UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

May 6, 2020

Mr. James Barstow
Vice President, Nuclear Regulatory
Affairs and Support Services
Tennessee Valley Authority
1101 Market Street, LP 4A-C
Chattanooga, TN 37402-2801

SUBJECT: BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2 & 3 – STAFF ASSESSMENT OF FLOODING FOCUSED EVALUATION (EPID NO. L-2019-JLD-0012)

Dear Mr. Barstow:

The purpose of this letter is to document the staff's evaluation of the Browns Ferry Nuclear Plant, Units 1, 2 & 3 (Browns Ferry) flooding focused evaluation (FE) which was submitted in response to Near-Term Task Force (NTTF) Recommendation 2.1 "Flooding." The U.S. Nuclear Regulatory Commission (NRC) has concluded that based on the licensee's evaluation and the staff's independent assessment, no further response or regulatory actions are required to address the reevaluated flood hazard at the site.

By letter dated March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340), the NRC issued a request for information to all power reactor licensees and holders of construction permits in active or deferred status, under Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.54(f) (hereafter referred to as the "50.54(f) letter"). The request was issued in connection with implementing lessons learned from the 2011 accident at the Fukushima Dai-ichi nuclear power plant, as documented in the NRC's NTTF report (ADAMS Accession No. ML111861807). Enclosure 2 to the 50.54(f) letter requested that licensees reevaluate flood hazards for their sites using present-day methods and regulatory guidance used by the NRC staff when reviewing applications for early site permits and combined licenses (ADAMS Accession No. ML12056A048).

By letter dated March 12, 2015 (ADAMS Accession No. ML15072A130), Tennessee Valley Authority (TVA, the licensee) responded to this request for Browns Ferry by providing its flood hazard reevaluation report (FHRR). By letter dated September 3, 2015 (ADAMS Accession No. ML15240A183), the NRC issued an interim staff response (ISR) letter for Browns Ferry. The ISR letter provided the reevaluated flood hazard mechanisms that exceeded the current design basis (CDB) for Browns Ferry that are a suitable input for further assessments as the site's response to the 50.54(f) letter. As stated in the ISR letter, because the local intense precipitation (LIP) flood-causing mechanism at Browns Ferry is not bounded by the plant's CDB, additional assessment of that flood hazard mechanism is expected to be performed by the licensee.

By letter dated October 11, 2019 (ADAMS Accession No. ML19284F761, non-public), the licensee submitted an FE for Browns Ferry. The FEs are intended to confirm that licensees have adequately demonstrated, for unbounded mechanisms identified in the ISR letter, that: 1) a flood mechanism is bounded by the CDB based on a reevaluation of the flood

mechanism parameters; 2) effective flood protection is provided for the unbounded mechanism; or 3) a feasible response is provided if the unbounded mechanism is LIP. The purpose of this letter is to provide the NRC's assessment of the Browns Ferry FE.

The licensee provided an FHRR analysis update as Attachment A to the FE. The updated analysis utilizes a new site-specific probable maximum precipitation (PMP). In addition to the use of a site-specific PMP, the following key changes were made in the FHRR analysis update:

1. Updated the channel geometry and/or the overbank storage volumes of the stream course model consistent with recommendations from the U.S. Army Corps of Engineers.
2. Updated the dam stability analysis to account for a modification at Douglas dam.
3. Updated the rainfall distribution methodology to be consistent with the gridded rainfall data format used to develop the new PMP and to apply TVA's antecedent precipitation index.

By letter dated June 22, 2016 (ADAMS Accession No. ML16175A518), TVA provided the NRC with dates for several project deliverables associated with the ongoing Hydrologic Engineering Center - River Analysis System (HEC-RAS) external flood modeling project. In a letter to the NRC dated January 14, 2020 (ADAMS Accession No. ML20016A396), TVA submitted a License Amendment Request (LAR) to revise the Sequoyah Nuclear Plant, Units 1 & 2 (Sequoyah), updated final safety analysis report regarding changes to the hydrologic analysis. TVA is expected to submit a similar LAR for Browns Ferry. The same methodologies are expected to be used in the LAR and the FHRR analysis update provided with the FE.

The staff did not perform a detailed evaluation of the methodology associated with the FHRR analysis update to complete the FE assessment. The staff will evaluate the methodology associated with the FHRR analysis update and associated flood levels as part of the expected Browns Ferry LAR review. The site-specific LIP PMP is not considered in the FE except in a sensitivity study supporting the evaluation of available physical margin for safety-related equipment in the Standby Gas Treatment Building. All other flood-causing mechanisms in the FHRR update remain bounded by the CDB and are not considered in the FE. In addition, since the same methodologies are expected to be used in the LAR and the FHRR analysis update in the FE, a detailed review of the methodologies is not required for the staff to complete its assessment of the FE.

In addition to the FHRR analysis update, TVA also provided an updated warning time analysis in Attachment B to the FE. The staff did not perform a detailed evaluation of the methodology associated with the updated warning time analysis. The shortest probable maximum flood (PMF) warning time calculated for the flood levels to rise from the trigger level to plant grade (considering wind wave effects) is 24 hours. This is bounded by the 12 hours required for completion of flood mode preparation procedures and plant entry into cold shutdown. Thus, the CDB minimum time to prepare for operation in the flood mode is retained. The staff can evaluate the updated warning time analysis as part of the LAR process and a separate evaluation for purposes of the licensee's response to the 50.54(f) letter is not needed.

The NRC staff performed its review of the Browns Ferry FE in accordance with the guidance described in Nuclear Energy Institute (NEI) 16-05, Revision 1, "External Flooding Assessment Guidelines" (ADAMS Accession No. ML16165A178). Guidance document NEI 16-05, Revision 1, has been endorsed by the NRC in Japan Lessons-Learned Division (JLD) interim staff guidance (ISG) JLD-ISG-2016-01, "Guidance for Activities Related to Near-Term Task Force Recommendation 2.1, Flood Hazard Reevaluation" (ADAMS Accession

No. ML16090A140). The NRC staff concludes that, if implemented as described, the licensee has effective flood protection for the beyond-design-basis LIP flood-causing mechanism at Browns Ferry. This closes out the licensee's response for Browns Ferry for the reevaluated flooding hazard portion of the 50.54(f) letter and the NRC's efforts associated with EPID No. L-2019-JLD-012.

If you have any questions, please contact me at 301-415-2621 or by email at Robert.Bernardo@nrc.gov.

Sincerely,

/RA/

Robert J. Bernardo, Project Manager
Integrated Program Management
and BDB Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Enclosure:
Staff Assessment Related to the
Flooding Focused Evaluation for Browns Ferry

Docket Nos. 50-259, 50-260, and 50-296

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STAFF ASSESSMENT BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE FOCUSED EVALUATION FOR

BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2 & 3

AS A RESULT OF THE REEVALUATED FLOODING HAZARD NEAR-TERM TASK FORCE

RECOMMENDATION 2.1 - FLOODING

1.0 INTRODUCTION

By letter dated March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340), the U.S. Nuclear Regulatory Commission (NRC) issued a request for information to all power reactor licensees and holders of construction permits in active or deferred status, under Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.54(f) (hereafter referred to as the "50.54(f) letter"). The request was issued in connection with implementing lessons learned from the 2011 accident at the Fukushima Dai-ichi nuclear power plant, as documented in the NRC's Near-Term Task Force (NTTF) report (ADAMS Accession No. ML111861807).

Enclosure 2 of the 50.54(f) letter requested that licensees reevaluate flood hazards for their respective sites using present-day methods and regulatory guidance used by the NRC staff when reviewing applications for early site permits and combined licenses (ADAMS Accession No. ML12056A046). If the reevaluated hazard for any flood-causing mechanism is not bounded by the plant's design basis flood hazard, an additional assessment of plant response would be necessary. Specifically, the 50.54(f) letter stated that an integrated assessment (IA) should be submitted and described the information that the IA should contain. By letter dated November 30, 2012 (ADAMS Accession No. ML12311A214), the NRC staff issued Japan Lessons-Learned Project Directorate[1] (JLD) interim staff guidance (ISG) JLD-ISG-2012-05, "Guidance for Performing the Integrated Assessment for External Flooding."

On June 30, 2015 (ADAMS Accession No. ML15153A104), the NRC staff issued COMSECY-15-0019, describing the closure plan for the reevaluation of flooding hazards for operating nuclear power plants. The Commission approved the closure plan on July 28, 2015 (ADAMS Accession No. ML15209A682). COMSECY-15-0019 outlines a revised process for addressing cases in which the reevaluated flood hazard is not bounded by the plant's design basis. The revised process describes a graded approach in which certain licensees with hazards exceeding their design basis flood will not be required to complete an IA, but instead will perform a focused evaluation (FE). As part of the FE, these licensees will assess the impact of the hazard(s) on their site and then evaluate and implement any necessary programmatic, procedural, or plant modifications to address the hazard exceedance.

Nuclear Energy Institute (NEI) 16-05, Revision 1, "External Flooding Assessment Guidelines" (ADAMS Accession No. ML16165A178), has been endorsed by the NRC as an appropriate methodology for licensees to perform the FE in response to the 50.54(f) letter.

[1] The Japan Lessons-Learned Project Directorate was subsequently replaced by the Japan Lessons-Learned Division, which uses the same initials (JLD). No distinction is made between the two organizations in this evaluation.

The NRC's endorsement of NEI 16-05, including exceptions, clarifications, and additions, is described in NRC JLD-ISG-2016-01, "Guidance for Activities Related to Near-Term Task Force Recommendation 2.1, Flood Hazard Reevaluation" (ADAMS Accession No. ML16162A301).

In the flood hazard reevaluation report (FHRR) submittal for Browns Ferry Nuclear Plant, Units 1, 2 & 3 (Browns Ferry), Tennessee Valley Authority (TVA, the licensee) committed to submit an IA to address the required flood hazard impact assessments. By letter dated March 10, 2017 (ADAMS Accession No. ML17069A380), TVA informed the NRC of its intent to submit an FE for Browns Ferry, consistent with the changes discussed above, in lieu of an IA.

By letter dated October 11, 2019 (ADAMS Accession No. ML19284F761, non-public), the licensee submitted its FE for Browns Ferry. The FEs are intended to confirm that licensees have adequately demonstrated, for unbounded mechanisms, that: 1) a flood mechanism is bounded by the current design basis (CDB) based on further reevaluation of flood mechanism parameters; 2) effective flood protection is provided for the unbounded mechanism; or 3) a feasible response is provided if the unbounded mechanism is local intense precipitation (LIP). The purpose of this staff assessment is to provide the results of the NRC's evaluation of the Browns Ferry FE.

2.0 BACKGROUND

This NRC staff assessment is the last staff assessment associated with the information that the licensee provided in response to the reevaluated flooding hazard portion of the 50.54(f) letter. Therefore, the background section includes a discussion of the reevaluated flood information provided by the licensee and the associated staff assessments. The reevaluated flood information includes: 1) the FHRR; 2) the mitigation strategies assessment (MSA); and 3) the FE.

Flood Hazard Reevaluation Report

By letter dated March 12, 2015 (ADAMS Accession No. ML15072A130), TVA responded to the 50.54(f) letter for Browns Ferry and submitted the FHRR. As stated in the FHRR, the reevaluation results for LIP are not bounded by the CDB for Browns Ferry. The licensee planned to submit an IA to assess the site impact from LIP. By letter dated March 10, 2017 (ADAMS Accession No. ML17069A380), TVA informed the NRC of its intent to submit an FE for Browns Ferry, consistent with the changes discussed in Section 1.0 above, in lieu of the IA.

By letter dated September 3, 2015 (ADAMS Accession No. ML15240A183), the NRC issued an interim staff response (ISR) letter for Browns Ferry. The ISR letter provided the reevaluated flood hazard mechanisms that exceeded the CDB for Browns Ferry and parameters that are a suitable input for the MSA and other assessments associated with NTTF Recommendation 2.1 "Flooding." The ISR letter is sometimes referred to as the Mitigating Strategies Flood Hazard Information (MSFHI) letter. The ISR letter identified that the LIP flood-causing mechanism exceeds the CDB.

By letter dated August 5, 2016 (ADAMS Accession No. ML16196A088), the NRC issued its assessment of the licensee's FHRR. The staff assessment provides the documentation supporting the NRC staff's conclusions summarized in the ISR letter. The staff's conclusions regarding the LIP flood-causing mechanism remained unchanged from the information provided in the ISR letter.

Because the LIP flood-causing mechanism at Browns Ferry is not bounded by the plant's CDB, additional assessment of that flood hazard mechanism is expected to be performed by the licensee. The licensee is expected to submit an FE to address this reevaluated flood hazard, as described in a letter from the NRC dated September 1, 2015 (ADAMS Accession No. ML15174A257).

Mitigation Strategies Assessment

By letter dated December 27, 2016 (ADAMS Accession No. ML16363A386), the licensee submitted its MSA for Browns Ferry. The MSAs were intended to confirm that licensees have adequately addressed the reevaluated flooding hazards within their mitigating strategies for beyond-design-basis external events. The mitigation strategies have been put in place to meet NRC Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events." The NRC staff's safety evaluation (SE) for the licensee's compliance plans for Order EA-12-049 was issued on September 24, 2018 (ADAMS Accession No. ML18236A331). By letter dated September 5, 2017 (ADAMS Accession No. ML17222A328), the NRC issued its assessment of the Browns Ferry MSA.

In SECY-16-0142, "Draft Final Rule – Mitigation of Beyond-Design-Basis Events [MBDBE] (RIN 3150-AJ49)," (ADAMS Accession No. ML16291A186) provisions were proposed that would have required the mitigation strategies to address the reevaluated flood hazard information on a generic basis. As reflected in the Affirmation Notice and Staff Requirements Memorandum (SRM) dated January 24, 2019 (ADAMS Accession No. ML19023A038), associated with SECY-16-0142, the Commission determined that addressing the reevaluated hazards in the mitigation strategies on a generic basis was not needed for adequate protection of public health and safety but should instead be assessed on a plant-specific, case-by-case basis under the requirements of 10 CFR Section 50.109, "Backfitting," and Section 52.98, "Finality of combined licenses; information requests."

The January 24, 2019, Affirmation Notice and SRM directed the staff to continue to use the 50.54(f) process to ensure that the NRC and its licensees will take the needed actions, if any, to ensure there is no undue risk to public health and safety due to the potential effects of the reevaluated flood hazards. The SRM further directed that the staff should continue these efforts, utilizing existing agency processes, to determine whether an operating power reactor license should be modified, suspended, or revoked considering the reevaluated hazard.

In a letter dated August 20, 2019 (ADAMS Accession No. ML19067A247), the NRC staff provided a path forward to treat the reevaluation of flood hazards in light of the Commission's direction in the Affirmation Notice and SRM dated January 24, 2019. The staff assessment documented herein was performed in accordance with the information in the August 20, 2019, letter, including a plant-specific determination on whether additional regulatory actions are warranted to address the reevaluated hazard.

In the MSA staff assessment, the staff concluded that that the licensee demonstrated the capability to implement FLEX strategies against the reevaluated hazards described in the ISR letter. The NRC staff made its determination based on:

- Consideration that a reevaluated LIP hazard is not expected to impact the storage, deployment and/or staging areas of FLEX equipment given the estimated floodwaters

present during the deployment trigger and the physical characteristics of the haul paths and staging areas;
- All Phase 1 and 2 strategies, as currently designed, contain sufficient margin to allow local floodwaters to recede prior to any established FLEX actions or equipment deployment. As a result, implementation timelines described in the overall integrated plan may be revised and adjusted to reflect deployment delays, but the overall completion time should not be impacted;
- Consideration that Phase 3 equipment is not impacted; and
- The availability of procedures that incorporate warning time attributes for LIP that are consistent with NEI 15-05, "Warning Time for Local Intense Precipitation Events" (ADAMS Accession No. ML18005A076).

In its FE, the licensee updated the applicable flood-causing mechanisms (except LIP - see Attachment A to the FE) from that provided in the FHRR. Flood-causing mechanisms that were bound by the CDB in the original FHRR remain bounded in the FHRR update. Flood-causing mechanisms that were noted to be below the plant grade in the original FHRR remained below the plant grade of 565.0 feet (ft.). in the FHRR update. The LIP flood levels were not changed from those noted in the ISR letter. Therefore, the FHRR update in the FE does not affect the results submitted in the original FHRR and MSA, nor the staff's conclusions in the previous applicable staff assessments.

The staff continues to conclude that FLEX strategies can be implemented assuming a flooding event of the magnitude described in the ISR letter and bounds the revised flood elevations provided in the FE. In its MSA, TVA concluded that the results from the licensee's original FHRR did not change the overall strategies. However, once the FLEX implementation timeline is finalized, the ability to mobilize FLEX equipment within the allotted timeframe from the final FLEX documents will be verified. Condition Report (CR) #1231026 tracks completion of this activity and timelines for the staging and deployment of FLEX equipment. Using an audit process, the NRC staff confirmed that the applicable CR has been completed. The mitigation strategies at Browns Ferry can be implemented as designed. The staff concludes that implementation of FLEX strategies, assuming the ISR flood conditions, continue to provide an important defense-in-depth function should the installed Structures, Systems and Components (SSCs) be unable to maintain the Key Safety Functions (KSFs) during the conditions associated with the flood levels found in the ISR letter.

Focused Evaluation

As noted in the ISR letter, the LIP flood-causing mechanism at Browns Ferry is not bounded by the plant's CDB. Additional assessment of this flood hazard mechanism is expected to be performed by the licensee.

By letter dated October 11, 2019 (ADAMS Accession No. ML19284F761), TVA submitted the FE for Browns Ferry. The FEs are intended to confirm that licensees have adequately demonstrated, for unbounded mechanisms identified in the ISR letter, that: 1) a flood mechanism is bounded by the CDB based on further reevaluation of flood mechanism parameters; 2) effective flood protection is provided for the unbounded mechanism; or 3) a feasible response is provided if the unbounded mechanism is LIP. These options associated with performing an FE are referred to as Paths 1, 2, or 3, as described in NEI 16-05, Revision 1.

In November 2015, TVA Corporate Engineering identified a potential error in the Browns Ferry FHRR Hydrologic Engineering Center-River Analysis System (HEC-RAS) hydrologic flooding

simulation model (TVA CR# 1101784). This potential error could result in an overestimation of flood storage capacity in reservoirs within the HEC-RAS model and an underestimation of flooding levels at critical dams and at the Browns Ferry plant site. This issue and the proposed changes to address the issue were discussed in detail with the NRC in a public meeting with TVA concerning the Sequoyah Nuclear Plant, Units 1 & 2 (Sequoyah) on April 4, 2016 (ADAMS Accession No. ML16117A551).

As a result of the HEC-RAS error, TVA has updated the FHRR flooding simulation models. The following key changes were made:

1. Probable Maximum Precipitation (PMP): updated to a Browns Ferry site specific PMP based on an NRC reviewed Topical Report (TR) TVA-NPG-AWA16-A, "TVA Overall Basin Probable Maximum Precipitation and Local Intense Precipitation Analysis, Calculation CDQ0000002016000041, Revision 1" (ADAMS Accession No. ML19155A047). The NRC SE associated with the TR, dated March 18, 2019, can be found at ADAMS Accession No. ML19010A212.
2. Channel Geometry and Overbank Storage in Stream Course Model: updated the channel geometry and/or the overbank storage volumes of the stream course model consistent with recommendations from the United States Army Corps of Engineers.
3. Dam Modifications: updated dam stability analysis to account for a modification at Douglas dam.
4. PMP Areal Application and Loss Methods: updated the rainfall distribution methodology to be consistent with the gridded rainfall data format in TR TVA-NPG-AWA16-A and to apply TVA's antecedent precipitation index (API) rainfall runoff method.

The licensee provided an FHRR analysis update as Attachment A to the FE. Table A-3 of the FE tabulates the FHRR analysis update results. Except for the LIP flood-causing mechanism, which was not changed in Attachment A to the FE, the FHRR analysis update results remain bounded by the CDB. The staff did not perform a detailed evaluation of the methodology associated with the FHRR analysis update for purposes of the FE. The LIP flood is the only flood identified in the ISR letter that exceeded the CDB. The value in the ISR letter is used in the FE and is not affected by the updated FHRR provided as Attachment A. As noted in Section 5.1 of the FE, the FHRR PMP resulted in a total rainfall of 16.47 inches. An NRC approved site-specific PMP for the Browns Ferry site results in a total rainfall of 11.6 inches. The site-specific PMP is not considered in the FE except for a sensitivity study in the evaluation of adequate physical margin for safety-related equipment in the Standby Gas Treatment Building (SGTB). All other FHRR flood-causing mechanism hazard levels were bounded by the CDB and remain bound in the FHRR analysis update.

In addition to the FHRR analysis update, TVA provided a warning time analysis in Attachment B to the FE. The staff did not perform a detailed evaluation of the methodology associated with the warning time analysis update for purposes of the FE. The shortest probable maximum flood (PMF) warning time calculated is 24 hours and bounds the 12 hours required for completion of flood mode preparations procedures and entry into cold shutdown. The overall strategy to protect key SSCs in a LIP event relies on plant building design and configuration, with one exception, which does not depend on warning time.

The licensee credits an operator action to close three diesel generator building emergency drain isolation valves as temporary protection for a LIP event. In its FE, the licensee completed an analysis of time critical activities to demonstrate the valves can be closed with adequate margin. The actions to close the valves depends on direct observations of actual flood conditions and

does not depend on warning time. Thus, the warning time analysis has no impact on the conclusions in the FE.

In a letter to the NRC dated January 14, 2020 (ADAMS Accession No. ML20016A396), TVA applied to revise the Sequoyah updated final safety analysis report (UFSAR) regarding changes to the hydrologic analysis. TVA is expected to submit a similar LAR for Browns Ferry in the future. The same methodologies are expected to be used in the LAR and the FHRR analysis update provided with the FE. The original FHRR results bound the FHRR analysis update in the FE and a detailed review of the FHRR analysis update is not required to complete the review of the FE. The staff can evaluate the methodology associated with the updated flood levels and warning times as part of the LAR review. A separate, detailed evaluation for purposes of the licensee's response to the 50.54(f) letter is not needed.

The licensee's FE provides a "Path 2" LIP evaluation (i.e., the licensee has effective flood protection for this event).

3.0 TECHNICAL EVALUATION

As described in the ISR letter, the LIP flood-causing mechanism exceeds the CDB. The Browns Ferry FE addresses this flood-causing mechanism. This technical evaluation characterizes flood parameters and evaluates the following flood impact assessment topics for the LIP unbounded flood-causing mechanism: a description of the impact of the unbounded hazard; an evaluation of available physical margin (APM) and reliability of flood protection features; and the overall site response.

3.1 Characterization of Flood Parameters

The flood parameters that are used as inputs to the Browns Ferry FE staff's assessment are based on the ISR LIP flood levels. All other flood-causing mechanisms were bound by the CDB as noted in the ISR letter. Those flood-causing mechanisms remained bound by the CDB in the FHRR analysis update provided as attachment A to the FE. The FHRR analysis update incorporates the changes to the FHRR simulation models as discussed in Section 2.0. The FHRR analysis update flood elevations are bounded by the CDB flood elevations except for LIP, and do not affect the staff's evaluation.

For the LIP flood-causing mechanism, the staff's assessment credits passive protection features, combined with plant procedures to close Diesel Generator Building (DGB) emergency drain line isolation valves, to demonstrate that SSCs and the associated KSFs are protected from the LIP flooding mechanism.

For the LIP flood-causing mechanism, Browns Ferry followed Path 2 of NEI 16-05, Revision 1. The staff reviewed the FE considering the flooding elevations provided in the ISR letter. The staff did not perform a detailed evaluation of the methodology associated with the FHRR analysis update provided in Attachment A of the FE. For the LIP flood-causing mechanism, the FHRR analysis update did not change the flood level noted in the ISR letter, remains bounded by the licensee's evaluation in the original FHRR, and does not affect the staff's evaluation. The site-specific PMP from the NRC-approved topical report was used to perform a sensitivity study for the SGTB. The sensitivity study provides additional assurance that the negligible available physical margin is acceptable. This was the only change to the FHRR LIP model reviewed in the FHRR staff assessment. The staff's assessment credits passive protection features, combined with plant procedures to close DGB emergency drain line isolation valves, to

demonstrate that SSCs and the associated KSFs are protected from the LIP flooding mechanism up to the flood levels noted in the ISR letter.

The new flood hazard analysis detailed methodologies can be reviewed as part of an upcoming LAR review. In a letter to the NRC dated January 14, 2020 (ADAMS Accession No. ML20016A396), TVA provided an application (license amendment request, or LAR) to revise the Sequoyah UFSAR regarding changes to the hydrologic analysis. TVA is expected to provide a similar LAR in the future for Browns Ferry. Given that essentially the same methodologies are expected to be used in both the FHRR analysis update and the LAR, in the interest of efficiency, the staff has determined that a detailed review of the methodologies can be done during the LAR review. An identical, detailed evaluation for purposes of the licensee's response to the 50.54(f) letter is not needed. The staff considers this reasonable for the following reasons:

- The topical report used to provide input to the site-specific PMP has been approved for use by the NRC.
- The stream course model updates are consistent with recommendations from the U.S. Army Corps of Engineers.
- Dam modifications discussed in the FHRR have been completed and are used to update the dam stability analysis.
- The same methodologies are expected to be used in both the FHRR analysis update and the LAR.
- The LIP flood-causing mechanism was not changed.
- The warning time analysis retains the design basis time required for plant safe shutdown.
- The conclusions reached in the FE staff assessment will not be affected since the ISR LIP level is used in the FE.
- In the MSA staff assessment, the NRC staff concluded that the licensee demonstrated its capability to implement FLEX strategies, as designed, against the reevaluated hazards discussed in the ISR letter.
- Any results identified during the LAR review that may adversely impact the conclusions described in this staff assessment (i.e., an increase in the applicable FCM critical flood height or a decrease in the design basis warning time) can be reviewed and the impact on the site assessed as part of the LAR review.

3.2 Evaluation of Flood Impact Assessment for Local Intense Precipitation

3.2.1 Description of Impact of Unbounded Hazard

A comparison of the CDB to the reevaluation results is provided in Table 4-1 of the licensee's FE. These results are summarized in Table 3.2.1-1 below.

Table 3.2.1-1 – Comparison of Current Design Basis Elevations and Reevaluation Results (Table 4-1 of FE)

Flood Causing Mechanism	Design Basis (ft.)	Reevaluation (ft.)	Bounded (Yes/No)	Comments
Local Intense Precipitation	<=592	590.4	Yes	West Channel
	<=578	578.2	No	East Switchyard Channel
	<=565	566.2	No	Plant Lower West
		565.2	No	Plant Lower Mid
		566.6	No	Plant Lower East

The 578.2 ft. flood elevation in the East Switchyard Channel results in overflow into the Cooling Tower hot water discharge channel and the East Switchyard. This overflow is fully contained in these areas. There are no safety impacts from the increased flow in the discharge channel. The effects of the increase in the discharge channels were considered in the analysis of LIP runoff from the lower plant area. In addition, overflow from the East Switchyard channel will enter the switchyard area north of the plant main site. The graded level of the ground north of the turbine building is at least 578.6 ft. Therefore, the overflow is blocked from the lower plant area by the ground surface elevation between the switchyard and turbine building with a 0.4 ft. margin. The time the flood water remains at this elevation prior to receding is minimal. Any overflow from the East Switchyard Channel does not enter the lower plant area and does not impact any main plant structures.

In the lower plant area, the Reactor Building, the Intake Pumping Station (IPS), and the DGB house and protect safety-related equipment. In addition, the Radwaste Building houses and protects equipment required for liquid radwaste processing. The reevaluated LIP flood elevation exceeds the CDB at these locations. Each of these buildings have exterior access doors with thresholds near or below the elevations listed in Table 3.2.1-1. The licensee states that all of these exterior doors are watertight, by design, up to elevation 578.0 ft. In addition, the doors were observed during the flooding walkdowns performed in February 2015, along with floodwalls and penetrations. The licensee walkdowns determined that the barriers and penetrations were acceptable up to the design basis PMF height of 578.0 ft., thus providing protection of the equipment within the buildings from the maximum LIP flood heights of 566.6 ft.

Three additional structures, located in the plant lower west area, are discussed in the licensee's FE that could potentially be affected by the LIP floodwaters. The SGTB houses and protects safety-related equipment. The single entry door is not designed leak tight. The LIP floodwater elevation at this location is 566.2 ft., which can potentially affect safety-related breakers on the Standby Gas Treatment electrical board and required additional analysis by the licensee.

The Off Gas Treatment Building is sealed against flood up to elevation 568.42 ft., which is above the LIP flood elevation of 566.2 ft. The Off Gas Stack is sealed against flood to elevation 567.75 ft with a floor elevation of 568.0 ft, which is above the LIP flood elevation of 566.2 ft. No LIP floodwater in leakage is expected at these two locations.

The NRC staff reviewed the potential in-leakage paths for LIP floodwater into the Reactor Building noted by the licensee in the FE. The Reactor Building has a floor level of 565.0 ft. Access to the building is through an equipment/personnel airlock on the south side. The LIP flood elevation at this point is 565.2 ft., which exceeds the floor elevation at the airlock by 0.2 ft. (2.4 inches). The equipment airlock is a secondary containment boundary, consisting of two interlocked doors such that only one door may be opened at a time. Each door has inflatable

seals to maintain the design air seal. The status of the doors is monitored each shift as required by site procedures. By procedure, any open door will be closed as warranted by forecast weather conditions.

The Reactor Building also has a small exterior personnel access door adjacent to the equipment airlock. This door was identified in the licensee's FHRR as a normally closed watertight door having a 3 ½ inch threshold which exceeds the LIP flood elevation by 1 inch. In its FE, the licensee notes that the door is now closed permanently with masonry blocks and is no longer a potential in-leakage location.

On the north side of the Reactor Building, the doors between the Turbine Building and the Reactor Building would potentially be exposed to LIP flood water when the flood elevation in the lower plant area exceeds the Turbine Building floor elevation of 565.0 ft. LIP flood elevation in this area can exceed the 565.0 ft. elevation by up to 1.6 ft. The Reactor Building wall at the Turbine Building is an interior wall and not subject to wind or wave action. The personnel access doors and equipment access doors are normally closed, watertight doors designed for a PMF water height of 572.5 ft. Any small leakage is bound by the internal flooding analysis for the 565.0 general area.

Considering the watertight design characteristics of the doors, the physical size of the doors, the design operations of the exterior airlock doors, and the minimal height and duration of any LIP flood waters at or above elevation 565.0 ft., the NRC staff considers it reasonable that little to no leakage beyond the external airlock doors is expected and that minimal to no leakage into the Reactor Building is expected. For the north side Reactor Building doors, any minimal leakage through an inadequate seal is bound by the internal flooding analysis.

The NRC staff reviewed the potential in-leakage into the DGBs noted by the licensee in the FE. The DGBs have a finished floor elevation of 565.5 ft. The LIP flood elevations at these locations exceeds this level by up to 1.1 ft. The two DGBs (Unit 1/2 and Unit 3) each have five similar exterior doors. These doors are normally closed, watertight doors designed for the PMF water elevation of 578.0 ft. No LIP floodwater leakage is expected into the DGBs through these doors.

Based on the watertight design, limited flood height, and short duration of exposure, the NRC staff considers it reasonable that no floodwater ingress is expected into the DGBs through these doors. Any minimal leakage through a door seal will be small and will not impact diesel operations.

The licensee notes in the FE that there is a potential for LIP floodwater to backflow through emergency drain lines into the corridors outside the diesel generator bays. The emergency drain lines have normally open shutoff valves and are routed to valve pits located at 565.0 ft. just outside the DGBs. The LIP floodwater may backflow through the emergency drain lines, into the corridor, and backflow through the floor drain piping into the diesel generator bay compartments. Normally closed doors between the corridor and the safety-related components in the diesel generator bays will limit the potential flow of water from the corridor into the bays. Backflow of any LIP floodwater into the DGB could result in a "Diesel Generator Floor Drain Sump Level High" alarm in the control room, which requires an operator to be dispatched to investigate the cause of the alarm. The critical elevation inside the diesel generator bays is 566.17 ft., or approximately 8 inches above the 565.5 ft. floor elevation.

In the its FHRR, TVA committed to determine a resolution to the potential backflow of water through the emergency drain lines. In the its MSA, TVA determined that plant-specific procedures would be developed and implemented to close the emergency drain line isolation valves based on specific trigger conditions. A drainage analysis using the FLO-2D computer code was used to supplement the credited FHRR analysis to determine the LIP flood hydrograph at locations near the valve pits for the emergency drain lines. The analysis provided a more precise LIP flood event duration (FED) at the emergency drain line valve pits to support the determination of the time required to respond to the LIP event and close the drain line isolation valves. The licensee states in its MSA that abnormal operating procedure, 0-AOI-100-7, "Severe Weather," has been modified to provide guidance to operations staff to close the emergency drain line isolation valves before the reevaluated LIP flood waters could exceed the critical flood elevations within the DGB. The actions to close these drain valves is based on weather forecast warnings, DGB sump level alarms, meteorological tower water accumulation alarms and direct observations of flooding conditions. Using an audit process, the NRC confirmed that the changes described in the MSA have been included in severe weather procedure 0-AOI-100-7.

The action to close the emergency drain line isolation valves is considered a Time Sensitive Action (TSA). As required by NEI 16-05, this action is evaluated by the licensee in Section 5.4.1 of its FE. The NRC staff's evaluation of the TSAs is provided in Section 3.2.3 of this staff assessment. Based on the licensee's analysis, the floodwater could rise to a height of 565.4 ft. inside the Unit 3 (controlling) DGB drain line boxes in the DGB corridor before the drain line isolation valves are fully closed. This is 0.8 ft. below the 566.2 ft. critical elevation inside the DGB compartments. The NRC staff also notes that this is below the 565.5 ft. floor elevation in the DGB compartments.

Based on the procedures in place, clear procedural triggers, available margin, and the staff's review of the TSAs, the NRC staff considers that it is reasonable to conclude that the floodwater ingress into the DGBs through the emergency drain lines will not impact any safety-related equipment in the DGBs.

The staff reviewed the potential in-leakage into the IPS identified by the licensee. The IPS has a floor elevation of 564.7 ft, with access curbs up to 565.2 ft. The reevaluated LIP flood in the plant lower east area of 566.6 ft. exceeds the floor elevation by 1.9 ft. The IPS has four similar exterior doors, each one accessing one of the four residual heat removal service water (RHRSW) pump compartments. The external doors are normally closed, watertight doors, which are verified once per shift by procedure. If a watertight door is not in a closed position, operations personnel will take action to close the door under severe weather procedure 0-AOI-100-7 as warranted by forecast weather conditions. The doors are designed to withstand the PMF height of 578.0 ft. Little to no LIP floodwater ingress is expected through these doors into the four RHRSW pump compartments.

In addition, the RHRSW pump compartment are open at the roof by design. Two sump pumps per compartment are provided to remove rain water or other potential water inputs. A single sump pump is capable of removing the rain intrusion from the PMP, coincident with an RHRSW seal failure and gross strainer leakage, with margin.

Given the watertight design, limited flood height, limited associated effects (AE), and short duration of the LIP flood, the staff considers it reasonable to conclude that minimal to no in-leakage to the IPS RHRSW pump compartments is expected. Based on the designed capacity

of the sump pumps, it is reasonable that no significant accumulation of LIP rainfall is expected inside the RHRSW pump compartments.

The staff reviewed the potential in-leakage into the Radwaste Building identified by the licensee. The Radwaste Building has a finished floor elevation of 565.0 ft. The LIP flood level of 566.2 ft. in the lower west area can exceed the floor elevation by 1.2 ft. The exterior and interior doors subject to the LIP flooding are all designed as watertight to at least a level of 572.5 ft, and verified once each shift by procedure. If a Radwaste Building watertight door is not in a closed position, operations will take action to close the door under severe weather procedure 0-AOI-100-7 as warranted by forecast weather conditions. The Radwaste Building does not contain safety-related equipment needed to safely shutdown the plant.

The licensee identified three additional structures, the SGTB, the Off Gas Treatment Building, and the Off Gas Stack, that are located in the plant lower west area and are potentially affected by the LIP floodwaters.

The staff reviewed the potential in-leakage into the SGTB identified by the licensee. The SGTB has a floor elevation of 565.5 ft. The LIP flood elevation in that area is 566.2 ft at the exterior door of the SGTB. The single exterior door is not designed watertight. The SGTB houses, in the access hallway, the 480V Standby Gas Treatment electrical board, which contains safety-related breakers located 8 inches above the 565.5 ft. floor elevation. The licensee analysis in the FE conservatively assumes two non-watertight double doors, which lead to additional building spaces, are closed during a LIP event. Having these two doors shut results in the highest water level inside the SGTB hallway and the lowest margin to the safety-related breakers. No credit is taken for floor drains, sumps, and sump pumps. The licensee's analysis results in an available physical margin (APM) of 0.2 inches to the safety-related breakers in the SGTB hallway. Per NEI 16-05, negligible or zero APM can be justified as acceptable if the use of conservative assumptions, inputs, and/or methods are used. The NRC staff evaluation of the acceptability of the negligible APM is provided in Section 3.2.4.

In addition, because the APM is low, the licensee performed a sensitivity study of the LIP levels in the plant lower west area. The sensitivity study used the NRC-approved site-specific PMP in place of the FHRR hydrometeorlogical report (HMR) PMP as the only change to the FHRR LIP model reviewed by the staff in Section 3.2 of the FHRR staff assessment. The sensitivity study indicates a maximum flood elevation of 565.9 ft., providing a margin of at least 0.3 ft. to the critical safety-related equipment inside the SGBT.

The staff reviewed the licensee's analysis of the potential impact of the LIP floodwaters on the SGTB. The debris and hydrodynamic loads within the hallway are negligible. The time that the LIP flood levels is at the maximum height will be minimal and begin to recede almost immediately. The NRC staff considered the conservative nature of the assumptions and the fact that no credit is taken for floor drains, sumps, and sump pumps. In addition, the NRC staff considered the sensitivity analysis using an NRC-approved site-specific PMP value, which shows additional margin to the safety-related breakers. The negligible available physical margin is assessed in Section 3.2.4. Based on the above, the NRC considers it reasonable that the LIP floodwaters will not affect the safety-related equipment in the SGTB.

The Off Gas Treatment Building is sealed against flood up to an elevation of 568.42 ft., which is above the LIP flood elevation of 566.2 ft. at this location. The Off Gas Stack is sealed against flood to an elevation of 567.75 ft., and has a finished floor elevation of 568.0 ft., which is above

the LIP flood elevation of 566.2 ft. at this location. No LIP floodwater in leakage is expected at these two locations.

In its MSA, the licensee states that the LIP AEs, such as debris loads, hydrodynamic loads, and hydrostatic loads are expected to be negligible. The period of inundation is 1.5 hours, and the period of rescission is 3.0 hours. In its assessment of the licensee's MSA, the NRC staff concluded that the licensee's justifications and methods related to the AE and FED parameters are appropriate and reasonable.

Based on the discussions above, the staff concludes that key SSCs and their associated KSFs are effectively protected against the LIP flood levels identified in the FE due to the following:

- Exterior doors and hatches would prevent/minimize water intrusion into safety-related areas of the plant.
- By design, doors leading to safety-related areas that are subject to LIP floodwater ingress are designed watertight (except the exterior door to the SGTB). Any leakage through these doors will be minimal and does not impact any safety-related SSCs.
- In-leakage through the non-watertight SGTB door will not impact safety-related breakers in the SGTB hallway
- Actions to shut the DGB emergency drain isolation valves
    - are included in plant operations severe weather procedures
    - can reasonably be completed within the time constraints necessary to avoid impacting safety-related equipment
    - are feasible
    - have clearly defined monitoring triggers
- The time for LIP flood waters to fully recede from the site is 1 ½ hours (MSA staff assessment, Section 3.3.1).
- The debris loads, hydrodynamic loads, and hydrostatic loads due to the LIP flood levels are minimal (MSA staff assessment, Section 3.3.2).

Therefore, the staff concludes that the licensee has met the guidance in NEI 16-05, Revision 1, as endorsed by the NRC, of a Path 2 evaluation (i.e., "effective flood protection") for the FE LIP event. The KSFs, without reliance on FLEX, can reasonably be expected to be met with installed plant equipment.

Defense-in-Depth

In addition to the staff concluding that Browns Ferry meets the Path 2 guidance in NEI 16-05, Revision 1, for the LIP event, the staff also concludes that Browns Ferry would meet Path 3 guidance for this event by demonstrating a feasible flood response for LIP. The feasible flood response for the ISR LIP event was evaluated by the staff and found to be acceptable as documented in the MSA staff assessment dated September 5, 2017 (ADAMS Accession No. ML17222A328). In its MSA, the licensee stated that, once the FLEX implementation timeline is finalized, the ability to deploy and mobilize FLEX equipment within the allotted timeframe from the final FLEX documents will be verified to ensure the Browns Ferry FLEX strategies can be implemented as designed. Minor changes to the mitigation strategies were made to the licensee's final integrated plan, which was submitted on May 31, 2018 (ADAMS Accession No. ML18166A086), to address the ISR LIP flood elevation. The CR#1231026 tracked completion of this activity. Through an audit process, NRC staff confirmed that this CR has been completed and closed out. Mitigation of the LIP event does not require any protective

actions to occur before the site in inundated. The information in the FE does not change the conclusions in the MSA staff assessment regarding the LIP flood event.

3.2.2 Evaluation of Available Physical Margin and Reliability of Flood Protection Features

During a LIP event, LIP floodwater backflow into the DGB emergency drain lines is terminated by plant operators in accordance with severe weather procedures, providing a margin of 0.8 ft. Leakage into the SGTB through a closed, non-watertight security door during a LIP event results in a margin of 0.2 inches to safety-related breakers. Because the margin for the SGBT is small, a sensitivity study using an NRC approved site-specific PMP in place of the design basis HMR PMP was completed. In the sensitivity study, the margin increases to 0.3 ft. to the safety-related equipment inside the SGTB.

With the exception of the closing of the DGB emergency drain line isolation valves, Browns Ferry flood protection from a LIP event does not rely on active features or operator actions. Flood protection in the LIP event is provided by passive civil/structural and architectural design features. These features are periodically inspected under Technical Instruction, 0-TI-600, "External Flood Protection Program Bases Document." The emergency drain line valves are included in the licensee's preventative maintenance program on a 52 week frequency.

During a LIP event, flood water leaking into the Reactor Buildings, DGBs, IPS, Radwaste Building, Off Gas Treatment Building and Off Gas Stack is minimized or prevented by the design of the access doors and hatches. For example:

1. Doors are designed as watertight and minimal or no leakage is expected
2. Interlocks prevent opening internal doors and external doors simultaneously
3. The Off Gas Treatment Building and Off Gas Stack are sealed against flood to an elevation above the LIP flood level

The only access to an area containing safety-related SSCs with a non-watertight door that is below the LIP flood height is the SGTB. Leakage into the SGTB through a closed, non-watertight security door results in a margin of 0.2 inches to safety-related breakers.

During a LIP event, LIP floodwater backflow into the DGB emergency drain lines is terminated by plant operators in accordance with the site's severe weather procedure. A time sensitive action analysis performed by the licensee determined that there is sufficient time for the valves to be shut, terminating the backflow, providing a margin of 0.8 ft. to the 566.2 ft. critical elevation.

Per NEI 16-05 Appendix B, Section B.1, negligible or zero APM can be justified as acceptable if the use of conservative assumptions, inputs, and/or methods are used. The following are examples of conservatisms used in the licensee's LIP flood analysis:

1. All site surfaces are considered impervious, so no infiltration is credited.
2. All catch basins and storm culverts are assumed to be blocked and unavailable for drainage.
3. The plant drainage channels are postulated to experience partial, although severe, blockage that significantly reduces the conveyance capacity of the channels.
4. No credit is taken for the capability of building drains, sumps, and sump pumps in the SGTB or DGB to remove water in-leakage.
5. No credit is taken for the slowing of back leakage through the DGB emergency drain lines as the isolation valves begin to shut.

6. A sensitivity study using an NRC approved site-specific PMP in place of the design basis HMR PMP indicates a margin improvement to 0.3 ft. to the safety-related equipment inside the SGTB.

The NRC staff reviewed the licensee's assumptions, inputs and methods used for the LIP flood levels used in the FE. Based on these conservatisms, the NRC staff concludes that adequate APM is available for the LIP event described in the FE.

Based on the above evaluation, the NRC staff concludes that existing margins are adequate and protective features are reasonably reliable to provide effective flood protection from the LIP event to maintain KSFs for the LIP event, consistent with Appendix B of NEI 16-05, Revision 1.

3.2.3 Overall Site Response

The licensee stated in its FE that site response to a LIP event relies on normal passive/civil structural and architectural design features. No specific operator actions are required to respond to a LIP event, with the exception of closing three emergency drain line isolation valves for the DGBs.

The TSAs required for the LIP protection strategy have been identified and determined to be feasible. Mitigation of the LIP event requires no site protective actions to occur prior to the start of the LIP rainfall. The licensee follows the guidance of NEI 16-05, Appendix C to demonstrate that the overall site response to LIP is adequate. The licensee's evaluation against the criteria of Appendix C and the staff's assessment follow.

3.2.3.1 Defining the Critical Path and Identify Time Sensitive Actions

To prevent/limit backflow of LIP floodwaters through the DGB emergency drain lines, operator action to close the three emergency drain line isolation valves is needed as temporary protection against the LIP event. The licensee identified these actions as Time Sensitive Actions. Warning time protocols in weather monitoring procedure 0-AOI-100-7, "Severe Weather," are consistent with NEI 15-05, "Warning Time for Local Intense Precipitation Events" (ADAMS Accession No. ML18005A076). Meteorological tower rainfall accumulation alarms, DGB sump level alarms, weather forecast warnings, and other plant pre-cursor flooding indications initiate Plant Operations protective actions to close the emergency drain line isolation valves to protect safety-related components inside the DGBs. Operations implement the LIP procedure based on the following inputs: National Weather Service (NWS) severe weather forecasting, TVA meteorological tower rainfall accumulation alarms, or reports of local flooding in buildings at plant grade. Severe weather procedure 0-AOI-100-7 has three increasing levels of focus by Plant Operations. An operations watch in the DGB is established when the High Concern Precipitation event protocol is reached. Direction to close the emergency drain line isolation valves is given when direct observation of 0.75 inches of rainfall in 15 minutes or water is observed in the lunchroom corridor and the DGB watch observes water beginning to backflow through the emergency drain or a DGB high sump level alarm is received. Based on the licensee's critical activity analysis, the flood elevation inside the DGBs is expected to be no more than 565.4 ft. or a margin of 0.8 ft. to safety-related components. The staff notes that this is conservative, in that the water rise within the DGB will begin to slow as valve closure begins. This is not credited in the licensee's analysis.

Using an audit process, the NRC staff reviewed the licensee's severe weather procedure. The NRC staff notes that the licensee uses weather forecasts and predictions (Quantitative

Precipitation Forecasts, or QPF and Probabilistic Quantitative Precipitation Forecasts, or PQPF) consistent with those recommended in NEI 15-05. Three increasing levels of operations personnel focus and increased monitoring are based on the QPF and PQPF, as well as direct observations. Appropriate monitoring thresholds have been established, and clearly delineated conditions to initiate actions are defined in the procedure.

In its FE, the licensee provides a summary of the critical path activities to close the DGB emergency drain line isolation valves. The licensee's analysis determined that the two Unit 3 DGB valves are required to be closed within 20.67 minutes, and the Unit 1/2 drain valve is required to be shut within 42 minutes. Shutting the valves within the time specified will insure any back leakage into the DGB will remain below the 566.2 ft. critical elevation, assuming the latest observation of water actually entering the DGB. The licensee's analysis provides a timeline of the critical path activities to accomplish the closure. The Unit 1/2 emergency drain path is isolated in 12 minutes and 38 seconds, and the Unit 3 drain path is isolated in 14 minutes.

Using an audit process, the NRC staff reviewed the licensee's validation report associated with the TSAs (TVA QA Record, "Validation of Closure Time of the DGB Emergency Drain Isolation Valves in the Event of a LIP Event," August 1, 2019). The staff noted that the TSAs were evaluated using TVA's FLEX Strategy Validation process. The staff also noted the conservatisms included in the validation process including:

- The validation uses the assumed latest observation of water actually entering the DGBs. Operations may close the DGB emergency drain isolation valves at any time the conditions appear threatening.
- The hydrograph inside the DGB lags the exterior hydrograph. The exterior hydrograph is conservatively used to approximate the inside hydrograph.
- The flood rise inside the DGB is not adjusted for the fact that the hydrograph rise inside the DGB will begin to be delayed as the valves are closed

Based on the above, the NRC staff concludes that the critical path activities and TSAs have been appropriately identified and defined. The staff concludes that it is reasonable that TSAs can be completed within the required time to reasonably protect the SSCs within the DGB during the LIP event.

3.2.3.2 Additional Review of NEI 16-05, Appendix C, Criteria

In its FE, the licensee analysis concludes that the two Unit 3 emergency drain isolation valves must be closed within 20.67 minutes to protect SSCs within the Unit 3 DGB. Likewise, the single Unit 1/2 emergency drain valve must be closed within 42.0 minutes to protect SSCs within the Unit 1/2 DGB. Therefore, based on the critical path activities timeline, sufficient time is provided to implement the TSA to close the emergency drain isolation valves, and the response is considered feasible.

In its FE, the licensee states that the monitoring triggers were developed in accordance with NEI 15-05 and are based on notification from TVA meteorologists and/or NWS of consequential rainfall, severe storms, or flash flooding events. The licensee's severe weather procedure, 0-AOI-100-7, is entered at low concern precipitation levels and is increased as needed based on weather forecast information and actual monitored conditions. When the high concern level is reached, watches are established in each DGB to monitor for backflow of LIP floodwaters. If

backflow is seen, or more than 0.75 inches of rain in a 15 minute period is expected, plant operations direct the DGB emergency drain line isolation valves to be shut.

Severe weather procedure 0-AOI-100-7 provides clear guidance on the responsibilities for the rainfall/flood event.

The detailed flood response timeline for the LIP event is provided in Section 5.4.1 of the FE.

Time critical actions will be performed during severe rainfall. Operations personnel are exposed for less than 15 minutes, and sufficient extra time is available to complete the valve closure activities, considering the adverse environmental conditions.

The staff reviewed the licensee's Time Critical Analysis, as noted above. The staff considers that the TSAs can reasonably be expected to be completed within the time required to avoid potentially impacting the SSCs in each DGB.

Based on the above, the licensee concluded that the site response to the LIP event is adequate as demonstrated by meeting the guidelines in NEI 16-05, Appendix C.

The NRC staff reviewed the licensee's conclusions related to Appendix C of NEI 16-05. Using the audit process, the staff reviewed 0-AOI-100-7. The staff concludes that the overall site response to the LIP event is adequate. The staff's conclusion is based on:

- Unambiguous procedural triggers are clearly specified
- Clear responsibilities are specified
- Three increasing levels of focus provides adequate advance preparation time prior to protective action being needed
- The staff review of the TSA and critical path activities concludes that it is reasonable that the TSAs can be completed within the required time, with sufficient margin
- The time margins to complete the TSAs provide sufficient time to implement the TSAs and will accommodate expected adverse environmental conditions
- The LIP flood event duration is minimal
- LIP AEs, such as debris loads, hydrodynamic loads, and hydrostatic loads are negligible

Based on the above, the NRC staff concludes that the licensee has demonstrated an adequate overall site response to the ISR LIP event in accordance with the NRC approved guidance in NEI 16-05.

As an additional defense-in-depth measure, as outlined in the MSA, the licensee demonstrated the capability to deploy its FLEX strategies against a postulated beyond-design-basis flooding event up to the ISR flood levels and that the FLEX strategies are reasonably protected against the reevaluated flooding hazard. If implemented and maintained as described in the MSA, the FLEX strategies are expected to provide an additional layer of protection against the reevaluated LIP flooding hazard.

4.0 AUDIT REPORT

The July 18, 2017 (ADAMS Accession No. ML17192A452), generic audit plan describes the NRC staff's intention to issue an audit report that summarizes and documents the NRC's regulatory audit of the licensee's FE. Because this staff assessment appropriately summarized the results of the audit, the NRC staff concludes a separate audit report is not necessary, and that this staff assessment serves as the audit report described in the staff's July 18, 2017, letter.

5.0 CONCLUSION

Based on the staff's review that was performed in accordance with the guidance described in NEI 16-05, Revision 1, as endorsed by JLD-ISG-2016-01, the staff concludes that Browns Ferry has effective flood protection for the LIP event as described in the FE. The staff concludes that, because the licensee meets Path 2 FE guidance for the LIP flood event, an integrated assessment is not needed to support NRC Phase 2 decisionmaking. Browns Ferry screens out for an integrated assessment based on the guidance found in JLD-ISG-2016-01. As such, the staff concludes that, in accordance with Phase 2 of the process outlined in the 50.54(f) letter, additional regulatory actions associated with the reevaluated flood hazard are not warranted. The staff further concludes that the licensee has satisfactorily completed providing responses to the 50.54(f) activities associated with the reevaluated flood hazards.

SUBJECT: BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2 & 3 – STAFF ASSESSMENT OF FLOODING FOCUSED EVALUATION (EPID NO. L-2019-JLD-0012) DATED MAY 6, 2020

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