

## NUCLEAR REGULATORY COMMISSION

[Docket No. 50-328]

### Tennessee Valley Authority, Sequoyah Nuclear Plant, Unit 2; Exemption

#### 1.0 Background

Tennessee Valley Authority (TVA, the licensee) is the holder of Facility Operating License No. DRP-79 which authorizes operation of Sequoyah Nuclear Power Station, Unit 2 (SQN2). The license provides, among other things, that the facility is subject to all rules, regulations, and orders of the U.S. Nuclear Regulatory Commission (NRC, the Commission) now or hereafter in effect.

The facility consists of a pressurized water-reactor located on TVA's Sequoyah site, which is located in Hamilton County, Tennessee.

#### 2.0 Request/Action

Title 10 of the Code of Federal Regulations (10 CFR), part 50, appendix G, which is invoked by 10 CFR 50.60, requires that pressure-temperature (P-T) limits be established for reactor pressure vessels (RPVs) during normal operating and hydrostatic or leak rate testing conditions. Specifically, appendix G to 10 CFR part 50 states that "[t]he appropriate requirements on . . . the pressure-temperature limits and minimum permissible temperature must be met for all conditions," and "[t]he pressure-temperature limits identified as 'ASME Appendix G limits' . . . require that the limits must be at least as conservative as limits obtained by following the methods of analysis and the margins of safety of Appendix G of Section XI of the ASME Code." Appendix G of 10 CFR part 50 also specifies that the Editions and Addenda of the ASME Boiler and Pressure Vessel (B&PV) Code which are incorporated by reference in 10 CFR 50.55a apply to the requirements in appendix G to 10 CFR part 50. The NRC endorsed Editions and Addenda of the ASME B&PV Code through the 1998 Edition and 2000 Addenda. However, TVA has currently incorporated the 1995 Edition through the 1996 Addenda of the ASME B&PV Code into the SQN2 licensing basis for defining the ASME B&PV Code requirements which apply to the unit's ASME B&PV Code, Section XI program. Hence, with respect to the statements from appendix G to 10 CFR part 50 referenced above, it is the 1995 Edition through 1996 Addenda of ASME B&PV Code, Section XI, Appendix G which apply for SQN2. Finally, 10 CFR 50.60(b) states that, "[p]roposed

alternatives to the described requirements in [Appendix G] of this part or portions thereof may be used when an exemption is granted by the Commission under [10 CFR 50.12]."

TVA requested in its submittal dated September 6, 2002, as supplemented by letters dated December 19, 2002, and June 24, 2003, that the staff exempt SQN2 from application of specific requirements of appendix G to 10 CFR part 50, and substitute use of ASME B&PV Code Case N-640. ASME B&PV Code Case N-640 permits the use of an alternate reference fracture toughness curve for RPV materials for use in determining the P-T limits. The exemption request is consistent with, and needed to support, a SQN2 license amendment request that was submitted on June 5, 2003, to modify the P-T limit curves in the facility's Technical Specifications (TS). The SQN2 license amendment request will revise the P-T limits for heatup, cooldown, and inservice test limitations for the reactor coolant system (RCS) to 32 effective full power years of operation.

#### Code Case N-640

The licensee has proposed an exemption to allow use of ASME Code Case N-640 in conjunction with ASME Section XI, Appendix G, 10 CFR 50.60(a) and 10 CFR part 50, appendix G, to establish P-T limits for the SQN2 RPV. The revised P-T limits have been developed using the lower bound  $K_{IC}$  fracture toughness curve shown in ASME Section XI, Appendix A, Figure A-2200-1, in lieu of the lower bound  $K_{IA}$  fracture toughness curve of ASME Section XI, Appendix G, Figure G-2210-1, as the basis fracture toughness curve for defining the SQN2 P-T limits. The other margins involved with the ASME Section XI, Appendix G process of determining P-T limit curves remain unchanged.

Use of the  $K_{IC}$  curve as the basis fracture toughness curve for the development of P-T operating limits is more technically correct than use of the  $K_{IA}$  curve. The  $K_{IC}$  curve appropriately implements the use of a relationship based on static initiation fracture toughness behavior to evaluate the controlled heatup and cooldown process of an RPV, whereas the  $K_{IA}$  fracture toughness curve codified into Appendix G to Section XI of the ASME Code was developed from more conservative crack arrest and dynamic fracture toughness test data. The application of the  $K_{IA}$  fracture toughness curve was initially codified in Appendix G to Section XI of the ASME Code in 1974 to provide a conservative representation of RPV material fracture

toughness. This initial conservatism was necessary due to the limited knowledge of RPV material behavior in 1974. However, additional knowledge has been gained about RPV materials which demonstrates that the lower bound on fracture toughness provided by the  $K_{IA}$  fracture toughness curve is well beyond the margin of safety required to protect the public health and safety from potential RPV brittle failure. Application of the provisions of ASME Code Case N-640 will result in the implementation of P-T limit curves having sufficient margin to ensure that, when stressed, the reactor pressure vessel will behave in a nonbrittle manner and that the probability of rapidly propagating brittle fracture is extremely low.

In addition, P-T limit curves based on the  $K_{IC}$  fracture toughness curve will enhance overall plant safety by opening the P-T operating window with the greatest safety benefit in the region of low temperature operations. The operating window through which the operator heats up and cools down the RCS is determined by the difference between the maximum allowable pressure determined by Appendix G of ASME Section XI, and the minimum required pressure for the reactor coolant pump seals adjusted for instrument uncertainties. A narrow operating window could potentially have an adverse safety impact by increasing the possibility of inadvertent overpressure protection system actuation due to pressure surges associated with normal plant evolutions such as RCS pump starts or swapping operating charging pumps with the RCS in a water-solid condition.

Therefore, the licensee concluded that these considerations were special circumstances pursuant to 10 CFR 50.12(a)(2)(ii), and supported the requested exemption to utilize the provisions of ASME B&PV Code Case N-640 in the development of SQN2 RPV P-T limit curves.

The NRC staff has reviewed the exemption request submitted by TVA and has concluded that an exemption should be granted to permit the licensee to utilize the provisions of ASME B&PV Code Case N-640 for the purpose of developing SQN2 RPV P-T limit curves. The NRC staff agrees that special circumstances pursuant to 10 CFR 50.12(a)(2)(ii), "[a]pplication 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," exist. The NRC staff concurs that the licensee may acceptably apply the provisions of