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

CNL-20-009

June 12, 2020

10 CFR 50.90

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

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

Subject: **Sequoyah Nuclear Plant Unit 1 and Unit 2 – License Amendment Request to Revise Technical Specification 4.2.2, "Control Rod Assemblies" (SQN-TS-20-04)**

References:

1. NRC Letter to TVA, "Sequoyah Nuclear Plant, Unit 1 - Issuance of Exigent Amendment No. 348 to Operate One Cycle With One Control Rod Removed (EPID L-2019-LLA-0239)," dated November 21, 2019 (ML19319C831)

2. NRC Letter to TVA, "Sequoyah Nuclear Plant, Unit 2 - Issuance of Exigent Amendment No. 342 to Operate One Cycle with One Control Rod Removed (EPID L 2020 LLA 0078)," dated April 23, 2020 (ML20108F049)

In accordance with the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR) 50.90, "Application for amendment of license, construction permit, or early site permit," Tennessee Valley Authority (TVA) requests license amendments to Sequoyah Nuclear Plant (SQN), Units 1 and 2 RFOL Nos. DPR-77 and DPR-79, respectively, for Nuclear Regulatory Commission (NRC) approval. The proposed amendments would revise each unit's Technical Specification (TS) 4.2.2, "Control Rod Assemblies," to permit the SQN Unit 1 Cycle 25 (U1C25) and SQN Unit 2 Cycle 25 (U2C25) cores to contain 52 full length control rods with no full length control rod assembly in core location H-08 for one additional cycle. Currently, each unit's TS 4.2.2 requires the core to contain 53 full-length control rod assemblies except for the Cycle 24 core, which shall contain 52 full-length control rod assemblies with no full-length control rod assembly in core location H-08 (H-08 control rod).

By Reference 1, the NRC approved an exigent license amendment request for the SQN Unit 1 Cycle 24 (U1C24) core to contain 52 full-length control rod assemblies with no full-length control rod assembly in core location H-08. This exigent Amendment was needed due to the inability of the control rod drive mechanism stationary gripper latch mechanism to maintain the control rod in position.

By Reference 2, the NRC approved a similar exigent change for the SQN Unit 2, Cycle 24 (U2C24) core to contain 52 full-length control rod assemblies with no full-length control rod assembly in core location H-08. This was necessitated by inspections of SQN Unit 2 gripper latch mechanisms that drove TVA to remove the H-08 control rod during the most recent refueling outage.

Because this rod cluster control assemby configuration is technically justified and can be safely accommodated in the reload analyses, TVA has elected to permanently adopt the 52 control rod configuration for both SQN units. However, as discussed in the February 20, 2020 public meeting with the NRC (ML20050C866), this license amendment request proposes to extend the 52 control rod configuration through Cycle 25 for SQN Unit 1. This extension request will also apply to SQN Unit 2. The technical evaluation supporting permanent removal is planned for a future fuel transition license amendment request in support of Cycle 26 for SQN Units 1 and 2.

The Enclosure to this letter provides a technical and regulatory evaluation of the proposed amendment. Attachments 1 and 3 provide a marked-up version of the affected pages of SQN Unit 1 and SQN Unit 2 TS 4.2.2, respectively, showing the proposed changes. Attachments 2 and 4 provide the SQN Units 1 and 2 clean version of the TS pages.

Submittal of this LAR was delayed by the emergent need to include SQN Unit 2 within its scope. Accordingly, approval of this LAR is requested on an expedited basis by April 10, 2021, prior to the start of the next Unit 1 refueling outage (U1R24), currently scheduled to begin in April 2021. Once approved, the amendment shall be implemented prior to entering Mode 5 from Mode 6 during startup from each unit’s Cycle 24 refueling outage (U1R24 and U2R24). TVA is only requesting NRC approval of the proposed change to TS 4.2.2; as all other design changes and supporting safety analyses discussed in this document were performed in accordance with the station design change process, core reload design process, and the current licensing basis.

TVA determined that there are no significant hazards consideration associated with the proposed change and that the TS change qualifies for a categorical exclusion from environmental review pursuant to the provisions of 10 CFR 51.22(c)(9). Additionally, in accordance with 10 CFR 50.91(b)(1), TVA is sending a copy of this letter and enclosure to the Tennessee State Department of Environment and Conservation.

There are no new regulatory commitments associated with this submittal. Please address any questions regarding this request to Gordon R. Williams, Senior Manager, Fleet Licensing (Acting), at (423) 751-2687.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 12th day of June 2020.

Respectfully,

James Barstow
Vice President, Nuclear Regulatory Affairs & Support Services

Enclosure:

Evaluation of the Proposed Change

cc (Enclosure):

NRC Regional Administrator - Region II
NRC Senior Resident Inspector - Sequoyah Nuclear Plant
NRC Project Manager – Sequoyah Nuclear Plant
Director, Division of Radiological Health - Tennessee State Department of Environment and Conservation

**TENNESSEE VALLEY AUTHORITY**
**SEQUOYAH NUCLEAR PLANT, UNIT 1 AND UNIT 2**

**EVALUATION OF THE PROPOSED CHANGE**

Subject: **Sequoyah Nuclear Plant Unit 1 and Unit 2 - License Amendment Request to Revise Technical Specification 4.2.2, "Control Rod Assemblies" (SQN-TS-20-04)**

**Contents**



ATTACHMENTS
1. Proposed TS Changes (Mark-Ups) for SQN Unit 1
2. Proposed TS Changes (Final Typed) for SQN Unit 1
3. Proposed TS Changes (Mark-Ups) for SQN Unit 2
4. Proposed TS Changes (Final Typed) for SQN Unit 2

## 1.0 SUMMARY DESCRIPTION

This evaluation supports a request to amend Renewed Facility Operating Licenses DPR-77 and DPR-79 for Sequoyah Nuclear Plant (SQN), Units 1 and 2, by revising the note for each unit's SQN Technical Specification (TS) 4.2.2, "Control Rod Assemblies," to permit the SQN Unit 1 and SQN Unit 2 Cycle 25 (U1C25 and U2C25, respectively) cores to contain 52 full length control rods with no full length control rod in core location H-08 (H-08 control rod). Currently, TS 4.2.2 requires the core to contain 53 full-length control rod assemblies except for the U1C24 and U2C24 cores, which shall contain 52 full-length control rod assemblies with no full-length control rod assembly in core location H-08. A SQN operating cycle is nominally 18 months.

## 2.0 DETAILED DESCRIPTION

### 2.1 PROPOSED TECHNICAL SPECIFICATION CHANGE

The proposed license amendment request would revise the notes in SQN Unit 1 and SQN Unit 2 TS 4.2.2 which permitted operation with 52 full length control rods during Cycle 24 in lieu of the requirement for 53 full length control rods, to extend through Cycle 25. TVA has reviewed the SQN Units 1 and 2 TS and has determined that no additional TS changes are required.

The proposed revision to the TS 4.2.2 note is as follows:

> Operation with 52 full length control rod assemblies (with no control rod assembly installed in core location H-08) is permitted during Cycle**s** 24 **and 25**.

The design changes and supporting safety analyses discussed in this document are performed in accordance with the current licensing basis. TVA is requesting NRC approval only for the proposed change to TS 4.2.2.

Attachments 1 and 3 provide a marked-up version of the affected pages of SQN Unit 1 and SQN Unit 2 TS 4.2.2, respectively, showing the proposed changes. Attachments 2 and 4 provide the SQN Units 1 and 2 clean version of the TS pages.

Note that for the purposes of this submittal, the terms "control rod" and "rod cluster control assemblies" (RCCAs) are used synonymously.

### 2.2 H-08 CONTROL ROD ISSUE

The details surrounding the inoperability of the SQN Unit 1 H-08 control rod were described in the November 16, 2019, exigent License Amendment Request (Reference 1). TVA determined that the safest option was to operate SQN Unit 1 during U1C24 with the H-08 control rod removed. Despite U1C24 being designed for 53 control rods, the removal of the H-08 control rod was accommodated in the reload safety analyses. Because in-situ replacement of the affected control rod drive mechanism (CRDM) would be a first-of-a-kind activity in the United States requiring special tooling that is unavailable at this time, TVA elected to remove the H-08 control rod and operate SQN Unit 1 with 52 full length control rods for U1C24. This exigent request was approved by the Nuclear Regulatory Commission (NRC) in Reference 2.

The details surrounding the decision to remove the SQN Unit 2 H-08 control rod were described in the April 17, 2020 exigent License Amendment Request (Reference 3). In summary, extent of condition inspections of the CRDM gripper latch associated with the SQN Unit 2 H-08 control rod during U2R23 suggested that, similar to SQN Unit 1, the SQN Unit 2 H-08 control rod was unlikely to reliably maintain its fully withdrawn or nearly fully withdrawn position. As performed for SQN Unit 1, TVA elected to preemptively remove the SQN Unit 2 H-08 control rod. This exigent request was approved by the NRC in Reference 4.

Because this control rod configuration can be safely accommodated in the reload analyses, TVA has elected to permanently adopt this for both SQN units. However, as discussed in the February 20, 2020, public meeting with the NRC (ML20050C866), this license amendment request proposes to extend the 52 control rod configuration through Cycle 25 for SQN Unit 1. This extension request will also apply to SQN Unit 2. The technical evaluation supporting permanent removal is planned for a future fuel transition license amendment request in support of Cycle 26 for SQN Units 1 and 2.

## 3.0 TECHNICAL EVALUATION

### 3.1 SYSTEM DESCRIPTION

SQN Unit 1 and SQN Unit 2 each normally contain 53 full length control rod assemblies divided into four control banks (Control Banks A, B, C, D) and four shutdown banks (Shutdown Banks A, B, C, D). Of the eight banks, Control Bank D is used for reactivity control during normal at-power operation. The remaining control banks are normally used for reactor startup and shutdown. The shutdown banks provide additional negative reactivity to meet shutdown margin (SDM) requirements. During MODES 1 and 2, the shutdown banks are fully withdrawn from the core in accordance with TS 3.1.5 and as specified in the Core Operating Limits Report (COLR).

The H-08 control rod is part of Control Bank D and is located in the center of the core as shown in Figure 1. With the removal of the H-08 control rod, U1C24 and U2C24 cores contain 52 full length control rod assemblies as shown in the table to Figure 1. The H-08 control rod would remain removed for U1C25 and U2C25.

Each control rod is moved by a full length CRDM consisting of a stationary gripper, movable gripper, and a lift pole. Three coils are installed external to the CRDMs to electromechanically manipulate the CRDM components to produce rod motion. The CRDMs are magnetic jacking type mechanisms that move the control rods within the reactor core by sequencing power to the three coils of each mechanism to produce a stepping rod motion. Rod position is achieved through a timed sequence of stationary, movable, and lift coil current. At each point in time during rod positioning, the control rod is being held by either the stationary gripper or movable grippers. Should both sets of grippers be de-energized simultaneously, the corresponding control rod would drop into the core. The primary function of the CRDMs is to insert, withdraw, or hold control rods within the core to control average core temperature and to shut down the reactor. Mechanically, each control rod location includes a guide tube, which is an assembly that houses and guides the control rod through the upper internals.

## Figure 1 - Control Rod Locations

| | R | P | N | M | L | K | J | H | G | F | E | D | C | B | A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | | | | | |
| 2 | | | | SA | | CB | | CC | | CB | | | | | |
| 3 | | | | | SD | | SB | | SB | | SC | | | | |
| 4 | | | | CD | | | | CD | | | | CD | | SA | |
| 5 | | | SC | | SA | | | | | | SA | | SD | | |
| 6 | | CB | | | | CC | | CA | | CC | | | | CB | |
| 7 | | | SB | | | | | | | | | | SB | | |
| 8 (90°) | | CC | | CD | | CA | | CD | | CA | | CD | | CC | |
| 9 | | | SB | | | | | | | | | | SB | | |
| 10 | | CB | | | | CC | | CA | | CC | | | | CB | |
| 11 | | | SD | | SA | | | | | | SA | | SC | | |
| 12 | | SA | | CD | | | | CD | | | | CD | | | |
| 13 | | | | | SC | | SB | | SB | | SD | | | | |
| 14 | | | | | | CB | | CC | | CB | | SA | | | |
| 15 | | | | | | | | | | | | | | | |

0°

| Bank Identifier | Number of Locations | Bank Identifier | Number of Locations |
|---|---|---|---|
| SA | 8 | CA | 4 |
| SB | 8 | CB | 8 |
| SC | 4 | CC | 8 |
| SD | 4 | CD | 8 |

Note: The control rods in core location H-08 were removed for U1C24 and U2C24 and will remain removed for U1C25 and U2C25.

The full length Rod Control System receives rod speed and direction signals from the $T_{avg}$ control system (contained within the Distributed Control System). The automatic rod speed demand signal varies over the corresponding range of 5 to 45 inches per minute (8 to 72 steps/minute) depending on the magnitude of the error signal. The rod direction demand signal is determined by the positive or negative value of the error signal. Manual control is provided to move a control bank in or out at a prescribed fixed speed.

## 3.2 CURRENT LICENSING BASIS

Framatome performs the reload licensing analysis for SQN and applies NRC-approved codes and analytical methods to design the reload core. The NRC-approved codes and analytical methods used to generate the reload safety evaluation are included in TS 5.6.3, "Core Operating Limits Report," and are also listed in the cycle-specific COLR.

The reload safety analysis methods are not invalidated by the removal of the H-08 control rod from the core design because these methods are not dependent on a particular RCCA configuration. Reload safety analysis methods and supporting computer codes remain applicable to model and evaluate the as-designed/operated configuration of the plant, and the reload methodology is not dependent upon control bank configuration. Cycle-specific reload evaluations of TS limits, safety analysis limits, and operating limits without the H-08 control rod for U1C25 and U2C25 have not yet been completed and are typically not finalized until approximately 30 days prior to the start of the refueling outage; however, the reload analyses for U1C24 and SQN Unit 2 Cycle 24 (U2C24) support the removal of H-08:

- The U1C24 and U2C24 cores are similar in design to the expected design of the Cycle 25 cores (i.e., similar energy requirements, feed batch size and enrichment).

- The Cycle 25 analyses' results will not vary appreciably from the U1C24 and U2C24 results.

- The U1C24 and U2C24 cores demonstrate that a core designed assuming 53 control rods (i.e., assuming the H-08 control rod present) can still meet all required safety analysis acceptance criteria when the H-08 control rod is removed.

- Designing the Cycle 25 cores with the H-08 control rod removed assures the core designs will meet all acceptance criteria.

- The U1C24 and U2C24 margin assessments form a strong technical justification for the H-08 RCCA removal extension.

The reload core design methodology requires the performance of cycle-specific thermal-hydraulic and limiting transient analysis checks to ensure the core does not reduce the existing safety analysis margin. Therefore, satisfaction of the operating and safety analysis limits by the Cycle 25 cores is assured.

As described in Updated Final Safety Analysis Report (UFSAR) Section 4.2.3.2.1, "Reactivity Control Components":

*The rod cluster control assemblies are divided into two categories: control and shutdown. The control groups compensate for reactivity changes due to variation in operating conditions of the reactor, i.e., power and temperature variations.*

*Two criteria have been employed for selection of the control groups. First the total reactivity worth must be adequate to meet the nuclear requirements of the reactor. Second, in view of the fact that some of these rods may be partially inserted at power operation, the total power peaking factor should be low enough to ensure that the power capability is met. The control and shutdown groups provide adequate shutdown margin which is defined as the instantaneous amount of reactivity by which the reactor is subcritical or would be subcritical from its present condition assuming all full length rod cluster assemblies (shutdown and control) are fully inserted except for the single rod cluster assembly of highest reactivity worth which is assumed to be fully withdrawn.*

As described in UFSAR Section 4.3.2.5.2, "Rod Cluster Control Assemblies":

*The number of Rod Cluster Control Assemblies is shown in Table 4.3.2-1. The Rod Cluster Control Assemblies are used for shutdown and control purposes to offset fast reactivity changes associated with:*

1. *The required shutdown margin in the hot zero power, stuck rod condition,*
2. *The reactivity compensation as a result of an increase in power above hot zero power (power defect including Doppler, and moderator reactivity changes), ·*
3. *Unprogrammed fluctuations in boron concentration, coolant temperatures, or xenon concentration (with rods not exceeding the allowable rod insertion limits),*
4. *Reactivity ramp rates resulting from load changes.*

*The allowed full length control bank reactivity insertion is limited at full power to maintain shutdown capability. As the power level is reduced, control rod reactivity requirements are also reduced and more rod insertion is allowed. The control bank position is monitored and the operator is notified by an alarm if the limit is approached. The determination of the insertion limit uses conservative xenon distributions and axial power shapes. In addition, the Rod Cluster Control Assembly withdrawal pattern determined from these analyses is used in determining power distribution factors and in determining the maximum worth of an inserted Rod Cluster Control Assembly ejection accident. For further discussion, refer to the Technical Specifications on Rod Insertion Limits.*

*Power distribution, Rod Ejection and Rod Misalignment analyses are based on the arrangement of the shutdown and control groups of the Rod Cluster Control Assemblies shown in Figure 4.3.2-36. All shutdown Rod Cluster Control Assemblies are withdrawn before withdrawal of the control banks is initiated. In going from zero to 100 percent power, control banks [A], B, C and D are withdrawn sequentially. The limits of rod positions and further discussion on the basis for rod insertion limits are provided in the SQN Technical Specifications.*

### 3.3 IMPACT ON THE SAFETY ANALYSIS

The removal of the H-08 control rod from Control Bank D is considered to apply for the entirety of U1C25 and U2C25 operation and impacts the nuclear design and safety analysis characteristics for this reload core design. As such, the reload safety evaluation process, which is used for each new fuel cycle, will be followed to determine the nuclear design changes and impact to core and fuel performance, as well as impact to the accident analyses described in UFSAR Chapter 15 for the H-08 control rod removed. The nuclear design parameter changes associated with core operation with the H-08 control rod removed will be evaluated against a set of bounding values contained in the pertinent accident and transient analyses for the plant. The results of those evaluations are typically not completed until approximately 30 days prior to the refueling outage, so Cycle 25 results are unavailable at this time. However, the results of such evaluations both with and without the H-08 control rod removed are available for U1C24 and U2C24, as described in References 1 and 3. The Cycle 25 cores will be designed with consideration of the H-08 control rod removed. Therefore, the U1C24 and U2C24 reload evaluation margin assessments form the technical basis for the H-08 control rod extension LAR, and are discussed in this section.

For both Cycle 24 cores, NRC-approved reload safety analysis codes and methods were used to determine if the change in core design parameters adversely impacted the bounding key safety parameters assumed in the UFSAR Chapter 15 safety analysis. Additionally, impacts on margins to fuel thermal and power peaking limits related to departure from nucleate boiling (DNB) and centerline fuel melt (CFM) safety criteria due to the change in power distribution attributable to operation with the H-08 control rod removed were evaluated. The cycle-specific power distribution maneuvering analysis (MA) was also evaluated to determine the acceptability of the TS and COLR operating limits related to the loss of coolant accident (LOCA) and loss of forced reactor coolant flow accident initial condition criteria.

Evaluation of impacts to core and fuel performance, as well as the impact to the safety analyses described in UFSAR Chapter 15 and safety analysis parameters, is summarized in the cycle-specific reload safety evaluation documentation to confirm the acceptability of safe operation with the new core configuration. No changes in analytical methods or safety analysis limits are used to perform the core reload safety evaluations with the H-08 control rod removed. The analyses supporting the evaluation of these impacted parameters is performed using NRC-approved methodology described in TS 5.6.3.

Evaluation summaries for the following items were presented in References 1 and 3, for U1C24 and U2C24, respectively.

- Shutdown Margin (SDM)
- Boron concentration and boron worth
- Moderator Temperature Coefficient (MTC)
- UFSAR Chapter 15 Accident Analyses Impacts
    - Hot Zero Power (HZP) Steam Line Break (SLB) Accident
    - Steam Line Break Coincident with Bank Withdrawal at Power (SLB c/w RWAP)
    - Locked Rotor Accident (LRA)
    - Uncontrolled Bank Withdrawal (UCBW) from Subcritical
    - UCBW at Power

  - Rod Cluster Control Assembly Misoperation
    - Withdrawal of a Single RCCA
    - Statically Misaligned RCCA
    - One or more dropped RCCAs within the same group or a dropped RCCA bank
  - Rod Ejection Accident (REA)
- Miscellaneous Neutronics Parameters (delayed neutron data, Doppler temperature coefficients, fuel temperatures)
- Maneuvering Analyses (MA)

As discussed in Reference 5, due to the discovery of a damaged fuel assembly after the above analyses were performed, the U2C24 reload core design had to be modified from that documented in Reference 3. The core design changes were assessed using the SQN fuel vendor's redesign criteria to assess if differences in key parameters would have challenged safety analysis limits. The redesigned core acceptably met the redesign criteria, requiring only a few core and safety analysis parameters to be recalculated. Due to this conclusion from the reduced scope core redesign process, although some of the parameters presented in Reference 3 may change, it is expected there would only be minor changes to these parameters and there would still be margin to the acceptance criteria. Therefore, the U2C24 H-08 evaluations still form a technical basis for the operation without the H-08 control rod.

In conclusion, the reload safety evaluations for the U1C24 and U2C24 cores with the H-08 control rod removed validated all cycle-specific safety analysis limits, and determined the UFSAR Chapter 15 accident analyses remain bounding with respect to the safety analysis physics parameters, MA, Nuclear Design Report, and core thermal-hydraulic parameters with the H-08 control rod removed. These Cycle 24 cores are similar in design to the expected design of the Cycle 25 cores. The Cycle 25 analyses results will not vary appreciably from the Cycle 24 results. Therefore, the acceptable results seen from the evaluations of Cycle 24 indicate that the U1C25 and U2C25 cores can be safety designed without the H-08 control rod.

### 3.4 EVALUATION OF PHYSICAL IMPACTS

As described in References 1 and 3, TVA performed the following work activities in support of removing the H-08 control rods.

- Unlatched the control rod drive shaft from the RCCA and CRDM and completely removed the drive shaft from the reactor vessel
- Removed RCCA located in core location H-08
- Installed a flow restriction plate in the H-08 control rod guide tube (CRGT)
- Removed H-08 control rod inputs to the Rod Position Indication (RPI) system
- Modified plant computer position indication and alarm points for the H-08 control rod
- Removed visual indications of rod position and rod bottom light for the H-08 control rod on the Main Control Room M-4 panel
- Removed rod control system fuses for control power to the H-08 CRDM
- Reprogrammed the Integrated Computer System computer to account for the H-08 control rod being removed.

Modifications to the RPI system configuration ensured that H-08 does not impact any alarms or annunciators. Modifications to the RPI system and Rod Control system related to the removal of the H-08 control rod have no impact to the ability to manipulate the remaining control rods or the ability to trip the reactor via the reactor protection system (RPS).

These changes were reviewed and approved by SQN engineering using TVA procedures for design changes, and would remain in place for U1C25 and U2C25.

## 3.5 EVALUATION OF POTENTIAL DESIGN IMPACTS

Thermal-hydraulic impacts

When the H-08 control rod and driveshaft was removed from service, a flow restrictor was installed in the H-08 control rod guide tube in the reactor vessel upper internals. The flow restrictors were described in Section 3.5 of Reference 1 (with additional information provided in Reference 6) for U1C24 and Reference 3 for U2C24, and were accepted as discussed in Section 3.3.1 of References 2 and 4. The flow restrictor will remain installed as-is for U1C25 and U2C25.

Seismic and structural impacts

As previously described in References 1 and 3, and approved in References 2 and 4, there is no impact on the functionality or structural integrity of the reactor vessel upper internals with the removal of the control rod drive shaft and RCCA at core location H-08 as long as the flow restrictor remains installed in its place. The CRDM dynamic stress evaluation remains bounding with removal of the H-08 control rod.

Other Considerations

The changes in reactor coolant system water volume and metal mass are not appreciably impacted by removal of the H-08 RCCA and driveshaft, and installation of the flow restrictor.

## 3.6 ADEQUATE LEVEL OF SAFETY

The evaluations of the impact on the safety analyses have demonstrated that requirements for reactivity control provided by control rods continue to be met if the H-08 control rod is removed from the U1C24 and U2C24 cores, and therefore will continue to be met by the Cycle 25 core designs. The assumption that control rod insertion will provide sufficient negative reactivity to shut down the reactor remains valid.

There is a reduction in the available SDM as a result of removing the H-08 control rod. However, SDM will continue be maintained within the limits provided in the COLR and as required by TS 3.1.1. As shown in Section 3.3, Table 1 of References 1 and 3 for U1C24 and U2C24, respectively, the required SDM is maintained, and additional margin is still present. Compliance with the TS provides reasonable assurance that the proposed change does not endanger the health and safety of the public.

### 3.7 IMPACT ON OPERATOR ACTIONS

The safety evaluations performed for the U1C24 and U2C24 H-08 RCCA removal validated that the impacts to the nuclear design parameters were within the bounds of those already assumed in the UFSAR Chapter 15 accident analyses. No new or revised operator actions were required to meet the safety analyses' acceptance criteria. As a result, there are no changes required to the emergency operating procedures or the operator actions assumed for these accidents. This conclusion would remain valid for the Cycle 25 cores.

## 4.0 REGULATORY EVALUATION

### 4.1 APPLICABLE REGULATORY REQUIREMENTS/CRITERIA

TS 4.2.2, "Control Rod Assemblies," describes a Design Feature required per 10 CFR 50.36(c)(4). The proposed change does not eliminate the design feature requiring control rod assemblies. Rather, it allows for a revised number of control rod assemblies for an additional cycle. As outlined in the Technical Evaluation, all safety analysis limits were met, and both the U1C24 and U2C24 cores were evaluated with and without the H-08 control rod assembly per the methodologies set forth in TS 5.6.3, "Core Operating Limits Report (COLR)."

SQN Unit 1 and SQN Unit 2 TS 3.1.4, "Rod Group Alignment Limits," requires all shutdown and control rods to be operable. Because the control rod in location H-08 remains removed under the proposed change, this TS requirement is still not applicable to that control rod position. As such, no changes to TS 3.1.4 are required.

The requirements of 10 CFR 50.62(c) applicable to SQN Units 1 and 2 continue to be met. Removal of the H-08 control rod does not impact Anticipated Transient Without Scram (ATWS) Mitigation System Actuation Circuitry, and changes to parameters described in the license amendment request (LAR) do not impact the ATWS analysis. Therefore, the requirements of 10 CFR 50.62(c)(1) continue to be met. Subsection (c)(2) is not pertinent to Westinghouse reactors such as SQN Units 1 and 2, and subsections (c)(3) through (c)(5) are applicable only to boiling water reactors.

### 4.1.1 General Design Criteria

SQN was designed to meet the intent of the Proposed General Design Criteria (GDC) for Nuclear Power Plant Construction Permits published in July 1967. The SQN construction permit was issued in May 1970. The UFSAR, however, addresses the NRC GDCs published as Appendix A to 10 CFR 50 in July 1971. Conformance with the GDCs is described in Section 3.1.2 of the UFSAR.

Each criterion listed below is followed by a discussion of the design features and procedures that meet the intent of the criteria. Any exception to the 1971 GDCs resulting from the earlier commitments is identified in the discussion of the corresponding criterion.

<u>Criterion 10 - Reactor Design</u>

*The reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences.*

Compliance

The reactor core with its related coolant, control, and protection systems is designed to function throughout its design lifetime without exceeding acceptable fuel damage limits. The Reactor Trip System is designed to actuate a reactor trip, when necessary, for any anticipated combination of plant conditions, to ensure that fuel design limits are not exceeded. The core design, together with reliable process and decay heat removal systems, provides for this capability under all expected conditions of normal operation with appropriate margins for uncertainties and anticipated transient situations, including the effects of the loss of reactor coolant flow, trip of the turbine-generator, loss of normal feedwater, and loss of power.

Cycle 24 redesign reload analyses were performed in accordance with the methods described in TS 5.6.3 and confirmed that the fuel design limits are not exceeded during any condition of normal operation including the effects of anticipated operational occurrences with the H-08 control rod removed. This conclusion will remain valid for U1C25 and U2C25.

<u>Criterion 11 - Reactor Inherent Protection</u>

*The reactor core and associated coolant systems shall be designed so that in the power operating range the net effect of the prompt inherent nuclear feedback characteristics tends to compensate for a rapid increase in reactivity.*

Compliance

The fuel temperature coefficient is negative and the moderator temperature coefficient of reactivity is non-positive for power operating conditions, thereby providing negative reactivity feedback characteristics.

This criterion remains satisfied because removal of the H-08 control rod does not impact the ability to detect or control core power distribution, and the at-power nuclear reactivity feedback coefficients remain unchanged.

<u>Criterion 12 - Suppression of Reactor Power Oscillations</u>

*The reactor core and associated coolant, or, control and protection systems shall be designed to assure that power oscillations which can result in conditions exceeding specified acceptable fuel design limits are not possible or can be reliably and readily detected and suppressed.*

Compliance

Power oscillations of the fundamental mode are inherently eliminated by the negative Doppler and non-positive moderator temperature coefficient of reactivity.

Oscillations, due to xenon spatial effects, in the radial, diametral and azimuthal overtone modes are heavily damped due to the inherent design and due to the negative Doppler and nonpositive moderator temperature coefficients of reactivity.

Oscillations, due to xenon spatial effects, in the axial first overtone mode may occur. Assurance that fuel design limits are not exceeded by xenon axial oscillations is provided as a result of reactor trip functions using the measured axial power imbalance as an input.

Oscillations, due to xenon spatial effects, in axial modes higher than the first overtone, are heavily damped due to the inherent design and due to the negative Doppler coefficient of reactivity.

This criterion remains satisfied because, as per the COLR analysis, the removal of the H-08 control rod will not result in power oscillations, which would result in conditions exceeding specified acceptable fuel design limits.

<u>Criterion 23 - Protection System Failure Modes</u>

*The Protection System shall be designed to fail into a safe state or into a state demonstrated to be acceptable on some other defined basis if conditions such as disconnection of the system, loss of energy (e.g., electric power, instrument air), or postulated adverse environments (e.g., extreme heat or cold, fire, pressure, steam, water, and radiation) are experienced.*

Compliance

The Protection System is designed with due consideration of the most probable failure modes of the components under various perturbations of the environment and energy sources. Each reactor trip channel is designed on the de-energize-to-trip principle so loss of power, disconnection, open channel faults, and the majority of internal channel short-circuit faults cause the channel to go into its tripped mode.

This criterion remains satisfied, because the removal of the H-08 control rod from the reactor vessel does not impact the fail-safe function of the remaining 52 control rods, which will still reliably maintain an adequate reactor shutdown capability. The mechanical removal of the control rod drive shaft does not have any mechanical impact on the function of the remaining 52 control rods. The electrical removal from service of the H-08 control rod involved pulling fuses to remove control power to the respective stationary, lift, and movable coils. The remaining control rods are not impacted by this electrical change and continue to meet their design function. The modification design change process ensured that the associated plant modifications involve only the H-08 control rod and do not affect other control rods.

Therefore, the requirements for Criterion 23 are met by maintaining the control rod insertion capability upon failure of the drive mechanisms or induced failure by an outside force.

Criterion 25 - Protection System Requirements for Reactivity Control Malfunctions

*The Protection System shall be designed to assure that specified acceptable fuel design limits are not exceeded for any single malfunction of the Reactivity Control Systems, such as accidental withdrawal (not ejection or dropout) of control rods.*

Compliance

Reactor shutdown by full length rod insertion is completely independent of the normal control function, because the trip breakers interrupt power to the rod mechanisms regardless of existing control signals. The Protection System is designed to limit reactivity transients so that fuel design limits are not exceeded.

In addition, the analysis presented in SQN UFSAR Chapter 15 shows that for postulated dilution during refueling, startup or manual or automatic operation at power, the operator has ample time to determine the cause of dilution, terminate the source of dilution and initiate reboration before the shutdown margin is lost.

This criterion remains satisfied because Cycle 24 redesign reload analyses, performed according to methods referenced in TS 5.6.3, confirmed that the fuel design limits are not exceeded. Such analyses will also be performed for the Cycle 25 cores. The reactor trip function remains fully capable of performing its function with 52 control rods, and fuel design limits are not exceeded for analyzed malfunctions of the reactivity control systems.

Criterion 26 - Reactivity Control System Redundance and Capability

*Two independent reactivity control systems of different design principles shall be provided. One of the systems shall use control rods, preferably including a positive means for inserting the rods, and shall be capable of reliably controlling reactivity changes to assure that under conditions of normal operation, including anticipated operational occurrences, and with appropriate margin for malfunctions such as stuck rods, specified acceptable fuel design limits are not exceeded. The second reactivity control system shall be capable of reliably controlling the rate of reactivity changes resulting from planned, normal power changes (including xenon burnout) to assure acceptable fuel design limits are not exceeded. One of the systems shall be capable of holding the reactor core subcritical under cold conditions.*

Compliance

Two Reactivity Control Systems are provided. These are rod cluster control assemblies (RCCA) and chemical shim (boration). The RCCA are inserted into the core by the force of gravity.

During operation the shutdown rod banks are fully withdrawn. The full length Control Rod System maintains a programmed average reactor temperature compensating for reactivity effects associated with scheduled and transient load changes. The shutdown rod banks along with the full length control banks are designed to shut down the reactor with adequate margin under conditions of normal operation and anticipated operational occurrences thereby ensuring that specified fuel design limits are not exceeded. The most restrictive period in core life is assumed in all analyses and the most reactive rod cluster is assumed to stick in out of core position.

The boron chemical shim is unaffected and will maintain the reactor in the cold shutdown state independent of the position of the control rods and can compensate for all xenon burnout transients.

This criterion remains satisfied because, removal of the H-08 control rod does not impact the ability of the reactivity control system to perform its function. Under normal operating conditions, including anticipated operational occurrences, acceptable fuel design limits are not exceeded. This includes appropriate margin for malfunctions, such as a single stuck rod. Rod control, reactor trip, and reactor coolant system boron addition functions will continue to perform their design and safety functions with removal of the H-08 control rod.

Criterion 27 - Combined Reactivity Control Systems Capability

*The Reactivity Control Systems shall be designed to have a combined capability, in conjunction with poison addition by the Emergency Core Cooling System (ECCS), of reliably controlling reactivity changes to assure that under postulated accident conditions and with appropriate margin for stuck rods the capability to cool the core is maintained.*

Compliance

Sufficient capability is provided to control reactivity for any anticipated cooldown transient, i.e., accidental opening of a steam bypass or relief valve or safety valve stuck open. This capability is achieved by a combination of RCCA and automatic boron addition via the ECCS with the most reactive control rod assumed to be fully withdrawn. Manually controlled boric acid addition is used to supplement the RCCA in maintaining the shutdown margin for the long-term conditions of xenon decay and plant cooldown.

This criterion remains satisfied, because the removal of the H-08 control rod does not impact the ability of the reactivity control systems to reliably control reactivity changes and that adequate SDM is maintained when considering highest stuck rod worth. As performed for the Cycle 24 cores, evaluations of the removal of the H-08 control rod during U1C25 and U2C25 will demonstrate that SDM and safety analysis limits are met throughout the fuel cycle.

Criterion 28 - Reactivity Limits

*The Reactivity Control Systems shall be designed with appropriate limits on the potential amount and rate of reactivity increase to assure that the effects of postulated reactivity accidents can neither (1) result in damage to the reactor coolant pressure boundary greater than limited local yielding nor (2) sufficiently disturb the core, its support structures or other reactor pressure vessel internals to impair significantly the capability to cool the core. These postulated reactivity accidents shall include consideration of rod ejection (unless prevented by positive means), rod dropout, steam line rupture, changes in reactor coolant temperature and pressure, and cold water addition.*

Compliance

The maximum reactivity worth of the control rods and the maximum rates of reactivity insertion employing control rods and boron removal are limited to values that prevent rupture of the Reactivity Control (RC) System boundary or disruptions of the core or vessel internals to a degree that could impair the effectiveness of emergency core cooling.

The appropriate reactivity insertion rate for the withdrawal of RCCA and the dilution of the boric acid in the RC Systems are controlled by the Technical Specifications for the facility. The specification includes or references appropriate graphs that show the permissible mutual withdrawal limits and overlap of functions of the several RCCA banks as a function of power.

Assurance of core cooling capability following accidents, such as rod ejection, steam line break, etc., is given by keeping the reactor coolant pressure boundary stresses within faulted condition limits as specified by applicable ASME codes. Structural deformations are checked also and limited to values that do not jeopardize the operation of needed safety features.

This criterion remains satisfied, because removal of the H-08 control rod has been evaluated to ensure trip reactivity insertion rate, SDM, and the safety analysis limits remain met for the UFSAR Chapter 15 accidents for the entire fuel cycle.

Criterion 29 - Protection against Anticipated Operational Occurrences

*The Protection and Reactivity Control Systems shall be designed to assure an extremely high probability of accomplishing their safety functions in the event of anticipated operational occurrences.*

Compliance

The Protection and Reactivity Control Systems are designed to ensure an extremely high probability of fulfilling their intended functions. The design principles of diversity and redundancy coupled with a rigorous Quality Assurance Program and analyses support this probability, as does operating experience in plants using the same basic design.

This criterion remains satisfied, because the removal of control rod H-08 does not impact the ability of the reactivity control systems to perform their safety functions. The mechanical removal of the control rod drive shaft and RCCA do not have any mechanical impact on the function of the remaining 52 control rods. The electrical removal from service of the H-08 control rod involved pulling fuses to remove control power to the respective stationary, lift, and movable coils. The remaining control rods are not impacted by this electrical change and continue to meet their design function. The modification design change process ensured that the associated plant modifications involve only the H-08 control rod and do not affect other control rods. Therefore, a high probability of control rod insertion continues to exist under anticipated operational occurrences, even with the removal of the H-08 control rod.

## 4.2 PRECEDENT

TVA has identified the following precedent licensing actions where operation with a removed control rod assembly was approved. Insights from these precedent licensing actions have been incorporated into the proposed change as appropriate. Note that these precedents requested only a single cycle of operation with a removed control rod. In contrast, the proposed amendment requests a second cycle without the subject control rod. These precedents are still deemed applicable because the technical justification for the second cycle without H-08 is based on the ability to accommodate the H-08 removal in the safety analyses despite the Cycle 24 cores having been designed assuming H-08 was present.

NRC Letter to TVA, "Sequoyah Nuclear Plant, Unit 1 - Issuance of Exigent Amendment No. 348 to Operate One Cycle with One Control Rod Removed (EPID L-2019-LLA-0239)," dated November 21, 2019 (ML19319C831)

NRC Letter to TVA, "Sequoyah Nuclear Plant, Unit 2 - Issuance of Exigent Amendment No. 342 to Operate One Cycle with One Control Rod Removed (EPID L-2020-LLA-0078)," dated April 23, 2020 (ML20108F049)

NRC Letter to South Texas Project, "South Texas Project Unit 1 - Issuance of Amendment Re: Revision to Technical Specifications for One Operating Cycle Operation with 56 Control Rods (Emergency Circumstances) (TAC No. MF7142)," dated December 11, 2015 (ML15343A128)

In addition, a similar License Amendment Request was submitted for McGuire Nuclear Station Unit 2 (ML18254A182), but this was ultimately withdrawn when repair efforts were successful.

## 4.3 NO SIGNIFICANT HAZARDS CONSIDERATION

Tennessee Valley Authority (TVA) is proposing an amendment to Sequoyah Nuclear Plant (SQN) Unit 1 and Unit 2 Technical Specification (TS) 4.2.2, "Control Rod Assemblies," to permit Unit 1 and Unit 2 Cycle 25 (U1C25 and U2C25) to contain 52 full length control rods with no full length control rod in core location H-08. Currently, TS 4.2.2 requires the SQN Unit 1 and SQN Unit 2 cores to contain 53 full length control rod assemblies except for the U1C24 and U2C24 cores, which shall contain 52 full length control rod assemblies with no full length control rod assembly in core location H-08.

An evaluation has been performed to determine whether or not a significant hazards consideration is involved with the proposed amendments by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. *Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?*

   **Response: No.**

   Operation of SQN Units 1 or 2, Cycle 25 with the H-08 control rod removed will not involve a significant increase in the probability or consequences of an accident previously evaluated. Shutdown Margin (SDM) is reduced by the absence of the H-08 control rod, but remains bounded by the limits specified by

the COLR. Because the impacts on the cycle-specific nuclear design parameters will be bounded by the conservative input values used in the Updated Final Safety Analysis Report (UFSAR) accident analyses, the current accident analyses remain bounding. Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. *Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?*

   **Response: No.**

   Operation of SQN, Units 1 and 2, for Cycle 25 with the H-08 control rods removed will not create the possibility of a new or different kind of accident from any accident previously evaluated and the safety evaluations performed for U1C24 and U2C24 with the H-08 control rods removed validated that the impacts to the nuclear design parameters were within the bounds of those already assumed in the UFSAR Chapter 15 accident analyses. The current accident analyses remain bounding. Additionally, by installing a flow restrictor in the H-08 upper internals control rod guide tube, the hydraulic characteristics of the reactor vessel upper internals are unchanged and all plant equipment will continue to meet applicable design and safety requirements. Therefore, the proposed change does not create the possibility of a new or different kind of accident than those previously evaluated.

3. *Does the proposed change involve a significant reduction in a margin of safety?*

   **Response: No.**

   Operation of SQN, Units 1 and 2, for Cycle 25 with the H-08 control rod removed will not involve a significant reduction in a margin of safety. The margin of safety is established by setting safety limits and operating within those limits. The proposed change does not alter any UFSAR design basis or safety limit and does not change any setpoint at which automatic actuations are initiated. The proposed change was evaluated for effects on available shutdown margin, boron worth, trip reactivity as a function of time, and moderator temperature coefficient. The results of these evaluations demonstrate that the proposed change will not exceed or alter a design basis or safety limit. Therefore, the proposed change does not significantly reduce a margin of safety.

Based on the above, TVA concludes that the proposed amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and accordingly, a finding of “no significant hazards consideration” is justified.

## 4.4 CONCLUSIONS

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission’s regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

## 5.0 ENVIRONMENTAL CONSIDERATION

A review has determined that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

## 6.0 REFERENCES

1. TVA Letter to NRC, CNL-19-116, “Sequoyah Nuclear Plant Unit 1 – Exigent License Amendment Request to Revise Technical Specification 4.2.2, “Control Rod Assemblies” (SQN-TS-19-05),” dated November 16, 2019 (ML19320C333)

2. NRC Letter to TVA, “Sequoyah Nuclear Plant, Unit 1 - Issuance of Exigent Amendment No. 348 to Operate One Cycle with One Control Rod Removed (EPID L-2019-LLA-0239),” dated November 21, 2019 (ML19319C831)

3. TVA Letter to NRC, CNL-20-042, “Sequoyah Nuclear Plant Unit 2 – Exigent License Amendment Request to Revise Technical Specification 4.2.2, “Control Rod Assemblies” (SQN-TS-20-05),” dated April 17, 2020 (ML20108F672)

4. NRC Letter to TVA, “Sequoyah Nuclear Plant, Unit 2 - Issuance of Exigent Amendment No. 342 to Operate One Cycle with One Control Rod Removed (EPID L-2020-LLA-0078),” dated April 23, 2020 (ML20108F049)

5. TVA Letter to NRC, CNL-20-045, “Sequoyah Nuclear Plant, Unit 2 -- Supplement to Exigent License Amendment Request to Revise Technical Specification 4.2.2, “Control Rod Assemblies” (SQN-TS-20--05) (EPID L-2020-LLA-0078)” dated April 22, 2020 (ML20113E939)

6. TVA Letter to NRC, CNL-19-119, “Response to Request for Additional Information Regarding Sequoyah Nuclear Plant, Unit 1 Exigent License Amendment Request to Revise Technical Specification 4.2.2, “Control Rod Assemblies” (SQN-TS-19-05) (EPID L-2019-LLA-0239),” dated November 19, 2019 (ML19323F774)

Enclosure

ATTACHMENT 1

Proposed TS Changes (Mark-Ups) for SQN Unit 1

# 4.0 DESIGN FEATURES

## 4.1 Site Location

The Sequoyah Nuclear Plant is located on a site near the geographical center of Hamilton County, Tennessee, on a peninsula on the western shore of Chickamauga Lake at Tennessee River mile (TRM) 484.5. The Sequoyah site is approximately 7.5 miles northeast of the nearest city limit of Chattanooga, Tennessee, 14 miles west-northwest of Cleveland, Tennessee, and approximately 31 miles south-southwest of TVA's Watts Bar Nuclear Plant.

## 4.2 Reactor Core

### 4.2.1 Fuel Assemblies

The reactor shall contain 193 fuel assemblies. Each assembly shall consist of a matrix of Zircaloy or M5 clad fuel rods with an initial composition of natural or slightly enriched uranium dioxide ($UO_2$) as fuel material. Limited substitutions of zirconium alloy or stainless steel filler rods for fuel rods, in accordance with approved applications of fuel rod configurations, may be used. Fuel assemblies shall be limited to those fuel designs that have been analyzed with applicable NRC staff approved codes and methods and shown by tests or analyses to comply with all fuel safety design bases. A limited number of lead test assemblies that have not completed representative testing may be placed in nonlimiting core regions. Sequoyah is authorized to place a limited number of lead test assemblies into the reactor as described in the Framatome-Cogema Fuels report BAW-2328, beginning with the Unit 1 Operating Cycle 12.

### 4.2.2 Control Rod Assemblies

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-----NOTE-----
Operation with 52 full length control rod assemblies (with no control rod assembly installed in core location H-08) is permitted during Cycle 24.

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The reactor core shall contain 53 full length and no part length control rod assemblies. The full length control rod assemblies shall contain a nominal 142 inches of absorber material. The nominal values of absorber material shall be 80 percent silver, 15 percent indium, and 5 percent cadmium. All control rods shall be clad with stainless steel tubing.

## 4.3 Fuel Storage

### 4.3.1 Criticality

4.3.1.1 The spent fuel storage racks are designed and shall be maintained with:

a. Fuel assemblies having a maximum U-235 enrichment of 5.0 weight percent;

ATTACHMENT 2

Proposed TS Changes (Final Typed) for SQN Unit 1

# 4.0 DESIGN FEATURES

## 4.1 Site Location

The Sequoyah Nuclear Plant is located on a site near the geographical center of Hamilton County, Tennessee, on a peninsula on the western shore of Chickamauga Lake at Tennessee River mile (TRM) 484.5. The Sequoyah site is approximately 7.5 miles northeast of the nearest city limit of Chattanooga, Tennessee, 14 miles west-northwest of Cleveland, Tennessee, and approximately 31 miles south-southwest of TVA's Watts Bar Nuclear Plant.

## 4.2 Reactor Core

### 4.2.1 Fuel Assemblies

The reactor shall contain 193 fuel assemblies. Each assembly shall consist of a matrix of Zircaloy or M5 clad fuel rods with an initial composition of natural or slightly enriched uranium dioxide ($UO_2$) as fuel material. Limited substitutions of zirconium alloy or stainless steel filler rods for fuel rods, in accordance with approved applications of fuel rod configurations, may be used. Fuel assemblies shall be limited to those fuel designs that have been analyzed with applicable NRC staff approved codes and methods and shown by tests or analyses to comply with all fuel safety design bases. A limited number of lead test assemblies that have not completed representative testing may be placed in nonlimiting core regions. Sequoyah is authorized to place a limited number of lead test assemblies into the reactor as described in the Framatome-Cogema Fuels report BAW-2328, beginning with the Unit 1 Operating Cycle 12.

### 4.2.2 Control Rod Assemblies

---------------------------------------------NOTE-----------------------------------------------
Operation with 52 full length control rod assemblies (with no control rod assembly installed in core location H-08) is permitted during Cycles 24 and 25.
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The reactor core shall contain 53 full length and no part length control rod assemblies. The full length control rod assemblies shall contain a nominal 142 inches of absorber material. The nominal values of absorber material shall be 80 percent silver, 15 percent indium, and 5 percent cadmium. All control rods shall be clad with stainless steel tubing.

## 4.3 Fuel Storage

### 4.3.1 Criticality

4.3.1.1 The spent fuel storage racks are designed and shall be maintained with:

a. Fuel assemblies having a maximum U-235 enrichment of 5.0 weight percent;

ATTACHMENT 3

Proposed TS Changes (Mark-Ups) for SQN Unit 2

# 4.0 DESIGN FEATURES

## 4.1 Site Location

The Sequoyah Nuclear Plant is located on a site near the geographical center of Hamilton County, Tennessee, on a peninsula on the western shore of Chickamauga Lake at Tennessee River mile (TRM) 484.5. The Sequoyah site is approximately 7.5 miles northeast of the nearest city limit of Chattanooga, Tennessee, 14 miles west-northwest of Cleveland, Tennessee, and approximately 31 miles south-southwest of TVA's Watts Bar Nuclear Plant.

## 4.2 Reactor Core

### 4.2.1 Fuel Assemblies

The reactor shall contain 193 fuel assemblies. Each assembly shall consist of a matrix of Zircaloy or M5 clad fuel rods with an initial composition of natural or slightly enriched uranium dioxide ($UO_2$) as fuel material. Limited substitutions of zirconium alloy or stainless steel filler rods for fuel rods, in accordance with approved applications of fuel rod configurations, may be used. Fuel assemblies shall be limited to those fuel designs that have been analyzed with applicable NRC staff approved codes and methods and shown by tests or analyses to comply with all fuel safety design bases. A limited number of lead test assemblies that have not completed representative testing may be placed in nonlimiting core regions. Sequoyah is authorized to place a limited number of lead test assemblies into the reactor as described in the Framatome-Cogema Fuels report BAW-2328, beginning with the Unit 2 Operating Cycle 10 core.

### 4.2.2 Control Rod Assemblies

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-----------------------------------------------NOTE-----------------------------------------------
Operation with 52 full length control rod assemblies (with no control rod assembly installed in core location H-08) is permitted during Cycle 24.
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The reactor core shall contain 53 full length and no part length control rod assemblies. The full length control rod assemblies shall contain a nominal 142 inches of absorber material. The nominal values of absorber material shall be 80 percent silver, 15 percent indium, and 5 percent cadmium. All control rods shall be clad with stainless steel tubing.

## 4.3 Fuel Storage

### 4.3.1 Criticality

4.3.1.1 The spent fuel storage racks are designed and shall be maintained with:

a. Fuel assemblies having a maximum U-235 enrichment of 5.0 weight percent;

ATTACHMENT 4

Proposed TS Changes (Final Typed) for SQN Unit 2

# 4.0 DESIGN FEATURES

## 4.1 Site Location

The Sequoyah Nuclear Plant is located on a site near the geographical center of Hamilton County, Tennessee, on a peninsula on the western shore of Chickamauga Lake at Tennessee River mile (TRM) 484.5. The Sequoyah site is approximately 7.5 miles northeast of the nearest city limit of Chattanooga, Tennessee, 14 miles west-northwest of Cleveland, Tennessee, and approximately 31 miles south-southwest of TVA's Watts Bar Nuclear Plant.

## 4.2 Reactor Core

### 4.2.1 Fuel Assemblies

The reactor shall contain 193 fuel assemblies. Each assembly shall consist of a matrix of Zircaloy or M5 clad fuel rods with an initial composition of natural or slightly enriched uranium dioxide ($UO_2$) as fuel material. Limited substitutions of zirconium alloy or stainless steel filler rods for fuel rods, in accordance with approved applications of fuel rod configurations, may be used. Fuel assemblies shall be limited to those fuel designs that have been analyzed with applicable NRC staff approved codes and methods and shown by tests or analyses to comply with all fuel safety design bases. A limited number of lead test assemblies that have not completed representative testing may be placed in nonlimiting core regions. Sequoyah is authorized to place a limited number of lead test assemblies into the reactor as described in the Framatome-Cogema Fuels report BAW-2328, beginning with the Unit 2 Operating Cycle 10 core.

### 4.2.2 Control Rod Assemblies

----------------------------------------------NOTE-----------------------------------------------
Operation with 52 full length control rod assemblies (with no control rod assembly installed in core location H-08) is permitted during Cycles 24 and 25.
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The reactor core shall contain 53 full length and no part length control rod assemblies. The full length control rod assemblies shall contain a nominal 142 inches of absorber material. The nominal values of absorber material shall be 80 percent silver, 15 percent indium, and 5 percent cadmium. All control rods shall be clad with stainless steel tubing.

## 4.3 Fuel Storage

### 4.3.1 Criticality

4.3.1.1 The spent fuel storage racks are designed and shall be maintained with:

a. Fuel assemblies having a maximum U-235 enrichment of 5.0 weight percent;