October 10, 1991

Docket Nos. 50-390
50-391

Mr. Dan A. Nauman
Senior Vice President, Nuclear Power
Tennessee Valley Authority
6N 38A Lookout Place
1101 Market Street
Chattanooga, Tennessee 37402-2801

Dear Mr. Nauman:

SUBJECT: WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2 - TMI ITEM II.D.1, RELIEF AND SAFETY VALVE TESTING (TAC 79992)

We have reviewed your submittals dated July 22, 1983 and July 11, 1991, addressing the subject issue. We find that the information provided is not sufficient for us to complete the review. Enclosed please find a request for additional information (RAI). Note that the Electric Power Research Institute (EPRI) has prepared a document (Reference 3 of the RAI) to assist utilities in preparing their plant-specific submittals; in general, we find submittals prepared in accordance with Reference 3 acceptable.

We will be glad to confer with your staff if any clarification on this RAI is needed. After your staff had reviewed this RAI, we will determine a target date for your response at the next licensing status meeting.

This requirement affects 9 or fewer respondents and, therefore, is not subject to Office of Management and Budget review under P.L. 96-511.

Sincerely,

Original signed by

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

Enclosure:
Request For Additional
Information

cc w/enclosure:
See next page

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WATTS BAR NUCLEAR PLANT

TMI ITEM II.D.1, RELIEF AND SAFETY VALVE TESTING

REQUEST FOR ADDITIONAL INFORMATION

Questions related to inlet fluid conditions

1. Safety Valve Inlet Pressure Drop

The EPRI Test Conditions Report (Reference 4) stated that a method of demonstrating safety valve stability is to compare the total pressure drop of the inlet piping for the plant safety valve with the total pressure drop of the inlet piping for the EPRI test valve. The total inlet piping pressure drop is comprised of frictional and acoustic wave components evaluated under steam conditions. The inlet pressure drop provided in Reference 1 (30 psi at rated flow) appears to be too low relative to the EPRI test pressure drop of 263 psi on valve opening and 181 psi pressure rise on valve closing for the Crosby 6M6 test valve. Clarify how the value provided was calculated and ensure it includes both the frictional and acoustic wave components (see Reference 3). Provide a similar value for the inlet pressure rise on valve closing; the WBN value for inlet pressure rise should also include both frictional and acoustic wave components. Provide the requested information for both WBN units. Also, if the WBN calculated values exceed the test values, justify why the EPRI test results are applicable to the WBN valve configuration.

2. Backpressure

The submittal in Reference 1 provided the maximum backpressure calculated for the WBN discharge piping (610 psi). Because this value was provided in 1983, clarify if it is still applicable to the WBN Units 1 and 2 safety valves. Also, because Reference 4 identified the Target Rock PORV as susceptible to backpressure effects, provide the maximum calculated backpressure at WBN Units 1 and 2 for the PORVs. If the maximum plant backpressure for the safety valves or the PORVs exceeds the tested backpressure, justify the applicability of the EPRI tests to the WBN valve configuration. In particular, if the backpressure of 610 psi given in Reference 1 is also applicable to the PORVs, justify how the EPRI tests, where

the maximum backpressure measured for the test Target Rock PORV was 520 psi in a water seal simulation test, show operability of the WBN PORVs.

3. Cold Overpressure Transient

The expected inlet fluid conditions for the PORV during cold overpressure transients were not provided by the licensee. Provide the temperature range expected at the PORV inlet for both the low and high pressure setpoints and the maximum pressure calculated to occur during a cold overpressure transient for both the low and high pressure setpoints. Compare the expected inlet conditions to the test inlet conditions for the Target Rock PORV. If the expected plant inlet conditions are not bounded by the test conditions, justify the applicability of the EPRI tests to WBN.

4. Feedwater Line Break Inlet Conditions for WBN, Unit 2

Reference 5 identified the feedwater line break (FWLB) valve inlet conditions for WBN, Unit 1. The inlet conditions for WBN, Unit 2, were not given. Clarify if the Unit 1 conditions are also applicable to Unit 2; if not, provide the maximum pressure and pressurization rate, the maximum liquid surge rate into the pressurizer when the valves are passing liquid, and the range of liquid temperatures at the valve inlet for Unit 2. If the expected plant inlet conditions are not bounded by the test conditions, justify the applicability of the EPRI tests to WBN, Unit 2.

5. Applicability of Valve Inlet Conditions

Reference 5, the Westinghouse valve inlet conditions report, is now almost 10 years, and some of the information in the report is based on even older analyses. For example, the Unit 1 FWLB valve inlet conditions given in Reference 5 were based on a 1977 FSAR analysis. Clarify if the valve inlet conditions in Reference 5 are still applicable to WBN Units 1 and 2 for FSAR steam discharge, FSAR liquid discharge, extended high pressure injection, and cold overpressure protection transients. If not, provide updated valve inlet conditions for WBN Units 1 and 2 and identify the applicable EPRI tests for the new valve inlet conditions. If none of the EPRI tests are applicable to the new inlet conditions or the EPRI tests applicable to the new inlet

conditions indicate potential valve operability problems (chatter, test valve did not close, etc.) for the safety valves or PORVs, provide information and test data to justify valve operability for the new valve inlet conditions.

Questions related to valve operability

6. Valve Ring Settings

References 1 and 2 did not provide the ring settings for the WBN Units 1 and 2 Crosby 6M6 safety valves. Provide the settings for the upper and lower rings in the WBN valves for review. Compare these rings settings with those used in the EPRI tests and identify which of the tests are applicable to WBN valves (both ring settings and inlet conditions should be considered). These settings should be provided relative to the level position to be consistent with the method used to report the ring positions in the EPRI tests. If the ring settings at WBN are not comparable to applicable EPRI tests on the 6M6 valve, justify the applicability of the EPRI tests to the WBN safety valves.

7. Bending Moments

The information in References 1 and 2 did not provide the maximum bending moment calculated to occur on the valve discharge flanges of the safety valves and PORVs at both WBN units. Compare the worst case, plant calculated values to those applied to the valves in the EPRI tests. The calculated bending moments should include the effects of deadweight, thermal expansion, earthquake (SSE), and valve actuation loads. If the bending moments for the plant safety valves or PORVs exceed those applied to the test valves, justify that the plant valves will operate satisfactorily with the higher bending moment. Also, because the WBN and test PORVs are not identical, justify that none of the differences between the plant and test valves invalidate the use of the EPRI PORV bending moment data to demonstrate operability of the WBN PORVs with the plant specific bending moment.

8. Block Valve Motor Operator Torque

The Westinghouse 3GM88 valve in the EPRI tests was shown to open and close completely with a motor operator torque output of 182 ft-lbs. In

Reference 2, TVA stated the block valve operators at WBN were modified from torque control closure to limit control closure to ensure complete closure. To ensure that the plant block valve operators provide sufficient torque to open and close the valves at WBN, clarify whether the torque supplied by the motor operators at the plant is greater than or equal to 182 ft-lbs when using the limit control method. If the torque output of the plant operators is less than 182 ft-lbs, justify that they provide sufficient torque to close the valves under all expected inlet fluid conditions. This justification should be supported by test data.

9. Extended Safety Valve Blowdown

The safety valve blowdown in the applicable EPRI tests ranged from 4.8% to 12.7%. This indicates operation of the plant safety valves may result in blowdowns that exceed the design safety valve blowdown of 5%. Provide sufficient information to show: (a) the extended safety valve blowdown will not cause voiding of the primary system or degrade decay removal if voiding occurs, (b) the safety valves will operate acceptably if the extended safety valve blowdown results in filling the pressurizer, and (c) the extended safety valve blowdown will not challenge plant safety systems.

10. Similarity of Test and Plant PORVs

The TVA stated in Reference 1 that the Target Rock Model No. 82UU-001 PORVs at WBN Units 1 and 2 are the same type valve as the Target Rock Model No. 80X-006 PORV tested by EPRI. Provide additional information to clarify this statement. At the time of the EPRI valve justification report (Reference 6), only the now canceled Midland plant was identified as using Target Rock PORVs. The information in Reference 6 justified the similarity of the Midland and EPRI PORVs. However, the model number for the Midland PORVs (81CC-001) is different from the model number for the WBN PORVs (82UU-001). Therefore, additional information is needed to justify the tests on the EPRI PORV are applicable to the WBN PORVs. List all differences between the plant and test valves and justify the differences do not affect operability. If operability is affected, justify the applicability of the EPRI tests to the WBN PORVs.

11. Block Valve Orientation

The Westinghouse 3GM88 block valve was tested in the horizontal position (valve stem vertical) by EPRI. Clarify the orientation of the plant block valves (vertical or horizontal). If the plant orientation is different from the EPRI test orientation, clarify how the EPRI data justifies the operability of the WBN Units 1 and 2 block valves or provide other test data to support the operability of the plant valves.

12. PORV Control Circuitry

As noted in the introduction, NUREG-0737, Item II.D.I, requires qualification of the PORV control circuitry.

A. For environmental qualification, the NRC staff agreed that meeting the licensing requirements of 10 CFR 50.49 for this circuitry is satisfactory and specific testing per NUREG-0737 is not required. Therefore, verify whether the PORV control circuitry was reviewed and accepted under the requirements of 10 CFR 50.49.

If the PORV circuitry has not been qualified to the requirements of 10 CFR 50.49, provide information to demonstrate that the control circuitry is qualified per the guidance provided in Reg. Guide 1.89, Revision 1, Appendix E.

As an alternative, the staff has determined that the requirements of NUREG-0737 regarding the qualification of the PORV control circuitry may be satisfied if one or more of the following conditions is met.

a. The PORVs are not required to perform a safety function to mitigate the effects of any design basis event in a harsh environment and failure in a harsh environment will not adversely impact safety functions or mislead the operator (PORVs will not experience any spurious actuations and, if emergency operating procedures do not specifically prohibit use of PORVs in accident mitigation, it must be ascertained that PORVs can be closed under harsh environment conditions).

b. The PORVs are required to perform a safety function to mitigate the effects of a specific event but are not subjected to a harsh environment as a result of that event.

c. The PORVs perform their function before being exposed to a harsh environment and the adequacy of the time margin provided is justified; subsequent failure of the PORVs as a result of the harsh environment will not degrade other safety functions or mislead the operator (PORVs will not experience any spurious actuations and, if emergency operating procedures do not specifically prohibit use of PORVs in accident mitigation, it must be ascertained that PORVs can be closed under harsh environment conditions).

d. The safety function can be accomplished by some other designated equipment that has been adequately qualified and satisfies the single-failure criterion.

B. Clarify how the PORV control circuitry is qualified for normal operation. That is, clarify what tests are done to ensure the PORV control circuits will respond properly to operator actions in normal operation or emergency situations or automatic signals in emergency situations.

<u>Questions related to thermal-hydraulic analysis</u>

13. The following information is needed to complete the review of the WBN Units 1 and 2 thermal-hydraulic analysis:

a. The computer programs used for the thermal-hydraulic analysis were identified as WATHAM and STEHAM. Verification of STEHAM and WATHAM was provided in other utilities' submittals if STEHAM and WATHAM are Stone & Webster computer programs. Clarify if STEHAM and WATHAM were developed by Stone & Webster. If not, provide verification of STEHAM and WATHAM and the post processor, if any, used in conjunction with the thermal-hydraulic analysis program to

compute the fluid forces. The verification effort should include comparisons to EPRI/CE data or another benchmarked code.

b. For all thermal-hydraulic analyses, identify parameters such as valve flow rates, valve opening/closing times, valve opening pressure, pressure ramp rate, peak pressure, choked flow location, steam and water temperatures, fluid qualities, and time steps. Discuss the rationale for their selection relative to expected valve inlet conditions and/or EPRI test results on valve performance. If applicable, provide information on the node spacing used in STEHAM and WATHAM and justify the node sizes used in the analysis. Provide evidence to show that with the parameters used bounding forces were calculated, i.e., piping forces calculated with WATHAM and STEHAM were not underestimated due to numerical smearing because of the nodalization or time step size used. Also, provide evidence to show the conditions used result in forces that bound the expected forces based on plant conditions and EPRI test results.

c. Reference 2 stated the analysis of the pressurizer relief piping included the following transients: (a) safety valve opening/closing, (b) PORV opening/closing, and (c) PORV opening/closing during a cold overpressure transient. In case (a), clarify if both PORVs were closed while the safety valves actuated. In case (b), clarify if all safety valves were closed while the PORVs actuated. If simultaneous actuation of the safety valves and PORVs was assumed, justify that the forces calculated would bound the forces calculated assuming safety valve actuation only or PORV actuation only.

d. Justify that the conditions analyzed in cases a, b, and c above result in forces that bound the forces from all transient conditions expected at WBN Units 1 and 2. This would include steam discharge only transients, steam-to-water transition with hot water (such as the feedwater line break), steam-to-water transition with cold water (such as a cold overpressure transient), and hot and cold water discharge only transients.

e. Because the ASME Code requires derating of the safety valves to 90% of actual flow capacity, the piping analysis for safety valve discharge should be based on a flow rating at least equal to 111% of the flow rate stamped on the valve, unless another flow rate can be justified. Also, a higher flow rate may need to be used if higher safety valve or PORV flow rates were measured in the EPRI tests. Describe the methods used to establish flow rates for the safety valves and PORVs in the thermal-hydraulic analyses. If a flow rate less than the maximum flow rate measured in the EPRI tests was used in the thermal-hydraulic analysis, justify that the analysis provided bounding forces on the piping and supports.

Questions related to structural analysis

14. The submittal does not present details of the structural analysis. To allow for a complete evaluation of the methods used and results obtained from the structural analysis, please provide the following information:

a. Reference 2 indicated TPIPE was used to perform the structural analysis for WBN Units 1 and 2. Clarify how this program was verified. The verification effort should include comparisons to EPRI/CE data or another benchmarked code.

b. Describe the methods used to model supports, the pressurizer and relief tank connections, and the safety valve bonnet assemblies and PORV actuator. Identify the time step, the mass point spacing, damping factors, and the cutoff frequency used in the analysis model for various pipe sizes. Give the rationale for the choice of the computation time step, mass point spacing, damping, and cutoff frequency. Justify they provide bounding analyses for the WBN Units 1 and 2 pressurizer piping system. The values for the parameters chosen should adequately analyze the piping system response to frequencies of at least 100 Hz. For example, the time steps chosen should be approximately 0.001 s to allow a minimum of eight points per cycle to define the forces applied to the piping. If the parameters chosen do not adequately address frequencies of at least 100 Hz, provide sufficient information to justify that

the structural analysis accounts for the dominant piping frequencies at both WBN units.

c. Identify the load combinations used in the analysis and the allowable stress limits. Provide the load combinations used for the piping and supports upstream and downstream of the safety valves and PORVs. Explain the mathematical methods used to perform the load combinations. If the load combinations and methods differ from those suggested in Reference 3, discuss how the load combinations used satisfy the FSAR commitment for the piping and supports. Identify the governing design codes and standards used to determine the adequacy of the upstream and downstream piping and supports.

d. Provide an evaluation of the results of the structural analysis. Present tables listing the worst case load or stress for the piping and supports upstream and downstream of the safety valves and PORVs compared to the applicable design load or allowable stress. Identify the associated load combination equation. Indicate the piping location or support number, location, and type with respect to the piping model (i.e., node number) requested in item f below. Discuss the modifications made to the piping or supports, if any, and clarify when the modifications were completed.

e. Compare the stresses and loads calculated for the pressurizer nozzles for the safety valves and PORVs to the allowable stresses and loads. If the calculated stresses and loads exceed the allowable values, discuss the modifications TVA will make to bring the system into compliance.

f. Provide a sketch of the structural model showing lumped mass locations, pipe sizes, support locations, and application points of fluid forces.

Questions related to Watts Bar, Unit 2

15. The list of commitments included in Reference 2 indicated the fluid transient loads for Unit 2 would be reanalyzed. This would indicate Unit 2 is different from Unit 1, and the differences are being accounted for in the piping analyses. Identify the differences between Units 1 and 2, and clarify whether the differences were considered when determining items such as: (a) valve inlet/outlet conditions, (b) valve operability, (c) the maximum safety valve inlet piping pressure drop/rise, (d) the maximum backpressure for the safety valves and PORVs, and (e) the maximum bending moments on the safety valve and PORV discharge flanges.

16. The list of commitments in Reference 2 stated any modifications to the Unit 2 safety and relief valve piping would be completed before Unit 2 was turned over to Operations. The NRC staff position is that any modifications should be completed prior to Unit 2 licensing. Clarify if TVA can meet the NRC required schedule for Unit 2.

Principal Contributor: C. G. Hammer

Dated: October 10, 1991

REFERENCES

1. Letter from D. S. Kammer, TVA, to E. Adensam, USNRC, "In the Matter of the Application of Tennessee Valley Authority, Docket Nos. 50-390/50-391," July 22, 1983.

2. Letter from E.G. Wallace, TVA, to USNRC Document Control Desk, "In the Matter of the Application of Tennessee Valley Authority, Docket Nos. 50-390/50-391, Watts Bar Nuclear Plant (WBN) Units 1 and 2 - NUREG-0737, Item II.D.1 - Safety and Relief Valve Testing (TAC No. 79992)," July 11, 1991.

3. MPR Associates, Inc., EPRI PWR Safety and Relief Valve Test Program Guide for Application of Valve Test Program Results to Plant-Specific Evaluations, Revision 2, Interim Report, July 1982.

4. PWR Valve Program Staff, Electric Power Research Institute, EPRI PWR Safety and Relief Valve Test Program, Test Condition Justification Report, EPRI-NP-2460, December 1982.

5. Westinghouse Electric Company, Valve Inlet Fluid Conditions for Pressurizer Safety and Relief Valves in Westinghouse-Designed Plants, EPRI-NP-2296, December 1982.

6. MPR Associates, Inc., EPRI PWR Safety and Relief Valve Test Program, Valve Selection/Justification Report, EPRI-NP-2292, December 1982.