



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

CNL-14-036

March 11, 2014

10 CFR 50.54(f)

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 Licensing No. DPR-33, DPR-52, and DPR-68  
NRC Docket Nos. 50-259, 50-260, and 50-296

Subject: Extension Request Regarding the Flooding Hazard Reevaluation Report  
Required by NRC Request for Information Pursuant to Title 10 of the Code of  
Federal Regulations 50.54(f) Regarding Recommendation 2.1, Flooding, of  
the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi  
Accident

- References:
1. NRC Letter, "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," dated March 12, 2012 (ML12053A340)
  2. NRC Letter, "Prioritization of Response Due Dates for Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Flooding Hazard Reevaluations for Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," dated May 11, 2012 (ML12097A509)
  3. NRC Letter, "Supplemental Information Related to Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Flooding Hazard Reevaluations for Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," dated March 1, 2013 (ML13044A561)

4. TVA Letter to NRC, "Tennessee Valley Authority (TVA) - Extension Request Regarding the Flooding Hazard Reevaluation Report Required by NRC Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendation 2.1, Flooding, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," dated March 12, 2013 (ML13080A073)
5. TVA Letter to NRC, "Revised Commitments for the Extension Request Regarding the Flooding Hazard Reevaluation Report Required by NRC Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendation 2.1, Flooding, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," dated May 9, 2013 (ML13133A004)
6. NRC Letter to TVA, "Sequoyah Nuclear Plant, Units 1 and 2, and Watts Bar Nuclear Plant, Units 1 and 2 - Relaxation of Response Due Dates Regarding Flooding Hazard Reevaluations for Recommendation 2.1 of the Near-Term Task Force Review of the Insights from the Fukushima Dai-ichi Accident," dated July 1, 2013 (ML13163A296)

On March 12, 2012, the NRC issued the Reference 1 letter to all power reactor licensees and holders of construction permits in active or deferred status. Enclosure 2 of Reference 1 contains specific Requested Actions, Requested Information, and Required Responses for Near Term Task Force Recommendation 2.1 associated with the reevaluation of flooding hazards at nuclear power plants. In a letter dated May 11, 2012 (Reference 2), the NRC categorized Browns Ferry Nuclear Plant (BFN) as a "Category 2" plant and established a due date for submission of the flooding hazard reevaluation of March 12, 2014.

In Reference 3, the NRC provided supplemental information stating incomplete Hazard Reevaluation Reports (HRRs) that only contain an analysis of some flooding hazard mechanisms would not be of substantive benefit for staff review and would not be acceptable. Therefore, licensees should not submit partial reports, but should instead submit an extension request on or before March 12, 2014.

On March 12, 2013, Tennessee Valley Authority (TVA) submitted an extension request for the Sequoyah Nuclear Plant (SQN) and Watts Bar Nuclear Plant (WBN) HRRs requesting an extension from March 12, 2013 to May 9, 2015 (Reference 4). The primary reason for this extension request was to allow additional time to complete the evaluation of seventeen upstream dams and one downstream dam in order to fully assess the flood hazard for the SQN and WBN sites. After meeting with the NRC and presenting its HRR extension request, TVA revised the requested extension date for submitting the SQN and WBN HRRs from May 9, 2015, to March 12, 2015 (Reference 5). The NRC granted the extension request for the SQN and WBN HRRs from March 12, 2013, to March 12, 2015, in its July 1, 2013 letter to TVA (Reference 6).

U.S. Nuclear Regulatory Commission  
Page 3  
March 11, 2014

In its July 1, 2013 letter for the SQN and WBN HRRs (Reference 6), the NRC acknowledged that the reevaluation of SQN and WBN, which are upstream of BFN, would likely be an input to the BFN hazard reevaluation. The staff also maintained the expectation that all HRRs be submitted on or before March 12, 2015. In addition to the reevaluation of SQN and WBN being an input to the BFN HRR, there are four additional dams that are required to be evaluated for the BFN HRR.

Therefore, the purpose of this letter is to request an extension to the due date for the BFN HRR from March 12, 2014 to March 12, 2015. This extension request was prepared using the guidance in Reference 3 and the previous submitted extension request for the SQN and WBN HRRs in References 4 and 5. For extension requests, Reference 3 states the following information should be included: 1) the reason for the delay; 2) a proposed schedule for the submittal of a complete HRR; and 3) the basis for the acceptability of the revised schedule.

The reasons for the delay, detailed information regarding the proposed schedule, and the basis for the acceptability of the revised schedule are included in Enclosure 1 to this letter.

Enclosure 2 contains a list of new regulatory commitments regarding this letter. If you have questions regarding this matter, please contact Kevin Casey at (423) 751-8523.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 11th day of March 2014.

Respectfully,



J.W. Shea  
Vice President, Nuclear Licensing

#### Enclosures

1. Reason for the Delay and the Basis for the Acceptability of the Revised Schedule
2. List of Commitments

cc (w/Enclosures):

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

**ENCLOSURE 1**

**REASON FOR THE DELAY  
AND THE BASIS FOR THE ACCEPTABILITY  
OF THE REVISED SCHEDULE**

## **Introduction**

On March 12, 2012, the NRC issued a letter pursuant to 10 CFR 50.54(f) to all power reactor licensees and holders of construction permits in active or deferred status. Enclosure 2 of the March 12, 2012 50.54(f) letter contains specific Requested Actions, Requested Information, and Required Responses for Near Term Task Force Recommendation 2.1 associated with reevaluation of flooding hazards at nuclear power plants. In a subsequent letter dated May 11, 2012, the NRC categorized Browns Ferry Nuclear Plant (BFN) as a "Category 2" plant and established a due date for submission of the flooding hazard reevaluation of March 12, 2014.

In a letter dated March 1, 2013, the NRC provided supplemental information stating that incomplete Hazard Reevaluation Reports (HRRs) containing an analysis of only some flooding hazard mechanisms would not be of substantive benefit for staff review and would not be acceptable. Therefore, licensees were advised not to submit partial reports, but rather to submit an extension request on or before March 12, 2014.

On March 12, 2013, Tennessee Valley Authority (TVA) submitted an extension request for the Sequoyah Nuclear Plant (SQN) and Watts Bar Nuclear Plant (WBN) HRRs from March 12, 2013, to May 9, 2015 (Reference 1). The primary reason for this extension request was to allow additional time to complete the evaluation of seventeen upstream dams and one downstream dam in order to fully assess the flood hazard for the SQN and WBN sites. After meeting with the NRC and presenting its HRR extension request, TVA revised the requested extension date for submitting the SQN and WBN HRRs from May 9, 2015, to March 12, 2015 (Reference 2). The NRC granted the extension for the SQN and WBN HRRs from March 12, 2013, to March 12, 2015, in its July 1, 2013 letter to TVA (Reference 3).

In its July 1, 2013, letter (Reference 3) for the SQN and WBN HRRs, the NRC acknowledged that the reevaluation of SQN and WBN, which are upstream of BFN, would likely be an input to the BFN hazard reevaluation. In addition to the reevaluation of SQN and WBN being an input to the BFN HRR, there are four additional dams that are required to be evaluated for the BFN HRR. The staff also maintained the expectation that all HRRs be submitted on, or before, March 12, 2015.

Therefore, the purpose of this letter is to request an extension to the due date for the BFN HRR from March 12, 2014, to March 12, 2015. This extension request was prepared using the guidance in Reference 4 and the previous submitted extension request for the SQN and WBN HRRs in References 1 and 2. For extension requests, Reference 4 states the following information should be included: 1) the reason for the delay; 2) a proposed schedule for the submittal of a complete HRR; and 3) the basis for the acceptability of the revised schedule. TVA's response to each of these specific requests follows.

### **Reason for the Delay**

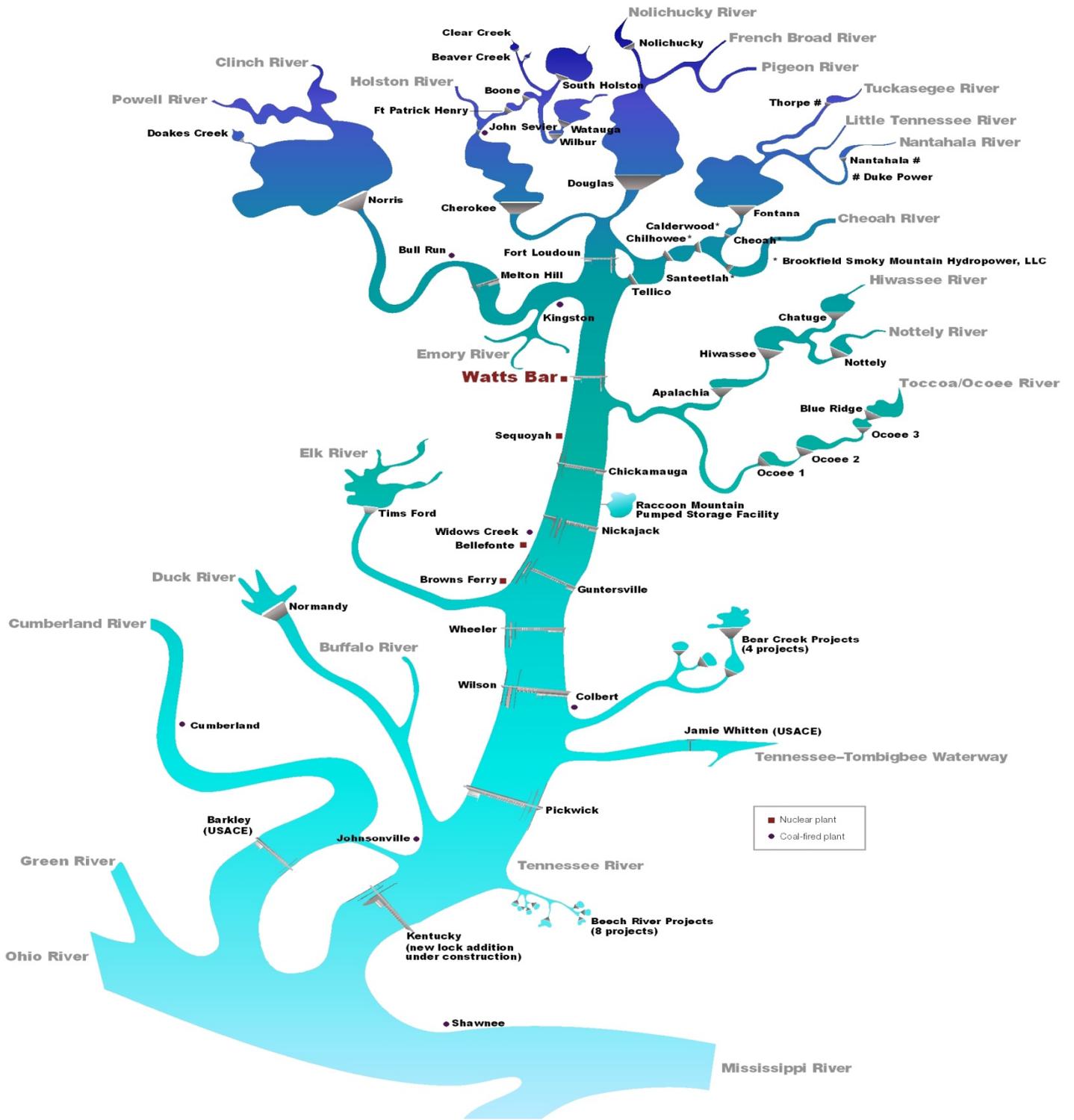
TVA is requesting an extension for completion of the BFN HRR until March 12, 2015.

The overall scope of activities required to complete the HRR for BFN is described in the section of this enclosure below entitled "Summary of TVA's Hazard Reevaluation Report Project" and depicted in Attachment 1 to this Enclosure. The activities for BFN shown in Attachment 1 are similar to those activities that were described in the SQN and WBN HRR extension request.

The overarching reason for the additional time is due to the significant number of dams upstream or downstream of BFN that must be evaluated in order to fully assess the flood hazard for the site. Specifically, BFN is located on the Wheeler Reservoir on the Tennessee River and TVA must evaluate the stability of twenty-one upstream and one downstream dam to determine if each of these dams is stable in both probable maximum flood (PMF) and seismic loading conditions.

TVA has prioritized its resources on the original 18 dams required to be analyzed to support the SQN and WBN HRR project. Planning for the 4 additional dams required to be analyzed to support the BFN HRR was being made in parallel under a separate project. Those plans are now complete and the BFN HRR project has been finalized as summarized below.

In addition to the 18 dams (Chickamauga, Blue Ridge, Appalachia, Hiwassee, Nottely, Chatuge, Watts Bar, Melton Hill, Norris, Tellico, Fontana, Fort Loudoun, Cherokee, Fort Patrick Henry, Boone, South Holston, Watauga, and Douglas) that are being analyzed to support the SQN and WBN HRRs, three additional dams upstream from BFN, Nickajack, Guntersville, and Tims Ford, and one additional dam downstream of BFN, Wheeler, are also required to be analyzed. The dams are shown in Figure 1. As discussed below, the analysis for PMF stability requires substantive field work to develop the data needed to perform the appropriate civil engineering analyses. Similarly, in order to complete the analyses of seismic stability of the affected dams, applicable dam specific seismic hazards must be developed and analyzed using the NRC's Interim Staff Guidance (ISG) JLD-ISG-2013-01, "Guidance for Assessment of Flooding Hazards Due to Dam Failure." Upon completion of the stability analyses, TVA will need to perform the associated simulations that develop the final site specific flood hazard values.



**Figure 1**  
 Pictorial of Tennessee Valley Authority Dams

## Summary of TVA's Hazard Reevaluation Report Project

TVA has developed a project plan that includes the actions needed to complete the HRR required by Enclosure 2 of the March 12, 2012, 50.54(f) letter as described in the SQN and WBN extension request. The project plan for BFN is to complete the HRR and will follow the same actions. The schedule details of the project plan are included in Attachment 1 of this Enclosure. The key actions and analysis within the scope of the project are listed below:

1. Migrate TVA Tennessee River modeling from the Simulated Open Channel Hydraulic (SOCH) code to U.S. Army Corps of Engineers (USACE) Hydraulic Engineering Center River Analysis System (HEC-RAS) program.
  - a. Geometry for two reservoirs
  - b. Develop unsteady flow rules for use in the HEC-RAS model
  - c. Calibrate the HEC-RAS model
2. Perform analysis to confirm critical storm probable maximum precipitation (PMP) selection. (This action was completed with the SQN/WBN HRR Project.)
3. Perform local intense precipitation analysis for BFN.
4. Perform analysis of Sunny Day dam failures for three scenarios upstream of BFN.
5. Evaluate stability of the 4 dams under PMF conditions consistent with the dam stability ISG JLD-ISG-2013-01.
  - a. Collect geotechnical data
  - b. Perform 2D analysis
  - c. Perform 3D analysis as required on a limited basis
6. Perform PMF simulation using results of PMF stability analysis as input assumptions. Consideration will be given to the following:
  - a. Assuming no downstream dam failures;
  - b. Including downstream dam failures;
  - c. Attributing for the volume of National Inventory of Dams; and,
  - d. Revision to earthen embankment breach sizes using updated methodology.
7. Develop applicable dam specific seismic hazards based on methodology as described in the dam stability ISG JLD-ISG-2013-01.
8. Evaluate seismic stability of the 4 dams consistent with dam stability ISG JLD-ISG-2013-01.
  - a. Collect geotechnical data
  - b. Perform 2D analysis
  - c. Perform 3D analysis, as required on a limited basis

9. Perform simulation for seismic combined events as described in the dam stability ISG JLD-ISG-2013-01 using results of seismic stability analysis as input.
  - a. Three single simulations assumed
  - b. Three simulations assumed for combinations of dams failing under seismic loading
10. Perform simulations to quantify uncertainties. Consideration will be given to the following:
  - a. Mannings “n” variations;
  - b. 100 percent runoff;
  - c. Gate operability;
  - d. Peak/Lag Unit Hydrograph; and,
  - e. Controlling warning time seismic.
11. Prepare HRRs with results and interim actions, as required.

The proposed schedule provided in Attachment 1 of this Enclosure provides a completion date for all of these activities of March 12, 2015. Actions that have already been started to date are noted with an “A” in the “Start” column. TVA will provide quarterly status reports to the BFN NRC Project Manager to provide the status of completed actions and progress toward completing the HRR starting in June 30, 2014. This status report will be included with the quarterly status report for the SQN and WBN as described in TVA’s May 9, 2013 letter to NRC.

The proposed schedule includes schedule uncertainty based on an estimated number of seismic dam failure simulations, because seismic dam evaluations are not yet complete. The schedule estimates three single upstream seismic dam failure simulations and three combinations of upstream seismic dam failure simulations. These estimates were derived based on review of historic dam failure scenarios.

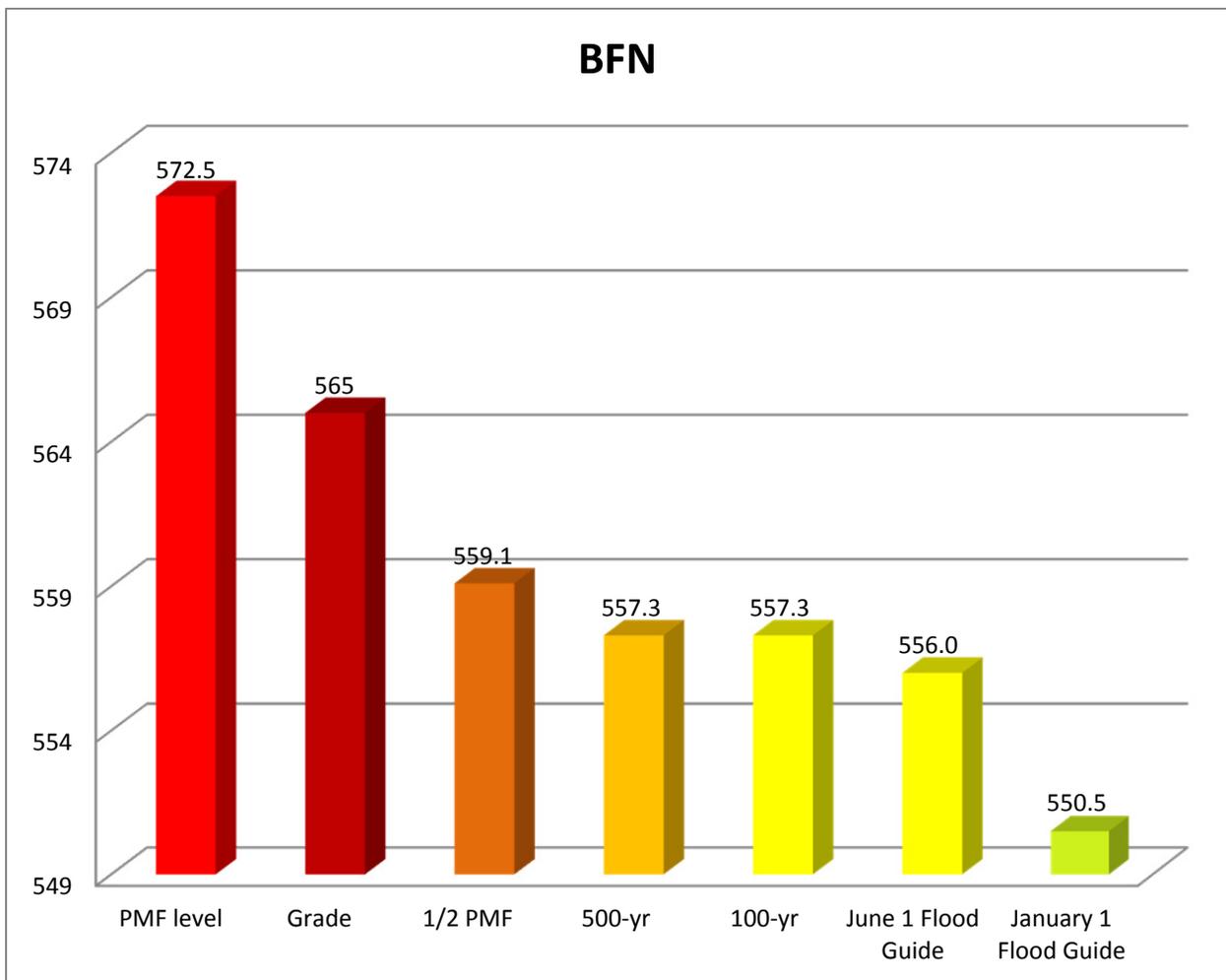
### **Basis for the Acceptability of the Revised Schedule**

TVA is requesting the proposed schedule extension be accepted based on the factors discussed below.

The NRC’s March 12, 2012, 50.54(f) cover letter states that the current regulatory approach and the resultant plant capabilities provide confidence that an accident with consequences similar to the Fukushima accident is unlikely to occur in the United States. The NRC letter concluded that continued plant operation and the continuation of licensing activities do not pose an imminent risk to public health and safety.

The HRR project includes analyses that contain beyond-design-basis scenarios. In accordance with Enclosure 2 of the March 12, 2012, 50.54(f) letter item 1.d, interim evaluations and actions will be taken or planned to address any reevaluated higher flooding hazards relative to the design basis. These interim evaluations and actions, if any, will be included in the complete BFN HRR.

TVA's position is that, assessed qualitatively as discussed below, the reevaluated flooding hazard is a very low probability event. Figure 2 below compares the potential (100 year (yr), 500 yr, 1/2 PMF, and PMF) and Wheeler Reservoir seasonal flood elevations to site grade elevations. While the flooding elevations listed in Figure 2 only consider coincident river elevations due to precipitation events alone and do not consider combinations of events which could lead to site flooding (e.g., a flooding event coincident with a seismic event causing a dam failure), the recorded history of the Tennessee River system indicates that no historical floods have exceeded plant grade and TVA's position is that the probability of such an event occurring within the extension request timeframe is very low.



**Figure 2**  
Comparison of BFN Flooding Elevations (both potential and seasonal) vs Site Grade

TVA operates the Tennessee River reservoir system and has extensive experience and expertise in managing river and stream flooding scenarios. TVA staffs a River Forecasting Center (RFC) twenty-four hours a day to monitor and manage the system through a continuous process. The operating plan, referred to as a river forecast, is monitored and modified as necessary to meet operating objectives to the extent possible. The current plan is monitored by checking observed discharges and reservoir elevations against those that were planned, and modifications are made in response to changing demands on the system (e.g., more or less hydropower needed) and changes in weather that result in more or less streamflow coming into the reservoir than was anticipated when the current reservoir forecast was developed.

The forecasting cycle begins with data collection and validation including: 1) rainfall measurements from over 200 rain gages throughout the valley showing how much precipitation has occurred; 2) streamgage measurements from over 60 streamgages located throughout the valley showing the elevation of the river levels, and where appropriate, the amount of stream flow; and 3) reservoir headwater, tailwater, and discharge measurements at 35 TVA dams, four Brookfield Smoky Mountain Hydropower (formally Alcoa) dams, and nine U.S. Army Corps of Engineers (USACE) dams. These data are then validated and questionable data are flagged for further review and correction as necessary.

The river forecasting staff also reviews the latest precipitation forecast. The forecast will contain a quantitative precipitation forecast over the next 10 days, broken down into 5 geographical areas within the Tennessee Valley. In addition to area average rainfall amounts, the forecast issuer includes possible high spot amounts. There are usually three forecasts provided: 1) a “most likely” forecast that reflects what the forecast issuer thinks will happen; 2) a “minimum” forecast, that estimates a lower limit (i.e., the precipitation will be at least this amount); and 3) a “maximum” forecast that estimates an upper limit not likely to be exceeded.

Both the observed rainfall data and forecasted precipitation data is entered into a river modeling software program which includes both tributary and main river reservoirs. When the entire system has been scheduled, instructions to the individual dams are provided which direct both power generation and sluice or gated spillway configurations to manage the river system to support TVA operating objectives of flood control, navigation, hydropower production, water supply for TVA thermal facilities and other industries and municipalities, water quality, recreation and fisheries.

The RFC has a standard operating procedure that is used to document the required notifications and actions during flood or other hydrological events that may threaten safe operation of TVA nuclear facilities. Included in that standard operating procedure are instructions to notify BFN when certain potential flooding scenarios are forecasted.

By procedure, BFN contacts the RFC when the Wheeler Reservoir is observed to be at elevation 558 feet or greater. The RFC will then give an estimate of the peak river level and, if the river level is predicted to rise above elevation 565 feet, BFN will commence all operating units to cold shutdown conditions.

## References

1. TVA Letter to NRC, "Tennessee Valley Authority (TVA) - Extension Request Regarding the Flooding Hazard Reevaluation Report Required by NRC Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendation 2.1, Flooding, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," dated March 12, 2013 (ML13080A073)
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**ENCLOSURE 1  
ATTACHMENT 1**

**PROPOSED SCHEDULE FOR THE SUBMITTAL  
OF COMPLETE HAZARD REEVALUTED REPORTS  
FOR THE BROWNS FERRY NUCLEAR PLANT**

| Activity Name                            | Start              | Finish           | 2014                              |   |   |   |   |   |   |   |   |   |   |   | 2015        |   |   |  |  |
|--|--------------------|------------------|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|-------------|---|---|--|--|
|  |                    |                  | M                                 | A | M | J | J | A | S | O | N | D | J | F | M           | A | M |  |  |
| <b>2.1 Flooding Hazard Re-evaluation</b> | <b>Aug-30-13 A</b> | <b>Mar-11-15</b> |                                   |   |   |   |   |   |   |   |   |   |   |   |             |   |   |  |  |
| <b>BFN</b>                               | <b>Aug-30-13 A</b> | <b>Mar-11-15</b> |                                   |   |   |   |   |   |   |   |   |   |   |   |             |   |   |  |  |
| Dam Stability Analysis                   | Aug-30-13 A        | Sep-30-14        |                                   |   |   |   |   |   |   |   |   |   |   |   |             |   |   |  |  |
| BFN Develop Model Inputs                 | Oct-15-13 A        | May-01-14        |                                   |   |   |   |   |   |   |   |   |   |   |   |             |   |   |  |  |
| BFN Inflow Development                   | Apr-11-14          | Jul-03-14        |                                   |   |   |   |   |   |   |   |   |   |   |   |             |   |   |  |  |
| Develop Dam Rating Curves                | Oct-01-14          | Oct-27-14        |                                   |   |   |   |   |   |   |   |   |   |   |   |             |   |   |  |  |
| TVA Review Dam Rating Curves             | Oct-28-14          | Nov-06-14        |                                   |   |   |   |   |   |   |   |   |   |   |   |             |   |   |  |  |
| Develop HEC-RAS Unsteady Flow Rules      | Oct-28-14          | Nov-14-14        |                                   |   |   |   |   |   |   |   |   |   |   |   |             |   |   |  |  |
| TVA Review HEC-RAS Unsteady Flow Rules   | Nov-17-14          | Nov-26-14        |                                   |   |   |   |   |   |   |   |   |   |   |   |             |   |   |  |  |
| Sunny Day Dam Failure                    | Nov-17-14          | Dec-17-14        |                                   |   |   |   |   |   |   |   |   |   |   |   |             |   |   |  |  |
| Uncertainty Simulations                  | Nov-17-14          | Dec-30-14        |                                   |   |   |   |   |   |   |   |   |   |   |   |             |   |   |  |  |
| Seismic Failure Simulations              | Nov-17-14          | Jan-02-15        |                                   |   |   |   |   |   |   |   |   |   |   |   |             |   |   |  |  |
| PMF Simulations                          | Nov-17-14          | Jan-07-15        |                                   |   |   |   |   |   |   |   |   |   |   |   |             |   |   |  |  |
| TVA Review Simulations                   | Jan-08-15          | Jan-27-15        |                                   |   |   |   |   |   |   |   |   |   |   |   |             |   |   |  |  |
| Prepare Review and Submit Final Report   | Jan-28-15          | Mar-11-15        |                                   |   |   |   |   |   |   |   |   |   |   |   |             |   |   |  |  |
|  |                    |                  | 2.1 Flooding Hazard Re-evaluation |   |   |   |   |   |   |   |   |   |   |   | Feb-27-14   |   |   |  |  |
|  |                    |                  | NRC Extension request for BFN     |   |   |   |   |   |   |   |   |   |   |   | Page 1 of 1 |   |   |  |  |

## **ENCLOSURE 2**

### **LIST OF COMMITMENTS**

1. TVA will provide quarterly status reports to the Browns Ferry Nuclear Plant NRC Project Manager to provide a status of completed actions and progress to completing the Hazard Reevaluation Reports starting in June, 2014. This status report will be included with the quarterly status reports for the Sequoyah and Watts Bar Nuclear Plants as described in TVA's May 9, 2013 letter to NRC.
2. TVA will provide the Browns Ferry Nuclear Plant Flooding Hazard Reevaluation Report to the NRC by March 12, 2015.