Tennessee Valley Authority, Post Office Box 2000, Soddy-Daisy, Tennessee 37379-2000

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Vice President, Sequoyah Nuclear Plant

June 5, 1993

10 CFR 50.12

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

Gentlemen:

In the Matter of	)	Docket Nos. 50-327
Tennessee Valley Authority	)	50-328

SEQUOYAH NUCLEAR PLANT (SQN) - REQUEST FOR EXEMPTION FROM 10 CFR 50.60, "ACCEPTANCE CRITERIA FOR FRACTURE PREVENTION MEASURES FOR LIGHTWATER NUCLEAR POWER REACTORS FOR NORMAL OPERATION"

The purpose of this letter is to request, in accordance with the provisions of 10 CFR 50.12, an exemption from certain requirements of 10 CFR 50.60, "Acceptance criteria for fracture prevention measures for lightwater nuclear power reactors for normal operation" for SQN Units 1 and 2.

Paragraph 10 CFR 50.60 states that all lightwater nuclear power reactors must meet the fracture toughness and material surveillance program requirements for the reactor coolant pressure boundary as set forth in Appendices G and H to 10 CFR Part 50. Paragraph 10 CFR 50.60 specifies that proposed alternatives to the described requirements of 10 CFR Part 50 Appendices G and H may be used when an exemption is granted by NRC under 10 CFR 50.12.

This exemption is requested to allow the application of American Society of Mechanical Engineers (ASME) Code Case N-514, "Low Temperature Overpressure Protection," in determining the acceptable low temperature overpressure protection (LTOP) setpoints for SQN Units 1 and 2 and is similar to that recently granted for the Turkey Point Nuclear Plant.

Enclosed is the subject exemption with a detailed discussion of the application of ASME Code Case N-514 to SQN's LTOP setpoints. NRC review and response are requested by June 15, 1993, to support the current Unit 1 schedule for requiring LTOP operability before reactor coolant system venting.

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Please direct questions concerning this issue to D. V. Goodin at (615) 843-7734.

Sincerely,

Robert A. Fenech

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Enclosure
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Discussion

Pressure/temperature (P/T) limits for low temperature overpressure protection (LTOP) events can be characterized by two parameters: (1) the system enabling temperature, and (2) the vessel maximum pressure. According to current regulatory guidelines, the LTOP system must be enabled at temperatures less than or equal to RT_{NDT} + 90 degrees Fahrenheit (F), where RT_{NDT} is the adjusted reference temperature, including margin, at the one quarter thickness location. At temperatures greater than RT_{NDT} + 90 degrees F, LTOP need not be provided. The maximum LTOP system pressure is determined based on system-specific considerations, but is chosen so that the maximum pressure attained in the vessel will not exceed the P/T limit curve defined by Appendix G to American Society of Mechanical Engineers (ASME) Sections III and XI and Appendix G to 10 CFR Part 50.

Current LTOP limits produce operational constraints by limiting the range available to the operator to heat-up and cool-down the plant. The "operating window" for heat-up or cool-down of the reactor coolant system (RCS) is determined by the difference between the maximum allowable pressure (determined from ASME Section XI, Appendix G) and the reactor coolant pump (RCP) seal pressure, adjusted for LTOP system overshoot and instrument errors.

The LTOP system can have a significant economic impact by restricting plant operation. In addition, the narrow operating window can have an adverse impact if it increases the possibility of unnecessary actuations of the LTOP system.

Based on information recently provided to TVA by Westinghouse Electric Corporation, it has been determined that the generic methodology used to calculate the LTOP setpoints for SQN did not account for the differential pressure across the reactor core during RCP operation. The pressure input to the LTOP system is sensed at the RCS hot leg. After factoring in typical Westinghouse 4-loop, 12-foot core design plant data, an error of 74 pounds per square inch (psi) in the nonconservative direction was discovered. The additional pressure errors are because of: (1) static head differences between the sensing point of the RCS wide range pressure transmitters and the referenced point of the Appendix G curve, (2) flow velocity induced pressure drops throughout the RCS, and (3) nozzle differential pressure drop.

TVA has reviewed plant-specific LTOP setpoint calculations for SQN Units 1 and 2 and determined that insufficient margin exists to offset the errors. Adding this differential pressure to the SQN Units 1 and 2 LTOP setpoint analyses results in the design basis event pressure exceeding the limits of the Appendix G curves in a water-solid condition when reactor coolant temperature is below approximately 171 degrees F for Unit 1 and 118 degrees F for Unit 2. The design basis mass addition event is the injection of coolant into the water-solid RCS by a centrifugal charging pump. Although the centrifugal charging pump mass addition event is a part of the licensing basis assumption included in the LTOP setpoint analysis, the SQN Units 1 and 2 technical specifications require that the emergency core cooling system pathways for water injection be isolated below 350 degrees F.

TVA has evaluated lowering the LTOP setpoints to account for the omission. This would require lowering the existing LTOP pressure setpoints for RCS temperature below 171 degrees F for Unit 1 and 118 degrees F for Unit 2. A minimum of 200 pounds per square inch gauge (psig) differential across RCP seals is required for RCP starting. With all considerations taken into account, plant operating procedures recommend that RCS pressure be above 325 psig before operating RCPs. LTOP setpoints near the RCP operating range would provide little margin for pressure surges associated with normal operating evolutions (e.g., RCP starting or shifting operating charging pumps) with the RCS in a water-solid condition. This could result in unnecessary actuation of the LTOP system (i.e., opening of power-operated relief valves [PORVs]).

The present LTOP setpoints for SQN are based on a plant specific evaluation that determined parametrically the maximum permissible PORV setpoints. TVA Calculation SQN-IC-014 documents the accuracy of the instrumentation used by the LTOP system to demonstrate that the instrumentation is sufficiently accurate to perform its intended function without safety or operational limits being exceeded. A table identifies the existing margin between the Appendix G curve and the highest setpoint relief valve settings after correction for instrument errors. The margin is smallest at lower temperatures and increases as temperature increases. By interpolating between data points, it can be shown that the breakpoint for a 74 psi available margin will occur at 170.8 degrees F for Unit 1 and 117.5 degrees F for Unit 2. An excerpt of the calculation results is provided as follows:

Unit 1		Unit 2	
Temperature	Margin	Temperature	Margin
85 degrees F	24.23 psi	85 degrees F	17.11 psi
120 degrees F	52.86 psi	117.5 degrees F	74.0 psi
165 degrees F	62.45 psi	120 degrees F	78.44 psi
170.8 degrees F	74.0 psi	165 degrees F	172.37 psi
200 degrees F	131.64 psi	200 degrees F	290.90 psi

SQN specific analysis has been completed by Westinghouse to "fine tune" the 74-psi error previously reported. Westinghouse identified the circumferential weld between the two-ring forgings that encompass the beltline region as having the highest RT_{NDT} and therefore constitute the elevation of reference for the Westinghouse differential pressure-error calculations performed to determine the available margin. That elevation is 684 feet 6 inches, which is 126 inches below the reactor vessel hot leg centerline of 695 feet 0 inch. Westinghouse has reanalyzed the differential pressure for both units using actual SQN data. Using the reference point for the highest RT_{NDT} location and the 696-foot-9-inch elevation for the pressure transmitter combined with actual steam generator tube plugging data of 1.06 percent (144 tubes) has resulted in a reduction of the 74-psi additional error to 68.33 psi.

Additionally, the ASME Main Committee and Board of Nuclear Codes and Standards recently approved Code Case N-514 for use in plants having LTOP systems. This code case enables the LTOP system to limit the maximum pressure in the vessels to 110 percent of the pressure determined to satisfy Appendix G of Section XI, Article G-2215. In addition, Code Case N-514 requires the LTOP system to be effective at coolant temperatures less than 200 degrees F or at coolant temperatures corresponding to a reactor vessel metal temperature less than RT_{NDT} plus 50 degrees F, whichever is greater. Since the current RT_{NDT} for SQN Unit 1 is 195 degrees F and the current RT_{NDT} for Unit 2 is 142 degrees F, the code case will be applicable below RT_{NDT} plus 50 or 245 degrees F for Unit 1 and 200 degrees F for Unit 2. Westinghouse evaluated this code case and has incorporated the 10 percent relaxation in SQN's current pressure-temperature curves for temperature below 245 degrees F for Unit 1 and 200 degrees F for Unit 2. Applying Code Case N-514 to Appendix G limit curves will increase to the operating margin in the region of the limit curves where LTOP is active. The following table presents the results of the Westinghouse analysis and the new margins.

UNIT 1

Temp	Existing Margin	Margin Increase From Code Case N-514	Sum
85 degrees F	24.23 psi	50.098 psi	74.438 psi
120 degrees F	52.86 psi	52.95 psi	105.81 psi
165 degrees F	62.45 psi	59.517 psi	121.967 psi

UNIT 2

Temp	Existing Margin	Margin Increase From Code Case N-514	Sum
85 degrees F	17.11 psi	55.075 psi	72.185 psi
120 degrees F	78.44 psi	61.208 psi	139.648 psi
165 degrees F	172.37 psi	72.357 psi	247.727 psi

As can be seen from this table, the worst case is Unit 2 at 85 degrees F where the margin is slightly greater than 72 psi. However, combining this with the new differential pressure error of 68.33 psi will result in a remaining margin of 3.855 psi.

Code Case N-514

ASME Code Case N-514 allows setting the LTOP actuation setpoints such that the Appendix G curves are not exceeded by more than 10 percent. The application of this code case to SQN Units 1 and 2 would allow continued operation with the present setpoints.

The ASME Working Group on Operating Plant Criteria (WGOPC) developed code guidelines to define LTOP limits that will avoid certain unnecessary operational restrictions, provide adequate margins against failure, and reduce the potential for unnecessary activation of pressure-relieving devices used for LTOP.

The philosophy used by the WGOPC for developing these guidelines is to ensure that the LTOP limits are still below the P/T limits for normal operation, but allow the pressure that may occur with activation of pressure-relieving devices to exceed the P/T limits, provided acceptable margins are maintained during these events. This philosophy protects the pressure vessel from LTOP events, and still maintains the TS P/T limits applicable for normal heat-up and cool-down in accordance with Appendix G to 10 CFR Part 50 and Sections III and XI of the ASME code.

Inherent Margins to 10 CFR Part 50 Appendix G

There are numerous conservatisms in the development of Appendix G pressure and/or temperature curve calculations. Some of these are as follows:

1. The safety factor of 2 on the principal membrane (pressure) stresses.

2. A margin factor applied to RT_{NDT} by using Regulatory Guide 1.99, Revision 2.

3. The disregarding of increased mechanical properties of the vessel that accompany material embrittlement (elevated yield strength and flow stress).

These conservatisms support the determinations made by the WGOPC in the development of Code Case N-514.

Bases for Exemption

The requested exemption to the regulations is authorized by law, will not present an undue risk to the public health and safety, and is consistent with the common defense and security.

TVA believes the requested exemption meets the criteria in 10 CFR 50.12(a)(2) in that special circumstances are present. These special circumstances include:

1. 10 CFR 50.12(a)(2)(ii)

   The application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule.

Basis - The basis for the LTOP setpoints is to preclude RCS pressure from exceeding the Appendix G curves when there is a potential for brittle failure of reactor vessel material. ASME Code Case N-514 recognizes the conservatism of the Appendix G curves and allows establishing a setpoint that preserves the acceptable margin of safety while maintaining operational margins for RCP operation at low temperatures and pressures. Setpoints established in accordance with Code Case N-514 will also minimize the unnecessary actuation of protection system pressure-relieving devices. Therefore, establishing LTOP setpoints using Code Case N-514 criteria satisfies the underlying purpose of the ASME code and NRC's regulations to ensure nuclear power plant systems and components are operated to ensure an acceptable level of safety and environmental impact.

Based on the above, the application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule.

2. 10 CFR 50.12(1)(2)(iii)

Compliance would result in undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted, or that are significantly in excess of those incurred by others similarly situated.

Basis - Administrative restrictions on RCP operations while at low RCS temperatures would result in an unnecessary burden in that an excessive delay would be required to ensure minimum RCS temperature before starting the RCPs. TVA believes that this burden can be alleviated by the application of the code case. The guidelines developed by the WGOPC for LTOP P/T limits provide acceptable margin against crack initiation and failure in reactor vessels. These limits do not significantly change the likelihood of vessel failure associated with normal heat-up and cool-down P/T limits. Moreover, the LTOP guidelines will reduce the potential for unnecessary activation of protection system pressure-relieving devices. Consequently, the LTOP limits developed by the WGOPC provide both economic and safety benefits.

Therefore, compliance would result in undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted.

Conclusion

ASME Code Case N-514 allows setting the LTOP setpoints such that the Appendix G curves are not exceeded by more than 10 percent. The ASME code committee has concluded the LTOP guidelines provide acceptable margin against crack initiation and failure in reactor vessels, and will reduce the potential for unnecessary activation of protection system pressure-relieving devices. Consequently, the current LTOP setpoints provide both operational (economic) and safety benefits with no adverse safety or environmental impact. TVA believes that use of Code Case N-514 provides an acceptable level of quality and safety.

Compliance with the currently approved pressure and/or temperature limits would result in economic hardship to TVA, without a compensating increase in the level of quality or safety.

TVA requests that this exemption from certain requirements of 10 CFR 50.60 be processed in an expeditious manner. Presently, SQN Unit 1 RCS filling and venting following placement of the reactor vessel head are projected to commence on June 15, 1993. We request that this exemption request be granted before that time in order to provide maximum operational flexibility in returning Unit 1 to service.