Sequoyah Nuclear Plant

Pre-submittal Meeting for a License Amendment Request to Revise TS 5.5.3 “Radioactive Effluent Controls Program” Regarding Application of Potassium Hydroxide (KOH)

August 20, 2025

TVA TENNESSEE VALLEY AUTHORITY

Agenda

- Introduction
- Purpose
- Regulations Applicable to Sequoyah ODCM
- Sequoyah Technical Specification Markup
- Proposed License Amendment
- Basis for Proposed Amendment
- NRC Questions from Previous Public Meeting
- Summary
- Schedule for Submittal

Introduction

- SQN is planning addition of KOH to control the pH of the primary side reactor coolant, a first of a kind application for a North American PWR.
- Background information provided during April 15, 2025 public meeting with NRC
    - SQN was considering a potential exemption request
    - History of rulemaking and regulatory precedents were presented
    - NRC staff provided relevant questions which will be further discussed
    - Meeting summary provided in ML25108A105
- SQN is now planning to propose a license amendment supporting application of KOH and performing a revision of the ODCM

Purpose

- The purpose of this meeting is to discuss the need for an amendment to the operating licenses for SQN Units 1 and 2 related to KOH application
    - Proposed amendment would revise TS 5.5.3 “Radioactive Effluent Controls Program” to allow for the application of specific ICRPs and FGRs in the determination of dose coefficients for KOH radionuclides
    - Dose coefficients associated with KOH radionuclides are required to evaluate compliance with the requirements of 10 CFR Part 20 and 10 CFR Part 50, Appendix I
- Proposed license amendment would support a revision of the SQN ODCM that accounts for the additional radionuclides generated when using KOH

Regulations Applicable to SQN ODCM

- 10 CFR Part 20 Standards for Protection Against Radiation
  - 10 CFR Part 20.1302, Compliance with dose limits for individual members of the public
  - 10 CFR Part 20 Appendix B, Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage
- 10 CFR Part 50 Domestic Licensing of Production and Utilization Facilities
  - 10 CFR Part 50 Appendix I, Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low as is Reasonably Achievable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents

SQN Technical Specification Markup

5.5.1 Offsite Dose Calculation Manual (ODCM)

a. The ODCM shall contain the methodology and parameters used in the calculation of offsite doses resulting from radioactive gaseous and liquid effluents, in the calculation of gaseous and liquid effluent monitoring alarm and trip setpoints, and in the conduct of the radiological environmental monitoring program; and

b. The ODCM shall also contain the radioactive effluent controls and radiological environmental monitoring activities, and descriptions of the information that should be included in the Annual Radiological Environmental Operating, and Radioactive Effluent Release Reports required by Specification 5.6.1 and Specification 5.6.2.

Licensee initiated changes to the ODCM:

a. Shall be documented and records of reviews performed shall be retained. This documentation shall contain:

   1. Sufficient information to support the change(s) together with the appropriate analyses or evaluations justifying the change(s) and

   2. A determination that the change(s) maintain the levels of radioactive effluent control required by 10 CFR 20.1302, 40 CFR 190, 10 CFR 50.36a, and 10 CFR 50, Appendix I, and not adversely impact the accuracy or reliability of effluent, dose, or setpoint calculations,

b. Shall become effective after the approval of the plant manager, and

c. Shall be submitted to the NRC in the form of a complete, legible copy of the entire ODCM as a part of or concurrent with the Radioactive Effluent Release Report for the period of the report in which any change in the ODCM was made. Each change shall be identified by markings in the margin of the affected pages, clearly indicating the area of the page that was changed, and shall indicate the date (i.e., month and year) the change was implemented.

Proposed license amendment would <u>not</u> change any of the existing requirements of SQN TS 5.5.1

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SQN Technical Specification Markup

5.5.3 Radioactive Effluent Controls Program

This program conforms to 10 CFR 50.36a for the control of radioactive effluents and for maintaining the doses to members of the public from radioactive effluents as low as reasonably achievable. The program shall be contained in the ODCM, shall be implemented by procedures, and shall include remedial actions to be taken whenever the program limits are exceeded. The program shall include the following elements:

a. Limitations on the functional capability of radioactive liquid and gaseous monitoring instrumentation including surveillance tests and setpoint determination in accordance with the methodology in the ODCM,

b. Limitations on the concentrations of radioactive material released in liquid effluents to unrestricted areas, conforming to ten times the concentration values in Appendix B, Table 2, Column 2 to 10 CFR 20.1001-20.2402,

c. Monitoring, sampling, and analysis of radioactive liquid and gaseous effluents in accordance with 10 CFR 20.1302 and with the methodology and parameters in the ODCM,

d. Limitations on the annual and quarterly doses or dose commitment to a member of the public from radioactive materials in liquid effluents released from each unit to unrestricted areas, conforming to 10 CFR 50, Appendix I,

e. Determination of cumulative dose contributions from radioactive effluents for the current calendar quarter and current calendar year in accordance with the methodology and parameters in the ODCM at least every 31 days. Determination of projected dose contributions from radioactive effluents in accordance with the methodology in the ODCM at least every 31 days,

5.5.3 Radioactive Effluent Controls Program (continued)

f. Limitations on the functional capability and use of the liquid and gaseous effluent treatment systems to ensure that appropriate portions of these systems are used to reduce releases of radioactivity when the projected doses in a period of 31 days would exceed 2% of the guidelines for the annual dose or dose commitment, conforming to 10 CFR 50, Appendix I,

g. Limitations on the dose rate resulting from radioactive material released in gaseous effluents from the site to areas at or beyond the site boundary shall be in accordance with the following:

   1. For noble gases: a dose rate ≤ 500 mrem/yr to the whole body and a dose rate ≤ 3000 mrem/yr to the skin and

   2. For iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days: a dose rate ≤ 1500 mrem/yr to any organ,

h. Limitations on the annual and quarterly air doses resulting from noble gases released in gaseous effluents from each unit to areas beyond the site boundary, conforming to 10 CFR 50, Appendix I,

i. Limitations on the annual and quarterly doses to a member of the public from iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half lives > 8 days in gaseous effluents released from each unit to areas beyond the site boundary, conforming to 10 CFR 50, Appendix I, and

j. Limitations on the annual dose or dose commitment to any member of the public, beyond the site boundary, due to releases of radioactivity and to radiation from uranium fuel cycle sources, conforming to 40 CFR 190.

International Commission on Radiological Protection (ICRP) publications 72, 119, 144, and 151, and Federal Guidance Reports (FGRs) 12 and 15 may be used to determine dose coefficients for potassium hydroxide (KOH) related radionuclides when evaluating compliance with the requirements of 10 CFR Part 20 and 10 CFR Part 50, Appendix I.

The provisions of SR 3.0.2 and SR 3.0.3 are applicable to the Radioactive Effluent Controls Program surveillance frequency.

Proposed License Amendment

- Proposed license amendment for SQN Units 1 and 2 would be an allowance to use specific ICRP and FGR methodologies to calculate dose coefficients associated with KOH radionuclides
    - ICRPs 72, 119, 144 and 151 along with FGR-12 and FGR-15 would be used to determine dose coefficients for radionuclides of Chlorine, Potassium and Argon only
    - Dose coefficients used in the evaluation of compliance with requirements of 10 CFR Part 20, 10 CFR 50 Appendix I
- Proposed amendment would not apply to the determination of dose coefficients for any other radionuclides
- Proposed amendment would not limit SQN to using KOH as the only method for RCS pH control

Basis for Proposed Amendment

- 10 CFR Part 20 and 10 CFR Part 50 Appendix I are based on ICRP 2 and ICRP 30 which do not account for KOH as an RCS pH control agent.
- NRC has recognized that current regulations and guidance documents are static in relation to developments in standards such as ICRPs and others.
    - ICRPs 72, 119, 144, and 151 are industry standards.
    - FGR-12 and FGR-15 were developed jointly by the Environmental Protection Agency (EPA) and Oak Ridge National Laboratory (ORNL) for use in implementing radiation protection programs.

NRC Question Responses

- **NRC asked if TVA determined if any of the new KOH radionuclides would be considered principal radionuclides**
  - Principal radionuclides are those that contribute greater than 1 percent of 10 CFR Part 50, Appendix I design objective dose when all radionuclides in the type of effluent are considered as outlined in RG 1.21
  - EPRI performed an activation analysis to evaluate KOH nuclide concentrations in the reactor coolant and potential effects on dose
    - Only six KOH radionuclides have half-lives greater than 24 hours
    - Cumulative increase in activity of these longer-lived radionuclides projected to represent less than 0.1% of the total activity in typical reactor coolant and subsequent effluents

NRC Question Responses

- **The NRC staff noted that the doses discussed during the meeting were to the public and asked TVA if there would be an occupational dose concern.**
  - Occupational exposure trends at VVERs indicate that use of KOH for pH control is unlikely to be a major contributor to personnel exposure for PWRs
  - For SQN, the addition of potassium in the primary coolant anticipated to increase letdown resin gamma dose rates
    - Sodium impurities likely to lead to an initial transient increase in resin gamma dose rates in the first few days until it is removed
    - Linear decrease in resin gamma dose rate expected over the course of the cycle concurrent with potassium removal from the coolant
  - Potential for increase in gaseous waste generation due to accumulation and release of argon nuclides

NRC Question Responses

- **The NRC staff inquired about potassium-40 (K-40) and how TVA would distinguish between dose from naturally occurring K-40 and K-40 from an airborne event at the plant. The NRC staff also asked how TVA plans to distinguish between the K-40 from the plant and naturally occurring K-40 in its environmental monitoring program.**
    - SQN has added historical K-40 data to the plant chemistry database that has been captured as part of the radioactive effluents monitoring program
    - Newly collected data with results above two standard deviations in three consecutive samples would indicate a potential airborne event at the plant

NRC Question Responses

- **The NRC staff asked TVA how it plans to assess the food chain in RG 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," since it does not consider K-40 in the transference to milk.**
    - SQN radioactive effluents monitoring program sampling does not include milking animals
    - Food chain is assessed using guidance in NUREG-1301 where vegetation is sampled in lieu of milk
    - SQN effluents sampling plan includes analysis for K-40

NRC Question Responses

- **The NRC staff inquired if any changes would be needed to the plant's pollution discharge elimination system permit.**
  - SQN National Pollutant Discharge Elimination System (NPDES) Permit is TN0026450
  - Application of KOH in the RCS is not considered a Biocide/Corrosion Treatment (B/CTP) chemical. Therefore, it would not change the SQN compliance with NPDES permit Part IV.B.
  - KOH is not listed in 40 CFR Part 122, Appendix D and the notification levels of NPDES permit Part III.A.1 are not applicable.
  - NPDES permit application treatment code 2K authorizes the treatment method provided permit limitations and water quality standards are not exceeded

Summary

- Recognized supply chain concerns for continued availability of Enriched LiOH
- SQN is working with EPRI to evaluate the use of KOH as an alternative to Enriched LiOH for reactor coolant pH control
- Use of KOH would introduce radionuclides not considered in the current licensing basis for SQN
- Existing regulations do not support use of newer ICRP and FGR methodologies needed for calculation of KOH radionuclide dose coefficients for inclusion in the ODCM for SQN
- Proposed license amendment to TS 5.5.3 would allow the identified ICRP and FGR methodologies to calculate KOH radionuclide dose coefficients and evaluate compliance with 10 CFR Part 20 and 10 CFR Part 50, Appendix I

Schedule for Submittal

- TVA plans to submit the license amendment request to the NRC no later than September 30, 2025.

- TVA requests NRC approval by September 30, 2026
  - Allows for timely revision and approvals of the SQN ODCM
  - Supports scheduled fall 2026 refueling outage


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