October 5, 2000

Mr. J. A. Scalice
Chief Nuclear Officer
and Executive Vice President
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, Tennessee 37402-2801

SUBJECT: RELIEF FROM ASME CODE REQUIREMENTS FOR PUMP AND VALVE INSERVICE TESTING REQUIREMENTS AT SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2 (TAC NOS. MA7966 AND MA7967)

Dear Mr. Scalice:

By letter dated November 15, 1999, as supplemented on July 21, 2000, the Tennessee Valley Authority (TVA) submitted a request for relief from the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, inservice testing (IST) requirements for pumps and valves at Sequoyah Nuclear Plant, Units 1 and 2, under *Title 10 of the Code of Federal Regulations* (10 CFR), Section 50.55a(a)(3)(i). The letters comprised Request for Relief No. RP-08, which proposed relief from Sections 4.6.1.6 and 5.2 of ASME Standard OM-6 for IST of the Residual Heat Removal (RHR) pumps during quarterly mini-flow testing. Specifically, TVA proposed to exclude the measurement of vibration in the response range from one-third of the pump shaft rotational speed up to one-half of the rotational speed for the quarterly mini-flow test of the affected pumps. The reason for the request is that these pumps have a high natural resonant vibration level in the low frequency range (10 to 11 Hertz) that, if included, would place the pumps in the alert or required action range. These vibrations are significantly less during the full-flow IST tests, which are more indicative of actual pump service conditions.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the information provided in TVA's November 15, 1999, and July 21, 2000, letters. The staff's evaluation and conclusions are contained in the enclosed Safety Evaluation. Although the TVA relief request proposed relief pursuant to 10 CFR 50.55a(a)(3)(i) as an alternative that would provide an acceptable level of quality and safety, the NRC staff concluded that relief should, more appropriately, be authorized pursuant to 10 CFR 50.55a(a)(3)(ii), on the basis that compliance with the Code requirement for mini-flow testing would result in hardship without a compensating increase in the level of quality and safety. Therefore, based on the information provided in Relief Request RP-08, the staff concludes that compliance with the Code requirements would result in a hardship without a compensating increase in the level of quality and safety, and that TVA's proposed alternative will provide reasonable assurance of the components' operational readiness. Accordingly, the NRC staff authorizes the use of the proposed alternative pursuant to 10 CFR 50.55a(a)(3)(ii) for the RHR pump mini-flow IST testing only.

If you or your staff have any questions regarding this matter, please call the assigned NRC Project Manager for Sequoyah, Mr. Ronald Hernan, at (301) 415-2010.

Sincerely,

/RA/
Richard P. Correia, Chief, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-327 and 50-328

Enclosure: Safety Evaluation

cc w/enclosure: See next page

If you or your staff have any questions regarding this matter, please call the assigned NRC Project Manager for Sequoyah, Mr. Ronald Hernan, at (301) 415-2010.

Sincerely,

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Richard P. Correia, Chief, Section 2
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Enclosure: Safety Evaluation

cc w/enclosure: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

OF RELIEF REQUEST FROM ASME SECTION XI REQUIREMENTS

PUMP AND VALVE INSERVICE TESTING

FOR

TENNESSEE VALLEY AUTHORITY

SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2

DOCKET NUMBERS 50-327 AND 50-328

1.0 INTRODUCTION

Title 10 of the Code of Federal Regulations (10 CFR), Section 50.55a, requires that inservice testing (IST) of certain American Society of Mechanical Engineers (ASME) Code Class 1, 2, and 3 pumps and valves are performed in accordance with Section XI of the ASME *Boiler and Pressure Vessel Code* (the Code) and applicable addenda, except where alternatives have been authorized or relief has been requested by the licensee and granted by the U.S. Nuclear Regulatory Commission (NRC or the Commission) pursuant to paragraphs (a)(3)(i), (a)(3)(ii), or (f)(6)(i) of 10 CFR 50.55a. In proposing alternatives or requesting relief, the licensee must demonstrate that: (1) the proposed alternatives provide an acceptable level of quality and safety; (2) compliance would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety; or (3) conformance is impractical for its facility. Section 50.55a authorizes the Commission to approve alternatives and to grant relief from ASME Code requirements upon making the necessary findings. Guidance related to the development and implementation of IST programs is given in NRC Generic Letter 89-04, "Guidance on Developing Acceptable Inservice Testing Programs," issued April 3, 1989, and its Supplement 1, issued April 4, 1995. Also see NUREG-1482, "Guidelines for Inservice Testing at Nuclear Power Plants," and NUREG/CR-6396, "Examples, Clarifications, and Guidance on Preparing Requests for Relief from Pump and Valve Inservice Testing Requirements."

The 1989 Edition of the ASME Code is the applicable Code of record for the second 10-year interval IST program at the Sequoyah Nuclear Plant (SQN), which began on December 16, 1995. Subsection IWV of the 1989 Edition, which gives the requirements for IST of valves, references Part 10 of the American National Standards Institute/ASME *Operations and Maintenance Standards* (OM-10) as the rules for IST of valves. OM-10 replaces specific requirements in previous editions of Section XI, Subsection IWV, of the ASME Code. Subsection IWP of the 1989 Edition, which gives the requirements for IST of pumps, references Part 6 of the American National Standards Institute/ASME *Operations and Maintenance Standards* (OM-6) as the rules for IST of pumps. OM-6 replaces specific requirements in previous editions of Section XI, Subsection IWP, of the ASME Code.

Enclosure

By letter dated November 15, 1999, the Tennessee Valley Authority (TVA) submitted a pump Request for Relief (RP-08) for SQN Units 1 and 2, requesting relief from the requirements of Paragraph 4.6.1.6 of the OM-6 standard. On May 2, 2000, a conference call was held with the licensee to discuss the relief request. By letter dated July 21, 2000, the licensee submitted a revised relief request, requesting relief from the requirements of Paragraph 5.2 of the OM-6 standard. The NRC staff has completed its review of the relief request RP-08 and is providing the following evaluation.

2.0 PUMP RELIEF REQUEST RP-08

Relief is requested for the Residual Heat Removal (RHR) System pumps (1A, 1B, 2A, and 2B) from the testing requirements of vibration measurements as required by Paragraph 5.2 of OM-6. TVA proposes to exclude the measurement of vibration in the response range from one-third of the pump shaft rotational speed up to one-half of the rotational speed.

2.1 Licensee's Basis for the Relief Request

The licensee has provided a summary of the basis for the relief request (see licensee's submittal dated July 21, 2000) and states:

> SQN proposes to exclude from the OM Part 6 pump test the vibration measurement in the range from one-third up to one-half of pump shaft rotational speed. The exclusion of vibration measurements from one-third to one-half minimum pump shaft rotational speed will exclude the readings associated with the natural frequencies as described above. It has been shown that these frequencies do not affect pump performance. Excluding this range of vibration for test measurements would prevent placing the pumps in an "Increased Frequency" test status. Placing SQN's RHR pumps on an increased frequency test status provides no added value for monitoring pump performance. The dominant peak at one-third running speed masks data trending at the frequencies that represent actual pump/motor health. This places unnecessary burden on SQN resources and of having to place the pumps on an increased frequency for testing resulting in additional wear on the equipment and potential challenges to the plant. Pump degradation due to real pump problems, will be evident with OM Part 6 pump test monitoring the representative pump/motor condition frequencies without being masked by the unrelated structural resonant peak. This will ensure appropriate corrective actions are taken to address these levels of vibration that could result in pump degradation.
>
> Based upon the above, SQN concludes that the pumps operate acceptably and will perform their safety function as required during normal and accident conditions.

2.2 Proposed Alternate Testing

The licensee states:

> Vibration measurements of the upper motor bearing of the RHR pumps will be taken during the quarterly OM Part 6 pump tests in a range from one-half minimum pump shaft rotational speed to at least 1000 Hz.

2.3 Evaluation and Conclusion

Paragraph 5.2 of OM-6 requires that an IST be conducted with the pump operating at specific reference conditions, and vibration measurements be broad band (unfiltered from one-third minimum pump shaft rotational speed to at least 1000 Hz). The licensee proposes to take vibration measurements of the upper motor bearing of the RHR pumps during the quarterly OM Part 6 pump tests in a range from one-half minimum pump shaft rotational speed to at least 1000 Hz.

At SQN, the RHR pumps are tested quarterly, using the minimum flow recirculation line and the nominal mini-flow rate is 500 gpm for pump protection. During each refueling outage, the RHR pumps are tested in accordance with OM-6 at full flow to ensure compliance with their emergency core cooling safety function requirements. Although the licensee requested relief for both full-flow and mini-flow tests, the staff finds that the basis for the relief and the proposed alternative test is applicable only to the quarterly mini-flow tests for the following reasons.

According to the licensee, the RHR pumps for SQN are the typical design for more recent Westinghouse four-loop plants (i.e., centrifugal pumps with the motor in the vertical position). There is no typical bearing housing associated with these pumps as there is with centrifugal pumps where the pump and the driver are in the horizontal position. The pump and motor utilize one continuous shaft. There is no coupling located along the shaft and all of the bearings for the pump/motor assembly are located in the motor. Prior to initial operation, a natural frequency of 10 to 11 Hz for the RHR pumps was identified by SQN. The same 10 to 11 Hz natural frequency was identified by SQN again in a more recent, advanced vibration diagnostic.

The pump mini-flow characteristics create low-frequency flow pulsations which tend to excite the structural resonant frequencies of the pump assembly. The natural system frequency of 10 to 11 Hz can exhibit sufficient force such that when measurements are taken during the mini-flow testing at the upper motor bearing, the vibration readings exceed the OM-6 acceptable ranges. However, the data from full-flow tests conducted during refueling outages show that the vibration is significantly reduced in this frequency range, and more importantly, the full-flow test results meet the OM-6 acceptance criteria. This indicates that higher vibration only occurs during mini-flow tests, and is primarily caused by low frequency flow pulsations combined with the low structural resonant frequencies of the pump assembly. Although the RHR pump has experienced high vibration during previous mini-flow tests, the spectral analysis performed by TVA indicates that there are no problems with the bearings or rotating elements. Furthermore, TVA has monitored this high vibration condition since original installation of these pumps and has concluded that there is no degradation of the pump/motor/foundation assembly from the inherent high vibration in this range during mini-flow tests.

The high vibration level in the low frequency range caused by reduced flow and low natural frequency of the pump assembly can occasionally result in overall vibration velocity higher than the OM-6 acceptable limits. Exceeding the vibration limits during the mini-flow test would place the RHR pumps in an “Increased Frequency” test status. However, the pump operation histories and the spectral analyses performed by TVA indicates no degradation of the affected pumps since original installation, and the pump operability has been demonstrated each refueling outage by full-flow tests. Thus, increasing the mini-flow test frequency would not cause an increase in the level of safety or quality in monitoring pump performance. The pumps are designed to run at full-flow conditions, an increased frequency of mini-flow tests could result in additional wear on the equipment and potential challenges to the plant, as well as cause unnecessary burden on the licensee. Therefore, the licensee proposes to exclude the measurement of vibration in the small range from one-third of the rotational speed up to one-half of the rotational speed but continue monitoring the pump vibration level from one-half of the rotational speed to 1000 Hz. The staff finds that the combined test of monitoring the vibration from one-half of the rotational speed to 1000 Hz for mini-flow tests, and from one-third of the rotational speed to 1000 Hz of the Code-required range for a full-flow test will provide reasonable assurance of operational readiness of the affected pumps.

3.0 CONCLUSION

Pursuant to 10 CFR 50.55a(a)(3)(ii), the staff concludes that Relief Request RP-08 is authorized for the quarterly mini-flow tests on the basis that compliance with the Code requirements would result in hardship without a compensating increase in the level of quality and safety. It should be noted that the authorization does not apply to full-flow tests because, as discussed above, the full-flow test meets the Code requirements and does not impose undue hardship or unusual difficulty on the licensee. When performed at each refueling outage, the full-flow test will provide reasonable assurance of the operational readiness of the affected pumps.

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Date: October 5, 2000

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