TENNESSEE VALLEY AUTHORITY

Fourth Semiannual Report on the Progress of Remedy Selection

Stilling Pond CCR Unit

TVA Kingston Fossil Plant, Harriman, Roane County, Tennessee

January 6, 2023

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1.0 Introduction

In accordance with Title 40 Code of Federal Regulations (CFR) § 257.97(a), the Tennessee Valley Authority (TVA) has prepared this semiannual report to document progress toward remedy selection and design at the Stilling Pond (also referred to herein as the CCR Unit) at the Kingston Fossil Plant (KIF) in Harriman, Roane County, Tennessee.

1.1 Regulatory Background

On April 17, 2015, the United States Environmental Protection Agency published a rule that sets forth national criteria for the management of coal combustion residuals (CCR) produced by electric utilities. The requirements can be found in Title 40, CFR Part 257, Subpart D (CCR Rule). The CCR Rule includes requirements for monitoring groundwater and assessing corrective measures if constituents listed in Appendix IV to the CCR Rule are detected in groundwater samples collected from downgradient monitoring wells at statistically significant levels (SSLs) greater than established groundwater protection standards (GWPS).

In July 2020, TVA determined there were SSLs over established GWPS as defined in 40 CFR § 257.95(h) for one or more Appendix IV constituents in accordance with 40 CFR § 257.95(g). At that time, assessment monitoring detected SSLs above GWPS for cobalt in downgradient monitoring wells 6AR, KIF-103 and KIF-104. Since this time, TVA has updated the statistical analysis.

- In late 2020, TVA updated the statistical analysis after incorporating additional groundwater monitoring data from the second assessment monitoring event in 2020. The same SSLs were observed at the same monitoring wells.
- In mid and late 2021, TVA updated the statistical analysis after incorporating results from the 2021 assessment monitoring events. The same SSLs were observed at the same monitoring wells.
- In mid and late 2022, TVA updated the statistical analysis after incorporating results from the 2022 assessment monitoring events. The same SSLs were observed at the same monitoring wells.

As of the date of this report, TVA has not demonstrated that a source other than the CCR Unit has caused the SSLs associated with monitoring wells 6AR, KIF-103, and KIF-104, as allowed under 40 CFR § 257.95(g)(3)(ii).

In accordance with 40 CFR § 257.96(a), TVA prepared the 2021 Assessment of Corrective Measures (ACM) Report for the CCR Unit at KIF, placed it in the facility operating record on January 8, 2021, and uploaded it to the TVA CCR Rule Compliance Data and Information website on February 5, 2021. The ACM Report provided an assessment of the effectiveness of corrective measures in accordance with 40 CFR § 257.96(c). Three primary strategies were evaluated to address groundwater exhibiting concentrations of cobalt above the GWPS:

- Enhanced In-Situ Treatment (EIST)
    - Direct Injection
    - Infiltration Galleries
    - Permeable Reactive Barriers (PRB)
- Hydraulic Containment and Treatment
    - Physical Barriers
    - Pumping Systems
- Monitored Natural Attenuation (MNA).

Following preparation of the ACM Report, TVA began the remedy selection process. Semiannual reports are required pursuant to 40 CFR § 257.97(a) to document progress toward remedy selection and design. TVA placed prior Semiannual Reports on the Progress of Remedy Selection into the facility operating record pursuant to 40 CFR § 257.97(a) and § 257.105(h)(12). TVA provided notification of the availability of the semiannual reports describing the progress in selecting and designing the remedy and placed the reports on the TVA CCR Rule Compliance Data and Information website in accordance with 40 CFR § 257.106(h)(9) and § 257.107(h)(9). TVA will continue to review new data as it becomes available and implement changes to the groundwater monitoring and corrective action program as necessary to maintain compliance with 40 CFR § 257.90 through § 257.98.

At least 30 days prior to final groundwater remedy selection pursuant to the CCR Rule, a public meeting will be held with interested and affected parties to discuss the results of the corrective measures assessment in accordance with 40 CFR § 257.96(e). The selected remedy must meet the requirements of 40 CFR § 257.97(b) and must consider the evaluation factors set forth in 40 CFR § 257.97(c). Once a final remedy is chosen, a final report describing the remedy and how it meets the standards set forth in 40 CFR § 257.97(b) will be prepared. The owner/operator must provide a schedule for implementing the selected remedy that considers the factors set forth in 40 CFR § 257.97(d).

1.2 Summary of State Required Investigation and Remedy Selection Process

With oversight from the Tennessee Department of Environment and Conservation (TDEC), TVA is currently conducting environmental investigations of the CCR Unit at KIF in accordance with the TDEC Commissioner's Order, OGC 15-0177 (TDEC Order). The TDEC Order sets forth the process by which TVA will investigate the site, will provide an assessment of the data to TDEC, and will present proposed corrective measures and remedies, including for groundwater, to TDEC for approval. More specifically, once TDEC determines that the environmental investigations are complete, TVA will submit an environmental assessment report that provides an analysis of the extent of CCR impacts, including groundwater impacts, at KIF to TDEC for approval. Then, as part of the TDEC Order process, TVA will submit a Corrective Action/Risk Assessment (CARA) Plan to TDEC for approval. The CARA Plan will specify actions that TVA plans to take at the site, including corrective measures for groundwater

remediation. TDEC must approve the CARA Plan, including the CCR Unit's closure methodology and corrective measures for groundwater remediation. The TDEC Order process includes a public comment period for the CARA Plan.

1.3 Report Contents

This semiannual progress report provides a summary of KIF site characteristics, the groundwater assessment monitoring program, the findings of the ACM process, and the current progress of selecting and designing a final remedy for statistically significant GWPS exceedances.

2.0 Site Background and Characteristics

KIF is located in Harriman, Roane County, Tennessee. The facility lies on the west bank of the Emory River (mile 2 to 2.5) near the Emory River's confluence with Clinch River/Watts Bar Lake. **Figure 1** shows an overview map of KIF including the Stilling Pond. Construction of KIF began in 1951 and was completed in 1955. The Stilling Pond is located northeast of the Sluice Trench and Area East of Sluice Trench adjacent to the Emory River. This CCR Unit is an inactive CCR surface impoundment (i.e., vacatur unit) under the CCR Rule and is subject to the deadlines set forth in 40 CFR § 257.100.

2.1 Conceptual Site Model Summary

The hydrogeologic conceptual site model (CSM) is one of the primary tools that can be used to support decisions on corrective measures. This section of the report provides a summary of the hydrogeologic CSM.

The KIF Plant is located within a valley of the Valley and Ridge province of the Appalachian Highlands, with Pine Ridge to the west and a secondary parallel northeast- to southwest-trending ridge to the east of the Emory River. The natural unconsolidated materials consist primarily of residuum and alluvium overlying bedrock. Residuum is the material that remains after bedrock has weathered to a point that it is no longer considered rock. Alluvium refers to native materials that are deposited by moving water. The alluvium can be further differentiated into silts and clays that overlie a sand to silty sand layer. The upper fine-grained alluvium layer varies in thickness from 2.5 to 27.5 feet and is primarily comprised of clay and silty clays. Clay soils of variable thickness are present under the CCR units, although they are believed to be discontinuous in areas based on geotechnical drilling records. The lower alluvial layer, ranging in thickness from 0.5 to 52.5 feet, is primarily sand and silty sand. Bedrock underlying the CCR management units is the Conasauga Group Shale, which is comprised of sandstone, siltstone, shale, limestone, and dolomite and is of low permeability. A cross-section location is provided on **Figure 2** with a cross-section view of the typical subsurface geology shown on **Figure 3**.

The geology and hydrogeology of the KIF site under the CCR Unit have been characterized during implementation of multiple investigations. These investigations provide an understanding of site geology and the presence of water-bearing zones. The primary groundwater flow direction from the CCR Unit is to the southeast and east toward the intake channel and Emory River. **Figure 4** presents a groundwater potentiometric surface map using groundwater data collected on September 19, 2022.

2.2 Potential Receptor Review

Public water surrounding the KIF plant is supplied by five separate public water districts that obtain their water from local surface water sources. The Roane Central Water District supplies public water to areas west and southwest of KIF with water sourced from the Rockwood Water Utility approximately five miles southwest and downstream of the plant. The Rockwood Water Utility obtains water from Watts Bar Lake near the Postoak Creek inlet. The Harriman Utility Board supplies public water to areas north and northwest of KIF with water sourced from the Emory River approximately 2.5 miles northwest and upstream of the plant. The Kingston Water Department supplies public water to areas south and southeast of KIF, including the fossil plant, with water sourced from Watts Bar Lake approximately two miles south and downstream of

KIF. The Cumberland Water Utility supplies public water to areas east and northeast of KIF with water sourced from the Little Emory River approximately four miles northeast and upstream of KIF.

3.0 Groundwater Assessment Monitoring Program

Groundwater assessment monitoring for the CCR Unit is conducted at KIF in accordance with 40 CFR § 257.95.

3.1 Groundwater Monitoring System

In compliance with 40 CFR § 257.91, one background well (AD-1) and three downgradient wells (6AR, KIF-103, and KIF-104) were certified for the groundwater monitoring system for the CCR Unit. The locations of these monitoring wells are presented on **Figure 1**.

3.2 Groundwater Characterization

Groundwater assessment monitoring was conducted in 2020 and 2021, and at the time of this report, the first and second assessment monitoring and retest events in 2022 had been conducted. In 2022 the following Appendix IV constituent was detected at SSLs above a GWPS:

<u>Cobalt</u>

- SSLs for cobalt were identified at monitoring wells 6AR, KIF-103 and KIF-104
    - The GWPS for cobalt is 6 µg/L

Data from existing wells have been used to characterize the nature and extent of SSLs as required by 40 CFR 257.95(g)(1). The monitoring wells with cobalt concentrations above the GWPS are illustrated on **Figure 5**. The work being performed under the TDEC Order will further refine this characterization and inform the evaluation and selection of the remedy(s) under 40 CFR 257.97 of the CCR Rule.

4.0 Assessment of Corrective Measures

TVA prepared the 2021 ACM Report for the CCR Unit and placed it in the operating record on January 8, 2021. The report was posted to the TVA CCR Rule Compliance Data and Information website on February 5, 2021. The ACM Report provided an assessment of the effectiveness of corrective measures in accordance with 40 CFR § 257.96(c).

4.1 Planned Source Control Measures

The objectives of corrective measures under 40 CFR § 257.96(a) are to "prevent further releases [from the CCR units], to remediate any releases, and to restore affected areas to original conditions." Ultimately, in accordance with 40 CFR § 257.97(b)(3), the selected corrective measure must at a minimum "Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents of appendix IV to this part into the environment."

The Preamble (80 Fed. Reg. 21302, 21406) to the CCR Rule discusses that source control measures may include modifying operational procedures. The management of wet CCR has ceased in order to achieve TVA's commitment to convert from wet to dry handling of CCR and to comply with regulatory requirements and timeframes under the CCR Rule. Additionally, the Stilling Pond has been closed with a geosynthetic cap in accordance with the requirements set forth in 40 CFR § 257.102(d).

These measures will reduce the potential for migration of CCR constituents to groundwater. Subsequent groundwater assessment monitoring will be conducted to track changes in groundwater conditions resulting from these operational changes. These data will also be considered in the selection and design of a remedy in accordance with 40 CFR § 257.97.

4.2 Potential Remedial Technologies

Subject to necessary environmental reviews, the CCR Unit has been closed in accordance with the requirements set forth in 40 CFR § 257.102(d).

In addition to source control measures, three primary strategies were evaluated to address groundwater exhibiting concentrations of cobalt above the GWPS including:

- EIST
    - Direct Injection
    - Infiltration Galleries
    - PRB
- Hydraulic Containment and Treatment
    - Physical Barriers
    - Pumping Systems

- MNA

The ACM Report provides a more detailed description of these corrective measures. The effectiveness of each potential corrective measure was assessed in accordance with 40 CFR § 257.96(c) and all are currently considered feasible for remediating the groundwater at the CCR Unit.

5.0 Selection of Remedy: Current Progress

A remedy to address the SSLs in groundwater will be selected in accordance with 40 CFR § 257.97. Upon selection of a remedy, the owner or operator must prepare a final report (i.e., Remedy Selection Report) describing the selected remedy and how it meets the standards specified below pursuant to 40 CFR § 257.97(b)(1)-(5). Remedies must:

- Be protective of human health and the environment
- Attain the groundwater protection standard as specified pursuant to §257.95(h)
- Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in Appendix IV to this part into the environment
- Remove from the environment as much of the contaminated material that was released from the CCR Units as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems, and
- Comply with standards for management of wastes as specified in §257.98(d).

In support of the remedy selection process, additional investigation is needed and ongoing and is described in the following sub-section.

5.1 Data Requirements for Design of Groundwater Corrective Action

Additional data to address data gaps to further refine the targeted area for corrective measures and to evaluate and select the groundwater remedy(s) for the CCR Unit will include ongoing TDEC Order work that is reported separately. Pursuant to the TDEC Order, the groundwater remedy for the CCR Unit must be approved by TDEC upon completion of the TDEC Order process, which is currently ongoing.

Activities completed to further evaluate site conditions include:

- Completed initial phase of bench-scale in-situ treatability testing to evaluate reagent effectiveness for treating cobalt in-situ.
- An evaluation was conducted to further refine the hydrogeologic conceptual site model, provide calibration data for the groundwater flow model, provide input for geochemical modeling and to guide potential corrective measures at the CCR Unit. This evaluation included the use of in-well point velocity probes and passive flux meters in six existing wells to supplement understanding of the groundwater system at the CCR Unit. Well locations are provided on **Figure 6**.

On-going and potential future activities to evaluate EIST include:

- TVA initiated geochemical modeling at the CCR Unit to evaluate the influence of native soils on groundwater chemistry. Geochemical models have been developed to aid in evaluating the effect of various potential corrective measures. The geochemical models account for the geochemical

processes operating between groundwater and the native soils that can influence the mobility of Appendix IV constituents through adsorption, ion exchange, and potential mineral precipitation/dissolution. The time frame of effectiveness and capacity of the native soil system to attenuate Appendix IV constituents and EIST alternatives are being evaluated using geochemical modeling. Additional geochemical modeling efforts will continue, and models will be further refined as the ACM process progresses.

- Groundwater Treatability Study – Initial bench-scale in-situ treatability testing results were favorable and bench-scale testing has advanced to the final phase. Assuming final phase testing remains favorable, a field-scale pilot test would be developed to further advance engineering design criteria for potential full-scale implementation. Ongoing and potential future activities to further evaluate hydraulic containment and treatment include:

- Supplemental Hydraulic Properties Evaluation – This evaluation could be necessary if the understanding of subsurface hydraulic characteristics are insufficient to evaluate capture zone geometry and potential groundwater recovery rates. Installation of new groundwater wells and performance of pumping tests to evaluate capture zone geometry and potential groundwater recovery rates would be incorporated into the groundwater flow modeling simulations for groundwater extraction. These data would inform the feasibility, design, and implementation of groundwater recovery systems if hydraulic containment and treatment is the selected corrective measure.

- Groundwater Flow Modeling – The numerical groundwater flow model may be used to evaluate the effectiveness of hydraulic containment, as appropriate. A calibrated groundwater model may be used to evaluate a variety of approaches (e.g., vertical wells, horizontal wells, physical barriers) and to estimate the groundwater extraction rates necessary to contain an identified target zone.

Ongoing and potential future activities to further evaluate MNA include:

- A geochemical investigation is being conducted to evaluate groundwater and aquifer solids proximal to the CCR Unit.

- Numerical groundwater flow modeling is being conducted to support geochemical modeling and selection of a final remedy by incorporating the additional groundwater elevation data gained from ongoing environmental investigation and hydrogeologic characterization efforts under the TDEC Order.

- Groundwater fate and transport modeling may be conducted to further evaluate the natural attenuation and migration of constituents. The refined groundwater flow model and geochemical model would be used in conjunction with the fate and transport model to evaluate potential corrective measures.

5.2 Semiannual Reporting, Public Meeting, Remedy Selection and Final Report

Progress toward the selection and design of the remedy will be documented in semiannual reports in accordance with 40 CFR § 257.97(a). Semiannual reports will be placed into the facility operating record pursuant to 40 CFR § 257.105(h)(12). TVA will provide notifications of the availability of the semiannual reports describing the progress in selecting and designing the remedy and will place the reports on the TVA CCR Rule Compliance Data and Information website in accordance with 40 CFR § 257.106(h)(9) and § 257.107(h)(9), respectively, 30 days after placement in the facility operating record. At least 30 days prior to selecting a remedy, a public meeting to discuss the results of the corrective measures assessment will be conducted as required by 40 CFR § 257.96(e).

A final report will be prepared after the remedy is selected. This final report will describe the remedy and how it meets the standards specified in 40 CFR § 257.97. Recordkeeping requirements specified in 40 CFR § 257.105(h), notification requirements specified in 40 CFR § 257.106(h), and internet requirements specified in 40 CFR § 257.107(h) will be complied with as required by 40 CFR § 257.97(e).

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Attachments:

Figures

Figure 1 – CCR Units with Background and Downgradient Wells

Figure 2 – Cross-Section Transect Map

Figure 3 – Geologic Cross-Section (Stilling Pond)

Figure 4 – Potentiometric Map September 19, 2022

Figure 5 – Monitoring Wells and Appendix IV Constituents Above GWPS

Figure 6 – KIF Plant IWPVP and PFM Test Well Location Map

FIGURES