UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

May 7, 2019

Mr. Joseph W. Shea
Vice President, Nuclear Regulatory Affairs
and Support Services
Tennessee Valley Authority
1101 Market Street, LP 4A
Chattanooga, TN 37402-2801

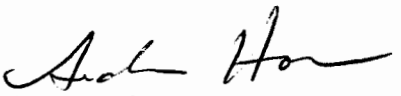
SUBJECT: SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2 - ISSUANCE OF AMENDMENTS RE: REQUEST TO MODIFY ESSENTIAL RAW COOLING WATER MOTOR CONTROL CENTER BREAKERS AND TO REVISE THE UPDATED FINAL SAFETY ANALYSIS REPORT (EPID L-2018-LLA-0060)

Dear Mr. Shea:

The Nuclear Regulatory Commission (the Commission) has issued the enclosed Amendment Nos. 344 and 337 to Renewed Facility Operating License Nos. DPR-77 and DPR-79, respectively, for Sequoyah Nuclear Plant (SQN), Units 1 and 2, in response to the Tennessee Valley Authority (TVA) application dated March 9, 2018, as supplemented by letters dated April 11, 2018, and January 30, 2019, requesting an amendment to the Updated Final Safety Analysis Report (UFSAR). SQN has implemented a design change to remove the existing mechanical (Kirk Key) interlocking scheme from the feeder breakers and tie-breakers for Essential Raw Cooling Water (ERCW) Motor Control Centers (MCCs) 1A-A and 2A-A. The amendments approve TVA's plans to complete the implementation of the design change to remove the mechanical interlock device from the feeder breakers and tie-breakers from the ERCW MCCs 1B-B and 2B-B and to revise the ERCW System Description in Section 9.2.2.2 of the SQN Updated Final Safety Analysis Report to describe the normal and alternate power sources for the ERCW system.

A copy of the related Safety Evaluation is also enclosed. A Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,



Andrew Hon, Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-327 and 50-328

Enclosures:
1. Amendment No. 344 to DPR-77
2. Amendment No. 337 to DPR-79
3. Safety Evaluation

cc: Listserv

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-327

SEQUOYAH NUCLEAR PLANT, UNIT 1

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 344
Renewed License No. DPR-77

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by the Tennessee Valley Authority (the licensee), dated March 9, 2018, as supplemented by letters dated April 11, 2018, and January 30, 2019, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, as amended; the provisions of the Act; and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, by Amendment No. 344, Facility Operating License No. DPR-77 is hereby amended to authorize the change to the Updated Final Safety Analysis Report (UFSAR) as requested by letter dated March 9, 2018, as supplemented by letters dated April 11, 2018, and January 30, 2019, and evaluated in the NRC staff safety evaluation dated May 7, 2019. The licensee shall submit the update of the UFSAR authorized by this amendment in accordance with 10 CFR 50.71(e).

3. This license amendment is effective as of the date of its issuance, and shall be implemented no later than 60 days from the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Undine Shoop, Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Renewed
Facility Operating License

Date of Issuance: May 7, 2019

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-328

SEQUOYAH NUCLEAR PLANT, UNIT 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 337
Renewed License No. DPR-79

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by the Tennessee Valley Authority (the licensee), dated March 9, 2018, as supplemented by letters dated April 11, 2018, and January 30, 2019, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, as amended; the provisions of the Act; and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, by Amendment No. 337, Facility Operating License No. DPR-79 is hereby amended to authorize the change to the Updated Final Safety Analysis Report (UFSAR) as requested by letter dated March 9, 2018, as supplemented by letters dated April 11, 2018, and January 30, 2019, and evaluated in the NRC staff safety evaluation dated May 7, 2019. The licensee shall submit the update of the UFSAR authorized by this amendment in accordance with 10 CFR 50.71(e).

3. This license amendment is effective as of the date of its issuance, and shall be implemented no later than 60 days from the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Undine Shoop, Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Renewed
Facility Operating License

Date of Issuance: May 7, 2019

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO

AMENDMENT NO. 344 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-77, AND

AMENDMENT NO. 337 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-79

TENNESSEE VALLEY AUTHORITY

SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2

DOCKET NOS. 50-327 AND 50-328

1.0 INTRODUCTION

By letter dated March 9, 2018 (Agencywide Document Access Management System (ADAMS) Accession No. ML18071A349), as supplemented by letters dated April 11, 2018 (ADAMS Accession No. ML18102B430) and January 30, 2019 (ADAMS Accession No. ML19031C844), Tennessee Valley Authority (TVA), the licensee for Sequoyah Nuclear Plant (SQN), Units 1 and 2, requested U.S. Nuclear Regulatory Commission (NRC) staff approval to modify Essential Raw Cooling Water (ERCW) Motor Control Center (MCC) Breakers and revise the Updated Final Safety Analysis Report (UFSAR) for SQN Units 1 and 2 to clarify the normal and alternate power supply for ERCW. The supplemental letters provided additional information that clarified the application, did not expand the scope of the application as originally noticed, and did not change the NRC staff's original proposed no significant hazards consideration determination as published in the *Federal Register* on June 5, 2018 (83 FR 26107).

SQN has implemented a design change to remove the existing mechanical (Kirk Key) interlocking scheme from the feeder breakers and tie-breakers for ERCW MCCs 1A-A and 2A-A. The physical control of the ERCW MCC feeder breakers was replaced with administrative (procedural) controls. In NRC Inspection Report 05000327/2015007 and 05000328/2015007, dated September 14, 2015 (ADAMS Accession No. ML15257A435), the NRC determined that this design change required prior NRC approval. By this license amendment request (LAR), TVA requested NRC approval to complete the implementation of the design change to remove the mechanical interlock device from the feeder breakers and tie-breakers from the ERCW MCCs 1B-B and 2B-B and to revise the ERCW System Description in Section 9.2.2.2 of the SQN UFSAR for the ERCW system. Thus, this request would resolve the issues in NRC Inspection Report 05000327/2015007 and 05000328/2015007.

2.0 REGULATORY EVALUATION

2.1 System Description of the ERCW MCC Power Supplies

The onsite Class 1E Alternating Current (AC) Electrical Power Distribution System is divided into two redundant and independent load groups with two 6.9 kilo-Volt (kV) shutdown boards in each load group. Each 6.9 kV shutdown board has a connection to a preferred offsite power source and a dedicated emergency diesel generator (EDG). The 6.9 kV shutdown boards in a load group (i.e., 1A-A and 2A-A, or 1B-B and 2B-B) are normally powered by the same offsite power circuit. Two EDGs associated with one load group can provide all safety-related functions to mitigate a loss-of-coolant accident (LOCA) in one unit and safely shut down the other unit. The Train A and Train B engineered safety feature (ESF) systems each provide for the minimum safety functions necessary to shut down the plant and maintain it in a safe shutdown condition.

There are four 480 Volt (V) ERCW MCC boards, 1A-A, 1B-B, 2A-A, and 2B-B, all located in the ERCW building. Each board is fed from its associated Unit and train 6.9 kV shutdown board (1A-A, 1B-B, 2A-A, and 2B-B). The 480 V ERCW MCCs support various ERCW loads such as ERCW strainers, ERCW screen wash pumps, and travelling screens.

The alternate power source for the 1A-A ERCW MCC board is from the opposite Unit's 2A-A ERCW MCC board through the tie-breakers. Similarly, the alternate power source for the 1B-B ERCW MCC board is from the opposite Unit's 2B-B ERCW MCC board through the tie-breakers. Alternate power can be provided to the 480 V ERCW MCC boards through manual operation of tie-breakers.

2.2 Proposed Change

Reason for the Change

In Section 3.1 of the LAR, the licensee stated:

> The original design of the 480V ERCW MCCs included a mechanical interlock (Kirk Key), which prevented paralleling of the normal and alternate power supply on each MCC. The mechanical interlock was provided with the original MCC procurement in the original purchase specification. The Kirk Key provides a mechanical interlock between these same-train normal and alternate power sources.
>
> The existing ERCW feeder breakers are obsolete. The replacement breakers were evaluated through TVA's equivalency process. However the replacement breakers have a slightly different physical footprint, which prevents the existing Kirk Key interlocking scheme to be mounted onto the breaker. Therefore, the removal of the Kirk Key interlock was required to install the new ERCW MCC feeder breakers.

In Section 2.2 of the LAR, the licensee also stated that the physical control of the Train A ERCW MCC feeder breakers has been replaced with administrative (procedural) controls. While redundancy is maintained through independent trains, a physical barrier (Kirk Key) was

replaced with an administrative barrier. If a human performance error (single failure) were to occur and an operator mistakenly closed the cross tie-breaker without first opening a feeder breaker, this action could potentially parallel two standby power sources due to the removal of the mechanical interlock. The licensee stated that it has conservatively considered that independence could be impacted by this change. In accordance with Nuclear Energy Institute (NEI) guidance, NEI 96-07, Revision 1, "Guidelines for 10 CFR [Title 10, Code of Federal Regulations] 50.59 Evaluation," Section 4.3.2 (ADAMS Accession No. ML003771157), a change that may reduce system/equipment redundancy, diversity, separation or independence requires prior NRC approval.

Proposed Changes

The licensee requested approval to complete the implementation of a design change to remove the existing mechanical (Kirk Key) interlocking scheme from the feeder breakers and tie-breakers for ERCW MCCs 1B-B and 2B-B. Upon implementation, the physical control of the ERCW MCC feeder breakers will be replaced with administrative (procedural) controls. The Kirk Key interlock has already been removed from the feeder breakers and tie-breakers for ERCW MCCs 1A-A and 2A-A.

Additionally, the licensee proposed to revise the following paragraph in SQN UFSAR Section 9.2.2.2 to clarify the normal and alternate power supply for ERCW (additions are indicated in **bold**):

> Since there are two independent power trains, four of the eight ERCW pumps will be assigned to train A **(1A/2A)** and four to train B **(1B/2B)**. **Likewise, two of the associated ERCW MCCs are assigned to train A and two to train B. Because the mechanical loads powered from each power train feed into a header/piping system that is shared among both units, there is no need to have unit separation on the associated power sources. The normal and alternate power source for each ERCW MCC are provided by the same train from each unit.** Two each of the traveling screens, screen wash pumps, and strainers will be assigned to the power train corresponding to that of the ERCW pumps which this equipment serves.

2.3 Regulatory Requirements and Guidance

In its review of this LAR, the staff applied the following regulatory requirements to determine whether the proposed changes continued to meet the intent of the General Design Criteria (GDC):

The SQN was designed to meet the intent of the Proposed GDC for Nuclear Power Plant Construction Permits published in the *Federal Register* in July 1967 (32 FR 10213). The SQN construction permit was issued in May 1970. In February 1971, a final rule that added Appendix A to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "General Design Criteria for Nuclear Power Plants" was published in the *Federal Register* (36 FR 3255), as amended in July 1971 (36 FR 12733). Differences between the Proposed GDC and final GDC included a consolidation from 70 to 64 criteria. As discussed in the NRC Staff Requirements Memorandum, SECY-92-223, "Resolution of Deviations Identified During the Systematic Evaluation Program," dated September 18, 1992 (ADAMS Accession No. ML12256B290), the Commission decided not to apply the final GDC to plants with construction permits issued prior to May 21, 1971. However, Section 3.1.2 of the SQN UFSAR, states that the UFSAR

addresses the final GDC published in July 1971. There are no significant differences between the Proposed GDC to which the SQN is designed and the final GDC.

The NRC staff identified the following GDC as being applicable in its review of this LAR.

Criterion 5, "Sharing of Structures, Systems, and Components" states:

> Structures, systems, and components important to safety shall not be shared between nuclear power units unless it is shown that such sharing will not significantly impair their ability to perform their safety functions, including, in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units.

Compliance to Criterion 5: In Section 3.1.2 of UFSAR, the licensee stated:

> The two units share several structures and systems, many of which have no safety function. The structures important to safety are the Auxiliary/Control Building, Diesel Generator Building, component cooling water (CCW) Pumping Station, the ERCW pumping station, and a few miscellaneous structures. Shared safety-related systems include the ERCW, CCW, fire protection, fuel handling/storage and cooling, fuel oil storage, preferred and emergency electric power, chemical and volume control, condensate, radioactive waste, Gas Treatment System, and Control and Auxiliary Building Ventilation Systems. The Vital Direct-Current (DC) Power System is shared to the extent that a few loads (e.g., the vital inverters) in one nuclear unit are energized by the DC power channels assigned primarily to power loads of the other unit. In no case does the sharing inhibit the safe shutdown of one unit while the other unit is experiencing an accident. All shared systems are sized for all credible initial combinations of normal and accident states for the two units, with appropriate isolation to prevent an accident condition in one unit from carrying into the other.

Criterion 17, "Electric power systems," states, in part:

> An onsite and offsite electric power system shall be provided to permit the functioning of structures, systems, and components that are important to safety. The safety function for each system (assuming the other system is not functioning) shall be to provide sufficient capacity and capability to assure that (1) specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents.
>
> The onsite electric power sources, including the batteries, and the onsite electric distribution system, shall have sufficient independence, redundancy, and testability to perform their safety functions assuming a single failure.

Compliance to Criterion 17: In Section 3.1.2 of the UFSAR, the licensee stated:

> The capacity and capability of either the onsite or offsite electric power system is sufficient to assure that (1) specified fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents. The Onsite Electrical Power System serves both nuclear power units and certain common plant equipment. It

consists of two independent diesel generator systems, two redundant Class IE electric power distribution trains, and four redundant vital instrument and control power channels, each provided with a battery, battery charger, and inverter for each unit. Each redundant onsite power supply, train, and channel has the capability and capacity to supply the required safety loads assuming the failure of its redundant counterpart. The offsite electrical power source consists of two physically independent circuits that are normally energized. One of these circuits is immediately available (within a few seconds) following a LOCA. The offsite power is provided via the common station service transformers.

The staff also considered the following guidance documents in its review of this LAR.

Regulatory Guide (RG) 1.6, Revision 0, "Independence between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems" (ADAMS Accession No. ML003739924) states that the electrically powered safety loads (AC and DC) should be separated into redundant load groups such that loss of any one group will not prevent the minimum safety functions from being performed.

RG 1.81, Revision 1, "Shared Emergency and Shutdown Electric Systems for Multi-Unit Nuclear Power Plants" (ADAMS Accession No. ML003740343) states that a single failure (a false or spurious accident signal at the system level in the non-accident unit should be considered as a single failure) should not preclude the capability to automatically supply minimum engineered safety feature loads in any one unit and safely shut down the remaining unit, assuming a loss of the offsite power.

According to Section 8.1.5 of the SQN UFSAR, the licensee meets the intent of RGs 1.6 and 1.81.

NUREG-1764, Revision 1, "Guidance for the Review of Changes to Human Actions," (ADAMS Accession No. ML072640413) provides human factors review guidance for changes to human actions using a risk-informed approach. Appendix A to NUREG-1764 provides examples of the types of actions that are considered risk-important or potentially risk-important for boiling water reactors and pressurized water reactors. In accordance with the generic risk categories established in Appendix A to NUREG-1764, the tasks under review involve human actions associated with a risk-important system and should receive a "Level II" human factors review. NUREG-1764, Section 4, "Level II Review Guidance," provides the areas of review for human actions of medium risk significant, including the following 4 areas of review:

1. General Deterministic Review
2. Human Action Analysis
3. Design of Human System Interface (HSI), Procedures, and Training
4. Human Action Verification

3.0 TECHNICAL EVALUATION

The staff reviewed the LAR to evaluate whether the proposed changes in LAR would adversely impact (1) the current compliance with the GDC as described in the SQN UFSAR, (2) the system/equipment degradation, redundancy, diversity, separation or independence, which could impact SQN's defense-in-depth, and (3) operator actions and human factors.

3.1 Impact of Proposed Changes on Current Compliance with NRC Regulations

In accordance with wiring diagrams supplied by the licensee in the letter dated April 11, 2018 (ADAMS Accession No. ML18102B430), the various ERCW MCCs are powered as follows:

480V ERCW MCC 1A-A: From 6.9 kV shutdown board 1A-A through 6.9 kV-480 V transformer 1A-A with a feeder breaker (main incoming breaker to the MCC 1A-A) or alternatively from 480V ERCW MCC 2A-A through two tie-breakers (one tie-breaker on each MCC, tie-breaker on MCC 1A-A normally closed).

480V ERCW MCC 2A-A: From 6.9 kV shutdown board 2A-A through 6.9 kV-480 V transformer 2A-A with a feeder breaker (main incoming breaker to the MCC 2A-A) or alternatively from 480V ERCW MCC 1A-A through two tie-breakers (one tie-breaker on each MCC, tie-breaker on MCC 1A-A normally closed).

A note on the wiring diagram relating to the MCCs discussed above states that 480 V main feeder breakers on MCCs 1A-A, 2A-A, and the tie-breaker on MCC 2A-A are interlocked to prevent the transformers from being paralleled.

Based on review of the wiring diagram, the staff notes that the power supplies to ERCW MCCs 1B-B, and 2B-B are similar.

The staff notes that with the removal of Kirk Key (mechanical) interlock, there is potential for inadvertent paralleling of the two power sources from 6.9 kV shutdown board 1A-A and 6.9 kV shutdown board 2A-A by an operator mistake, such as during or after maintenance on an ERCW MCC. The paralleling of two sources can potentially cause degradation/tripping/failure of the safety-related 6.9 kV and 480 V shutdown boards, 480 V MCCs, and related loads. The staff notes that tie-breakers exist only within the same train (such as between 1A-A ERCW MCC and 2A-A ERCW MCC). Therefore, inadvertent paralleling of the two sources (within the same train) would impact only one safety-related train at any given time.

SQN UFSAR Section 8.1.2 states that the major safety-related loads for each nuclear unit are divided electrically into two redundant load groups. Each redundant load group of each unit has access to a standby (onsite) source and access to each of the two preferred (offsite) sources. Due to a number of shared systems, two (must be the same train) out of four diesels and load groups are required to provide all safety functions for each unit.

Since inadvertent paralleling of power sources would be limited to only one train (for example between 1A/2A related switchgear) at any given time, the plant would be able to meet all its safety-related functions by the other train (1B/2B). Therefore, the NRC staff finds that the licensee would continue to be in compliance with GDC 5 and 17.

At SQN, some loads or systems are shared between the two units, but are divided between Train A (1A/2A) and Train B (1B/2B). In the event of a complete train failure, one of the units can still meet the design basis accidents and the other unit can be safely shutdown, thus meeting the intent of GDC 5. The licensee would also continue to meet the intent of RG 1.6, which recommends that electrically powered loads should be separated into redundant load groups such that loss of any one group will not prevent the minimum safety functions from being performed.

Similarly, the offsite and onsite power sources consist of Train A and Train B. In the event of a complete train failure, one of the units can still meet the design basis accidents and the other unit can be safely shutdown, thus meeting the intent of GDC 17. The licensee would also continue to meet the intent of RG 1.81, which recommends that a single failure should not preclude the capability to automatically supply minimum ESF loads in any one unit and safely shutdown the remaining unit, assuming a loss of the offsite power.

3.2 Reduction in System/Equipment Redundancy, Diversity, Separation, or Independence

The staff notes that because paralleling of two sources can potentially cause degradation/tripping/failure of the safety-related 6.9 kV and 480 V shutdown boards, 480 V MCCs, and related loads, there is a potential reduction in the system/equipment redundancy or separation during any period when inadvertent paralleling of the two sources is not detected. The staff was particularly concerned with the potential for inadvertent out-of-phase paralleling of the offsite or onsite power sources, which could lead to severe damage and extended unavailability of safety-related equipment of one train.

In a request for additional information (RAI) dated December 10, 2018 (ADAMS Accession No. ML18344A075), the staff requested that the licensee provide additional information on whether the offsite power sources can be inadvertently connected out-of-phase within the same train (e.g., at ERCW MCCs 1A and 2A). In its RAI response dated January 30, 2019 (ADAMS Accession No. ML19031C844), the licensee stated:

> If administrative controls were to fail and the tie-breakers left closed, the supplies to the ERCW MCCs from each unitized source will not be out of phase if the 6.9kV shutdown boards (1A and 2A) are powered from offsite power. Defense in depth of the SQN auxiliary power system would not be compromised. Both the 161kV and 500kV grids feeding the switchyard are in phase, connected through an intertie transformer that is Y-Y with no phase shift.

Based on a review of the information provided by the licensee in the RAI response, the staff finds that in all alignments with offsite power, the SQN auxiliary power supply system will remain in-phase with both unit generators and the switchyard supply.

In Section 3.2 of the LAR, the licensee provided an evaluation of inadvertent paralleling of power sources at ERCW MCCs (with in-phase power supplies) as follows:

> Replacing the Kirk Key mechanical interlocks with administrative controls does introduce the possibility of aligning two ERCW transformers to a single MCC in the event that the administrative controls are not effective. However, this action would not affect the ability of the ERCW system to perform its safety function. The paralleling of the two ERCW transformers onto a single MCC increases the available short circuit current and causes circulating currents that can heat and damage equipment. The effects of circulating currents are minimized in this case, due to the high impedance of the connection and similarity/symmetry of the circuit design. The parallel connection passes through two transformers, multiple boards, and substantial length of cables, which increase the impedance (resistance) and limit the circulating currents. Additionally, each of the ERCW main feeder breakers is equipped with a thermal trip unit that provides an additional level of protection against the possible heating effects. Regarding fault current, the MCC buses, MCC breakers, and cross-

tie breakers are rated to clear the maximum fault current supplied by two paralleled ERCW transformers without affecting the electrical supply. Although, the available fault current could potentially double, the capacity of the MCC buses, MCC breakers, and cross-tie breakers are sufficiently sized to withstand and clear the available fault current. There are two breakers that feed from the two 6.9 kV sources, one above and one below the step down transformers. It would take a failure of more than one breaker to affect either 6.9 kV source, and more than a single failure to affect both 6.9 kV sources.

Based on electrical engineering principles and practice, two in-phase power sources can be paralleled safely after requisite analysis, as has been performed by the licensee. Based on the information above, the staff finds that if the offsite power sources are inadvertently paralleled at the ERCW MCCs, but are in-phase, this would not cause a significant degradation. However, because the staff considers this to be a reduction in defense-in-depth, the inadvertent paralleling of the two sources must be identified and corrected within reasonable time. A review of the licensee's procedures to identify this degradation and avoid paralleling two power sources at ERCW MCCs when 6.9 kV shutdown boards are fed by EDGs is provided in Section 3.3 of this SE.

3.3 Human Factors Review

The scope of the human factors review is limited to a review of the operator actions and human factors considerations discussed in the LAR. The NRC staff reviews the human performance aspects of LARs using the guidance in NUREG-1764 Rev. 1, "Guidance for the Review of Changes to Human Actions" (ADAMS Accession No. ML072640413). In accordance with the generic risk categories established in Appendix A to NUREG-1764, the tasks under review in this LAR involve potentially risk-important human actions associated with a risk-important system. Due to the potential risk importance of the human actions, the NRC staff performed a Level II human factors review per the guidance in Section 4 of NUREG-1764, Rev. 1. NUREG-1764, Section 4, "Level II Review Guidance," includes the following 4 areas of review:

1. General Deterministic Review
2. Human Action Analysis
3. Design of Human System Interface (HSI), Procedures, and Training
4. Human Action Verification

3.3.1 General Deterministic Review

The general deterministic review guidance in NUREG-1764 states that the licensee should provide adequate assurance that the change meets current regulations and does not compromise defense in depth. As discussed in Section 3.1 above, inadvertent paralleling of the normal and alternate power supplies to a single ERCW MCC would be limited to only one train of safety-related equipment, and therefore the change meets current regulations. As discussed in Section 3.2 above, inadvertent paralleling of the normal and alternate power sources to a single ERCW MCC when those power sources are supplied by offsite power would not cause severe damage, which would reduce defense in depth, because the normal and alternate power sources would be in-phase. However, if the normal or alternate power sources were not both supplied by offsite power sources, severe damage could occur, reducing defense in depth. This configuration is possible if the normal and alternate power sources for a single ERCW MCC are inadvertently paralleled to a single ERCW MCC while one or both of the related 6.9 kV

shutdown boards are being supplied by an EDG, or if an ERCW MCC is inadvertently left connected to both its normal and alternate power supplies after the completion of maintenance and an event occurred in which an EDG was required to repower one or both of the 6.9 kV shutdown boards.

As stated in the LAR, the licensee is proposing to rely on administrative controls to ensure that the normal and alternate power sources are not inadvertently paralleled to a single ERCW. In the RAI dated December 10, 2018 (ADAMS Accession No. ML18344A075), the staff requested that the licensee provide additional information regarding the administrative controls proposed to be used to ensure that the alternate power supply is only aligned for maintenance purposes and ensure that the alternate power supplies are not aligned when powered from the EDGs. In its response dated January 30, 2019 (ADAMS Accession No. ML19031C844), the licensee stated:

> Alignment of the ERCW MCCs is governed by the SQN System Operating Instructions 1,2-SO-201-9, "480V ERCW Motor Control Centers." Precaution 3.1.K in these procedures and a note in each section to realign ERCW MCC power supplies requires an engineering evaluation in accordance with drawing 1,2-15E500-3. Table 3 of drawing 1,2-15E500-3 describes the alignment restrictions and limitations for the electrical distribution system. Aligning ERCW MCC from alternate power is not a "Normal Alignment," which is defined as "ALL 6.9KV AND 480V BOARDS RECEIVING POWER FROM THEIR NORMAL SUPPLY AS SHOWN ON SHEETS 1 AND 2." Note 10 of Table 3 requires that any alignment not specified by this table to be evaluated by SQN electrical design engineering prior to implementation.
>
> The above evaluation is requested by operations and provided in the form of an engineering work request in accordance with TVA procedure NPG-SPP-09.0, "Conduct of Engineering," Section 3.2.9.C, "Engineering Work Requests." This requirement evaluates any restrictions on concurrent alignments to ensure operability of emergency diesel generators and offsite power sources during the period of alternate alignment. An emergency diesel generator supplying a 6.9KV Shutdown Board would not be considered a normal alignment and such an alignment is only normally performed during the performance of SQN TS [Technical Specification] SR [Surveillance Requirement] .8.1.18, "AC Sources - Operating."

In the RAI dated December 10, 2018 (ADAMS Accession No. ML18344A075), the staff also requested that the licensee provide additional information regarding how operators will verify that the breaker alignment is correct after restoration of normal breaker alignment. In its response dated January 30, 2019 (ADAMS Accession No. ML19031C844), the licensee stated that the procedural steps to return to normal power from the alternate power alignment for the ERCW MCCs require operators to perform an independent verification of the correct lineup (i.e., tie-breaker off and normal feeder breaker on).

Based on the general deterministic review guidance in NUREG-1764, the NRC staff finds that the licensee has proposed adequate administrative controls, including procedural cues and an engineering evaluation, to ensure that the process to align alternate power to an ERCW bus is not performed when the normal or alternate power sources are supplied by sources that could be out of phase. The NRC staff also finds that the licensee has proposed adequate administrative controls, consisting of independent verification of the correct configuration, to

ensure that the normal and alternate power supplies are not inadvertently left paralleled after the completion of any activities that required the transferring of power supplies to an ERCW MCC. Therefore, the NRC staff concludes that the human actions described in the LAR will not adversely impact train separation, redundancy, or independence. Furthermore, the NRC staff finds that the licensee's proposed change does not overly rely on human actions to preclude cross-connection of safety-related buses and maintain independence of the electrical sources.

3.3.2 Human Action Analysis

The analysis review guidance in NUREG-1764 states that the licensee should perform a functional and task analysis to identify how personnel will know when the human action is necessary and has been performed correctly, identify how performance requirements are being changed, and identify potential errors and their consequences.

In Section 3.2 of the LAR, the licensee stated the following regarding the administrative controls that are proposed to be used to ensure that the normal and alternate power sources are not inadvertently paralleled to a single ERCW MCC:

> The TVA procedure for 480V ERCW MCCs has concurrent verification (CV) to reduce the likelihood of a human performance event. Five manual actions with CV steps involving four circuit breakers must be taken to manually make the transfer from the MCC normal supply to the alternate supply. An operations procedure step would have to be incorrectly followed and incorrectly verified (CV) for this failure to occur. The CV process provides reasonable assurance that a credible error in performance would be detected and corrected prior to component mispositioning. The time to recover would be minimal as a result of the CV being a real time second party verification. The breakers interrupting capability and selective coordination ensures that only the affected train ERCW MCCs are electrically isolated. The result of this failure is the loss of 480V power supply to one train of ERCW MCCs. This failure would not result in an immediate loss of ERCW flow on the affected train, but the ERCW traveling screens and strainers would be de-energized. This action would result in gradual flow degradation as debris accumulated on the screens and strainers.

In the RAI dated December 10, 2018 (ADAMS Accession No. ML18344A075), the staff requested that the licensee provide additional information regarding how operators will verify that the ERCW bus that will be powered by its alternate power supply is de-energized prior to aligning the alternate supply. In its RAI response dated January 30, 2019 (ADAMS Accession No. ML19031C844), the licensee stated that the required actions to transfer from normal power to alternate power and back will be performed as a "dead bus" transfer, such that both ERCW buses will be de-energized prior to the transfer of power. The licensee further stated that steps will be included in the procedure to check for annunciation of loss of voltage and to check that the bus is "dead" prior to proceeding to steps to connect to alternate supply.

Based on the analysis review guidance in NUREG-1764, the NRC staff finds that the licensee has proposed adequate administrative controls to ensure that the ERCW bus that will be powered by its alternate power supply is de-energized prior to aligning the alternate supply, including concurrent verification of breaker manipulations and verification of a dead bus prior to transfer of power supplies. Based on the above evaluation, the NRC staff finds that the licensee's proposed change includes adequate administrative controls to alert the operators

when it is acceptable to perform the required actions, direct the operators to perform the required actions, and has evaluated potential errors and their consequences.

3.3.3 Design of Human System-Interfaces (HSI), Procedures and Training

The HSI, procedures, and training review guidance in NUREG-1764 states that the licensee should describe any modifications to HSI, procedures, and training and include any relevant operating experience.

In Section 3.2 of the LAR, the licensee stated that the administrative controls proposed to ensure that the normal and alternate power sources are not inadvertently paralleled to a single ERCW MCC have been reflected in operating procedures for the ERCW MCCs and that the modification to remove the mechanical interlock was reviewed for its effect on training. The licensee also stated that initial operator training includes training on breaker operation and preventing inappropriate paralleling of sources for electrical boards. The licensee further stated that the modification was included in licensed operator requalification training as part of the plant status update.

In the RAI dated December 10, 2018 (ADAMS Accession No. ML18344A075), the staff requested that the licensee describe any relevant operating experience related to failure of administrative controls, breaker manipulations, or concurrent/independent verification techniques and how that operating experience was considered in the proposed LAR. In its RAI response dated January 30, 2019 (ADAMS Accession No. ML19031C844), the licensee stated that it is not aware of any relevant operating experience at SQN related to failure of administrative controls, breaker manipulations, or concurrent/independent verification techniques that would affect procedural requirements related to the ERCW MCCs.

Based on the HSI, procedures, and training review guidance in NUREG-1764, the NRC staff finds that the licensee has proposed adequate changes to operating procedures and operator training, and reviewed relevant operating experience. Based on the evaluation above, the NRC staff finds that the design of HSIs, procedures, and operator training have been adequately addressed and that the licensee has considered relevant operating experience.

3.3.4 Human Action Verification

The human action verification guidance in NUREG-1764 states that the licensee should demonstrate that the human actions can be successfully accomplished using the modified HSIs, procedures, and training.

In Section 3.2 of the LAR, the licensee stated that removal of the mechanical interlock has no direct effect on plant systems because the evolution to transfer power from the normal to alternate supply is performed for maintenance or when there is an issue with the normal power supply and is not performed in response to a plant perturbation. Therefore, the evolution is not required to mitigate any design basis accidents. The licensee also stated that operation of breakers in such instances is considered fundamental operator knowledge.

Based on the human action verification guidance in NUREG-1764, the NRC staff notes that the breaker manipulations associated with transferring the power from the normal to alternate power supply and the verification techniques proposed are not complex or unique, and are not time-limited. The licensee has trained its operators on the procedure changes. Based on the

evaluation above, the NRC staff finds that the licensee has adequately validated that plant operators can perform the required actions.

3.4 Summary

Based on the technical evaluation above, the staff finds that modifications to the ERCW MCCs breakers would result in a minimal increase in the likelihood of occurrence of a malfunction of a structure, system or component important to safety previously evaluated in the SQN UFSAR. The changes would not impact the licensee's current compliance with GDC 5 and 17. The staff finds the proposed change to UFSAR Section 9.2.2.2 acceptable because it clarifies the normal and alternate power supply for ERCW. Therefore, the staff concludes that the proposed license amendment is acceptable.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Tennessee State official was notified of the proposed issuance of the amendment on March 7, 2019. The State official indicated a strong preference for the mechanical interlock system over the administrative control upon installation of the new feeder breakers, but was not opposed to the concept of administrative controls. While the State official generally prefers mechanical interlock systems over administrative controls, the NRC staff notes that there is no specific requirement for such a mechanical interlock system. Follow up communication between the State official and the NRC staff on meeting safety-related functions without the mechanical interlock system and adequacy of administrative controls addressed the State official's comment.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, or any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, published in the *Federal Register* on June 5, 2018 (83 FR 26107), and there has been no public comment on such finding. Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) there is reasonable assurance that 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.

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Date: May 7, 2019

SUBJECT: SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2 - ISSUANCE OF AMENDMENTS RE: REQUEST TO MODIFY ESSENTIAL RAW COOLING WATER MOTOR CONTROL CENTER BREAKERS AND TO REVISE THE UPDATED FINAL SAFETY ANALYSIS REPORT (EPID: L-2018-LLA-0060) DATED MAY 7, 2019

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