



Post Office Box 2000, Soddy Daisy, Tennessee 37384-2000

April 26, 2024

10 CFR 50.4  
10 CFR 50.46

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

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

Subject: **10 CFR 50.46 Annual Report for Sequoyah Nuclear Plant Units 1 and 2**

Reference:

Letter from TVA to NRC, "10 CFR 50.46 Annual Report for Sequoyah Nuclear Plant Units 1 and 2, and 30-Day for Sequoyah Nuclear Plant, Unit 2," dated April 20, 2023

In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," paragraph (a)(3)(ii), this letter provides the annual report of changes and errors in the emergency core cooling systems (ECCS) evaluation model for Sequoyah Nuclear Plant (SQN) Units 1 and 2. The enclosed report provides a summary of the changes, as a result of errors and improvements, to the calculated peak cladding temperature (PCT) for the limiting ECCS analyses applicable to each unit. There have been no changes to the calculated PCTs since the submittal of the referenced letter.


As the Sequoyah units are currently operating with transition cores containing coresident Westinghouse Robust Fuel Assembly-2 (RFA-2) assemblies and Framatome High Thermal Performance (HTP) assemblies, a PCT is reported for each fuel type. The accumulated PCT changes for RFA-2 fuel have not yet exceeded the 50 degree Fahrenheit (°F) threshold for a significant change or error as identified in 10 CFR 50.46(a)(3)(i). The accumulated PCT changes for the Framatome HTP fuel have exceeded the 50°F threshold for a significant change or error as defined in 10 CFR 50.46(a)(3)(i). 10 CFR 50.46(a)(3)(ii) requires the licensee to provide a proposed schedule for providing a reanalysis or taking other action as may be needed to show compliance with the 10 CFR 50.46 requirements. The Enclosure demonstrates that the HTP fuel's updated net licensing basis PCT for the large break loss of coolant accident (LOCA) is below the 10 CFR 50.46(b)(1) PCT limit of 2200°F. Additionally, the HTP fuel's LOCA

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analysis will be retired from the SQN licensing basis upon completion of the transition to RFA-2 fuel. Therefore, TVA has concluded that no proposed schedule for reanalysis or other action is required to show compliance with 10 CFR 50.46 requirements

There are no new regulatory commitments associated with this submittal. If you have any questions regarding this information, please contact Ricardo Medina, SQN Site Licensing Manager, at (423) 843-8129 or rmedina4@tva.gov.

Respectfully,

Marshall, Thomas B.  Digitally signed by Marshall,  
Thomas B.  
Date: 2024.04.25 13:35:49 -04'00'

Thomas B. Marshall  
Site Vice President  
Sequoyah Nuclear Plant

Enclosure: 10 CFR 50.46 Annual Report of Changes in PCT

cc:

NRC Regional Administrator - Region II  
NRC Senior Resident Inspector - Sequoyah Nuclear Plant  
NRC Project Manager - Sequoyah Nuclear Plant

## ENCLOSURE

### TENNESSEE VALLEY AUTHORITY SEQUOYAH NUCLEAR PLANT (SQN) UNITS 1 and 2

#### 10 CFR 50.46 ANNUAL REPORT OF CHANGES IN PCT

In accordance with the reporting requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) 50.46(a)(3)(ii), Tennessee Valley Authority (TVA) is providing the following summary of the limiting design basis loss of coolant (LOCA) analysis results established using the Emergency Core Cooling System (ECCS) evaluation models for Sequoyah Nuclear Plant (SQN) Units 1 and 2. This report describes the changes and errors affecting the calculated peak cladding temperatures (PCTs) since the last analysis of record was submitted to the Nuclear Regulatory Commission (NRC).

TVA submitted the last 10 CFR 50.46 annual report in Reference 1 of this Enclosure. The SQN Units are transitioning from Framatome High Thermal Performance (HTP) fuel to Westinghouse Robust Fuel Assembly -2 (RFA-2) fuel assemblies. Until full cores of RFA-2 fuel are loaded, each vendor calculates a PCT for its respective fuel type using its own LOCA analysis methodologies, resulting in two distinct PCTs. The LOCA Analysis of Record (AOR) for RFA-2 fuel at SQN uses the Full-Spectrum Loss of Coolant Accident (FSLOCA) evaluation model (EM). The application for use of the FSLOCA EM for SQN was approved by NRC as documented in Reference 2 of this Enclosure.

The baseline PCTs for RFA-2 fuel in the SQN Units result from the implementation of this FSLOCA analysis. Table 1 lists the subsequent changes in the large break LOCA (LBLOCA) PCT for the RFA-2 fuel since the baseline analysis, for both offsite power available (OPA) and Loss of Offsite Power (LOOP) scenarios. Table 2 lists the changes in the small break LOCA (SBLOCA) PCT for the RFA-2 fuel since the baseline analysis. PCT impacts incurred since the adoption of the baseline AOR are described in the notes to the tables.

The LOCA AORs for the HTP fuel at SQN are detailed in Topical Reports ANP-2970(P) and ANP-2970Q1(P), "Sequoyah Units 1 and 2 HTP Fuel Realistic Large Break LOCA Analysis," and ANP-2971(P), "Sequoyah Units 1 and 2 HTP Fuel S-RELAP5 Small Break LOCA Analysis." These reports were submitted to the Nuclear Regulatory Commission (NRC) as part of SQN Technical Specifications (TS) Change TS-SQN-2011-07 to modify the TS to authorize the use of AREVA HTP fuel assemblies which was approved by the NRC as documented in Reference 3 of this Enclosure.

Table 3 details the changes in the LBLOCA and SBLOCA AOR PCTs for the HTP fuel since the baseline analysis. There have been no new PCT impacts incurred against this analysis since the last submitted Summary of Changes (Reference 1 of this Enclosure).

The PCTs for both the RFA-2 fuel and the HTP fuel remain unchanged since the last report, as summarized below:

- The calculated PCT in the LBLOCA analysis for RFA-2 fuel remains unchanged, with a current licensing basis PCT of 1878°F.
- The calculated PCT in the SBLOCA analysis for RFA-2 fuel remains unchanged, with a current licensing basis PCT of 1213°F.
- The calculated PCT in the LBLOCA analysis for HTP fuel remains unchanged, with a current licensing basis PCT of 2024°F.
- The calculated PCT in the SBLOCA analysis for HTP fuel remains unchanged, with a current licensing basis PCT of 1543°F.

**TABLE 1**

Summary of Changes in SQN Units 1 and 2 LBLOCA PCT for RFA-2 Fuel

| Year        | Description   | OPA               |                     | LOOP              |                     | Note |
|-------------|---|-------------------|---------------------|-------------------|---------------------|------|
|             |   | $\Delta$ PCT (°F) | $ \Delta$ PCT  (°F) | $\Delta$ PCT (°F) | $ \Delta$ PCT  (°F) |      |
| <b>2020</b> | <b>FSLOCA AOR Baseline</b>  | <b>1,878</b>      | <b>---</b>          | <b>1,878</b>      | <b>---</b>          |      |
| 2020        | General Code Maintenance  | 0                 | 0                   | 0                 | 0                   |      |
| 2021        | General Code Maintenance  | 0                 | 0                   | 0                 | 0                   |      |
| 2022        | Hoop Stress Error   | 0                 | 0                   | 0                 | 0                   |      |
| 2022        | GEDM Energy Non-Conservation  | 0                 | 0                   | 0                 | 0                   |      |
| 2022        | General Code Maintenance  | 0                 | 0                   | 0                 | 0                   |      |
| 2023        | Purge Valve Modeling Error  | 0                 | 0                   | 0                 | 0                   | 1    |
| 2023        | Thimble Components Flow Error   | 0                 | 0                   | 0                 | 0                   | 2    |
| 2023        | General Code Maintenance  | 0                 | 0                   | 0                 | 0                   | 3    |
| 2023        | Vapor/Continuous Liquid Interfacial Drag Coefficient                    | 0                 | 0                   | 0                 | 0                   | 4    |
| ---         | <b>Updated (net) licensing basis PCT</b><br>AOR PCT + $\sum \Delta$ PCT | <b>1,878</b>      | <b>---</b>          | <b>1,878</b>      | <b>---</b>          |      |
| ---         | <b>Cumulative sum of PCT changes</b><br>$\sum  \Delta$ PCT              | <b>---</b>        | <b>0</b>            | <b>---</b>        | <b>0</b>            |      |

**TABLE 2**

Summary of Changes in SQN Units 1 and 2 SBLOCA PCT for RFA-2 Fuel

| <b>Year</b> | <b>Description</b>  | <b><math>\Delta</math>PCT<br/>(°F)</b> | <b><math> \Delta</math>PCT <br/>(°F)</b> | <b>Note</b> |
|-------------|---|--|--|-------------|
| <b>2020</b> | <b>FSLOCA AOR Baseline</b>  | <b>1,213</b>                           | <b>---</b>                               |             |
| 2020        | General Code Maintenance  | 0                                      | 0  |             |
| 2021        | General Code Maintenance  | 0                                      | 0  |             |
| 2022        | Hoop Stress Error   | 0                                      | 0  |             |
| 2022        | GEDM Energy Non-Conservation  | 0                                      | 0  |             |
| 2022        | General Code Maintenance  | 0                                      | 0  |             |
| 2023        | Thimble Components Flow Error   | 0                                      | 0  | 2           |
| 2023        | General Code Maintenance  | 0                                      | 0  | 3           |
| 2023        | Vapor/Continuous Liquid Interfacial Drag Coefficient                    | 0                                      | 0  | 4           |
| ---         | <b>Updated (net) licensing basis PCT</b><br>AOR PCT + $\sum \Delta$ PCT | <b>1,213</b>                           | <b>---</b>                               |             |
| ---         | <b>Cumulative sum of PCT changes</b><br>$\sum  \Delta$ PCT              | <b>---</b>                             | <b>0</b>                                 |             |

**TABLE 3**

Summary of Changes in SQN Units 1 and 2 LBLOCA and SBLOCA PCT for HTP Fuel

| Year                           | Description  | LBLOCA<br>$\Delta$ PCT (°F) | LBLOCA<br>  $\Delta$ PCT  (°F) | SBLOCA<br>$\Delta$ PCT (°F) | SBLOCA<br>  $\Delta$ PCT  (°F) | Note |
|--------------------------------|--|-----------------------------|--------------------------------|-----------------------------|--------------------------------|------|
| 2013                           | <b>AOR PCT associated with AREVA HTP fuel</b>  | 1,950                       | ---                            | 1,470                       | ---                            |      |
| 2012                           | Sleicher–Rouse heat transfer correlation equation error  | Included in AOR PCT         | 0                              | -89                         | 89                             |      |
| 2013                           | Cathcart-Pawel Uncertainty Correlation in RLBLOCA  | 0                           | 0                              | ---                         | ---                            |      |
| 2013                           | RODEX3a error in treatment of “trapped stack” condition  | -10                         | 10                             | ---                         | ---                            |      |
| 2014                           | S-RELAP5 vapor absorptivity correlation  | 0                           | 0                              | +11                         | 11                             |      |
| 2014                           | Axial power shape mapping by modal decomposition   | 0                           | 0                              | ---                         | ---                            |      |
| 2015                           | Operator action time allowance for restarting the high head ECCS pumps when transferring the pump suctions from the RWST to the containment sump | ---                         | ---                            | +151                        | 151                            |      |
| 2017                           | M5 <sup>®</sup> LOCA Swelling and Rupture Model (SRM) Update   | 0                           | 0                              | 0                           | 0                              |      |
| 2017                           | Higher metal water reaction rate   | 61                          | 61                             | 0                           | 0                              |      |
| 2019                           | Cathcart-Pawel correlation implementation  | 0                           | 0                              | ---                         | ---                            |      |
| 2022 (Unit 1)<br>2023 (Unit 2) | RFA-2 Fuel Transition Core Effects   | +23                         | 23                             | 0                           | 0                              |      |
| ---                            | <b>Updated (net) licensing basis PCT</b><br>AOR PCT + $\sum \Delta$ PCT  | <b>2,024</b>                | ---                            | <b>1,543</b>                | ---                            |      |
| ---                            | <b>Cumulative sum of PCT changes:</b><br>$\sum \Delta$ PCT and $\sum  \Delta$ PCT  | <b>+74</b>                  | <b>94</b>                      | <b>+73</b>                  | <b>251</b>                     |      |

Notes for Tables 1, 2, and 3:

- 1) A discrepancy was identified in the LOTIC2 containment pressure calculation for the SQN Units 1 and 2 Region II (large break) analysis with the FSLOCA evaluation model. Two purge lines can be open during power operation (one purge supply line and one purge exhaust line), which is inconsistent with the LOTIC2 containment pressure calculation that modeled one purge line as part of the analysis. The additional open purge line results in a lower LOTIC2 calculated containment pressure. The error was evaluated to have a negligible impact on the calculated results, leading to an estimated peak cladding temperature impact of 0°F.
- 2) The number of assemblies modeled in the LOCA analysis was inconsistent with the number of assemblies represented by one or more thimble components, leading to an incorrect flow area and volume for the affected thimble components. The error was evaluated to have a negligible impact on the calculated results, leading to an estimated PCT impact of 0°F.
- 3) Various changes have been made to enhance the usability of codes and to streamline future analyses. Examples of these changes include improving the input diagnostic checks; enhancing the code output; optimizing active coding; and eliminating inactive coding. The nature of these changes leads to an estimated peak cladding temperature impact of 0°F.
- 4) Two deficiencies were identified in the calculation of the churn-turbulent vapor / continuous liquid interfacial drag coefficient calculation within WCOBRA/TRAC-TF2 due to the potential calculation of a negative critical liquid fraction. The negative critical liquid fraction results in an over-prediction of the vapor / continuous liquid interfacial area and a negative vapor / continuous liquid interfacial drag coefficient which leads to a significantly large interfacial drag coefficient (i.e., no slip). The closely-related group of deficiencies was qualitatively evaluated, and the nature of the deficiencies leads to an estimated peak cladding temperature impact of 0°F.



## REFERENCES

1. Letter from TVA to NRC, "10 CFR 50.46 Annual Report for Sequoyah Nuclear Plant Units 1 and 2, and 30-Day for Sequoyah Nuclear Plant, Unit 2," dated April 20, 2023
2. Letter from NRC to TVA, "Sequoyah Nuclear Plant, Units 1 and 2 - Issuance of Amendment Nos. 356 and 349 Regarding the Transition to Westinghouse Robust Fuel Assembly-2 (RFA-2) Fuel (EPID L-2020-LLA-0216)," dated October 26, 2021
3. Letter from NRC to TVA, "Sequoyah Nuclear Plant, Units 1 and 2 - Issuance of Amendments to Revise the Technical Specification to Allow Use of AREVA Advanced W17 High Thermal Performance Fuel (TS-SQN-2011-07) (TAC Nos. ME6538 and ME6539)," dated September 26, 2012