fire Hazard Analysis Methods for the US Nuclear Regulatory Commission Fire Protection Inspection Program," December 2004, and Fire Induced Vulnerability Evaluation (FIVE), "EPRI Fire Induced Vulnerability Evaluation Methodology", Revision 1, Referenced by EPRI Report 1002981, 2002. The fire modeling correlations within the Fire Modeling Workbook (FMWB) have been verified, by "black box" testing, to ensure that the results were identical to the verified and validated models. "Black box" testing (or functional testing) is testing that ignores the internal mechanism of a system or component and focuses solely on the outputs generated in response to selected inputs and execution conditions. The results from the FMWB were compared to those produced by the NUREG-1805 FDTs and FIVE-Rev1, when identical inputs were entered into both. Since the correlations from NUREG-1805 FDTs and FIVE, Rev1, were verified and validated in NUREG-1824, including the Supplement 1 Draft and the results match the results produced by the FMWB, the FMWB is verified and validated with respect to NUREG-1934 and NUREG-1824 Supplement 1, Draft.

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Table J-4 V & V Basis for Fire Models / Model Correlations Used

Calculation	Application	V & V Basis	Discussion
Correlation for Heat Release Rates and Ignition Timing of Cable Fires (Method of Lee)	Used to correlate benchscale data to heat release rates from cable tray fires and estimate the ignition time of cable tray fires or secondary ignition of cable tray(s).	• NUREG/CR-6850, Appendix R • SFPE Handbook, 4th Edition, Chapter 3	The correlation is recommended by NUREG/CR-6850. The correlation is documented in an authoritative publication of the SFPE Handbook of Fire Protection Engineering. The correlation is used within the limits of its range of applicability.
Plume Radius (Method of Heskestad)	Calculates the horizontal radius, based on temperature, of the plume at a given height. The correlation is derived from the Heskestad centerline plume correlation.	• FIVE – Revision 1, Referenced by EPRI Report 1002981, 2002 • NUREG-1824, Volume 4, 2007 • NUREG-1824, Supplement 1, Draft, 2014 • NUREG-1934, Chapter 2, 2012 • SFPE Handbook of Fire Protection Engineering, 4th Edition, Chapter 2-1, Heskestad, G., 2008	The correlation is contained in the FIVE-Rev1 fire model. The correlation is documented in an authoritative publication of the "SFPE Handbook of Fire Protection Engineering." Although not specifically verified and validated in NUREG-1824, Page 2-7 of the 4th Edition of the SFPE Handbook of Fire Protection Engineering states that the value calculated by this correlation is the point where the temperature has declined to half of the centerline plume temperature. The Heskestad centerline plume correlation is verified and validated in NUREG-1824, including the Supplement 1, Draft. The correlation will be applied within its limits of applicability and the validated range reported in NUREG-1934 and NUREG-1824 Supplement 1, Draft or, if applied outside the validated range, the model will be justified as acceptable, either by qualitative analysis, or by quantitative sensitivity analysis. The methodology for justifying application of the fire model outside the range is in accordance with methods documented in NUREG-1934.

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Table J-4 V & V Basis for Fire Models / Model Correlations Used

Calculation	Application	V & V Basis	Discussion
Ceiling Jet Temperature (Method of Alpert)	Calculates the horizontal separation distance, based on temperature at the ceiling of a room, to a target in order to determine the horizontal extent of the ZOI.	• FIVE - Revision 1, Referenced by EPRI Report 1002981, 2002 • NUREG-1824, Volume 4, 2007 • NUREG-1824, Supplement 1, Draft, 2014 • NUREG-1934, Chapter 2, 2012 • SFPE Handbook of Fire Protection Engineering, 4th Edition, Chapter 2-2, Alpert, R., 2008	The correlation is used in the FIVE – Revision 1 fire model, for which V&V is documented in NUREG-1824, including the Supplement 1, Draft, 2014. The correlation is documented in an authoritative publication of the "SFPE Handbook of Fire Protection Engineering." The correlation will be applied within its limits of applicability and the validated range reported in NUREG-1934 and NUREG-1824 Supplement 1, Draft, 2014 or, if applied outside the validated range, the model will be justified as acceptable, either by qualitative analysis, or by quantitative sensitivity analysis. The methodology for justifying application of the fire model outside the range is in accordance with methods documented in NUREG-1934.
Smoke Detection Actuation Correlation	Estimates smoke and heat detector timing based on the Alpert ceiling jet temperature, velocity, and thermal response of sprinkler.	• NUREG-1805, Chapter 11, 2004 • NFPA Fire Protection Handbook, 19th Edition, Chapter 3-9, Budnick, E., Evans, D., and Nelson, H., 2003 • NUREG-1824, Volume 4, 2007 • NUREG-1824, Supplement 1, Draft, 2014 • NUREG-1934, Chapter 2, 2012	The smoke detection correlation is contained in NUREG-1805. The temperature to smoke density correlation is documented in an authoritative publication of the NFPA Fire Protection Handbook. The correlation V&V is documented in NUREG-1824, including the Supplement 1, Draft. The correlation will be applied within its limits of applicability and the validated range reported in NUREG-1934 and NUREG-1824 Supplement 1, Draft, 2014 or, if applied outside the validated range, the model will be justified as acceptable, either by qualitative analysis, or by quantitative sensitivity analysis. The methodology for justifying application of the fire model outside the range is in accordance with methods documented in NUREG-1934.

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Table J-4 V & V Basis for Fire Models / Model Correlations Used

Calculation	Application	V & V Basis	Discussion
Sprinkler Activation Correlation	Used to estimate sprinkler actuation timing based on the Alpert ceiling jet temperature, velocity, and thermal response of sprinkler.	• NUREG-1805, Chapter 10, 2004 • NFPA Handbook, 19th Edition, Chapter 3-9, Budnick, E., Evans, D., and Nelson, H., 2003 • NUREG-1824, Volume 4, 2007 • NUREG-1824, Supplement 1, Draft, 2014	The sprinkler actuation correlation is used in the NUREG-1805 fire model. The correlation is documented in an authoritative publication of the NFPA Fire Protection Handbook. The correlation V&V is documented in NUREG-1824 Supplement 1, Draft, 2014.The correlation will be applied within the validated range reported in NUREG-1934 and NUREG-1824 Supplement 1, Draft, 2014 or will be justified as acceptable by qualitative analysis or quantitative sensitivity analysis.
Plume/Hot Gas Layer Interaction Study using FDS	Determines the point at which hot gas layer and plume interact and establish limits for plume temperature application.	• FDS Version 5 • NIST Special Publication 1018-5, Volume 2, 2010 • NIST Special Publication 1018-5, Volume 3, 2010 • NUREG-1824, Volume 7, 2007 • NUREG-1824, Supplement 1, Draft, 2014 • NUREG-1934, Chapter 2, 2012 • Calvert V&V Calculation	V&V of the FDS is documented in NIST Special Publication 1018-5. The V&V of FDS specifically for Nuclear Power Plant applications is documented in NUREG-1824, including the Supplement 1, Draft, 2014.The model has been applied within its limits of applicability and the validated range reported in NUREG 1934 and NUREG-1824 Supplement 1, Draft, 2014 or, if applied outside the validated range, the model has been justified as acceptable, either by qualitative analysis, or by quantitative sensitivity analysis. The methodology for justifying application of the fire model outside the range is in accordance with methods documented in NUREG-1934.

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Table J-4 V & V Basis for Fire Models / Model Correlations Used

Calculation	Application	V & V Basis	Discussion
Temperature Sensitive Equipment Hot Gas Layer Study	Determine the upper and lower gas layer temperatures for various compartments, and the layer height, for use in assessing damage to temperature sensitive equipment.	• NIST Special Publication 1086, 2012 • CFAST Version 6 • NUREG-1824, Volume 5, 2007 • NUREG-1824, Supplement 1, Draft, 2014 • NUREG-1934, Chapter 2, 2012 • Calvert V&V Calculation	V&V of the CFAST code is documented in the NIST Special Publication 1086. The V&V of CFAST specifically for Nuclear Power Plant applications has also been documented in NUREG-1824. The models are applied within their validated range reported in NUREG-1824 Supplement 1, Draft, 2014 or have been justified as acceptable by qualitative analysis or quantitative sensitivity analysis.
Correlation for Flame Spread over Horizontal Cable Trays (FLASH-CAT)	Predicts the growth and spread of a fire within a vertical stack of horizontal cable trays.	• NUREG/CR-7010, Section 9, 2012 • NUREG/CR-6850, Volume 2, Appendix R, 2005	The correlation is recommended by NUREG/CR-7010 and follows guidance set forth in NUREG/CR-6850. The FLASH-CAT model is validated in NUREG/CR-7010, Section 9.2.3, through experimentally measured HRRs compared with the predictions of the FLASH-CAT model. The correlation will be applied to configurations consistent with those reported in NUREG/CR-7010 or the correlation will be qualitatively justified as acceptable.

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Table J-4 V & V Basis for Fire Models / Model Correlations Used

Calculation	Application	V & V Basis	Discussion
PyroSim	Used to create FDS input files.	• Calvert V&V Calculation	PyroSim software is a graphical interface used to create FDS input files. The developers of PyroSim (Thunderhead Engineering) confirmed that PyroSim is verified to build the input file correctly. A multi-level process is used to do this, including testing during development and running example problems through the software to ensure the correct input data is written and results obtained. The software is benchmarked against selected examples from NUREG-1824, "Verification & Validation of Selected Fire Models for Nuclear Power Plant Applications, Volume 7: Fire Dynamics Simulator," to ensure the input is written correctly. In addition, PyroSim has been widely used since 2006 and any discrepancies identified by users are addressed in subsequent releases of the software via a software maintenance agreement.

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Table J-4 V & V Basis for Fire Models / Model Correlations Used

Calculation	Application	V & V Basis	Discussion
Engineering Planning and Management (EPM) Fire Modeling Workbook (FMWB)	Used to calculate the zone of influence associated with fire scenarios.	• Calvert V&V Calculation	The FMWB is a collection of fire modeling correlations that are already documented in NUREG-1805 FDTs, "Fire Dynamics Tools (FDTs),:Quantitative Fire Hazard Analysis Methods for the US Nuclear Regulatory Commission Fire Protection Inspection Program," December 2004, and Fire Induced Vulnerability Evaluation (FIVE), "EPRI Fire Induced Vulnerability Evaluation Methodology", Revision 1, Referenced by EPRI Report 1002981, 2002. The fire modeling correlations within the Fire Modeling Workbook (FMWB) have been verified, by "black box" testing, to ensure that the results were identical to the verified and validated models. "Black box" testing (or functional testing) is testing that ignores the internal mechanism of a system or component and focuses solely on the outputs generated in response to selected inputs and execution conditions. The results from the FMWB were compared to those produced by the NUREG-1805 FDTs and FIVE-Rev1, when identical inputs were entered into both. Since the correlations from NUREG-1805 FDTs and FIVE, Rev1, were verified and validated in NUREG-1824, including the Supplement 1 Draft and the results match the results produced by the FMWB, the FMWB is verified and validated with respect to NUREG-1934 and NUREG-1824 Supplement 1, Draft.

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References

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10. Peacock, R.D., et al, CFAST – Consolidated Model of Fire Growth and Smoke Transport (Version 6) User's Guide, NIST Special Publication 1041, National Institute of Standards and Technology, Gaithersburg, MD, December 2005. FM RAI 03
11. Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications, Supplement 1, Draft Report for Comment, EPRI and USNRC, EPRI 3002002182 & NUREG/CR-1824, Supplement 1, November 2014.
12. Fire Modeling Guide for Nuclear Power Plant Applications, EPRI 1002981, FINAL REPORT, August 2002.
13. The NFPA Fire Protection Handbook, 19th Edition, A. E. Cote, Editor-in-Chief, National Fire Protection Association, Quincy, MA, 2003.
14. Nuclear Power Plant Fire Modeling Analysis Guidelines (NPP FIRE MAG), Final Report, EPRI and USNRC, EPRI 1023259 & NUREG-1936, November 2012.

Exemptions

Rescind the following exemptions granted against 10 CFR 50, Appendix R dated as follows:

- ~~August 16, 1982 – An exemption from the requirements of Section III.G.2 of Appendix R to allow alternatives to the 3-hour fire rated barriers for areas listed in the exemption.~~
- April 21, 1983 – An exemption from the requirements of Section III.G.3 of Appendix R for the control room complex and the intake structure related to the installation of fixed fire suppression systems.
- March 15, 1984 — -(Not all parts are rescinded, See Appendix K for more detail.)~~An exemption from the requirements of Section III.G to allow alternatives to the 3-hour rated fire barriers for areas listed in the exemption. An~~The exemptions ~~was also~~ granted for Section III.G for Fire Areas 10 and 11 related to the installation of fixed fire suppression systems. ~~Additionally, an exemption from the requirements of Section III.O was granted regarding the capacity of the oil collection systems for the reactor coolant pumps.~~
- August 22, 1990 – An exemption from the requirements of Section III.J to allow the use of portable hand lights as an alternative to permanently installed 8-hour emergency lights in the Unit 1 and 2 containment buildings.
- April 7, 1999 – An exemption from the requirements for Section III.J to allow the use of security lighting in exterior areas, the use of portable lights in high radiation areas and the use of helmet mounted lights inside of switchgear cabinets as alternatives to permanently installed 8-hour emergency lights.

Specific details regarding these exemptions are contained in Attachment K.

Orders

No Orders need to be superseded or revised.

CCNPP implemented the following process for making this determination:

- A review was conducted of the CCNPP docketed correspondence. The review was performed by reviewing the correspondence files and performing electronic searches of internal CCNPP records and the NRC's ADAMS document system.

A specific review was performed of the license amendment that incorporated the mitigation strategies required by Section B.5.b of Commission Order EA-02-026 to ensure that any changes being made to ensure compliance with 10 CFR 50.48(c) do not invalidate existing obligations applicable to the plant. The review of this order demonstrated that changes to the fire protection program will not affect measures required by B.5.b.

The Fukushima Orders are being independently evaluated. Any plant changes will be evaluated for impact on the fire protection program in accordance with the CCNPP design change process.