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

October 21, 1994

Mr. Oliver D. Kingsley, Jr.
President, TVA Nuclear and
Chief Nuclear Officer
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, Tennessee 37402-2801

SUBJECT: WATTS BAR NUCLEAR PLANT - REQUEST FOR ADDITIONAL INFORMATION AND PARTIAL SAFETY EVALUATION, BULLETIN 88-08, THERMAL STRESS IN PIPING CONNECTED TO REACTOR COOLANT SYSTEMS (TAC NOS. M89581 AND M89582)

Dear Mr. Kingsley:

In a letter dated March 29, 1994, Tennessee Valley Authority (TVA) provided additional responses to Item 3, "Actions Requested," of Bulletin 88-08. TVA stated that it has completed the implementation of a program for Watts Bar Unit 1, and the engineering evaluation for Unit 2, to address concerns of potential stratification and thermal cycling that could cause fatigue failure in unisolable sections of piping connected to the reactor coolant system (RCS) that are susceptible to inadvertent in-leakage or out-leakage. The program implementation and the evaluations were performed by TVA in conjunction with its contractor, Aptech Engineering Services, Inc.

The staff has reviewed TVA's March 29, 1994 submittal, and concludes that TVA has provided acceptable responses to the concerns stated in the bulletin, with the exception of the following lines for each unit:

- The auxiliary pressurizer spray line.
- The letdown line to the excess letdown heat exchanger.
- The residual heat removal supply line.

For these lines, the staff concludes that TVA has not provided the assurance requested in Item 3 of the bulletin that the unisolable sections of these lines will not be subjected to thermal stresses which could cause fatigue failure during the life of the unit. This assurance can be provided by one of the options listed in Item 3, in conjunction with the guidelines provided in the staff's letter to TVA dated September 19, 1991 (editorially modified by letter dated October 23, 1991). The staff's request for additional information and partial evaluation are documented in the enclosure. This requirement affects nine or fewer respondents and, therefore, is not subject to Office of Management and Budget review under P.L. 96-511.

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APTECH also identified a safety injection line in Unit 2 where potential fatigue failure may result from inadvertent in-leakage. APTECH proposed a number of options to TVA to resolve this issue. TVA has committed to adopt one of these options before initial criticality, and, within 30 days of completion, confirm in writing that the modifications have been accomplished. The staff finds this acceptable.

This review was performed by Mr. Mark Hartzman.

Sincerely,

Original signed by

Peter S. Tam, Senior Project Manager
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Division of Reactor Projects II-4
Office of Nuclear Reactor Regulation

Docket Nos. 50-390 and 50-391

Enclosure: RAI/Safety Evaluation

cc w/enclosure: See next page

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WASHINGTON, D.C. 20555-0001

REQUEST FOR ADDITIONAL INFORMATION AND PARTIAL SAFETY EVALUATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RESPONSE TO NRC BULLETIN 88-08

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2

DOCKET NOS. 50-390 AND 50-391

1.0 BACKGROUND

By Reference 1, Tennessee Valley Authority (TVA) provided an additional response to Item 3 of "Actions Requested" of Bulletin 88-08 (Reference 2), as applicable to Watts Bar Nuclear Plant (WBN), Units 1 and 2. TVA stated that it has completed the implementation of a program for WBN Unit 1, and the engineering evaluation for WBN Unit 2, to address concerns of potential stratification and thermal cycling that could cause fatigue failure in unisolable sections of piping connected to the reactor coolant system (RCS). The program implementation and the evaluations were done by TVA in conjunction with Aptech Engineering Services, Inc. (APTECH).

2.0 EVALUATION

In Reference 1, APTECH identified all lines connected to the RCS in both units which contain unisolable sections, and evaluated these lines for susceptibility to in-leakage or out-leakage according to guidance provided by the NRC staff in Reference 3. Based on the operating conditions for each system, APTECH identified a number of lines which were potentially susceptible to the phenomena described in the bulletin (fatigue failure due to thermal stratification and cycling caused by isolation valve leakage).

The concerns for the majority of lines subjected to in-leakage were resolved by determining that the isolating check valves were located at a distance greater than 25 diameters from the RCS hot or cold leg nozzles, or by determining that the upstream pressure was lower than the RCS pressure during plant operation, as recommended in the NRC guidelines in Reference 3. The staff finds this acceptable.

Based on the review of system operating conditions, APTECH identified the following lines as requiring further evaluation: the auxiliary pressurizer spray lines; the normal and alternate charging lines; the safety injection lines; and the residual heat removal system (RHR) lines. Based on an engineering evaluation, APTECH determined that only the safety injection line attached to RCS Loop 1 of Unit 2 was found to be susceptible to the phenomena described in the bulletin.

ENCLOSURE

The staff has reviewed the APTECH evaluation, and has identified a number of lines in both units, for which the bulletin concerns have not been adequately addressed. These lines are as follows:

- The Auxiliary Pressurizer Spray line. This line was considered as not susceptible to in-leakage because the check valve is located outside the normal pressurizer spray line "turbulent penetration zone." No supporting documentation, calculations or test data were provided for this assertion, and is therefore not acceptable. The application of the concept of "turbulent penetration" is currently under review by the staff, and has as yet not been found acceptable as a basis for the exclusion of unisolable lines to susceptibility of the phenomena described in the bulletin.

- The 1-inch excess letdown line to the excess letdown heat exchanger. This line is isolated by an air-operated globe valve. This line was determined to be potentially susceptible to out-leakage since the pressure on the heat exchanger side is lower than the RCS pressure. APTECH has stated that there is no likelihood of out-leakage since the air operator always exerts a closing force on the valve disc when the valve is closed, and the disc will therefore not experience cyclic opening and closing, as described in Supplement 3 of the bulletin. No analytical or experimental basis for this statement has been provided. In addition, it appears that due to the thermal gradient from the upstream to the downstream side of the valve, there is a potential of disc seat warping; this warping may permit leakage through the valve to occur, heating up the downstream fluid sufficiently to eliminate the thermal gradient and thus shut off the leakage. The staff concludes that the concern for this line has not been adequately resolved.

- The 14-inch RHR line. This line is isolated by two motor-operated valves. APTECH stated that these valves are closed by torque setting, and will remain closed whether the valve discs are hot or cold. APTECH therefore concluded that this line is not susceptible to the phenomena described in Supplement 3 of the bulletin. However, this approach was described in Supplement 3; it was considered in the foreign plant mentioned in the supplement as a means for preventing intermittent valve leakage in RHR lines, but was rejected since no assurance could be provided that the valve would open on demand. This consideration is feasible if sufficient torque is exerted to assure that the disc sits tightly in its seat. However, no evaluation or test data was submitted to provide assurance that if the valves were closed and seated under the required torque to prevent leakage, these valves would also be able to open on demand as required. Such assurance is required by the provisions of Generic Letter 89-10 (Reference 4).

  APTECH also stated that the isolation valves on these lines are within the RCS "turbulent penetration" zone, which is essentially at RCS temperature. No documentation, supporting calculations and experimental data have been provided regarding the extent and temperature of this penetration, and the relevance of this fact to these lines has not been established. In addition, the application of the concept of "turbulent

penetration" as a basis for the exclusion of unisolable lines to susceptibility of the phenomena described in the bulletin is currently under review by the staff, and has as yet not been found acceptable.

Based on these considerations the staff concludes that the concerns described in Supplement 3 of the bulletin, as applicable to the RHR lines in both units, have not been adequately addressed or resolved.

- Safety Injection (SI) Lines from the Boron Injection Tank. APTECH determined that under the current RCS configurations only the SI line for Loop 1 of Unit 2 may be susceptible to excessive thermal stresses due to in-leakage. APTECH performed a thermal fatigue evaluation for this line and have concluded that fatigue failure, characterized by calculating a cumulative usage factor greater than one, would occur in less than one fuel cycle. These calculations have not been provided to the NRC staff and have therefore not been evaluated. APTECH therefore proposed a number of options to TVA to resolve this issue, such as relocating the valve to a distance greater than 25 diameters from the RCS nozzle, or the addition of a small recirculation line to connect a point downstream of the BIT isolation valves to the Charging Pump header. TVA has committed, in Enclosure 2 to Reference 1, to implement one of these options before initial criticality of Unit 2 and to report the completion of this action within 30 days of the completion of the modification. The staff finds both options acceptable.

3.0 REQUEST FOR ADDITIONAL INFORMATION

The staff finds that the issues and concerns described in Bulletin 88-08 and Supplement 3 have not been acceptably resolved for the auxiliary pressurizer line, the excess let-down line and the RHR line, for both Units 1 and 2. For these lines the staff concludes that TVA has not provided the requested assurance in Item 3 that the unisolable sections of these lines will not be subjected to thermal stresses which could cause fatigue failure during the life of the unit. This assurance can be provided by one of the options listed in Item 3, in conjunction with the guidelines provided in Reference 3.

4.0 REFERENCES

1. Letter of March 29, 1994, from W. J. Museler, Tennessee Valley Authority (TVA), to the NRC Document Control Desk, with enclosed engineering report "Watts Bar Nuclear Plant Response to NRC Bulletin 88-08", by Aptech Engineering Services, Inc. (APTECH), March 1994.

2. NRC Bulletin 88-08 "Thermal Stresses in Piping Connected to Reactor Coolant Systems," with three supplements.

3. Letter of September 19, 1991, from P. S. Tam, NRC, to D. A. Nauman, TVA, with enclosure titled "Evaluation Criteria for Responses to NRC Bulletin 88-08, Action 3, and Supplement 3."

4. NRC Generic Letter 89-10, "Safety Related (1) Motor Operated Valve Testing and Surveillance," June 28, 1989.

Principal Contributor: Mark Hartzman

Dated: October 21, 1994