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

CNL-15-035

February 27, 2015

10 CFR 2.202
10 CFR 50.4

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

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

Subject: **Fourth Six-Month Status Report in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) for Browns Ferry Nuclear Plant (TAC Nos. MF0902, MF0903, and MF0904)**

References:

1. NRC Order Number EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated March 12, 2012 (ML12054A735)

2. NRC Interim Staff Guidance JLD-ISG-2012-01, "Compliance with Order EA-12- 049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," Revision 0, dated August 29, 2012 (ML12229A174)

3. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 0, dated August 2012 (ML12242A378)

4. Letter from TVA to NRC, "Tennessee Valley Authority (TVA) - Initial Status Report in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated October 29, 2012 (ML12307A104)

5. Letter from TVA to NRC, "Tennessee Valley Authority (TVA) - Overall Integrated Plan in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) for Browns Ferry Nuclear Plant," dated February 28, 2013 (ML13064A465)

6. Letter from TVA to NRC, "First Six-Month Status Report in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) for Browns Ferry Nuclear Plant," dated August 28, 2013 (ML13247A284)

7. Letter from NRC to TVA, "Browns Ferry Nuclear Plant, Units 1, 2, and 3 – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Mitigation Strategies) (TAC Nos. MF0902, MF0903, and MF0904)," dated December 19, 2013 (ML13353A166)

8. Letter from TVA to NRC, "Second Six-Month Status Report in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) for Browns Ferry Nuclear Plant (TAC Nos. MF0902, MF0903, and MF0904)," dated February 28, 2014 (ML14064A240)

9. Letter from TVA to NRC, "Third Six-Month Status Report in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) for Browns Ferry Nuclear Plant (TAC Nos. MF0902, MF0903, and MF0904)," dated August 28, 2014 (ML

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued an order (Reference 1) to Tennessee Valley Authority (TVA). Reference 1 was immediately effective and directs TVA to develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities following a beyond-design-basis external event. Specific requirements are outlined in Attachment 2 of Reference 1.

Reference 1 required submission of an initial status report 60 days following issuance of the final interim staff guidance (Reference 2) and an overall integrated plan pursuant to Section IV, Condition C. Reference 2 endorses industry guidance document Nuclear Energy Institute (NEI) 12-06, Revision 0 (Reference 3) with clarifications and exceptions identified in Reference 2. Reference 4 provided the TVA initial status report regarding mitigation strategies. Reference 5 provided the TVA Browns Ferry Nuclear Plant (BFN), Units 1, 2, and 3 overall integrated plan.

Reference 1 requires submission of a status report at six-month intervals following submittal of the overall integrated plan. Reference 3 provides direction regarding the content of the status reports. TVA provided the first six-month status report on August 28, 2013 (Reference 6). The NRC issued its Interim Staff Evaluation regarding TVA's overall integrated plan on December 19, 2013 (Reference 7). TVA provided the second six-month status report on February 28, 2014 (Reference 8) and the third six-month status report was provided August 28, 2014 (Reference 9).

The purpose of this letter is to provide the fourth six-month status report pursuant to Section IV, Condition C.2, of Reference 1, that delineates progress made in implementing the requirements of Reference 1. The Open Items table in the Enclosure has been updated. The milestone target completion dates have also been updated as shown in Attachment 2 of the Enclosure.

There are no regulatory commitments in this letter. If you have any question regarding this submittal, please contact Mike Oliver at (256) 729-7874.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 27th day of February 2015.

Respectfully,

J. W. Shea
Vice President, Nuclear Licensing

Enclosure: Tennessee Valley Authority Browns Ferry Nuclear Plant's Fourth Six Month Status Report for the Implementation of Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events

cc (Enclosure):

NRR Director - NRC Headquarters
NRO Director - NRC Headquarters
NRC JLD Director - NRC Headquarters
NRC Regional Administrator - Region II
NRC Project Manager - Browns Ferry Nuclear Plant
NRC JLD Project Manager - Browns Ferry Nuclear Plant
NRC Senior Resident Inspector - Browns Ferry Nuclear Plant

ENCLOSURE

TENNESSEE VALLEY AUTHORITY BROWNS FERRY NUCLEAR PLANT'S FOURTH SIX MONTH STATUS REPORT FOR THE IMPLEMENTATION OF ORDER EA-12-049, ORDER MODIFYING LICENSES WITH REGARD TO REQUIREMENTS FOR MITIGATION STRATEGIES FOR BEYOND-DESIGN-BASIS EXTERNAL EVENTS

1 Introduction

Browns Ferry Nuclear Plant (BFN) developed an Overall Integrated Plan (Reference 1 in Section 8), documenting the diverse and flexible strategies (FLEX), in response to Reference 2. This attachment provides an update of milestone accomplishments since submittal of the third six-month status report regarding the Overall Integrated Plan, including any changes to the compliance method or schedule.

2 Milestone Accomplishments

The following milestone(s) have been completed since the development of the Overall Integrated Plan (Reference 1 in Section 8), and are current as of February 16, 2015.

- Perform Staffing Analysis
- U2 Design Engineering
- Develop Strategies with RRC
- Develop Training Plan

3 Milestone Schedule

The following provides an update to Attachment 2 of the Overall Integrated Plan. It provides the activity status of each item, and whether the expected completion date has changed. The dates are planning dates subject to change as design and implementation details are developed.

The revised milestone target completion dates do not impact the order implementation date.

Activity	Original Target Date	Activity Status	Revised Target Completion Date
Submit Overall Integrated Plan	February 2013	Complete	
Submit 6 Month Updates:			
Update 1	August 2013	Complete	
Update 2	February 2014	Complete	
Update 3	August 2014	Complete	
Update 4	February 2015	Complete	
Update 5	August 2015	Not Started	
Update 6	February 2016	Not Started	
Update 7	August 2016	Not Started	
FLEX Strategy Evaluation	March 2014	Complete	

Activity	Original Target Date	Activity Status	Revised Target Completion Date
Unit 1 - Validation of connection points for FLEX Phase 2 & 3 via walkthrough or demonstration. (Graded approach)	November 2016	Not Started	
Unit 2 - Validation of connection points for FLEX Phase 2 & 3 via walkthrough or demonstration. (Graded approach)	April 2015	Started	
Unit 3 - Validation of connection points for FLEX Phase 2 & 3 via walkthrough or demonstration. (Graded approach)	April 2016	Not Started	
Perform Staffing Analysis	January 2015	Complete	
Modifications:			
Modifications Evaluation	March 2014	Complete	
Unit 1 N-1 Walkdown	October 2014	Complete	
Unit 1 Design Engineering	November 2014	In-Progress	August 2015
Unit 1 Implementation Outage	November 2016	Not Started	
Unit 2 N-1 Walkdown	March 2013	Complete	
Unit 2 Design Engineering	December 2014	Complete	
Unit 2 Implementation Outage	April 2015	In-Progress	
Unit 3 N-1 Walkdown	March 2014	Complete	
Unit 3 Design Engineering	November 2014	In-progress	April 2015
Unit 3 Implementation Outage	April 2016	Not Started	
Storage:			
Storage Design Engineering	August 2014	Complete	
Storage Implementation	April 2015	Started	
FLEX Equipment:			
Procure On-Site Equipment	January 2015	In-Progress	March 2015
Develop Strategies with RRC	February 2015	Complete	
Install Off-Site Delivery Station	April 2015	Started	
Procedures:			
BWROG issues FSG guidelines	April 2014	Complete	
Create Browns Ferry FSGs	April 2015	In-Progress	
Create Maintenance Procedures	April 2015	In-Progress	
Training:			
Develop Training Plan	December 2014	Complete	
Implement Training	February 2015	In-Progress	March 2015
Unit 1 FLEX Implementation	November 2016	Not Started	
Unit 2 FLEX Implementation	April 2015	In-Progress	
Unit 3 FLEX Implementation	April 2016	Not Started	
Full Site FLEX Implementation	November 2016	Not Started	
Submit Completion Report	December 2016	Not Started	

4 Changes to Compliance Method

The following is a list of changes made to the information provided in the August 28, 2013, Overall Integrated Plan (Reference 1) and not provided in previous 6 month updates. These changes meet the NEI 12-06 compliance method.

4.1 Section 1, Liquefaction, was changed to read as follows:

The Emergency Equipment Mobilization Routes for BFN Plant were evaluated (Ref. 35a through 3). These evaluations covered the haul routes from off-site Staging Areas C and D to Staging Area B, and from Staging Area B to the Protected Area Fence. It included a review of areas that were of concern for liquefaction and other possible failure modes. This evaluation concluded that the state routes from off-site Staging Areas C and D to the on-site Staging Area B may not be available subsequent to the occurrence of a significant seismic event and alternate means to transport equipment may be required. Two paths from each off-site staging area have been considered. In case of severe seismic and flood events, if the state routes are not passable for both primary and alternate path, alternate air transportation arrangements are available and included in the BFN SAFER Response Plan (Ref. 26a). In all other areas, including paths from Staging Area B to FLEX pump pads, the displacements were estimated not to exceed +/- 3" which is relatively small and therefore, considered acceptable for deployment paths and staging. For those deployment paths inside the protected area fence, the liquefaction study done for the ISFSI pad (Ref. 5j) demonstrate that the relatively short distance inside the protected area fence will not be susceptible to any significant liquefaction and hence is acceptable as a deployment path.

4.2 Section 2, Key Assumptions, was completely rewritten to reflect assumptions given in NEI 12-06 Section 3.2.1, General Criteria and Baseline Assumptions.

4.3 Section 4, Discussion of time constraints identified in Attachment 1A table, and Attachment 1A, Sequence of Events Timeline, were revised as follows:

- Items 1-3: Deployment time for all FLEX Pump Systems changed from 6 hours to 9 hours; deployment time for 480v FLEX generator changed from 6 hours to 8 hours.
- Item 8: Revised to add information on environmental qualification of ADS SRV solenoids.
- Item 9-11: Items were re-ordered to accurately reflect sequence of performance during the event.
- Item 13: Completion of battery load shed changed for 4 hours to 1 hour to comply with results of BFN battery analysis.
- Item 14: Pressure band after cooldown changed from "above 150 psig" to "200-250 psig".
- Item 16: Battery coping time changed from 8 hours to 12 hours.
- Item 17: Revised to remove references to further evaluations and improvements. Deployment for the first FLEX Pump System is 8 hours.
- Technical Basis Support information, Item Number 2: Rewritten to state BFN performed site specific analyses to provide the bases for actions and timing of the FLEX strategies.

4.4 Maintain Core Cooling, Section 10, Power Operation, Startup, and Hot Shutdown, changed to read as follows:

At the initiation of the Beyond-Design-Basis External Event (BDBEE), Main Steam Isolation Valves (MSIVs) automatically close, feedwater is lost, and Safety Relief Valves (SRVs) automatically cycle to control pressure, causing reactor water level to decrease. When reactor water level reaches -45 inches from instrument zero, Reactor Core Isolation Cooling (RCIC), and High Pressure Coolant Injection (HPCI), automatically start with normal suction from the Condensate Storage Tanks (CST) and inject to the RPV. Condensate Storage Tanks (CSTs) at BFN are not qualified for all the hazards listed in Section 1 and therefore, are not credited for Phase 1 coping, but they would be used if available. If not available, the HPCI suction will automatically transfer to the suppression pool, and HPCI will restore RPV level. RCIC suction will be manually transferred using 1,2,3-EOI Appendix-20M, RCIC Operation during Station Blackout (Ref. 11i), and RCIC will assist in restoring RPV level. When RCIC operation is restored, HPCI will be tripped and manually locked out. It remains available for injection if needed, but due to its larger DC load requirements and steam use/injection rate, it is used only if RCIC is unavailable. All equipment and valves necessary to operate HPCI and RCIC are powered from the station Class 1E batteries and remains available throughout the event.

Main Steam Relief Valves (MSRVs) will be used for pressure control. Within 20 minutes, a cooldown is initiated near the maximum allowable rate (100°F/hour), per the guidance given in GEH Evaluation of FLEX Implementation Guidelines (Ref. 18) and AOI-57-1A, Station Blackout (Ref. 9a). Power for the MSRVs is supplied by the Class 1E station batteries and remains available throughout the event. At event initiation the nitrogen storage tank, with a backup supply from the Containment Atmosphere Dilution system, automatically supplies pneumatic pressure for MSRV operation. However, these nitrogen tanks are not designed to withstand all BDBEE. Each of the 6 Automatic Depressurization System (ADS) MSRV is provided an accumulator which contains enough pneumatic pressure to operate each valve through five open/close cycles, per the Updated Final Safety Analysis Report (UFSAR) (Ref. 1e). An alternate nitrogen (N2) supply is being added (Ref. 15e.) and is available to be manually connected using 1,2,3-EOI Appendix-20H Alternate N2 Supply to SRVs (Ref. 11f) if needed. BFN EOIs have been revised to allow termination of RPV depressurization at a pressure that will allow continued RCIC operation, because steam driven RCIC is the sole means of core-cooling (approximately 200-250 psig)

After confirmation that the Emergency Diesel Generators (EDGs) cannot be restarted, but no later than 15 minutes, the crew enters 0-FSI-1 FLEX Response Instruction (Ref. 14a). Personnel will be dispatched to perform DC load shed in order to increase availability of the batteries to at least 12 hours. New procedure, O-FSI-3F Load Shed of 250V Main Bank Batteries 1,2,3 (Ref. 14c), will be used to perform the load shed.

In order to assure continued operation with high RCIC room temperatures, 2 EOI appendices are directed to be performed by the AOI (Ref 9 a.). 1,2,3-EOI Appendix-16K (Ref. 11c) is performed to bypass the RCIC area high temperature isolations. 1,2,3-EOI Appendix-20M (Ref. 11i) is performed, and it contains steps to

disable the RCIC EG-M and control flow with the RCIC trip/throttle valve, FCV-71-9. The EG-M is susceptible to failure at room temperatures above 150°F, which occurs at approximately 7-8 hours into the event. These appendices are performed as soon as the AOI (Ref. 9a.) is entered.

RCIC exhaust and MSRV cycling will increase torus and drywell temperatures and pressures. During an extended SBO beyond the plant design basis, local temperatures may increase to the extent that the RCIC exhaust can no longer be completely condensed. It is appropriate to vent the relatively clean RCIC discharge through the containment vent path to maintain pressure suppression capability and avoid emergency RPV depressurization. Containment venting will be performed in accordance with EOIs (Ref. 10b) and AOIs (Ref 9a) to limit containment parameters. Without venting, containment design temperatures and pressures may be exceeded. BFN MAAP analysis (Ref. 5e) and GEH guidelines (Ref. 18) indicate containment stability can be maintained during Phase 1 of the event.

4.5 Maintain Core Cooling, Section 11, BWR Portable Equipment Phase 2, Primary Phase 2 Strategy for a unit that is not in cold shutdown, and Alternate Phase 2 Strategy for a unit that is not in cold shutdown, have been changed to read as follows:

Phase 2 strategy for a unit that is not in cold shutdown.

During Phase 2, as in Phase 1, the preferred coping strategy for reactor core cooling is using RCIC. In addition to actions taken during Phase 1, RCIC will be supplied with cooling water from FPS1 for the lube oil cooler.

During Phase 2, reactor pressure is controlled by manual operation of MSRVs as described in Phase 1. An alternate supply of N2 for the BFN Drywell Control Air system headers Loop A and Loop B is being installed for control of MSRVs following a BDBEE (Ref. 15e). The quantity of N2 cylinders required to meet system requirements for a BDBEE has also been established (Ref. 5i). RCIC will, as plant parameters dictate, be secured with vessel makeup taken over by the FLEX pump strategy. RPV pressure will be lowered with MSRVs, and injection will commence using a FLEX pump strategy.

The FLEX pump strategy will use the Tennessee River as their source of suction supply. The pumps will be deployed to the staging area (Attachment 3, Figure 3). Debris entering into the suction of the pumps will be mitigated by strainers located in the suction supply flowpath.

The BWROG has issued BWROG-TP-14-006, Rev. 0 March 2014, "Fukushima Response committee Raw Water Issue: Fuel inlet blockage from debris" (Ref. 17d), to address fuel blockage from debris present in raw water injection. If the fuel inlet becomes blocked, assuring that injected water reaches the inside core shroud region and thus enter the fuel through the top of the channel is the primary strategy. An expanded reactor water level band has been approved by the BWROG Emergency Procedures Committee (Ref. 17b) and is utilized by BFN procedures (Ref. 9a, 10a).

4.6 Maintain Containment, Section 13, BWR Installed Equipment Phase 1, changed to read as follows:

The current as-designed HCVS is capable of preventing the pressure in the pressure suppression chamber (torus) from exceeding the primary containment pressure limit of 56 psig, for a single unit, by releasing 1 percent thermal power for the BFN units which have been upgraded to 3458 MWt. This vent will later be modified in accordance with the schedule for NRC Order EA-13-109 "Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions"(Ref. 2d). The revised schedule and implementation timeline contained in NRC Order EA-13-109 impacts the ability to achieve full implementation of the mitigations strategy requirements of NRC Order EA-12-49 (Ref. 2b) with respect to current required dates for BFN Units 2 and 3. Relaxation and request for extension of the requirements contained in NRC Order EA-12-49 has been approved (Ref. 2f). BFN Unit 1 will comply with the timeline required by NRC Order EA-12-049 and EA-13-109. In the interim, the primary strategy for maintaining containment is through the use of the current as-designed Hardened Containment Vent System (HCVS) to remove heat from the Suppression Pool.

Anticipatory venting utilizing the Hardened Containment Vent will be performed by direction of BFN AOIs (Ref. 9a) and EOIs (Ref. 10b) during the first several hours of the event based on BFN calculation (Ref. 5e) and GEH recommendations (Ref. 18). This venting is performed well before containment limits are approached. The impact on RCIC Pump Net Positive Suction Head (NPSH) is monitored using curves and cautions provided on EOI-1 (Ref. 10a).

4.7 Maintain Containment, Section 14, BWR Portable Equipment Phase 2, changed to read as follows:

The Phase 2 strategy to maintain containment uses the HCVS for torus venting to maintain containment parameters within EOI limits (Ref. 10a). This is a continuation of the Phase 1 strategy, with the addition of the portable 480v FLEX Generator as discussed in the Maintain Core Cooling-(Section 11) BWR Portable Equipment Phase 2 section.

The HCVS is powered from the Class 1E Unit Batteries. As described in the Maintain Core Cooling (Section 11) BWR Portable Equipment Phase 2 section, the 480v FLEX Generator will be deployed to provide power to all 3 Unit Battery Chargers, to maintain sufficient battery power to operate the HCVS DC solenoids.

In addition, suppression pool level is controlled during Phase 2 to maintain containment. As described in the Maintain Core Cooling (Section 11) BWR Portable Equipment Phase 2 section, the FLEX Pumping Strategy can be utilized for suppression pool makeup as required by EOIs (Ref. 10a, 10b).

RCIC may still be in service for all or part of Phase 2. If suction has been from the CST during the event, suppression pool level may become high. EOIs (Ref. 10b) require transfer of RCIC suction supply from CST to the suppression pool, or removal of water from the suppression pool, to prevent excessively high level. The CST is not credited as being able to sustain all the events listed in Section 1; however, it would be used if available, because it provides additional margin before

containment temperature is challenged, and it reduces the temperature of the RCIC bearing cooler.

4.8 Maintain Containment, Section 15 BWR Portable Equipment Phase 3, changed to read as follows:

For Phase 3, the containment cooling maintenance strategy is initially the same as the strategy being implemented in Phase 2 (containment venting via the hardened wetwell vent in accordance with existing procedures and design).

Phase 3 will provide additional support to continue and reinforce the Phase 2 strategy. Phase 3 will provide generators & load distribution centers, pumps to backup FPS1, FPS2, & FPS3, additional diesel fuel, supplies and redundancy for the FLEX equipment being used. Additionally, Phase 3 equipment capable of providing for demineralized water to makeup to the torus, Spent Fuel Pool (SFP), and Reactor Pressure Vessel (RPV) as necessary. See Section 23 for a detailed list of equipment available for Phase 3.

4.9 Maintain Spent Fuel Pool Cooling, Section 16 BWR Installed Equipment Phase 1, changed to read as follows:

There is no installed equipment to cope with this event. When the event is entered, procedures (Ref. 9 a, 10c) direct calculation of fuel pool heatup , routing/securing of makeup hoses to the fuel pool edge (Ref. 14 b), and monitoring level (Ref. 10a). Direction will also be given to open doors to help maintain refuel floor temperature. Walkdowns of procedures indicate these actions will be complete within 2 hours. No further actions are taken until FLEX pump strategy is available and Phase 2 is entered.

During operation with a normal SFP heat load, the maximum heatup rate is approximately 3°F/hour. Starting from a Technical Specification maximum temperature of 150°F, the time to boil is approximately 21 hours. The FLEX pump strategy will be available within 8 hours, adequate time to provide makeup to the SFP prior to loss of inventory.

During operation with a full core offload, BFN calculations (Ref. 5d) data shows the following:

- Time for the SFP to boil is 2.3 hours.
- Required makeup to offset boil off is 150 gallons per minute.
- Time required for level to reach 8.5 feet above top of the fuel racks is 19 hours.
- Pool level will lower approximately 6 feet before makeup is available. Approximately 17 feet of water remains above the top of the spent fuel.

When the FLEX pump strategy become available, makeup to the SFP can be initiated without access to the Refuel Floor. The makeup rate fro the FLEX pump strategy is greater than the boil off rate of the pool (Ref. 5l).

4.10 Maintain Spent Fuel Pool Cooling, Section 18 BWR Portable Equipment Phase 3, changed to read as follows:

For Phase 3, the spent fuel pool cooling maintenance strategy is initially dependent on the strategy being implemented in Phase 2 (primary or alternate); however, the end state strategy is the same.

Phase 3 will provide additional support to continue and reinforce the Phase 2 strategy. Phase 3 will provide generators & load distribution centers, pumps to backup FPS1, FPS2, & FPS3, additional diesel fuel, supplies and redundancy for the FLEX equipment being used. Additionally, Phase 3 equipment capable of providing for demineralized water to makeup to the torus, SFP, and Reactor Pressure Vessel (RPV) as necessary. See Section 23 for a detailed list of equipment available for Phase 3.

Primary Strategy when SFP heat load is high (early in cycle after an offload).

The additional capacity provided by the Phase 3 equipment could be used in several ways. The Fuel Pool Cooling system could be returned to service, using power from the Phase 3 generators and cooling water supplied from the FLEX pumps.

4.11 Safety Functions Support, Section 19, RCIC Room Habitability, changed to read as follows:

RCIC Room Habitability

Draft calculations indicate RCIC room temperature will exceed 150°F , the RCIC EG-M limit, in approximately 7-8 hours. At 200°F failure occurs (Ref. 17f). In order to assure continued operation with high RCIC room temperatures, 2 EOI appendices are directed to be performed by the AOI (Ref 9a). EOI Appendix-16K (Ref. 11c) is performed to bypass the RCIC area high temperature isolations. EOI Appendix-20M (Ref. 11i) is performed, and it contains steps to disable the RCIC EG-M and control flow with the RCIC trip/throttle valve, FCV-71-9. These appendices are performed as soon as the SBO flowchart (Ref. 15a) is entered and do not require entry into the RCIC room. At approximately one hour into the event, entry into the room for approximately 30 minutes will be required to perform initial lineup of the cooling water supply to the RCIC oil cooler (Ref. 14b). The temperature at this time is low enough that protective measures are not required.

At approximately 8 hours, FLEX pumps are available for service allowing RCIC to be shutdown, if necessary.

For the purposes of NEI 12-06 (Ref. 3), it is not anticipated that continuous habitability would be required in the RCIC pump room.

Other areas/rooms at BFN were evaluated. The rooms selected contain equipment necessary and/or desired for coping with emergency plant functions during an ELAP condition. These areas are not anticipated to require continuous habitability. If personnel entry is required into these areas, then personal protective measures such as ice vests will be taken.

4.12 Safety Functions Support, Section 19, added the following:

Lighting

Portable lighting in the Control Bay will be established as required using LED light stands (Ref. 14d). All plant Assistant Unit Operators (AUOs) are required to carry flashlights (Ref. 6c), with additional lights/batteries are available (Ref. 37). FLEX Support Instructions contain steps directing the use of flashlights.

4.13 Safety Functions Support, Section 20, BWR Portable Equipment Phase 2, RHR/CS Habitability, change to read as follows:

No entry to the RHR/CS rooms, other than the RCIC area, is required during Phase 2 operations. If personnel entry is required into the pump room, then personal protective measures such as ice vests will be taken.

4.14 Safety Functions Support, Section 20, Engineered Safety Feature (ESF) Switchgear Rooms, changed to read as follows:

Engineered Safety Feature (ESF) Switchgear Rooms

For Phase 2, there is limited access required to these rooms, with none requiring continuous occupation. Calculations (Ref. 5c) indicate that none of the rooms will exceed 110°F if required ventilation is established. Procedures (Ref. 14d) will be performed to establish the required open doors, fans and ductwork required by the calculation.

4.15 Safety Functions Support, Section 20, BWR Portable Equipment Phase 2, Section 20b, List Modifications, changed to read as follows:

DCN 71470, 480v Generator (Ref. 15b) provides an adequate staging area above the PMF for the 480v generators and a permanently installed load distribution center to provide power to the class 1E safety related battery chargers and other auxiliary power requirements such as temporary Control Building ventilation.

4.16 BWR Portable Equipment, (section 22) BWR Portable Equipment Phase 2, changed as follows:

- added twelve portable ventilation fans and ductwork
- added twenty portable LED light stands, and
- changed number of compact track loaders from two to one.

4.17 BWR Portable Equipment, (section 23) BWR Portable Equipment Phase 3, changed to read as follows:

(Section 23) BWR Portable Equipment Phase 3							
Use and (potential / flexibility) diverse uses						*Performance Criteria*	*Maintenance*
List portable equipment	*Core*	*Containment*	*SFP*	*Instrumentation*	*Accessibility*		*Maintenance/PM requirements*
Three Low Pressure High Flow Pumps	X	X	X			5000 gpm 150 psig	Will follow EPRI template requirements
Six Suction Booster Lift Pumps	X	X	X			5,000 gpm 26 ft Lift	Will follow EPRI template requirements
Three Low Pressure/Medium Flow Pumps	X	X	X			2500 gpm 300 psig	Will follow EPRI template requirements
Three RPV Makeup Pumps	X					500 gpm 500 psig	Will follow EPRI template requirements
Three High Pressure Injection Pumps	X					60 gpm 2000 psig	Will follow EPRI template requirements
Six Medium Voltage Generators	X	X	X	X	X	4kv 1.1MW	Will follow EPRI template requirements
Six Low Voltage Generators	X	X	X	X		480 V 1000 KW	Will follow EPRI template requirements
Hoses, adapters and connectors	X	X	X		X	As required to implement strategies	Will follow EPRI template requirements
Three Diesel Transfer Pumps	X	X	X	X		200 gpm	Will follow EPRI template requirements
Nine Mobile Lighting Towers							Will follow EPRI template requirements
Three Portable Diesel Fuel Transfer Pumps						60 gpm	Will follow EPRI template requirements
Three Diesel Fuel Air Lift Containers						500 gal.	Will follow EPRI template requirements
Three Portable Diesel Fuel Tanks with attached Transfer Pumps						264 gal 25 gpm DC 30 gpm AC	Will follow EPRI template requirements
Three Mobile Water Purification Units	X	X	X			250 gpm ea., Reverse Osmosis	Will follow EPRI template requirements
Three Water treatment pre-filters						500 gpm ea.	Will follow EPRI template requirements

4.18 (Section 24) Phase 3 Response Equipment/Commodities changed as follows:

- Commodities, changed to read " **TVA procedures (Ref. 38) directs the provision of lodging and meals, as necessary, for critical personnel when abnormal conditions exist."**
- Portable Interior Lighting changed to read: **EPIP-12, Emergency Equipment and Supplies (Ref. 37) contains the provisions for storing and maintaining personnel lighting and batteries in a protected facility.**
- Personnel Equipment deleted.

5 Need for Relief/Relaxation and Basis for the Relief/Relaxation

TVA has requested and received relaxation from full implementation until the completion of the spring 2017 refueling outage for BFN Unit 2 and the spring 2018 refueling outage for BFN Unit 3 to allow sufficient time to implement a severe accident capable hardened containment wetwell vent (Reference 6 in Section 8).

6 Open Items from Overall Integrated Plan and NRC Evaluation

The following tables provide a summary of the open items documented in the Overall Integrated Plan or the NRC Evaluation and the status of each item.

Overall Integrated Plan Open Item		Status
OI-1:	Flood and seismic re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 are not completed and therefore not assumed in this submittal. As the re-evaluations are completed, appropriate issues will be entered into the corrective action system and addressed.	Started
OI-2:	Liquefaction of haul routes for FLEX will be analyzed from Staging Area B to Staging Area A. Also, an evaluation will be conducted of haul routes from Staging Area D and Staging Area C to Staging Area B.	**Closed.** Liquefaction study for path from Staging Area B to the West Access Portal is performed by Amec Environment and Infrastructure Inc and is documented in their report dated August 19, 2014. The report concluded that liquefaction induced settlement will not exceed 2.5" and cracking due to lateral spreading will be insignificant. The Staging Areas inside the Protected Area (PA) were evaluated during construction of ISFSI Pad and it was determined that there would be no significant displacement (< 1.0") due to SSE seismic event (Ref Calc No. CDQ007920030261). Therefore, it can be concluded that paths to the staging areas inside the protected area will not be susceptible to any significant deformations that would impact deployment of FLEX Equipment after any severe seismic event.

Overall Integrated Plan Open Item	Status
OI-3: TVA will confirm that they have enough fuel onsite for the first 24 hours. A diesel fuel storage and refueling plan also has to be developed.	**Closed.** The duration of the ELAP is 72 hours and all permanent plant sources of AC power are considered unavailable. The T/Gs will burn No. 2 Diesel Fuel at a full load consumption rate of 110 gallons/hour per T/G. The T/Gs are not provided with their own fuel oil storage tanks. Two portable trailer mounted "Transcube" fuel oil storage tanks with 1200 gallon of No. 2 Diesel Fuel each will be stored in the FESB and available for deployment with the 480V and 4kV generator sets. Each "Transcube" will be equipped with adequate hose, valves, manual priming pump, and compatible connections necessary to support initial generator operation. One dedicated "Transcube" for the 480V generator will provide adequate fuel for the first 10 hours of operation, and one shared "Transcube" between the two 4kV generators for the first 5 hours. Three Gorman-Rupp portable diesel engine driven self-priming centrifugal diesel fuel pumps will be stored in the FESB. These pumps can be staged to transfer fuel oil from any of the eight Diesel 7 Day fuel oil storage tanks with a Tech Spec minimum capacity of >35,280 gal each, or one of two fuel oil storage tank located on the east side of the plant. The total combined Technical Specification minimum volume for the 8 installed EDGs is 282,240 gallons.
OI-4: BFNP will evaluate SRV qualification against the predicted containment response with FLEX implementation to ensure there will be sufficient DC bus voltage and pneumatic pressure to operate the SRVs throughout Phase 1 and Phase 2.	Started

Overall Integrated Plan Open Item	Status
OI-5: A reference source for the plant operators will be developed that provides approaches to obtaining necessary instrument readings to support the implementation of the coping strategy (NE 12-06, Section 3.2.1.1 0). This reference source should include control room and non-control room readouts and should also provide guidance on how and where to measure key instrument readings at containment penetrations, where applicable, using a portable instrument (e.g., a Fluke meter). Such a resource could be provided as an attachment to the plant procedures/guidance. Guidance will include critical actions to perform until alternate indications can be connected and on how to control critical equipment without associated control power.	**Status: Closed.** 0-FSI-6C, "Key Instrument Readings During Loss of DC Power", is a new FLEX procedure that has been developed to provide guidance during a BDBEE with the loss of instrument power. A 3-Tiered approach to FLEX measurement strategies as follows (all three tiers may not be applicable for every measurement to be obtained): TIER 1: Provide power to primary instruments (i.e. transmitter or RTD) and measure at locations directly accessible from the Control Bay. These locations are the Auxiliary Instrument Rooms or Electric Board Rooms. Primary instrument wiring would be lifted and handheld devices connected which provide both power and measuring capabilities. TIER 2: Provide power to primary instruments and measure at Reactor Building locations. These locations are within Secondary Containment. Primary instrument wiring would be lifted and handheld devices connected which provide both power and measuring capabilities. TIER 3: Provide alternate instruments to measure the desired parameters as close to the process as is practical.
OI-6: Validate the preliminary Battery studies that were performed to ensure appropriate battery life will be available with regards to the overall FLEX strategies. Ensure that buildup of hydrogen is considered and mitigated appropriately.	**Closed.** Calculation EDQ0099992013000202 does the load calculation for the 250 volt unit batteries. This load study strips nonessential loads to allow BFN1, 2, 3 to last 12 hours. DCN 71470 is the modification that procures fans for installation in the battery rooms during a beyond design basis event to account for the hydrogen production during battery off gassing during battery charging. Flex procedure 0-FSI-4A installs the fans during a design basis event in the battery rooms on elevation 1C (593') in the control bay.
OI-7: BFNP will take actions as necessary to assure RCIC can operate at elevated temperatures.	Started

Overall Integrated Plan Open Item	Status
OI-8: Perform modifications, as necessary, to ensure that RCIC is seismically robust.	**Closed.** Reactor Core Isolation Cooling (RCIC) system has been evaluated using the Expedited Seismic Evaluation Process (ESEP). This evaluation is a part of Calculation CDQ0009992014000268 . This evaluation has determined that RCIC system is seismically rugged and complies with the requirements of BFN FLEX Strategies. Based on the conservative evaluation documented in this calculation, BFN Units 1, 2 & 3 meet all seismic capacity requirements for ESEP. ESEP review performed for BFN Units 1, 2 & 3 were summarized in Letter No. 30M737 (Expedited Seismic Evaluation Process Summary Report) for Browns Ferry Nuclear Plant dated December 10, 2014.
OI-9: Develop and perform the design modifications identified in the FLEX Strategy document to permit the timely and safe connection of the FLEX and RRC equipment during the adverse conditions encountered during these beyond design basis events.	**Open.** DCN 71329 installs connection points in the "B" EECW pump room , "D" RHRSW pump room and the "B" RHRSW pump room for connection of the portable FLEX pump systems. This DCN also establishes a connection point and isolation for the RCIC oil cooler. The EECW and "D" RHRSW system tie-ins are complete and the manifolds construction are in progress. The "B" RHRSW tie in and manifold installation will be completed in the Summer of 2015 prior to Unit 3 FLEX compliance date, it is not required for Unit 2 compliance. FSI's direct the connections and operation of FLEX pump systems. DCN 71454 installs pump a deployment path from the FLEX Equipment Storage Building (FESB) to the new FLEX Pump Deployment pads at the Intake Pump Station forebay. Construction of the path and pads are in progress. 0-FSI-6A provides guidance during a BDBEE. Steps are directed to identify issues that will impede deployment of equipment and implementation of FLEX strategies.
OI-10: Design and construct a Flexible Equipment Storage Building, located above the probable maximum flood level, which is adequately protected from the hazards listed in Section 1	**Closed.** Flex Mitigation System Design Criteria BFN-50-7360 identifies the design attributes and storage requirements for the Flex Equipment Storage Building(FESB). DCN 70745 implements the design of the building which complies with the Flex Design Criteria.

Overall Integrated Plan Open Item	Status
OI-11: Modify currently installed hardened wetwell vent to install backup pneumatic supply or provided procedural guidance for manual operation, to allow use within current design limits.	**Closed.** Proposed modifications to the existing Hardened Wet Well Vent (HWWV) to comply with NRC Order EA-13-109 includes the design for a backup pneumatic supply for operation of the Hardened Containment Vent System (HCVS) valves (FCV-064-0221 & 0222) during an BDBEE. However, compliance with Order EA-13-109 does not support implementation schedule of the FLEX Order EA-12-049. Based on the difference in implementation schedules between Orders EA-13-109 and EA-12-049, Browns Ferry has received a relaxation for full compliance with Order EA-12-049. Valves FCV-064-0221 and 0222 have the ability to be manually operated based on the design implemented under GL 89-16. The event in which operation of the HCVS valves would be needed is a beyond Design Basis External Event (BDBEE). Operations would be performing actions as needed to maintain the plant in a safe condition and operation of components to vent containment would be performed in accordance with procedure 2-EOI Appendix 13. Since the plant is performing mitigation strategies and fuel damage has not occurred, environmental conditions in the area would allow access to the valves for operation.
OI-12: Design and install the modifications required by Order EA-12-051 for enhancing the SFP.	**Closed.** The design and implementation of the Spent Fuel Pool Level Instrumentation will be completed in accordance with Engineering Change Packages DCN 71159, DCN 71160, and DCN 71161. The applicable codes, standards, regulatory requirements and procedures are spelled out within the stated DCN's.

<table>
<tr><th>Overall Integrated Plan Open Item</th><th>Status</th></tr>
<tr><td>OI-13: Determine the design specifications for FLEX equipment yet to be ordered, such as the Six Portable ventilation fans, the Mobil Water Purification Unit, debris removal equipment for the FLEX Equipment Haul path and piping for the FLEX low pressure pumps.</td><td>Closed. BFN has ordered two Ford F550 trucks equipped with scraper blades and winch for debris removal, and one compact track loader CAT 299D for debris removal. DCN 71470 will provide a 480v supply and connection strategy to portable lighting and ventilation during a BDBEE.

20 Smithlight Battery operated LED work lights are identified in the DCN.

A total of 12 fans are identified in the DCN and will be deployed and operated using 0-FSI-4A in the Control Bay.
<table>
<tr><th>Fan</th><th>Quantity</th></tr>
<tr><td>TA16-5000</td><td>3</td></tr>
<tr><td>Coppus Vano 175CV</td><td>3</td></tr>
<tr><td>Coppus Vano 250CV</td><td>2</td></tr>
<tr><td>Pedestal Fan</td><td>3</td></tr>
<tr><td>30 inch Barrel Fan</td><td>1</td></tr>
</table></td></tr>
<tr><td>OI-14: Deployment strategies and deployment routes will be assessed for impact due to identified hazards and guidance developed/provided to ensure that 1) sufficient area is available for deployment, 2) haul paths remain accessible without interference from outage equipment during refueling outages and 3) deployment locations for the pumps including ramps, winches or other transfer assemblies as appropriate to deploy all pumps and hoses within the 8 hour Phase 1 coping interval.</td><td>Closed. DCN 70745 - Site Bunker Building, DCN 71454 - Install Deployment Roads and Pump Landings, DCN 71405 - Stage 4kv Diesels for Fukushima Event and Provide Connection Points, and DCN 71470 Stage 480v power supply and support equipment to charge the Unit Battery Chargers have ensured sufficient area is available for deployment. Additionally all deployment accessories such as pumps, ramps, winches, and other transfer assemblies such as “equipment trailers” as appropriate have been assessed and are included to ensure OIP timeframes are met.

Haul paths and deployment pads will be observed daily during Nuclear Security rounds to ensure both paths and pads are accessible without interference.</td></tr>
<tr><td>OI-15: Detailed staffing studies based on the procedures/guidance developed.</td><td>Started</td></tr>
<tr><td>OI-16. Validation of the time lines for the various strategies.</td><td>Started</td></tr>
</table>

Overall Integrated Plan Open Item	Status
OI-17: Browns Ferry Nuclear Plant (BFNP) will utilize the industry developed guidance from the Owners Groups, EPRI and NEI Task team to develop site specific procedures or guidelines to address the criteria in NEI 12-06. These procedures and/or guidelines will support the existing symptom based command and control strategies in the current EOIs.	**Closed.** Browns Ferry Nuclear Plant has utilized the industry developed guidance from the BWROG, EPRI and NEI Task team to develop site specific procedures that addressed the criteria in NEI 12-06 (Ref. 6). 0-AOI-57-1A, EOI appendices, and FSIs support the existing symptom based command and control strategies in the current EOIs.
OI-18: New training of general station staff and EP will be performed prior to the first BFNP unit design implementation outage. These programs and controls will be implemented in accordance with the Systematic Approach to Training.	**Closed.** TRN-30, Radiological Emergency Preparedness Training, requires the Emergency Preparedness responders to complete INPO Generic Basic Flex Training (NANTEL 00002382), and for persons assigned key positions the INPO Generic Advanced Flex Training (NANTEL 00002385). Training requirements by position are listed in TRN-30, Attachment 3. This TRN was developed in accordance with the Systematic Approach to Training (SAT). Additional overview training was developed for Maintenance personnel that may be asked to deploy and connect equipment in various scenarios. This training was developed using the SAT process and approved by the respective Maintenance training oversight committees. The Technical training organizations also documented Training Needs Analysis for their groups with conclusions being that Nantel Basic FLEX overview is sufficient at this time.
OI-19: TVA will establish a contract with the Strategic Alliance for FLEX Emergency Response (SAFER) team. A local assembly area must also be established by SAFER and TVA for equipment moved from the Regional Response Center (RRC) to BFNP.	**Closed.** A contract has been established between TVA and the SAFER team, AREVA NP Inc., Documents Engineering Information Record, Document No.: 51 - 9233061 – 000, Browns Ferry Nuclear Plant SAFER Response Plan . Two off-site local staging areas have been identified and one onsite staging area has been identified. The onsite staging area (Staging Area B) is located in the Northeast corner of the Owner Controlled Area at the Facility and Vehicles Maintenance Shop. The two off-site staging areas are TVA Helicopter Operations at the Northwest Alabama Regional Airport (Staging Area C) in Muscle Shoals, Alabama and Pryor Field Regional Airport (Staging Area D) in Decatur, Alabama.

Overall Integrated Plan Open Item	Status
OI-20: Evaluate different strategies to allow removal of water from the Suppression Pool. Determine if any modifications are required and what strategies are deemed feasible.	**Closed**. 2-EOI Appendix 20K is a new procedure written to utilize RCIC in test mode to pump the torus to the CST(s). The required valves are dc powered and will be available to operate from the Main Control Room. Suction will be from the torus or transferred to the torus.
OI-21: Abnormal operating procedure, AOI-100-9, Turbine Building Internal Flooding, provides the symptoms and operator actions to be taken for this condition. During development of procedures to support FLEX strategies, adequate guidance will be given to operators to ensure their travel paths avoid these areas.	**Closed**. 0-FSI-6A Damage Assessment is a New FLEX procedure that has been developed to provide guidance during a BDBEE. Steps are directed to identify issues that will impede deployment of equipment and implementation of FLEX strategies. Building assessments are performed and information provided to the FLEX Response SRO, Shift Manager or Site Emergency Director to make decisions based on results. Internal plant flooding will be identified and alternate routes are available for performance of these strategies. Doors are verified unlocked and available to allow access to the Control Bay and Reactor Buildings via Electric Board Rooms on elevation 621' and 593'.

7 Potential NRC Evaluation Impacts

There are no potential impacts to the NRC Evaluation identified at this time.

8 References

The following references support the updates to the Overall Integrated Plan described in this attachment.

1. Letter from TVA to NRC, "Tennessee Valley Authority (TVA) - Overall Integrated Plan in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) for Browns Ferry Nuclear Plant," dated February 28, 2013 (ML13064A465)

2. NRC Order Number EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated March 12, 2012 (ML12054A735)

3. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide" Revision 0, dated August 2012 (ML12242A378)

4. Letter from TVA to NRC, "First Six-Month Status Report in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) for Browns Ferry Nuclear Plant," dated August 28, 2013 (ML13247A284)

5. Letter from NRC to TVA, "Browns Ferry Nuclear Plant, Units 1, 2, and 3 – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Mitigation Strategies) (TAC Nos. MF0902, MF0903, and MF0904)," dated December 19, 2013 (ML13353A166)

6. Letter from TVA to NRC, "Second Six-Month Status Report in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) for Browns Ferry Nuclear Plant (TAC Nos. MF0902, MF0903, and MF0904)," dated February 28, 2014 (ML14064A240)

7. Letter from TVA to NRC, "Third Six-Month Status Report and Revised Overall Integrated Plan in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) for Browns Ferry Nuclear Plant (TAC Nos. MF0902, MF0903, and MF0904)," dated August 28, 2014 (ML14247A644)