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

September 20, 2012

Mr. Joseph W. Shea
Manager, Corporate Nuclear Licensing
Tennessee Valley Authority
3R Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

SUBJECT: SEQUOYAH NUCLEAR PLANT, UNIT 1 – SAFETY EVALUATION CORRECTIONS FOR AMENDMENT NO. 330 ASSOCIATED WITH UNIT 2 REPLACEMENT STEAM GENERATOR PROJECT TO CONDUCT HEAVY LOAD LIFTS (TAC NO. ME7225) (TS-SQN-2011-05)

Dear Mr. Shea:

On September 6, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued Amendment No. 330 to Facility Operating License No. DPR-77 for the Sequoyah Nuclear Plant, Unit 1. This amendment is in response to Tennessee Valley Authority's application dated September 29, 2011, as supplemented by letters dated February 10, March 5, April 5, and May 22, 2012.

It recently became apparent that the safety evaluation issued with the amendment needed certain corrections that are consistent with the licensee's amendment request. This was an oversight on our part and does not affect the NRC staff's overall conclusions associated with Amendment No. 330.

Enclosed is the corrected safety evaluation to be included with the issued amendment. We regret any inconvenience this may have caused.

Sincerely,

Siva P. Lingam

Siva P. Lingam, Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-327

Enclosure: Corrected safety evaluation

cc w/enclosures: Distribution via Listserv

UNITED STATES
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 330 TO FACILITY OPERATING LICENSE NO. DPR-77

TENNESSEE VALLEY AUTHORITY

SEQUOYAH NUCLEAR PLANT, UNIT 1

DOCKET NO. 50-327

1.0 INTRODUCTION

By application dated September 29, 2011 (Agencywide Document Access and Management System (ADAMS) Accession No. ML11273A169), as supplemented by letters dated February 10, March 5, April 5, and May 22, 2012 (ADAMS Accession Nos. ML12046A646, ML120890728, ML121140124, and ML12144A297, respectively), Tennessee Valley Authority (TVA or the licensee) proposed an amendment to add a one-time license condition to the Sequoyah Nuclear Plant (SQN), Unit 1 operating license for the conduct of heavy load lifts for the SQN, Unit 2 steam generator replacement project (SGRP). The one-time license condition establishes special provisions and requirements for the safe operation of SQN, Unit 1, while large heavy load lifts are performed on SQN, Unit 2. In addition, a one-time change to SQN, Unit 1 Technical Specification (TS) 3.7.5, "Ultimate Heat Sink," is also proposed to implement additional restrictions with respect to maximum average essential raw cooling water (ERCW) system supply header water temperature during large heavy load lifts performed to support the SQN, Unit 2 SGRP during fall 2012 refueling outage (RFO).

The supplements dated February 10, March 5, April 5, and May 22, 2012, provided additional information that clarified the application, did not expand the scope of the application as originally noticed, and did not change the U.S. Nuclear Regulatory Commission (NRC or the Commission) staff's initial proposed no significant hazards consideration determination as published in the *Federal Register* on December 27, 2011 (76 FR 80977).

This safety evaluation (SE) addresses the areas of crane design, maintenance, inspection, safe load paths and procedures associated with the requested amendment. Specific compensatory measures were developed to provide reasonable assurance of the safe shutdown of SQN, Unit 1 following a postulated accidental load drop that could damage the ERCW system.

2.0 REGULATORY EVALUATION

The SQN units are pressurized-water reactors (Westinghouse Ice Condenser design) that operate with an ERCW system that supplies cooling water to both units. Water is supplied to the auxiliary building station from the ERCW pumping station through four independent, sectionalized supply headers designated as 1A, 2A, 1B, and 2B. Four pumps are assigned to train A and four to train B. The two headers associated with the same train (i.e., 1A/2A or 1B/2B) may be cross-tied to provide greater flexibility. The headers are arranged and fitted with isolation valves such that a rupture in any header can be isolated and will not jeopardize the safety functions of the other headers.

During the SQN, Unit 2 Cycle 18 RFO, a nonsingle failure-proof commercial crane (i.e., outside lift system (OLS)) will be used to lift the old steam generators (OSGs) and replacement steam generators (RSGs) through the top of the steel containment vessel and concrete shield building. However, if these heavy loads were dropped during handling with the OLS, the drop could potentially damage both trains of ERCW in SQN, Unit 2 and affect Unit 1 while Unit 1 continues to operate during the Unit 2 outage. The existing SQN, Unit 1 and SQN, Unit 2 updated final safety analysis report (UFSAR) does not include an evaluation of the consequences of such a load drop. Therefore, the licensee is requesting a one-time change to SQN, Unit 1 Operating License DPR-77 to ensure safe operation of SQN, Unit 1 during the Unit 2 SGRP. As stated above, if a steam generator (SG) was dropped onto the ERCW system, it could potentially affect the continued safe operation of Unit 1.

The requested amendment would add a one-time license condition to the SQN, Unit 1 operating license (OL) establishing requirements to ensure that the ERCW System remains capable of supporting the continued operation and safe shutdown capability of SQN, Unit 1, and remains capable of maintaining the required cooling water flow to essential structures, systems, and components (SSCs) following a postulated heavy load drop. As such, the ERCW System will remain capable of performing its required safety function to support equipment credited in the mitigation of consequences of design-basis events.

In NRC Bulletin (BL) 96-02, "Movement of Heavy Loads Over Spent Fuel, Over Fuel in the Reactor Core, or Over Safety-Related Equipment," dated April 11, 1996, the NRC staff addressed specific instances of heavy-load-handling concerns and requested licensees to provide specific information detailing their extent of compliance with the guidelines and their licensing basis. BL 96-02 stated, in part, that licensees planning to perform activities that involve the handling of heavy loads over spent fuel, fuel in the reactor core, or safety-related equipment while the reactor is at power (in all modes other than cold shutdown, refueling, and defueled) and that involve a potential load drop accident that has not been evaluated in the final safety analysis report, must submit a license amendment request (LAR) in advance of the planned movement of the loads to afford the NRC staff sufficient time to perform an appropriate review.

NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants: Resolution of Generic Technical Activity A-36," issued in July 1980, provides regulatory guidelines in two phases (Phases I and II) to ensure safe handling of heavy loads in areas where a load drop could impact stored spent fuel, fuel in the reactor core, or equipment that may be required to achieve safe shutdown or permit continued decay heat removal. Phase I guidelines address measures for reducing the likelihood of dropping heavy loads and provide criteria for establishing safe load paths; procedures for load handling operations; training of crane operators; design, testing, inspection, and maintenance of cranes and lifting devices; and analyses of the impact of heavy load drops. Phase II guidelines address alternatives for mitigating the consequences of heavy load drops, including using either (1) a single-failure-proof crane for increased handling system reliability, (2) electrical interlocks and mechanical stops for restricting crane travel, or (3) load drops and consequence analyses for assessing the impact of dropped loads on plant safety and operations.

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix A, "General Design Criteria [GDC] for Nuclear Power Plants [NPPs]," establishes minimum requirements for the Principle Design Criteria of NPPs. General Design Criterion 4 (GDC-4), "Environmental and

Dynamic Effects Design Bases," requires in part that SSCs important to safety be designed to withstand dynamic effects resulting from failures of equipment, such as a dropped load.

GDC-5, "Sharing of Structures, Systems, and Components," requires that SSCs important to safety shall not be shared among nuclear power units unless it can be shown that such sharing will not significantly impair their ability to perform their safety function. An accident on one unit should not prevent the plant from achieving an orderly shutdown and cooldown on the other units.

The regulatory guidelines for the risk-informed LAR are based on:

- Regulatory Guide (RG) 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," describes a risk-informed approach, acceptable to the NRC staff, for assessing the nature and impact of propose licensing-basis changes by considering engineering issues and applying risk insights. RG 1.174 provides risk acceptance guidelines for evaluating the results of such evaluations.

- RG 1.177, "An Approach for Plant-Specific, Risk-Informed Decisionmaking: Technical Specifications," describes methods acceptable to the NRC staff for assessing the nature and impact of proposed TS changes by considering engineering issues and applying risk insights. RG 1.177 augments the RG 1.174 risk acceptance guidelines with additional guidelines for evaluating increases in risk during the duration of a planned activity.

- RG 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment [PRA] Results for Risk-Informed Activities," describes one acceptable approach for determining whether the technical adequacy of the PRA, in total or the parts that are used to support an application, is sufficient to provide confidence in the results required to support an application.

General guidance for the NRC staff for evaluating the technical basis for proposed risk-informed changes is provided in Section 19.2, "Review of Risk Information Used to Support Permanent Plant-Specific Changes to the Licensing Basis: General Guidance" of the NRC Standard Review Plan (SRP), NUREG-0800. Section 19.2 of the SRP states that a risk-informed application should be evaluated to ensure that the proposed changes meet the following key principles:

- The proposed change meets the current regulations unless it explicitly relates to a requested exemption or rule change.

- The proposed change is consistent with the defense-in-depth philosophy.

- The proposed change maintains sufficient safety margins.

- When proposed changes increase core damage frequency or risk, the increase(s) should be small and consistent with the intent of the Commission's Safety Goal Policy Statement.

- The impact of the proposed change should be monitored using performance measurement strategies.

3.0 TECHNICAL EVALUATION

The NRC staff review scope associated with the subject amendment covers the following technical areas as they apply to the establishment of the aforementioned one-time license condition at SQN, Unit 1: crane design, maintenance, inspection, safe load paths and procedures associated with the planned heavy load lift. Specific compensatory measures were developed to provide reasonable assurance of the safe shutdown capability of SQN, Unit 1 following a postulated accidental load drop that damages the ERCW system. The NRC staff based the following evaluation on the material presented in the Rigging and Heavy Load Handling Technical Report (TR) SQN2-SGR-TR1, "Sequoyah Unit 2 Steam Generator Replacement Rigging and Heavy Load Handling," Revision 3, contained in the licensee's April 5, 2012, submittal, supplementary information and discussions with the licensee.

During the SQN, Unit 2 Cycle 18 RFO, lifts of heavy loads will be performed in accordance with BL 96-02 and will adhere to the prescribed compensatory measures contained in the TR and supplemental information. In its submittal, the licensee requested a one-time change to the SQN, Unit 1 operating license during the SQN, Unit 2 Cycle 18 RFO. Additionally, the licensee stated in its submittal that compensatory measures included in the license condition ensure that safe shutdown capability will be maintained for SQN, Unit 1 in the event of a load drop that affects the ERCW system. As a result, a one-time license condition will be added to the SQN, Unit 1 OL to establish special provisions and requirements for the safe operation of SQN, Unit 1, while heavy load lifts are performed on SQN, Unit 2. In addition, a one-time change to SQN, Unit 1 TS 3.7.5, "Ultimate Heat Sink," was requested in the submittal to implement additional restrictions with respect to maximum average ERCW System supply header water temperature during heavy load lifts. These measures will ensure that the ERCW system will remain capable of performing its required safety function to support equipment credited in the mitigation of design-basis accident consequences.

The licensee also stated that a large heavy load drop that would cause loss of ERCW supply to SQN, Unit 1, and other essential SSCs is considered to be an unlikely accident for the following reasons:

- The lifting equipment was specifically chosen for the subject heavy lifts;
- Crane operators will be specially trained in the operation of the lift equipment and in the SQN site conditions;
- Qualifying analyses and administrative controls will be used to ensure adequate protection of the lifts from the effects of external events;
- The areas over which a load drop could cause loss of ERCW system are a small part of the total travel path of the loads.

The NRC staff has reviewed the TR and notes that the valves associated with the ERCW system, component cooling system (CCS) and essential air distribution system are located outside of the SQN, Unit 2 shield building and these valves will be closed before lifting heavy loads with the OLS. Therefore, a load drop from the OLS inside or above the SQN, Unit 2 containment will not affect the shutdown and cooling capabilities of SQN, Unit 1.

3.1 Heavy Loads and Rigging

The TVA heavy load control measures for the SQN are presented in TR SQN2-SGR-TR1, Revision 3, as Enclosure 1 to the April 5, 2012, supplement letter. This TR provides the technical justification for handling heavy loads over safety-related SSCs. The review of the proposed operation during the SQN, Unit 2 Cycle 18 RFO focuses on the procedures for controlling heavy loads, as well as on compensatory measures, crane design, and similar operating experience for commercial cranes lifting similar loads.

3.1.1 Outside Lift System

The SG lifts will be performed by a Mammoet Platform Twin-Ring Containerized Heavy Lift Crane, referred to as the OLS. The OLS is a commercially designed, nonsingle-failure-proof crane with a maximum rated load of 66 tons to 1227 tons, dependent upon the lift radius, in the configuration proposed for the SQN, Unit 2 SG replacement. The OLS will be assembled on site using a Manitowoc 2250 mobile crane. A Liebherr 1400/1 or 1400/2 crawler crane will be erected onsite to perform miscellaneous heavy load lifts in support of the SGRP before, during, and after the SQN, Unit 2 fall 2012 RFO.

Rigging and lifting of the OSGs and RSGs would be performed by the OLS, in part, by following the load handling procedures that are discussed in more detail in this SE. The maximum lifted load of the SGs during the SQN, Unit 2 SGRP is approximately 419 tons, and the maximum lift radius with the full SG load is 54.8 meters. The licensee stated that the rated load for the proposed crane configuration ranges from 66 tons to 1227 tons, depending on the lift radius. Based on the comparison between the load capacities and corresponding lift radii and the approximately load and lift radius to be used during the SQN, Unit 2 SGRP, the NRC staff considers OLS acceptable, from a capacity standpoint. The NRC staff also notes that the OLS meets or exceeds the design requirements stipulated in American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance (NQA)-1-1994 Subpart 2.15, "Quality Assurance Requirements for Hoisting, Rigging, and Transporting of Items for Nuclear Power Plants."

The licensee stated that the OLS would be supported on top of an 8-feet (ft) wide, 70.5-ft diameter (centerline) concrete ring foundation that is supported by approximately 80 piles to bedrock with an integral concrete cap that is a minimum of 4 feet thick. The crane base would be supported on 24 independent jacks, which are seated on top of the pile cap. The NRC staff notes that the OLS ringer design with 24 jacks enables good distribution of bearing pressure under the jack pads. The OLS will be seated on the reinforced concrete pile cap extension of an engineered battered pile foundation consisting of approximately 80 piles anchored into bedrock. The battered pile foundation is designed for lateral loads (seismic and wind) in addition to the deadweight loads of the crane and SG loads. Based on the details of the OLS support system and load distribution discussed above, the NRC staff considers the licensee's method for supporting the OLS during the SQN, Unit 2 heavy load lift adequate and acceptable.

The licensee stated that the OLS would be assembled and disassembled in accordance with the user manual by operators provided by the owner and designer who are well trained with full knowledge of the operating manual and experience with assembly or disassembly of the OLS. Further, following erection, the licensee stated that it would perform functional tests of the OLS over the intended range of use and a load test would be performed after it was erected to ensure that the control, operating, and safety systems of the OLS are functioning properly. Load lifts using the OLS will be performed after SQN, Unit 2 is defueled and will be completed before the start of refueling.

Since the OLS is a mobile-type crane, certain criteria specified in NUREG-0612 may not be applicable to the design, load handling, testing, inspection, operator training, and maintenance of the OLS. Consequently, the licensee, in the TR, identified American National Standards Institute (ANSI) B30.5-2004, "Mobile and Locomotive Cranes," as an alternative to the maintenance, testing, inspection, and operator training criteria identified within the guidelines of NUREG-0612. Because the guidance in ANSI B30.5-2004 meets the intent of NUREG-0612, the NRC staff found this to be an acceptable alternative to the ANSI B30.2-2005, "Overhead and Gantry Cranes (Multiple Girder)," requirements identified in NUREG-0612.

The licensee provided information concerning the OLS safety devices and the alternative design criteria that the OLS satisfies. The licensee indicated that the OLS design includes the following safety features:

- Anti two-block switch - prevents raising the lifting block into the boom tip;
- Boom back stop switch - prevents the boom from being boomed back too far;
- Jib preventer switch - keeps the jib from being boomed up too far;
- Minimum and maximum radius switches – these will be set during erection based on the load path for loads to be moved;
- Load cells to indicate the lifted load – these will be tested during the load test;
- Safe load indicator system - is tied into the load cell and the min/max radius switches.

3.1.1.1 Load test of the OLS

The licensee stated that the OLS will be load tested prior to use by lifting a 265 tons (530 kilo-pounds (kip)) test load assembly with the OLS boomed out to a radius of approximately 75 meters, where the test load represents 110 percent of the OLS rated capacity at this radius. In comparison, the maximum lifted load of the SGs during the Unit 2 SGRP is approximately 419 tons, and the maximum lift radius with the full SG load is 54.8 meters. Since the load test will be performed with a test load of known weight, it will confirm the calibration of the OLS load cells. Additionally, the OLS boom radius indication readouts will be verified during load test, which will also verify the incline meter readings. The licensee also stated that the safe load indicator, which stops crane operation unless the operation improves the safety margin, will also be tested during the load test. The NRC staff reviewed and compared the provided information from the licensee and found the OLS loaded test by lifting 265 tons at the radius of approximately 75 meters is equivalent to 533 tons at the radius of 54.8 meters. The NRC staff found the load test of the OLS is acceptable because the OLS load capacity at the 54.8 meter is greater than the actual SG replacement (SGR) (533 tons versus 419 tons) weight. In addition, the safe load indicator, will stop crane operation unless the operation improves the safety margin.

3.1.2 Seismic Analysis

The OLS was not designed to withstand the external events addressed by 10 CFR Part 50, Appendix A, GDC-2, that are part of the SQN, Unit 2 design and licensing basis. Since the OLS was not necessarily required to meet the design and licensing basis for external events at SQN, Unit 2, the NRC staff reviewed the robustness of the OLS design and its ability to withstand a design-basis event, such as a safe shutdown earthquake during heavy load handling operations. A seismic analysis was performed for the OLS by the licensee. The seismic evaluation of the OLS was based on a dynamic modal analysis using the response spectra method with a GT-STRUDL 3-D lumped mass finite element model. The licensee also stated that the model included the soil-structure interaction effects at the OLS ring foundation using spring stiffness elements at the base node of the crane, which acted as the single support node for the model.

The seismic evaluation of the OLS is based on an appropriate ground spectrum corresponding to the minimum safe shutdown earthquake (SSE) design basis spectra. It is also noted that since the OLS is a temporary system that will be in service for a short period of time and will be loaded for an even smaller period of time, the use of a spectrum based on the minimum seismic design basis of the plant is conservative. Table 3.7.1-1 of the SQN UFSAR specifies a maximum damping of 5 percent for Category I bolted steel structures for SSE. RG 1.61 allows 7 percent for bolted steel structures for SSE loading conditions. As such, the NRC staff notes that the use of a 5 percent damping value in the OLS seismic analysis results in a conservative seismic analysis.

Since the OLS is supported on a concrete ring foundation seated on a large number of piles that are supported well into bedrock, the vertical response spectrum used for the crane seismic analysis was the minimum design basis vertical spectrum for 5 percent damping from Figure 2.5.2-14 of the SQN UFSAR. As stipulated in Section 2.5.2.4 of the SQN UFSAR, the vertical response spectrum used by the licensee in its analysis is two-thirds of the horizontal minimum design spectrum. The OLS is supported on a concrete ring foundation seated on a large number of piles anchored to bedrock. Based on borehole data taken during soil investigation for the SGRP, the average depth of soil deposit above bedrock at the location of the OLS is approximately 30 ft. Since the OLS will be supported on top of a 30 ft thick soil deposit above bedrock, the response spectra used in the analysis is an amplified spectrum at ground surface corresponding to the design basis spectrum (see Section 2.5.2.4 and Figure 2.5.2-14 of SQN UFSAR). Based on the above, the NRC staff finds the licensee's input spectra and its location proper and the licensee's overall approach to the seismic analysis of the OLS acceptable, as it is consistent with the SQN UFSAR. Further, the seismic-induced crane failure or load drop has been considered and analyzed to show that the OLS will not collapse or drop a load while loaded or unloaded during the SSE.

3.1.3 Lifting Materials and the Rigging Points

(a) Replacement Steam Generators

Slings: The NRC staff reviewed the TR and notes that the slings are designed to satisfy the 5:1 working load limit as required by ASME Standard B30.9, 2003 edition (5.0 versus 5.4 for SQN, Unit 2).

Trunnions: The NRC staff reviewed the TR and notes that the allowable stress for the lifting trunnions is greater than the actual stresses required by the ASME NQA-1, Subpart 2.15, which requires a factor of safety of 1.67, and the trunnions are designed in accordance with the allowable stress design of American Institute of Steel Construction (AISC) Manual of Steel Construction, 9th Edition. The results of the licensee's evaluations demonstrate that the trunnions meet the design requirements of ASME NQA-1, Subpart 2.15 and the allowable stress design of AISC Manual of Steel Construction, 9th edition as shown below:

Factor of Safety for RSG Rigging: Lifting Trunnion

	Allowable Stress (ksi)	Actual Stress (ksi²)	Interaction Ratio (Actual/Allowable)	Factor of Safety (Yield/Actual Stress)
Shear	14.4	1.83	0.127	19.67
Bearing	32.4	10.81	0.334	3.33
Bending	21.6	0.45	0.021	80.0

Factor of Safety for RSG Rigging: Trunnion Bolts

	Allowable Stress (ksi)	Actual Stress (ksi	Interaction Ratio (Actual/Allowable)	Factor of Safety (Yield/Actual Stress)
Shear	21.0	17.0	0.810	7.35
Tension	23.2	5.7	0.246	22.0

(b) Old Steam Generators (interfacing lift point is a secondary Manway Keeper Plate)

Slings: The NRC staff reviewed the TR and found slings are designed to satisfy the 5:1 working load limit as required by ASME B30.9, 2003 edition (5.0 versus 5.1 for SQN, Unit 2).

OSG keeper plates: The NRC staff reviewed the TR and notes that the keeper plate is a Grade 50 steel plate, which is attached to the OSG secondary manways by using 1.25 inches diameter American Society for Testing Materials A490 bolts. The purpose of the keeper plate is to prevent the sling from slipping off of the secondary manway. The OSG keeper plates meet the design (greater than 1.67) requirements of ASME NQA-1, Subpart 2.15 and the allowable stress design of AISC Manual of Steel Construction, 9th edition, as shown below:

Factor of Safety for OSG Rigging: Keeper Plate

	Allowable Stress (N/mm^2)	Actual Stress (N/mm^2)	Interaction Ratio (Actual/Allowable)	Factor of Safety (Yield/Actual Stress)
Shear	100.0	4.0	0.04	86
Bending	216.0	75.0	0.35	4.6

Factor of Safety for OSG Rigging: Keeper Plate Bolts

	Allowable Stress (N/mm^2)	Actual Stress (N/mm^2)	Interaction Ratio (Actual/Allowable)	Factor of Safety (Tensile Strength/Actual Stress)
Shear	267.0	19.0	0.07	54.4
Tension	431.0	22.5	0.05	46.0

3.1.4 Safe Load Path

Section 5.1.1 of NUREG-0612 states that all plants should satisfy the following for handling heavy loads that could be brought in proximity to or over safe shutdown equipment:

> "Load paths should be defined for the movement of heavy loads to minimize the potential for heavy loads to impact safe shutdown equipment. These load paths should be defined in procedures, shown on equipment layout drawings, and clearly marked in the area where the load is to be handled."

The safe load path that will be used during the proposed replacement of the SQN, Unit 2 SGs will be posted on the OLS and on the transporter used to handle and move the SGs to and from the SG storage facility. The SGs are considered critical loads in accordance with NUREG-0612 since they will be carried over the SQN, Unit 2 shield building and over safety-related SSCs that support both SQN, Unit 2 (defueled) and Unit 1 (operating at full power). The licensee has satisfied the intent of the guidance in Section 5.1.1 of NUREG-0612. Therefore, the NRC staff finds the licensee's provisions for establishing a safe load path acceptable.

3.1.5 Load Drops

To eliminate the effects of wind conditions beyond the maximum operating wind speed, a lift will not commence if analysis of weather data for the expected duration of the lift indicates the potential for wind conditions in excess of the maximum operating wind speed. Further, should there be an unexpected detrimental change in weather while the OLS is loaded, the lift will be completed and the OLS will be placed in its optimum safe configuration or the load will be grounded and the crane will be placed in a safe configuration.

The guidance of NUREG-0612 describes a defense-in-depth philosophy to achieve the safety goals associated with heavy load handling. This philosophy endorses preventative measures and controls to reduce the likelihood of a load drop in addition to ensuring that the potential consequences of a load drop can be mitigated. As stated in the LAR, the licensee has addressed all the guidance of NUREG-0612 Section 5.1.1, which outlines general preventive measures and controls used to limit the likelihood of a heavy load drop accident. The licensee has analyzed postulated load drops in accordance with the guidance of NUREG-0612 Appendix A to ensure that the safety objectives of NUREG-0612 Section 5.1 are met. Enclosure 2 to the LAR, "Sequoyah Unit 2 Steam Generator Replacement Rigging and Heavy Load Handling Technical Report," describes the licensee's heavy load handling plan and outlines their compliance with the guidance of NUREG-0612.

The design, inspection, testing, and maintenance of all cranes described in the Heavy Load Handling Technical Report will conform to the guidelines of ASME B30.5, "Mobile and Locomotive

Cranes." Crane operator training will conform to the guidelines of ASME B30.5 as well. While NUREG-0612 Section 5.1.1 references ASME B30.2, "Overhead and Gantry Cranes," ASME B30.5 is appropriate to the type of cranes being used for the SGRP and satisfies the intent of ASME B30.2.

Safe load paths have been defined in the Heavy Load Handling Technical Report such that the potential for impacts with safe shutdown equipment is minimized. Procedures for load handling operations, including depictions of safe load paths, crane assembly and disassembly, response to changes in weather conditions, and load drop responses have been developed. Additional precautions for monitoring during heavy load lifts have been captured as a new license condition to the SQN, Unit 1 OL. By taking the steps described in the Heavy Load Handling Technical Report, the licensee has met the intent of NUREG-0612 Section 5.1.1 to limit the likelihood of a heavy load drop accident.

The licensee determined that the following SSC could potentially be impacted by a heavy load drop: Unit 2 containment, auxiliary building, essential raw cooling water system, Unit 2 refueling water storage tank (RWST), Unit 2 primary water storage tank (PWST), exterior Unit 2 main steam piping, exterior Unit 2 feedwater piping, and fire protection system piping.

The potential impact of a heavy load drop with each of these systems was evaluated to ensure the safety objectives of NUREG-0612 Section 5.1 were met, specifically that damage to equipment in redundant or dual safe shutdown paths resulting from a heavy load drop will not result in a loss of required safe shutdown function.

The Auxiliary Building is a reinforced concrete structure that houses Unit 1 and 2 engineered safety features equipment. No loads will be carried above the Auxiliary Building, but a dropped SG could potentially deflect off of the Unit 2 shield building and impact the Auxiliary Building. In order to preclude this impact, the SGs will be lifted to a minimum height of 20 feet above the Unit 2 shield building dome. From this height, a dropped SG will perforate the Unit 2 containment rather than impact the dome and deflect into the Auxiliary Building.

A dropped heavy load from the OLS could impact the Unit 2 RWST, PWST, ERCW pipe tunnel and piping, or fire protection piping and potentially fill the ERCW pipe tunnel and flood into the Auxiliary Building. This impact will be precluded by installing a temporary wall in the ERCW pipe tunnel prior to movement of heavy loads with the OLS. This wall will be capable of holding back flooding from the ERCW pipe tunnel and will be equipped with a means to measure the amount of water on the tunnel side and measure leakage past the wall. Construction of the ERCW pipe tunnel wall and development of appropriate procedures prior to commencing any heavy load lift with the OLS has been captured as a new license condition on the SQN, Unit 1 OL. Isolation of the high pressure fire pump and the flood mode pump piping in the ERCW pipe tunnel is also captured as a license condition to limit potential flooding sources.

The ERCW System provides a safety-related source of cooling water for various loads on SQN, Units 1 and 2. The 2A and 2B ERCW supply headers and the B ERCW discharge header run through an underground concrete pipe tunnel which passes below the SG load path. A large heavy load drop could sever or crush the ERCW system piping, potentially preventing the ERCW system from meeting its safe shutdown function for Unit 1. As a compensatory measure, the licensee described an alternate alignment of the ERCW system and performed an analysis to show that this alignment could provide adequate cooling to ensure the shutdown of SQN, Unit 1.

The methodology used to analyze the ERCW alternate configuration was previously approved for license amendments revising the ultimate heat sink temperature. The results of this analysis show that the alternate alignment is capable of providing adequate cooling following a large heavy load drop, provided that the maximum temperature of the ERCW supply header is limited to 74 degrees fahrenheit (°F).

A new limiting condition for operation will be added to SQN, Unit 1 TS 3.7.5, "Ultimate Heat Sink," to capture the requirement for ERCW supply header water temperature less than or equal to 74 °F while the ERCW system is in the alternate alignment to support large heavy load lifts. This revision to the TS ensures that actual ERCW supply header temperature will support the analysis of the alternate ERCW system configuration. While in the alternate ERCW system alignment, SQN, Unit 1 will be required to shut down and reach a safe condition if the supply header temperature is outside of the requirement identified in the analysis. A SQN, Unit 1 license condition captures the requirement to place the ERCW system in alternate alignment prior to moving heavy loads with the OLS. In addition, the ERCW supply header temperature requirement is included as a license condition to the SQN, Unit 1 OL.

The results of an impact on the RWST, PWST, main steam piping, main feedwater piping, and fire protection piping during heavy load lifts with the OLS are bounded by the potential damage to the ERCW system and pipe tunnel flooding. The licensee's evaluation of the potential consequences of a heavy load have established that damage to equipment in dual or redundant safe shutdown paths will be prevented. The additional limiting condition for operation in TS 3.7.5 and the new SQN, Unit 1 license conditions provide assurance that the assumptions of the licensee's analysis will match actual conditions. The NRC staff finds that the licensee has addressed the potential consequences of a heavy load drop and has provided protection for the safe shutdown of SQN, Unit 1 in accordance with the guidance of NUREG-0612.

Based on the above discussion, the conditions that could result in credible crane failure modes or load drops (i.e., operator errors, use of improper rigging or inappropriate slings, and crane component failures) have been minimized or eliminated through the training of rigging personnel, use of engineer-developed procedures for the load lifts, performance of engineering evaluations of the OLS and rigging components, and inspection and testing of the OLS. In addition, an OLS failure or load drop caused by a tornado or seismic event has been considered and evaluated. The likelihood of a tornado-initiated OLS failure or load drop will be minimized through implementation of procedures to preclude load handling when high winds or severe weather or tornado conditions are anticipated. The seismic-induced crane failure or load drop has been considered and analyzed to show that the OLS will not collapse or drop a load while loaded or unloaded during the SSE. Given the training, procedures, evaluations, inspections, and testing undertaken to support the use of the OLS for the SQN, Unit 2 SGRP, the NRC staff finds these undertakings acceptable and concludes that there is reasonable assurance that the failure of the OLS resulting in a load drop should not occur.

3.2 Load Handling Procedures

NUREG-0612 recommends that licensees provide an adequate defense-in-depth approach to maintaining safety during the handling of heavy loads near spent fuel or over safety-related equipment and cited four major causes of accidents: operator errors, rigging failures, lack of adequate inspection, and inadequate procedures. With respect to the SQN, Unit 2 Cycle 18 RFO, special precautions are required to handle the removal and replacement of the SGs.

3.2.1 Assembly/Disassembly of the OLS

The licensee stated that the OLS would be assembled and disassembled in accordance with the user's manual by operators provided by the owner and designer who are well trained with full knowledge of the operating manual and experience with assembly/disassembly of the OLS. Further, following erection, the licensee stated that it would perform functional tests of the OLS over the intended range of use and a load test would be performed after it was erected to assure that the control, operating, and safety systems of the OLS are functioning properly. With respect to the mobile cranes, the licensee stated that it would perform tests on the mobile cranes in accordance with ANSI B30.5-2004 and prior to each shift, a preoperational checklist of the crane would be conducted by the shift operators. Based on the review of information submitted by the licensee, the NRC staff finds that the licensee's procedures for the assembly and disassembly of the OLS and use of the mobile cranes satisfy the intent of NUREG-0612.

3.2.2 Lifting Devices

NUREG-0612 provides guidelines for the design and use of lifting devices. The licensee stated that slings would meet the guidelines of NUREG-0612 and alternatively below the hook devices would meet the requirements of ANSI B30.2-2005. Further, the design of lifting trunnions would be qualified to meet the requirements of ASME NQA-1-1994, Subpart 2.15. The NRC staff found the alternative criteria proposed for the lifting trunnions acceptable, as the alternative criteria satisfy the guidelines of NUREG-0612. In addition, for lifting devices other than the trunnions, the licensee stated that it would employ the use of devices that meet the guidelines of Phase I of NUREG-0612 and are, therefore, acceptable.

3.2.3 Crane Operator Qualifications

NUREG-0612 states that crane operators should be trained, qualified and conduct themselves in accordance with Chapter 2-3, "Operation" of ANSI B30.2-2005. Since the OLS does not satisfy the criteria of ANSI B30.2-2005 with respect to operator qualifications, the licensee needed to provide alternate requirements that meet the guidelines of NUREG-0612. Therefore, the TR indicates that operators would be qualified to meet the requirements of ANSI Standard B30.5-2004 "Mobile and Locomotive Cranes." The NRC staff evaluated the qualification requirements in ANSI B30.5-2004 and found that the criteria within the standard satisfies the intent of Phase I of NUREG-0612 as an alternative and therefore, is acceptable.

3.2.4 Design and Operating Wind Conditions

NUREG-0612 specifies that licensees should take special precautions as necessary in handling heavy loads in the vicinity of safe shutdown equipment. SGs traveling over the specified load path could be subject to high winds that can potentially cause a load drop. The design basis wind speed for SQN is 153 kilometers per hour (kph) (95 miles per hour (mph)) and wind speeds exceeding 166 kph (103 mph) can be expected only during a tornado. The OLS has two anemometers for measuring wind speed, one in the boom tip and a duplicate at the top of the back stay. The licensee stated that the OLS manufacturer qualified the crane for wind speeds up to 166 kph (103 mph), with the lower block secured to a 550 kip load and pretensioned to 440 kips. The licensee stated that the maximum allowable wind speed during operation of the OLS when the load was more than 0.9 meters (3 ft) off the ground and outside the containment would be 10 meters per second (m/s) (36 kph or 22 mph). The maximum allowable wind speed would be

14.75 m/s (53 kph or 33 mph) when the OLSs load is less than or equal to 0.9 meters (3 ft) off the ground.

Mobile cranes for OLS assembly or disassembly would cease operations if wind speeds exceed 56 kph (35 mph). This wind speed was based upon the crane manufacturer's operating manual. The wind speed for operations using the mobile cranes was not lowered as the load drop and consequence analysis showed that no unacceptable consequences would result from a dropped load with the safe load path, load handling restrictions, and compensatory measures in place, which were found to be acceptable by the NRC staff. In addition, to ensure that any restrictions on the wind speeds are implemented, the mobile cranes would rely on the site wind speed readings that are recorded at the site meteorological tower. Consequently, during heavy lift operations with the OLS and mobile cranes the licensee would also use meteorological forecasts to ensure operations are not conducted during severe weather conditions.

3.2.5 Commercial Crane Operating Experience

Since the OLS is a commercial crane not specifically designed for use at a nuclear facility, the NRC staff conducted a review of commercial crane operating experience. In particular, the NRC staff evaluated an event that occurred on July 14, 1999, during the Miller Park construction project in Wisconsin. The stadium construction project included a multipanel retractable roof supported by curved truss assemblies. The contractor constructed the truss assemblies supporting the retractable roof panels on the ground in approximately 200 ton to 450 ton sections and used a heavy lift (Lampson) crane to hoist the loads over the stadium structure, place them, and connect them in the proper place. This operation followed specific procedures for lifting each roof section that used the heavy lift crane and was coordinated by the lift supervisor, who was in radio contact with the crane crews and observers' stations at strategic locations around the job site. During a critical lift of one of the truss assemblies, wind speed measured up to 27 kph (17 mph), with the Lampson crane lowering the load over its proper place, the crane failed, killing three workers on site. The NRC staff was concerned that the licensee's operations, lifting similar loads under similar conditions, could lead to a heavy load drop that may result in unacceptable consequences.

The licensee provided the NRC staff with a comparison of the proposed OLS for the SGR and the Lampson crane used during the Miller Park construction project.

> The boom and jib of the Lampson crane are of single lattice frame construction. The crane is mounted at the base on crawlers with a relatively smaller footprint, which induces relatively higher ground pressures on the base or [soil] foundation. The Lampson crane used on the Miller Park project was seated on the ground, not on an engineered foundation. The ground on which it was seated was not a level surface and it is reported that at the time of failure there were apparent cracks in the ground on which the crane was seated.
>
> In comparison, the main mast (main boom) and back mast are of a significantly more robust A-Frame construction with the two legs of the A-Frame connected by a horizontal cross beam/frame. The two pivots at the base of the A-Frame masts are 33 ft apart laterally for both the main mast and the back mast. Further, the jib of the crane was a double frame construction with the two parallel frames connected by cross beams at three levels. The two jib pivots at the base of the double frame are 13 ft apart laterally.

> The OLS has a 70.5-ft diameter ringer base mounted on 24 jacks seated on top of an engineered foundation using outrigger plates. The OLS ringer design with 24 jacks enables good distribution of bearing pressure under the jack pads. The OLS would be seated on the reinforced concrete pile cap of an engineered pile foundation consisting of approximately 80 piles anchored into bedrock. The battered pile foundation was designed for lateral loads (seismic and wind) in addition to gravity loads of the crane and [lifted] load.

Active Monitoring Actions during OLS Operation:

(1) Monitor weather conditions, for the expected duration of the lift, to ensure conditions are acceptable for OLS operation.

(2) If weather conditions exceed operational limits of OLS, and heavy loads are in the vicinity of safety-related SSCs that are required to be operable, then take actions to terminate heavy load operation and place loads in a safe condition.

(3) Use safe load paths defined in procedures during OLS operation.

(4) Monitor OLS operation to ensure that a minimum clearance of 20 ft exists between the shield building dome and the SG when an SG is being moved over the shield building.

In reviewing the commercial crane operating experience and the information above related to the proposed use of the OLS for the SQN, Unit 2 SGRP, the NRC staff notes that the activities undertaken by the licensee, including analyses, testing, inspections and OLS support development, provide a structurally advantageous approach for the proposed heavy load lift at SQN, Unit 2 in comparison to other commercially constructed cranes lifting similar loads.

Therefore, the NRC staff finds the proposed use of the OLS, considering the above discussion acceptable, as it satisfies the intent of NUREG-0612 and the UFSAR when considering various external events. Additionally, having found the stress and stability of the OLS acceptable, the NRC staff concurs with the results of the licensee's analyses and procedural controls for handling heavy loads under the specified wind conditions. In addition, the regulatory commitments and compensatory measures associated with the proposed license amendment satisfy the guidelines of NUREG-0612 for the handling and control of heavy loads during the SGRP.

3.3 <u>Risk Evaluation</u>

RG 1.177 provides the NRC staff's recommendations for utilizing risk information to evaluate changes to nuclear power plant TS completion time and surveillance frequencies in order to assess the impact of such proposed changes on the risk associated with plant operation. RG 1.177 clarifies that other types of TS changes that follow the principles outlined in the RG may be proposed and will be considered on their own merit. Although this LAR requests neither changes to a completion time (CT) nor a surveillance frequency, there will be a temporary increase in risk during the time the SGs pass over safety-related equipment. This increase in risk is similar to the increase in risk associated with other planned, temporary plant activities (i.e., maintenance on safety-related equipment covered by the TSs). The request to put the plant in a TS controlled "degraded" state for a limited time is similar to a request for an acceptable CT. Therefore, the NRC staff has reviewed this TS change request against the acceptance guidelines in RG 1.177 for acceptable risk increases.

In addition to the average annual increases in core damage frequency (ΔCDF) and large early release frequency (ΔLERF) discussed in RG 1.174, RG 1.177 identifies additional metrics to be considered in a TS change request, i.e., incremental conditional core damage probability (ICCDP), and the incremental conditional large early release probability (ICLERP).

3.3.1 Technical Adequacy of the Probabilistic Risk Assessment (PRA)

The quality of the PRA must be compatible with the safety implications of the proposed TS change and the role the PRA plays in justifying the change. The NRC has developed regulatory guidance to address PRA technical adequacy, RG 1.200. The RG endorses, with comments and clarifications, ASME/American Nuclear Society (ANS) RA-Sa-2009, "Standard for Level1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications Capability." The RG clarifies that the NRC staff anticipates that capability category II of ASME/ANS RA-Sa-2009 is the level of detail that is adequate for the majority of applications.

The current PRA model for SQN was issued on May 27, 2011. A peer review of the model was performed in January 2011 on the internal events and internal flooding supporting requirements of ASME/ANS RA-Sa-2009. The Licensee stated that the peer review team endorsed the model as being compliant with the ASME/ANS PRA standard with 77 Facts and Observations (F&Os) identified. The licensee further clarified that all of the F&Os were resolved to meet capability category II prior to issue of the model of record. This TS change request will slightly increase the risk during a single series of heavy load movements totaling no more than 18 hours. The NRC staff finds the quality of the PRA acceptable because the licensee reported completion of the NRC-endorsed PRA quality control process, including responding to all F&Os, which provides sufficient confidence in the quality of the PRA given and the very small risk increase.

3.3.2 Scope of the PRA

RG 1.200 states that all initiating events must be considered during a risk analysis. The licensee reported that it does not have a peer reviewed fire or seismic PRA. RG 1.200 provides that missing scope items are to be addressed in some way, such as by using bounding analyses, or by limiting the scope of the application. As discussed below, the licensee evaluated the missing scope items using bounding analyses based, in part, on the short 18-hour exposure time.

A fire and a load drop are independent events. A fire is not expected to cause a load drop and a load drop is not expected to cause a fire, therefore the likelihood of a load drop and a fire is very low. The licensee reported that a load drop may damage a segment of high pressure fire protection (HPFP) system piping. However, the fire protection system will be realigned before moving the loads so that there will be no impact on operability of the HPFP system and fire fighting capability would not be affected by a load drop. Therefore, the NRC staff concurs that additional PRA analysis of fires in support of this LAR will not substantively affect the quantitative results and therefore are not required.

A seismic event during the exposure time may cause a load drop if the seismic event is strong enough. The licensee's letter dated September 29, 2011, stated that the OLS is designed for the SSE and will not drop a load during such an event. In the licensee's letter dated May 22, 2012, the licensee estimated the annual frequency of an SSE (or stronger) to be 3E-4/year. This yields a probability of about 6E-7 that the seismic event will occur during the 18-hour exposure time. This probability is well below the probability of having a random failure causing a load drop, which is estimated to be about 1E-3 over all 18 lifts. The facility is designed to be capable of shutting down following an SSE so there should be little consequential risk from such an event or slightly stronger events. Stronger seismic events occur with rapidly diminishing frequency. Therefore, the NRC staff concurs that additional PRA analysis of seismic events in support of this LAR will not substantively affect the quantitative results and, therefore, are not required.

3.3.3 PRA Modeling

The SGs in SQN, Unit 2 will be replaced. Unit 2 will be shutdown and defueled during these maneuvers; Unit 1 will be operating at full power. The risk during the maneuver is the risk that a heavy load will be dropped on safety related equipment required for the safe shutdown of Unit 1. The licensee reported in the submittal that there will be a total of 18 lifts of items heavy enough to damage safety-related equipment if dropped. It will take approximately 1 hour for each of these items to pass over the areas where a drop could damage the safety-related equipment. The systems involved are ERCW System, Component Cooling (CC) System, and Essential Air Distribution (EAD) System.

The licensee reported in the submittal that the only safety-related equipment required to be operable during the lifts is the ERCW system. The ERCW system will be realigned from its normal operating configuration to minimize damage and simplify recovery of the system if damaged by a dropped load. As illustrated by the fault trees in the licensee's letter dated September 29, 2011, the realigned ERCW, CC, and EAD systems will be cross-tied, or capable of being cross-tied by procedure, so that the undamaged parts of the systems can fulfill the functions necessary to shutdown Unit 1. The flooding following rupture of the realigned ERCW piping will submerge the residual heat removal (RHR) and the containment spray (CS) pumps if a temporary dam constructed in the pipe tunnel fails.

The licensee reported that the risk estimates were developed by modifying its PRA to reflect the following assumption:

1. The frequency used for the load drop initiator is the [estimated] industry average value of $5.6X10^{-5}$ per lift.

2. The new alignment of the ERCW valves is assumed to be in place for sixty days during which all heavy lifts will be performed.

3. Each lift of a heavy load is assumed to take one hour, and will occur eighteen times for a total exposure window of eighteen hours.

4. A load drop will sever all ERCW lines in the Unit 2 pipe tunnel and the Unit 2 RWST supply line.

5. The probability of dam failure (i.e., failure of the wall installed in the SQN, Unit 2, pipe tunnel that seals the tunnel from the Auxiliary Building) is assumed to be 1.0.

6. The operators will not succeed in isolating the flooding caused by the load drop prior to flooding elevation 653, which would submerge the RHR and CS pumps at that elevation.

7. It will take about 75 minutes for elevation 669'-0" to flood. The operators could stop the flooding by isolating the "B" discharge header of the ERCW system according to abnormal operating procedures preventing flooding above the 653'-0" elevation and the loss of equipment beyond the RHR and CS systems. The failure of the action to stop the flooding by isolating the discharge header is modeled in the PRA.

8. The fully loaded OLS will only fail during a seismic event that exceeds the SSE.

The licensee references an industry report as the source for the probability of load drop of $5.6X10^{-5}$ per lift. The same value is estimated in NUREG-1774, "A Survey of Crane Operating Experience at U.S. Nuclear Power Plants from 1968 through 2002," therefore, the NRC staff finds this value acceptable for use to support this LAR.

In the licensee's letters dated September 29, 2011, February 10, 2012, and April 5, 2012, the licensee described the modifications to its fault trees to 1) model the realigned systems and 2) model the loss of equipment if a heavy load was dropped on the realigned system. Based on these descriptions, the NRC staff concludes that the licensee PRA modeling is acceptable because it has identified and estimated all significant contributions to risk increase associated with the proposed activity.

3.3.4 Acceptance Guidelines

Consistent with RG 1.174, each change to TSs that can be shown to result in a risk impact below 10^{-6} per year for change to CDF, and below 10^{-7} per year for change to LERF would be expected to meet principle four of SRP Section 19.2 unless the total CDF and LERF are excessively high. RG 1.177 further states that an ICCDP of less than 10^{-6} and an ICLERP of less than 10^{-7} are considered small for a single TS condition entry. The total risk increase from system realignment and possible heavy load drop is to be compared to these guidelines.

In the licensee's letter dated September 29, 2011, the Licensee calculated the increase in CDF and LERF caused by realigning the ERCW system to be $7.20X10^{-7}$/year and $4.05X10^{-8}$/year respectively. The ICCDP and ICLERP values given that the systems will only be in the realigned condition for 60 days are $1.18X10^{-7}$ and $6.65X10^{-9}$, respectively.

In the licensee's letter dated May 22, 2012, the licensee provided the conditional core damage probability (CCDP) and conditional large early release probability (CLERP) given that a heavy load was dropped on the realigned system. The values reported for CCDP and CLERP are $1.24X10^{-4}$ and $9.03X10^{-6}$, respectively. All 18 heavy load lifts can be considered a single TS condition entry because they are covered by one, one-time TS change and will be performed sequentially with the ERCW system re-aligned. The ICCDP and ICLRP from a dropped load can be estimated as the product of the CCDP and CLERP and the total probability over all 18 lifts that a load drops.

ICCDP = $1.24X10^{-4}$ X $5.6X10^{-5}$ per lift X 18 lifts
ICCDP = $1.25X10^{-7}$

ICLERP= $9.03X10^{-6}$ X $5.6X10^{-5}$ per lift X 18 lifts
ICLERP= $9.10X10^{-9}$

The Total ICCDP and ICLERP are the values from the dropped load plus the values from realignment of the system for 60 days (cross term values should be subtracted out but they are negligible given these low values).

	ICCDP	ICLERP
Realignment	$1.18X10^{-7}$	$6.65X10^{-9}$
Drop	$1.25X10^{-7}$	$9.10X10^{-9}$
Total	$2.43X10^{-7}$	$15.75X10^{-9}$

The sequence of 18 heavy load lifts will occur once, and will occur in an interval that is less than 1 year. Changes in CDF and LERF are normalized to a 1-year interval for comparison with the annual change guidelines in RG 1.174. For a one time TS change that is accomplished within a 1-year interval, the ICCDP/ICLERP and ΔCDF/ΔLERF have the same numeric value. The estimated values are less than the $1X10^{-6}/1X10^{-7}$ and the $1X10^{-6}$ per year/$1X10^{-7}$ per year guideline values and therefore, acceptable.

The PRA quality, modeling, and quantitative results discussed above indicate that all the guidelines associated with an acceptable increase in risk are satisfied.

4.0 SUMMARY

Based on the preceding discussions, the NRC staff finds the crane design, maintenance, and inspection, safe load paths and procedures addressed within Enclosure 2 of the application letter dated September 29, 2011, as supplemented by letter dated April 5, 2012, acceptable with respect to the movement of heavy loads over safety-related SSCs during the SQN, Unit 2 SGRP. This acceptance is based on the NRC staff's determination that the licensee has adequately analyzed the potential load drop over safety-related SSCs during the SGRP, which results in a different type of accident than that previously evaluated in the UFSAR. As such, the NRC staff notes that the licensee will implement compensatory measures to preclude and mitigate the potential hazards of a drop, in accordance with BL 96-02. Therefore, the NRC staff finds the licensee's proposed, one-time license condition to OL DPR-77 for SQN, Unit 1 to support the SQN, Unit 2 SGRP acceptable.

The NRC staff finds the quality of the internal events PRA acceptable because the licensee recently applied the NRC endorsed PRA quality control process including responding to each observed F&O. The licensee does not have a peer reviewed fire and seismic PRA. Fires and load drops are independent and fire fighting capabilities should not be affected by a load drop. The OLS system is designed to withstand an SSE and the facility is designed to be capable of shutting down following an SSE so there should be little consequential risk from seismic events. Therefore, the NRC staff finds that additional PRA analysis of fire and seismic events in support of this LAR will not substantively affect the quantitative results and, therefore, are not required.

Based on the licensee summary of the PRA modeling, the NRC staff concludes that the modeling is acceptable because it has identified and estimated all significant contributions to risk increase associated with the proposed activity. All the estimated risk increases are below the guideline values and therefore acceptable.

The PRA quality, modeling, and quantitative results discussed above indicate that all the guidelines associated with an acceptable increase in risk are satisfied. Therefore, the NRC staff finds that risk increase is small and consistent with the intent of the Commission's safety goal policy statement.

Based on the evaluations discussed in this safety evaluation, the NRC staff finds that the licensee's proposed change to add a one-time condition to the SQN, Unit 1 license, for the conduct of heavy load lifts associated with the SQN, Unit 2, SGRP is acceptable because the applicable risk-related principles of risk-informed decisionmaking identified in RG 1.174 and RG 1.177 have been satisfied.

The NRC staff finds that the licensee has met the intent of NUREG-0612 to provide defense in depth during the performance of heavy load lifts in the vicinity of safety-related equipment. The licensee has followed the guidance of NUREG-0612 Section 5.1.1 to limit the probability of a heavy load handling accident. Potential heavy load accidents during the SGRP have been analyzed in accordance with the guidance of NUREG-0612 Appendix A to ensure that safe shutdown of the reactors can be achieved. The proposed addition to SQN, Unit 1 TS 3.7.5 limits the ERCW supply header temperature such that the system can still perform its safe shutdown function after a worst-case heavy load drop. The proposed plant modification to construct a wall in the ERCW pipe tunnel protects the Auxiliary Building equipment from flooding resulting from a heavy load drop. All preliminary actions required for the plant to conform to the analyses provided with the LAR are captured in license condition 2.C.(30) and Appendix C of the SQN, Unit 1 OL. By meeting the guidance in NUREG-0612, the NRC staff finds that the licensee has satisfied the intent of GDC-4 and GDC-5 with respect to heavy load handling during the SQN, Unit 2 SGRP. After reviewing the information provided by the licensee, the NRC staff finds the LAR to modify the TS and OL of SQN, Unit 1 acceptable.

Based on the above discussions, key principles of Section 19.2 of the SRP as stated in Section 2.0 have been satisfied.

The licensee included in its application the revised TS Bases to be implemented with the TS change. The NRC staff finds that the TS Bases Control Program is the appropriate process for updating the affected TS Bases pages and has, therefore, not included the affected Bases page with this amendment.

5.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Tennessee State official was notified of the proposed issuance of the amendment. The State official had no comments.

6.0 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, of 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, and there has been no public comment on such finding issued on December 27, 2011 (76 FR 80977). 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.

7.0 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.

Principal Contributors: D. Hoang
S. Dinsmore
E. Davidson

Date: September 20, 2012

September 20, 2012

Mr. Joseph W. Shea
Manager, Corporate Nuclear Licensing
Tennessee Valley Authority
3R Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

SUBJECT: SEQUOYAH NUCLEAR PLANT, UNIT 1 – SAFETY EVALUATION CORRECTIONS FOR AMENDMENT NO. 330 ASSOCIATED WITH UNIT 2 REPLACEMENT STEAM GENERATOR PROJECT TO CONDUCT HEAVY LOAD LIFTS (TAC NO. ME7225) (TS-SQN-2011-05)

Dear Mr. Shea:

On September 6, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued Amendment No. 330 to Facility Operating License No. DPR-77 for the Sequoyah Nuclear Plant, Unit 1. This amendment is in response to Tennessee Valley Authority's application dated September 29, 2011, as supplemented by letters dated February 10, March 5, April 5, and May 22, 2012.

It recently became apparent that the safety evaluation issued with the amendment needed certain corrections that are consistent with the licensee's amendment request. This was an oversight on our part and does not affect the NRC staff's overall conclusions associated with Amendment No. 330.

Enclosed is the corrected safety evaluation to be included with the issued amendment. We regret any inconvenience this may have caused.

Sincerely,

/RA/

Siva P. Lingam, Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-327

Enclosure: Corrected safety evaluation

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OFFICE	LPL2-2/PM	LPL2-2/LA	EMCB/BC	SBPB/BC	LPL2-2/BC (A)
NAME	SLingam	BClayton	YLi for MMurphy	RPlasse for GCasto	JQuichocho
DATE	09/20/12	09/20/12	09/20/12	09/20/12	09/20/12

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