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TVA

1101 Market Street, Chattanooga, Tennessee 37402

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October 6, 2014

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 for Additional Information Regarding the 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) - Probabilistic Risk Assessment Follow Up (90-Day Responses)**

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) (Technical Specification Change TS-480)," dated March 27, 2013 (ADAMS Accession No. ML13092A393)

2. Letter from TVA to NRC, "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)," dated May 16, 2013 (ADAMS Accession No. ML13141A291)

3. Letter from NRC to TVA, "Browns Ferry Nuclear Plant, Units 1, 2, and 3 - Request for Additional Information Regarding License Amendment Request to Adopt National Fire Protection Association Standard 805 Performance-Based Standard for Fire Protection for Light Water Reactor Generating Plants (TAC Nos. MF1185, MF1186, and MF1187)," dated November 19, 2013 (ADAMS Accession No. ML13298A702)

4. Letter from TVA to NRC, "Response to NRC Request for Additional Information Regarding the 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) - Set 1," dated December 20, 2013 (ADAMS Accession No. ML13361A093)

5. Letter from TVA to NRC, "Response to NRC Request for Additional Information Regarding the 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) - Set 2," dated January 10, 2014 (ADAMS Accession No. ML1401A088)

6. Letter from TVA to NRC, "Response to NRC Request for Additional Information Regarding the 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) - Set 3," dated January 14, 2014 (ADAMS Accession No. ML14077A201)

7. Letter from TVA to NRC, "Response to NRC Request for Additional Information Regarding the 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) - Set 4," dated February 13, 2014 (ADAMS Accession No. ML14055A305)

8. Letter from TVA to NRC, "Response to NRC Request for Additional Information Regarding the 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) - Set 5," dated March 14, 2014 (ADAMS Accession No. ML14079A159)

9. Letter from NRC to TVA, "Browns Ferry Nuclear Plant, Units 1, 2, and 3 - Request for Additional Information Regarding License Amendment Request to Adopt National Fire Protection Association Standard 805, Performance-Based Standard for Fire Protection for Light Water Reactor Generating Plants (TAC Nos. MF1185, MF1186, and MF1187)," dated July 31, 2014 (ADAMS Accession No. ML14203A125)

10. Letter from TVA to NRC, "Response to NRC Request for Additional Information Regarding the 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) - Probabilistic Risk Assessment Follow Up (60-Day Responses)," dated August 29, 2014 (ADAMS Accession No. ML14248A291)

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 addition, by letter dated May 16, 2013 (Reference 2), TVA provided information to supplement the Reference 1 letter.

By letter dated November 19, 2013 (Reference 3), the NRC staff requested additional information to support the review of the LAR. By letters dated December 20, 2013, January 10, 2014, January 14, 2014, February 13, 2014, and March 14, 2014 (References 4, 5, 6, 7, and 8, respectively), TVA responded to the Nuclear Regulatory Commission (NRC) staff's request for additional information (RAI).

By letter dated July 31, 2014 (Reference 9), the NRC provided a follow-up RAI specific to the probabilistic risk assessment. The required due dates for responding to the RAI varied from 60 days to 162 days. By letter dated August 29, 2014 (Reference 10), TVA responded to the NRC's 60-day RAIs.

Enclosure 1 provides the second set of TVA responses to some of the RAIs identified in the Reference 9 letter. As stated in the Reference 9 letter, these responses are nominal 90-day responses and are due by October 7, 2014. Enclosure 2 provides updated TVA responses to PRA RAI 01.r and PRA RAI 14.01, which were previously responded to in the Reference 4 and Reference 10 letters, respectively. Changes to the responses are denoted by deleted text struck through, inserted text in bold, underline, and a revision bar in the right margin. Enclosure 3 provides a listing of all RAIs listed in the Reference 9 letter and the actual date of the TVA response to each RAI.

Consistent with the standards set forth in Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50.92(c), TVA has determined that the additional information, as provided in this letter, does not affect the no significant hazards consideration associated with the proposed application previously provided in Reference 1.

There are no new regulatory commitments contained in this submittal. Please address any questions regarding this submittal to Mr. Edward D. Schrull at (423) 751-3850.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 6th day of October 2014.

Respectfully,

J. W. Shea
Vice President, Nuclear Licensing

Enclosures:

1. TVA Response to NRC Request for Additional Information: PRA Follow-Up RAIs (90-day)
2. Updated TVA Response to Probabilistic Risk Assessment (PRA) Request for Additional Information (RAI) 01.r and PRA RAI 14.01
3. Summary of BFN NFPA 805 PRA Follow-Up RAI Response Dates

cc (Enclosure):

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

ENCLOSURE 1
Tennessee Valley Authority
Browns Ferry Nuclear Plant, Units 1, 2, and 3
TVA Response to NRC Request for Additional Information: PRA Follow-Up RAIs (90-day)

Probabilistic Risk Assessment (PRA)
Request for Additional Information (RAI) PRA 01.r.01

PRA RAI 01.r.01

By letter to the Nuclear Regulatory Commission (NRC) dated December 20, 2013, (Agencywide Documents Access and Management System (ADAMS) Accession Number ML13361A093), the licensee responded to PRA RAI 01.r stating that modelling of junction box scenarios is consistent with frequently asked question (FAQ) 13-0006, "Modeling Junction Box Scenarios in a Fire PRA." However, the descriptions of the detailed evaluation do not appear to be consistent with the FAQ.

a. *The first bullet (<u>Full compartment burn scenarios</u>) states that in some cases a junction box fire was included in the frequency of full compartment burn scenarios. The FAQ allows for such screening but the assumption is that screening at this level is appropriate when identifiable methods and appropriate risk results are achieved. What are the decision guidelines that were used to determine that this screening method is appropriate?*

b. *The first sub-bullet under the second bullet (<u>Fire scenarios</u>) states that, "For selected plant physical analysis units (PAUs), one scenario was added consisting of the sum of the frequency of self-ignited cable fires and junction box fires only and the failure of all the targets in the PAU." This would only differ from the first bullet mentioned above if junction box fires and/or self-ignited cable fires are the only full compartment burnout in some PAUs. What is the difference between the first bullet and the first sub-bullet under the second bullet? Are there some PAUs where junction box or cable fires are the only compartment burnout scenarios?*

c. *The second sub-bullet states, "[f]or the remaining PAUs (i.e., those where the conservatisms associated with failing all targets in the PAU had to be refined), the conditional core damage probability (CCDP) was re-calculated using the two most risk significant raceways as documented in the Browns Ferry Nuclear (BFN) Fire PRA Cable Tray Sensitivity evaluation." In contrast, the FAQ states, "[f]or junction boxes that are Fire PRA targets, calculate the CCDP values assuming the loss (failure) of one junction box at a time in the PAU (i.e., never more than one junction is involved, and there is no sequential fire propagation from the initiating junction box to other intervening combustibles)." The approach in the response appears to be failing far more equipment than assuming the loss of one junction box. Provide additional discussion about how failing the two most significant raceways is consistent with the FAQ guidance that only the loss of one junction box at a time should be assumed.*

d. *The second sub-bullet also states, "[t]he process consisted of identifying the highest pair of risk contributing targets (i.e., raceways) in a PAU and selecting those as targets for the Junction Box scenario." There is some allowance in the FAQ for assuming that junction boxes are located at routing points but not just generally at any point in a raceway. Provide additional discussion about how failing the two most significant raceways is consistent with the FAQ guidance that junction boxes should be assumed at routing points which may or may not be located in a position to fail two different raceways.*

e. *The second sub-bullet also states that, "The frequency calculation for these scenarios included the generic frequency apportioned to the fire zone and an ignition source weighting factor based upon the length of trays selected as target sets compared to the total length of trays in the fire PAU." Since junction boxes are fires that only fail the equipment in the junction box it is unclear what "length of tray" is associated with target sets. It is also unclear why cable tray length can be substituted for number of junction boxes or even number of cables. Finally, it would seem that the PAU frequency, rather than the zone frequency, would be modified by the ratio of junction box or cable number for the target set to the PAU. Provide additional discussion about how the PAU frequency is assigned to each junction box location.*

RESPONSE:

<u>Response to Part a:</u>

The Fire Probabilistic Risk Analysis (Fire PRA) has some physical analysis units (PAUs) that were evaluated by a single Full Compartment Burn scenario. In the TVA response to PRA RAI 01.r (TVA letter dated December 20, 2013), the first bullet (i.e., Full compartment burn scenarios:) discussion addressed the PAUs that are modeled as full compartment burns. The response to PRA RAI 01.r states in the first bullet discussion, "The ignition frequency for these scenarios was the sum of the contribution from each of the ignition sources assigned to the PAU." The risk contribution of PAUs modeled as full compartment burn scenarios is calculated by multiplying the sum of the frequencies associated with all the ignition sources in the PAU times the conditional core damage probability (CCDP) or conditional large early release probability (CLERP) obtained from failing all the targets mapped to the PAU. These full compartment burn scenarios include the frequency contribution of junction boxes (Bin 18) as apportioned to the PAU.

Each PAU was evaluated based on core damage frequency (CDF) and large early release frequency (LERF) to determine if appropriate risk results were achieved or if detailed fire scenario analysis within the PAU was necessary for risk reduction purposes. PAUs modeled as full compartment burn were not subdivided into multiple scenarios if the resulting PAU CDF and LERF values were lower than 1.0E-08/year (yr) and 1.0E-09/yr, respectively.

<u>Response to Part b:</u>

The difference between the first bullet under "Fire Scenarios" heading and the "Full compartment burn scenarios" heading in the TVA response to PRA RAI 01.r is the level of resolution in the scenario definition. Specifically, the first heading refers to "full compartment burn scenarios." These are PAUs in the Fire PRA where no detailed analysis has been conducted (i.e., multiple fire scenarios within the PAU with separate target sets are not specified for the ignition sources identified in the PAU). The risk contribution of full compartment burn scenarios is calculated as described in the response to Part a of this RAI.

In contrast, the first bullet under the "Fire Scenarios" heading in the TVA response to PRA RAI 01.r refers to the group of PAUs that received more detailed analysis where multiple fire scenarios have been defined and quantified within a PAU. Fire scenarios for the different ignition sources identified in the PAU have been quantified, including scenarios associated with junction boxes. There are some PAUs within this group where the target set for junction box or self-ignited cable fires scenarios are the only ignition source within the PAU postulated as full compartment burns. That is, in some PAUs where multiple fire scenarios have been defined and quantified, the risk associated with the junction box and self-ignited cable fires scenarios is calculated by multiplying the ignition frequency of junction box and self-ignited cable fires apportioned to the PAU by the CCDP (or CLERP) resulting from failing all the targets in the PAU. This approach is only performed in PAUs where the resulting risk values are relatively low when compared to scenarios associated with other ignition sources within the PAU.

Response to Part c:

For all PAUs, the fire ignition frequency of the self-ignited cable fires and junction box fires are assigned to the same target sets. Therefore, junction box fires utilize the same CCDP as the self-ignited cable fires. The risk contribution of the junction box fire scenarios is expected to be significantly reduced by the Fire PRA frequently asked question (FAQ) 13-0005 update, as discussed in the TVA response to PRA RAI 19.b.01.a in this enclosure.

Consistent with Fire PRA FAQs 13-0005 and 13-0006, based on risk contribution, the self-ignited cable fires and junction box scenarios are refined by an iterative process to reduce the risk contribution of these scenarios until the risk is low enough to meet the PRA objective. The criteria for determining whether a junction box fire scenario would be evaluated for further refinement is based on meeting the Fire PRA objective of refining scenarios to a CDF of less than or near 1E-07/yr and a LERF or less than or near 1E-08/yr. Scenarios that do not meet this criteria have been or will be evaluated further for refinement.

The iterative approach used is consistent with the quantitative screening guidelines in Chapter 7 of NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities," and the screening techniques recommended in FAQ 13-0006, Section 3.2 "Preliminary Analysis" for establishing a conservative CCDP for the first screening level.

For all PAUs, junction box fire scenarios have been modeled in the updated model using one of the following methods:

1. Because of the relatively low frequency of junction boxes and self-ignited cable fires, the CCDP of the full compartment is used as a conservative surrogate for consequences to produce relatively low risk contribution. This is consistent with the general approach of developing a Fire PRA where all targets in a PAU are initially conservatively mapped to all fire scenarios for the purpose of determining if additional fire modeling refinements are necessary.

2. For PAUs where the application of method 1 did not meet the PRA objective, the cable fire and junction box fire scenarios were refined in the updated PRA model by an iterative process to reduce the risk contribution of these scenarios until the risk is not overly conservative. A target set for these scenarios was developed using the zone of influence of a cable tray fire (per the guidance of Appendix R, section R.1 of NUREG/CR-6850). This resulted in multiple trays and/or conduit (depending on the raceway configuration of the PAU) being assumed damaged. This was the guidance available at the time of the License Amendment Request (LAR) development when neither Fire PRA FAQ 13-0005 nor FAQ 13-0006 were available.

   For all PAUs, with the exception of Fire Compartments 16-A and 25-1, this level of refinement, if necessary, is expected to result in sufficiently low risk contribution for junction box fires that meet the PRA objectives, such that further analysis is not warranted.

3. PAU 16-A comprises the Main Control Room (MCR) and the Cable Spreading Room (CSR). In the MCR and the CSR, junction box fire scenarios use the same target sets as the self-ignited cable fire scenarios. The cable fire frequency was apportioned between the MCR and the CSR based on the cable tray length ratio within each room.

This is consistent with the NUREG/CR-6850, Chapter 6 bin frequency apportionment process.

As described in the TVA response to PRA RAI 17.d (in TVA letter dated February 13, 2014), the cable fire scenarios in the LAR model for the MCR were divided by unit and conservatively assumed damage to all cable trays located in that unit's MCR. However, the PRA model has been updated since the LAR to incorporate the guidance of Fire PRA FAQ 13-0005 for Unit 1 (Units 2 and 3 did not necessitate further refinement). The risk values for these scenarios in the MCR either currently meet the risk objective of being less than or near 1E-07/yr for CDF and 1E-08/yr for LERF, or will be evaluated further for refinement.

In the CSR portion of PAU 16-A, junction box fire scenarios also use the same target sets as the self-ignited cable fire scenarios. As with the Unit 1 MCR, the PRA model for the CSR has been updated since the LAR to incorporate the guidance of Fire PRA FAQ 13-0005. The scenarios assume that the fire damages one of the top 25 most risk significant cable trays in each unit of the CSR.

Because the target set for each scenario includes at least one cable tray, this is considered bounding of any actual fire damage that could be caused by a junction box fire. Although the target set for scenarios that represent junction box fires in PAU 16-A is conservative, the risk values of these scenarios either currently meet the risk objective of being less than or near 1E-07/yr for CDF and 1E-08/yr for LERF, or will be evaluated further for refinement. TVA considers this to be appropriate and consistent with the intent of Fire PRA FAQ 13-0006.

4. PAU 25-1 comprises the 550' elevation of the Intake Pumping Station, the Cable Tunnels up to door 440, and the 565' Condenser Circulating Water (CCW) Pump Deck, excluding the A and C Residual Heat Removal Service Water (RHRSW) Rooms. In PAU 25-1, junction box fire scenarios were developed that analyze self-ignited cable fires, and junction box fires.

   The target set for these scenarios was developed using the zone of influence of a cable tray fire (per the guidance of Appendix R, section R.1 of NUREG/CR-6850). This was the guidance available at the time of the LAR development, when neither Fire PRA FAQ 13-0005 or FAQ 13-0006 were available. This results in multiple trays and conduit being assumed damaged. Two of the scenarios were limited to a single cable tray due to the presence of cable coating material. Using one tray as the target set for these scenarios is consistent with the Fire PRA FAQ 13-0005 process for cable fires.

   Because the target set for each scenario includes at least one cable tray, this is considered bounding of any actual fire damage that could be caused by a junction box fire. Although the target set for scenarios that represent junction box fires in PAU 25-1 is conservative, the risk values of these scenarios either currently meet the risk objective of being less than or near 1E-07/yr for CDF and 1E-08/yr for LERF, or will be evaluated further for refinement. TVA considers this to be appropriate and consistent with the intent of Fire PRA FAQ 13-0006, Section 3.2 "Preliminary Analysis" for establishing a conservative CCDP for the first screening level.

<u>Response to Part d:</u>

Although some of the target sets for scenarios that represent junction box fires may be conservative (as detailed in the response to Part c of this RAI), the risk values of these scenarios either currently meet the risk objective of being less than or near 1E-07/yr for

CDF and 1E-08/yr for LERF, or will be evaluated further for refinement. TVA considers this to be appropriate and consistent with the intent of Fire PRA FAQ 13-0006.

The iterative approach used is consistent with the screening techniques recommended in FAQ 13-0006, Section 3.2 "Preliminary Analysis" for establishing a conservative CCDP for the first screening level.

Response to Part e:

With respect to the calculation for junction box frequency, TVA would like to clarify the following:

- The frequency of junction box fires is apportioned using the "PAU" frequency and not "fire zone." The term "fire zone" is a term that is used in FAQ 13-0006 and was an error in the PRA RAI 01.r response. A revised response to PRA RAI 01.r is provided in Enclosure 2 of this letter.

- Consistent with Chapter 6 of NUREG/CR-6850, TVA used a process for apportioning the generic (i.e., plant wide) junction box frequency based on a cable loading ratio in the different PAUs within the scope of the Fire PRA. Chapter 6 of NUREG/CR-6850 recommends on page 6-17 that "The number of junction boxes in an area may be difficult to determine. The frequency can be apportioned based on ratio of cable in the area to the total cable in the plant. Therefore, the ignition source-weighting factor of the cables may be used for this bin, as well." TVA did not identify and count the junction boxes in any PAUs.

- Section 3.1 of FAQ 13-0006 states that the process for apportioning the generic junction box fire ignition frequency based on the amount of cable (e.g., cable loading, number of cables, cable lengths) in the different PAUs within the scope of the Fire PRA remains a valid approach and the clarifications and recommendations presented in the FAQ are alternative methods.

- In all but two PAUs, the resultant PAU ignition frequency for junction box fires is mapped to a single target set (as discussed above in the response to Part c), and no further frequency adjustment is applied for these PAUs.

- For two PAUs (16-A and 25-1), a frequency adjustment factor was applied to the PAU junction box frequency. This frequency adjustment factor used length of trays within the PAU as a representative ratio of cables and as a surrogate for the ratio of junction boxes. This is discussed in more detail below.

    - PAU 16-A comprises the MCR and the CSR. In the MCR and the CSR, junction box fire scenarios use the same target sets as the self-ignited cable fire scenarios. The cable fire frequency was apportioned between the MCR and the CSR based on the cable tray length ratio within each room. This is consistent with the Chapter 6 of NUREG/CR-6850 bin frequency apportionment process.

      As described in the TVA response to PRA RAI 17.d, the cable fire scenarios in the LAR model for the MCR were divided up by unit and conservatively assumed damage to all cable trays located in that unit's MCR. However, the PRA model has since been refined to incorporate the guidance of Fire PRA FAQ 13-0005 for Unit 1 (Units 2 and 3 did not necessitate further refinement). For Unit 1, three scenarios were developed and these scenarios now only assume damage to one of the three cable trays for each Unit. The frequency adjustment factor for these three scenarios is based on the ratio of cable length. All cable tray length in the PAU is included in the denominator of the ratio calculation. The length of the respective tray in each of the three scenarios is the numerator in the ratio calculation. The risk values for these scenarios in the MCR either currently meet the risk objective of being less than or near 1E-07/yr for CDF and 1E-08/yr for LERF, or will be evaluated further for refinement.

In the CSR portion of PAU 16-A, junction box fire scenarios use the same target sets as the self-ignited cable fire scenarios. For these scenarios, a frequency adjustment factor was used based on the ratio of cable tray length. A CCDP was calculated for all cable trays in the PAU, however, due to the large number of scenarios only the top 25 most risk significant cable trays in each unit of the CSR were used in the analysis. All cable tray length in the PAU is included in the denominator of the ratio calculation. The portion of tray in each of the 25 scenarios is the numerator of the ratio calculation. The 25^{th} scenario includes the remaining cable tray length to capture all cable trays that have a CCDP that is equal to or less than the 25^{th} cable tray CCDP.

The cable trays and conduits in the CSR portion of PAU 16-A are uniformly distributed throughout the floor area. Therefore, the use of cable tray length as an apportioning factor is reasonable. This is consistent with the guidance in Fire PRA FAQ 13-0006. Because the target set for each scenario includes at least one cable tray, this is considered bounding of any actual fire damage that could be caused by a junction box fire. As discussed above, all scenarios are considered bounding of junction box fires.

- In PAU 25-1, junction box fire scenarios use the same target sets as the self-ignited cable fire scenarios. The frequency adjustment factor for these junction box fire scenarios is based on the ratio of cable length. All cable tray length in the PAU is included in the denominator of the ratio calculation. The portion of tray in each of the junction box fire scenarios is the numerator of the ratio calculation.

  The target set for these scenarios was developed using the zone of influence of a cable tray fire (per the guidance of Appendix R, section R.1 of NUREG/CR-6850). This results in multiple trays and conduit being assumed damaged. Two of the scenarios were limited to a single cable tray due to the presence of cable coating material. Using one tray as the target set for these scenarios is consistent with the Fire PRA FAQ 13-0005 process for cable fires.

  Because the target set for each scenario includes at least one cable tray, this is considered bounding of any actual fire damage that could be caused by a junction box fire. Because these scenarios combine to incorporate the full junction box PAU frequency, and the targets set are considered bounding of junction box fires for each scenario, the frequency adjustment factor that is based on cable length is not important to junction boxes.

Although the target set for scenarios that represent junction box fires is conservative, the risk values of these scenarios either currently meet the risk objective of being less than or near 1E-07/yr for CDF and 1E-08/yr for LERF, or will be evaluated further for refinement. TVA considers this to be appropriate and consistent with the intent of Fire PRA FAQ 13-0006.

PRA RAI 04.01

By letter dated February 13, 2014, (ADAMS Accession No. ML14055A305), the licensee responded to PRA RAI 04 stating that main control room (MCR) abandonment due to loss of control is assumed for fire compartments 16-A, 16-K, 16-M and 16-O, if fire damage alone leaves no available Nuclear Safety Capability Assessment (NSCA) safe shutdown success path.

a. Clarify the basis for this assumption. In doing so, discuss how the criteria to abandon due to loss of control assumed by the Fire PRA is modeled in the compliant and going-forward fire PRA (if different).

b. Describe the cues used by operators to abandon the MCR, including how the timing of these cues are determined and modeled.

Note that there is currently no accepted guidance on crediting MCR abandonment due to loss of control and that absent an acceptable analysis, the staff will not accept credit for this particular type of recovery. An alternative, appropriate method is to not credit MCR abandonment due to loss of control and resolve variance from deterministic requirements (VFDRs) in the compliant case (e.g., by setting associated recovery actions in the variant case to be successful).

RESPONSE:

TVA acknowledges that there is currently no generic NRC-accepted guidance on crediting MCR abandonment due to loss of control. However, TVA is aware of the series of drafts of Fire PRA FAQ 14-0002 that discussed loss of control, the associated white papers, and the ongoing RAI response discussions with other licensees regarding this topic. TVA is revising the modeling of MCR abandonment on loss of control to be consistent with the drafts and the ongoing RAI response discussions. TVA's intent is for this to constitute an acceptable analysis method. As such, there is no plan to implement the alternative method identified in this RAI. The following is a description of the original and revised MCR abandonment modeling used for the Fire PRA.

As a general overview, the original modeling approach used in support of the LAR and reflected in the TVA response to RAI 04 (in TVA letter dated February 13, 2014) was to generate a CCDP and CLERP for each scenario external to the fault tree model itself in a spreadsheet. The CCDP/CLERP was not conditional on the frequency of the fire scenario, but rather on the frequency of the fire scenario times the conditional probability that the scenario would lead to abandonment (i.e., the PRA model calculated the frequency of abandonment, and the conditional probability of failing to successfully complete the required actions to effect an orderly shutdown given that abandonment had occurred was calculated externally). This CCDP/CLERP was then appended to the frequency of abandonment.

The revised approach TVA is implementing will eliminate the use of the spreadsheet to calculate the CCDP/CLERP externally and replace it with fully integrated MCR abandonment logic in the fault tree model. The remainder of the response to this RAI is given in the context of the revised modeling.

a. As noted in the RAI, the original model assumed that the MCR is always abandoned on a loss of control (i.e., the decision to abandon was always successful, and only failure of execution actions was considered in the CCDP). In the revised model, a cognitive human failure event (HFE) will be incorporated into the model that will represent "Failure to Abandon the MCR in Time to Effect Orderly Shutdown on Loss of Control." This will be used in both the compliant and variant (i.e., post-transition) Fire PRA. Because failure of this new cognitive HFE means that an orderly shutdown cannot be achieved, it will be modeled in the Fire PRA as resulting in core damage. This will be modeled such that this HFE will be added to the cutsets for the loss of control scenario whenever the scenario is within the capabilities of the backup control panel and the abandonment procedures. That is, any cutset where the fire-induced damage or random failures create a situation where the use of the abandonment procedure cannot successfully achieve orderly shutdown due to the presence of the fire-induced damage or random failures will not receive abandonment credit, and will be taken directly to core damage.

b. TVA is revising its MCR abandonment procedure for the loss of control case. The revised abandonment procedure has not been written yet, but the approach will be to incorporate symptom-based, risk-informed cues for making the decision on when to abandon. For the purposes of modeling loss of control, the Fire PRA will use a risk-informed entry condition approach that contains the following cues for crediting abandonment for risk significant loss of control scenarios.

- A fire alarm is received or indicates a fire has occurred in fire compartment 16-A, 16-K, 16-M, or 16-O

  AND

- Visual confirmation that a severe fire has occurred (i.e., the fire brigade reports that the fire is severe and that they do not feel they can stop it from affecting large numbers of cable trays)

  AND

- Inability to monitor, restore, and maintain reactor vessel water level from the main control room

The specific details of the loss of control cues will be developed during the process of revising the procedure, but TVA considers the list above as a sufficient basis for developing the required human error probability (HEP).

c. The HEP for the cognitive HFE discussed in Part a above will be determined by considering these cues. Because the issue is not whether the MCR is ever abandoned, but whether it is abandoned in time, the timeline will be established (using the revised procedure) as follows:

- Existing thermal-hydraulic analysis has been used to determine how long the operators have to establish cooling. This will be the total time in the cognitive HFE assessment.

- Existing operator interviews and walkthroughs that have been performed to determine how long it takes to complete the necessary execution actions following abandonment will be incorporated into the cognitive HEP model. This will be the execution time in the cognitive HFE assessment.

- Operator interviews, simulator runs, and walkthroughs will be used to determine how long it takes to reach the point in the procedure where abandonment is considered and how long it would take from receipt of a fire alarm to perform the visual observation. The longer of these two will be taken as the delay time in the cognitive HFE assessment.

- Operator interviews and simulator runs will be used to determine the time taken for the diagnosis once the delay time has ended. This will be used to develop the median cognition time in the cognitive HFE assessment.

Simulator exercises to observe the diagnosis process will be conducted after the operators are trained on the revised procedure. If necessary, additional improvements will be made to training and procedures to assure that the risk acceptance criteria are met. As with all other key inputs used in the Fire PRA, the symptoms, cues and timing inputs into the analysis of the cognitive HFE will be verified during the implementation phase, using the final version of the procedure, prior to using the Fire PRA for self-approval. This commitment is identified in LAR Attachment S, "Modifications and Implementation Items," Table S-3, "Implementation Items," Item 33.

In summary, implementing the approach discussed above is within the current capabilities of both PRA modeling and Human Reliability Analysis (HRA) quantification techniques and is consistent with both draft industry guidance and recent discussions of RAI responses with NRC on other plants. Thus, it constitutes an acceptable approach for calculating delta risk for these scenarios. Therefore, the alternative method mentioned in the RAI is not necessary.

PRA RAI 04.c.01

In the letter dated February 13, 2014, the licensee's response to 04.c states the largest CCDP following MCR abandonment is reported to be 0.351. CCDP's of 1.0 are generally used in some infrequent fire scenario where, for example, large MCR fires cause multiple structure system and component (SSC) failures and spurious operations such that the likelihood of successfully shutting down the plant is very low. Describe how such large MCR fires were evaluated that would support the estimated maximum CCDP of 0.351?

RESPONSE:

As noted in this RAI, the TVA response to RAI 04.c (in TVA letter dated February 13, 2014) reported a maximum CCDP of 0.351. The response further explained the approach that was used to implement the abandonment modeling in the Fire PRA. That approach was more sophisticated than the majority of Fire PRAs for other licensees because it developed a CCDP for each abandonment scenario based on the specific characteristics of the scenario rather than developing a few CCDPs and applying them to broad bins of scenarios. This latter approach, implemented by most licensees, results in the need to insert some conservatism because the CCDP needs to bound the potential worst case characteristics of the scenarios in the bin, which will be conservative for the other scenarios in the bin. Because the approach used in the BFN Fire PRA considers each abandonment scenario individually, the CCDPs are scenario specific and reflect variables such as fire size and extent of fire damage without having to use a bounding approach.

TVA is currently revising the modeling of MCR abandonment as described in the TVA response to PRA RAI 04.01 in this enclosure. This revision, which is further discussed in our responses to PRA RAI 04.k.01 and PRA RAI 04.l.01, both in this enclosure, will result in changes in the MCR Abandonment CCDPs. When the calculation is completed, the updated CCDPs will be provided with the updated risk results as part of the combined/integrated analysis requested in PRA RAI 24 Part a, along with an explanation of the CCDP values, as needed. In order to promote a complete understanding of the frequencies of core damage resulting from abandonment cases, there will be four values (one frequency and three probabilities) reported for each case considered, based on the following construct.

CDF = Fs * CCDP

CCDP = CLOHP * CAFP, or

CCDP = CLOCP * CAFP

Where:

CDF = Core Damage Frequency

Fs = Frequency of the Fire Scenario (the frequency that the fire starts in a particular ignition source and affects a particular set of targets based on the scenario)

CCDP = Conditional Core Damage Probability (probability of core damage given the occurrence of the fire scenario)

CLOHP = Conditional Loss of Habitability Probability (probability that the scenario leads to a loss of habitability of the control room, requiring abandonment – applies to fire in the control room only)

CLOCP = Conditional Loss of Control Probability (probability that the scenario leads to a loss of control from the control room, requiring abandonment – applies to fires in the four Control Building areas cited in RAI PRA 04.01).

CAFP = Conditional Abandonment Failure Probability (probability that achieving safe shutdown fails given that abandonment is required).

For large early release (LER), CDF becomes LERF and CCDP becomes CLERP.

TVA will prepare a control room abandonment results table providing the following information regarding core damage results.

For Loss of Habitability Scenarios:

- The total ignition frequency of the scenarios that have the potential to lead to loss of habitability
- The range of CLOHP values for these scenarios
- The range of CAFP values for these scenarios
- The range of CCDP values for these scenarios
- The total CDF for loss of habitability

For Loss of Control Scenarios:

- The total frequency of scenarios that can lead to loss of control for three cases:
  - Scenarios where the MCR should be abandoned on loss of control, but either the operators fail to abandon or operators fail to shut down the plant successfully, despite of the availability of all of the required equipment outside the MCR (i.e., at the remote shutdown panel or at other locations in the plant)
  - Scenarios where the MCR is abandoned due to a loss of control and the remote shutdown still fails due to a loss of equipment (either fire-induced or random) that is required to be available for remote shutdown.
  - Scenarios where the conditions created by the fire-induced failures are beyond the capability of the alternate shutdown equipment or procedures (i.e., even if the operators follow the abandonment procedure correctly and all the equipment they actuate functions properly, successful shutdown cannot be achieved)
- The total frequency of all scenarios that can lead to loss of control. This value is not equal to the sum of the values from the three loss of control abandonment cases mentioned above, because there would be double counting involved. The reason for the double counting is that there is not necessarily a one-to-one correspondence between each scenario and those cases. That is, any given scenario could have two or three possible outcomes if there are failure probabilities involved rather than just direct fire failures (e.g., some cutsets could lead to failure due to human actions, some cutsets could lead to failure due to equipment failures, and some cutsets could lead to failure due to conditions beyond the capability of alternate shutdown). Therefore, that scenario frequency would appear in all three lists.
- The range of CLOCP values across all of these scenarios.
- The range of CAFP values for the first and second cases above.

  - For the first case, the CAFP value for any given scenario will be the sum of the HEPs (or dependent HEP terms) that appear in the cutsets for the scenario, and the range will be the smallest and largest sum across all scenarios.
  - For the second case, the CAFP value for any given scenario will be the sum of the equipment failure probabilities (or probabilities of failure combinations) of the equipment required for achieving successful remote shutdown that appear in the cutsets for the scenario. These could be random failures or fire-induced failures. If a cutset exists that contains only direct fire-induced failures (i.e., the fire causes loss of control AND fails a function essential to alternate shutdown), the CAFP would be 1.0. The range will be the smallest and largest sum across all scenarios.
  - For the third case, CAFP is (by definition) 1.0.

- The range of CCDP values for all three cases.

- The total CDF for loss of control for the same three cases, and total for all loss of control scenarios.

The equivalent information will be supplied for Large Early Release.

Given this construct, when a detailed MCR model is fully integrated into the Fire PRA fault trees (as TVA is in the process of doing) CAFP is the metric of interest because it is equivalent to what the plants using a simplified approach have been reporting as the CCDP. TVA will determine whether there are any CAFP values of 1.0 (that is, are there any scenarios at BFN where abandonment is the only way of successfully shutting down the plant, and the conditions are such that following the abandonment procedure will not achieve the goal of avoiding core damage). If there are no scenarios with CAFP values of 1.0, TVA will provide additional detail explaining and justifying why such a result is reasonable.

Updated risk results including the results of this analysis will be provided as part of the combined/integrated results in response to PRA RAI 24 Part a.

PRA RAI 04.k.01

In the letter dated February 13, 2014, the licensee's response to PRA RAI 04.k suggests that dependencies between alternate shutdown actions were not addressed because the two credited shutdown paths are independent from a systems perspective. Provide justification for the assumption that all alternate shutdown actions are independent. If such actions are found to exhibit dependency, provide updated risk results as part of the integrated analysis requested in PRA RAI 24 Part A, addressing identified dependencies.

RESPONSE:

The TVA response to PRA RAI 04.k (in TVA letter dated February 13, 2014) discussed that the dependencies in the MCR abandonment model were considered to be negligible because failure of any one modeled abandonment action was assumed to fail the entire Compartment 16 Safe Shutdown Instruction (SSI) for a safe shutdown train. The MCR abandonment model that addresses alternate shutdown actions is being updated, as discussed in the response to PRA RAI 04.01 in this enclosure, including the definition of HFEs. As part of these updates, dependencies are being evaluated to ensure that any contribution, however negligible, is included in the risk results. An HFE is being added to address the cognitive error to abandon the main control room and to capture the major dependency between the subsequent execution errors. An HRA dependency analysis for these alternate shutdown actions is also being performed, based on the execution HFE timing and locations and the way these actions are being placed in the MCR abandonment model. The dependency analysis will account for the fact that all operator actions are directed by the same procedure during the same coordinated effort.

Updated risk results including this dependency analysis will be provided as part of the combined/integrated results in response to PRA RAI 24 Part a.

PRA RAI 04.l.01

In the letter dated February 13, 2014, the licensee's response to PRA RAI 04.l states that component random failure probabilities for the backup control panel shutdown path were "ignored" and notes that such failures are small in comparison to human error probabilities (HEPs) credited for MCR abandonment.

a. *Given that no quantitative basis for excluding random failure probabilities is provided, confirm that the contribution of each respective random failure mode omitted from the Fire PRA results meets the criteria for exclusion provided by SR SY-A15 of ASME/ANS-RA-Sa-2009 or any other appropriate method.*

b. *Alternatively, provide updated risk results as part of the integrated analysis requested in PRA RAI 24 Part A, accounting for random failures.*

RESPONSE:

In the prior response to RAI 04.l (in TVA letter dated February 13, 2014), TVA stated that the Fire PRA model included random failures for the Emergency High Pressure Makeup (EHPM) pump and hardened wetwell vent shutdown path, and ignored other possible random failures because they are small in comparison to the human error probabilities. As discussed in the response to RAI 04.01 (in this enclosure), TVA is updating the MCR abandonment model. As part of that update, rather than providing a quantitative basis for excluding the failures, TVA is incorporating the previously excluded equipment failures that could affect the ability to achieve safe shutdown following abandonment. This includes the random and fire-induced failures of the shutdown panel itself as well as failure of the equipment operated from the panel or locally in the field as part of the abandonment shutdown process that would affect the safe shutdown path. TVA will provide updated risk results as part of the combined/integrated analysis requested in PRA RAI 24 Part a, accounting for random failures.

PRA RAI 10.c.01

In a letter dated March 14, 2014, (ADAMS Accession No. ML14079A159) the licensee's response to PRA RAI 10.c indicates that an unavailability and unreliability value of 2.0E-02 is applied to the to-be-installed total-flooding, clean agent system credited in the cable spreading room. While justification is provided as to why values in "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities, Final Report" (ADAMS Accession No. ML052580075) (NUREG/CR-6850) for gaseous suppression systems may not be applicable, the response does not provide a basis for the value of 2.0E-02. Given the large risk impact of using 5.0E-02 noted by the sensitivity study provided in Section V.2.4 of the license amendment request (LAR), as supplemented, provide technical justification for the chosen system unavailability and unreliability.

RESPONSE:

The unavailability and unreliability value of 2.0E-02 applied for the non-detection portion of the proposed clean agent system is based on the United Facilities Criteria (UFC) 3-601-02. UFC 3-601-02 provides an Inspection, Testing, and Maintenance (IT&M) program for achieving 99% system performance. UFC 3-601-02 references U.S. Air Force: Headquarters Air Force Civil Engineer Support Agency Operations and Programs Support Division (AFCESA/CES) Technical Report 01-10, which provides a system availability and reliability of 0.99 for total-flooding clean agent systems. This 0.99 value includes the detection capability of the system.

The IT&M program provided in UFC 3-601-02 is consistent with NFPA and manufacturer requirements and frequencies. Therefore, a total-flooding clean agent system, including the detection system components, when designed and installed per NFPA 2001, Standard for Clean Agent Fire Extinguishing Systems (2012) and maintained in accordance with NFPA and manufacturer requirements is capable of achieving a 0.99 availability and reliability value. For the Fire PRA, TVA used the value of 2.0E-02 for the suppression system components and a value of 1.0E-02 for the detection system components. These values combined provide a conservative value exceeding the value found in the UFC 3-601-02.

An additional representative data point provided in NSAC-179L, Automatic and Manual Fire Suppression Reliability Data for Nuclear Power Plant Fire Risk Analyses, for Halon systems shows a value of 1.6E-02, when not including the detection systems.

In summary, the availability and reliability value of 2.0E-02 represents the non-detection components of the clean agent suppression system, and is conservative with respect to current performance criteria from the UFC. The value also reflects that the new gaseous suppression system and components will be listed/approved by a nationally recognized testing agency, installed in accordance with manufacturer requirements and current codes and standards (which have undergone significant changes over the past 26 years), and will be fully supervised and monitored.

TVA is considering the deletion of one or both of the modifications related to area wide Incipient Detection and automatic gaseous fire suppression in the Cable Spreading Rooms (i.e., LAR, Table S-2, "Plant Modifications Committed," items 78 and 79) as discussed in TVA Letter dated September 16, 2014. The final disposition of these modifications will be reflected in the submittal of updated fire risk results planned for December 17, 2014.

PRA RAI 19.b.01.a

In the letter dated February 13, 2014, the licensee's response to PRA RAI 19.b and as clarified by the BFN Fire Risk Evaluation report, the top risk-significant fire scenarios for the compliant plant in Fire Area 03-03 for Units 1, 2 and 3 are associated with junction box (discussed in the response to PRA RAI 01.r.01) and cable (discussed in the response PRA RAI 17.d) fires. A review of the BFN Fire Risk Evaluation report confirms that similar scenarios, including self-ignited cable fires and cable fires due to welding and cutting, dominate the risk results of other fire areas, presumably because some of these fires are leading to full room burnout. However, as noted in FAQs 13-0005, "Cable Fires Special Cases: Self-Ignited and Caused by Welding and Cutting," and 13-0006 past experimentation and operating experience indicate that the impact of such fires is limited such that only the tray or box of initiation may be assumed as the zone of influence. Other examples of apparently conservative modeling techniques include the assumed failure for all fire scenarios of some components whose cables are not routed (as discussed in the response to PRA RAI 11.a and RAI SSA 14). When introduced into the compliant plant, such conservatisms may produce non-conservative estimates of delta risk because risk-reduction modifications that reduce the risk of scenarios with conservatively high risk estimates will overestimate the magnitude of the actual risk reduction that will be achieved.

a. Explain why normally relatively benign ignition sources, such as junction boxes and self-ignited cable fires, yield high risk estimates. If the contribution to the change in risk from junction boxes and cables fires is not identifiable in the information in the response to subpart iii [c] below, provide the contribution of these two ignition sources to the variant and the compliant pant risk.

RESPONSE:

The treatment of risk significant self-ignited cable fire scenarios has been updated in the BFN fire modeling analysis to follow the guidance in Fire PRA FAQ 13-0005. Based on risk contribution, the self-ignited cable tray fire scenarios are refined by an iterative process to reduce the risk contribution of these scenarios until the risk from these scenarios is not overly conservative. Self-ignited cable fires are no longer assumed to propagate beyond the initial tray, and therefore, the Fire PRA target damage set has been significantly reduced. As such, self-ignited cable fires are no longer expected to yield high risk estimates.

The fire ignition frequency for junction box fires and self-ignited cable fires are combined into single scenarios in the updated model as allowed by Fire PRA FAQ 13-0005. Refer to the TVA response to PRA RAI 01.r.01 in this enclosure for additional discussion on the treatment of junction box fires. The junction box fires initially utilize the same CCDP as the self-ignited cable fires, which is expected to be reduced by the Fire PRA FAQ 13-0005 update. This approach is consistent with Fire PRA FAQ 13-0006. Based on risk contribution, the junction box scenarios are refined by an iterative process to reduce the risk contribution of these scenarios until the risk from these scenarios is not overly conservative. Therefore, junction box fires are no longer expected to yield high risk estimates.

The treatment of self-ignited cable fires and junction boxes is appropriate and will not be overly conservative in the compliant case. The final disposition of junction box fire scenarios 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 the response to PRA RAI 24 Part A.

PRA RAI 19.b.01.b

In the letter dated February 13, 2014, the licensee's response to PRA RAI 19.b and as clarified by the BFN Fire Risk Evaluation report, the top risk-significant fire scenarios for the compliant plant in Fire Area 03-03 for Units 1, 2 and 3 are associated with junction box (discussed in the response to PRA RAI 01.r.01) and cable (discussed in the response PRA RAI 17.d) fires. A review of the BFN Fire Risk Evaluation report confirms that similar scenarios, including self-ignited cable fires and cable fires due to welding and cutting, dominate the risk results of other fire areas, presumably because some of these fires are leading to full room burnout. However, as noted in FAQs 13-0005, "Cable Fires Special Cases: Self-Ignited and Caused by Welding and Cutting," and 13-0006 past experimentation and operating experience indicate that the impact of such fires is limited such that only the tray or box of initiation may be assumed as the zone of influence. Other examples of apparently conservative modeling techniques include the assumed failure for all fire scenarios of some components whose cables are not routed (as discussed in the response to PRA RAI 11.a and RAI SSA 14). When introduced into the compliant plant, such conservatisms may produce non-conservative estimates of delta risk because risk-reduction modifications that reduce the risk of scenarios with conservatively high risk estimates will overestimate the magnitude of the actual risk reduction that will be achieved.

b. Identify generally what functions, systems, and components were assumed to fail with every fire because the routing of cables is not known. The response to Facts & Observations (F&O) 4-25 states that a sensitivity study was performed, TVA Calculation NDN0009992012000016, "TVA Fire PRA-Task 7.15 Uncertainty and Sensitivity Analysis", Revision 0, which restored credit for all of the non-credited systems, and assumed they would never suffer any fire-induced failures. The resulting sensitivity study showed that there is very little risk benefit to pursue routing any of the non-credited systems." Summarize the results of this study.

RESPONSE:

Any system or electrical equipment that is not credited in the Fire PRA (i.e., for which cable routing is not known) is failed during the quantification of the Fire PRA model. These systems and equipment are failed in the worst possible failure mode, including spurious operation.

Systems and equipment not being credited by the Fire PRA (i.e., failed) are:

- Alternate Rod Insertion
- Control Rod Drive Hydraulic System for injection
- Standby Liquid Control System following an Anticipated Transient Without Scram (ATWS)
- Recirculation Pump Trip System
- Recirculation Discharge Valve Closure
- 161 kiloVolt (kV) Electrical Distribution as backup to the 500kV Electrical Distribution
- Reactor Feedwater
- Condenser
- High drywell pressure for automatic closure of the containment isolation valves

The sensitivity study investigated the assumption that no credit should be taken for components without cable routing information, i.e., the equipment listed above is failed in the study. This assumption leads to an overestimation of fire risk, because many of these components may not be failed in many fire scenarios. The sensitivity study assumes that this equipment is subject only to random failure rather than being always failed. This alternate approach leads to an underestimation of fire risk, because some of these components will fail in certain fire scenarios.

This sensitivity study indicates that the lack of cable routing information (i.e., assuming all of the listed equipment fails) has a small (≥1%, <10%) effect on the calculated total fire CDF for each of the three BFN units. Numerical results are shown below based on the Fire PRA post-transition model:

Description	**Sensitivity Analysis Results**[1]			
No fire damage to components for which cable routing is not known	**Unit**	**CDF**	**ΔCDF**	**%ΔCDF**
	U1	6.01E-05	-2.72E-06	-4.3%
	U2	6.36E-05	-2.30E-06	-3.5%
	U3	5.21E-05	-8.71E-07	-1.6%

1. ΔCDF and %ΔCDF are defined as follows: ΔCDF ≡ ($CDF_{sensitivity}$ - $CDF_{basecase}$) and %ΔCDF ≡ (ΔCDF/$CDF_{basecase}$)*100.

PRA RAI 24.b

Section 2.4.3.3 of the NFPA 805 standard incorporated by reference into Title 10 of Code of Federal Regulations (10 CFR) Section 50.48(c) "Fire Protection - Part 50: Domestic Licensing of Production And Utilization Facilities - Code of Federal Regulations - Title 10: Energy," states that the probabilistic safety assessment (PSA) (PSA is also referred to as PRA) approach, methods, and data shall be acceptable to the authority having jurisdiction, which is the NRC. RG 1.205, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants," identifies NUREG/CR-6850, NEI [Nuclear Energy Institute] 04-02, Revision 2, "Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c)," and the ongoing FAQ process as documenting approaches, methods, and data acceptable to the staff for adopting a fire protection program consistent with NFPA 805.

The NRC staff identified several methods and weaknesses that were used in the Fire PRA. RAIs were provided about these methods and weaknesses, and the responses have been reviewed. The staff noted that the justification provided for the methods and weaknesses listed below is not complete.

<u>Methods and weaknesses:</u>

- *PRA RAI 01.f regarding the frequency of MCB scenarios*
- *PRA RAI 01.h.ii regarding the frequency and severity factor of catastrophic turbine generator fires*
- *PRA RAI 01.o regarding treatment of dependency for LERF-related HFEs*
- *PRA RAI 01.r (as clarified by PRA RAI 01.r.01) regarding treatment of junction box fires*
- *PRA RAI 01.s regarding use of quantitative screening criteria consistent with CC-II of SR QNS-C1 as clarified by RG 1.200, Revision 2*
- *PRA RAI 01.v regarding use of minimum joint HEPs*
- *PRA RAI 10 regarding removal of credit for area-wide incipient detection in the auxiliary instrument rooms*
- *PRA RAI 12 regarding scenario-specific timing for emergency depressurization dependent on both fire-induced and random failures*
- *PRA RAI 20 (as clarified by PRA RAI 20.01) regarding credit for existing, non-fire-specific operator actions in the compliant plant*
- *PRA RAI 22.01 regarding estimation of circuit failure probabilities*

The following Fire Modeling RAI appears to have caused changes that may impact the fire-affected components for a variety of fires. The aggregate change-in-risk evaluation should include the potential impact of changes in:

- *FM RAI 01.g regarding treatment of cable spreading room oil spill fires*

The following Fire Protection Engineering RAI appears to have caused changes that may impact risk results. The aggregate change-in-risk evaluation should include the potential impact of changes in:

- *FPE RAI 05 regarding the risk treatment of electrical raceway fire barrier*

The following methods and weaknesses have been identified, but the NRC staff review is continuing with additional RAIs and further supporting information has been requested. Alternatively, the licensee may replace any of these methods and weaknesses with another method by modifying the Fire PRA model.

<u>Methods and weaknesses still under review</u>:

- *PRA RAI 04.01 regarding the credit for MCR abandonment due to loss of control*
- *PRA RAI 04.k.01 regarding dependencies between alternate shutdown actions*
- *PRA RAI 04.l.01 regarding the modeling of random failure probabilities for the backup control panel shutdown path*
- *PRA RAI 10.c.01 regarding the unavailability and unreliability value applied to the total flooding, clean agent suppression system in the cable spreading room*
- *PRA RAI 19.b.01 regarding the apparent dominance of risk scenarios from normally, relatively benign ignition sources (e.g., junction boxes)*

The following methods and weaknesses have been identified for which the NRC staff review is continuing with additional Fire Modeling RAIs that may cause changes that impact the fire-affected components for a variety of fires:

- *FM RAI 01.01 regarding fire propagation in cable trays*
- *FM RAI 02.01 regarding the damage delay time for cables in covered trays*

b. For each method (i.e., each bullet) above, explain how the issue will be addressed in i) the final composite analysis results provided in support of the LAR and ii) the PRA that will be used at the beginning of the self-approval of post-transition changes. In addition, provide a method 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.

RESPONSE:

The following describes how each method (i.e., each bullet) will be addressed in the final composite analysis results provided in support of the LAR and the PRA that will be used at the beginning of the self-approval of post-transition changes:

- PRA RAI 01.f regarding the frequency of Main Control Board (MCB) scenarios: The frequency of MCB fires has been revised and will be included in the composite analysis provided in response to PRA RAI 24 Part a and the PRA that will be used at the beginning of the self-approval of post-transition changes.

- PRA RAI 01.h.ii regarding the frequency and severity factor of catastrophic turbine generator fires: The frequency and severity factor of catastrophic turbine generator fires will be revised and included in the composite analysis provided in response to PRA RAI 24 Part a and the PRA that will be used at the beginning of the self-approval of post-transition changes.

- PRA RAI 01.o regarding treatment of dependency for LERF-related HFEs: Dependency between LERF and CDF actions will be included in the composite analysis provided in response to PRA RAI 24 Part a and the PRA that will be used at the beginning of the self-approval of post-transition changes.

- PRA RAI 01.r (as clarified by PRA RAI 01.r.01) regarding treatment of junction box fires: The treatment of junction box fires is described in the TVA response to RAI 01.r.01 in this enclosure. Based on the technical justifications provided in the response to RAI 01.r.01, the approach is being retained in the fire PRA. As stated in the TVA response to PRA RAI 19.b.01 in this enclosure, TVA has incorporated guidance from Fire PRA FAQs 13-0005 and 13-0006 to reduce the contribution of self-ignited cable fires and junction box fires and these fires are not expected to be significant.

- PRA RAI 01.s regarding use of quantitative screening criteria consistent with CC-II of SR QNS-C1 as clarified by RG 1.200, Revision 2: The quantitative screening criteria has been updated to be consistent with the criteria in NUREG/CR-6850 Task 7 and non-propagating fire scenarios that do not screen will be included in the composite analysis provided in response to PRA RAI 24 Part a and the PRA that will be used at the beginning of the self-approval of post-transition changes.

- PRA RAI 01.v regarding use of minimum joint HEPs: Minimum joint HEPs of 1E-05 for all combinations that do not contain long term decay heat removal actions and 1E-06 for those that do will be included in the composite analysis provided in response to PRA RAI 24 Part a and the PRA that will be used at the beginning of the self-approval of post-transition changes.

- PRA RAI 10 regarding removal of credit for area-wide incipient detection in the auxiliary instrument rooms: Credit has been removed from the Fire PRA for area-wide incipient detection in the auxiliary instrument rooms and updated risk results will be included in the composite analysis provided in response to PRA RAI 24 Part a and the PRA that will be used at the beginning of the self-approval of post-transition changes.

- PRA RAI 12 regarding scenario-specific timing for emergency depressurization dependent on both fire-induced and random failures: The Fire PRA will be revised to consider random failures of high pressure injection when determining the timing for emergency depressurization. This will be included in the composite analysis provided in response to PRA RAI 24 Part a and the PRA that will be used at the beginning of the self-approval of post-transition changes.

- PRA RAI 20 (as clarified by PRA RAI 20.01) regarding credit for existing, nonfire-specific operator actions in the compliant plant: Credit will be given for existing nonfire-specific operator actions taken both internal to and outside of the main control room in the Fire PRA post-transition and compliant plant models and updated results will be included in the composite analysis provided in response to PRA RAI 24 Part a and the PRA that will be used at the beginning of the self-approval of post-transition changes.

- PRA RAI 22.01 regarding estimation of circuit failure probabilities: Updated results estimating the circuit failure probabilities using NUREG/CR-7150 will be included in the composite analysis provided in response to PRA RAI 24 Part a and the PRA that will be used at the beginning of the self-approval of post-transition changes.

- FM RAI 01.g regarding treatment of cable spreading room oil spill fires: The detailed fire modeling analysis has been revised to include cable spreading room oil fires. The results of these fire scenarios will be included in the composite analysis provided in response to PRA RAI 24 Part a and the PRA that will be used at the beginning of the self-approval of post-transition changes.

- FPE RAI 05 regarding the risk treatment of ERFBS [Electrical Raceway Fire Barrier System]: The 1-hour ERFBS without automatic suppression will be treated as a Variance from Deterministic Requirement (VFDR) and resolved with the Fire Risk Evaluation Process. The results of these fire scenarios will be included in the composite analysis provided in response to PRA RAI 24 Part a and the PRA that will be used at the beginning of the self-approval of post-transition changes.

- PRA RAI 04.01 regarding the credit for MCR abandonment due to loss of control: Cognitive failure of the operators to abandon will be included in the Fire PRA. Updated results will be included in the composite analysis provided in response to PRA RAI 24 Part a and the PRA that will be used at the beginning of the self-approval of post transition changes.

- PRA RAI 04.k.01 regarding dependencies between alternate shutdown actions: Dependencies will be included where necessary between alternate shutdown actions. Updated results will be included in the composite analysis provided in response to PRA RAI 24 Part a and the PRA that will be used at the beginning of the self-approval of post-transition changes.

- PRA RAI 04.l.01 regarding the modeling of random failure probabilities for the backup control panel shutdown path: Random failure probabilities for the backup control panel shutdown path will be included in the Fire PRA. Updated results will be included in the composite analysis provided in response to PRA RAI 24 Part a and the PRA that will be used at the beginning of the self-approval of post-transition changes.

- PRA RAI 10.c.01 regarding the unavailability and unreliability value applied to the total flooding, clean agent suppression system in the cable spreading room: Justification has been provided for the unavailability and the unreliability value applied as described in the TVA response to PRA RAI 10.c.01 in this enclosure.

- PRA RAI 19.b.01 regarding the apparent dominance of risk scenarios from normally, relatively benign ignition sources (e.g., junction boxes): The treatment of self-ignited cable fires has been updated to follow Fire PRA FAQ 13-0005 for risk significant cable fires as described in the TVA response to PRA RAI 10.b.01 Part a in this enclosure. Therefore, self-ignited cable fires are no longer expected to be risk significant. The fire ignition frequency of the junction box fires and self-ignited cable fires are combined into one scenario per the guidance of Fire PRA FAQ 13-0006. Because the junction box fires utilize the same conditional core damage probabilities as the self-ignited cable fires, junction box fires are no longer expected to be risk significant either. If junction box fires are significant, they will be investigated to determine if further refinement is needed. Updated results will be included in the composite analysis provided in response to

PRA RAI 24 Part a and the PRA that will be used at the beginning of the self-approval of post-transition changes.

- FM RAI 01.01 regarding fire propagation in cable trays: As described in the TVA response to FM RAI 01.01 (in TVA letter dated June 13, 2014), TVA considered "immediately adjacent" trays consistent with the guidance in FAQ 08-0049. Ignition timing and flame propagation of adjacent stacks was modeled consistent with NUREG/CR-6850. This will be retained in the Fire PRA.

- FM RAI 02.01 regarding the damage delay time for cables in covered trays: As described in the TVA response to FM RAI 02.01 (in TVA letter dated June 13, 2014), all cables that use the delay time guidance in NUREG/CR-6850, Section Q.2.2, are qualified cables. Covered trays containing unqualified cables are credited with a delay time of four minutes. This four-minute delay time is based on the tests whose results are documented in NUREG/CR-0381 "A Preliminary Report on Fire Protection Research Program Fire Barriers and Fire Retardant Coatings Tests." This will be retained in the Fire PRA.

Each change that needs to be made is being tracked by the TVA commitment tracking system. As described in the TVA response to PRA RAI 11.b and 11.c (in the TVA letter dated January 14, 2014), a focused scope peer review will be performed prior to transition to NFPA 805. To ensure this peer review is performed, the TVA response to PRA RAI 11.b and 11.c added Implementation Item 47, to LAR Table S-3. The LAR table requires that certain items be completed prior to the implementation of the NFPA 805 fire protection program. The response to PRA RAI 23.d (in the TVA letter dated March 14, 2014), as corrected in Enclosure 2 to this letter, further revised the proposed Implementation Item 47 provided in the response to PRA RAI 11.b and c to include the LERF Analysis (element LE-C6) as follows: "Perform a focused-scope peer review of the Fire PRA. The peer review will include, as a minimum, the following elements: Fire PRA Cable Selection and Location (CS), Human Reliability Analysis (HRA), Fire Risk Quantification (FQ), Uncertainty and Sensitivity Analysis (UNC), and LERF Analysis (element LE-C6)."

To provide assurance that the focused scope peer review findings will be resolved before self-approval of post-transition changes, this response to PRA RAI 24.b revises the proposed LAR, Table S-3 Implementation Item 47 to require resolution of any focused scope peer review findings as follows: "Perform a focused-scope peer review of the Fire PRA. The peer review will include, as a minimum, the following elements: Fire PRA Cable Selection and Location (CS), Human Reliability Analysis (HRA), Fire Risk Quantification (FQ), Uncertainty and Sensitivity Analysis (UNC), and LERF Analysis (element LE-C6). Any focused scope peer review Finding level Facts & Observations (F&Os) will be resolved prior to self-approval of post-transition changes."

PRA RAI 24.d

Section 2.4.3.3 of the NFPA 805 standard incorporated by reference into Title 10 of Code of Federal Regulations (10 CFR) Section 50.48(c) "Fire Protection - Part 50: Domestic Licensing of Production And Utilization Facilities - Code of Federal Regulations - Title 10: Energy," states that the probabilistic safety assessment (PSA) (PSA is also referred to as PRA) approach, methods, and data shall be acceptable to the authority having jurisdiction, which is the NRC. RG 1.205, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants," identifies NUREG/CR-6850, NEI [Nuclear Energy Institute] 04-02, Revision 2, "Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c)," and the ongoing FAQ process as documenting approaches, methods, and data acceptable to the staff for adopting a fire protection program consistent with NFPA 805.

The NRC staff identified several methods and weaknesses that were used in the Fire PRA. RAIs were provided about these methods and weaknesses, and the responses have been reviewed. The staff noted that the justification provided for the methods and weaknesses listed below is not complete.

<u>Methods and weaknesses:</u>

- *PRA RAI 01.f regarding the frequency of MCB scenarios*
- *PRA RAI 01.h.ii regarding the frequency and severity factor of catastrophic turbine generator fires*
- *PRA RAI 01.o regarding treatment of dependency for LERF-related HFEs*
- *PRA RAI 01.r (as clarified by PRA RAI 01.r.01) regarding treatment of junction box fires*
- *PRA RAI 01.s regarding use of quantitative screening criteria consistent with CC-II of SR QNS-C1 as clarified by RG 1.200, Revision 2*
- *PRA RAI 01.v regarding use of minimum joint HEPs*
- *PRA RAI 10 regarding removal of credit for area-wide incipient detection in the auxiliary instrument rooms*
- *PRA RAI 12 regarding scenario-specific timing for emergency depressurization dependent on both fire-induced and random failures*
- *PRA RAI 20 (as clarified by PRA RAI 20.01) regarding credit for existing, non-fire-specific operator actions in the compliant plant*
- *PRA RAI 22.01 regarding estimation of circuit failure probabilities*

The following Fire Modeling RAI appears to have caused changes that may impact the fire-affected components for a variety of fires. The aggregate change-in-risk evaluation should include the potential impact of changes in:

- *FM RAI 01.g regarding treatment of cable spreading room oil spill fires*

The following Fire Protection Engineering RAI appears to have caused changes that may impact risk results. The aggregate change-in-risk evaluation should include the potential impact of changes in:

- *FPE RAI 05 regarding the risk treatment of electrical raceway fire barrier*

The following methods and weaknesses have been identified, but the NRC staff review is continuing with additional RAIs and further supporting information has been requested. Alternatively, the licensee may replace any of these methods and weaknesses with another method by modifying the Fire PRA model.

<u>*Methods and weaknesses still under review*</u>*:*

- *PRA RAI 04.01 regarding the credit for MCR abandonment due to loss of control*
- *PRA RAI 04.k.01 regarding dependencies between alternate shutdown actions*
- *PRA RAI 04.l.01 regarding the modeling of random failure probabilities for the backup control panel shutdown path*
- *PRA RAI 10.c.01 regarding the unavailability and unreliability value applied to the total flooding, clean agent suppression system in the cable spreading room*
- *PRA RAI 19.b.01 regarding the apparent dominance of risk scenarios from normally, relatively benign ignition sources (e.g., junction boxes)*

The following methods and weaknesses have been identified for which the NRC staff review is continuing with additional Fire Modeling RAIs that may cause changes that impact the fire-affected components for a variety of fires:

- *FM RAI 01.01 regarding fire propagation in cable trays*
- *FM RAI 02.01 regarding the damage delay time for cables in covered trays*

d. If any of the identified methods or weaknesses will be retained in the PRA that will be used to estimate the change in risk of post-transition changes to support self-approval, explain how the quantitative results for each future change will account for the use of the particular method or weakness.

RESPONSE:

The unavailability and reliability value applied to the total flooding, clean agent suppression system in the cable spreading room discussed in the TVA response to PRA RAI 10.c.01 in this enclosure, the treatment of junction box and self-ignited cable fires discussed in the TVA response to PRA RAI 19.b.01 in this enclosure, the treatment of fire propagation between trays discussed in the TVA response to Fire Modeling (FM) RAI 01.01 in TVA letter dated June 13, 2014, and damage timing associated with covered trays described in the TVA response to FM RAI 02.01 in TVA letter dated June 13, 2014, will be retained. The assumptions associated with each will be evaluated as part of the application of the PRA model. No other methods or weaknesses will be retained in the PRA that is used to estimate the change in risk of post-transition changes to support self-approval.

ENCLOSURE 2
Tennessee Valley Authority
Browns Ferry Nuclear Plant, Units 1, 2, and 3

Updated TVA Response to Probabilistic Risk Assessment (PRA) Request for Additional Information (RAI) 01.r and PRA RAI 14.01

PRA RAI 01.r

TVA previously responded to PRA RAI 01.r by letter dated December 20, 2013 (CNL-13-141). As discussed in the TVA response to PRA RAI 01.r.01, part e provided in Enclosure 1 to this letter, TVA has determined that the original response to PRA RAI 01.r contained an error. The below response supersedes the previous response for PRA RAI 14.01. The change from the previous response is shown with deleted text struck through, inserted text in bold, underline, and a revision bar in the right margin.

REVISED RESPONSE

F&O 5-11 states that "more detail needed when saying boxes appear well sealed." As a possible resolution, the peer reviewers suggested that the contribution of junction box fires should be added to the Fire PRA. To resolve the F&O, the contribution of junction box fires was added to the Fire PRA as described below:

- Full compartment burn scenarios. These were scenarios where all the targets in the Physical Analysis Unit (PAU) were assumed to be failed by fire at the time of fire ignition. The Conditional Core Damage Probability (CCDP) for these scenarios was calculated assuming all the targets mapped to the PAU were failed by fire. The ignition frequency for these scenarios was the sum of the contribution from each of the ignition sources assigned to the PAU. The contribution of junction box fires was included in the total frequency assigned to the PAU. Specifically, in the BFN Fire PRA, the frequency contribution of Bin 18 junction boxes was combined (i.e., summed) with the frequency of Bin 12 cable run (i.e., self-ignited cable fires). Therefore, for the full compartment burn scenarios, the frequency contribution from junction boxes was accounted for in the Fire PRA.

- Fire scenarios. For PAUs where fire scenarios were defined, the contribution for junction box fires was accounted for as follows:

    - For selected PAUs, one scenario was added consisting of the sum of the frequency of self-ignited cable fires and junction box fires only and the failure of all the targets in the PAU. This scenario conservatively bounds the risk contribution of junction boxes as the CCDP was calculated assuming failure of all the targets assigned to the PAU.

    - For the remaining PAUs (i.e., those where the conservatisms associated with failing all targets in the PAU had to be refined), the CCDP was re-calculated using the two most risk significant raceways as documented in the BFN Fire PRA Cable Tray Sensitivity evaluation. The process consisted of identifying the highest pair of risk contributing targets (i.e., raceways) in a PAU and selecting those as targets for the Junction Box scenario. This approach was consistent with FAQ 13-0006, "Modeling Junction Box Scenarios in a Fire PRA," as the damage associated with junction box fires was limited to one junction box (i.e., one target). In the BFN evaluation, the approach used is bounding because the BFN evaluation assumed junction box fires damaged two targets, not one target.

The frequency calculation for these scenarios included the generic frequency apportioned to the ~~fire zone~~**PAU** and an ignition source weighting factor based upon the length of trays selected as target sets compared to the total length of trays in the fire PAU.

In summary, the contribution of junction box fires was included in the BFN Fire PRA. The frequency of full compartment burn scenarios included the contribution for junction box fires as apportioned to individual PAUs. For PAUs subdivided into fire scenarios, the contribution of junction box fires was accounted for by either: 1) postulating one scenario per PAU with the sum of the frequencies of self ignited cable fires and junction box fires and the CCDP associated with full room burn, or 2) postulating one scenario with a refined fire ignition frequency that included an ignition source weighting factor and the CCDP associated with the pair of top risk significant targets in the PAU.

PRA RAI 14.01

TVA previously responded to PRA RAI 14.01 by letter dated August 29, 2014 (CNL-14-147). Subsequent to the submittal of the response, the Nuclear Regulatory Commission (NRC) Project Manager for Browns Ferry Nuclear Plant, Units 1, 2, and 3, contacted TVA concerning a possible typographical error in the response. TVA concurred that the typographical error required a revision to the original response. The below response supersedes the previous response for PRA RAI 14.01. The change from the previous response is shown with deleted text struck through, inserted text in bold, underline, and a revision bar in the right margin.

REVISED RESPONSE

LAR Attachment S, Table S-3, Implementation Items 32 and 33 are the TVA commitments to update the Fire PRA model to reflect design modifications and fire response human actions. These two implementation items were revised in the response to PRA RAI 14 in the letter dated January 10, 2014 (ADAMS Accession No. ML14014A088). TVA further revises Implementation Items 32 and 33 as follows to provide a plan of action should the change in risk exceed risk acceptance guidelines.

Implementation Item 32 is revised to read: "Update the Fire PRA ~~HRA (Human Reliability Analysis)~~ model after all modifications are complete (returned to operation) and in their as-built configuration. The update will include a verification of the validity of the reported change in risk on as-built conditions after the modifications are completed. If this verification determines that the risk metrics have changed such that the RG 1.174 acceptance guidelines are not met, the NRC will be notified and additional analytical efforts, and/or procedure changes, and/or plant modifications will be made to assure the RG 1.174 risk acceptance criteria are met."

Implementation Item 33 is revised to read: "Update the Fire HRA **<u>(Human Reliability Analysis)</u>** upon completion of all procedure updates, all modifications and all training. The update will include a verification of the validity of the reported change in risk on as-built conditions after the procedures updates, modifications, and training are completed. If this verification determines that the risk metrics have changed such that the RG 1.174 acceptance guidelines are not met, the NRC will be notified and additional analytical efforts, and/or procedure changes, and/or plant modifications will be made to assure the RG 1.174 risk acceptance criteria are met."

The revised implementation items will ensure that the Fire PRA model and Fire HRA are reviewed when a modification or procedure change is finalized to ascertain deltas from the as-modeled configuration to the as-built, as-operated configuration and to make appropriate updates and that appropriate actions will be taken in the event risk acceptance guidelines are not met. Verification of the validity of the reported risk results will be performed as the Fire PRA model and Fire HRA are updated.

ENCLOSURE 3

Tennessee Valley Authority

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

Summary of BFN NFPA 805 PRA Follow-Up RAI Response Dates

RAI Question Number	**Date and Type of Response**	**Actual Date of Response**
Probabilistic Risk Assessment (PRA) Follow-up RAIs		
PRA 01.r.01	10/7/2014 (90)	CNL-14-172 October 6, 2014
PRA 04.01	10/7/2014 (90)	CNL-14-172 October 6, 2014
PRA 04.c.01	10/7/2014 (90)	CNL-14-172 October 6, 2014
PRA 04.k.01	10/7/2014 (90)	CNL-14-172 October 6, 2014
PRA 04.l.01	10/7/2014 (90)	CNL-14-172 October 6, 2014
PRA 10.c.01	10/7/2014 (90)	CNL-14-172 October 6, 2014
PRA 14.01	9/9/2014 (60)	CNL-14-147 August 29, 2014
PRA 19.a.01	12/17/2014 (162)	Future Letter
PRA 19.b.01.a	10/7/2014 (90)	CNL-14-172 October 6, 2014
PRA 19.b.01.b	10/7/2014 (90)	CNL-14-172 October 6, 2014
PRA 19.b.01.c	12/17/2014 (162)	Future Letter
PRA 20.01	9/9/2014 (60)	CNL-14-147 August 29, 2014
PRA 22.01 - Discussion of method - Updated risk results	9/9/2014 (60) 12/17/2014 (162)	CNL-14-147 August 29, 2014 Future Letter
PRA 24.a	12/17/2014 (162)	Future Letter
PRA 24.b	10/7/2014 (90)	CNL-14-172 October 6, 2014
PRA 24.c	12/17/2014 (162)	Future Letter
PRA 24.d	10/7/2014 (90)	CNL-14-172 October 6, 2014