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

June 27, 2014

Mr. Joseph W. Shea
Vice President Nuclear Licensing
Tennessee Valley Authority
1101 Market Street, LP 3D-C
Chattanooga, TN 37402-2801

SUBJECT: SEQUOYAH NUCLEAR PLANT UNITS 1 AND 2 – STAFF ASSESSMENT OF THE FLOODING WALKDOWN REPORT SUPPORTING IMPLEMENTATION OF NEAR-TERM TASK FORCE RECOMMENDATION 2.3 RELATED TO THE FUKUSHIMA DAI-ICHI NUCLEAR POWER PLANT ACCIDENT (TAC NOS. MF0281 AND MF0282)

Dear Mr. Shea:

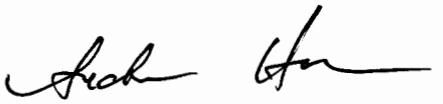
On March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued a request for information letter per Title 10 of the *Code of Federal Regulations*, Section 50.54(f) (the 50.54(f) letter). The 50.54(f) letter was issued to power reactor licensees and holders of construction permits requesting addressees to provide further information to support the NRC staff's evaluation of regulatory actions that may be taken in response to lessons learned from Japan's March 11, 2011, Great Tōhoku Earthquake and subsequent tsunami. The request addressed the methods and procedures for nuclear power plant licensees to conduct flooding hazard walkdowns to identify and address degraded, nonconforming, or unanalyzed conditions through the corrective action program, and to verify the adequacy of the monitoring and maintenance procedures.

By letter dated November 27, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12335A340), Tennessee Valley Authority (TVA, the licensee) submitted a Flooding Walkdown Report as requested in Enclosure 4 of the 50.54(f) letter for the Sequoyah Nuclear Plant Units 1 and 2 site. By letter dated February 7, 2014 (ADAMS Accession No. ML14042A393), TVA provided a response to the NRC request for additional information for the staff to complete its assessments.

The NRC staff reviewed the information provided and, as documented in the enclosed staff assessment, determined sufficient information was provided to be responsive to Enclosure 4 of the 50.54(f) letter.

If you have any questions, please contact me at (301) 415-8480 or by e-mail at Andrew.Hon@nrc.gov.

Sincerely,



Andrew Hon, Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-327 and 50-328

Enclosure:
Staff Assessment of Flooding Walkdown Report

cc w/encl: Distribution via Listserv

STAFF ASSESSMENT OF FLOODING WALKDOWN REPORT

NEAR-TERM TASK FORCE RECOMMENDATION 2.3 RELATED TO

THE FUKUSHIMA DAI-ICHI NUCLEAR POWER PLANT ACCIDENT

TENNESSEE VALLEY AUTHORITY

SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2

DOCKET NOS. 50-327 AND 50-328

## 1.0 INTRODUCTION

On March 12, 2012,[1] the U.S. Nuclear Regulatory Commission (NRC) issued a request for information per Title 10 of the *Code of Federal Regulations* (10 CFR), Subpart 50.54(f) (the 50.54(f) letter) to all power reactor licensees and holders of construction permits in active or deferred status. The request was part of the implementation of lessons learned from the accident at the Fukushima Dai-ichi nuclear power plant. Enclosure 4, "Recommendation 2.3: Flooding,"[2] to the 50.54(f) letter requested licensees to conduct flooding walkdowns to identify and address degraded, nonconforming, or unanalyzed conditions using the corrective action program (CAP), verify the adequacy of monitoring and maintenance procedures, and report the results to the NRC.

The 50.54(f) letter requested licensees to include the following:

a. Describe the design basis flood hazard level(s) for all flood-causing mechanisms, including groundwater ingress.
b. Describe protection and migration features that are considered in the licensing basis evaluation to protect against external ingress of water into structures, systems, and components (SSCs) important to safety.
c. Describe any warning systems to detect the presence of water in rooms important to safety.
d. Discuss the effectiveness of flood protection systems and exterior, incorporated, and temporary flood barriers. Discuss how these systems and barriers were evaluated using the acceptance criteria developed as part of Requested Information item 1.h.
e. Present information related to the implementation of the walkdown process (e.g., details of selection of the walkdown team and procedures) using the documentation template discussed in Requested Information item 1.j, including actions taken in response to the peer review.
f. Results of the walkdown including key findings and identified degraded, nonconforming, or unanalyzed conditions. Include a detailed description of the actions taken or planned

[1] Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340.
[2] ADAMS Accession No. ML12056A050.

to address these conditions using guidance in Regulatory Issue Summary 2005-20, Revision 1, Revision to the NRC Inspection Manual Part 9900 Technical Guidance, "Operability Conditions Adverse to Quality or Safety," including entering the condition in the corrective action program.

g. Document any cliff-edge effects identified and the associated basis. Indicate those that were entered into the corrective action program. Also include a detailed description of the actions taken or planned to address these effects.
h. Describe any other planned or newly installed flood protection systems or flood mitigation measures including flood barriers that further enhance the flood protection. Identify results and any subsequent actions taken in response to the peer review.

In accordance with the 50.54(f) letter, Enclosure 4, Required Response Item 2, licensees were required to submit a response within 180 days of the NRC's endorsement of the flooding walkdown guidance. By letter dated May 21, 2012,[3] the Nuclear Energy Institute (NEI) staff submitted NEI 12-07, Revision 0 A, "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features" to the NRC staff to consider for endorsement. By letter dated May 31, 2012,[4] the NRC staff endorsed the walkdown guidance.

By letter dated November 27, 2012,[5] Tennessee Valley Authority (TVA, the licensee), provided a response to Enclosure 4 of the 50.54(f) letter Required Response Item 2, for the Sequoyah Nuclear Plant (SQN), Units 1 and 2. The NRC staff issued a request for additional information (RAI) to the licensee regarding the available physical margin (APM) dated December 23, 2013.[6] The licensee responded by letter dated February 7, 2014.[7]

The NRC staff evaluated the licensee's submittals to determine if the information provided in the walkdown report met the intent of the walkdown guidance and if the licensee responded appropriately to Enclosure 4 of the 50.54(f) letter.

## 2.0 REGULATORY EVALUATION

The SSCs important to safety in operating nuclear power plants are designed either in accordance with, or meet the intent of Appendix A to 10 CFR Part 50, General Design Criterion (GDC) 2: "Design Bases for Protection Against Natural Phenomena;" and Appendix A "Seismic and Geological Criteria for Nuclear Plants," to 10 CFR Part 100. GDC 2 states that SSCs important to safety at nuclear power plants shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions.

For initial licensing, each licensee was required to develop and maintain design bases that, as defined by 10 CFR 50.2, identify the specific functions to be performed by an SSC, and the specific values or ranges of values chosen for controlling parameters as reference bounds for the design.

---

[3] ADAMS Package Accession No. ML121440522.
[4] ADAMS Accession No. ML12144A142.
[5] ADAMS Accession No. ML12335A340.
[6] ADAMS Accession No. ML13325A891.
[7] ADAMS Accession No. ML14042A393.

The design bases for the SSCs reflect appropriate consideration of the most severe natural phenomena that have been historically reported for the site and surrounding area. The design bases also reflect sufficient margin to account for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.

The current licensing basis (CLB) is the set of NRC requirements applicable to a specific plant, and a licensee's written commitments for ensuring compliance with, and operation within, applicable NRC requirements and the plant-specific design basis that are in effect.

## 3.0 TECHNICAL EVALUATION

### 3.1 Design Basis Flooding Hazard Sequoyah Nuclear Plant

The licensee reported that the design basis flood (DBF) hazard for the SQN site is the probable maximum flood (PMF) resulting from the probable maximum precipitation in the Tennessee River watershed upstream of the site, plus the wind wave runup resulting from a 45-miles per hour (mph) overwater wind. The current DBF is 723.8 feet (ft) relative to mean sea level (MSL), composed of a 719.6 ft MSL still water PMF elevation plus 4.2 ft wind wave runup on the vertical external wall of the essential raw cooling water (ERCW) pumping station. The wind wave runup estimate is from a 45-mph wind blowing from the north-northwest over an effective fetch of 1.7 miles. The SQN plant grade is 705.0 ft MSL.

The licensee reported that the current licensing basis (CLB) for SQN includes a minimum warning time of 27 hours (hr) from the time a flood warning is received to the time the local water elevation would exceed plant grade. The walkdown report states that SQN Units 1 and 2 could be readied for flood mode operation in 27 hr, and could be maintained in flood mode until "appropriate recovery steps can be formulated and taken." Both the Updated Final Safety Analysis Report (UFSAR) and the walkdown report give a flood duration of 1 to 6 days.

The staff noted that the walkdown report references the revised SQN Units 1 and 2 UFSAR submitted with a License Amendment Request (LAR) in August 2012, stating that "the flooding evaluation report is based on the LAR updated DBF elevations because they are more conservative (higher) than the current licensing basis." Because the purpose of Recommendation 2.3 was to verify flood protection and mitigation features relative to the existing CLB and the LAR is still under review, the staff will assess the licensee's responses to the 50.54(f) letter in relation to its currently approved licensing basis.

The licensee stated that the PMF is the controlling flood hazard; however, the licensee also stated that seismic dam failure and local intense precipitation could result in flood water elevations above plant grade. The walkdown report states that the PMF resulting from a postulated seismic dam failure scenario would be 708.6 ft at SQN, and that there would be time for safe plant shutdown after the seismic event but before flood water exceeds the plant grade.

Based on the NRC staff's review, the licensee appears to have described the DBF hazard level(s) requested in the 50.54(f) letter and consistent with the walkdown guidance.

## 3.2 Flood Protection and Mitigation

### 3.2.1 Flood Protection and Mitigation Description

The licensee reported that the CLB flood protection elevation is the DBF of 723.8 ft MSL. The licensee stated that SQN Units 1 and 2 are designed to meet Regulatory Position 2 of Regulatory Guide 1.59, Design Basis Floods for Nuclear Power Plants. The Turbine, Control, and Auxiliary Buildings are allowed to flood. Equipment required to maintain plant safety during the flood, and for 100 days after the beginning of the flood, is designed to operate submerged, located above the maximum flood level, or otherwise protected. Additionally, the licensee stated that SQN Units 1 and 2 can be prepared for flood-mode operation, in which the plant is safely maintained from the flood waters exceeding plant grade until recovery is accomplished, within 24 hr of a Stage I flood warning, with an additional 3-hr contingency margin available.

The walkdown report summarizes SQN Units 1 and 2 flooding-protection design features with respect to the revised licensing basis proposed in its LAR, which is also consistent with the CLB described in the UFSAR. The Reactor Building, Diesel Generator Building, and ERCW intake station would be maintained dry during flood mode. The ERCW deck at 720.0 ft MSL is protected by outside walls but has a wall penetration for non-flood drainage that is designed to be sealed in the event of a flood. In addition, redundant sump pumps are available to remove rainfall from the deck and seepage from interior rooms. The lowest floor and exterior doors of the Diesel Generator Building are at 722.0 ft MSL, are located on the uphill side facing away from the reservoir and would be above the maximum flood water elevation expected to reach that location of 721.8 ft MSL. Entrances and penetrations to safety-related areas of the Diesel Generator Building are sealed to prevent leakage up to the PMF, including wind wave runup. In addition, sump pumps are available to remove seepage from the interior. The Shield Building has three major exterior access points: one personnel lock located at 691.0 ft MSL, designed and constructed to be watertight; another personnel lock located at an elevation of 732.0 ft MSL; and an equipment hatch located at an elevation of 730.0 ft MSL. The Service, Turbine, Auxiliary, and Control Buildings are allowed to flood, as equipment is located above the DBF or operable when submerged.

TVA's flood response considers flood-preparation procedures under any normal mode, including either or both Units 1 and 2 operating at power or refueling. In addition to flood-protection design features, TVA relies upon the Tennessee River Operations (RO) flood forecast system that triggers flood-mode preparations for the fastest rising flood, and an Abnormal Operating Instruction (AOI) for a two-stage flood response. Stage I procedures are initiated when RO issues a Stage 1 flood warning and include a controlled reactor shutdown and moving flood-mode supplies above the PMF elevation and making load adjustments to the onsite power supply. Under the CLB for SQN, a Stage I warning is triggered when there is sufficient upstream rainfall to result in a water elevation at SQN of 697.0 ft MSL in winter or 703.0 ft in summer. Under the proposed LAR for SQN, those Stage I warning trigger elevations would change to 694.5 ft MSL for winter and 699.0 ft for summer. The Stage I warning is intended to allow at least 10 hr to complete the Stage I procedures. Stage II procedures are those actions necessary for flood mode when the flood water exceeds the plant grade. A Stage II warning occurs when the RO confirms that rainfall conditions would result in a flood above 703.0 ft MSL at SQN. Stage II warning is intended to allow at least 17 hr to complete the Stage II procedures. The seasonal trigger levels for Stage I and confirmatory estimate for Stage II

ensure that TVA's RO system would provide a minimum of 27 hr total warning from the time a rainfall flood is predicted to when a flood would reach 705.0 ft MSL at SQN. With 4 hr to evaluate rainfall data, the warning system provides 31 hr from the start of a precipitation event in the watershed to flood water elevation reaching plant grade at SQN. TVA's flood-warning plan considered adverse weather conditions such as concurrent wind waves by setting the critical predicted flood elevation 2 ft below plant grade, but it is not clear whether TVA considered adverse conditions such as intense precipitation or high winds at the SQN site in its flood-mode response time.

3.2.2 Incorporated and Exterior Barriers

The walkdown report did not specifically describe incorporated and exterior flood-protection barriers that are credited in the CLB for SQN Units 1 and 2. However, the design features described in Section 3.2.1 of this staff assessment are credited with maintaining all safety-related SSCs from floods up to plant grade. The Shield Building is watertight to above the DBF elevation, and the Diesel Generator Building doors and operating floor are located above the DBF elevation. The outside walls of the ERCW intake station protect the pumps and equipment on the operating deck at 720.0 ft MSL and external penetrations are permanently sealed. However, in the event of a flood, operator action would be required to seal a drain opening in the wall. The flood-warning system and flood-preparation procedures are credited for flood protection above plant grade.

3.2.3 Temporary Barriers and Other Manual Actions

The licensee did not describe any temporary flood-protection barriers around any safety-related SSCs. In its calculation of the PMF in streams and rivers, the licensee stated that temporary flood barriers have been installed to increase the height of embankments at the upstream Watts Bar, Fort Loudon, Tellico, and Cherokee Dams. The PMF calculation assumes that these barriers would remain functional under the most severe flooding conditions, preventing overflow and embankment failure.

The walkdown report describes the actions to be taken during flood preparation, including the relocation of supplies needed for implementing the flood-protection plan above the DBF level. Temporary piping connections would be made to switch plant cooling loads from the component cooling water (CCW) system to the ERCW system. Onsite power-supply loads would be adjusted; power and communication lines below the DBF not designed for submerged operation would be disconnected. The wall penetration for drainage from the ERCW deck would be sealed if necessary. If flood preparation were to occur during refueling, actions would depend on the stage of refueling and the available warning time. The spent fuel pool cooling and cleanup system heat exchanger output flow would require a temporary piping (spool piece) to connect it to the residual heat removal system heat exchanger bypass line.

3.2.4 Reasonable Simulation and Results

The licensee reviewed its operating procedures, used a reasonable simulation of its flood-response AOI, and conducted field simulations of time-critical operation and maintenance activities. The flood-response AOI is a collection of maintenance and operational procedures for activities that need to be accomplished to place the plant in safe shutdown mode within 27 hr

of a Stage I flood warning. These simulations showed that licensee's flood-mode procedures could perform their function as credited in the CLB; however, the ability to meet the CLB was reliant on the 3 hr contingency added to the 24-hr warning time provided by TVA's Tennessee RO system. The licensee did not discuss the conditions considered during its flood-response AOI simulation, for example, whether actions or movement were assumed to be affected by adverse weather. From its reasonable simulation, the licensee entered a number of observations into its CAP, most of which would reduce the response time of Stage II flood preparations.

The licensee stated that the simulation was primarily a step-through of the procedures by a licensed Senior Reactor Operator with assistance from a team of key staff (i.e., maintenance, engineering, chemistry, and an assistant operator) to determine the time and resources required at each step. The licensee reported that for at least one AOI, manipulation of hand valves by an assistant unit operator, was simulated in the field to establish time and resource requirements. In addition, the licensee simulated seven maintenance procedures in the field to establish time and resource requirements for locating tools and flood-mode components. The licensee also installed one spool piece (temporary piping connection) and partial rigging and lifting of another spool piece. The licensee used the simulation data to develop a timeline for flood preparations for comparison to the available warning time and evaluate the effectiveness of maintenance procedures for flood-mode components and special tools needed to perform flood-preparation activities.

The licensee concluded the following from its reasonable simulations of the flood-response AOI:

- Flood-mode preparation required 25.7 hr, indicating that flood-response AOI procedures could not be performed within 24 hr of a Stage I flood warning.
- Flood-response AOI procedures were adequate, but could be improved to reduce the response time by providing more specific direction and sequenced steps, identifying specific tools required, and clarifying manpower requirements.
- Tool and equipment accessibility was adequate, but accessibility, staging, and maintenance could be improved to reduce the response time. Valves and spool-piece installation points for switching from CCW to ERCW systems were noted as particularly challenging to access.
- Some flood-mode materials were not available onsite in sufficient quantity, and some equipment required maintenance or repair.
- Operations and maintenance personnel could perform flood-mode preparation, but personnel training could be improved (following procedure modification) to reduce the response time.

The staff determined that although the licensee's simulation of its flood-response AOI was reasonable, the procedures required more than half of the 3 hr contingency period to complete. The walkdown report does not indicate whether any concurrent conditions (e.g., intense rainfall and high winds) were considered when performing the simulation other than to note that wind wave runup was considered in setting the flood-warning trigger levels. As conducted, the simulation showed that the flood-response AOI did not meet the 24-hr flood-preparation timeline of the CLB, and revealed a number of potential improvements that would reduce the response time. These potential improvements are discussed in Section 3.6.5 of this staff assessment.

3.2.5 Conclusion

Based on the NRC staff's review, the licensee appears to have described protection and mitigation features as requested in the 50.54(f) letter consistent with the walkdown guidance.

3.3 Warning Systems

The licensee stated that there are no level detection devices credited at SQN for the detection of external flooding. However, both the reactor building containment flood and equipment drain sump level and pocket sump are annunciated in the Main Control Room. The licensee also stated that the turbine, control and auxiliary buildings are allowed to flood for condition which the flood level exceeds the plant grade. The licensee also described the flood detection system using conductivity type water level detectors to monitor and actuate alarms for the Emergency Core Cooling System rooms and other locations in the Auxiliary building. The system has a common alarm in the main control room with a flood indicator panel located outside the control room to identify the exact location of the tripped detector.

As stated above, the CLB states that SQN Units 1 and 2 would be flooded during the PMF event and the effects of the PMF on the plant are mitigated by staged flood-response procedures that prepare the reactor for safe shutdown. The licensee's flood response is reliant upon TVA's RO forecast system for monitoring upstream precipitation, reservoir operations, and reservoir water levels and communicating flood warnings to SQN. The CLB does not credit warning systems in rooms with safety-related SSCs.

Based on the NRC staff's review, the licensee appears to have provided information to describe any warning systems as requested in the 50.54(f) letter and consistent with the walkdown guidance.

3.4 Effectiveness of Flood Protection Features

The SQN flood protection relies on the ability of TVA's RO system to predict a flood that has the potential to exceed plant grade at SQN and to provide adequate warning time for SQN operations and maintenance personnel to ready the plant for flood-mode operations. TVA's evaluation of flood-protection effectiveness focused on its reasonable simulation of flood-response AOI procedures being accomplished within the warning time credited in the CLB. As noted in Section 3.2.3 of this staff assessment, the licensee found that its flood-response AOI could not be performed within 24 hours (hr), but could be performed in less than 27 hr. The licensee identified this as a deficiency, but also noted a discrepancy between SQN and another TVA site interpreted the warning time as SQN did not include the 3-hr contingency period as part of the allowed time under the CLB, whereas another TVA site did.

From its reasonable simulation of its flood-response AOI, the licensee identified a number of physical and procedural improvements that would shorten the response time and documented these improvements in the CAP. In addition, the licensee identified a number of improvements to maintenance procedures that would ensure that flood-response equipment, components, and tools would be accessible and would function reliably. Many of these issues are being

addressed in a fleetwide Flood Mode Operation Improvement Strategy, discussed further in Section 3.6.2 of this staff assessment.

The licensee evaluated the effectiveness of flood-protection features at SQN Units 1 and 2 to include visual inspections of site features and flood-protection barriers and reviews of flood-protection procedures. The licensee's inspection of the ERCW intake station revealed potential flooding pathways into the station through unsealed conduit penetrations. The licensee also identified conduit penetrations through the Shield Building below the PMF for further evaluation for potential ingress of water. Inspection of the Diesel Generator Building revealed two inoperable manual isolation valves for the building drain. These items were entered into the CAP.

The licensee reported that these inspections and field observations were performed in accordance with NEI 12-07 and documented on NEI 12-07 Forms C or D. As necessary, findings were entered into the CAP.

Based on the NRC staff's review, the licensee appears to have discussed the effectiveness of flood protection features as requested in the 50.54(f) letter and consistent the walkdown guidance.

### 3.5 Walkdown Methodology

By letter dated June 11, 2012,[8] the licensee responded to the 50.54(f) letter that it intended to use the NRC endorsed walkdown guidelines contained in NEI 12-07, "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features."[9] The licensee's walkdown submittal dated November 27, 2012, indicated that the licensee implemented the walkdowns consistent with the intent of the guidance provided in NEI 12-07. The licensee did not identify any exceptions from NEI 12-07.

Based on the NRC staff's review, the licensee appears to have presented information related to the implementation of the walkdown process as requested in the 50.54(f) letter and consistent with the walkdown guidance.

### 3.6 Walkdown Results

#### 3.6.1 Walkdown Scope

The licensee performed walkdowns of the SQN Units 1 and 2 Shield, Turbine, Auxiliary, Diesel Generator, Service, and Control Buildings as well as the ERCW intake station. Flood-protection features were visually inspected, incorporated features verified, and flood-protection procedures were reviewed. As noted in Section 3.2.4 of this staff assessment, the licensee performed a reasonable simulation of its flood-response AOI using a representative team of personnel to step-through procedures, combined with field physical simulations of two operational procedures and seven maintenance procedures.

---

[8] ADAMS Accession No. ML12164A674.
[9] ADAMS Accession No. ML12173A215.

The licensee considered one or both units at normal power operation mode and one unit in refueling mode in its walkdown. The licensee stated that its flood-warning time considers wind wave runup with the PMF. The walkdown report states that the licensee expanded the SQN walkdown scope to include inspection of certain subcomponents and related equipment after the Watts Bar Nuclear Plant flooding walkdown identified chilled-water circulating pumps in the Main Control Room and Shutdown Board Room would be partially submerged during a PMF, and that expanded scope walkdowns were ongoing at the time the walkdown report was submitted.

The licensee applied acceptance criteria to identify degraded, nonconforming, or unanalyzed conditions. For the reasonable simulation that evaluated the credited flood-response procedures, the licensee used the time limit stated in the CLB to determine acceptability of its flood-response AOI.

3.6.2 Licensee evaluation of flood protection effectiveness, key findings, and identified deficiencies

The licensee evaluated the overall effectiveness of the plant's flood protection features using a combination of visual inspections of site features and flood-protection barriers, reviews of flood-protection procedures, and the reasonable simulation of its flood-response AOI. The licensee identified three deficiencies and entered 66 items into the CAP to document observations as well as deficiencies.

The licensee reviewed the existing site topography and water runoff calculations and observations in the field. The walkdown report does not present any walkdown findings with respect to site grading or drainage, or note any related deficiencies or observations entered into the CAP.

The licensee inspected the flood-mode barriers, including the ERCW intake station walls and penetrations, Shield Building penetrations below the PMF elevation, flood barriers at the Diesel Generator Building, and the steel enclosure around the spent fuel pit cooling pumps. The walkdown report discusses walkdown findings with respect to these inspections or the effectiveness of the barriers and identified two flood-mode barrier deficiencies that were entered into the CAP: unsealed conduit penetrations at the ERCW intake station and inoperable isolation valves on the Diesel Generator Building drain. Shield Building conduit penetrations below the PMF elevation are "under evaluation" as potential pathways for water transport; this finding was entered into the CAP but was not identified as a deficiency. The walkdown report does not present any findings related to the spent fuel pit cooling pump enclosure, but the licensee previously committed to installing caps on the enclosure by March 31, 2013. This modification to the spent fuel pit cooling pumps and other flood-protection modifications to protect the Diesel Generator Building and the ERCW intake station are being put in place in response to the higher DBF proposed in the SQN LAR.

The licensee reviewed the flood-mode material availability and equipment condition and determined that certain materials, such as filter resins, were not available onsite in sufficient quantity to implement flood-preparation procedures. The licensee also determined that the Jon

boat required maintenance and needed to be sent out for repairs to ensure operability. These issues were entered into the CAP.

The licensee reviewed the maintenance procedures for flood-mode components and, although specific components were not identified, entered observations into the CAP regarding permanently installed flood-response components that were not included in a preventive-maintenance program.

As described in Section 3.2.4 of this staff assessment, the licensee concluded that the flood-response AOI did not conform to the CLB as it could not be performed within 24 hr. The licensee also noted that the response time could be improved by revising operation and maintenance procedures, by preventive maintenance and staging of flood-response components, and by improvements to personnel training. These items resulted in a number of CAP entries, although no specific accounting of entries was provided in the walkdown report. NEI 12-07 defines a deficiency as follows: "a deficiency exists when a flood protection feature is unable to perform its intended function when subject to a design basis flooding hazard." The licensee identified three deficiencies at SQN Units 1 and 2 because of the flooding walkdowns: unsealed conduit penetrations at the ERCW intake station, inoperable isolation valves on the Diesel Generator Building drain, and failure to perform flood-preparation procedures within 24 hr. As noted previously, the licensee evaluated its protection effectiveness relative to the proposed LAR DBF elevation (722.0 ft still water, 726.2 ft MSL maximum) rather than the CLB DBF elevation (719.6 ft still water, 723.8 ft MSL maximum).

NEI 12-07 specifies that licensees identify observations in the CAP that were not yet dispositioned at the time the walkdown report was submitted. TVA did not identify specific observations awaiting disposition at the time the FWR was submitted, but did identify general types of observations for which actions would be taken. Observations related to reducing the flood-mode preparation timeline by reviewing and modifying maintenance procedures and flood-preparation procedures, equipment and tool availability are being addressed in a fleetwide Flood Mode Operation Improvement Strategy.

### 3.6.3 Flood Protection and Mitigation Enhancements

The walkdown report states that as a result of the flooding walkdown, the licensee implemented or planned the following enhancements that improve or increase flood protection or mitigation throughout its operating reactor fleet, including SQN Units 1 and 2:

- clarify and express, consistently, the response time for implementing flood-response procedures, particularly with respect to consideration of the 3-hr contingency period
- improve flood-response procedures to ensure optimum usage during flood events and to reduce flood-response time
- improve flood-mode equipment reliability by including it in the plant preventive-maintenance program
- improve flood-mode tool and equipment accessibility and ease of equipment or component installation

The licensee implemented or planned the following additional enhancements that improve or increase flood protection or mitigation at SQN Units 1 and 2 as a result of its flooding walkdown:

- seal potential flooding pathways and install temporary sump pumps at the ERCW intake station
- purchase and stage Diesel Generator Building drain plugs and revise procedures to direct installation of drain plugs
- purchase and stage sufficient quantities of flood-mode materials (e.g., filter resins)
- repair and maintain flood-mode equipment to ensure operability during a flood event (e.g., the plant Jon boat)
- evaluate conduit penetrations below PMF elevation on the Shield Building
- revise site-specific flood-mode procedures to improve the response time by adding specific instructions, better tool identification, critical step sequencing, and actions to address as-found deficiencies
- revise other operations and maintenance procedures to enhance flood-mode preparation procedures.

3.6.4 Planned or newly installed features

The licensee determined that changes were necessary by the flooding walkdowns. As noted in the previous section, the licensee is implementing a fleetwide review of flood-response warning time definitions, flood-response and related procedure improvements, flood-mode equipment accessibility, and flood-mode equipment maintenance programs. Specific changes to SQN Units 1 and 2 include additional flood protection at the ERCW intake station and the Diesel Generator Building. At the ERCW intake station, a personnel access door will be added for protection and traveling screen vent piping will be extended. Flood protection would be added to personnel access, emergency exit, and equipment doors of the Diesel Generator Building and restroom fixtures would be removed and capped to prevent water intrusion. The licensee also planned to extend and encase in protective concrete the fill ports on the 7-day tanks outside the Diesel Generator Building. This will prevent water from entering the tanks and allow the tanks to be filled during a PMF. However, these actions were initiated in response to the revised LAR DBF and commitments, rather than as a result of the flooding walkdown.

3.6.5 Deficiencies Noted and Actions Taken or Planned to Address

As described in Section 3.6.2 of this staff assessment, the licensee identified three deficiencies at SQN Units 1 and 2 that were entered into the CAP and actions have already been taken to address them. ERCW conduit penetrations are being sealed, and temporary sump pumps were installed. Plugs for the Diesel Generator Building drain have been purchased and staged and, at the time the walkdown report was submitted, procedures were being modified to include instructions to install the drain plugs. The licensee is addressing the flood-response timeline deficiency across the entire TVA fleet, but site-specific actions include improving accessibility to flood-mode components, staging tools and equipment efficiently, improving flood-preparation procedures, reviewing flood-mode equipment classification, clarifying equipment testing and inspection programs, and creating preventive-maintenance procedures if necessary.

3.6.6 Staff Analysis of Walkdowns

Staff reviewed the licensee walkdown report dated November 27, 2012. The licensee implemented its flooding walkdown process in accordance with NEI 12-07, with the exception of inspecting to the proposed LAR flood elevation and not the CLB. The licensee evaluated whether flood protection features and procedures were able to perform their function as would be credited in the proposed LAR flood elevation which is higher than the CLB flood elevation. The licensee reviewed its operating procedures, used a reasonable simulation of its flood-response AOI, and conducted field simulations of time-critical operation and maintenance activities. These simulations showed that TVA's flood-mode procedures could not perform their function as credited in the CLB without relying on the 3-hr contingency added to a 24-hr warning time provided by TVA's Tennessee RO system. The licensee identified this failure to perform as a deficiency and entered this and a number of other observations into the CAP, most of which would reduce the response time of flood preparations. The licensee did not discuss the conditions considered during its flood-response AOI simulation, for example, whether actions or movement were assumed to be affected by adverse weather.

The licensee discussed the results of flood-protection feature and equipment inspections, identifying two deficiencies and a number of observations entered into its CAP. Other findings were that flood mode equipment was not available in sufficient quantity or maintained in good condition, some components were difficult to access, some equipment was not covered by a preventive-maintenance program, and that improvements could be made in tool and equipment accessibility, maintenance procedures, and staff training. The licensee did not identify any inaccessible or restricted access features at SQN Units 1 and 2.

The licensee stated that many observations entered into the CAP would be addressed in a fleetwide Flood Mode Operation Improvement Strategy, but did not provide a timeline for related activities. The licensee also discussed several other flood-protection barriers that were planned or recently installed as a result of the higher proposed LAR DBF, including permanent barriers surrounding the spent fuel pit cooling pumps, protection for ERCW intake station personnel access and traveling screens, and protection for a number of Diesel Generator Building doors.

Based on the NRC staff's review, the licensee appears to have provided results of the walkdown and described any other planned or newly installed flood protection systems or flood mitigation measures as requested in the 50.54(f) letter and consistent with the walkdown guidance. Based on the information provided in the licensee's submittals, the NRC staff concludes that the licensee's implementation of the walkdown process meets the intent of the walkdown guidance.

3.6.7 Available Physical Margin

NRC staff issued an RAI to the licensee regarding the available physical margin (APM) dated December 23, 2013.[10] The licensee responded with a letter dated February 7, 2014.[11] The licensee has reviewed their APM determination process, and noted that the APM was based on

[10] ADAMS Accession No. ML13325A891.
[11] ADAMS Accession No. ML14042A393.

the higher LAR proposed flood elevation. Staff reviewed the response, and concluded that the licensee met the intent of the APM determination per NEI 12-07.

Based on the NRC staff's review, the licensee appears to have documented the information requested for any cliff-edge effects, as requested in the 50.54(f) letter and consistent with the walkdown guidance. Further, staff reviewed the response, and concludes that the licensee met the intent of the APM determination per NEI 12-07.

## 3.7 NRC Oversight

### 3.7.1 Independent Verification by Resident Inspectors

On June 27, 2012, the NRC issued Temporary Instruction (TI) 2515/187 "Inspection of Near-Term Task Force Recommendation 2.3 Flooding Walkdowns." In accordance with the TI, NRC inspectors and technical staff observed the licensee's walkdowns and independently verified that the licensee implemented the flooding walkdowns consistent with the intent of the walkdown guidance. Additionally, the inspectors and staff independently performed walkdowns of a sample of flood protection features. The inspection reports dated February 13, 2013,[12] and May 9, 2013,[13] document the results of this inspection.

The inspectors identified a green finding associated with a conduit penetration seal, two penetrations below the PMF level that were not sealed and two diesel generator drain lines that could not be isolated. The licensee entered the findings into the CAP. The inspectors performed a significance determination and concluded the finding had very low safety significance. Licensee's corrective actions will be reviewed during routine inspection finding followups.

## 4.0 SSCs NOT WALKED DOWN

The licensee did not identify any inaccessible or restricted access features.

## 5.0 CONCLUSION

The NRC staff concludes that the licensee's implementation of flooding walkdown methodology meets the intent of the walkdown guidance. The staff concludes that the licensee, through the implementation of the walkdown guidance activities and, in accordance with plant processes and procedures, verified the plant configuration with the current flooding licensing basis; addressed degraded, nonconforming, or unanalyzed flooding conditions; and verified the adequacy of monitoring and maintenance programs for protective features. Furthermore, the licensee's walkdown results, which were verified by the staff's inspection, identified no immediate safety concerns. The NRC staff reviewed the information provided and determined that sufficient information was provided to be responsive to Enclosure 4 of the 50.54(f) letter.

---

[12] ADAMS Accession No. ML13050A394.
[13] ADAMS Accession No. ML13129A330.

If you have any questions, please contact me at (301) 415-8480 or by e-mail at Andrew.Hon@nrc.gov.

Sincerely,

*/RA/*

Andrew Hon, Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-327 and 50-328

Enclosure:
Staff Assessment of Flooding Walkdown Report

cc w/encl: Distribution via Listserv

DISTRIBUTION:

| | | |
|---|---|---|
| PUBLIC | RidsOgcMailCenter Resource | RidsRgn2MailCenter Resource |
| LPL2-2 R/F | RidsOpaMail Resource | JNick, EDO RI, RII, RIII, RIV |
| RidsNroDsea | RidsNrrLABClayton Resource | RidsAcrsAcnw MailCTR Resource |
| RidsNrrDorl Resource | RidsNrrPMSequoyah Resource | RidsNrrDorlLpl2-2 Resource |
| RKuntz, NRR | AKock, NRO | SFlanders, NRO |
| CCook, NRO | RKaras, NRO | PChaput, NRO |
| MJardaneh, NRO | EMiller, NRR | |

**ADAMS Accession No.: ML14143A336** * concurrence by e-mail

| OFFICE | DORL/LP2-2/PM | JLD/PMB/PM | DORL/LPL2-2/LA | DSEA/RHM2 * |
|---|---|---|---|---|
| NAME | AHon | RKuntz | BClayton | RKaras |
| DATE | 6/12/14 | 6/9/14 | 6/9/14 | 05/22/14 |
| OFFICE | OGC - NLO w/comments | DORL/LPL2-2/BC(A) | DORL/LPL2-2/PM | |
| NAME | BHarris | LRegner | AHon | |
| DATE | 6/12/14 | 6/27/14 | 6/27/14 | |

**OFFICIAL RECORD COPY**