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

CNL-18-032

March 27, 2018

10 CFR 50.4
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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, 50-296, and 72-052

Subject: Tennessee Valley Authority Response to NRC Request for Additional Information (Set 2) Related to BFN Application to Revise Technical Specification 5.5.12 "Primary Containment Leakage Rate Testing Program" (BFN-TS-497)

References:

1. Letter from TVA to NRC, CNL-17-056, “Application to Revise Technical Specification 5.5.12 ‘Primary Containment Leakage Rate Testing Program’ (BFN-TS-497),” dated August 15, 2017 (ML17228A490)

2. Letter from NRC to TVA, “Browns Ferry Nuclear Plant Units 1, 2, and 3 - Request for Additional Information related to License Amendment Request to Revise Technical Specification 5.5.12 ‘Primary Containment Leakage Rate Testing Program’ (CAC NOS. MG0113, MG0114, AND MG0115; EPID L-2017-LLA-0292),”dated January 25, 2018 (ML18010B055)

3. Letter from TVA to NRC, CNL-18-011, “Tennessee Valley Authority Response to NRC Request for Additional Information Related to BFN Application to Revise Technical Specification 5.5.12 ‘Primary Containment Leakage Rate Testing Program’ (BFN-TS-497),” dated February 5, 2018 (ML18036A901)

By letter dated August 15, 2017 (Reference 1), Tennessee Valley Authority (TVA) submitted a License Amendment Request (LAR) to the Nuclear Regulatory Commission (NRC) to revise Browns Ferry Nuclear Plant Units 1, 2, and 3 (BFN) Technical Specification 5.5.12 “Primary Containment Leakage Rate Testing [ILRT] Program,” to adopt Nuclear Energy Institute (NEI) 94-01, Revision 3-A, “Industry Guideline for Implementing Performance-Based Option of Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix J,” as the implementation document for the performance-based Option B of 10 CFR Part 50, Appendix J.

In Reference 2, the NRC transmitted a Request for Additional Information (RAI) related to the Reference 1 LAR. As described in the Reference 2 letter, TVA would provide responses to selected RAIs by February 5, 2018. In Reference 3, TVA provided those responses. Enclosure 1 to this letter contains TVA's response to the remaining RAIs that were due by March 27, 2018.

Consistent with the standards set forth in 10 CFR 50.92(c), TVA has determined that the additional information, as provided in this letter, does not affect the no significant hazards determination associated with the request provided in Reference 1.

There are no new regulatory commitments contained in this submittal. If you have any questions concerning this submittal, please contact Ed Schrull at (423) 751-3850.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 27th day of March 2018.

Sincerely,

Joseph W. Shea
Vice President, Nuclear Regulatory Affairs and Support Services

Enclosure:

TVA Response to NRC Request for Additional Information

cc (Enclosures):

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 Public Health

By letter dated August 15, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17228A490), Tennessee Valley Authority (TVA or the licensee) submitted a license amendment request (LAR) for Browns Ferry Nuclear Plant (BFN or Browns Ferry) Units 1, 2, and 3. The proposed amendment would revise Browns Ferry's Technical Specification (TS) 5.5.12 "Primary Containment Leakage Rate Testing Program," by adopting Nuclear Energy Institute (NEI) 94-01, Revision 3-A, "Industry Guideline for Implementing Performance-Based Option of 10 CFR [Title 10 of the Code of Federal Regulations] Part 50, Appendix J," as the implementation document for the performance-based Option B of 10 CFR Part 50, Appendix J. The proposed changes would allow the licensee to extend the Type A containment Integrated leakage rate testing (ILRT) interval from 10 to 15 years and the Type C local leakage rate testing (LLRT) interval from 60 to 75 months.

The U.S. Nuclear Regulatory Commission (NRC) staff from Probabilistic Risk Assessment (PRA) Licensing Branch A (APLA) reviewed the information provided by TVA and determined that additional information as discussed below is needed to complete its review.

<u>APLA RAI 01</u>

In the license amendment request (LAR) dated August 15, 2017 (ML 17228A490) the licensee specified that the risk assessment evaluation performed to support the proposed change follows the guidelines of NEI 94-01, Revision 3-A "Industry Guideline for Implementing Performance-Based Option of 10 CFR Part 50, Appendix J, dated July 2012 (ML12221A202) and the EPRI Report 1018243,"Risk Impact Assessment of Extended Integrated Leak Rate Testing Intervals, Revision 2-A of 1009325," dated August 1994.

a. *EPRI Report 1018243 described Class 2 sequences as large containment isolation failures. This group consists of all core damage accident progression bins for which a pre-existing leakage due to failure to isolate the containment occurs. These sequences are dominated by failure to close of large (>2 inches [5.1 cm] in diameter) containment isolation valves.*

   Table 3 of the LAR describes Class 2 as "Dependent failure modes, or common cause failures" and provides further interpretation for the BFN assigning of Class 2 sequences as isolation faults that are related to a loss of power or other isolation failure mode that is not a direct failure of an isolation component. Confirm that Class 2- Large Containment Isolation Failures as described in Section 8.1.2 of the LAR is consistent with the EPRI Report 1018243.

b. *Section 4.2.7, External Events, of the EPRI report 1018243 states in part,*

   "If the external event analysis is not of sufficient quality or detail to allow direct application of the methodology provided in this document, the quality or detail will be increased or a suitable estimate of the risk impact from the external events should be performed. This assessment can be taken from existing, previously submitted and approved analyses or another alternate method of assessing an order of magnitude estimate for contribution of the external event to the impact of the changed interval."

   To estimate the external events (EE) Large Early Release Frequency (LERF), Sections 10.2 and 10.3 of the LAR applied the internal events LERF to CDF ratio. Since external events can subject plants to common-cause failures of multiple SSCs, it is possible for the LERF to CDF ratio to be higher than for internal events. Provide justification for assuming that the internal events CDF to LERF ratio also applies to the seismic CDF to LERF ratio. In addition, explain the basis for using the internal events LERF to CDF ratio to the external events, specifically for seismic and high winds.

TVA Response

TVA provided the response to this request for additional information (RAI) on February 5, 2018 (ML18036A901).

APLA RAI 02 [Fire Probabilistic Risk Assessment (FPRA)]

Section 2.5.5, “Comparisons with Acceptance Guidelines,” of RG 1.174 states that when the contributions from the contributors modeled in the PRA are close to the risk acceptance guidelines, the argument that the contribution from the missing items is not significant must be convincing and in some cases may require additional PRA analyses (e.g., bounding analyses, detailed analyses, or by a demonstration that the change has no impact on the unmodeled contributors to risk). When the margin is significant, a qualitative argument may be sufficient. In addition, Section 2.5.3, “Model Uncertainty,” of RG 1.174 states that the impact of using alternative assumptions or models may be addressed by performing appropriate sensitivity studies or by using qualitative arguments.

Table 38, “Peer Reviews” of the BFN LAR outlines Fire (Focused Scope) and Internal Events 2009 F&O Resolution Review (Focused Scope) that occurred in May 2015 and July 2015, respectively. Furthermore, the licensee states that the 2015 fire PRA (FPRA) peer review focused on specific aspects of the FPRA that had changed including updated PRA methodologies/approaches. However, there have been numerous changes to fire PRA methodology since review of BFN FPRA NFPA 805 staff review and issuance of the SE that may be relevant for the FPRA to include such as the following:

- *The NRC issued a letter, “Recent Fire PRA Methods Review Panel Decisions and EPRI 1022993, ‘Evaluation of Peak Heat Release Rates in Electrical Cabinet Fires” (ADAMS Accession No. ML12171A583), June 21, 2012, providing staff positions on 1) frequencies for cable fires initiated by welding and cutting, 2) clarifications for transient fires, 3) alignment factor for pump oil fires, 4) electrical cabinet fire treatment refinement details, and 5) the EPRI 1022993 report.*

- *The NRC published NUREG/CR-7150, "Joint Assessment of Cable Damage and Quantification of Effects from Fire (JACQUE-FIRE)," Volume 2, which is supported by a letter from the NRC to NEI, "Supplemental Interim Technical Guidance on Fire-Induced Circuit Failure Mode Likelihood Analysis" (ADAMS Accession Nos. ML14086A165 and ML14017A135).*

- *The NRC published NUREG-2169, “Nuclear Power Plant Fire Ignition Frequency and Non-Suppression Probability Estimation Using the Updated Fire Events Database: United States Fire Event Experience Through 2009” (ADAMS Accession No. ML15016A069).*

- *Guidance on the credit taken for very early warning fire detection system (VEWFDS) is available in NUREG-2180, "Determining the Effectiveness, Limitations, and Operator Response for Very Early Warning Fire Detection Systems in Nuclear Facilities, (DELORES-VEWFIRE)" (ADAMS Accession Nos. ML16343A058). The guidance provided in FAQ 08-0046, "Closure of National Fire Protection Association 805 Frequently Asked Question 08-0046 Incipient Fire Detection Systems" (ADAMS Accession No. ML093220426), has been rescinded.*

In review of the BFN LAR (ML 17228A490), the calculated total LERF that includes EE is close to the RG 1.174 risk acceptance criteria. However, the integration of NRC-accepted fire PRA methods and studies described above that are relevant to this submittal could potentially result in an exceedance of the risk acceptance guidelines. For example, previous risk-informed LARs have shown that integration of NRC approved methods can lead to a calculated risk increase of up to approximately a factor of 3 in some cases. Therefore, in accordance with Section 2.5.5 of RG 1.174, additional analysis is necessary to ensure that contributions from this influence would not change the conclusions of the LAR.

Provide a detailed justification for why the integration of NRC-approved fire PRA methods and studies would not change the conclusions of the LAR. As part of this justification, identify the fire PRA methodologies used in the fire PRA that have not been formally accepted by the NRC staff, provide technical justification for their use and evaluate the significance of their use on the risk metrics for the application (total LERF, ΔLERF, Population Dose Rate (PDR), and CCFP). Provide updated tables that include the increase in total LERF (IE and EE), total LERF (IE and EE), ΔLERF, PDR, and CCFP for each unit to assess the risk impact as appropriate.

TVA Response

The 2015 focused scope peer review did not identify any Unreviewed Analysis Methods related to the BFN fire PRA. The following response to this RAI will address the above-identified NRC guidance documents.

NRC letter, "Recent Fire PRA Methods Review Panel Decisions and EPRI 1022993, 'Evaluation of Peak Heat Release Rates in Electrical Cabinet Fires'" (ML12171A583), June 21, 2012, was reviewed. The insights provided in ML12171A583, as well as the guidance provided in NUREG/CR-7150 and NUREG/CR-2169 were included in Revision 7 of the BFN Fire PRA Model.

TVA has not incorporated the guidance in NUREG-2180 into the Fire PRA model, because the NUREG was issued after the freeze date for the model revision. However, TVA has performed a sensitivity evaluation to determine the effect NUREG-2180 would have on the fire CDF and LERF values. This sensitivity study was performed using the latest revision of the fire PRA model, which includes consideration of the three documents described in the preceding paragraph.

In the BFN Fire PRA Model, Fire Compartments 16-K, 16-M, and 16-O are the only Fire Compartments that take credit for incipient detection. Therefore, the incorporation of NUREG-2180 would only affect those three compartments. The tables below provide the change in CDF and LERF values for the Controlled Fire PRA Model due to the inclusion of NUREG-2180 for BFN Units 1, 2 and 3, respectively.

Table 1

Change in Unit 1 Risk Against the Controlled Fire PRA Model						
Fire Compartment	**Controlled Fire PRA Model**		**Incorporated NUREG-2180**		**% Change in CDF**	**% Change in LERF**
	CDF	**LERF**	**CDF**	**LERF**		
16-K	3.25E-06	3.20E-07	1.12E-05	2.10E-06	242%	555%
16-M	2.22E-06	1.56E-07	6.42E-06	4.05E-07	189%	159%
16-O	8.04E-07	5.93E-08	4.25E-06	2.08E-07	428%	248%
All Others	5.29E-05	6.24E-06	5.29E-05	6.24E-06	-	-
Totals	**5.91E-05**	**6.78E-06**	**7.48E-05**	**8.95E-06**	**26%**	**32%**

Table 2

Change in Unit 2 Risk Against the Controlled Fire PRA Model						
Fire Compartment	**Controlled Fire PRA Model**		**Incorporated NUREG-2180**		**% Change in CDF**	**% Change in LERF**
	CDF	**LERF**	**CDF**	**LERF**		
16-K	2.23E-06	1.29E-07	5.71E-06	3.22E-07	156%	150%
16-M	2.95E-06	2.78E-07	1.03E-05	1.97E-06	248%	606%
16-O	1.85E-06	1.14E-07	5.16E-06	2.90E-07	179%	153%
All Others	5.69E-05	6.86E-06	5.69E-05	6.86E-06	-	-
Totals	**6.40E-05**	**7.38E-06**	**7.81E-05**	**9.43E-06**	**22%**	**28%**

Table 3

Change in Unit 3 Risk Against the Controlled Fire PRA Model						
Fire Compartment	**Controlled Fire PRA Model**		**Incorporated NUREG-2180**		**% Change in CDF**	**% Change in LERF**
	CDF	**LERF**	**CDF**	**LERF**		
16-K	3.87E-07	2.08E-08	9.03E-07	3.95E-08	133%	90%
16-M	4.22E-07	1.65E-08	9.03E-07	3.84E-08	114%	128%
16-O	3.26E-06	3.06E-07	1.02E-05	1.86E-06	214%	508%
All Others	6.04E-05	5.63E-06	6.04E-05	5.63E-06	-	-
Totals	**6.45E-05**	**5.98E-06**	**7.25E-05**	**7.57E-06**	**12%**	**27%**

In order to demonstrate the effect of NUREG-2180 on the CILRT, two versions (original and "2180") of the affected tables from Enclosure 2 of the August 15, 2017 LAR (the "original submittal") are provided below. The "2180" tables also include the results from the response to APLA RAI 01b for seismic and high winds.

<u>Table 31</u>

Table 31 provides the contribution to CDF and LERF from External Events (EE), Internal Events (IE), and the combined (EE+IE).

Table 31 (Original)						
External Hazard	**CDF/yr**			**LERF/yr**		
	Unit 1	Unit 2	Unit 3	Unit 1	Unit 2	Unit 3
Seismic	3.70E-06	5.40E-06	5.40E-06	6.73E-07	1.04E-06	1.01E-06
Fire	5.03E-05	5.64E-05	5.92E-05	5.47E-06	5.37E-06	5.02E-06
High Winds	1.00E-06	1.00E-06	1.00E-06	1.82E-07	1.92E-07	1.88E-07
Other Hazards	Screened	Screened	Screened	Screened	Screened	Screened
External Events - Total	5.50E-05	6.28E-05	6.56E-05	6.32E-06	6.60E-06	6.22E-06
Internal Events	6.93E-06	6.29E-06	7.72E-06	1.26E-06	1.21E-06	1.45E-06
Internal + External	6.19E-05	6.91E-05	7.33E-05	7.58E-06	7.81E-06	7.67E-06

Table 31 (2180)						
External Hazard	**CDF/yr**			**LERF/yr**		
	Unit 1	Unit 2	Unit 3	Unit 1	Unit 2	Unit 3
Seismic	3.70E-06	5.40E-06	5.40E-06	1.10E-06	1.70E-06	1.66E-06
Fire	7.48E-05	7.81E-05	7.25E-05	8.95E-06	9.43E-06	7.57E-06
High Winds	1.00E-06	1.00E-06	1.00E-06	2.98E-07	3.14E-07	3.08E-07
Other Hazards	Screened	Screened	Screened	Screened	Screened	Screened
External Events - Total	7.95E-05	8.45E-05	7.89E-05	1.03E-05	1.14E-05	9.54E-06
Internal Events	6.93E-06	6.29E-06	7.72E-06	1.26E-06	1.21E-06	1.45E-06
Internal + External	8.64E-05	9.08E-05	8.66E-05	1.16E-05	1.27E-05	1.10E-05

The 2180 table includes the following changes:

- The Seismic contribution to LERF includes the data from the response to APLA RAI 01b.
- The High Winds contribution to CDF and LERF includes the data from the response to APLA RAI 01b.
- Revised CDF and LERF inputs from the NUREG-2180 impact sensitivity study.

The effects of the input changes are:

- Seismic LERF increased by approximately 63% for each unit based on the APLA RAI 1b results.
- Fire CDF increased by approximately 22% to 49%, depending on the unit, based on the sensitivity study performed using NUREG-2180 values.
- Fire LERF increased by approximately 51% to 76%, depending on the unit, based on the sensitivity study performed using NUREG-2180 values.
- External Hazards CDF increased by approximately 20% to 45%, depending on the unit.
- External Hazards LERF increased by approximately 53% to 73%, depending on the unit.
- Total Risk (External Hazards + Internal Hazards) CDF increased by approximately 18% to 40%, depending on the unit and remains below the RG 1.174 R3 acceptance guideline of <1.0E-04/yr.
- Total Risk (External Hazards + Internal Hazards) LERF increased by approximately 43% to 62%, depending on the unit. Note that the Total Risk is slightly above the RG 1.174 R3 acceptance guideline of <1.0E-05/yr.

<u>Table 32</u>

Table 32 provides the data for EPRI Class 3b, which represents those sequences that could result in a Large, Early Release, for the Original Licensing Basis (3 tests/10 years), the Current Licensing Basis (1 test/10years) and the Proposed Licensing Basis (1 test/15 years). The LERF increase column was calculated by subtracting the Proposed Licensing Basis values from the Original Licensing Basis values for the proposed CILRT extension.

Table 32 (Original)

Contributor	Original Licensing Basis			Current Licensing Basis			Proposed Licensing Basis			LERF Increase[1]		
	Unit 1	Unit 2	Unit 3	Unit 1	Unit 2	Unit 3	Unit 1	Unit 2	Unit 3	Unit 1	Unit 2	Unit 3
IE (3b) From Tables 27-29	8.27E-09	8.07E-09	7.48E-09	2.76E-08	2.69E-08	2.49E-08	4.14E-08	4.04E-08	3.74E-08	3.31E-08	3.23E-08	2.99E-08
EE to IE Ratio	7.94	9.98	8.50	7.94	9.98	8.50	7.94	9.98	8.50			
EE Contribution to 3b	6.57E-08	8.06E-08	6.36E-08	2.19E-07	2.68E-07	2.12E-07	3.28E-07	4.03E-07	3.18E-07	2.63E-07	3.22E-07	2.54E-07
Combined	7.39E-08	8.87E-08	7.11E-08	2.46E-07	2.95E-07	2.37E-07	3.70E-07	4.43E-07	3.55E-07	2.96E-07	3.55E-07	2.84E-07

[1]Associated with the change from the baseline of 3 tests per 10 years to the proposed 1 test per 15 years.

The values for Internal Events (IE) were based on inputs from the quantified Model of Record, and documented in the original submittal (reference Tables 27 - 29). To determine the contribution of External Events (EE) hazards on the Class 3b frequencies, a ratio is calculated using the EE ÷ IE data from Table 31, which is then multiplied by the Internal Events Class 3b frequencies. The ratios (EE to IE) calculated from Table 31 (2180) are as follows:

Unit 1 1.03E-05 ÷ 1.26E-06 = 8.21
Unit 2 1.14E-05 ÷ 1.21E-06 = 9.46
Unit 3 9.54E-06 ÷ 1.45E-06 = 6.58

The following revised Table 32 represents the results of multiplying the Internal Events 3b frequencies by the ratios described above resulting in the External Events contribution to Class 3b. The Internal Events and External Events contributions to Class 3b are summed to provide the combined change in the Large Early Release Frequency.

Table 32 (2180)

Contributor	Original Licensing Basis			Current Licensing Basis			Proposed Licensing Basis			LERF Increase[1]		
	Unit 1	Unit 2	Unit 3	Unit 1	Unit 2	Unit 3	Unit 1	Unit 2	Unit 3	Unit 1	Unit 2	Unit 3
IE (3b) From Tables 27-29	8.27E-09	8.07E-09	7.48E-09	2.76E-08	2.69E-08	2.49E-08	4.14E-08	4.04E-08	3.74E-08	3.31E-08	3.23E-08	2.99E-08
EE to IE Ratio	8.21	9.46	6.58	8.21	9.46	6.58	8.21	9.46	6.58	8.21	9.46	6.58
EE Contribution to 3b	6.79E-08	7.63E-08	4.92E-08	2.26E-07	2.54-07	1.64E-07	3.40E-07	3.82E-07	2.46E-07	2.72E-07	3.05E-07	1.97E-07
Combined	7.62E-08	8.44E-08	5.67E-08	2.54E-07	2.81E-07	1.89E-07	3.81E-07	4.22E-07	2.84E-07	3.05E-07	3.38E-07	2.27E-07

[1]Associated with the change from the baseline of 3 tests per 10 years to the proposed 1 test per 15 years.

As can be seen by comparing the revised results with the original results, the Unit 1 Class 3b LERF increase value increased by about 3% from the Original Combined Class 3b LERF increase value, Unit 2 decreased by about 5% and Unit 3 decreased by about 25%.

Table 33

Table 33 summarizes the change in risk for LERF, Population Dose and the Conditional Containment Failure Probability (CCFP).

Table 33 (Original)												
Event Contributor	ΔLERF/yr			Population Dose in ΔPerson-REM/yr (% Increase)						ΔCCFP[1]		
	Unit 1	Unit 2	Unit 3	Unit 1		Unit 2		Unit 3		Unit 1	Unit 2	Unit 3
Internal	3.31E-08	3.23E-08	2.99E-08	4.27E-02	0.63%	4.60E-02	0.68%	4.51E-02	0.47%	1.08%	1.16%	0.87%
External	2.63E-07	3.22E-07	2.54E-07	3.39E-01	4.99%	4.59E-01	6.83%	3.84E-01	3.97%	1.08%	1.16%	0.87%
Combined	2.96E-07	3.55E-07	2.84E-07	3.82E-01	5.62%	5.05E-01	7.52%	4.29E-01	4.44%	1.08%	1.16%	0.87%
Acceptance Guideline	<1.0E-06/yr (Small)			<1.0 person-rem/yr or <1.0% (Whichever is Less Restrictive)						<1.5%		

[1] Associated with the change from the baseline of 3 test per 10 years to the proposed 1 test per 15 years.
ΔLERF is a direct input from the Table 32 results from the original submittal
ΔPopulation Dose (Internal Events) is carried from Tables 27 - 29, Units 1 - 3, respectively
ΔPopulation Dose (External Events) is determined by multiplying the IE dose by the EE / IE ratio calculated in Table 32.

Table 33 (2180)												
Event Contributor	ΔLERF/yr			Population Dose in ΔPerson-REM/yr (% Inc)						ΔCCFP[1]		
	Unit 1	Unit 2	Unit 3	Unit 1		Unit 2		Unit 3		Unit 1	Unit 2	Unit 3
Internal	3.31E-08	3.23E-08	2.99E-08	4.71E-02	0.69%	4.84E-02	0.84%	4.26E-02	0.48%	1.08%	1.16%	0.87%
External	2.72E-07	3.05E-07	1.97E-07	3.87E-01	5.70%	4.58E-01	7.98%	2.80E-01	3.19%	1.08%	1.16%	0.87%
Combined	3.05E-07	3.38E-07	2.27E-07	4.34E-01	6.39%	5.06E-01	8.82%	3.23E-01	3.67%	1.08%	1.16%	0.87%
Acceptance Guideline	<1.0E-06/yr (Small)			<1.0 person-rem/yr or <1.0% (Whichever is Less Restrictive)						<1.5%		

[1] Associated with the change from the baseline of 3 test per 10 years to the proposed 1 test per 15 years.
ΔLERF is a direct input from the Table 32 results from the original submittal
ΔPopulation Dose (Internal Events) is carried from Tables 27 - 29, Units 1 - 3, respectively
ΔPopulation Dose (External Events) is determined by multiplying the IE dose by the EE / IE ratio calculated in Table 32.

As can be seen by the revised Table 33 data:

- ΔLERF falls within the RG 1.174 R3 (Figure 5) with the small change in risk band (i.e., less than 1.0E-06/yr).
- ΔDose - the guidance provided in "EPRI 1019243 'Risk Impact Assessment of Extended Integrated Leak Rate Testing Intervals' October 2008" states that the less restrictive of the increase in person-rem/yr and the percent increase is to be used. Therefore, for BFN the increase in dose is least restrictive with all three units remaining below the acceptance guideline of <1.0 person-rem/yr.
- ΔCCFP - the changes reflected by NUREG-2180 and the CDF/LERF ratio methodology changed as stated by the response to APLA RAI 01b do not affect this metric.
- CCFP does not take inputs (CDF or LERF) from the PRA; therefore, changes to PRA risk metrics do not cause a change to the CCFP.

Table 34

The following Table 34 presents total LERF based on a one CILRT in 15 years frequency.

Table 34 (Original)					Table 34 (2180)			
LERF Contributor	LERF/yr				LERF Contributor	LERF/yr		
	Unit 1	Unit 2	Unit 3			Unit 1	Unit 2	Unit 3
Internal Events (from Table 31)	1.26E-06	1.21E-06	1.45E-06		Internal Events	1.26E-06	1.21E-06	1.45E-06
External Events (from Table 31)	6.32E-06	6.60E-06	6.22E-06		External Events	1.03E-05	1.14E-05	9.54E-06
Internal Events Due to ILRT at 15-year Frequency[1]	4.64E-08	4.53E-08	4.20E-08		Internal Events Due to ILRT at 15-year Frequency[1]	4.64E-08	4.53E-08	4.20E-08
External Events Due to ILRT at 15-year Frequency	2.33E-07	2.47E-07	1.80E-07		External Events Due to ILRT at 15-year Frequency	3.81E-07	4.28E-07	2.76E-07
Total LERF	7.86E-06	8.10E-06	7.89E-06		Total LERF	1.20E-05	1.31E-05	1.13E-05
Acceptance Guideline	<1.0E-05/yr				Acceptance Guideline	<1.0E-05/yr		

[1]Including age adjusted steel liner corrosion likelihood, reference Table 27 (Unit 1), Table 28 (Unit 2) and Table 29 (Unit 3).

Total LERF

The metrics of concern for the CILRT extension include ΔLERF, ΔDose (or %Increase, whichever is less restrictive), and CCFP. The deltas for all three metrics on BFN Units 1, 2, and 3 remain with the acceptance guideline for the CILRT extension. There is no change to the CCFP as CDF and LERF are not inputs for this metric.

An additional metric that is required for risk-informed applications is Total LERF. In accordance with RG 1.174 R3, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," Figure 5 "Acceptance Guidelines for Large Early Release Frequency" shows a LERF acceptance guideline of <1.0E-05/yr. Figure 4 shows a CDF acceptance guideline of <1.0E-04/yr.

As can be seen on the figure below, the BFN Total LERF and ΔLERF meet at a point which resides near the boundary that provides flexibility with respect to the acceptance guideline for Total LERF.

According to the footnote for Figure 5, "The analysis is subject to increased technical review and management attention as indicated by the darkness of the shading of the figure. In the context of integrated decision making, the boundaries between regions are not definitive; the numerical values associated with defining the regions in the figure are to be interpreted as indicative values only."

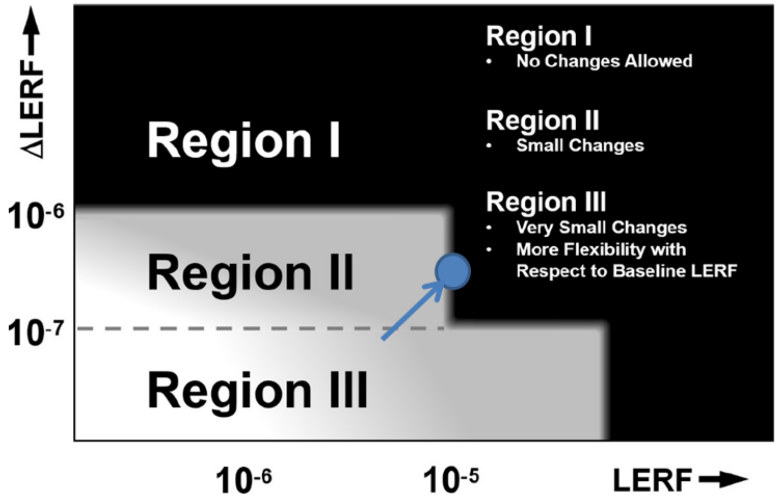

Figure 5. Acceptance guidelines* for large early release frequency

* The analysis is subject to increased technical review and management attention as indicated by the darkness of the shading of the figure. In the context of integrated decision making, the boundaries between regions are not definitive; the numerical values associated with defining the regions in the figure are to be interpreted as indicative values only.

RG 1.174 further states, “As indicated in the footnote to Figures 4 and 5, the boundaries between regions are not definitive. In applying these guidelines, it is particularly important to recognize that the risk metrics calculated using PRA models are a function of the assumptions and approximations made in the development of those models. This is particularly important when the results from PRA models for multiple hazard groups are combined, since the results from some hazard groups, depending on the state of practice, may be conservatively or nonconservatively biased.”

The inclusion of NUREG/CR-2180 significantly increases CDF and LERF. The incipient fire detection failure rate was increased from 0.0199 using the guidance in NUREG/CR-6850 Supplement 1, to 0.53 using NUREG 2180. As a result, the baseline LERF numbers increased by up to 32%. Using Unit 2 as the worst case effect of NUREG 2180, the LERF increased to 94.3% of the RG 1.174 limit for fire risk alone. This increase is not acceptable from TVA’s standpoint given the inclusion of other hazard risk that will cause the total LERF risk to exceed the acceptability limits of RG 1.174 for approval of risk informed applications. The sensitivity provided above only considers the risk increases associated with incorporation of NUREG 2180 and does not consider the current FAQ (FAQ 17-0012) given this FAQ is still unresolved. TVA chose to expend resources to install incipient detection to reduce fire risk based on the guidance in FAQ 08-0046 and as such did not pursue additional fire refinements in certain fire areas, namely 16K, 16M and 16O. As a result of the publication of NUREG-2180, TVA is currently refining the fire risk models to remove conservatism to reduce the CDF and LERF to counteract the increase due to NUREG-2180.

In the BFN Controlled Fire PRA Model, cabinets in fire compartment 16K, 16M and 16O were refined to only two scenarios, one with damage to just the source cabinet and one that assumed to be a full room burn if incipient detection failed. This treatment is very conservative given the number of PRA targets in the Aux Relay rooms, however, this produced acceptable risk results using the previously approved approach. Further refinement of the ignition sources in fire compartments 16K, 16M and 16O is expected to produce significant risk reductions in these compartments. Additionally, during Rev. 8 (currently in development) of BFN Fire PRA Model, the cabinets in these fire compartments have been changed to NUREG 2178 group type 4a (large enclosure) with a 400 kW heat release rate (HRR). Additional walkdowns of the actual cabinets could result in NUREG 2178 group refinement and decreased HRR. Aside from increased fire modeling, fire PRA FAQ 16-0011, “Cable Tray Ignition” will be incorporated in the next subsequent revision which will produce a reduction in both CDF and LERF. TVA expects that the current on-going refinements will reduce the CDF and LERF values to close to those originally submitted in the LAR.

RG 1.174 Section 2.5 states, “As discussed in Section C.2.3.1, the scope of the PRA needed to support a particular application may include several hazard groups or plant operating modes. The process of combining the risk contributions from different hazard groups is sometimes referred to as “aggregation.” When the assessments of the risk implications from different hazard groups must be combined, it is important to understand the relative level of realism associated with the modeling of each of the hazard groups. For example, the analysis of specific scope items, such as internal fire, internal flooding, or seismic initiating events, typically involves a successive screening approach that allows the detailed analysis to focus on the more significant contributions. The analysis of the less significant contributions is generally more conservative. In addition, for each of the risk contributors, there are unique sources of model uncertainty. The assumptions made in response to these sources of model uncertainty and any conservatism or non-conservatism introduced by the analysis approach discussed above can bias the results. This is of particular concern for the assessment of importance measures (as contrasted with mean-value risk results) with respect to the combined risk assessment and the relative contributions of the hazard groups to the various risk metrics.”

As shown above, the inclusion of NUREG/CR-2180 significantly increases CDF and LERF, with Total LERF residing near the boundary of Figure 5. Therefore, to justify the acceptability of the original submittal, TVA has considered the following other factors to determine the risk impact of the CILRT extension.

- CDF is not a metric of concern because the proposed application does not cause a change in the risk of core damage.
- A pre-existing containment liner flaw large enough to result in a large, early release would be easily detected as the BWR-4 Mark I containment is inerted with nitrogen during power operations. Therefore, plant operators would have indication of leakage from the drywell.
- The change in LERF for all hazards is small, ranging from 2.27E-07/yr to 3.38E-07/yr.
- The CILRT simply verifies the containment (drywell) liner does not have an existing flaw that could result in a leakage path to the environment given core damage. The additional five-year window represented by the original submittal results in a small increase in risk.
- The BFN FPRA model included consideration for NUREG 2169 and NUREG/CR7150.
- The sensitivity analysis that considered inclusion of NUREG 2180 did not consider the on-going BFN Fire PRA revision or consider the reduction in CDF and LERF as a result of FAQ 16-011.

Conclusion

This sensitivity study was performed using the latest revision of the fire PRA model, Revision 7, which already included the insights provided in ML12171A583, as well as the guidance provided in NUREG/CR-7150 and NUREG/CR-2169. Although the inclusion of NUREG/CR-2180 significantly increases CDF and LERF, TVA expects that the current on-going refinements will reduce the CDF and LERF values to close to those originally submitted in the LAR.

APLA RAI 03 [Internal Events and Fire PRA: FACTS AND OBSERVATIONS]

Tables 50 and 51, Internal Events PRA F&O Resolution, and Fire PRA F&O Resolution of the LAR, provide resolution of the peer review facts and observations (F&Os) and their impacts on the application for the internal events and fire PRAs. Address the following:

a. *F&O 1-17 related to Supporting Requirement (SR) DA-C6 identified that post maintenance testing (PMT) demands were not excluded from the count of plant-specific demands on standby components. The SR states that additional demands from post-maintenance testing should not be counted because they are part of the successful renewal. In resolution to this F&O the licensee stated that it performed an analysis to quantify the effect that removal of potential PMT would have on the results by analyzing seven scenarios. It further states that "the results show that even with an extremely unrealistic number of PMTs the data is not significantly skewed by the inclusion of the PMT data." Describe how the analysis was performed and provide the results. In addition explain how the treatment of PMT demands contributes to under- or over-estimation of failure probabilities, the CDF and LERF estimates, and the subsequent risk metrics for ILRT acceptance (i.e. total LERF, ΔLERF, CCFP).*

TVA Response

The evaluation supporting F&O 1-17 used the Model of Record (MOR) Revision 6 PRA model. That evaluation demonstrated that inclusion of the post maintenance test (PMT) data does not significantly affect the Core Damage Frequency (CDF) results. The CILRT evaluation used MOR Revision 7. Using MOR R7, TVA performed a new sensitivity analysis, which was titled BFN 0-18-006, to respond to this request. The original analysis using MOR R7 was titled BFN 0-17-040. These designations are used in response to this RAI to show the effect of including PMT data in the PRA results.

In order to assess the impact of including PMT demands on the CDF results, each of the demand-type type codes was reviewed to determine the number of total demands. A conservative assumption was made that 10% of those demands for each type code represent the assumed number of PMTs for the 12 year period that data was gathered. The basis for this assumption is that most demands on a component are from manipulation for unit operation or surveillance testing, that is, they would not be related to maintenance activities. This assumption is supported by a recent analysis of the Sequoyah Nuclear Plant (SQN) IE PRA that counted the number of PMTs for various type codes in the SQN model. Of those type codes evaluated, the fraction of total demands that were PMTs were less than 2.5% of the total demands for the type code. All but one of the type codes had a fraction of PMTs less than 2% of the total demands for that type code. Similar experience is expected for the BFN units. Therefore, an assumption of 10% of total demands for a type code being PMTs for the BFN model is conservative.

Reducing the number of demands for a given number of failures results in a higher probability of failure. For example, the failure rate for Type Code AOCFC (AIR OPERATED VALVES FAILS CLOSE (TREATED WATER)) based on 6528 Demands is 1.211E-03. Assuming 10% of the demands are removed due to presumed PMTs, the new failure rate for Type Code AOCFC, based on 5875 Demands is 1.33E-03. Therefore, including demands due to preventative maintenance results in an under-estimation of the failure probability.

The following table shows how each Unit's CDF was affected by the removal of 10% of the demands due to PMTs from each type code.

	Baseline	**Removal of 10% of demands from each type code**	**Delta from Baseline**
U1 CDF	6.93E-06	7.14E-06	3.03%
U2 CDF	6.29E-06	6.47E-06	2.86%
U3 CDF	7.72E-06	7.92E-06	2.59%

Therefore, removing 10% of the demands due to PMTs from each type code results in an increase in CDF of approximately 3% for each unit or about a 2E-07 change in CDF. This strategy was employed to illustrate the effect of removing 10% of the demands due to PMTs on the various PRA-related tables from the original submittal. In the following tables, the original data from Table 4 of enclosure 2 of the original submittal is labelled BFN-0-17-040 and the current data with the adjusted reduced number of demands is labelled BFN-0-18-006.

CDF by EPRI Class:

BFN-0-17-040						**BFN-0-18-006**				
EPRI Class	**Description**	**Unit 1**	**Unit 2**	**Unit 3**		**EPRI Class**	**Description**	**Unit 1**	**Unit 2**	**Unit 3**
1	Containment Intact	2.91E-06	2.89E-06	2.54E-06		1	Containment Intact	3.03E-06	3.00E-06	2.64E-06
2	Large containment Isolation Failure	3.17E-08	2.99E-08	3.23E-08		2	Large containment Isolation Failure	3.26E-08	3.08E-08	3.36E-08
7a	Phenomena Induced - Early	6.88E-07	6.30E-07	7.14E-07		7a	Phenomena Induced - Early	7.12E-07	6.52E-07	7.35E-07
7b	Phenomena Induced - Late	2.98E-06	2.41E-06	4.09E-06		7b	Phenomena Induced - Late	3.05E-06	2.45E-06	4.17E-06
8	Containment Bypass	3.11E-07	3.31E-07	3.35E-07		8	Containment Bypass	3.22E-07	3.42E-07	3.45E-07
		6.92E-06	6.29E-06	7.71E-06				7.15E-06	6.47E-06	7.92E-06
	Rounded:	6.93E-06	6.29E-06	7.72E-06			Rounded:	7.15E-06	6.47E-06	7.92E-06

By taking the data for each EPRI Class, and dividing by the total CDF, the distribution for each class can be determined. The following tables show this distribution for the original data and the revised data.

CDF Distribution by EPRI Class:

BFN 0-17-040						BFN 0-18-006				
EPRI Class	**Description**	**Unit 1**	**Unit 2**	**Unit 3**		**EPRI Class**	**Description**	**Unit 1**	**Unit 2**	**Unit 3**
1	Containment Intact	41.991%	45.946%	32.902%		1	Containment Intact	42.398%	46.333%	33.318%
2	Large containment Isolation Failure	0.457%	0.475%	0.418%		2	Large containment Isolation Failure	0.456%	0.476%	0.424%
7a	Phenomena Induced - Early	9.928%	10.016%	9.249%		7a	Phenomena Induced - Early	9.963%	10.070%	9.276%
7b	Phenomena Induced - Late	43.001%	38.315%	52.979%		7b	Phenomena Induced - Late	42.678%	37.839%	52.628%
8	Containment Bypass	4.488%	5.262%	4.339%		8	Containment Bypass	4.506%	5.282%	4.354%

APLA RAI 01 and APLA RAI 04f identified issues that could potentially affect the CILRT results. This evaluation includes the changes from those RAI responses. APLA RAI 01b questioned the method used by TVA for determining the seismic and high winds contribution to LERF from these hazards. The results provided in the response to APLA RAI 01b was included in the data changes for this evaluation. Furthermore, APLA RAI 04d identified that the Seismic and Fire labels were reversed. The tables below reflect all of these changes.

<u>Table 31</u>

Table 31 provides the contribution to CDF and LERF from External Events (EE), Internal Events (IE), and the combined (EE+IE). Table 31 with the data from the original submittal and the revised Table 31, which includes applicable results from APLA RAI 01 and APLA RAI 04 described above and adjusted for the reduced number of demands are as follows:

Original Data:

External Hazard	**CDF/yr**			**LERF/yr**		
	Unit 1	Unit 2	Unit 3	Unit 1	Unit 2	Unit 3
Seismic	3.70E-06	5.40E-06	5.40E-06	6.73E-07	1.04E-06	1.01E-06
Fire	5.03E-05	5.64E-05	5.92E-05	5.47E-06	5.37E-06	5.02E-06
High Winds	1.00E-06	1.00E-06	1.00E-06	1.82E-07	1.92E-07	1.88E-07
Other Hazards	Screened	Screened	Screened	Screened	Screened	Screened
External Events - Total	5.50E-05	6.28E-05	6.56E-05	6.32E-06	6.60E-06	6.22E-06
Internal Events	6.93E-06	6.29E-06	7.72E-06	1.26E-06	1.21E-06	1.45E-06
Internal + External	6.19E-05	6.91E-05	7.33E-05	7.58E-06	7.81E-06	7.67E-06

Revised Data:

External Hazard	CDF/yr			LERF/yr		
	Unit 1	Unit 2	Unit 3	Unit 1	Unit 2	Unit 3
Seismic	3.70E-06	5.40E-06	5.40E-06	1.10E-06	1.70E-06	1.66E-06
Fire	5.03E-05	5.64E-05	5.92E-05	5.47E-06	5.37E-06	5.02E-06
High Winds	1.00E-06	1.00E-06	1.00E-06	2.98E-07	3.14E-07	3.08E-07
Other Hazards	Screened	Screened	Screened	Screened	Screened	Screened
External Events - Total	5.50E-05	6.28E-05	6.56E-05	6.87E-06	7.38E-06	6.99E-06
Internal Events	7.15E-06	6.47E-06	7.92E-06	1.30E-06	1.25E-06	1.49E-06
Internal + External	6.21E-05	6.93E-05	7.35E-05	8.17E-06	8.63E-06	8.48E-06

Table 33

The following Table 33 presents the data from the original submittal and revised considering all of the above changes with regard to change in LERF, change in Person-REM and the change in CCFP.

Original Data:

Event Contributor	ΔLERF/yr			ΔPerson-REM/yr (% Inc)						ΔCCFP		
	Unit 1	Unit 2	Unit 3	Unit 1		Unit 2		Unit 3		Unit 1	Unit 2	Unit 3
Internal	3.31E-08	3.23E-08	2.99E-08	4.27E-02	0.63%	4.60E-02	0.68%	4.51E-02	0.47%	1.08%	1.16%	0.87%
External	2.63E-07	3.22E-07	2.54E-07	3.39E-01	4.99%	4.59E-01	6.83%	3.84E-01	3.97%	1.08%	1.16%	0.87%
Combined	2.96E-07	3.55E-07	2.84E-07	3.82E-01	5.62%	5.05E-01	7.52%	4.29E-01	4.44%	1.08%	1.16%	0.87%
Acceptance Guideline	<1.0E-06/yr (Small)			<1.0 person-rem/yr or <1.0% (Whichever is Less Restrictive)						<1.5%		

Revised Data:

Event Contributor	ΔLERF/yr			ΔPerson-REM/yr (% Inc)						ΔCCFP		
	Unit 1	Unit 2	Unit 3	Unit 1		Unit 2		Unit 3		Unit 1	Unit 2	Unit 3
Internal	3.43E-08	3.35E-08	3.10E-08	4.43E-02	0.64%	4.33E-02	0.74%	4.00E-02	0.45%	1.08%	1.17%	0.88%
External	1.81E-07	1.99E-07	1.45E-07	3.41E-01	4.93%	4.20E-01	7.16%	3.31E-01	3.70%	1.08%	1.17%	0.88%
Combined	2.16E-07	2.32E-07	1.76E-07	3.85E-01	5.57%	4.63E-01	7.90%	3.71E-01	4.14%	1.08%	1.17%	0.88%
Acceptance Guideline	<1.0E-06/yr (Small)			<1.0 person-rem/yr or <1.0% (Whichever is Less Restrictive)						<1.5%		

The revised results indicate that the change in risk for all three units remain within the acceptance guidelines of RG 1.174 (ΔLERF) and EPRI 1018243 (ΔDose, ΔCCFP).

<u>Table 34</u>

The following Table 34 presents the data from the original submittal and revised considering all of the above changes with regard to Total LERF following a 15-year ILRT frequency.

	Original Results					Revised Results		
LERF Contributor	LERF/yr				LERF Contributor	LERF/yr		
	Unit 1	Unit 2	Unit 3			Unit 1	Unit 2	Unit 3
Internal Events	1.26E-06	1.21E-06	1.45E-06		Internal Events	1.30E-06	1.25E-06	1.49E-06
External Events	6.32E-06	6.60E-06	6.22E-06		External Events	6.87E-06	7.38E-06	6.99E-06
Internal Events Due to ILRT at 15-year Frequency[1]	4.64E-08	4.53E-08	4.20E-08		Internal Events Due to ILRT at 15-year Frequency[1]	4.81E-08	4.70E-08	4.34E-08
External Events Due to ILRT at 15-year Frequency	2.33E-07	2.47E-07	1.80E-07		External Events Due to ILRT at 15-year Frequency	2.54E-07	2.78E-07	2.04E-07
Total LERF	7.86E-06	8.10E-06	7.89E-06		Total LERF	8.47E-06	8.95E-06	8.72E-06
Acceptance Guideline	<1.0E-05/yr				Acceptance Guideline	<1.0E-05/yr		
[1] Including age adjusted steel liner corrosion likelihood, reference Table 27 (Unit 1), Table 28 (Unit 2) and Table 29 (Unit 3).								

The revised results indicate that the Total LERF remains below the RG 1.174 acceptance guideline of <1.0E-05/yr.

<u>Conclusion</u>

Including demands due to preventative maintenance results in an under-estimation of the failure probability. As demonstrated, removing 10% of the demands due to PMTs from each type code results in an increase in CDF of approximately 3% for each unit or about a 2E-07 change in CDF. Additionally, including the results from APLA RAIs 01 and 04f to the reduced demands cause a very small increase to ΔLERF, ΔDose, and ΔCCFP and a small increase for Total LERF above the results given in the original submittal. The figures of merit all remain within the acceptance guideline of RG 1.174 and the EPRI Guidance, 1018243, as shown in the above Tables 33 and 34.

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<u>APLA RAI 03 (cont)</u>

b. *F&O 4-18, associated with SR HR-G2 identified that for some operator actions the execution failure probability is assumed to be zero. The SR HR-G2 states to use an approach to estimation of Human Error Probabilities (HEPs) that addresses failure in cognition as well as failure to execute. The resolution states that "TVA staff considered plant data and judged that the most recent history is most applicable of the current as-operated plant. It is justifiable to screen 'break-in period' events from the history of a stably operating plant. BFN justification is judged adequate and appropriate." In support of NRC review:*

1. *Provide a summary of the data considered and explain how exclusion of the Human Failure Events (HFE) execution was determined to be adequate and appropriate for the HEP and its impact to the ILRT risk metrics for acceptability. In addition,*
2. *If determined that there exists potential impact on the application, provide a sensitivity evaluation that demonstrates the effect of exclusion of the HFE execution is negligible relative to the ILRT risk metrics.*

TVA Response

The following statement is referenced in APLA RAI 03b: "TVA staff considered plant data and judged that the most recent history is most applicable of the current as-operated plant. It is justifiable to screen 'break-in period' events from the history of a stably operating plant. BFN justification is judged adequate and appropriate." This statement is found in the "Impact on the CILRT Extension" column of Table 50 for F&O 4-18 of the original submittal. During the development of the response to this RAI, TVA determined that the referenced statement should not be associated with F&O 4-18.

During the update for MOR R7, several F&Os involving the human reliability analysis were resolved including F&O 4-18. As part of the resolution of F&O 4-18, several human error probabilities (HEPs) were reviewed to determine whether it was appropriate to exclude the execution error contribution to the HEP. The HRA Calculator (HRAC) for MOR R7 was reviewed to identify any HFE that exclude execution errors in the estimate of HEPs. The applicable HEPs noted in F&O 4-18 are listed below:

- HFA_0_ADSINHIBIT
- HFA_0063SLCINJECT
- HFA_0024RCWINTAKE
- HFA_0_ATWSLEVEL
- HFA_0027INTAKE

The review of the HRAC determined the following HEPs listed in the F&O are no longer applicable:

- HFA_0_ATWSLEVEL already includes the contribution for the execution error.
- HFA_0027INTAKE is no longer included in the model.
- HFA_0063SLCINJECT - An execution error was included for HFA_0063SLCINJECT (Failure of Standby Liquid Control (SLC) in response to an Anticipated Transient Without Scram (ATWS) event) as part of the MOR R7 update to address F&O 4-18. An execution error was added to this HFE because this is a time critical operator action, AND EOI-Appendix 3A (SLC INJECTION) specifies the appropriate steps required. While the actions are simple, these require transition between procedures for the execution, so it is appropriate to include execution errors.

As a result, the remaining HEPs were examined to determine whether the basis for excluding the execution error was adequate and appropriate. The following conclusions were determined for the remaining HFEs listed above and the HRA was updated accordingly to support MOR R7.

HFA_0024RCWINTAKE (Failure to clear debris at intake before reactor scram) The bases for excluding the execution contribution for HFA_0024RCWINTAKE are provided below. It is assumed that, if the action is initiated within 1 hour, it will be successful (i.e., only the cognitive error is included).

- This HFE is not used (credited) in the internal events average test and maintenance model of record model. A flag is used to turn off this part of the logic for the baseline MOR R7.
- This action is used to prevent a plant trip and operators would place a high priority to prevent a plant trip.
- There is significant time available to clear the debris once the operators have determine that a plant challenge may occur.
- Clearing traveling screens does not relate to a series of manual actions, but to an effort among several operators.
- Multiple errors of execution by several Auxiliary Unit Operators in parallel is considered unlikely.
- The raw cooling water (RCW) system is supplied river water from the condenser circulating water (CCW) conduits of each unit through fine mesh strainers that include a dP alarm. Pumps are run periodically to avoid fouling. These instruments would allow the Main Control Room (MCR) operators to determine if the actions are being implemented appropriately, and there is significant time to recover.
- The RCW system is assumed to fail when intake plugging occurs (initiator impact).

HFA_0_ADSINHIBIT (Failure to Inhibit ADS during ATWS). The bases for excluding the contribution for HFA_0_ADSINHIBIT are provided below.

- Inhibiting the automatic depressurization system (ADS) is a standard measure after any reactor scram, but is particularly important for an ATWS scenarios. Because there is only a single step to implement this action, errors of omission are integral to the cognitive error to omit the action. In this case, errors of commission are neglected because the action to inhibit ADS is unique, and because it is routinely performed following every reactor scram.
- The ADS switches are clearly distinct (Keylock) from other switches on the board. Keylock switches are used to Inhibit ADS and both keylocks must manually be placed in the “inhibit” position to prevent ADS blowdown.

A sensitivity analysis was performed for HFA_0_ADSINHIBIT solely to address this RAI because it is a time critical action and the time available for recovery is short. In this sensitivity analysis, an execution error of commission was included with an estimated probability of 4.3E-04. Because the assumed execution error is small relative to the cognitive error, the model was not re-quantified. Instead the contribution to CDF or LERF was scaled with a ratio of the “new” HEP vs. the baseline HEP (i.e., [(3.0E-03+4.3E-04)/3.0E-03 = 3.43E-03]). The results are shown in the table below.

CDF

Unit	CDF MOR R7 Baseline	HFE	Prob	RAW[1]	FV[2]	Contribution (CDF * FV) Baseline	Contribution scaled (x 3.43E-03/ 3E-03)	Delta CDF
U1	6.932E-06	HFA_0_ADSINHIBIT	3.0E-03	1.71	2.12E-03	1.47E-08	1.68E-08	**2.11E-09**
		Assumed execution	4.3E-04					
U2	6.286E-06	HFA_0_ADSINHIBIT	3.0E-03	1.78	2.34E-03	1.47E-08	1.68E-08	**2.11E-09**
		Assumed execution	4.3E-04					
U3	7.724E-06	HFA_0_ADSINHIBIT	3.0E-03	1.63	1.90E-03	1.47E-08	1.68E-08	**2.10E-09**
		Assumed execution	4.3E-04					
[1] Risk Achievement Worth [2] Fussel-Vesely								

LERF

Unit	LERF MOR R7 Baseline	HFE	Prob	RAW[1]	FV[2]	Contribution (LERF * FV) Baseline	Contribution scaled (x 3.43E-03/ 3E-03)	Delta LERF
U1	1.257E-06	HFA_0_ADSINHIBIT	3.0E-03	3.48	7.46E-03	9.38E-09	1.07E-08	**1.34E-09**
		Assumed execution	4.3E-04					
U2	1.210E-06	HFA_0_ADSINHIBIT	3.0E-03	3.58	7.75E-03	9.38E-09	1.07E-08	**1.34E-09**
		Assumed execution	4.3E-04					
U3	1.446E-06	HFA_0_ADSINHIBIT	3.0E-03	3.16	6.48E-03	9.37E-09	1.07E-08	**1.34E-09**
		Assumed execution	4.3E-04					
[1] Risk Achievement Worth [2] Fussel-Vesely								

Conclusion

As shown in the last column of the table, the change in CDF and LERF when an assumed execution error is included is insignificant (i.e., much less than 1%). Therefore, there would be no impact to the ILRT model.

APLA RAI 03 (cont)

c. *F&O IFNS-A1-01 identified that a screening value of 0.1 was used for the failure of the door to the air conditioning equipment room to perform its intended function, without proper justification. In resolution to this F&O the licensee stated that it revised the analysis to include supporting information pertaining to the air equipment room door design characteristics and physical location that would describe the likely failure of the door in the event of flood accumulation in the room. A screening factor of 0.1 was determined to be conservative and used for the double glass double door emergency exit.*

   To validate the use of the screening value of 0.1 from the expert judgement applied, confirm that use of this value (0.1) does not screen out any scenarios that could potentially be non-negligible risk contributors for Internal Events. For any identified scenarios provide justification why the screening value is appropriate and confirm that the risk metrics for the application are still met.

TVA Response

TVA provided the response to this request on February 5, 2018 (ML18036A901).

APLA RAI 03 (cont)

d. *F&O 6-8 related to SR IE-C8 identified that the loss of Raw Cooling Water (RCW) initiating event appeared to be reduced by an incorrectly calculated factor and for combinations where it is potentially not valid. BFN provided a resolution which described the RCW success criteria and stated that the frequency is calculated by summing 1) all combinations of a failure of three pumps and 2) all combinations of the failure of a single running pump and the failure of two additional pumps included in the system initiating event model.*

RG 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities,'' Revision 2 (ADAMS Accession No. ML090410014) describes one acceptable approach for determining whether the technical adequacy of the PRA, in total or the parts that are used to support an application, is sufficient to provide confidence in the results, such that the PRA can be used in regulatory decision-making for light-water reactors. RG 1.200 references American Society of Mechanical Engineers (ASME)/American Nuclear Society (ANS) standard ASME/ANS RA-Sa-2009, "Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," which was issued as at-power Level 1 and limited Level 2 PRA standard. RG 1.200 refers to this standard as one acceptable approach to demonstrate conformance with Regulatory Position 1 is to use a national consensus PRA standard or standards that address the scope of the PRA used in the decision-making. ASME/ANS RA-Sa-2009 provides both process and technical requirements for an at-power Level 1 and limited Level 2 PRA for IEs, internal flood, internal fire, seismic, wind, external flood and other EEs.

Specifically SR IE-C8 states that "some initiating events are amenable to fault-tree modeling as the appropriate way to quantify them. These initiating events, which usually support system failure events, are highly dependent upon plant-specific design features. If fault-tree modeling is used for initiating events, USE the applicable systems-analysis requirements for fault-tree modeling found in Systems Analysis (2-2.4)".

Confirm what factor was used for the RCW initiating event frequency, and provide justification to support why the factor used is appropriate.

TVA Response

TVA provided the response to this request on February 5, 2018 (ML18036A901). As a result of a teleconference with the NRC on February 26, 2018, TVA is revising the response to APLA RAI 03d. The following revised response supersedes the response provided in ML18036A901.

The response to the 2009 F&O 6-8 used an incorrectly calculated factor and for combinations where it is potentially not valid. The 2015 peer view team noted this error while reviewing the BFN F&O responses. Subsequent to the 2015 peer review, TVA removed the basic event (SR IE-C8) from the Rev. 7 Model of Record (MOR), which was used in the original submittal. The original submittal provided the 2009 disposition of F&O 6-8 in error, and did not describe the change to the MOR for this issue. TVA did not remove the RCW initiating event from the BFN PRA Model. In the original 2009 BFN PRA model, a correction factor was applied to cutsets that included three or more RCW pump failure-to-run basic events, each with one-year exposure times. This action was an attempt to model the frequency of failure of a single pump during a year's exposure combined with the conditional failure of two additional RCW pumps. The peer review team identified that this method was not correctly calculating the RCW initiating event frequency. The BFN PRA model was subsequently revised to explicitly model every possible combination of a single RCW pump failure-to-run basic event (with a one year exposure time) and the conditional failure of at least two more RCW running pumps. Because the model was revised in this manner, no cutset was produced that has more than one RCW pump failure to run basic events with a one-year exposure time. Therefore, the correction factor referred to in the original peer review F&O is not needed or used.

APLA RAI 03 (cont)

e. *Fire F&O 2-50, associated with SR HRA-C1 identified that, for instances where cues for human actions involve multiple individual instrumentation devices, they are modeled in the PRA as multiple inputs to a single AND gate. In this model, the availability of any single instrument, with the majority of the other instruments failed, would not disable the human action. The peer review team determined that the licensee did not consider or confirm the development of operator guidance that would allow operators to discern which instrument is not impacted by the fire. In resolution to this F&O the licensee stated that the AND gate was maintained with an assumption that the fire procedures will include the impacted instrumentation for fires in the respective area. Therefore, as long as one instrument is available and the operators can determine from the applicable fire procedure which instrument is available, that instrument can be credited. Retaining this modeling as an AND gate for instrumentation failures, given the development of procedures that will guide the operator regarding which, if any, instrument remains functional, appears non-conservative. Perform a sensitivity analysis to confirm that the assumption and the risk metrics for this ILRT application continue to be met by either (1) using an OR gate or (2) including the probability of human failure to choose the functioning instrument if the AND logic is retained.*

TVA Response

TVA performed a sensitivity analysis that included the probability of human failure to choose the functioning instrument. The instrument logic is OR'd with its associated HFE per TVA Fire PRA - Task 7.12 Post-Fire Human Reliability Analysis. The instruments are grouped under this logic according to function. For example, if reactor vessel level, suppression pool level, and containment pressure are needed for an action, the logic will have three groups of sub-logic, one for each function. These functions are OR'd so if any one function fails, it will fail the action. Under each function, the modeled instrument trains are AND'ed.

While this AND'ing of instruments may seem non-conservative, an assumption is made that the fire impacted instrumentation trains will be denoted in the fire procedures so the operator will know which trains are reliable and which are not. Therefore, as long as all of the instrument trains are not fire impacted, the operator would have an available instrument train and know which train that is, from the procedures. If all of the trains are fire impacted, the action will fail. This assumption is consistent with the guidance given in the BFN Fire Safe Shutdown Procedures.

Section 4.0, Precautions and Limitations, 0-FSS-001 states the following:

> "When monitoring parameters such as reactor water level and reactor pressure, it is preferred to use the credited instrumentation directed by the procedure since other instrumentation may be unreliable due to the fire."

Additionally Attachment 11, Recovery Action Criteria, Section 1.0.L.1 states:

> "FSS procedures use the equipment identified by analysis to be the least likely to be impacted by the fire. Those systems and instrumentation needed for post fire recovery action are listed in tabular located with each Fire Safe Shutdown procedure. Operations Training reinforces the expectation to use those tables when placing systems in service during fire events."

Based on the expectations in the FSS procedures and the training expectations associated with use of instrumentation in the FSS procedures, the modeling of the instrumentation is appropriate. Even though the Fire Safe Shutdown procedures denote which instrumentation trains are fire impacted, the sensitivity analysis was performed to show the impact of an operator choosing an incorrect instrument.

As mentioned above, the instruments were grouped according to function in the fault tree model and a loss of all of the instruments within that function would have to occur before a particular operator action would be failed. Failure to choose the wrong instrument was already included in the cognitive portion of the HRA action. A decision tree for availability of information was used in the HRA Calculator.

<u>Conclusion</u>

A sensitivity analysis was performed that demonstrated that the probability of a human failure to choose the functioning instrument causes a negligible impact to the human failure probability. This sensitivity analysis confirms that the assumptions and the risk metrics for the original submittal continue to be met.

<u>APLA RAI 03 (cont)</u>

f. For fire PRA F&Os 4-12, 4-21, 9-2, 2-38, 2-39, and 2-50 listed in Table 51 of the LAR the licensee states that "the evaluation used the FPRA model that will represent BFN at the time this ILRT application is applied. Therefore, the HFEs that will be in place will no longer be a strategy employed by BFN for fire hazards." Provide clarification confirming that the HFEs that have been proposed to be modeled in the FPRA will be representative of the strategy employed (i.e., as built, as operated) upon completion of all NFPA 805 milestones.

<u>TVA Response</u>

TVA provided the response to this request on February 5, 2018 (ML18036A901).

APLA RAI 03 (cont)

g. *F&O 6-10 associated with SR IE-C8 identified that common cause failure (CCF) for battery chargers is not included in the initiating event fault tree for loss of two DC buses, other than for the standby chargers. The licensee's resolution to this F&O addresses the exclusion of the CCF for battery chargers beyond the 24-hour mission time and states that the data used for modeling the individual buses is so conservative that it would be overly conservative to include the CCF. Section 2-2.4, "Supporting Requirements for HLR-SY-B," of the ASME/ANS PRA as it pertains to Systems Analysis states, in part, that "MODEL intra-system common-cause failures when supported by generic or plant-specific data (an acceptable model is the screening approach of NUREG/CR5485, which is consistent with DA-D5) or SHOW that they do not impact the results."*

   Provide a quantitative basis for the conclusion that modeling the CCF battery chargers would be over conservative.

TVA Response

TVA provided the response to this request on February 5, 2018 (ML18036A901).

APLA RAI 04

Throughout the submittal inconsistencies in values were identified by NRC staff across tables, and some editorial context could not be understood or validated. Please address (correct) each of the below excerpts from the submittal and confirm that there was no impact on the application as a result of any changes made.

a. *In Table 4, 'Section 7.1.1', 'Section 7.1.2', and 'Section 7.1.4' does not correspond to the Equation/Section in the EPRI Report.*

b. *Table 8, for Collapsed Accident Progression Bin #7 the population dose factor is 0.488. This value does not correspond to the calculated value for Browns Ferry 50-Mile Dose of 3.81E+06.*

c. *Table 12 identifies class 3b as the population dose-rate increase due to extending the ILRT interval, and is inconsistent with the description in Section 8.3.2, Unit-1 Population Dose-Rate Calculations.*

d. *Table 31 identifies the external events contribution for Fire CDF to be 3.70E-06, 5.40E-06, 5.40 E-06 and LERF to be 6.73E-07, 1.04E-06, and 1.01E-06 for Units 1, 2, and 3 respectively. The table also identifies the Seismic CDF to be 5.03E-05, 5.64E-05, 5.92E-05 and LERF 5.47E-06, 5.37E-06, and 5.02E-06 for Units 1, 2, and 3 respectively. This is inconsistent with the values provided in Section 10.1, Seismic Discussion.*

e. *Table 32, confirm the LERF Increase value for Unit 3. This is inconsistent with Table 33.*

f. *Table 33, for Units 2, and 3 the values of 4.60E-02, and 4.51E-02 respectively, are inconsistent with the values from Tables 18, and 22, which lists 0.0417 and 0.0387, respectively.*

g. *Section A-1.0 states in part,*

> *A discussion of the TVA model update process, model history, peer reviews performed on the Browns Ferry models, the results of those peer reviews and the potential impact of peer review findings on the containment ILRT extension risk assessment are provided in…*

Provide a statement to complete the last sentence in the above paragraph.

h. *With respect to Table 31, of the BFN ILRT submittal, the staff acknowledges the discrepancy between the labeling of the Seismic row for the Fire values and vice-versa. Using those values for fire, the LERF fractions relative to CDF for Units 1, 2, and 3 are 0.109, 0.0952, and 0.0848 respectively. NRC staff determined that the values identified in Table 50 of the submittal for resolution of F&O 5-1 are inconsistent. Provide explanation for the discrepancies in the values and confirm the values in Table 31 are the updated and correct values.*

TVA Response

TVA provided the response to this request on February 5, 2018 (ML18036A901).

APLA RAI 05

For SR HR-G7 in Table 50 of the BFN ILRT submittal, the licensee states that "the MOR uses a minimum joint HEP threshold of 1E-07." During further review of the BFN NFPA-805 SE dated Oct 2015 (ML 15212A796) the NRC staff requested that the licensee provide justification with respect to the establishment of acceptable minimum (or "floor") values for HEP combinations. In its response to NPFA-805 PRA RAI 01.v (ML14363A057), and PRA RAI 24 (ML14363A057), the licensee indicated that it updated the FPRA to apply a floor value of 1.0E-05 to all HEP combinations that do not include long-term decay heat removal (DHR) HFEs for FPRA CDF or those HFEs that are cued and guided by Severe Accident Mitigation Guideline (SAMG) procedures for FPRA LERF. For the remaining combinations, the licensee stated that the FPRA applied a floor value of 1.0E-06, given that a low dependency exists between long-term DHR and SAMG actions and other earlier actions. In its response to NFPA-805 PRA RAI 24 (ML14363A057), the licensee indicated that the revised floor values were incorporated in the integrated analysis. Specific to the NFPA-805 application, the NRC staff concluded that this issue is resolved because the FPRA includes the use of floor values consistent with guidance contained in NUREG-1921. To support review:

a. *Confirm that the licensee's justification with respect to the establishment of acceptable minimum (or "floor") values for joint HEPs as described above for resolution in the FPRA for NFPA 805 remains the same and unchanged for the ILRT application. Subsequently, If the values used in the FPRA depart (are lower than) from the values provided in the NFPA-805 PRA RAI 01.v response, perform an updated sensitivity analysis that applies a floor value of 1.0E-05 to all joint HEP combinations and provide the results. Provide justification for any joint HEPs in which a value lower than the floor value (1.0E-05) has been determined to be acceptable for use.*

TVA Response

The Fire PRA (FPRA) values in the original submittal utilized the multiple HRA floor values from the NFPA 805 baseline case. A sensitivity analysis was performed in response to NFPA 805 PRA RAI 01.v and PRA RAI 24 that compared the FPRA CDF and LERF metrics from the baseline case that used multiple HRA floor values of 1E-05 and 1E-06 with a sensitivity analysis that used only one HRA floor value of 1E-05. The values from this sensitivity analysis are shown below in Table 1 (See TVA Response to APLA RAI 05b). However, as discussed in the response to NFPA-805 PRA RAI 01.v, in subsequent FPRA quantifications a joint probability floor will be used.

APLA RAI 05 (cont)

b. For the internal events PRA, identify if any of the joint HEPs uses a value less than the floor value of 1.0E-06.

1. *If so, perform a sensitivity analysis for all the joint HFEs using a floor value of 1.0E-06 and provide the results, and*
2. *Provide justification for joint HEPs in which a value lower than the floor value (1.0E-06) was determined to be acceptable for use.*

TVA Response

A minimum joint human error probability (JHEP) value is intended to capture uncertainty caused by commonalities such as operator heart attack and other factors that are not inherently addressed in the HRA dependency process. A sensitivity analysis was performed in MOR R7 that used a 1E-06 minimum JHEP floor value. The sensitivity analysis identified a large number of combinations that are generated using a JHEP minimum value of 1E-06 versus a JHEP minimum value of 1E-07 as discussed below. The CDF and LERF results from this sensitivity analysis are shown below in Table 2.

It should be noted that the BFN PRA is sensitive to the application of a large floor value, and the use of a large minimum JHEP value of 1E-06 was considered inappropriate for the following reasons:

- The BFN PRA model includes a large number of operator actions and these operator errors result in thousands of combinations. This large number of combinations caused not only difficulty in quantifying the model, but it resulted in the generation of a very large number of cutsets associated with the minimum JHEP floor value.

- The process used does not allow adequate subsuming of the issues/factors intended to be addressed by the minimum JHEP floor value because each combination has a unique identifier and the unique name prevents adequate subsuming of combinations that share the same causes.

- The model yields conservative results and the use of a 1E-06 minimum JHEP skews the results, which artificially masks the risk insights of systems and events. The primary insight was that the main contributor to risk was associated with selection of the minimum JHEP floor value.

As noted in the third bullet, using a higher minimum JHEP primarily forces a higher contribution to CDF or LERF as a function of the selected floor value.

For the Unit 1 CDF, out of the 12,534 potential HEP combination identified by the HRA Dependency Analysis, 961 JHEP events were observed when a minimum JHEP floor value of 1E-07 is selected and 1331 were observed when a minimum JHEP floor value of 1E-06 is used. However, the total contribution to CDF by the additional 370 cutsets was 8.58E-09/rx-yr (i.e., much less than 1%) of the estimated CDF (1.53E-05/rx-yr) that uses a JHEP with a floor of 1E-06 or the original baseline CDF (6.93E-06/rx-yr). Furthermore, the increase in CDF when 1E-06 is used as the JHEP minimum floor value is primarily driven by JHEP combinations that were already identified and included in the baseline results that use a 1E-07 as the JHEP minimum floor value (i.e., the difference is caused by the selection of a higher floor value). The net contribution to the CDF of the additional JHEPs is negligible, and no additional risk insights are generated.

For the Unit 2 CDF out of the 12,534 potential HEP combination identified by the HRA Dependency Analysis, 944 JHEP events were observed when a minimum JHEP floor value of 1E-07 is selected and 1344 were observed when a minimum JHEP floor value of 1E-06 is used. However, the total contribution to CDF by the additional 400 cutsets was 1.09E-08/rx-yr (i.e., much less than 1%) of the estimated CDF (1.41E-05/rx-yr) that uses a JHEP with a floor of 1E-06 or the original baseline CDF (6.29E-06/rx-yr). Furthermore, the increase in CDF when 1E-06 is used as the JHEP minimum floor value is primarily driven by JHEP combinations that were already identified and included in the baseline results that use a 1E-07 as the JHEP minimum floor value (i.e., the difference is caused by the selection of a higher floor value). The net contribution to the CDF of the additional JHEPs is negligible, and no additional risk insights are generated.

For the Unit 3 CDF out of the 12,534 potential HEP combination identified by the HRA Dependency Analysis, 764 JHEP events were observed when a minimum JHEP floor value of 1E-07 is selected and 1051 were observed when a minimum JHEP floor value of 1E-06 is used. However, the total contribution to CDF by the additional 287 cutsets was 1.24E-08/rx-yr (i.e. much less than 1%) of the estimated CDF (1.31E-05/rx-yr) that uses a JHEP with a floor of 1E-06 or the original baseline CDF (7.72E-06/rx-yr). Furthermore, the increase in CDF when a 1E-06 is used as the JHEP minimum floor value is primarily driven by JHEP combinations that were already identified and included in the baseline results that use a 1E-07 as the JHEP minimum floor value (i.e., the difference is caused by the selection of a higher floor value). The net contribution to the CDF of the additional JHEPs is negligible, and no additional risk insights are generated.

The results are quantified below.

Table 1

Table 1- FPRA Results			
	Baseline (1E-05 and 1E-06 HRA Floor Values)	HRA Floor Value of 1E-05 only	Delta from Baseline
U1 CDF	5.03E-05	6.78E-05	34.75%
U2 CDF	5.64E-05	7.38E-05	30.84%
U3 CDF	5.92E-05	7.74E-05	30.70%
U1 LERF	5.47E-06	1.05E-05	92.87%
U2 LERF	5.37E-06	1.10E-05	104.81%
U3 LERF	5.02E-06	1.08E-05	115.49%

Table 2

Table 2 - Internal Events Results			
	Baseline (1E-07 HRA Floor Value)	HRA Floor Value of 1E-06	Delta from Baseline
U1 CDF	6.93E-06	1.53E-05	120.78%
U2 CDF	6.29E-06	1.41E-05	124.17%
U3 CDF	7.72E-06	1.31E-05	69.69%
U1 LERF	1.26E-06	2.43E-06	92.86%
U2 LERF	1.21E-06	2.30E-06	90.08%
U3 LERF	1.45E-06	2.15E-06	48.28%

As discussed in EPRI 3002003150 "A Process for HRA Dependency Analysis and Considerations on Use of Minimum Values for Joint Human Error Probabilities," Technical Update, August 2016:

> "Highly reliably organizations can fail, and these failures are often due to a string of human errors or organizational deficiencies at different levels. These failures can be active or latent, and often significant events include a mix of the two. Through a review of the psychological literature and operational events, we can understand some of the factors that can affect human performance. **Some of these factors, however, cannot be explicitly accounted for in current HRA methods either for the evaluation of individual HEPs or as sources of dependence.** Furthermore, there may be unknown factors that can affect dependence. It is the collection of these known and unknown factors that are thought to constitute a fundamental limit on the reliability of a crew or organization…
> Furthermore, **indiscriminate application of a minimum joint HEP to account for these factors can be problematic. In some cases, application of a minimum value can be technically inappropriate in that it has the potential to skew risk insights and risk metrics and artificially inflate the total risk metric** (i.e., CDF, LERF) because of double (or multiple) counting of a single cause during the quantification process (see section 2.3.2). This in turn can lead to incorrect or masked insights and poor decision-making. In other cases, it can cause a dramatic increase in the quantification time and effort, even when there is no substantial change in the risk metrics."

Conclusion:

The above evaluation demonstrated that by increasing the floor value, additional combinations were identified. The evaluation also demonstrated a significant increase in the risk metrics. However, this evaluation indicated that the total contribution to CDF or LERF by the additional JHEPs is negligible. The major contributor to the increase in CDF or LERF comes from the JHEP cutsets which were already present using 1E-07 floor values. The increase in CDF or LERF was a function of the minimum JHEP. Further, the additional sensitivity analysis did not provide any significant insights (i.e., the results already indicated that JHEPs were significant contributors to risk). The higher the minimum JHEP, the higher the increase in the risk metrics. However, including an arbitrarily high value for the minimum JHEP, can skew the results and insights. The evaluation demonstrated that increasing the minimum JHEP can identify hundreds of additional combinations of operator errors. However, the contribution of the additional combinations was not significant.

APLA RAI 06 [Browns Ferry NFPA 805 License Condition, and Implementation Actions]

In Section 4.6.2, "PRA Technical Adequacy" of the submittal the licensee states in part, "The external events analyses include the current Fire PRA (FPRA) model which represents the plant after all modifications are implemented in support of transition to NFPA-805. This work is scheduled for completion in 2019. The FPRA model will represent the as-built, as-operated plant in the time period for the proposed extended containment ILRT interval." Provide the following information to address and confirm that the results of the licensee risk evaluation performed to support the requested extension for the ILRT in the submittal dated, August 15, 2017, will continue to meet RG 1.174 risk metrics, and the specific risk metrics for acceptance of an ILRT extension outlined in the NRC final safety evaluation for NEI 94-01 (ML 081140105), after the scheduled work is due to be completed and prior to the next scheduled ILRTs on October 10, 2020, March 2021, and March 2020 for Units 1, 2, and 3 respectively.

a. *Provide the status of all implementation items for Units 1, 2, and 3 from Table S-3, Implementation Items," of Tennessee Valley Authority letter CNL-15-191, dated September 8, 2015 (ML 15251A598), to complete transition to full compliance with 10 CFR 50.48(c) and delineated as Transition License Condition (3) in the staff safety evaluation issued for approval of BFN transition to a risk-informed performance-based fire protection program in accordance with 10 CFR 50.48 (c) (ML15212A796).*

TVA Response

TVA provided the response to this request on February 5, 2018 (ML18036A901).

b. *For modifications that are listed in Table S-2, as delineated in Transition License Condition (2) of the above safety evaluation, and credited in the as-built as-operated FPRA model:*

   EITHER

   1. *Perform a sensitivity that excludes the incomplete modification(s) to assess if the acceptance criteria for the ILRT risk metrics continue to be met. This sensitivity should also incorporate the approved-NRC fire methods from RAI 02.a and provide updated tables that include total LERF, ΔLERF, PDR, and CCFP for each unit to assess the risk impact.*

      OR

   2. *Propose a license condition requiring that for the requested ILRT extensions, all modifications that are credited in the as-built as-operated FPRA model listed in Tables S-2 of the TVA letters dated September 8, 2015 and October 20, 2015 will be completed immediately following the first outage of occurrence, for the next scheduled ILRT for each respective unit.*

TVA Response

TVA provided the response to this request on February 5, 2018 (ML18036A901).