Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

CNL-15-150

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10 CFR 50 Appendix A

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Watts Bar Nuclear Plant Unit 2
Construction Permit No. CPPR-92
NRC Docket No. 50-391

Subject: **Watts Bar Nuclear Plant Unit 2 – Pressurizer PORV Block Valves – Dynamic Testing Alternative**

References:

1. Letter from NRC to All Licensees of Operating Nuclear Power Plants and Holders of Construction Permits for Nuclear Power Plants, "Safety-Related Motor-Operated Valve Testing And Surveillance (Generic Letter No. 89-10) - 10 CFR 50.54(f)," dated June 28, 1989 [ADAMS Accession No. ML031150300]

2. Letter from TVA to NRC, "Browns Ferry Nuclear Plant (BFN), Sequoyah Nuclear Plant (SQN), and Watts Bar Nuclear Plant (WBN) - Response to Generic Letter (GL) 89-10 - Safety-Related Motor-Operated Valve (MOV) Testing and Surveillance," dated December 21, 1989 [ADAMS Accession No. ML082320614]

3. Letter from TVA to NRC, "Watts Bar Nuclear Plant (WBN) Unit 2 - Status of Regulatory Framework for the Completion of Construction and Licensing for Unit 2 - Revision 12 (TAC No. MD6311), and Status of Generic Communications for Unit 2 - Revision 12 (TAC No. MD8314)," dated September 2, 2014 [ADAMS Accession No. ML14254A247]

The purpose of this letter is to inform the Nuclear Regulatory Commission (NRC) that Tennessee Valley Authority (TVA) has chosen to use the Electric Power Research Institute (EPRI) motor-operated valve (MOV) performance prediction methodology (PPM) in lieu of dynamic testing of the Watts Bar Nuclear Plant (WBN) Unit 2 Pressurizer Power Operated Relief Valve (PORV) block valves. TVA has determined that dynamic testing of the PORV block valves presents an unnecessary risk of rupturing the pressurizer relief tank rupture disks that relieve into containment and that an appropriate alternative exists. TVA is applying the EPRI MOV PPM instead of performing dynamic testing in order to address:

- Portions of NUREG-0737, "Clarification of TMI Action Plan Requirements," Item II.D.1, Performance Testing of Boiling-Water Reactor and Pressurized-Water Reactor Relief and Safety Valves;

- Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance;" and
- GL 96-05, "Periodic Verification of Design-Basis Capability of Safety-Related Motor Operated Valves."

In GL 89-10 (Reference 1), the NRC stated, in part, that the applicable MOV should be demonstrated to be operable by testing it at the design-basis differential pressure and/or flow determined from a review of the design basis for the operation of the MOV. If dynamic testing at design basis conditions is precluded by plant conditions, GL 89-10 stated that an explanation should be documented for any cases where testing with the design-basis differential pressure or flow cannot practicably be performed, including a description of the alternatives to design-basis differential pressure testing or flow testing that will be used. TVA provided the requested six month response (Reference 2) stating that TVA would develop and implement a comprehensive MOV testing and surveillance program for the Browns Ferry, Watts Bar, and Sequoyah Nuclear Plants, satisfying the intent of GL 89-10.

At the time TVA issued the Reference 3 Regulatory Framework letter for WBN Unit 2, TVA had planned to perform dynamic testing of the WBN Unit 2 Pressurizer PORV block valves. However, after reviewing the actual in-plant conditions required to perform the dynamic testing, TVA has determined that the risk associated with performing the testing does not justify the added assurance the test affords over using an alternative method. TVA, therefore, has determined that the use of the NRC approved EPRI Topical Report (TR)-103237, "EPRI MOV Performance Prediction Program," provides acceptable assurance of valve operation.

The enclosure to this letter contains a description and basis for TVA's determination that it is acceptable to use the EPRI TR-103237 methodology.

There are no new regulatory commitments associated with this submittal. Should you have any questions or require additional information, please contact Gordon Arent at (423) 365-2004.

Respectfully,

J. W. Shea

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J. W. Shea
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Enclosure: Description and Basis for TVA's Determination to use EPRI TR-103237, "EPRI MOV Performance Prediction Program," for Pressurizer PORV Block Valves

cc (Enclosure):

NRC Regional Administrator – Region II
NRC Senior Resident Inspector – Watts Bar Nuclear Plant, Unit 2
NRC Project Manager – Watts Bar Nuclear Plant, Unit 2
Director, Division of Radiological Health – Tennessee State Department of Environment and Conservation

ENCLOSURE

TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT UNIT 2

DESCRIPTION AND BASIS FOR TVA's DETERMINATION TO USE EPRI TR-103237, "EPRI MOV PERFORMANCE PREDICTION PROGRAM," FOR PRESSURIZER PORV BLOCK VALVES

1.0 BACKGROUND

In November 1980, the Nuclear Regulatory Commission (NRC) published NUREG-0737, “Clarification of TMI Action Plan Requirements,” (Reference 1). NUREG-0737, Item II.D.1 was associated with performance testing of relief and safety valves. The NRC stated that their position for this item was that licensees and applicants shall conduct testing to qualify the reactor coolant system relief and safety valves under expected operating conditions for design-basis transients and accidents.

Tennessee Valley Authority (TVA) provided several responses to Item II.D.1 with the final response dated July 22, 1983 (Reference 2). In Reference 2, TVA stated that as a participating utility in the Electric Power Research Institute's (EPRI) Safety and Relief Valve Testing Program, a full-scale test and evaluation program was completed to demonstrate the functional performance capabilities of the block, relief, and safety valves. Reference 2 also stated that the tested valves are the same type of valve utilized in Watts Bar Nuclear Plant (WBN), Unit 1 and Unit 2, reactor coolant system. Based on TVA’s evaluation of the EPRI testing, Reference 2 stated that changes to the block valves motor operator were necessary to ensure complete valve shutoff on the closing stroke.

For the Pressurizer Power Operated Relief Valves (PORVs), new Target Rock valves were installed and the PORV loop seals were removed. For the safety valves, TVA modified the safety valve loop seals to be self-draining and changed the safety valve internals from water to steam. The above change to the safety valve loop seals and the PORV loop seals, along with replacement of the new Target Rock valves, also reduced the higher than anticipated support loads identified in the piping/support evaluations.

In NUREG-0847, Supplement 3, (Reference 3) the NRC staff provided their evaluation of TVA's resolution of NUREG-0737 Item II.D.1. The NRC staff referenced the July 22, 1983 TVA letter (Reference 2) and stated the following.

> *"In summary, on the basis of a preliminary review, the staff has concluded that the applicant's general approach to responding to this TMI item is acceptable and provides adequate assurance that the Watts Bar reactor coolant system overpressure protection systems can adequately perform their intended functions until the staff completes its detailed review. If this detailed review reveals that modification or adjustments to safety valves, PORVs, PORV block valves, or associated piping are needed to ensure that the overpressure protection systems can perform their intended functions, the staff will require that the applicant make appropriate modifications. Therefore, the staff considers License Condition (1) to be resolved."*

Subsequently, in NRC Inspection Report dated March 29, 1985 (Reference 4), the NRC stated the item was closed.

> *"(Closed) TMI 80-RD-15, NUREG 0737 Item II.D.1, "Relief and Safety Valve Test Requirements." Supplement 3 to the Safety Evaluation Report (NUREG-0847) addressed the subject item. The supplement evaluation concluded that the licensee's approach to responding to this issue is acceptable and provides adequate assurance that the Watts Bar Reactor Coolant System overpressure protection systems can adequately perform their functions."*

In June 1989, the NRC issued Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," (Reference 5). In GL 89-10, the NRC stated that the licensee's motor-operated valve (MOV) testing program should provide for the testing, inspection, and maintenance of MOVs to provide the necessary assurance that they will function when subjected to the design-basis conditions that are to be considered during both normal operation and abnormal events within the design basis of the plant. In GL 89-10, the NRC provided eight recommended actions (a through h). Recommended action 'c' of GL 89-10 recommended, in part, that the MOV should be demonstrated to be operable by testing it at the design-basis differential pressure and/or flow (dynamic testing). GL 89-10 also stated that if testing MOVs at design-basis conditions is precluded by the existing plant configuration, an explanation should be documented including a description of the alternatives to design-basis differential pressure testing or flow testing that will be used. TVA's six month response to GL 89-10 stated that TVA planned to meet the GL 89-10 recommendations and to comply with the 5-year implementation schedule, i.e., by June 28, 1994 (Reference 6). References 7 and 8 documented the NRC's conclusion that GL 89-10 had been adequately addressed at WBN. However, WBN Unit 2 was maintained in a construction layup status without fully implementing GL 89-10.

By letter dated January 29, 2008 (Reference 9), TVA submitted the Regulatory Framework for the Completion of Construction and Licensing Activities for WBN Unit 2. This letter described the regulatory framework for the completion of construction and licensing activities for WBN Unit 2. Reference 9 contained an enclosure (Enclosure 2) that provided a summary of commitments and dates to respond to NRC requested information in cases where the requested information was not available. The letter contained three associated commitments:

- Commitment 18, GL 89-10, "Safety Related Motor-Operated Valve (MOV) Testing and Surveillance;"
- Commitment 19, GL 96-05, "Periodic Verification (PV) of Design Basis Capability of Safety-Related MOVs;" and
- Commitment 31, [NUREG-0737, Item] II.D.1, "Relief and Safety Valve Test Requirements."

Reference 9 provided details regarding each of the above commitments. Commitment 18 was to implement pressure testing and a surveillance program for safety-related MOVs, satisfying the intent of GL 89-10. Commitment 19 was to implement the Joint Owner's Group recommended GL 96-05 MOV PV program and begin testing during the first refueling outage after startup. Commitment 31 contained four activities:

1. Testing of relief and safety valves;
2. Reanalysis of fluid transient loads for pressurizer relief and safety valve supports and any required modifications;
3. Modifications to pressurizer safety valves, PORVs, PORV block valves and associated piping; and
4. Change motor operated block valves.

Implementation of these three commitments is impacted by this change in the testing of the WBN Unit 2 PORV block valves.

In consideration of the performance of Hot Functional Testing (HFT) at WBN Unit 2 in 2015, TVA reviewed the test conditions associated with the dynamic testing of the PORV block valves. TVA determined that differential pressure testing creates an equipment and personnel hazard. Specifically, the equipment hazards are associated with the potential for overfilling the Pressurizer Relief Tank (PRT), subsequently failing the PRT rupture disks, thus creating a risk for personnel injury. Based on this review, TVA decided to use the EPRI MOV Performance Prediction Methodology (PPM) analysis (EPRI TR-103237) (Reference 10) in lieu of dynamic differential pressure testing for the WBN Unit 2 Pressurizer PORV block valves (2-FCV-068-0332 and -0333).

2.0 DETERMINATION FOR USE OF ALTERNATE METHOD

TVA has evaluated the use of the EPRI MOV PPM (TR-103237) to address the following specific NRC communications:

1. NRC Generic Letter 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," June 28, 1989 (Reference 5),
2. NRC Generic Letter 96-05, "Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves," September 18, 1996 (Reference 11), and
3. NUREG-0737, "Clarification of TMI Action Plan Requirements," Item II.D.1, "Performance Testing of Boiling-Water Reactor and Pressurized-Water Reactor Relief and Safety Valves (NUREG-0578, Section 2.1.2)," (Reference 1).

2.1 Generic Letter 89-10 and Generic Letter 96-05

Generic Letter 89-10

At WBN Unit 2, the Pressurizer PORV block valves are active safety-related MOVs that are within the scope of GL 89-10.

As discussed in NRC Information Notice (IN) 2012-014, "Motor-Operated Valve Inoperable Due To Stem-Disc Separation," (Reference 12), the NRC stated that the staff has accepted four methods that a licensee could use to demonstrate the design-basis capability of safety-related MOVs. As described in NRC IN 2012-014, in descending order of acceptability, the four methods for demonstrating this capability are as follows.

1. **Dynamic testing at or near design-basis conditions with diagnostics of each MOV where practicable** - Valves dynamically tested at less than design-basis conditions may be extrapolated with proper justification. Although the valve factor derived from the test data might be low because of minimal valve operating history or recent maintenance that exposed the stellite valve material to air, the dynamic testing provided assurance that the valve performance was predictable. The licensee would consider the need to increase the valve factor during its design-basis evaluation and setup based on test data from similar valves.

2. **EPRI MOV PPM** - This method was developed for those valves that could not be dynamically tested. The PPM required internal measurements of the valve to provide assurance that the valve performance was predictable. The NRC staff began accepting the use of the PPM even where dynamic testing for an MOV was practicable.

3. **MOV valve grouping** - Where valve-specific dynamic testing was not performed and the PPM was not used, the staff accepted grouping of MOVs that were dynamically tested at the plant to apply the plant-specific test information to an MOV in the group. Using plant-specific data allowed the licensee to know the valve performance and maintenance history and helped provide confidence that the valve performance was predictable.

4. **The use of valve test data from other plants or research programs** - The NRC ranks this as the least-preferred approach (with the most margin required) because the licensee would have minimal information regarding the tested valve and its history. In such cases, the NRC inspectors would perform an available capability evaluation of the MOV to provide confidence that the MOV had significant capability margin to close GL 89-10 for that MOV.

DESCRIPTION AND BASIS FOR TVA's DETERMINATION TO USE EPRI TR-103237, "EPRI MOV PERFORMANCE PREDICTION PROGRAM," FOR PRESSURIZER PORV BLOCK VALVES

TVA used EPRI PPM Version 3.3 for this analysis which was previously approved by the NRC (References 10 and 16). The TVA PPM analysis was performed by industry valve experts, Kalsi Engineering, Inc., and reviewed by TVA. The analysis evaluated valve performance under design basis conditions.

Specific issues that were addressed as part of the analysis included the following:

- PPM Error Notices were evaluated to ensure none of these errors impacted the analysis.
- Conditions and limitations from the NRC safety evaluation were reviewed to determine which conditions applied and ensure they were accurately addressed. This included the conditions and limitations on the use of the PPM software as well as the use of the Westinghouse gate valve hand calculation methodology.
- Valve applicability criteria were evaluated and confirmed to be met as required.
- System applicability criteria were evaluated and confirmed to be met as required.
- Stem thrust analysis was performed using the appropriate EPRI guidance, which was implemented using a spreadsheet analysis developed by EPRI.

The results of the spreadsheet analysis are summarized in the table below.

Table 1

Stroke	Predictability	Required Thrust (lbs)
Opening - After Unwedging	Predictable	8,082
Opening - Unwedging	N/A	15,655
Closing	Predictable	14,387

The predicted unwedging thrust (15,655 lbs) is based on a maximum allowable closing thrust of 22,680 lbs and is less than the flow control valve (FCV) actuator capabilities of 21,897 lbs (2-FCV-068-0332) and 23,103 lbs (2-FCV-068-0333). As a result, no adjustment to the maximum allowable closing thrust was needed.

As described above, the analysis reviewed and discussed the applicability of the NRC safety evaluation conditions and limitations, verified the valve and system applicability criteria, and performed the stem thrust analysis per EPRI guidance as approved by the NRC. The results predicted the required opening and closing thrust considering bounding differential pressure conditions. The valves were shown to have predictable performance. The resultant analysis confirmed the acceptability of using the EPRI MOV PPM methodology and provides assurance that the valves will operate properly under design basis conditions.

The above results did not cover potential pressure locking and thermal binding effects. Consequently, TVA performed calculations that documents the design basis review, performs the required thrust/torque calculations, and assesses the valve and actuator capabilities. These calculations determined the actuator capability using bounding and conservative degraded voltage and environmental conditions to provide the lowest motor operator torque output. These calculations support the Generic Letter 89-10 engineering analysis for the PORV block valves, including the EPRI PPM analysis, to validate the MOV design basis thrust and torque requirements. In these calculations, the thrust/torque requirements are compared with the actuator capability and the maximum torque which may be applied without causing damage, in order to ensure sufficient thrust/torque is available to operate the valves.

These calculations concluded the following:

- The EPRI PPM analysis determined conservative required opening and closing thrusts.
- Pressure locking has been evaluated, using a conservative coefficient-of-friction, to ensure the valves have the capability of overcoming pressure locking forces.
- The actuators have adequate capability to overcome both pressure locking and EPRI PPM thrust requirements.

To address and prevent thermal binding, system operating instructions were revised.

NUREG-0847, Supplemental Safety Evaluation Report (SSER) 15 (Reference 15), stated that block valve operating requirements and capabilities are validated by dynamic testing that is part of the WBN Unit 1 and 2, GL 89-10 test program. Reference 15 further stated that including the PORV block valves in the GL 89-10 test program provides additional assurance the block valves will operate acceptably. TVA has determined that using the EPRI MOV PPM provides assurance the block valves will operate acceptably.

Generic Letter 96-05

In 1996, the NRC issued GL 96-05 (Reference 11) to provide guidance for the periodic verification of MOV design-basis capability in response to MOV performance issues at operating nuclear power plants. In GL 96-05, the NRC staff asked licensees to establish a program to verify on a periodic basis, that safety-related MOVs continue to be capable of performing their safety functions within the current licensing basis of the facility. The industry, with NRC input, developed an industry wide testing program evaluating age-related degradation and issued Topical Report (TR) MPR-2524-A, Rev. 1, “Joint Owners’ Group (JOG) Motor Operated Valve Periodic Verification Program Summary” (Reference 13). This topical report was formally reviewed and approved by the NRC (Reference 14) which requires MOVs within the scope of GL 89-10 and GL 96-05 be classified as either Class A or B to fully meet GL 96-05 requirements. When a MOV is

qualified using an EPRI MOV PPM methodology, it is automatically classified as Class A (unless qualified by PPM extension, becoming Class B) and fully meets the requirements of GL 96-05. The results of the EPRI MOV PPM analysis for WBN Unit 2 Pressurizer PORV block valves 2-FCV-068-0332 and -0333 show that the valves are predictable (fully meet PPM requirements) and the required opening (along with unwedging) and closing thrusts are less than what is currently calculated as available.

Therefore, these MOVs will be classified as Class A, per TR MPR-2524-A, and fully meet the requirements of GL 96-05.

2.2 NUREG-0737, Item II.D.1

Following the accident at Three Mile Island Unit 2 (TMI-2), the NRC staff developed an Action Plan under NUREG-0660, “TMI Unit 2 Action Plan.” Specific items from NUREG-0660 were approved by the Commission for implementation at nuclear reactors and compiled into NUREG-0737, "Clarification of TMI Action Plan Requirements," which included additional information and clarifications (Reference 1). Item II.D.1 in both reports addresses "Performance Testing of Boiling-Water Reactor and Pressurized-Water Reactor Relief and Safety Valves" and requires that the block valves be qualified to ensure that a stuck open PORV can be isolated.

Appendix CC in NUREG-0847 Supplemental Safety Evaluation Report (SSER) 15 (Reference 15) acknowledged that TVA participated in full-scale EPRI testing of the block, relief, and safety valves, and that TVA responses to NRC requests for additional information (RAIs) justified the applicability of the EPRI PORV block valve test data to the WBN (Units 1 and 2) specific conditions and geometry. Appendix CC in NRC SSER 15 also acknowledged that the block valves TVA used in WBN Units 1 and 2, are the same design as one of the valves tested in the EPRI test program, the Westinghouse 3GM88 block valve. Reference 15 also stated that the WBN Unit 1 block valves are limit switch controlled rather than torque switch controlled which ensures complete valve closure (full motor capability available). The WBN Unit 2 block valves have also been modified to be limit switch controlled like the WBN Unit 1 valves.

Therefore, the conclusion the NRC reached regarding TVA's response to NUREG-0737, Item II.D.1 of the acceptability of these valves for WBN Units 1 and 2 remains valid.

2.3 Conclusion:

Using the NRC endorsed EPRI MOV PPM methodology on WBN Unit 2 PORV block valves has been evaluated by TVA and determined to be acceptable. TVA has reviewed the guidance contained in NUREG-0737, ITEM II.D.1; GL 89-10; and GL 96-05 and determined that use of the EPRI MOV PPM for WBN Unit 2 PORV block valves ensures compliance with the above guidance.

3.0 REFERENCES:

1. NUREG-0737, "Clarification of TMI Action Plan Requirements," dated November 1980 [ADAMS Accession No.ML051400209]
2. Letter from TVA to NRC regarding TVA's final response to NUREG-0737 item II.D.1, dated July 22, 1983 [ADAMS Accession No. ML073530222]
3. NUREG-0847, "Safety Evaluation Report related to the operation of Watts Bar Nuclear Plant, Units 1 and 2," Supplement No. 3, dated January 1985 [ADAMS Accession No. ML072060520]
4. Letter from NRC to TVA, "Report Nos. 50-390/85-08 and 50-391/85-08," dated March 29, 1985 [ADAMS Accession No. ML082190699]
5. NRC Generic Letter 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," dated June 28, 1989 [ADAMS Accession No. ML031150300]
6. Letter from TVA to NRC, "Browns Ferry Nuclear Plant (BFN), Sequoyah Nuclear Plant (SQN), and Watts Bar Nuclear Plant (WBN) - Response to Generic Letter (GL) 89-10 - Safety-Related Motor-Operated Valve (MOV) Testing and Surveillance," dated December 21, 1989 [ADAMS Accession No. ML082320614]
7. Letter from NRC to TVA, "NRC Inspection Report No. 50-390/95-48 and 50-391/95-48," dated October 11, 1995 [ADAMS Accession No. ML072680934]
8. NUREG-0847, "Safety Evaluation Report related to the operation of Watts Bar Nuclear Plant, Units 1 and 2," Supplement No. 16, dated September 1995 [ADAMS Accession No. ML072060493]
9. Letter from TVA to NRC, "Watts Bar Nuclear Plant (WBN) - Unit 2 - Regulatory Framework for the Completion of Construction and Licensing Activities for Unit 2," dated January 29, 2008 [ADAMS Accession No. ML080320443]
10. Letter from NRC to NEI, "Electric Power Research Institute (EPRI) Topical Report TR-103237, 'EPRI MOV Performance Prediction Program' (Revision 1)," dated March 15,1996 [ADAMS Accession No. ML15142A761]
11. NRC Generic Letter 96-05, "Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves," September 18, 1996 [ADAMS Accession No. ML031110010]
12. NRC Information Notice 2012-14, "Motor-Operated Valve Inoperable Due to Stem-Disc Separation," dated July 24, 2012 [ADAMS Accession No ML12150A046]
13. Letter from PWR Owners Group to NRC, "JOG MOV PV Program Summary, MPR-2524-A, Rev. 1 (PA-SEE-0693)," dated March 3, 2011 [ADAMS Accession Nos. ML110680188 and ML110680193]

14. Letter from NRC to BWR Owners Group and PWR Owners Group, "Final Supplement to Safety Evaluation for Joint Owners' Group Motor-Operated Valve Periodic Verification Program (TAC Nos. MD8920 and MD8921)," dated September 18, 2008 [ADAMS Accession No. ML082480638]
15. NUREG-0847, "Safety Evaluation Report related to the operation of Watts Bar Nuclear Plant, Units 1 and 2," Supplement No. 15, dated June 1995 [ADAMS Accession No. ML 072060488]
16. Letter from NRC to NEI, "Supplement 4 to Final Safety Evaluation for Nuclear Energy Institute (NEI) Addenda 3, 4, 5, 6, and 7 to Electric Power Research Institute (EPRI) Topical Report (TR) 103237, 'EPRI MOV Performance Prediction Program,' Revision 2," dated February 24, 2009