TVA

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

CNL-17-094

July 18, 2017

10 CFR 52, Subpart A

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

Clinch River Nuclear Site
NRC Docket No. 52-047

Subject: Submittal of Supplemental Information Associated with Hydrologic Engineering in Support of the Clinch River Nuclear Site Early Site Permit Application

References:

1. Letter from TVA to NRC, CNL-16-081, "Application for Early Site Permit for Clinch River Nuclear Site," dated May 12, 2016
2. NRC Memorandum, "April 17 - 28, 2017, Audit of Clinch River Nuclear Site Early Permit Application - Hydrology and Health Physics Analyses," dated April 11, 2017
3. Letter from TVA to NRC, CNL-17-070, "Submittal of Supplemental Information Associated with Hydrologic Engineering in Support of the Clinch River Nuclear Site Early Site Permit Application," dated June 5, 2017
4. Letter from TVA to NRC, CNL-17-074, "Submittal of Supplemental Information Related to the Hydrologic Engineering in Support of the Clinch River Nuclear Site Early Site Permit Application - Groundwater," dated June 7, 2017

By letter dated May 12, 2016 (Reference 1), Tennessee Valley Authority (TVA) submitted an application for an early site permit for the Clinch River Nuclear (CRN) Site in Oak Ridge, TN. Between April 17, 2017 and April 27, 2017, the NRC conducted an audit of the hydrologic engineering information contained in the CRN Site Early Site Permit Application (ESPA), Part 2, "Site Safety Analysis Report (SSAR)," Section 2.4, "Hydrologic Engineering" (Reference 2). By letters dated June 5, 2017 (Reference 3) and June 7, 2017 (Reference 4), TVA provided supplemental information to SSAR Section 2.4 as presented during the NRC audit.

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The enclosures to this letter provide additional supplemental information related to the information provided by the Reference 3 and 4 letters.

There are no new regulatory commitments associated with this submittal. If any additional information is needed, please contact Dan Stout at (423) 751-7642.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 18th day of July 2017.

Respectfully,

Daniel P. Stout for

J. W. Shea
Vice President, Nuclear Regulatory Affairs and Support Services

Enclosure:

Supplemental Information Regarding Site Safety Analysis Report Section 2.4, "Hydrologic Engineering"

cc (w/ Enclosure):

A. Fetter, Project Manager, Division of New Reactor Licensing, USNRC

cc (w/o Enclosure):

V. McCree, Executive Director of Operations, USNRC
C. Haney, Regional Administrator, Region II, USNRC
M. Johnson, Deputy Executive Director for Reactor and Preparedness Programs, USNRC
V. Ordaz, Acting Director, Office of New Reactors, USNRC
F. Akstulewicz, Director, Division of New Reactor Licensing, USNRC
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M. M. McIntosh, Regulatory Specialist, Eastern Regulatory Field Office, Nashville District, USACE

ENCLOSURE

Supplemental Information Regarding Site Safety Analysis Report Section 2.4, "Hydrologic Engineering"

By letter dated May 12, 2016 (Reference 1), Tennessee Valley Authority (TVA) submitted an application for an early site permit for the Clinch River Nuclear (CRN) Site in Oak Ridge, TN. Between April 17, 2017 through April 27, 2017, the NRC conducted an audit of the hydrologic information contained in the CRN Site Early Site Permit Application (ESPA) (Reference 2). By letters dated June 5, 2017 (Reference 3) and June 7, 2017 (Reference 4), TVA provided supplemental information to SSAR Section 2.4 as presented during the NRC audit.

This enclosure provides additional supplemental information regarding the NRC's review of audit information needs 8, 20, 33-a, 35, and 40-c. Attachment 1 of this enclosure provides additional supplemental information for audit information need 8. Attachment 2 of this enclosure provides SSAR markups for audit information needs 20, 33-a, 35, and 40-c. The SSAR markups included in Attachment 2 of this enclosure will be incorporated in a future revision of the ESPA.

<u>References:</u>

1. Letter from TVA to NRC, CNL-16-081, "Application for Early Site Permit for Clinch River Nuclear Site," dated May 12, 2016
2. NRC Memorandum from Mallecia Sutton to Allen Fetter, "Audit of Clinch River Nuclear Site Early Permit Application - Hydrology and Health Physics Analysis," dated April 11, 2017
3. Letter from TVA to NRC, CNL-17-070, "Submittal of Supplemental Information Associated with Hydrologic Engineering in Support of the Clinch River Nuclear Site Early Site Permit Application," dated June 5, 2017
4. Letter from TVA to NRC, CNL-17-074, "Submittal of Supplemental Information Related to the Hydrologic Engineering in Support of the Clinch River Nuclear Site Early Site Permit Application - Groundwater," dated June 7, 2017

<u>Attachments:</u>

1. CD-ROM: Calculation Files Related to the Highway 58 Bridge
2. Site Safety Analysis Report Subsection 2.4 Mark-ups

<u>Supplemental Information Associated with NRC Audit Information Needs:</u>

Supplemental Information related to NRC Information Need 8

Following review of supplemental information submitted for audit information need 8, the NRC requested probable maximum flood data files related to the Highway 58 bridge over the Clinch River arm of the Watts Bar Reservoir. Attachment 1 provides the requested files on a CD-ROM.

ENCLOSURE

Supplemental Information related to NRC Information Need 20

After review of the supplemental information provided in Reference 3, the NRC requested clarification regarding references in the markup of SSAR Subsection 2.4.4.2.1, "Seismic Failure Analysis," provided in Attachment 3 of Reference 3. After review, it was determined that the Reference 2.4.4-10 in the second updated paragraph under the subheading "Flood Routing," of SSAR Subsection 2.4.4.2.1, is incorrect. This reference is being corrected and new references are being added. See the markup of SSAR Subsection 2.4.4.2.1 provided in Attachment 2 of this enclosure. The revised SSAR text will be incorporated in a future revision of the ESPA.

Supplemental Information related to NRC Information Need 35

The discussion for the 7-day required minimum flow value of 400 cfs average daily flow from Melton Hill Dam is being revised for consistency with the discussion contained in the ESPA Environmental Report. See the markup of SSAR Subsection 2.4.11.1.1 provided in Attachment 2 of this enclosure. The revised SSAR text will be incorporated in a future revision of the ESPA.

Supplemental Information related to NRC Information Need 33-a/40-c

An additional change is being made to the supplemental information related to NRC Information Need 33-a/40-c that was previously provided by TVA in Reference 4. For clarification, the summary section of SSAR Subsection 2.4.12C.7.1 is being revised to remove text that is not necessary to support the conclusion. The changes provided are in addition to those provided in Reference 4. See the markup of SSAR Subsection 2.4.12C.7.1 provided in Attachment 2 of this enclosure. The revised SSAR text will be incorporated in a future revision of the ESPA.

(SRI/CEII) [redacted]

ENCLOSURE

Attachment 2
Site Safety Analysis Report Subsection 2.4. Markups

SSAR Subsection 2.4.4.2.1, under subheading "Flood Routing," is being revised as indicated. Subsection 2.4.4-7, "References," is being revised to add the new references. Strikethroughs indicate text to be deleted. Underlines indicate text to be added.

2.4.4.2.1 Seismic Failure Analysis

Flood Routing

Flood inflow hydrographs were developed by using watershed gaged data to scale prototypical inflow hydrographs to meet estimated 25- and 500-year volume targets.

Guidance for development of probabilistic point rainfall estimates is published in Reference 2.4.4-~~10~~11. Reference 2.4.4-~~10~~11, Section 5, indicates point rainfall estimate data represents rainfall frequency at a point approximately 0.5-miles square and is not directly applicable for larger areas. Reference 2.4.4-~~10~~12 states that point estimates may be applied to larger areas after adjustment through the use of Areal Reduction Factors (ARFs) for areas up to 400 sq mi. Watersheds impacting the Clinch River Nuclear (CRN) Site are 17,310-sq mi above Watts Bar Dam and 3382-sq mi above the CRN Site. Because these areas are significantly beyond the published limits for ARFs, the application of ARF adjusted point rainfall based on Reference 2.4.4-~~10~~11 was judged not suitable. Therefore, an alternate methodology for production of scaled inflow hydrographs was developed to meet the requirements. This methodology uses historical gaged data across the watershed above Watts Bar Dam aggregated into annual maximum series for 1- to 5-day durations to estimate 25- and 500-year frequency stream flows.

2.4.4.7 References

2.4.4-8. Guidelines for Determining Flood Flow Frequency, Bulletin #17B of the Hydrology Subcommittee, Interagency Advisory Committee on Water Data, Office of Water Data Coordination, Geological Survey, U.S. Department of the Interior, Revised September 1981 with March 1982 Editorial Corrections

2.4.4-9. Moore, James N. and Ray C. Riley, "Comparison of Temporal Rainfall Distributions for Near Probable Maximum Precipitation Storm Events for Dam Design", National Water Management Center, Natural Resources Conservation Service (NRCS), Little Rock, Arkansas

2.4.4-10. Hovey, Peter and Thomas DeFiore, "Using Modern Computing Tools to Fit the Pearson Type III Distribution to Aviation Loads Data", Report # DOT/FAA/AR-03/62, Office of Aviation Research, Federal Aviation Administration, U.S. Department of Transportation, Washington, D.C., September 2003.

2.4.4-11. Bonnin, Geoffrey M., Deborah Martin, Bingzhang Lin, Tye Parzybok, Michael Yekta, David Riley, "NOAA Atlas 14, Precipitation-Frequency Atlas of the United States", Volume 2 Version 3.0: Delaware, District of Columbia, Illinois, Indiana, Kentucky, Maryland, New Jersey, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, West Virginia, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, Silver Spring, Maryland, 2004, revised 2006.

2.4.4-12. Hershfield, David M., "Technical Paper No. 40 Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years", Department of Commerce, Cooperative Studies Section, Hydrologic Services Division for Engineering Division, Soil Conservation Service, U.S. Department of Agriculture; Washington, DC May 1961, Repaginated and Reprinted January 1963.

SSAR Subsection 2.4.11.1.1 is being revised as indicated. Strikethroughs indicate text to be deleted. Underlines indicate text to be added.

2.4.11.1.1 Flow Release from Melton Hill Dam

Normal flow near the CRN Site is in the downstream, except when the water level in the lower reaches of Watts Bar Reservoir rises significantly enough to create a backwater effect. This flow reversal condition could occur when outflows from the Watts Bar and Melton Hill Dams are negligible and inflows from the upper Tennessee River watershed to the lower reaches of the Watts Bar Reservoir are significant. Runoff generated in the drainage area downstream of Melton Hill Dam also contributes to the flow, but is expected to be relatively minor, given that the distance between the CRN Site intake location and Melton Hill Dam is only about 5.2 river miles.

Construction of Melton Hill Dam started on September 6, 1960, and the dam was closed on May 1, 1963, when filling of the Melton Hill Reservoir began. The water level in the reservoir reached the normal maximum pool level of 795 ft National Geodetic Vertical Datum of 1929 (NGVD29) on May 30, 1963. Melton Hill Dam is operated for various purposes including navigation, hydroelectric power production, water supply, water quality and aquatic ecology enhancement, and recreation, but not flood control because of its limited storage capacity. The dam has a minimum release requirement of 400 cfs, on a daily average basis, for downstream water supply and water quality enhancement (Reference 2.4.11-1). From historical records (Reference 2.4.11-4), the occurrence of the minimum release flow (400 cfs) continuing for an extended period is ~~as long as seven days is found to be less than 0.1 percent, indicating that low flow conditions are~~ infrequent for this reach of the Clinch River arm of the Watts Bar Reservoir. In addition, the average weekly discharge from Melton Hill Reservoir over the long term is about 4800 cfs, with a maximum weekly discharge of about 25,450 cfs, much higher than the projected nonsafety-related water demand (consumptive surface water use) of 28.5 cfs from the CRN Site. The unregulated flow at the dam site is estimated to be of the same order as the regulated discharge, about 4950 cfs for the period 1903 to 1999.

The rare occurrence of low flow conditions is further illustrated by examining the zero flow events downstream of Melton Hill Dam. Based on daily average outflow statistics at Melton Hill Dam from May 30, 1963 to October 31, 2013 (more than 50 years of record with 18,418 of data points), the total number of days with zero flows was 676 (3.7 percent) for the entire record, and 13 (0.14 percent) for the most recent 25 years of record (since 1989). With the adoption of the reservoir operations policy of 2004 (Reference 2.4.11-1), the frequency of zero flow days decreases to about 0.06

SSAR Subsection 2.4.12C.7.1 is being revised as indicated. Strikethroughs indicate text to be deleted.

2.4.12C.7.1 Modifications to Pre-Construction Models

The general structure of the profile models along with hydraulic conductivity distributions for subsurface layers remained the same as the pre-construction model; however, some nominal changes were made to include representative structures (Figures 2.4.12C-23 and 2.4.12C-24). The following describes the changes to the pre-construction models to develop the post-construction profile models:

- An extra subsurface model layer was added below the bottom of the conceptualized SMR nuclear reactor (Layer 7) to determine the maximum head imposed at the base of the reactor foundation embedment depth and SMR structure. The hydraulic conductivity for this layer remained the same as in the pre-construction model for the same depth. Figures 2.4.12C-23 and 2.4.12C-24 shows the hydraulic conductivity distributions for the layers in the post-construction models for Profiles A and C.
- Surface grade elevations across the two profile models were based on the PPE with maximum foundation embedment depth of approximately 140 ft below grade. Additionally, a shallow SMR foundation embedment depth was also included (in a separate model configuration) at approximately 50 ft below grade (top of the competent rock) in order to represent a technology requiring a shallow foundation embedment depth. These two different excavation depths provide the bounding foundation embedment depths for the different SMR technologies. The width of the power block in the profile models approximates the width of the power block area in the site layout drawing. The grade elevations are approximate and may change when a specific technology is selected for the Combined License Application (COLA).
- Granular backfill material was included in areas where the surface elevation of the pre-construction model was raised to accommodate the post-construction model grade. The grade elevation of the power block area corresponds to an elevation of 821 ft NAVD88. The power block is assumed to include: a) radwaste building with foundation embedment elevation selected at 818 ft NAVD88; b) reactor building foundation embedment elevation selected at approximately 681 ft NAVD88 for the deepest SMR technology and at approximately 770 ft NAVD88 for the shallowest SMR technology; and c) auxiliary building elevation selected at 748 ft NAVD88 for the deepest SMR technology and at about 770 ft NAVD88 for the shallowest SMR technology. The embedment depth of the turbine building was assumed to be at an elevation of 814 ft NAVD88, which is 6 ft below grade. The assumption of the embedment depth of the turbine building is based on the approximation of a shallow depth of embedment. The turbine building depth is independent of the different SMR technologies. The inclusion of the radwaste, turbine, and auxiliary buildings, which are not part of the PPE, provides a representation of the type of buildings that are likely to be constructed for a nuclear power plant; these buildings do not have any appreciable impact on the outcome of the hydraulic heads. Embedded structures in the profile models are represented by no-flow cells.

In summary:

1. The hydraulic conductivity of the granular backfill material is assumed to be representative of clean sand with a value of 10^{-2} cm/s (28.35 ft/day) (Reference 2.4.12C-8). ~~This value corresponds to the mid-range of clean sand and is equivalent to a hydraulic conductivity value of granular backfill material that has undergone some compaction, which is typically within the range used in construction sites for a nuclear power plant.~~ The value of hydraulic conductivity is assumed to be uniform (i.e., homogeneous) and represents fill adjacent in and outside of the power block area.

2. Recharge is assumed to be 8.76 in./yr, based on an alternative conceptual model for the preconstruction model runs, except in the power block area and part of the turbine area, which are assumed to be impervious.