TENNESSEE VALLEY AUTHORITY

1101 Market Street, Chattanooga, Tennessee 37402

CNL-22-053

August 22, 2022

10 CFR 50.90

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

Sequoyah Nuclear Plant, Units 1 and 2
Renewed Facility License Nos. DPR-77 and DPR-79
NRC Docket Nos. 50-327 and 50-328

Subject: **Response to Request for Additional Information Regarding Application to Revise Sequoyah Nuclear Plant Units 1 and 2 Updated Final Safety Analysis Report Regarding Changes to Hydrologic Analysis - Second Partial Response to Additional Request for Additional Information (TS-19-02) (EPID L-2020-LLA-0004)**

References:

1. TVA Letter to NRC, CNL-19-066, "Application to Revise Sequoyah Nuclear Plant Units 1 and 2 Updated Final Safety Analysis Report Regarding Changes to Hydrologic Analysis (TS-19-02)," dated January 14, 2020 (ML20016A396 and ML20016A397)
2. TVA Letter to NRC, CNL-20-026, "Supplement to Application to Revise Sequoyah Nuclear Plant Units 1 and 2 Updated Final Safety Analysis Report Regarding Changes to Hydrologic Analysis, (TS-19-02) (EPID L-2020-LLA-0004)," dated February 18, 2020 (ML20049H184)
3. TVA Letter to NRC, CNL-20-032, "Application to Revise Sequoyah Nuclear Plant Units 1 and 2 Updated Final Safety Analysis Report Regarding Changes to Hydrologic Analysis - Response to Request for Additional Information (TS-19-02) (EPID L-2020-LLA-0004)," dated May 14, 2020 (ML20135H067)
4. TVA Letter to NRC, CNL-20-057, "Application to Revise Sequoyah Nuclear Plant Units 1 and 2 Updated Final Safety Analysis Report Regarding Changes to Hydrologic Analysis - Partial Response to Additional Request for Additional Information (TS-19-02) (EPID L-2020-LLA-0004)," dated August 12, 2020 (ML20225A170)
5. NRC Electronic Mail to TVA, "Sequoyah Nuclear Plant, Units 1 and 2 - Request for Additional Information Regarding Hydrologic UFSAR Update (EPID L-2020-LLA-0004)," dated September 14, 2020 (ML20261H417)

D D30
A053
NRR

6. NRC Letter to TVA, "Summary of October 13, 2020, Closed Meeting With Tennessee Valley Authority to Discuss Responses to Requests for Additional Information Regarding Updated Final Safety Analysis Report Hydrologic Analysis License Amendment Request (EPID L-2020-LLA-0004)," dated October 27, 2020 (ML20293A080)
7. TVA Letter to NRC, CNL-20-082, "Partial Response to Request for Additional Information Regarding Application to Revise Sequoyah Nuclear Plants Units 1 and 2 Updated Final Safety Analysis Report Regarding Changes to Hydrologic Analysis (TS-19-02) (EPID L-2020-LLA-0004)," dated November 10, 2020 (ML20328A093)
8. TVA Letter to NRC, CNL-21-095, "Application to Revise Sequoyah Nuclear Plant, Units 1 and 2 Updated Final Safety Analysis Report Regarding Changes to Hydrologic Analysis – Software Dedication Report 16-01 – Update to Revision 4 (TS-19-02) (EPID L-2020-LLA-0004)," dated December 21, 2021 (ML22013A278)

In Reference 1, Tennessee Valley Authority (TVA) submitted a request for an amendment to Renewed Facility Operating License Nos. DPR-77 and DPR-79 for Sequoyah Nuclear Plant (SQN), Units 1 and 2, respectively. This license amendment request (LAR) revises the SQN Units 1 and 2, Updated Final Safety Analysis Report (UFSAR) to reflect the results from the new hydrologic analysis. TVA determined that the proposed changes to the SQN UFSAR require prior Nuclear Regulatory Commission (NRC) approval.

In References 2, 3, and 4, TVA provided supplements to Reference 1. In Reference 5, the NRC provided a request for additional information (RAI) and requested that TVA respond by October 14, 2020.

Following receipt of Reference 5, TVA determined that there was a potentially unconservative unverified assumption in the calculations supporting the Apalachia Dam failure analysis and entered this issue into the TVA corrective action program. TVA communicated this information to the NRC during a closed public meeting on October 13, 2020 (Reference 6). This unverified assumption impacted some of the Reference 5 requested calculation files. As a result of this impact, TVA provided in Reference 7, a partial response to the Reference 5 request. Reference 7 included the calculation files which were considered to not be impacted by the unverified assumption issue related to the Apalachia Dam failure analysis. Reference 8 provided an update to the Software Dedication Report 16-01 transmitted in Reference 7.

Enclosure 1 to this letter provides responses to the RAIs in Reference 5 not previously answered in Reference 7. In addition, Enclosure 1 provides an updated response for RAI 2.4-5 (1) because of impacts associated with resolution of the unverified assumption. The responses provided in this letter are consistent with the content of the revision of Reference 1 which will be provided later.

As indicated in Enclosure 1, some of the information requested by the NRC is provided in Enclosure 2, which contains a digital versatile disc (DVD). Enclosure 2 contains security related information that TVA is requesting be withheld from public disclosure in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 2.390, "Public inspections, exemptions, requests for withholding."

This letter does not change the no significant hazard considerations nor the environmental considerations contained in Reference 1. Additionally, in accordance with 10 CFR 50.91(b)(1), TVA is sending a copy of this letter and the enclosure to the Tennessee Department of Environment and Conservation.

There are no new regulatory commitments associated with this submittal. Please address any questions regarding this submittal to Stuart L. Rymer, Senior Manager, Fleet Licensing at slrymer@tva.gov.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 22nd day of August 2022.

Respectfully,

James Barstow Digitally signed by Rearden, Pamela S Date: 2022.08.22 16:18:25 -04'00'

James Barstow
Vice President, Nuclear Regulatory Affairs & Support Services

Enclosures:

1. Response to NRC Additional Request for Additional Information
2. DVD Containing the Information Requested in Enclosure 1 (Security Related Information)

cc (w/o Enclosure 2):

NRC Regional Administrator - Region II
NRC Senior Resident Inspector - Sequoyah Nuclear Plant, Units 1 and 2
NRC Project Manager - Sequoyah Nuclear Plant
Director, Division of Radiological Health - Tennessee State Department of Environment and Conservation

Enclosure 1

Response to NRC Additional Request for Additional Information

RAI 2.4-2: PMP Input/Output Files

Section 2.4.3, "PMP [Probable Maximum Precipitation] on Streams and Rivers" of the proposed Updated Final Safety Analysis Report (UFSAR) revision present the revised flood hazard estimations at the plant site due to riverine flooding. NUREG-0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR [Light-water Reactor] Edition," Revision 4, Section 2.4.3, "Probable Maximum Flood (PMF) on Streams and Rivers" (Agencywide Documents Access and Management System (ADAMS) Accession No. ML070730405), and Regulatory Guide (RG) 1.59, "Design Basis Floods for Nuclear Power Plants" (ADAMS Accession No. ML003740388), provide guidelines for estimating this flood causing mechanism. After reviewing the license amendment request (LAR) and enclosed documents, the NRC staff has determined that it needs additional information related to estimating this flood causing mechanism to independently verify the licensee's proposed change. Therefore, the NRC staff requests all PMP input/output files be provided, as summarized in Figure No. 1 of "Response to NRC IQVB Request for Additional Information" (ADAMS Accession No. ML20135H067), including:

1. *Input Information*
   a. *User input (including storm types, durations, basins of interest)*
   b. *ArcGIS base Python script*
   c. *Tennessee Valley Authority (TVA) Project sub-basins shapefile*
   d. *Sub-basin geographic information system (GIS) encapsulating shapefile of TVA subbasins, shapes, area, and positions*
2. *Gridded PMP Point Data Development – Dedicated Software*
   a. *Sub-basin text file of user input*
   b. *Event specific Python script*
   c. *Modified PMP Evaluation Tool scripts and associated documentation*
   d. *Gridded PMP Point Data used for local intense precipitation (LIP) and PMF*
3. *Non-QA GIS Software Tools – Alternate ArcGIS Calculations*
   a. *Python scripts for creating Triangular Irregular Network (TIN) and utilizing Polygon Volume Tool*
   b. *ArcGIS sub-basin weighted average PMP depths for controlling PMF scenario*

TVA Response to *RAI 2.4-2*

The requested information in items 1, 2, and 3a were provided in previous response letters (References 1 and 2.) The requested information in item 3b is provided in the following files on the digital versatile disc (DVD) in Enclosure 2 to this submittal.

3.b. PMP Basin Depth following nesting volume adjustments for the Controlling PMF is in calculation CDQ0000002017000059 Revision 001. This calculation has been revised to address the dam safety issue at Apalachia Dam. Within this effort, it was determined that the controlling event nesting scenario changed from that which was previously provided in Reference 3. The precipitation timeseries file for the controlling simulation is located in Appendix_B.zip, Appendix_B-A_PCAT.zip, in folder "CHH_105," in folder "00_Precip," and in the file "CHH_105_HourlyDistributions.csv." The total applied rainfall depth files are in the same "CHH_105" folder in folder "09_OutputGraphics" in the files "Total_Applied_Rainfall_Depths_Antecedent.csv" and "Total_Applied_Rainfall_Depths_Main.csv."

Enclosure 3 of Reference 1 provided a flowchart aid to facilitate the understanding of the interactions of the various TVA calculations that make up the SQN Hydrology analyses.

RAI 2.4-3: LIP Modeling Input/Output Files

Section 2.4.2, "Floods" of the proposed UFSAR revision presents the revised flood hazard estimations at the plant site due to LIP flooding. SRP Section 2.4.2, "Floods" (ADAMS Accession No. ML070100647), provides guidelines for estimating this flood causing mechanism. After reviewing the submitted LAR and enclosed documents, the NRC staff has determined that it needs additional information related to estimating this flood causing mechanism to independently verify the licensee's proposed change. Therefore, the NRC staff requests all LIP modeling input/output files be provided, including:

- *LIP hydrodynamic model input/output files for simulating local intense precipitation surface runoff, routing, and flooding.*

TVA Response to *RAI 2.4-3*

The requested information was provided in a previous response letter (Reference 1).

RAI 2.4-4: PMF Modeling Input/Output Files

Section 2.4.3, "PMF Flood in Rivers and Streams" of the proposed UFSAR revision presents the revised flood hazard estimations at the plant site due to LIP flooding. SRP Section 2.4.3, provides guidelines for estimating this flood causing mechanism. After reviewing the license amendment request (LAR) and enclosed documents, the NRC staff has determined that it needs additional information related to estimating this flood causing mechanism to independently verify the licensee's proposed change. Therefore, the NRC staff requests all modeling input/output files be provided for controlling PMF (with hydrologic dam failures) scenario, including:

Enclosure 1

1. *Tabular data associated with "the controlling primary and secondary area nesting sequence and the controlling PMP rainfall depth spatial distribution over the watershed" (LAR Enclosure, Section 2.4.3.1) as well as executable version of the tools (if any) used to distribute the gridded PMP values into subbasin space and time.*

a. *LAR Enclosure 3, Figure 2.4.3-1*

b. *LAR Enclosure 3, Figure 2.4.3-5a (as provided in LAR Enclosure 4, Table 2.4.3-1)*

2. *Executable version of sub-basin unit hydrograph calculations (as referenced in LAR Enclosure 4, Section 2.4.3.3), as well as electronic version of data shown in LAR Enclosure 3, Figure 2.4.3-6.*

3. *Executable version of calculation files (if applicable) for estimating precipitation excess (as referenced in LAR Enclosure 4, Section 2.4.3.2).*

4. *Shapefiles (or similar locational data) for HEC-RAS model limits river gage, Sequoyah plant site and dam locations, as shown in LAR Enclosure 3, Figure 2.4.3-4 and Figure 2.4.3-5 (as referenced in LAR Enclosure 4, Section 2.4.3.3)*

5. *Executable version of the runoff and HEC-RAS model files, including HEC-RAS inputs such as calibrated geometry, unsteady flow rules and inflows (as reference in LAR Enclosure 4, Section 2.4.3.3).*

TVA Response to *RAI 2.4-4*

The requested information is provided in the following files on the DVD in Enclosure 2 to this submittal.

1. The process used to distribute the gridded PMP values is described in CDQ0000002017000080, Revision 001, Appendix B.

   1.a. The tabular data associated with LAR Enclosure 3, Figure 2.4.3-1 is in calculation CDQ0000002017000059, Revision 001. The precipitation timeseries file for the controlling simulation is in "Appendix_B.zip," "Appendix_B-A_PCAT.zip," in folder "CHH_105," in folder "00_Precip," and in the file "CHH_105_HourlyDistributions.csv." The total applied rainfall depth files are in the same "CHH_105" folder, in folder "09_OutputGraphics," and in the files "Total_Applied_Rainfall_Depths_Antecedent.csv" and "Total_Applied_Rainfall_Depths_Main.csv."

   1.b. The tabular data associated with LAR Enclosure 4, Table 2.4.3-1, is in calculation CDQ0000002017000059, Revision, 001. The total applied rainfall depth files for the controlling simulation are in "Appendix_B.zip," "Appendix_B-A_PCAT.zip," in folder "CHH_105," in folder "09_OutputGraphics," and in the files "Total_Applied_Rainfall_Depths_Antecedent.csv" and

"Total_Applied_Rainfall_Depths_Main.csv." The runoff determined in the excess computation is in folder "CHH_105," in folder "01_API_calculation," and in file "CHH_105_API_Outputs.dss." The subbasin areas used in the excess computation are in CDQ0000002016000044, Revision 000 in folder "Appendix_B" and in file "Appendix_B_Reservoir_Analysis.xlsx." CDQ0000002016000044, Revision 000 was previously provided in Reference 1.

2. The sub-basin unit hydrographs were developed in calculations CDQ000020080056 through CDQ0000020080073, and CDQ000020080091 and were also provided for NRC review in the External Hazards Branch (EXHB) Audit that began on September 14, 2020. The unit hydrographs calculations for the sub-basins above Chickamauga Dam also supported previous TVA submittals for WBN (Reference 4) that were reviewed and approved by the NRC in Safety Evaluation issued by letter dated January 28, 2015 (Reference 5). The unit hydrograph calculations for the sub-basins below Chickamauga Dam were also provided in the EXHB Audit because the Hydrologic Engineering Center- River Analysis System (HEC-RAS) model has been extended past Chickamauga Dam to Wheeler Dam below Browns Ferry Nuclear Plant. The unit hydrograph data were reformatted for use in the Hydrologic Engineering Center-Hydrologic Modeling System (HEC-HMS) in calculation CDQ0000002016000047 and were also provided for NRC review in the EXHB Audit. The sub-basin unit hydrographs before reformatting are provided within Excel spreadsheets in calculation CDQ0000002016000047 in file "Appendix A.zip," "Appendix_A1_NUH_S-Graphs.xlsx." The sub-basin unit hydrographs which were reformatted are provided in Excel spreadsheets within calculation CDQ0000002016000047 in file "Appendix A.zip," "Appendix_A2_NUH_Adjusted_S-GreaphsR3.xlsm." These Excel files provide electronic versions of the data shown in LAR Enclosure 3, Figure 2.4.3-6. The application of the sub basin unit hydrographs for the controlling event are included in the PMP/PMF Calculation Automation Tool (PCAT) simulation located in calculation CDQ0000002017000059, Revision 001, "Appendix_B.zip," "Appendix_B-A_PCAT.zip," in folder "CHH_105," and in folder "02_HEC-HMS_unit_hydrographs."

3. The process used to compute the precipitation excess is described in calculation CDQ0000002017000080, Revision 001, Appendix C. Precipitation Excess information for the controlling event is in CDQ0000002017000059, Revision 001 in "Appendix_B.zip," "Appendix_B-A_PCAT.zip," in folder "CHH_105," and in folder "01_API_calculation."

4. A shapefile for the subbasins is in CDQ0000002016000045, Revision 000 "Appendix A-A_Subbasins.zip." The HEC-RAS model was built utilizing river mile stations for each dam rather than coordinates. Table 6.4.6 in the HEC-RAS Model Set-up calculation, CDQ0000002014000021, Revision 005, lists each dam included in the model, the river on which it is located, its river mile, and the river miles for the headwater and tailwater cross-sections.

5. The automation for the hydrologic and hydraulic processes was performed by PCAT and is described in CDQ0000002017000080, Revision 001 as listed below.

The process for rain-on-reservoir calculation is described in CDQ0000002017000080, Revision 001, Appendix E. Rain-on-reservoir for the controlling event is in CDQ2000000017000059, Revision 001, "Appendix_B.zip," "Appendix_B-A_PCAT.zip," in folder "CHH_105," and in folder "03_ROR_calculation."

The process for surface runoff and baseflow calculations is described in CDQ0000002017000080, Revision 001, Appendix F. Surface runoff and baseflow for the controlling event is in CDQ2000000017000059, Revision 001, "Appendix_B.zip," "Appendix_B-A_PCAT.zip," in folder "CHH_105," and in folder "04_Surface_runnoff_scaling_and_baseflow. "

The process for tributary inflow routing is described in CDQ0000002017000080, Revision 001, Appendix G. Tributary inflow routing for the controlling event is in CDQ2000000017000059, Revision 001, "Appendix_B.zip," "Appendix_B-A_PCAT.zip," in folder "CHH_105," and in folder "05_Routing."

The process for inflow hydrograph distribution is described in CDQ0000002017000080, Revision 001, Appendix I. Inflow hydrograph distribution for the controlling event is in CDQ2000000017000059, Revision 001, "Appendix_B.zip," "Appendix_B-A_PCAT.zip," in folder "CHH_105," and in folder "07_Inflow_distribution."

The executable version of the HEC-RAS model for the controlling event is in CDQ2000000017000059, Revision 001, "Appendix_B.zip," "Appendix_B-A_PCAT.zip," in folder "CHH_105," and in folder "08_HEC-RAS."

The Controlling PMF Results Data is in CDQ2000000017000059, Revision 001, "Appendix_B.zip," "Appendix_B-A_PCAT.zip," in folder "CHH_105," and in folder "09_OutputGraphics."

RAI 2.4-5: Seismic Dam Failure Modeling Input/Output Files

Section 2.4.4, "Potential Dam Failures, Seismically Induced" of the proposed UFSAR revision in the application presents the revised flood hazard estimations at the plant site due to seismic dam failure flooding. SRP Section 2.4.3 provides guidelines for estimating this flood causing mechanism. After reviewing the license amendment request (LAR) and enclosed documents, the NRC staff determined that it needs additional information related to estimating this flood causing mechanism to independently verify the licensee's proposed change. Therefore, the NRC staff requests all modeling input/output data files be provided for controlling seismic dam failure scenario, including:

1. *Hydrologic Engineering Center River Analysis System simulation setup, input and output files for four potentially critical seismic-flood event combinations (as referenced in LAR Enclosure 4, Section 2.4.4.2).*

2. *Calculations for 25-year and 500-year flood inflows (as referenced in LAR Enclosure 4, Section 2.4.4.1)*

TVA Response to *RAI 2.4-5*

The requested information for items 1 and 2 of this RAI 2.4.5 was provided in a previous response letter (Reference 1). However, the information for item 1 was impacted by the calculation revisions prompted by the Apalachia Dam issue and as such, the seismic analysis was reevaluated. The requested information for item 1 is provided in the following files on the DVD in Enclosure 2 and supersedes the information provided in Reference 1.

1. The revised Seismic HEC-RAS files for the input and output files for the four potentially critical seismic-flood event combinations (as referenced in the LAR Enclosure 4, Section 2.4.4.2) are located in CDQ0000002014000024, Revision 006, "Seismic Dam Failure Simulations Calculation," "Appendix_A.zip," "Appendix_B.zip," "Appendix_C.zip," and "Appendix_F.zip."
2. The 25-year and 500-year flood inflow calculations were provided in a previous response letter (Reference 1).

References:

1. TVA Letter to NRC, CNL-20-082, "Partial Response to Request for Additional Information Regarding Application to Revise Sequoyah Nuclear Plants Units 1 and 2 Updated Final Safety Analysis Report Regarding Changes to Hydrologic Analysis (TS-19-02) (EPID L-2020-LLA-0004)," dated November 10, 2020 (ML20328A093)
2. TVA Letter to NRC, CNL-21-095, "Application to Revise Sequoyah Nuclear Plant, Units 1 and 2 Updated Final Safety Analysis Report Regarding Changes to Hydrologic Analysis – Software Dedication Report 16-01 – Update to Revision 4 (TS-19-02) (EPID L-2020-LLA-0004)," dated December 21, 2021 (ML22013A278)
3. TVA Letter to NRC, CNL-19-066, "Application to Revise Sequoyah Nuclear Plant Units 1 and 2 Updated Final Safety Analysis Report Regarding Changes to Hydrologic Analysis (TS-19-02)," dated January 14, 2020 (ML20016A396 and ML20016A397)
4. TVA Letter to NRC, "Application to Revise Watts Bar Nuclear Plant, Unit 1 Updated Final Safety Analysis Report Regarding Changes to Hydrologic Analysis, TAC No. ME8200 (WBN-UFSAR-12-01)," dated July 19, 2012 (ML122360173)
5. Letter from NRC to TVA, "Watts Bar Nuclear Plant, Unit 1 - Issuance of Amendment To Revise Updated Final Safety Analysis Report Regarding Changes to Hydrology Analysis (TAC No. ME9130)," dated January 28, 2015 (ML15005A314)

Enclosure 2

DVD Containing the Information Requested in Enclosure 1

1. Tennessee Valley Authority, Calculation CDQ0000002017000059, Chickamauga Dam (CHH) Probable Maximum Flood (PMF) Analysis, Revision 1, May 10, 2022 (Security-Related Information)

2. Tennessee Valley Authority, Calculation CDQ0000002014000021, HEC-RAS Model Setup, Revision 5, May 03, 2022 (Security-Related Information)

3. Tennessee Valley Authority, Calculation CDQ0000002016000045, Weekly API Determination, Revision 0, December 07, 2016

4. Tennessee Valley Authority, Calculation CDQ0000002014000024, Seismic Dam Failure Combined with Rainfall Event Simulations, Revision 6, May 10, 2022 (Security-Related Information)

5. Tennessee Valley Authority, Calculation CDQ0000002017000080, Revision 001, PMP/PMF Calculation Automation Tool (PCAT) Model Set-up, Revision 1, May 03, 2022 (Security-Related Information)

6. Tennessee Valley Authority, Calculation CDQ0000002016000047, Unit Hydrograph Data Translation for HEC-HMS, Revision 0, May 25, 2017