Sequoyah Nuclear Plant

Pre-submittal Meeting for 10 CFR Part 20, 10 CFR Part 50 Appendix I, and 40 CFR Part 190 Exemption Request

Regarding application of Potassium Hydroxide (KOH)
to control Reactor Coolant System pH

April 7, 2025

TVA TENNESSEE VALLEY AUTHORITY

Agenda

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Introduction

- U.S. Government Accountability Office raised questions in 2013 regarding supply of Enriched LiOH for nuclear power reactors; supply chain concern exists to this day.
    - Enriched LiOH is currently sourced only from Russia and China
    - Enriched LiOH is normally used in PWRs to control pH in RCS
- Utilities reached out to Electric Power Research Institute (EPRI) to identify other chemicals suitable for this application.
- EPRI reported that KOH has been used for decades in Eastern European Russian style reactors, VVERs, similar to PWRs in design.
- EPRI created a KOH Advisory group and identified the plants that would meet target criteria for KOH application.

Introduction

- Sequoyah (SQN) best met the target criteria for KOH application.
- 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.
    - Identified the need to revise the SQN offsite dose calculation manual (ODCM) to account for radionuclides associated with KOH.
    - Regulatory guidance including Regulatory Guide 1.109 and NUREG-0172 are based on standards for dose calculations developed before application of KOH was a consideration for pH control.
    - As a result, the method for determining dose conversion factors associated with KOH radionuclides of Chlorine, Potassium, and Argon are not part of the current license basis for SQN.
    - Methods for determining needed dose conversion factors are available in International Commission on Radiological Protection (ICRP) and Federal Guidance Report (FGR) standards

Purpose

- The purpose of this meeting is to discuss the need for a permanent exemption to the operating licenses for SQN Units 1 and 2 from the following regulations, as they relate to the application of KOH.
    - 10 CFR Part 20
    - 10 CFR Part 50 Appendix I
    - 40 CFR 190
- Exemption needed to 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 20.2301 Applications for exemptions – Exemptions may be granted if the Commission determines the exemption is authorized by law and would not result in undue hazard to life or property.

Regulations Applicable to SQN ODCM

- 10 CFR Part 50 Domestic Licensing of Production and Utilization Facilities
  - 10 CFR Part 50.36a, Technical specifications on effluents from nuclear power reactors
  - 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
  - 10 CFR Part 50.12 Specific exemptions
    - 50.12(a)(1) Exemptions may be granted if the Commission determines the exemption is authorized by law and would not result in undue hazard to life or property
    - 50.12(a)(2)(vi) Special circumstances present not considered when the regulation was adopted for which it would be in public interest to grant an exemption

Regulations Applicable to SQN ODCM

- 40 CFR Part 190 Environmental Radiation Protection Standards for Nuclear Power Operations
  - 40 CFR 190.10 Standards for Normal Operations
    - Annual dose equivalent limits to any member of the public
    - Limits on radioactive materials entering the general environment from the entire uranium fuel cycle

SQN Technical Specification

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 exemption would not change any of the existing SQN TS requirements.
- Proposed exemption would allow SQN to evaluate continued compliance with TS 5.5.1 and TS 5.5.3 with the implementation of KOH for pH control.

SQN Technical Specification

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.

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

History of Rulemaking

- SECY-01-0148 Process for revision of 10 CFR Part 20 regarding adoption of ICRP recommendations on occupational dose limits and dosimetric models and parameters.
    - Some licensees have requested exemption from sections of 10 CFR Part 20 that allows them to use updated ICRP internal dosimetry models.
    - Exemption requests have been granted on case-by-case basis.
- SECY-12-0064 Recommended Staff development of draft 10 CFR Part 20 regulatory basis to align with ICRP 103.
    - Significant NRC effort put forth including Advance Notice of Public Rulemaking (ANPR) and solicitation of public and stakeholder input.
- SECY-16-0009 Enclosure 1 subsequently concluded that current regulatory framework provided adequate protection and recommended rulemaking be discontinued.

Proposed Exemption

- Proposed exemption would be an allowance to use the following ICRP and FGR methodologies to calculate dose coefficients associated with identified KOH radionuclides for the purpose of evaluating compliance with the requirements of 10 CFR Part 20, 10 CFR 50 Appendix I and 40 CFR 190.
    - ICRPs 72, 119, 144 and 151 along with FGR-12 and FGR-15 to determine dose coefficients for radionuclides of Chlorine, Potassium and Argon only.
    - Proposed exemption would not apply to the determination of dose coefficients for any other radionuclides.
- This would be a permanent exemption for SQN Units 1 and 2.

Basis for Proposed Exemption

- 10 CFR Part 50 Appendix I, 40 CFR 190 and 10 CFR Part 20 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.

Precedents

- SECY-99-077 Exemption to OSRAM from all sections of 10 CFR Part 20.
    - Approved exemption from all sections of 10 CFR Part 20 that referred to quantities in Appendix B and instead use quantities calculated using ICRP 68.
    - Commission approval of the Staff granting of exemptions on a case-by-case basis.

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 methodologies needed for calculation of KOH radionuclide dose coefficients for inclusion in the ODCM for SQN.
- Proposed exemption would be an allowance to use the identified FGR and ICRP methodologies to calculate KOH radionuclide dose coefficients.

Schedule for Submittal

- TVA plans to submit the exemption request to the NRC within the next 60 days.

- TVA requests NRC approval by August 31, 2025
  - Allows for timely revision and approvals of the SQN ODCM
  - Supports fall 2025 refueling outage for SQN Unit 1


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