



Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

May 16, 2013

10 CFR 50.90

ATTN: Document Control Desk  
U. S. Nuclear Regulatory Commission  
Washington, D.C. 20555-0001

Browns Ferry Nuclear Plant, Units 1, 2, and 3  
Renewed Facility Operating License Nos. DPR-33, DPR-52, and DPR-68  
NRC Docket Nos. 50-259, 50-260, and 50-296

**Subject: Response to NRC Request to Supplement License Amendment Request to Adopt NFPA 805 Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants for the Browns Ferry Nuclear Plant, Units 1, 2, and 3 (TAC Nos. MF1185, MF1186, and MF1187)**

- References:
1. Letter from TVA to NRC, "License Amendment Request to Adopt NFPA 805 Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants (2001 Edition)," dated March 27, 2013
  2. Letter from TVA to NRC, "Additional Planned Fire Risk Reduction Modifications for Browns Ferry Nuclear Plant Units 1, 2, and 3," dated February 17, 2012 (ADAMS Accession No. ML12053A019)

By letter dated March 27, 2013 (Reference 1), Tennessee Valley Authority (TVA) submitted a license amendment request (LAR) for Browns Ferry Nuclear Plant (BFN), Units 1, 2, and 3, to transition to National Fire Protection Association Standard (NFPA) 805.

In a teleconference on May 8, 2013, the NRC requested that TVA supplement the Reference 1 submittal. Specifically, during the teleconference, the e-mail request from the NRC, transmitted to TVA on May 6, 2013, was discussed.

"As discussed in Section V.2 of Attachment V of the submittal dated March 27, 2013, sensitivity studies were performed to address the use of ignition frequencies from Supplement 1 of NUREG/CR-6850 ["Fire PRA Methodology for Nuclear Power Facilities"] and EPRI 1011989, "PERIL/NRC-RES Fire PRA Methodology for Nuclear Power Facilities," the use of a reduced 69 kW [kiloWatt] transient heat release rated (HRR), and crediting

A006  
HRR

prompt detection via the use of area-wide incipient detection systems. Although the results of the sensitivity study are stated as satisfying Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," Revision 2, risk acceptance guidelines, a summary of the numerical results is not provided. Provide the results (i.e., core damage frequency (CDF), large early release frequency (LERF), delta ( $\Delta$ ) CDF, and  $\Delta$  LERF) of all sensitivity analyses noted in Attachment V."

The requested supplemental information described above (i.e., the results - core damage frequency (CDF), large early release frequency (LERF), delta ( $\Delta$ ) CDF, and  $\Delta$  LERF - of all sensitivity analyses noted in Attachment V) is provided in Enclosure 1. Enclosure 1 provides the replacement pages for the first eight pages of Attachment V of Reference 1. The changes are shown by revision bars to the right of the change, and affect the last paragraph of Sections V.2.2, V.2.3, and V.2.4 only.

The Reference 1 letter also included commitments (Commitments 3 through 18) related to interim compensatory measures. As discussed in the Reference 1 letter, these interim compensatory measures are in addition to the currently existing BFN fire protection requirements and will apply until the modifications described in Attachment S, Table S-2, "Plant Modifications Committed," of the enclosure to the Reference 1 letter are installed. To facilitate any necessary NRC review when the modifications are complete, TVA will add a new commitment to notify the NRC 30 days prior to discontinuing any of the interim compensatory measures identified in Commitments 3 through 18. In addition, changes have been made to Commitments 6 and 15. Commitment 6 has been changed by adding an additional exception to when the temporary diesels generators will be credited. Specifically, they will not be credited during those periods when moving a filled spent fuel storage cask past the temporary diesel generators. The fire hazards analysis essentially requires the temporary diesel generators storage tanks to be drained of fuel oil during the spent fuel storage cask movement. Commitment 15 has been changed to provide an end date of until the modifications described in Attachment S, Table S-2 of the Reference 1 letter are installed. The previous end date was until the modifications associated with just the Switchyard Fire Area were complete. This new commitment (Commitment 19) and the modified Commitments 6 and 15 are provided in Enclosure 2, which provides a complete updated commitment list that supersedes the previous commitment list provided in the Reference 1 letter. The changes provided in this enclosure are also shown by revision bars to the right of the change.

In addition, by letter from TVA to the NRC dated February 17, 2012 (Reference 2), TVA provided a detailed list of additional planned modifications and associated implementation schedules for reducing fire risk at BFN. In a teleconference between TVA and NRC Region II on April 16, 2013, TVA provided the status of the 25 modifications contained in the Reference 2 letter. Enclosure 3 to this letter documents the current status of the 25 modifications.

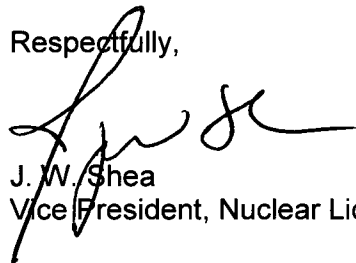
The requested supplemental information and commitment changes do not affect the 10 CFR 50.92 evaluation nor the environmental assessment previously provided in the Reference 1 letter.

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Please direct any questions concerning this matter to E. D. Schrull at (423) 751-3850.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 16th day of May 2013.

Respectfully,



J. W. Shea  
Vice President, Nuclear Licensing

- Enclosure 1: Attachment V supplemental information (replacement pages 1 through 8)
- Enclosure 2: Updated Commitment list
- Enclosure 3: Updated Status of Additional Planned Fire Risk Reduction Modifications for Browns Ferry Nuclear Plant Units 1, 2, and 3

cc (Enclosure):

NRC Regional Administrator - Region II  
NRC Senior Resident Inspector - Browns Ferry Nuclear Plant  
State Health Officer, Alabama State Department of Public Health

**Browns Ferry Nuclear Plant, Units 1, 2, and 3**

**Enclosure 1**

**Attachment V supplemental information (replacement pages V-1 through V-8)**

## V. Fire PRA Quality

158 Pages Attached

## V.1 Fire PRA Peer Quality Overview

In accordance with RG 1.205 Regulatory Position 4.3:

*“The licensee should submit the documentation described in Section 4.2 of Regulatory Guide 1.200 to address the baseline PRA and application-specific analyses. For PRA Standard “supporting requirements” important to the NFWA 805 risk assessments, the NRC position is that Capability Category II is generally acceptable. Licensees should justify use of Capability Category I for specific supporting requirements in their NFWA 805 risk assessments, if they contend that it is adequate for the application. Licensees should also evaluate whether portions of the PRA need to meet Capability Category III, as described in the PRA Standard.”*

The development of a Fire PRA is consistent with and satisfies the requirements of ASME/ANS RA-Sa-2009. In addition, the guidance of RG 1.200, Revision 2 and RG 1.205, Revision 1 were both included during the industry peer review. A full scope Fire PRA Peer Review was conducted during the period of January 23-27, 2012. The Fire PRA HLRs (High Level Requirements) (all SRs under the HLR) and SRs determined to be not applicable (N/A) by the Peer Review team are listed in Table V-1.

In the initial peer review report, a total of 130 Facts and Observations (F&Os) were documented. However, F&O 7-4 was counted in the total number of F&Os in the initial peer review, but subsequently has been removed from the peer review database after the consensus in the initial peer review. Therefore, the total number of F&Os in the initial peer review was 129.

A focused scope peer review was performed during the period of June 25-27, 2012. The focused scope peer review identified that a total of 66 unique F&Os from the initial peer review were considered resolved; however, the Peer Review team noted a number of F&Os in the focused scope peer review. Table V-2 documents the resolved F&Os in the initial peer review and their linked SRs. Table V-3 documents the resolved F&Os and their respective resolutions.

The following new F&Os (14 total) were generated in the follow-on peer review:

- F&Os 1-6 and 1-7
- F&Os 2-52 through 2-57
- F&O 8-3
- F&Os 9-1, 9-2, 9-4 and 9-5
- F&O 10-1

In addition, modifications to some F&Os in the initial peer review have been made to reflect the follow-on review:

- F&Os 2-3, 2-22, 2-46, 2-48, 4-7, 4-21, 4-28 and 3-14 have been updated;
- F&Os 4-25 and 5-23 have been updated and downgraded from ‘Finding’ to ‘Suggestion’; and
- F&Os 3-15 and 4-30 have some editorial changes.

As a result, a total of 77 F&Os (i.e., 129 – 66 + 14 = 77) exist after the BFN Fire PRA follow-on peer review.

During the peer reviews, each ASME/ANS PRA Standard Supporting Requirement is assigned a capability category. The capability categories are defined in ASME/ANS RA-Sa-2009, “Addenda to ASME/ANS RA-S-2008 Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications.”

The update of the Fire PRA addressed the Supporting Requirement assessed deficiencies (i.e., Not Met or CCI). Completion of recommendations related to Supporting Requirement assessments and 'Finding' F&Os results in a Capability Category II assessment for the majority of the Supporting Requirements. The basis for acceptability of Capability Category I requirements is documented in this attachment. Some items are not completed at this time and are deferred. These items have been dispositioned for the potential impact on the Fire PRA and the application.

Table V-4 documents the BFN Fire PRA Capability Category for each of the AMSE Supporting Requirements as determined by the Peer Review team. Table V-5 provides summary of the supporting requirement assessment from the follow-on peer review as a function of Capability Category. The Browns Ferry Fire PRA meets Capability Category II in most but not all cases (~15% of cases are Not Met or Capability Category I).

Table V-6 contains a breakdown of the F&Os from the follow-on peer review by technical element. These F&Os and their resolutions are documented in Table V-7. Based on the resolution of the peer review F&Os and the assessment of deferred items, the BFN Fire PRA is adequate to support the NFPA 805 Fire Risk Evaluation process.

No changes have been made to the Fire PRA model since completion of the June 2012 focused scope follow-on peer review that would constitute an upgrade (based on the definition provided in ASME/ANS RA-Sa-2009). Thus, no additional focused scope peer review is required to support this LAR.

## **V.2 Unreviewed Analysis Methods, Deviations, and Sensitivities**

### **V.2.1 Unreviewed Analysis Methods**

The BFN Fire PRA peer reviews identified one Unreviewed Analysis Method (UAM) as documented in F&O 3-14:

*The 'GE-Hitachi' methodology for assigning probabilities for fires propagating outside cabinets was applied. At the time of the review, this method is not reviewed by the industry. All other empirical models are based on guidance in NUREG/CR-6850, which provides the technical justification for their use.*

*The scenarios were analyzed for fires damaging the closest target. The severity factor computations take into account probability of fire propagating outside the electrical cabinet of origin based on a study that has not been subjected to industry review.*

The BFN Fire PRA no longer makes use of the 'GE-Hitachi' methodology for assigning probabilities for fires propagating outside cabinets. All cabinet fires are assumed to be capable of propagation outside the cabinets, and electrical cabinet fire scenarios follow the guidance in NUREG/CR-6850. Therefore, the identified UAM no longer applies to the BFN Fire PRA and no sensitivity study is required.

### **V.2.2 Generic Ignition Frequency Sensitivity Analysis**

Sensitivity Analysis for Use of Generic Ignition Frequency in NUREG/CR-6850 provides generic ignition frequencies as identified in task 6 in the NUREG. These frequencies have since been reviewed and updated as part of FAQ 08-0048. The updated generic frequencies are documented in NUREG/CR-6850 Supplement 1, Chapter 10. NUREG/CR-6850 Supplement 1 states that if the analyst uses these new generic frequencies then a sensitivity study must be done. The sensitivity is only required for bins, as defined in Task 6 of NUREG/CR-6850, that have an alpha value of less than or equal to 1 in EPRI 1016735. This is discussed in more detail in Footnote 10 of NUREG/CR-6850 Supplement 1 (Page 10-2).

A sensitivity study has been performed in TVA Calculation NDN0009992013000132, "BFN Fire PRA – NFPA 805 Application Calculation", Revision 0. This calculation documents the sensitivity requirement as outlined in Chapter 10 – Fire Ignition Frequency (FAQ 08-0048) in Supplement 1 to NUREG/CR-6850 to support the use of updated generic fire frequencies arising from the industry review of fire events. The guidance within FAQ 08-0048 requires that with the implementation of the fire ignition frequencies, a sensitivity analysis should be performed using the NUREG/CR-6850 frequencies to provide an adequate indication on the effects on risk and delta risk.

The results of this sensitivity study can be seen in tables 1 and 2 of TVA Calculation NDN0009992013000132. BFN meets the requirements for a Region II plant with total CDF and LERF below  $1E-04$ /rx-yr and  $1E-05$ /rx-yr, respectfully, for overall plant risk without credit for the revised ignition frequencies in table 1 of the calculation. BFN meets the CDF/LERF criteria for a Region II plant which allows a positive delta CDF of  $1E-05$ /rx-yr and LERF of  $1E-06$ /rx-yr for acceptable risk increases, as shown in table 2 of the calculation. Attachments 1 through 12 of NDN0009992013000132 show the data on a scenario level that was used to create tables 1 and 2 of the calculation. In summary, tables 1 and 2 show: a post-transition CDF and LERF (per rx-yr), respectively, for BFN Units 1, 2, and 3 (using the NUREG/CR-6850 ignition frequencies) of  $7.25E-05$  and  $2.85E-06$  (Unit 1),  $7.88E-05$  and  $2.50E-06$  (Unit 2), and  $6.97E-05$  and  $2.46E-06$  (Unit 3); and a post-transition minus the compliant delta CDF and delta LERF (per rx-yr), respectively, for BFN Units 1, 2, and 3 of  $-7.01E-04$  and  $3.33E-07$  (Unit 1),  $-6.21E-04$  and  $7.80E-08$  (Unit 2), and  $-6.88E-04$  and  $2.12E-07$  (Unit 3).

### V.2.3 Use of 69kW Heat Release Rate Used for Selected Transient Fires

NUREG/CR-6850 developed a fire ignition frequency for transient fires postulated to occur in various plant locations (Bin 7: Control/Aux Building, Bin 25: Plant-Wide Components, and Bin 37: Turbine Building). Transient fires could also occur as the result of hot work as noted in Table 6-1 of EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities Volume 2: Detailed Methodology. The guidance in NUREG/CR-6850, Appendices E and G, recommends a Heat Release Rate (HRR) distribution with a 98th percentile HRR of 317 kW, with the 317 kW value as the screening HRR under the conditions discussed below. The specific guidance provided in Section G.5 of NUREG/CR-6850 states:

*"Characteristics of transient fires should be determined by:*

- *Review of the maintenance and other activities performed in the area, and*
- *Review of past transient fire experience at the plant.*

*If the type and amount of combustible material that is expected or possible, based on this review, is bounded by the tested fuel package configurations in Table G-7, use Table G-1 for the recommended HRR probability distribution for transient fires and transient fires caused by hot work activities.*

*If not bounded by the fuel packages found in Table G-7, the HRR may be estimated using the characteristics of the combustible materials involved and heat of combustion from Table G-8. Note that this will result in a point value for the HRR. In this case the user should develop a representative distribution with adequate justification. An alternative approach is to use a single bounding HRR value with a severity factor of 1.0.*

*Liquid transient fires should be characterized similar to fixed oil fires, such as, pump oil fires, as described in Section G.4."*

The BFN Fire PRA makes use of reduced transient HRRs in limited areas that are administratively controlled (see Implementation Item 45 in Table S-3 of Attachment S) to reduce



the likelihood of large transient fires. Only six fire compartments modeled in the BFN Fire PRA have credited the transient controls to reduce the transient HRR to 69 kW (05, 09, 16-A, 16-K, 16-M, and 16-O).

The EPRI-led Fire PRA Methods Review Panel issued decisions on methods submitted for their review. Letter from NEI to NRC, B. Bradley to D. Harrison, "Recent Fire PRA Methods Review Panel Decisions: Clarifications for Transient Fires and Alignment for Pump Oil Fires," dated September 27, 2011, was provided as a clarification to the guidance of NUREG/CR-6850 and part of the new PRA methods. Letter Attachment 1 "Description of Treatment for Transient Fires," and Attachment 3 "Panel Decision," allow the user to choose a lower screening heat release rate for transient fires in a fire compartment based on "the specific attributes and considerations applicable to that location." The guidance indicates that "plant administrative controls should be considered in the appropriate HRR for a postulated transient fire" and that "a lower screening HRR can be used for individual plant specific locations if the 317 kW value is judged to be unrealistic given the specific attributes and considerations applicable to that location." By letter dated June 21, 2012, from NRC, J. Giiter, to NEI, B. Bradley, "Recent Fire PRA Methods Review Panel Decision" and EPRI 1022993, "Evaluation of Peak Heat Release Rates in Electrical Cabinet Fires", the NRC endorsed this method with some changes. The changes do not affect the manner in which BFN applied the method. The guidance in NUREG/CR-6850 was followed and no deviations were made in terms of fractional influence factors being utilized for the hot work and transient fire ignition frequency. NFPA 805 FAQ 12-0064 was not incorporated because it was released fairly late in the development of the BFN Fire PRA.

In the BFN Fire PRA, a 69 kW transient heat release rate was justified for certain fire compartments (05, 09, 16-A, 16-K, 16-M, and 16-O) based on several factors:

- All fire compartments which were credited for a reduced heat release rate will be subject to strict combustible controls (areas designated as "No Combustible Storage") and so paper, cardboard, scrap wood, rags and other trash shall not be allowed to accumulate in the area;
- Large combustible liquid fires are not expected in these areas since activities in the compartments do not include maintenance of oil containing equipment;
- A transient fire in compartments of strict combustible controls, where only small amounts of contained trash are considered possible, is judged to be no larger than the 75<sup>th</sup> percentile fire in an electrical cabinet with one bundle of qualified cable;
- The materials composing the fuel packages included in Table G-7 of NUREG/CR-6850 (e.g., eucalyptus duff, one quart of acetone, 5.9 kg of methyl alcohol, etc.) are not representative of the typical materials expected to be located in these compartments; and
- A review of the transient ignition source tests in Table G-7 of NUREG/CR-6850 indicates that of the type of transient fires that can be expected in these compartments (i.e., polyethylene trash can or bucket containing rags and paper) were measured at peak heat release rates of 50 kW or below.

Since only small quantities of trash in temporary containers can be expected, a 69 kW peak heat release rate was determined to be appropriate to represent this quantity of combustibles. The 69 kW heat release rate bounds the small trash can fires reported in NUREG/CR-6850 Appendix G.

Based on the discussion above, a sensitivity study on using 317 kW HRR is not required. However, a sensitivity has been performed in TVA Calculation NDN0009992013000132, "BFN Fire PRA – NFPA 805 Application Calculation", Revision 1 to evaluate violation of the

administrative controls placed on the fire compartments transient controls credited to reduce the transient HRR to 69 kW.

The results of the 69 kW fire sensitivity study can be seen in Tables 3 through 6 of TVA Calculation NDN0009992013000132. As can be seen in Tables 3 and 5 of the calculation, BFN meets the guidance for a Region II plant with total CDF and LERF below  $1E-04$ /rx-yr and  $1E-05$ /rx-yr for overall plant risk assuming either 10% (case 1) or 67% (case 2) of the transient fire frequency results in a full compartment burn (FCB). Browns Ferry Nuclear meets the CDF/LERF criteria for a Region II plant which allows a positive delta CDF of  $1E-05$ /rx-yr and LERF of  $1E-06$ /rx-yr for acceptable risk increases for both cases in Tables 4 and 6 of the calculation. In summary, Tables 3 through 6 show: a post-transition CDF and LERF (per rx-yr), respectively, for BFN Units 1, 2, and 3 of  $6.62E-05$  and  $2.16E-06$  (Unit 1, case 1),  $8.52E-05$  and  $2.24E-06$  (Unit 1, case 2),  $6.93E-05$  and  $1.92E-06$  (Unit 2, case 1),  $8.86E-05$  and  $2.02E-06$  (Unit 2, case 2),  $5.57E-05$  and  $1.85E-06$  (Unit 3, case 1), and  $7.08E-05$  and  $1.91E-06$  (Unit 3, case 2); and a post-transition minus the compliant delta CDF and delta LERF (per rx-yr), respectively, for BFN Units 1, 2, and 3 of  $-5.69E-04$  and  $1.98E-07$  (Unit 1, case 1),  $-6.28E-04$  and  $2.40E-07$  (Unit 1, case 2),  $-4.99E-04$  and  $3.78E-08$  (Unit 2, case 1),  $-5.52E-04$  and  $7.67E-08$  (Unit 2, case 2),  $-5.72E-04$  and  $1.17E-07$  (Unit 3, case 1), and  $-5.93E-04$  and  $1.10E-07$  (Unit 3, case 2).

#### **V.2.4 Credit for VEWFDs and Automatic Suppression for Fire Scenarios in Cable Spreading Room and Unit 1 Auxiliary Instrument Room**

The BFN Fire PRA applies a prompt detection credit and an automatic suppression credit for transient fires, cable fires caused by welding and cutting, transient fires caused by welding and cutting, and self-ignited cable fires in the Cable Spreading Rooms (Fire Area 16/Fire Compartment 16-A).

This is based on the planned modification to install aspirating smoke detectors (ASD) installed as very early warning fire detectors (VEWFDs) that will actuate a total flooding clean agent suppression system (Refer to Attachment S, Table S-2, items 78 and 79 for additional details on the modifications).

The detectors are credited with "prompt" detection, not detection of the fire in its incipient phase. The credit applied for the planned VEWFDs as a "prompt" detector is considered acceptable since:

- The credit for prompt detection is consistent with the guidance contained in NUREG/CR-6850, Appendix P, for crediting "High sensitivity detectors", and specifically aligns with the Detection-Suppression Event Tree Output for sequences A through E, as contained in Table P-1;
- The detection system availability and reliability of  $1E-02$  from FAQ 08-0046 is appropriately included;
- The appropriate manual fire suppression failure probabilities in NUREG/CR-6850, Supplement 1 (i.e., FAQ 08-0050) are selected based on the specific initiator;
- Even when the VEWFDs and manual suppression are successful, the tray damaged by the fire is conservatively assumed to be one of the top 25 risk contributing cable trays in Fire Compartment 16-A, for each unit. Transient scenarios have been quantified for the 25 top risk significant cable trays in each unit. A weighting factor for these scenarios was calculated and applied based on the length of each cable tray divided by the total length of the trays;
- When either the VEWFDs or manual suppression are unsuccessful, the analysis conservatively assumes whole room damage; and

- The majority of the cable trays in the cable spreading room are provided with Flamemastic coating and/or bottom covers which would delay damage and ignition, however, no credit was given for this in the analysis.

The credit for the planned total flooding clean agent suppression system is considered acceptable since:

- The credit for automatic suppression is consistent with the guidance contained in NUREG/CR-6850, Appendix P, for crediting "High sensitivity detectors" together with automatic suppression, and specifically aligns with the Detection-Suppression Event Tree Output for sequence B, contained in Table P-1;
- The automatic suppression availability and reliability of 2E-02 is appropriately included;
- Even when the VEWFs and automatic suppression system are successful, target damage is conservatively assumed to be one of the top 25 risk contributing cable trays in Fire Compartment 16-A, for each unit, as described above;
- When either the VEWFs or both automatic and manual suppression system are unsuccessful, the analysis conservatively assumes whole room damage; and
- The majority of the cable trays in the cable spreading room are provided with Flamemastic coating and/or bottom covers which would delay damage and ignition, however, no credit was given for this in the analysis.

The BFN Fire PRA also applies a prompt detection credit for two transient fire scenarios in the Unit 1 Auxiliary Instrument Room (Fire Area 16/Fire Compartment 16-K). The BFN Fire PRA does not apply a prompt detection credit for any fire scenarios in the Unit 2 and 3 Auxiliary Instrument Rooms (Fire Area 16/Fire Compartments 16-M and 16-N). The credit applied for the planned VEWFs as a "prompt" detector is considered acceptable for the same reasons described above for the Cable Spreading Room.

Based on the discussion above, the approach implemented is considered conservative, and in majority aligns with guidance within NUREG/CR-6850, Appendix P. Therefore, a sensitivity study on crediting VEWFs together with a total flooding clean agent suppression system is not required. However, a sensitivity has been performed in TVA Calculation NDN0009992013000132, "BFN Fire PRA – NFPA 805 Application Calculation", Revision 1, to illustrate that an increased probability of inadvertent lockout of the fire suppression system has only a small effect on the results of the PRA.

The sensitivity to model an increased probability of inadvertent lockout of the fire suppression system in the Cable Spreading Room was performed by increasing the non suppression probability for Transient Fires, Transient Fires due to Welding and Cutting, Self-Ignited Cable and Junction Box Fires, Cable Fires due to Welding and Cutting to 5.0E-02 for all four fire scenarios. The use of a 5.0E-02 as a probability of non-suppression for sensitivity purposes is based on that of Halon, Deluge or Pre-Action, which have the lowest reliability of the recommended values in NUREG/CR-6850, Appendix P (Section P.1.3 on Page P-6) for automatic suppression systems.

A sensitivity for the credit for prompt detection in the two Unit 1 Auxiliary Instrument Room transient fire scenarios was also performed by removing the credit for the VEWFs altogether.

The results of these sensitivity studies can be seen in Tables 7 and 8 of TVA Calculation NDN0009992013000132, Revision 1. As can be seen in Table 7 of the calculation, BFN meets the guidance for a Region II plant with total CDF and LERF below 1E-04/rx-yr and 1E-05/rx-yr for overall plant risk with the above sensitivities. BFN also meets the CDF/LERF criteria for a Region II plant which allows a positive delta CDF of 1E-05/rx-yr and LERF of 1E-06/rx-yr for

acceptable risk increases with the above sensitivities in Table 8 of the calculation. In summary, Tables 7 and 8 show: a post-transition CDF and LERF (per rx-yr), respectively, for BFN Units 1, 2, and 3 of  $7.33\text{E-}05$  and  $2.19\text{E-}06$  (Unit 1),  $7.61\text{E-}05$  and  $1.95\text{E-}06$  (Unit 2), and  $6.36\text{E-}05$  and  $1.88\text{E-}06$  (Unit 3); and a post-transition minus the compliant delta CDF and delta LERF (per rx-yr), respectively, for BFN Units 1, 2, and 3 of  $-5.52\text{E-}04$  and  $2.40\text{E-}07$  (Unit 1),  $-4.82\text{E-}04$  and  $7.94\text{E-}08$  (Unit 2), and  $-5.61\text{E-}04$  and  $1.68\text{E-}07$  (Unit 3).

#### **V.2.5 Credit for Electrical Raceway Fire Barrier Systems that are installed in accordance with NFPA 805 Chapter 3 Section 3.11.5**

Browns Ferry Nuclear has Electrical Raceway Fire Barrier Systems (ERFBS) installed, and modifications planned to install ERFBS, in accordance with NFPA 805 Chapter 3 Section 3.11.5 to meet the separation requirements of NFPA 805 Chapter 4 Section 4.2.4. In most cases the ERFBS are 1-hour rated and are or will be installed in areas where automatic detection and suppression is available. In some cases, the 1-hour rated ERFBS may not have automatic suppression. In those instances, an Engineering Equivalency Evaluation will be performed to determine that the 1-hour rated ERFBS is adequate for the hazard. The ERFBS are referenced in Tables C-1 and C-2 as a required Fire Protection System/Feature for the Fire Area. In addition, the engineering equivalency evaluation is referenced in Tables C-1 and C-2.

In order to take credit for the ERFBS in the Fire PRA, two fire scenarios were developed for ignition sources that would damage the PRA targets that have ERFBS. One scenario credits manual suppression at or before one hour. In this scenario, the PRA targets having the 1-hour rated ERFBS are not considered to be damaged. A second scenario was developed where suppression is unsuccessful and the fire continues to burn beyond one hour. This scenario damages all targets within the zone of influence, including any PRA targets with 1-hour rated ERFBS.

**Browns Ferry Nuclear Plant, Units 1, 2, and 3**

**Enclosure 2**

**Updated Commitment List (4 pages)**

## ATTACHMENT

### List of Regulatory Commitments

1. TVA will submit a License Amendment Request proposing Technical Specifications requirements for the new emergency high pressure makeup pump system on a schedule to support the modification implementation date provided in Section 5.5 of the enclosure to this letter.
2. TVA will revise the program that monitors BFN Residual Heat Removal (RHR) heat exchanger performance for consistency with the assumptions of the NFPA 805 Net Positive Suction Head (NPSH), Containment Parameters, and AREVA Fuel peak centerline temperature (PCT) Analysis calculation related to the RHR heat exchanger k-factor within 6 months following NRC approval of this amendment request.
3. TVA will maintain the existing hourly roving fire watches for all existing BFN fire areas (FAs): until the modifications described in Attachment S, Table S-2, "Plant Modifications Committed," of the enclosure to this letter are installed. The hourly roving fire watches for all existing BFN FAs is currently implemented.
4. TVA will implement stricter control of transient combustibles for the following BFN FAs: FA 01-03, FA 01-04, FA 02-02, FA 02-03, FA 02-04, FA 03-01, FA 03-02, FA 03-03, FA 04, FA 08, FA 09, FA 16 (except for Main Control Room), FA 20, FA 21, FA 22, FA 23, FA 24, FA 25-01, and FA 26 until the modifications described for the listed FAs in Attachment S, Table S-2, "Plant Modifications Committed," of the enclosure to this letter are installed. These controls will consist of:
  - a. Requiring permits to allow transient combustibles into these higher risk areas;
  - b. Tracking these permits to control quantities of transient combustibles allowed into these fire areas; and
  - c. Performing once-per-shift walkdowns to ensure that transient combustible controls are satisfied (e.g., waste, debris, scraps, rags, or other combustibles resulting from work activities are removed from the subject fire areas, and that no transient combustibles are placed in the 20-foot exclusion zone(s) within the listed FAs).

TVA will implement these controls by May 31, 2013.

5. TVA will implement controls limiting hot work activities (e.g., welding, cutting, and grinding) in FA 01-03, FA 01-04, FA 02-02, FA 02-03, FA 02-04, FA 03-01, FA 03-02, FA 03-03, FA 04, FA 08, FA 09, FA 16, FA 20, FA 21, FA 22, FA 23, FA 24, FA 25-01, FA 26, and FA SWITCH until the modifications described for the listed FAs in Attachment S, Table S-2, "Plant Modifications Committed," of the enclosure to this letter are installed.

If hot work activities are necessary, the existing hot work controls specified in NPG-SPP-18.4.8, Control of Ignition Sources, shall be augmented to require that the Fire Brigade or Senior Reactor Operator perform a pre-job briefing in accordance with NPG-SPP-18.2.2, Human Performance Tools, and perform a walkdown for job area familiarization prior to performing the hot work activity. This walkdown shall include, ensuring travel path is clear of obstructions, identifying the location of fire hoses and fire

extinguishers, and verifying fire suppression systems (manual and automatic) are properly aligned.

TVA will implement these controls by May 31, 2013.

6. TVA will implement controls to credit temporary diesel generators as an additional power source for a shutdown board, except during those periods when the temporary diesel generators are being used to support alternate decay heat removal or when moving a filled spent fuel storage cask past the temporary diesel generators, until the modifications described in Attachment S, Table S-2, "Plant Modifications Committed," of the enclosure to this letter are installed.

TVA will implement these controls by May 31, 2013.

7. TVA will implement controls to protect RHR Pump 1A and its associated support systems whenever hot work activities are performed in FA 01-04, FA 04, and FA 09 until the modifications for the listed FAs described in Attachment S, Table S-2, "Plant Modifications Committed," of the enclosure to this letter are installed.

TVA will implement these controls by May 31, 2013.

8. TVA will implement controls to protect the Unit 1 RHR Train A and its associated support systems whenever hot work activities are performed in FA 08 until the modifications associated with FA 08 described in Attachment S, Table S-2, "Plant Modifications Committed," of the enclosure to this letter are installed.

TVA will implement these controls by May 31, 2013.

9. TVA will implement controls to protect the following equipment whenever hot work is being performed in FA 02-02 until the modifications for FA 02-02 described in Attachment S, Table S-2, "Plant Modifications Committed," of the enclosure to this letter are installed:
  - a. Fire protection systems (detection and suppression) for this FA;
  - b. North Emergency Equipment Cooling Water (EECW) Header;
  - c. 4kV Shutdown Board B, 3EA, 3EB;
  - d. 250V DC Battery Charger 1;
  - e. 480V Reactor Motor Operated Valve (RMOV) Board 1A, 2A, 2D;
  - f. 480V Shutdown Boards 1A and 2A;
  - g. 2C RHR Pump;
  - h. 480V Shutdown Board 2A Transformer TS2A; and
  - i. Shutdown Board 250V DC Battery Charger SB-B.

TVA will implement these controls by May 31, 2013.

10. TVA will implement controls to protect the following equipment whenever hot work is being performed in FA 02-03 until the modifications for FA 02-03 described in Attachment S, Table S-2, "Plant Modifications Committed," of the enclosure to this letter are installed:
  - a. Fire protection systems (detection and suppression) for this FA;
  - b. North EECW Header;
  - c. Residual Heat Removal Service Water (RHRSW) Pump D1;
  - d. 4kV Shutdown Board D, 3EA, 3EB;
  - e. 250V DC Battery Charger 1;
  - f. 480V RMOV Board 1A, 2B, and 3A;
  - g. 480V Shutdown Boards 1A and 2B;
  - h. 2D RHR Pump & RHR Crosstie Unit 3 to Unit 2; and
  - i. 480V Shutdown Board 2B Transformer TS2B.

TVA will implement these controls by May 31, 2013.

11. TVA will implement controls to protect the following equipment whenever hot work is being performed in FA 02-04 until the modifications for FA 02-04 described in Attachment S, Table S-2, "Plant Modifications Committed," of the enclosure to this letter are installed:
  - a. Fire protection systems (detection and suppression) for this FA;
  - b. North EECW Header;
  - c. B1 and D1 RHRSW Pump;
  - d. 4kV Shutdown Board D, 3EA, 3EB, and 3ED;
  - e. Shutdown Board 250V DC Battery Charger SB-D;
  - f. 480V RMOV Board 1A and 3B;
  - g. 2D RHR Pump; and
  - h. 480V Shutdown Board 2B Transformer TS2B.

TVA will implement these controls by May 31, 2013.

12. TVA will implement controls to protect RHRSW Pump 2B and its associated support systems whenever hot work activities are performed in FA 03-03 until the modifications for FA 03-03 described in Attachment S, Table S-2, "Plant Modifications Committed," of the enclosure to this letter are installed.

TVA will implement these controls by May 31, 2013.

13. TVA will institute 30-minute roving fire watches in FA 16 for non-continuously manned areas until the modifications for FA 16 described in Attachment S, Table S-2, "Plant Modifications Committed," of the enclosure to this letter are installed.

TVA will implement these controls by May 31, 2013.

14. TVA will designate the FA 04, FA 08, FA 09, FA 16 (Cable Spreading Room only), FA 22, FA 23, FA 24, and FA 25-01 as transient combustible-free areas and establish the same controls as the current 20-foot exclusion zones, except that tags required by plant procedures may be present in these FAs, until the modifications for the listed FAs described in Attachment S, Table S-2, "Plant Modifications Committed," of the enclosure to this letter are installed.

TVA will implement these controls by May 31, 2013.

15. TVA will implement controls to limit the unavailability of an entire EECW header (north or south) until the modifications described in Attachment S, Table S-2, "Plant Modifications Committed," of the enclosure to this letter are installed.

TVA will implement these controls by May 31, 2013.

16. TVA will increase the testing frequency of automatic fire doors in FA 22, FA 23, and FA 24 to once-per-6 months until the modifications described for the listed FAs in Attachment S, Table S-2, "Plant Modifications Committed," of the enclosure to this letter are installed.

TVA will implement these controls by May 31, 2013.

17. TVA will implement controls to protect the following equipment whenever hot work is being performed in FA 20 until the modifications for FA 20 described in Attachment S, Table S-2, "Plant Modifications Committed," of the enclosure to this letter are installed:
  - a. Fire protection systems (detection and suppression) for this FA;
  - b. North EECW Header;
  - c. 4kV Shutdown Board 3EA and 3EB;
  - d. 480V Common Board 1 Transformer TC1A; and
  - e. 250V DC Battery Charger 1.

TVA will implement these controls by May 31, 2013.



18. TVA will implement controls to ensure that Heating, Ventilation and Air Conditioning (HVAC) is available to the BFN Unit 3 Main Control Room whenever Transformer TS3A is unavailable or the EECW South Header is unavailable until the modifications for FA 20 described in Attachment S, Table S-2, "Plant Modifications Committed," of the enclosure to this letter are installed.

TVA will implement these controls by May 31, 2013.

19. TVA will inform the NRC 30 days prior to discontinuing each of the interim compensatory measures identified in Commitments 3 through 18, above.

**Browns Ferry Nuclear Plant, Units 1, 2, and 3**

**Enclosure 3**

**Updated Status of Additional Planned Fire Risk Reduction Modifications for  
Browns Ferry Nuclear Plant Units 1, 2, and 3**

Updated Status of Additional Planned Fire Risk Reduction Modifications for Browns Ferry Nuclear Plant Units 1, 2, and 3

	Status	Modification	Commitment Date	Commitment Number	DCN	Reference (EDMS #)
1	Not Complete	Install fuses in ammeter circuit for Battery Board 2.	9/27/13	113380100	70434/S2	
2	Complete	Install fuses in ammeter circuit for Battery Board 3.	9/16/12	113380116	70434/S3	R20 120705 013
3	Complete	Install fuses in ammeter circuit for Battery Board 4.	6/22/12	113380128	70434/S4	R20 120719 019
4	Complete	Install fuses in ammeter circuit for Battery Board 6.	4/6/12	113380138	70434/S6	R20 120501 008
5	Complete	Install controls in the Main Control Room to isolate 4kV Shutdown Board 3EC from fire damage in 4kV Shutdown Board 3EA.	Prior to restart from Unit 3 Refueling outage 15 (Spring 2012)	113380143	70054	R20 120619 011
6	Complete	Isolate and abandon local control station for Residual Heat Removal Service Water (RHRSW) Pump A3.	1/11/13	113380156	70490/S1	R20 120815 023
7	Complete	Isolate and abandon local control station for RHRSW Pump B1.	10/12/12	113380168	70490/S2	R20 120719 020
8	Complete	Isolate and abandon local control station for RHRSW Pump B2.	12/14/12	113380183	70490/S3	R20 121031 040
9	Complete	Isolate and abandon local control station for RHRSW Pump B3.	12/14/12	113380197	70490/S4	R20 121031 041
10	Complete	Isolate and abandon local control station for RHRSW Pump C1.	1/4/13	113380246	70490/S5	R20 121011 036
11	Complete	Isolate and abandon local control station for RHRSW Pump C2.	3/1/13	113380259	70490/S6	R20 120920 028
12	Complete	Isolate and abandon local control station for RHRSW Pump C3.	3/1/13	113380276	70490/S7	R20 120920 027
13	Complete	Isolate and abandon local control station for RHRSW Pump D1.	2/22/13	113380286	70490/S8	R20 130212 005
14	Complete	Isolate and abandon local control station for RHRSW Pump D2.	2/15/13	113380299	70490/S9	R20 121130 045

Updated Status of Additional Planned Fire Risk Reduction Modifications for Browns Ferry Nuclear Plant Units 1, 2, and 3

	Status	Modification	Commitment Date	Commitment Number	DCN	Reference (EDMS #)
15	Complete	Isolate and abandon local control station for RHRSW Pump D3.	12/14/12	113380316	70490/S10	R20 120920 029
16	Not Complete	Install relays to isolate 4kV Shutdown Board A Normal Feeder Breaker 1614 control circuit from fire damage in 4kV Shutdown Board D.	Prior to restart from Unit 1 Refueling outage 10 (Fall 2014)	113380395	70491/S1	
17	Not Complete	Install relays to isolate 4kV Shutdown Board A Alternate Feeder Breaker 1716 control circuit from fire damage in 4kV Shutdown Board C.	Prior to restart from Unit 1 Refueling outage 10 (Fall 2014)	113380702	70491/S2	
18	Not Complete	Install relays to isolate 4kV Shutdown Board A Crosstie Breaker 1824 control circuit from fire damage in 4kV Shutdown Board 3EA.	Prior to restart from Unit 1 Refueling outage 10 (Fall 2014)	113380795	70491/S3	
19	Complete	Install relays to isolate 4kV Shutdown Board D Normal Feeder Breaker 1724 control circuit from fire damage in 4kV Shutdown Board C.	Prior to restart from Unit 2 Refueling outage 17 (Spring 2013)	113380952	70491/S12	R20 130417 014
20	Complete	Install relays to isolate 4kV Shutdown Board D Crosstie Breaker 1826 control circuit from fire damage in 4kV Shutdown Board 3ED.	Prior to restart from Unit 2 Refueling outage 17 (Spring 2013)	113380956	70491/S13	R20 130417 013
21	Not Complete	Separate normal power cables for 480 RMOV Board 3B from FA 13.	Prior to restart from Unit 3 Refueling outage 16 (Spring 2014)	113380966	70492	
22	Not Complete	Install incipient fire detection in the Unit 1 Auxiliary Instrument Room.	Prior to restart from Unit 1 Refueling outage 10 (Fall 2014)	113380973	70493/S1	

Updated Status of Additional Planned Fire Risk Reduction Modifications for Browns Ferry Nuclear Plant Units 1, 2, and 3

	Status	Modification	Commitment Date	Commitment Number	DCN	Reference (EDMS #)
23	Complete	Install incipient fire detection in the Unit 2 Auxiliary Instrument Room.	Prior to restart from Unit 2 Refueling outage 17 (Spring 2013)	113380987	70493/S2	R20 130503 018
24	Not Complete	Install incipient fire detection in the Unit 3 Auxiliary Instrument Room.	Prior to restart from Unit 3 Refueling outage 16 (Spring 2014)	113380993	70493/S3	
25	Not Complete	Separate normal cables required for Unit 1 RCIC from FA 17.	Prior to restart from Unit 1 Refueling outage 10 (Fall 2014)	113381009	70494	