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

September 5, 2017

Mr. Joseph W. Shea
Vice President, Nuclear Regulatory
Affairs and Support Services
Tennessee Valley Authority
1101 Market Street, LP 3R-C
Chattanooga TN 37402-2801

SUBJECT: BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2, AND 3 – FLOOD HAZARD MITIGATION STRATEGIES ASSESSMENT (CAC NOS. MF7900, MF7901 AND MF7902)

Dear Mr. Shea:

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, pursuant to Title 10 of the *Code of Federal Regulations*, Section 50.54(f), "Conditions of Licenses" (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 report (ADAMS Accession No. ML111861807).

Enclosure 2 to the 50.54(f) letter requested that licensees reevaluate flood hazards for their site(s) using present-day methods and regulatory guidance used by the NRC staff when reviewing applications for early site permits and combined licenses. Concurrent with the reevaluation of flood hazards, licensees were required to develop and implement mitigating strategies in accordance with NRC Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (ADAMS Accession No. ML12054A735). In order to proceed with implementation of Order EA-12-049, licensees used the current licensing basis flood hazard or the most recent flood hazard information, which may not have been based on present-day methodologies and guidance, in the development of their mitigating strategies.

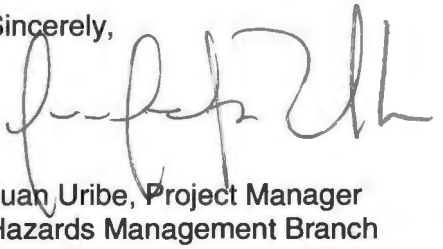
By letter dated December 27, 2016 (ADAMS Accession No. ML16363A386), Tennessee Valley Authority (the licensee) submitted its flooding mitigation strategies assessment (MSA) for Browns Ferry Nuclear Plant, Units 1, 2, and 3 (Browns Ferry). The MSAs are intended to confirm that licensees have adequately addressed the reevaluated flooding hazards within their mitigating strategies for beyond-design-basis external events. The purpose of this letter is to provide the NRC's assessment of the Browns Ferry MSA.

The NRC staff has concluded that the Browns Ferry MSA was performed consistent with the guidance described in Appendix G of Nuclear Energy Institute 12-06, Revision 2, as endorsed by Japan Lessons-Learned Division (JLD) interim staff guidance (ISG) JLD-ISG-2012-01,

Revision 1, and that the licensee has demonstrated that the mitigation strategies are reasonably protected from reevaluated flood hazard conditions for beyond-design-basis external events. This closes out the NRC's efforts associated with CAC Nos. MF7900, MF7901 and MF7902.

If you have any questions, please contact me at 301-415-3809 or at Juan Uribe@nrc.gov

Sincerely,



Juan Uribe, Project Manager
Hazards Management Branch
Japan Lessons-Learned Division
Office of Nuclear Reactor Regulation

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

Enclosure:
Staff Assessment Related to the
Mitigating Strategies for Browns Ferry

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STAFF ASSESSMENT BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATED TO MITIGATION STRATEGIES FOR BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2, AND 3 AS A RESULT OF THE REEVALUATED FLOODING HAZARD NEAR-TERM TASK FORCE RECOMMENDATION 2.1 – FLOODING (CAC NOS. MF7900, MF7901 AND MF7902)

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, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.54(f), "Conditions of Licenses" (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 to the 50.54(f) letter requested that licensees reevaluate flood hazards for their respective site(s) using present-day methods and regulatory guidance used by the NRC staff when reviewing applications for early site permits and combined licenses. Concurrent with the reevaluation of flood hazards, licensees were required to develop and implement mitigating strategies in accordance with NRC Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (ADAMS Accession No. ML12054A735). That order requires holders of operating reactor licenses and construction permits issued under 10 CFR Part 50 to modify the plants to provide additional capabilities and defense-in-depth for responding to beyond-design-basis external events, and to submit to the NRC for review a final integrated plan that describes how compliance with the requirements of Attachment 2 of the order was achieved. In order to proceed with implementation of Order EA-12-049, licensees used the current licensing basis flood hazard or the most recent flood hazard information, which may not have been based on present-day methodologies and guidance, in the development of their mitigating strategies.

The NRC staff and industry recognized the difficulty in developing and implementing mitigating strategies before completing the reevaluation of flood hazards. The NRC staff described this issue and provided recommendations to the Commission on integrating these related activities in COMSECY-14-0037, "Integration of Mitigating Strategies for Beyond-Design-Basis External Events and the Reevaluation of Flood Hazards," dated November 21, 2014 (ADAMS Accession No. ML14309A256). The Commission issued a staff requirements memorandum on March 30, 2015 (ADAMS Accession No. ML15089A236), affirming that the Commission expects licensees for operating nuclear power plants to address the reevaluated flood hazards, which are considered beyond-design-basis external events, within their mitigating strategies.

Nuclear Energy Institute (NEI) 12-06, Revision 2, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide" (ADAMS Accession No. ML16005A625), has been endorsed by the NRC as an appropriate methodology for licensees to perform assessments of the mitigating strategies against the reevaluated flood hazards developed in response to the March 12, 2012, 50.54(f) letter. The guidance in NEI 12-06, Revision 2, and Appendix G in particular, supports the proposed Mitigation of Beyond-Design-Basis Events rulemaking. The NRC's endorsement of NEI 12-06, including exceptions, clarifications, and additions, is described in Japan Lessons-

Learned Division (JLD) Interim Staff Guidance (ISG) JLD-ISG-2012-01, Revision 1, "Compliance with Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events"" (ADAMS Accession No. ML15357A163). As discussed in JLD-ISG-2012-01, Appendix G of NEI 12-06, Revision 2, describes acceptable methods for demonstrating that the reevaluated flooding hazard is addressed within the Browns Ferry Nuclear Plant, Units 1, 2, and 3 (Browns Ferry) mitigating strategies for beyond-design-basis external events.

2.0 BACKGROUND

By letter dated March 12, 2015 (ADAMS Accession No. ML15072A130), Tennessee Valley Authority (TVA, the licensee) submitted its flood hazard reevaluation report (FHRR) for Browns Ferry. By letter dated September 3, 2015 (ADAMS Accession No. ML15240A189), 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, which were to be used in conducting the mitigating strategies assessment (MSA), as described in NEI 12-06. For Browns Ferry, the mechanism listed as not bounded by the CDB in the ISR letter is local intense precipitation (LIP). By letter dated August 5, 2016 (ADAMS Accession No. ML16196A088), the NRC issued a FHRR staff assessment, which provided the documentation supporting the NRC staff's conclusions summarized in the ISR letter.

By letter dated December 27, 2016 (ADAMS Accession No. ML16363A386), TVA submitted its MSA for Browns Ferry for review by the NRC staff.

3.0 TECHNICAL EVALUATION

3.1 Mitigating Strategies under Order EA-12-049

By letter dated February 28, 2013 (ADAMS Accession No. ML13064A465), TVA submitted its Overall Integrated Plan (OIP) for Browns Ferry in response to Order EA-12-049. At 6 month intervals following the submittal of its OIP, the licensee submitted reports on its progress in complying with Order EA-12-049. The OIP was revised by letter dated August 28, 2014 (ADAMS Accession No ML14248A496). By letter dated December 19, 2013 (ADAMS Accession No. ML13353A166), the NRC staff issued the Browns Ferry interim staff evaluation documenting its review of TVA's proposed plan.

By letter dated August 28, 2013 (ADAMS Accession No. ML13234A503), the NRC notified all licensees and construction permit holders that the staff is conducting audits of their responses to Order EA-12-049 in accordance with NRC Office of Nuclear Reactor Regulation (NRR) Office Instruction LIC-111, "Regulatory Audits" (ADAMS Accession No. ML082900195). By letter dated April 6, 2015 (ADAMS Accession No. ML15069A358), the NRC staff issued an audit report in support of the ongoing audit performed at Browns Ferry from January 5-9, 2015, per the audit plan dated November 26, 2014 (ADAMS Accession No. ML14323A295).

The NRC staff notes that TVA is expected to submit its compliance letter and the Final Integrated Plan (FIP) in response to Order EA-12-049 in May 2018. The compliance letter is expected to describe the proposed mitigating strategies for Browns Ferry, and that the licensee has achieved full compliance with Order EA-12-049. The NRC plans to subsequently issue a safety evaluation documenting the results of the NRC staffs review of the FLEX strategies for Browns Ferry. If found acceptable, the safety evaluation will conclude that the final integrated

plans, if implemented as described, should adequately address the requirements of Order EA-12-049. An inspection to be performed after the issuance of the safety evaluation will confirm compliance with the order.

3.2. Licensee Evaluation of Current FLEX Strategies Against Reevaluated Hazard(s)

The licensee has assessed the potential impacts of LIP, as described in the ISR letter, against the mitigating strategies designed to meet Order EA-12-049. The purpose of the MSA is to determine if the licensee's mitigating strategies are adequate as-is, need to be modified, or new mitigating strategies need to be developed to address exceedances as described in the ISR letter.

Overall, the FLEX strategies at Browns Ferry can be implemented with minor revisions to the deployment timelines of certain activities. The impacted activities were originally designed with added margin; therefore a delay in deployment of these particular activities will not impact the implementation of the overall strategy.

The delay in deployment of certain FLEX activities allows additional time for floodwaters to recede from their deployment path, thus have minimal or negligible impact at the time of their revised deployment. As a result of these revisions to the deployment timelines, the licensee has completed (or is expected to complete) adjustments and revisions to FLEX implementation procedures. The revisions to the FLEX strategy are expected to be incorporated into the FIP and subsequently reviewed by the NRC staff.

As a result of the above, TVA determined in its evaluation that LIP does not significantly impact the existing FLEX strategies at the site given the available existing margin, site configuration, and the relatively short event duration of the event.

3.2.1 Summary of Mitigating Strategies Assessment

The licensee described in its OIP that implementation of the FLEX strategies at Browns Ferry is divided into three phases. In general, the first phase is to initially cope by relying on installed plant equipment and on-site resources, the second phase is to transition from installed plant equipment to the onsite FLEX equipment, and the third phase is to obtain additional capability and redundancy from off-site equipment.

In its MSA, the licensee stated that the current FLEX strategies were evaluated against a reevaluated LIP hazard of 578.2 feet (ft.) mean sea level (MSL) at the switchyard and 566.6 ft. MSL at the lower plant area, which are consistent with the FHRR and the ISR letter.

With regards to the east switchyard channel, the licensee stated in its MSA that the LIP event exceeded the CDB LIP flood of 578 ft. MSL by 0.2 ft. The licensee evaluated the potential impacts of the LIP exceedance and concluded that the overflow is fully contained in the Cooling Tower hot water discharge channel and in the switchyard area. While some overflow may enter the switchyard area north of the main plant site, the licensee determined that the elevation of the site north of the Turbine Building (TB) is at least 578.6 ft. MSL. As a result, no impact is expected to plant systems, structures, or components (SSCs) and/or flood protection plans.

With regards to flooding around the lower plant area, the licensee stated in the MSA that the LIP event exceeded the CDB LIP flood of 565 ft. MSL by up to 1.6 ft. at the exterior doors leading up to the Reactor Buildings, Intake Pumping Station, Diesel Generator Buildings, and Radwaste

Building. The licensee evaluated in the MSA the potential water ingress at each of these locations as described below.

- *Reactor Buildings*: The building has an airlock access point for equipment and personnel at the south side of the building that is exceeded by 0.2 ft. by the reevaluated LIP event. The airlock access is a secondary containment boundary that is equipped with inflatable seals in order to maintain an air seal and are interlocked such that only one door can be opened at once. Given the design considerations, the relatively short duration period of the event and the limited flood height above the door, the licensee concluded that this building will not be jeopardized. Water from a LIP event is also not expected to enter via the north side of the TB at the reactor building interface given the existing margin between the probable maximum flood (PMF) used as the design-basis for the area (572.5 ft. MSL) and the reevaluated LIP hazard (566.6 ft. MSL).

- *Intake Pumping Station*: This building has a floor elevation of 564.7 ft. MSL and access curbs located at the entrance doors with elevation 565.2 ft. MSL. In total, four doors exist that correspond to each one of the four residual heat removal service water (RHRSW) pump compartments. These watertight external doors are normally closed and are designed to withstand a PMF of 578 ft. MSL; therefore, no LIP runoff is expected to enter the building compartments. With regards to openings at the roof that would allow the entry of water, the licensee stated that each compartment contains two sump pumps that would remove rainwater. Furthermore, the licensee stated in its MSA that a single sump pump is capable of removing the rain with coincident RHRSW pump seal failure and emergency equipment cooling water strainer leakage. As a result, the licensee concluded that this building will not be negatively impacted by the LIP event.

- *Diesel Generator Buildings*: The buildings have a floor elevation of 565.5 ft. MSL and are exceeded by the reevaluated LIP hazard by up to 1.1 ft. There are five watertight exterior doors which are normally closed and are designed to withstand the design-basis PMF water elevation of 578 ft. MSL. Given the design considerations and the relatively short duration period of the event, the licensee concluded that this building will not be negatively impacted by the LIP event.

- *Radwaste Building*: This building has a floor elevation of 565 ft. MSL that would be exceeded by approximately 1.2 ft. at three exterior doors. The exterior doors are watertight and are designed to withstand the design-basis PMF water elevation of 578 ft. MSL. In addition, the equipment in the Radwaste Building is not considered essential to maintaining the reactors in a safe configuration.

The associated effects (AEs) and flood event duration (FED) parameters related to the reevaluated LIP hazard were also analyzed by the licensee as part of its MSA and are discussed in the following sections of this document. Finally, the licensee concluded in its MSA that with the exception of reduced warning time for a PMF event, the flooding reevaluation has no impact on the Browns Ferry strategy. In addition, equipment and personnel are available such that the strategies can be implemented, as described in the revised OIP. The NRC staff notes that prior to its MSA submittal, TVA had communicated to the NRC (via public meeting, ADAMS Accession Nos. ML16117A551 and ML16102A330, respectively) that an error had been identified in the analysis that supports the reevaluated external flood hazard elevations, and that the ongoing plan for resolution of the issue (related to storage volume calculations) is expected to result in lower flood levels at the site. Therefore, the PMF warning time analysis

presented in the MSA is expected to be a more conservative scenario based on the higher water elevations at the site.

3.3 Technical Evaluation

The NRC staff has reviewed the information presented in the MSA, as well as supporting documentation. This included:

- Review of licensing documents and previous NTTF flooding submittals;
- Review of the topographical features of the site; and
- Review and documentation of existing mitigating strategies under Order EA-12-049.

As part of its MSA review, the NRC staff sought to confirm if the unbounded reevaluated hazard(s) impacted any of the FLEX storage location(s), any staging areas, haul paths, connection points, activities, timelines, etc. The NRC staff also reviewed the flood hazard elevations in the MSA in order to confirm if the elevations matched the values provided in the Browns Ferry ISR letter. As previously stated, the only reevaluated flood-causing mechanism identified as not bounded by the CDB was LIP.

For LIP, the NRC staff confirmed that the stillwater surface elevation reported in the MSA matches the value in the ISR letter of 578.2 ft. MSL for the switchyard and 566.6 ft. MSL for the lower plant area. The NRC staff notes that wind/wave contributions were determined to be minimal and the stillwater levels remain unchanged.

At Browns Ferry, the FLEX equipment storage building (FESB) houses equipment necessary for the implementation of the FLEX strategy at the site, such as portable equipment and connection materials. During the MSA review, the NRC staff confirmed with TVA that the floor elevation of the FESB is 586.25 ft MSL. The licensee evaluated the FESB in the MSA and determined that no impacts are expected to occur given its position above the reevaluated LIP flood levels. The NRC staff confirmed this elevation with the licensee and agrees that no impact is expected to occur at the FESB.

In general, FLEX equipment deployment paths at Browns Ferry maintain a minimum elevation of 565 ft. MSL and the plant is expected to have over 4 days to deploy FLEX equipment based on plant response to a flooding event, as described in Browns Ferry procedure O-AOI-100-3. As stated in the OIP, plant personnel will deploy Phase 2 equipment during Phase 1 of the FLEX response. For some flood events, the equipment is staged many hours before the peak flood waters exceed the design-basis. For other events, equipment is placed in service beginning with the station blackout condition, which in some cases is before an extended loss of alternating current power is declared.

With regards to the reevaluated LIP hazard, the proposed deployment paths of equipment from the FESB to the staging areas were provided by the licensee in its MSA, and the analysis was supported by reevaluated LIP hydrographs. Based on the information obtained from the hydrographs, among other sources, the licensee provided an evaluation of equipment that may potentially be impacted by the reevaluated LIP water levels, as described below:

- The 480 volt (V) FLEX generators are staged at a location within the site (SA-A2 from Figure 3-2 of the MSA) where a peak water depth of 0.56 ft. is expected to occur approximately 1 hour into the event. However, water is expected to have completely

receded approximately 2.3 hours into the event. Since there is less than two inches of water remaining 2 hours after LIP starts, there is reasonable assurance that the generators should be able to be deployed within the 8 hour period designed in the FLEX strategy. Deployment is performed following procedure 0-FSI-3A.

- The FLEX pumps are staged at a location within the site (SA-A1 from Figure 3-2 of the MSA) where no impact from LIP is expected to occur. The path from the FESB to this location does not see any flooding and one of the pump pads is at elevation 578 ft. MSL, which is well above the reevaluated LIP water elevation of 566.6 ft. MSL. Given the shallow depths and recession time when compared to the 4 hours needed to fully deploy a FLEX pumping system, there is reasonable confidence that the deployment should occur within the 8 hours timeframe provided in the FLEX design-basis. Additional information related to recession times is provided in Section 3.3.1 of this document.

- One or two portable generators (4 kilo-Volt (kV) capacity) can be deployed to meet its intended FLEX function and will be staged at a location within the site (SA-A4 and/or SA-A5 from Figure 3-2 of the MSA) where they should not be impacted. This determination was made based on water levels that have receded and the 8 hour deployment time stated in the FLEX design-basis. It takes around 4 hours to fully deploy the 4 kV generators.

- Other staging areas and pathways that are expected to have increased flooding impacts as a result of LIP were analyzed and determined to be inconsequential given that no equipment needs to be deployed to these staging areas during a LIP event.

In addition to the above information, the vehicle and trailer used to transport equipment is of considerable capability and is expected to be able to transport the equipment without any considerable impacts. Based on the analysis provided by the licensee, the NRC staff agrees that LIP is not expected to impact the FLEX response at Browns Ferry with regards to deployment paths and/or staging areas.

With regards to the FLEX implementation timeline, the licensee stated that reduced warning time for site preparations in response to a PMF event has been assessed for impacts to FLEX strategies. The LIP event may delay the deployment of certain equipment, but is still within the FLEX design margin given the short event duration. The initial and extended load shed actions are conducted within the control building and are not impacted by the reevaluated LIP hazard. The NRC staff notes that a revised timeline and sequence of events (for specific activities that do not impact the overall strategy timeline) are expected to be included in the FIP to be submitted by TVA in May 2018. The revision should include any updates to the FLEX response timeline, as necessary. Once the final FLEX implementation timeline is finalized in the FIP, the licensee plans to verify that FLEX equipment can be mobilized and deployed within the allotted timeframe, as designed. TVA is tracking completion of this activity via Condition Report CR#1231026.

Finally, the licensee stated that any Phase 3 equipment is not expected to be impacted given the LIP floodwaters remaining at the site at the time of delivery. The NRC staff agrees that LIP is not expected to impact the FLEX response at Browns Ferry with regards to Phase 3 equipment. As a result of the above, the NRC staff agrees that the streams and rivers reevaluated hazard is not expected to impact the overall FLEX response at Browns Ferry, as described in the MSA.

3.3.1 Evaluation of Flood Event Duration

The NRC staff reviewed information provided by TVA regarding the FED parameters for the flood hazard(s) not bounded by the CDB. The FED parameters for the flood-causing mechanisms not bounded by the CDB are summarized in Table 3.3.1-1.

The licensee states in its MSA that FED parameters for the East Switchyard Channel are not applicable because there is no impact to the design-basis flood protection plan as a result of the reevaluated LIP event. The licensee also described how the CDB flood protection plan includes watertight doors designed for the PMF elevation that exceeds the maximum LIP flood elevation.

The staff had previously reviewed and concluded in the FHRR staff assessment and ISR letter, that the flood elevations of 566.6 ft. MSL (Lower Plant Area) and the 578.2 ft. MSL (East Switchyard) were acceptable for use in the MSA, based on the licensee's FHRR Hydrologic Engineering Center – River Analysis System (HEC-RAS) model for the LIP flood-causing mechanism.

The NRC staff notes that the licensee utilized the two-dimensional (2D) numerical model FLO-2D as part of its MSA to further refine LIP inundation depths and inundation times at various locations at the site. Results from this numerical model produced lower water surface elevations than the FHRR results. However, the licensee did not adjust the maximum flood elevations as part of its MSA, and maintained their commitment to the higher flood elevations reported in the FHRR as an added measure of conservatism.

The licensee also stated in its MSA that warning time protocols discussed in the Browns Ferry Nuclear Plant procedure 0-AOI-100-7 are consistent with the NEI's LIP warning time guidance described in NEI 15-05, "Warning Time for Local Intense Precipitation Events," Revision 6, dated April 8, 2015 (ADAMS Accession No. ML15104A158).

The NRC staff notes that warning time estimates were not provided as part of the MSA; however, the licensee has an operation procedure that is based on the information from: (1) National Weather Service severe weather forecast; (2) TVA meteorologists' significant rainfall warning; and (3) the plant site meteorological tower rainfall accumulation alarms or reports of local flooding at the plant grade.

The licensee concluded in its MSA that a period of inundation of 1.5 hours and a period of recession of 3 hours could occur the Lower Plant Areas at the Browns Ferry site. These periods were computed based on results from the FLO-2D model, and are similar to the periods computed using the FHRR's one-dimensional numerical model. Additional details can be found in the audit report related to the review of the FHRR issued by letter dated October 30, 2015 (ADAMS Accession No. ML15294A203). Because of the similarity in the results, the NRC staff did not review the licensee's FLO-2D model as part of the MSA review.

The NRC staff concludes that the inundation time and recession time periods computed by the licensee and documented in the MSA are reasonable. The staff also confirms that the licensee used present-day methodologies and regulatory guidance to determine the FED period. Based on this review, the staff determined that the licensee's FED parameters are reasonable and acceptable for use in the MSA analysis.

3.3.2 Evaluation of Associated Effects

The NRC staff reviewed the information provided by the licensee regarding AE parameters for the hazard(s) not bounded by the CDB. The AE parameters not directly associated with water surface elevation are discussed below and are summarized in Table 3.3.2-1 of this assessment.

For the LIP flood-causing mechanism, the licensee stated in its MSA that hydrodynamic and debris loading are minimal because of limited fetch lengths and flood depths. In addition, the low velocities are not expected to transport sediment and consequently produce significant deposition. The licensee also stated that other AE parameters, including groundwater ingress, adverse weather, and other pertinent factors (e.g., waterborne projectiles) are minimal due to the small water depths and low velocities associated with the LIP event. The NRC staff confirmed the licensee's statements by reviewing the licensee-provided HEC-Hydrologic Modeling System and HEC-RAS input and output files as discussed in the audit report related to the review of the FHRR.

The NRC staff concludes that the inundation depths and flow velocities reported in the MSA are reasonable. Therefore, the staff concludes the licensee's methods are appropriate and the AE parameters are reasonable for use in the MSA analysis.

3.4 Conclusion

The NRC staff has reviewed the information provided in the Browns Ferry MSA related to the FLEX strategies in the OIP, as assessed against the reevaluated hazard(s) not bounded by the CDB. The NRC staff concludes that the licensee has reasonably demonstrated its capability to implement FLEX strategies, as designed, against the reevaluated hazards described in the ISR letter.

The NRC staff made its determination based upon:

- 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 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 OIP may be revised and adjusted to reflect deployment delays, but the overall completion timeline 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.

Therefore, the NRC staff concludes that the licensee has demonstrated the capability to implement the FLEX strategies, as designed, under the conditions associated with the reevaluated LIP (including AEs and FED parameters), as described in NEI 12-06, Revision 2, and JLD-ISG-2012-01, Revision 1.

4.0 CONCLUSION

The NRC staff has reviewed the information presented by the licensee in its MSA for Browns Ferry. The NRC staff confirmed that the licensee's flood hazard MSA for Browns Ferry was performed consistent with the guidance in Appendix G of NEI 12-06, Revision 2, as endorsed by JLD-ISG-2012-01, Revision 1. Based on the licensee's use of the hazard characterized in the NRC staff's ISR letter, the methodology used in the Browns Ferry MSA evaluation, and the description of its current FLEX strategy in the MSA and supporting documentation, the NRC staff concludes that the licensee has demonstrated that the mitigation strategies appear to be reasonably protected from reevaluated flood hazard conditions, if appropriately implemented as described in Section 3 of this document.

However, the NRC staff also notes that TVA is expected to submit its compliance letter and the FIP in response to Order EA-12-049 in May 2018. The compliance letter is expected to state that the licensee has achieved full compliance with Order EA-12-049. The NRC plans to subsequently issue a safety evaluation documenting the results of the NRC staff's review of the FLEX strategies for Browns Ferry. If found acceptable, the safety evaluation will conclude that the FIPs, if implemented as described, should adequately address the requirements of Order EA-12-049.

Finally, the NRC staff notes that changes to the FLEX strategy, as a result of the reevaluated hazard and incorporated into the FIP, may be subject to inspection under Temporary Instruction 2515/191, "Inspection of the Implementation of Mitigation Strategies and Spent Fuel Pool Instrumentation Orders and Emergency Preparedness Communication/Staffing/Multi-Unit Dose Assessment Plans" (ADAMS Accession No. ML15257A188). This inspection will confirm compliance with order EA-12-049.

Table 3.3.1-1. Flood Event Durations for Flood-Causing Mechanisms Not Bounded by the CDB

Flood-Causing Mechanism	Location	Time Available for Preparation for Flood Event	Duration of Inundation of Site	Time for Water to Recede from Site
Local Intense Precipitation and Associated Drainage	East Switchyard channel	Procedure is consistent with NEI 15-05	Not Applicable due to watertight doors	Not Applicable due to watertight doors
	Lower Plant Areas	Procedure is consistent with NEI 15-05	1.5 hours	3 hours

Based on the Browns Ferry FHRR and MSA submittals.

Table 3.3.2-1. Associated Effects Parameters Not Directly Associated With Total Water Height for Flood-Causing Mechanisms Not Bounded by the CDB

Associated Effects Parameter	Local Intense Precipitation and Associated Drainage
Hydrodynamic loading at plant grade	Minimal
Debris loading at plant grade	Minimal
Sediment loading at plant grade	Minimal
Sediment deposition and erosion	Minimal
Concurrent conditions, including adverse weather - Winds	Minimal
Groundwater ingress	Minimal
Other pertinent factors (e.g., waterborne projectiles)	Minimal

Source: Browns Ferry FHRR and MSA submittals

BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2, AND 3 – FLOOD HAZARD MITIGATION STRATEGIES ASSESSMENT DATED SEPTEMBER 5, 2017

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RidsNrrPMBrownsFerry Resource	RidsRgn2MailCenter Resource	JBoska, NRR

ADAMS Accession No. ML17222A328

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DATE	8/13/2017	8/14/2017	8/31/2017	9/1/2017	9/5/2017

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