Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381

John H. Garrity
Vice President, Watts Bar Nuclear Plant

AUG 0 1 1991

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

Gentlemen:

In the Matter of the Application of	)	Docket Nos. 50-390
Tennessee Valley Authority	)	

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 - RESPONSE TO NRC INTEGRATED DESIGN INSPECTION (IDI) ISSUES (50-390/91-201) AT WBN

Enclosed are TVA's responses to the WBN IDI issues as identified in NRC Inspection Report 50-390/91-201 dated March 22, 1991. Enclosure 1 individually responds to each of the 15 deficiencies and 1 unresolved item for Watts Bar Unit 1.

Implications of these findings on the Sequoyah Nuclear Plant (SQN) will be addressed with a separate submittal under the SQN docket.

Commitments contained in the response are summarized in Enclosure 2.

The due date for this submittal was extended to July 31, 1991, per conversation with the NRC staff on June 26, 1991.

If any questions or further discussion are required on any of these issues, please contact P. L. Pace at (615) 365-1824.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

J. H. Garrity

Enclosures
cc: See page 2

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U.S. Nuclear Regulatory Commission

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cc (Enclosures):

Ms. S. C. Black, Deputy Director
Project Directorate II-4
U.S. Nuclear Regulatory Commission
One White Flint, North
11555 Rockville Pike
Rockville, Maryland 20852

NRC Resident Inspector
Watts Bar Nuclear Plant
P.O. Box 700
Spring City, Tennessee 37381

Mr. P. S. Tam, Senior Project Manager
U.S. Nuclear Regulatory Commission
One White Flint, North
11555 Rockville Pike
Rockville, Maryland 20852

Mr. B. A. Wilson, Chief, Project Chief
U.S. Nuclear Regulatory Commission
Region II
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

ENCLOSURE 1

RESPONSE TO NRC INTEGRATED DESIGN
INSPECTION (IDI) ISSUES
WATTS BAR NUCLEAR PLANT

INTRODUCTION

The NRC Integrated Design Inspection (IDI), performed from January 7 through 18 and February 4 through 8, 1991, at the Watts Bar site, reviewed in detail the design basis calculations for the Unit 1 Auxiliary Feedwater System (AFW). Results of that review were formally documented in NRC Inspection Report 50-390/91-201 dated March 22, 1991.

As a parallel effort, TVA engineering has conducted a self-assessment which examined the design basis calculations for each principal discipline. Upper-tier engineering documents such as design criteria and system descriptions were reviewed, in addition to the design change notices in support of this calculation evaluation effort.

As a result of this NRC inspection and TVA's self-assessment of calculations, TVA has taken action to correct problems with essential mechanical calculations and the specific interface with instrumentation and control (I&C). These actions are being tracked by Significant Corrective Action Reports (SCARs) WBN 910140SCA and WBP 910055SCA. The engineering self-assessment is a detailed, system-by-system review of system requirements, supporting engineering calculations, and other system documents (Final Safety Analysis Report [FSAR], drawings, NSSS information, etc.). AFW is the pilot system and the review phase is essentially complete. Self-assessment engineering corrective actions will be complete by September 30, 1992.

In response to specific concerns on the technical adequacy reviews of the mechanical system calculations and to the I&C/Mechanical interface on these systems, several programmatic changes are being implemented. A system review approach is now utilized for calculation open item closeout work. This approach assigns a responsible engineer to each of the safety-related systems included in the mechanical calculation upgrade program.

The assigned engineer is required to review requirements and commitments related to the system. The engineer verifies consistency between the design criteria/system description and the WBN commitments and design requirements. The safety-related calculations issued for the system are reviewed for adequacy. To be considered adequate, a calculation must be both technically correct and appropriately support the design criteria/system description documents that reference it. If a calculation involves the determination of a safety limit, the engineer is responsible for identifying that calculation to the I&C engineer. The I&C demonstrated accuracy calculation is then reviewed in conjunction with the safety limit calculation. This ensures an adequate I&C/Mechanical interface and confirms that the safety limit requirements have been properly interpreted into the I&C supporting calculation. When calculation revisions are required, they are performed in accordance with Nuclear Engineering Procedure (NEP)-3.1), "Calculations." Lastly, the engineer is responsible for ensuring that all open corrective action documents associated with the calculations within the system are closed.

A desk top instruction has been issued for use which standardizes the review approach for all the system reviews and ensures consistency between the products prepared by TVA and its contractors. This system review approach to the mechanical calculation upgrade program will upgrade the mechanical design documentation, ensure its consistency throughout, and most importantly, double check its technical adequacy by performing a review of the calculation against the criteria documents, and not solely against corrective action requests.

The programmatic actions described previously will serve to identify and correct any generic aspects of the deficiencies identified in the NRC inspection report. Corrective actions for each safety-related system will be completed before system turnover for prestart testing.

DEFICIENCY D-1

FINDING TITLE: Inconsistences and Incomplete Design Information Contained in AFW System Description

DESCRIPTION OF CONDITION:

The team concluded that the system description as it presently exists was inadequate and needed further revisions before it could be considered a valid design basis document.

References provided in the document to substantiate the design bases for the system were either incorrect or were nonexistent. The references listed in Section 7.1, "TVA Calculations", in many cases were marked "Later" and were not available. In some instances, the references cited did not support or did not pertain to the statements made in the document. For example, Reference 7.2.1 did not have information to support the steam generator safety valve set pressure as described in Section 2.2.8.7 of the system description. References provided for Table 9.5 and Table 9.6 were incorrect.

No bases were provided for some of the criteria specified in the document. For example, no basis was provided for the requirement that the AFW pumps should be sized to provide flow against the steam generator safety valve set pressure plus accumulation pressure equivalent to that required to relieve 11 percent nominal steam flow (Section 2.1.1.1). Also, the flow requirements of 940 gpm if the AFW system did not respond for 10 minutes (Section 3.1) were not supported by any bases.

Other calculations that were performed to support the design bases specified in the system description either did not support the design bases or were inconsistent with statements made in the system description. For example, the calculation for the AFW pump total dynamic head margin (Reference 2) did not consider the margins for pump degradation and seal leakage as stated in Section 2.2.8.2 of the system description. The calculation for estimating the time required to deliver rated flow (Reference 3) concluded that due to the inclusion of a timer in the steam supply switchover circuit, the time limit of one minute to deliver rated flow as stated in Section 2.2.6 of the system description could not be met for the condition requiring steam supply switchover from steam generator 1 to steam generator 4.

The list of active valves provided in Section 3.2.2 did not include check valves CKV-3-805, -806, and -810 ,even though these valves were required to open when the AFW pumps took suction from the condensate storage tank and must close when water is supplied from the Essential Raw Cooling Water (ERCW) System.

BASIS:

The purpose of the design basis document is to define, establish, and maintain the upper-tier design basis requirements necessary to meet 10 CFR 50, Appendix B, Criterion III, "Design Control." By TVA procedure (Reference 4), the design basis document is to be controlled and maintained throughout the life of the plant.

REFERENCES:

1. N3-3B-4002, Revison 1, "System Description for Auxiliary Feedwater System."
2. HCG-TBG-091981, Revision 0, "THD Margin for Motor Driven and Turbine Driven AFW Pumps."
3. EPM-SDK-110689, Revision 0, "Time Required to Deliver Rated Flow After Receipt of Accident Signal."
4. WBEP-5.10, Revision 4, "Maintenance of Design Basis Document."

TVA/WBN RESPONSE:

TVA agrees with the description of the deficiency.

At the time of the NRC inspection, TVA had already initiated a revision to the AFW system description to update it and resolve various deficiencies. The revision is in progress and has been expanded to resolve the deficiencies cited by the NRC and to also address concerns that were identified during TVA site engineering's self-assessment program. The system description is also being coordinated with Westinghouse.

The AFW system description revision will be completed by December 31, 1991.

DEFICIENCY D-2

FINDING TITLE: Time Required To Deliver Rated Auxiliary Feedwater Flow After Initiation of Actuation Signal.

DESCRIPTION OF CONDITION:

TVA performed an analysis (Reference 3) to verify if, for the various design basis events, the AFW pumps would deliver the rated flow to the steam generators. This analysis concluded that the AFW system components actuated within the specified time, and provided a list of valves that should be tested to verify opening within the allotted time. This calculation, however, did not consider the time required for the emergency diesel generator to start and energize the shutdown boards. Since a loss of offsite power was required to be considered concurrently with other design basis events, the time delay in energizing the shutdown boards should have been taken into account. Although actual system testing in 1985 verified that pump flow was attained within the required 1 minute, the errors in the calculation indicated a lack of understanding of system operation and interfaces with other systems.

Section 6.8 of Reference 3 and Section 3.2.2 of Reference 2 stated that the turbine-driven AFW pump would deliver rated flow within 15 seconds. Including a 2-second delay time for receipt of the start signal (Reference 3, Section 6.2.4), the pump would reach the rated speed in 17 seconds. The level control valves on the discharge side of this pump would be partially open at the time. When offsite power was not available, the essential raw cooling water pumps would not start until after 26 seconds (Reference 1, Table 8.3-3). The operation of the turbine-driven AFW pump earlier than that of the essential raw cooling water pumps should be evaluated to ensure that no loss of AFW pump suction occurs if water from the condensate storage tank is not available as a result of a seismic event.

Design Input Data No. 20 in Reference 3 stated that under non-blackout conditions the turbine-driven AFW pump could not be counted on to supply the required design basis flow. This statement conflicted with the design requirement that all AFW pumps deliver rated flow within 1 minute on a trip of both main feedwater pumps or a safety injection signal (Reference 1). The time requirement was relaxed to 10 minutes only in the event of a main feedwater or a main steamline break.

BASIS:

The FSAR commitment (Reference 1) requires that the rated AFW flow to at least 2 steam generators be provided within 1 minute after the initiation of any one of the specified events. The AFW system design must take into consideration the time required for actuation signal generation and time delay, emergency diesel generator start time, and actuation times for all pumps, valves, and other components.

REFERENCES:

1. FSAR Section 10.9.4.2, "Auxiliary Feedwater System Description."
2. N2-3B-4002, Revision 1, "System Description for Auxiliary Feedwater System."
3. EPM-SDK-110689, Revision 0, "Time Required To Deliver Rated Flow After Receipt Of Accident Signal."

TVA/WBN RESPONSE:

TVA agrees with the description of the deficiency.

The calculation "Time Required To Deliver Rated Flow After Receipt Of Accident Signal," EPM-SDK-110689, has been revised to address the concerns about the adequacy of the AFW system to deliver rated flow. The calculation demonstrates the adequacy of the pumps to perform satisfactorily.

The AFW system calculations will be reviewed and revised as required to include the situation where a loss of offsite power has shut down the ERCW pumps and the potential exists for a loss of AFW pump suction. The revisions will be issued by December 31, 1991.

The FSAR will be revised to clarify the statements made concerning the time requirements. The revision will be made by December 31, 1991.

DEFICIENCY D-3

FINDING TITLE: Minimum Condensate Storage Tank Usable Volume for Auxiliary Feedwater System

DESCRIPTION OF CONDITION:

In calculating the condensate storage tank (CST) reserve volume, the assumption in Reference 3 was that the water in the tank down to the top of the suction piping could be drawn by the AFW pumps. However, as water drains from the CST to a level a few inches above the open end of the suction pipe, a vortex would be produced as a result of localized eddies on the water surface. Vortexing would introduce air into the suction piping resulting in possible damage to the AFW pumps. Therefore, an allowance for vortexing above the open end of the pipe should have been considered in calculating the reserve volume in the tank. Reference 3 was deficient in not considering the effects of vortexing, and consequently the recommended low level setpoint did not reflect a usable volume of 200,000 gallons in the CST.

To verify if similar concerns existed for the other systems, the team reviewed the calculation for the refueling water storage tank (RWST) (Reference 4). This calculation incorporated test data from the Sequoyah nuclear plant on the height at which vortex formation was observed in the RWST. However, when this calculation was performed, TVA had failed to review other tank calculations to ensure that similar concerns did not exist.

BASIS:

The FSAR commitment (Reference 1) requires that 200,000 gallons of water in the CST be reserved for the AFW system. This stored water is used by the AFW system before the backup water supply systems are used. Therefore, the AFW pumps must be able to draw the reserved water in the CST without pump damage due to air entrainment in the suction piping. The quantity of water reserved in the CST must also be usable.

REFERENCES:

1. FSAR Section 10.9.4.2, "Auxiliary Feedwater System Description."
2. N3-3B-4002, Revision 1, System Description for Auxiliary Feedwater System."
3. HCG-LCS-043085, Revision 1, "AFW Condensate Storage Tank Low Level Setpoints (LS-2-229A and LS-2-232A)."
4. WBN-OSG4-071, Revision 1, "RWST and Containment RHR Sump Safety Limits."

TVA/WBN RESPONSE:

TVA agrees with the description of the deficiency.

TVA has revised calculation HCG-LCS-043085, "WBN Auxiliary Feedwater (AFW) - Minimum Condensate Storage Tank (CST) Water Level Required To Support The AFW System," to address the NRC's concerns about vortexing in the CST. In addition to the vortexing issue, TVA is evaluating, with Westinghouse, the required minimum volume of AFW to be maintained in the CST and will revise the calculation as required. The evaluation of the concern's applicability to other systems is being addressed as part of the resolution of the self-assessment deficiencies (SCAR WBP 910055SCA). Other documents that are affected by the results of the calculations (FSAR, System Descriptions, Westinghouse documents, etc.) will be revised as required. This work will be completed by December 31, 1991.

DEFICIENCY D-4

FINDING TITLE: Total Dynamic Head (TDH) Margin Calculation for Motor-and Turbine-Driven AFW Pumps

DESCRIPTION OF CONDITION:

The TDH margins established by the margin calculation (Reference 1) were inadequate because the calculation failed to make sufficient allowance for degradation of pump performance and seal leakage. In addition, the calculation did not assume the pressure in the steam generators to be equal to the lowest set safety valve pressure plus 3 percent accumulation pressure as assumed by Westinghouse in determining the maximum flow to the steam generators (Reference 2). A value of 2 percent accumulation pressure was assumed in the calculation instead of 3 percent. The calculation also failed to make allowance for the relief valve set pressure tolerance of +/-1 percent as specified in Reference 3. The team determined that a combination of all the above factors significantly increased the total system head and created negative TDH margins for each mode of pump operation examined.

BASIS:

The FSAR commitment (Reference 4) requires that each AFW pump supply sufficient water for evaporative heat removal to prevent operation of the primary system relief valves or uncovering of the core. The flow rates of 470 gpm and 940 gpm specified in the FSAR and system description (References 4 and 5) for the respective motor-and turbine-driven AFW pumps could not be achieved with negative TDH margins.

REFERENCES:

1. HCG-TBG-091981, Revision 1, "TDH Margins for Motor-and Turbine-Driven Auxiliary Feedwater System Pumps."
2. WAT-D-296, Westinghouse letter to TVA, August 1, 1972.
3. American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, Section III, Subparagraph NC-7614.2, 1971.
4. FSAR Section 10.4.9.2, "Auxiliary-Feedwater System Description."
5. N3-3B-4002, Revision 1, "System Description for Auxiliary Feedwater System."

TVA/WBN RESPONSE:

TVA agrees with the description of the deficiency. The TDH calculation (HCG-TBG-091981) is being revised to allow for safety valve setpoint error and 3 percent accumulation. Additionally, information from Westinghouse indicates that the AFW flow requirement can be reduced and thus restore margin in the TDH calculation for the AFW pumps to allow for pump wear and seal leakage. This reanalysis will be completed by October 24, 1991.

DEFICIENCY D-5

FINDING TITLE: Inadequate Analysis of Pressure Switch Settings and Time Delay for Backup Essential Raw Cooling Water (ERCW) Supply Valves

DESCRIPTION OF CONDITION:

The system analysis performed by TVA (Reference 2) was deficient in a number of respects. First, it failed to adequately document the sources of input data and assumptions. Specifically, no basis was given for the assumed available volume of water in the suction piping from the condensate storage tank to the AFW pumps. No references were given for the assumed friction pressure drops in the suction piping. The source document for the available ERCW system pressure was not identified. Second, because the current revision of the calculation appeared to have been performed to justify existing pressure switch and time delay relays settings, tolerances in setpoints, and actuation times of pressure switches, time delay relays and valves should have been considered in the analysis but were not. Margins for inaccuracies in determining the actual net positive suction head required by the pumps, the pump recirculation flows, and the tolerances in the pressure control valves were also omitted. Third, the recommended time delay settings stated as conclusions were not evaluated for other scenarios discussed in the calculation, and the time delay for resetting the train A pressure switches on the turbine-driven AFW pump suction was not evaluated. Potential worst-case conditions such as vortexing in the suction piping, suction line breaks, and three-pump operation were not adequately addressed.

In addition, TVA had not consulted with the pump vendor regarding the results of the analysis to verify that the pump could survive such a transfer, as specified in Reference 3, since a full-scale test of the switchover with the pumps in operation could be impractical.

BASIS:

The FSAR commitment (Reference 4) requires verification through system analysis that pump protection is ensured during the automatic transfer to the ERCW supplies by providing sufficiénts suction and flow to the pumps.

Reference 5 requires that analyses be sufficiently detailed as to purpose, methods, assumptions, design input, references, and units so that a technically qualified person can review and understand the analysis and verify the adequacy of the results without recourse to the originator.

In Reference 3, Section 10.4.9, the NRC staff required that the pump vendor concur with the results of the analysis that verify pump availability, or that the applicant perform a suitable test that demonstrates that the pumps can survive the automatic transfer of suction from one source to another.

REFERENCES:

1. N3-3B-4002, Revision 1, "System Description for Auxiliary Feedwater System."
2. Calculation HCG-JWA-041079, Revision 4, "Pressure Switch Settings and Time Delay for Backup ERCW Supply Valves."
3. NUREG-0847, "Safety Evaluation Report Related to the Operation of the Watts Bar Nuclear Plant - Units 1 and 2," June 1982.
4. FSAR Section 10.4.9.2, "Auxiliary Feedwater System Description."
5. American National Standards Institute, Standard N45.2.11-1974, "Quality Assurance Requirements for the Design of Nuclear Power Plants."

TVA/WBN RESPONSE:

TVA agrees with the description of the deficiency. Calculation HCG-JWA-041079 will be revised to correct the deficiencies cited in the inspection report. TVA will also consult with the pump vendor to verify that the pump will tolerate the transfer as required in the Safety Evaluation Report. These actions will be completed by November 30, 1991.

DEFICIENCY D-6

FINDING TITLE: Design Pressure and Temperature for the Auxiliary Feedwater System

DESCRIPTION OF CONDITION:

The team's evaluation of the pressure/temperature segments established by Reference 2 revealed the following deficiencies:

1. The design pressure and temperature identified for Segment 2 of the system was 250 psig and 120°F, respectively. The team calculated that a portion of this segment, from the discharge of the turbine-driven AFW pump to restriction orifice 186 upstream of the oil cooler, could reach pressures as high as 350 psig. The team used the same methodology to establish the discharge head of water extracted from the first stage of the turbine-driven pump, as that which had been used to established the overall pump discharge head in the calculation.

2. The calculated design pressure and temperature for Segment 8 was 250 psig and 165°F, respectively. However, the design pressure of 350 psig, calculated by the team for Segment 2, should have been used for sizing restriction orifice 186 and for establishing the maximum design pressure for segment 8.

3. The calculation recommended the creation of new Segment 9 with a design temperature of 600°F and a design pressure of 1975 psig. The team established that the valves procured for this segment were ANSI Class 900 fabricated from SA 216WCB. According to ASME Code, Section III, Subsection ND 3510 (Reference 3), and ANSI Standard B16.34 (Reference 4), the maximum allowable working pressure for a class 900 valve at 600°F is 1640 psig which is less then the 1975 psig design pressure.

   A check and a gate valve in this segment were directly welded to each other with no piping in between. This arrangement would require the use of higher stress intensity factors in the stress analysis for the piping system.

4. The calculation recommended the creation of a set of design conditions with a design pressure of 1600 psig and a design temperature of 120°F for the major AFW pressure-retaining components furnished under TVA Contract No. 7AC30-83094. This contract, however, applied to the steam turbine and motor-driven AFW pumps, motor, and spare parts.

   The design pressure shown on the flow diagram (Reference 5) and in the system description (Reference 6) for segment 3 was 1975 psig. Therefore, the team considered a proposed design pressure of 1600 psig for the pumps only (Segment 10) to be unacceptable.

5. Calculational errors were made in establishing the design temperature and pressure ratings for Segments 3 and 4, although the recommended design pressures and temperatures for the segments were acceptable. A value of 4300 rpm +/-2 percent for the turbine-driven AFW pump electrical overspeed trip should have been used in establishing design conditions for Segment 3 instead of the 4290 rpm used.

   Further, in establishing the design conditions for Segment 4, the flow-induced pressure drop of 30 psi was incorrect. This value was taken from the AFW system piping design pressure drop calculation (Reference 7). However, this calculation had not assumed the worst condition (all three pumps operating) in computing the system pressure drop. The correct value was 61 psig, which was calculated in the total dynamic head margin calculation (Reference 8).

6. Reference 2 (Section 8, pages 46 and 47; and Section 9, pages 49 and 50) identified design deficiencies in proposed Segments 5, 6, 7, 11, 12, and 13 and recommended the creation of design calculations to rectify these deficiencies. The results of those additional calculations as well as the above findings could affect the specified design conditions for the respective segments.

Design documentation should be revised based upon both the TVA-and NRC team-identified deficiencies and, where necessary, equipment should be hydrostatically tested in all segments where the design temperatures and pressures had been increased.

BASIS:

The FSAR commitment (Reference 1) requires that the AFW system be designed for pressures ranging from the residual heat removal system cut-in point (equivalent to 110 psig in the steam generator) to the steam generator safety valve set pressure plus 2 percent accumulation. ASME Code, Section/III (Reference 3) requires that all plant or system operating and test conditions that are anticipated or postulated to occur during the intended service life of the component be considered when identifying design loadings.

REFERENCES:

1. FSAR Section 10.4.9.1, "Auxiliary Feedwater System Design Bases."
2. EPM-ARS-090789, Revision 1, "Design Pressure and Temperature for the Auxiliary Feedwater System."
3. American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, Section III, Subsection ND 3510, 1980.
4. American National Standards Institute, Standard B16.34, "Valves-Flanged and Buttwelding Ends," 1977.
5. 1-47W803-2, Revision 2, "Auxiliary Feedwater System Flow Diagram."
6. N3-3B-4002, Revision 1, "System Description for Auxiliary Feedwater System."

7. HCG-LCS-121583, Revision 1, "Auxiliary Feedwater System Piping Pressure Drop Calculation."
8. HCG-TBG-091981, Revision 0, "TDH Margins for Motor-and Turbine-Driven AFW Pumps."
9. ASME B&PV Code Section 111 - 1971 with Addenda Up To and Including Summer 1973 Addenda.
10. HCG-TBG-091881, Revision 2, "Design Parameters from Motor and Turbine Driven AFW Pumps."
11. EPM-ARS-090789, Revision 2, "Design Pressure and Temperature for the Auxiliary Feedwater System."

TVA/WBN RESPONSE:

TVA agrees with the description of the deficiency to the extent that the documentation reviewed by the IDI team did not adequately describe or justify all aspects of the AFW system design.

1. The 350 psig pressure calculated by the NRC team results from a turbine-driven pump overspeed condition. This Segment of piping is part of the vendor-supplied package under TVA Contract 74C30-83094. The pumps are not designed for the overspeed conditions and therefore are not considered normal operating events. For the pump to reach this speed, a failure of the speed control must occur. This would be considered a single failure in the AFW system and the turbine pump would be considered inoperable. The system has adequate redundancy and physical separation (i.e., two motor-driven pumps located in a different room from the turbine-driven pump) to perform its safety function if the turbine-driven pump is lost. Consequently, it is not necessary to design this segment of piping for these conditions.

   The current design parameters are 250 psig and 120°F. The maximum first stage discharge pressure during normal operation is 290 psig for the turbine-driven pump operating at shutoff conditions. The first stage discharge pressure for the motor-driven pumps is lower. This overpressure condition can be justified as described below.

   Paragraph ND-3612.3 (b)(2) of the ASME B&PV Code Section III (Reference 9 - the Code of Record for WBNP) states that the pressure or temperature, or both, may exceed the design values if the stress in the pipe wall calculated by the formulas using the maximum expected pressure during the variation does not exceed the S-value (maximum allowable stress in the piping material) allowable for the maximum expected temperature by more than 20 percent during 1 percent of the plant operating period. The 290 psig overpressure condition is 16 percent over the design pressure. The pumps are not expected to operate more than 27 hours per year or 1080 hours (15 minutes per monthly surveillance test and 24 cooldown hours per year) over the 40-year life of the plant. This amounts to 0.3 percent of the plant life. The fraction of the time the pump will be operating at or near shutoff conditions will be less. Therefore, a design pressure of 250 psig and a design temperature of 120°F are acceptable.

2. Segment 8 is part of the vendor-supplied piping under TVA Contract 74C30-83094 and is downstream of Orifice 186. Per vendor information the orifice is designed to give approximately a 100 percent pressure drop (first stage discharge pressure to suction pressure) at all rpms. Therefore, Segment 8 will not be exposed to the full first stage discharge pressure. As discussed in number 1 above, the 350 psig pressure is caused by failure of the speed controls and need not be considered in establishing system design pressure.

3. Segment 9 has been added by Revision 2 to Reference 2 to clarify the change from Class C to Class B in accordance with paragraph NC-3612.4(a) of the ASME B&PV Code Section III. The design pressure for this new segment is 1975 psig. The design temperature is 120°F based on maximum water supply temperature and not 600°F. The valves and fittings in the segment are 900-pound class which have a rating of more than 2000 psig at 120°F.

   The check and gate valves in Segment 9 are butt welded to each other. A conservative stress intensity factor of 1.9 was utilized in the stress analysis for this arrangement in accordance with Figure ND-3673.2(b)-1 of the ASME Code.

4. The design pressure of 1975 psig for Segment 3 was established by TVA and is based on the turbine-driven pump overspeed condition. The turbine-driven pump is considered inoperable during this condition. Since the single failure is the turbine-driven pump speed controller, the AFW system has adequate redundancy and physical separation to maintain its safety function. Based on this logic, the 1600 psig design pressure for the pump casings is considered an exception to the design pressure of Segment 3. The design pressure calculation (Reference 2) and the system description (Reference 6) will be revised to reflect the exception. These revisions will be completed by December 31, 1991.

   The maximum pressure the motor and turbine-driven pumps will see during operation at normal speed at shutoff conditions is 1644 psig and 1596 psig, respectively. As discussed in number 1 above, the code allows 20 percent overpressure for not more than 1 percent of the time in piping systems. The motor driven pump is overpressurized by 3 percent, while the turbine-driven pump is not overpressurized while operating under shutoff conditions. The pumps are expected to operate only 0.3 percent of the time during the 40-year plant life. The fraction of the time the pumps will be operating at or near shutoff conditions will be less. These pumps have been hydrotested to 2400 psig. Therefore, the pumps are satisfactory and will perform the AFW system safety functions.

5. The design pressure and temperature calculation (Reference 2) has been revised (Reference 11) to use 4290 rpm plus 2 percent setpoint error (4376 rpm) to calculate the maximum pressure caused by the turbine-driven pump overspeed condition. The total dynamic head margin calculation (Reference 8) has been revised (Reference 10) and the piping pressure drop in Segment 4 is now 39 psi.

6. The design deficiencies identified by TVA in Reference 2 will be addressed in revisions to the calculations or will be corrected by design change notices. The calculation revisions and other document changes will be completed by December 31, 1991.

DEFICIENCY D-7

FINDING TITLE: Testing and Surveillance to Preclude Potential Waterhammer Events in the AFW System

DESCRIPTION OF CONDITION:

TVA performed an analysis (Reference 1) to identify potential fluid transient events affecting safety-related piping in the AFW system. The potential transients and the initial process conditions and data identified by Reference 1 were required to be used in piping stress analyses. Reference 1 identified potential waterhammer conditions in the AFW system due to check valve closures, actuation of pressure control valves, and steam void formation due to backleakage of high-energy fluids. The piping loads due to check valve closures were calculated in Reference 2 for inclusion in the pipe stress analysis program.

Reference 1 stated that AFW system valves PCV-3-122 and PCV-3-132 (which are air-operated pressure control valves) would be tested to ensure that their stroke times were greater than 6.0 seconds or the loadings associated with their actuation would be considered in the piping analysis. During the team inspection, TVA revised Reference 1 to incorporate, in addition to other changes, a statement to the effect that the loads due to PCV-3-122 and -132 were bounded by the check valve loads calculated in Reference 2, and therefore, these loads would not be considered separately.

Because waterhammer due to steam void collapse was not analyzed and forces due to such transients were not considered in the design, the formation of steam voids needed to be prevented and actions taken if steam leakage was detected. Reference 1 recommended that a surveillance program be established to monitor the temperature of the AFW discharge piping to detect leakages of high-energy fluid due to faulty check valves in the line. The team requested information from TVA to demonstrate that this requirement was met by the design. In response to the team's inquiry, TVA initiated a design change notice to relocate temperature elements TE-3-143 and -151 closer to their respective downstream check valves so that any temperature increase due to leakage of high-energy fluids could be detected before steam voiding of the long horizontal piping run inside the containment.

BASIS:

Waterhammer in the AFW piping due to steam void collapse can disable the redundant AFW pumps because of the failure of common discharge or suction piping, thus resulting in the possible loss of cooling flow to the steam generators. The FSAR commitment (Reference 3) requires that sufficient feedwater to the steam generators be supplied to remove primary system stored energy and residual core energy. Also, NRC Branch Technical Position ASB 10-2 (Reference 4) requires that design capability and verification be provided to reduce or eliminate possible waterhammer in the feedwater system.

REFERENCES:

1. WBN-APS2-024, Revision 1, "Fluid Transient Event Identification for Main and Auxiliary Feedwater System."
2. WBN-APS2-037, Revision 1, "Waterhammer Analysis of AFW Piping Due to Check Valve Closure Following a Pump Trip."
3. FSAR Section 10.4.9.1, "Auxiliary Feedwater System Design Basis."
4. NUREG-0800, Branch Technical Position ASB 10-2, Revision 3, "Design Guidelines for Avoiding Waterhammer Steam Generators."

TVA/WBN RESPONSE:

TVA agrees with the description of the deficiency. A Design Change Notice (M-16269-A) has been initiated to relocate temperature elements TE-3-143 and TE-3-151 closer to the AFW check valves to detect and thus preclude significant steam voiding in the AFW piping. Calculation WBN-APS2-024, "Fluid Transient Event Identification for Main and Auxiliary Feedwater System," will be revised to document the acceptability of the new temperature element locations. Design Change Notice issue and other engineering corrective actions will be completed by November 30, 1991. It should be noted that the need for a surveillance program had been identified prior to the NRC inspection as an unverified assumption (UVA) in calculation WBN-APS2-024. TVA was in the process of evaluating UVAs and would have uncovered this problem in that review. Since this item was documented as a UVA and would have been resolved, no further review for generic implications is required.

DEFICIENCY D-8

FINDING TITLE: Operability of Turbine-Driven Auxiliary Feedwater (AFW) Pump in the Event of Main Steamline Break

DESCRIPTION OF CONDITION:

The normally open motor-operated valve (MOV), FCV-1-15, in the steam supply line in the turbine-driven AFW pump from steam generator 1 and the normally closed MOV, FCV-1-16, in the backup steam supply line from steam generator 4 were located in the steam valve vault. These valves were not qualified for the pressure and temperature conditions in the vault following a main steamline break (Reference 2). If a break in the main steamline from steam generator 1 was assumed, valve FCV-1-16 would have to open to supply steam from steam generator 4 to the turbine-driven AFW pump. Since the valve was not qualified for the postulated post-accident environment, it might not open.

The turbine-driven AFW pump was designed to supply water to all 4 steam generators. Motor-driven AFW pump A was designed to supply water to steam generators 1 and 2, and pump B was designed to supply water to steam generators 3 and 4. The process design (Reference 1, Section 2.2.8.2) specified that at least 470 gpm of auxiliary feedwater had to be supplied to at least two steam generators. If a break in the main steamline from steam generator 1 occurred, the turbine-driven AFW pump would rely upon the backup steam supply. Backup valve FCV-1-16 which supplies steam from steam generator 4, might not open because of the surrounding harsh environment for which it was not qualified. If a single failure of motor-driven AFW pump B was assumed, motor-driven AFW pump A would provide cooling water to faulted steam generator 1 and steam generator 2 during the first 10 minutes of the event. The AFW flow to steam generator 1 would be isolated by operator action at 10 minutes, at which time the motor-driven pump would be supplying flow only to steam generator 2. Thus, the process design requirement to supply two steam generators could not be met.

During the inspection, TVA initiated a Condition Adverse to Quality Report (CAQR) to address this issue and included level control valves LCV-3-174 and -175 and their associated solenoid valves in the report because these valves located in the steam valve vault were also not qualified for the main steamline break environment (Reference 3). The level control valves control the flow in the discharge line from the turbine-driven AFW pump.

BASIS:

The FSAR commitment (Reference 4) requires that the AFW system provide cooling water to two or more steam generators. This requirement is also included in the system process design criteria (Reference 1).

REFERENCES:

1. N3-3B-4002, Revision 1, "System Description for Auxiliary Feedwater System."
2. WBN-OSG4-005, Revision 12, "Main and Auxiliary Feedwater System NUREG-0588 Category and Operating Times."
3. CAQR/PRD - WBP910043, Revision 0, January 11, 1991, requirement violated: For a main steamline break at least 470 gpm to at least two pressurized steam generators is required.
4. FSAR Section 10.4.9.1, "Auxiliary Feedwater System Design Basis."

TVA/WBN RESPONSE:

TVA agrees with the description of the deficiency. The corrective action for this deficiency will result in qualification of the components and revision of the appropriate documentation. Engineering corrective actions will be completed by December 31, 1991. This item is documented in SCAR WBP 910043SCA.

DEFICIENCY D-9

FINDING TITLE: Turbine-Driven Auxiliary Feedwater (AFW) Pump Flow Switch FS-46-57 Setpoint

DESCRIPTION OF CONDITION:

The setpoint for flow switch FS-46-57 was 950 gpm. TVA determined that the normal loop accuracy of the flow switch was -89.95 gpm and +48.64 gpm (Reference 1). Therefore, the flow switch could actuate at any flow between 860 gpm and 999 gpm.

The setpoint of flow-indicating controller FIC-46-57 was 940 gpm. TVA determined that the normal loop accuracy of the flow-indicating controller was +67.65 gpm and -109.06 gpm (Reference 1).

If the operator manually attempted to obtain the design flow 940 gpm, the flow switch could initiate a signal at about 860 gpm and revert from the manual mode to the automatic control mode. Therefore, the design flow of 940 gpm could not be supplied to the steam generators in the manual mode.

BASIS:

The AFW system description (Reference 2) requires that the operator be able to manually set turbine speed to control pump flow over the range of 0 to 940 gpm.

REFERENCES:

1. 1-FT-3-142, Revision 0, "Demonstrated Accuracy Calculation for Auxiliary Feedwater Pump Control Loop."
2. N3-3B-4002, Revision 1, "System Description for Auxiliary Feedwater System," Section 3.2.2.

TVA/WBN RESPONSE:

TVA agrees with the description of the deficiency.

TVA will evaluate the required accuracy calculation for this flow switch function and will make appropriate revisions. The demonstrated accuracy calculation will then be revised as needed. The calculation revisions will be issued by October 15, 1991.

DEFICIENCY D-10

FINDING TITLE: Instrumentation Loop Accuracy for Post-Accident AFW Flow Monitoring Instrumentation

DESCRIPTION OF CONDITION:

The team found that the required post-accident monitoring accuracy as stated in the FSAR (Reference 2) and in the AFW system description (Reference 3) was +/-17 gpm. This was in conflict with the acceptance criteria found in the accuracy calculations. The calculation gave the acceptance criteria as +/-235 gpm based upon a Westinghouse design document, WCAP-11376, (Reference 4). When the team questioned what the actual accuracy requirement should be, TVA determined that it should be the acceptance criteria value of +/-235 gpm divided by the number of steam generators (which was four) or +/-58.7 gpm.

However, TVA calculated the post-accident monitoring loop accuracy for each loop to be +169 and -182 gpm utilizing conservative input data. Therefore, the calculation failed to show that the instrumentation met the accuracy requirements of the FSAR, system description, or WCAP.

Further, the system description stated that for normal operation, the required accuracy was +/-11 percent. TVA calculated the loop accuracy for normal conditions as +133 and -147 gpm which was also much greater than the required +/-11 percent accuracy.

BASIS:

The calculated accuracy for the post-accident monitoring instrumentation used for determining AFW flow rates did not meet the instrumentation loop accuracy requirement specified in the FSAR, system description or WCAP-11376.

REFERENCES:

1. 1-FT-3-147A, Revision 2, "Post-Accident Monitoring Demonstrated Accuracy Calculation for Regulatory Guide 1.97 for Auxiliary Feedwater Flow."
2. FSAR Section 7.5, Table 7.5-1.
3. N3-3B-4002, Revision 1, "System Description for Auxiliary Feedwater System," Section 3.3.10.1, page 36.
4. Westinghouse Topical Report, WCAP-11376, December 1986, "Evaluation of Accuracy Requirement for R.G. 1.97 Instrumentation for Watts Bar Units 1 and 2."
5. Regulatory Guide 1.97, "Instrumentation for Light Water-Cooled Nuclear Power Plants to Assess Plant and Environs Condition During and Following an Accident," May 1983.

TVA/WBN RESPONSE:

TVA agrees with the description of the deficiency. As a part of the corrective actions from TVA's self assessment, TVA is reviewing system descriptions, required accuracy calculations, and essential demonstrated accuracy calculations. This effort is documented in significant corrective action report WBP 910055SCA. The AFW system description and required accuracy calculations will be reviewed under this SCAR and any needed changes made. The subject demonstrated accuracy calculation (1-FT-3-147A) will then be revised as necessary. These actions will be completed by December 31, 1991.

DEFICIENCY D-11

FINDING TITLE: Steam Generator Narrow Range Level Measurement Instruments

DESCRIPTION:

TVA calculations (References 5 and 6) addressed the accuracy of the steam generator narrow range level measurement instruments under normal and accident conditions. A major source of potential process error could be the partial loss of the reference leg as a result of the flashing of water due to high temperature caused by a high-energy line break in the area and low pressure due to steam generator depressurization. This type of error was recognized in the TVA setpoint calculation procedure (Reference 7), but was not considered in the actual calculations. In addition, the methodology adopted by TVA in the calculations did not take into account the insulation provided to prevent a rapid rise of temperature in the reference leg as a result of a high-energy line break (Reference 8).

BASIS:

The FSAR commitment (Reference 8) requires that a water head be maintained in the steam generator following a loss-of-coolant accident. The narrow range level loops are provided to meet this commitment and must remain functional after a high-energy line break. Therefore, all sources of potential errors in measurement must be evaluated.

REFERENCES:

1. N3-3B-4002, Revision 1, "System Description for Auxiliary Feedwater System."
2. 47W610-3-3, Revision 1, "Electrical Control Diagram-Auxiliary Feedwater System."
3. WBN-OSG4-049, Revision 1, "Category and Operation Times for Regulatory Guide 1.97."
4. WB-DC-30-7, Revision 3, "Design Criteria for Post-Accident Monitoring Instrumentation."
5. 1-LT-3-038, Revision 1, "PAM Demonstrated Accuracy Calculation for Regulatory Guide 1.97 Steam Generator Level (Narrow Range)."
6. 1-LT-3-148, Revision 0, "Demonstrated Accuracy Calculation for Steam Generator Narrow Range Level Control Loops."
7. Branch Instrumentation EEB-TI-28, Revision 1, "Setpoint Calculations," Section 15.6.1.2(B).
8. NUREG-0847, "Safety Evaluation Report Related to the Operation of the Watts Bar Nuclear Plant - Units 1 and 2," Supplement 2, January 1984.

TVA/WBN RESPONSE:

TVA agrees with the description of the deficiency. Corrective actions for the deficiency are given below.

Part A: Sense Line Flashing

RESPONSE: A basis did exist for the assumption that there was no flashing in the reference leg. However, the basis was a Sequoyah Nuclear Plant calculation, and it was not properly referenced as input to the Watts Bar calculation. Calculation WBN OSG4-163, "SG Reference Leg Error Corrections - Determination of Onset of Flashing Using HEATING 5," has since been prepared to address sense line flashing. The calculation concluded that sense line flashing occurs only for faulted steam generators. Level measurement of a faulted steam generator is not required. Accuracy Calculations 1-LT-3-038 and 1-LT-3-148 will be revised by December 31, 1991, to correct self-assessment errors and to reference calculation WBN OSG4-163 as the source justification for not having to consider line flashing.

Part B: Sense Line Insulation:

RESPONSE: TVA considers the failure to consider sense line insulation for temperature effects on the reference leg to be inconsequential since that results in a conservative analysis. TVA chose to retain this conservatism. However, the calculations will be clarified at the same time as the sense line flashing discrepancy is corrected (December 31, 1991), to reflect that the omission of the insulation effect was intentional and results in conservative analysis.

DEFICIENCY D-12

FINDING TITLE: Evaluation of System Response Time

DESCRIPTION OF CONDITION:

The team found a failure to adequately analyze system response time as required by References 2 and 3. This deficiency exists in the determination of the time delay settings for the switchover of the turbine-driven AFW pump ERCW Train A suction valves to ERCW Train B suction valves, when the process system response to the control action that signalled the Train A valves to open was lacking (Reference 4). A 4-second timer was provided to allow the control logic to reset as a result of the build up of suction pressure in the line when the Train A valves opened. However, many parameters would contribute to the process system response time, such as the time for the valves to open sufficiently, time for the piping to refill, and time for the pressure switches to reset. Understanding of these process system parameters is essential for establishing the setting of the timer in order to ensure that the switchover from Train A to Train B takes place only when a system condition exists that justifies doing so. TVA was unable to demonstrate that these conditions were considered in establishing the time delay settings.

Also, the actuation signals for the motor and turbine-driven AFW pumps were required to be delivered within 1.2 seconds of the initiating condition including sensor delays (Reference 5). The team found no calculation which demonstrated that the system response time of the as-designed system would meet this requirement.

The team concluded TVA that had not established a uniform methodology for assessing system response time for safety-related control actions.

BASIS:

Reference 2 and Chapter 7 of the NRC Standard Review Plan (Reference 3) require system response time to be evaluated for all safety-related systems. The team found two examples where TVA had failed to adequately evaluate system response time resulting in the AFW potentially not meeting its safety-related functional requirements.

REFERENCES:

1. EEB-TI-28, Revision 1, "Setpoint Calculations."
2. Institute of Electrical and Electronics Engineers, Standard 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations."
3. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants", LWR Edition, July 1981.
4. 47W611-3-3, Revision 9, "Electrical Logic Diagram - Auxiliary Feedwater System."
5. N3-3B-4002, Revision 1, "System Description for Auxiliary Feedwater System", Section 2.2.6.

TVA/WBN RESPONSE:

TVA agrees with the description of the deficiency. Corrective actions for the deficiency are given below:

PART A:

Timing of Train A and Train B ERCW valves to the suction of the turbine driven AFW pump.

RESPONSE:

By December 31, 1991, TVA will prepare a calculation to demonstrate that the system's total response time for repressurization on switchover from CST to ERCW is adequate considering all appropriate parameters.

PART B: Actuation time for the motor turbine driven AFW pumps.

RESPONSE:

By December 31, 1991, TVA will prepare a calculation to verify the adequacy of the AFW pumps actuation signals allowable time. Following the verification of the actuation time, TVA will, before system turnover, prepare a calculation to demonstrate that the allowable actuation time is met by the presently designed instrumentation system.

DEFICIENCY D-13

FINDING TITLE: Incorrect Secondary Connections of Emergency Diesel Generator (EDG) Neutral Grounding Transformers

DESCRIPTION OF CONDITION:

Neither the single-line diagram (Reference 3) nor the applicable schematic diagram (Reference 4) showed which transformer ratio was in use with the WBN EDG neutral grounding calculation.

When the team identified this discrepancy, TVA first determined that the relay setting sheets (Reference 5) for the ground fault voltage relays showed the transformer ratio was 7200:240 V. TVA then field-checked the ratio and discovered that the transformers were actually connected for a ratio of 7200:120 V. This connection would deliver a ground fault current of only 1.03 A. TVA needs to determine the cause for this deficiency and address its implications to other transformer tap settings.

In the absence of a completed grounding calculation, the team performed an approximate calculation of capacitive charging current using related data from TVA drawings, calculations, and Reference 6. The team estimated the capacitive charging current was approximately 2.8 A. The existing ground fault current (1.03A) was only 37 percent of the required minimum and clearly inadequate for limiting overvoltage.

Poor ground fault detection sensitivity during a loss of offsite power (LOOP) event was a further functional deficiency of the existing transformer connection. The ratio of the neutral grounding transformer determined the sensitivity of the relays that actuate the ground fault alarm in the main control room. If the ratio was 7200:120 V, the relays would fail to detect any ground faults in 83 percent of the lengths of motor and transformer windings nearest the neutral, and most high-impedance faults elsewhere.

BASIS:

The existing grounding transformer connection would allow an intermittent low-level ground fault capable of causing severe transient overvoltages in the Class IE system to persist undetected indefinitely. This condition could potentially lead to multiple consequent failures of safety-related motors within one division. This condition is contrary to TVA's commitment in Reference 7 to provide effective grounding for the 6.9-kV Class IE system and unacceptably degrades the reliability of the safe shutdown system.

REFERENCES:

1. Institute of Electrical and Electronics Engineers, Standard 142-1982, "Recommended Practice for Grounding of Industrial and Commercial Power Systems."
2. Donald Beeman, Ed., Industrial Power Systems Handbook, McGraw-Hill, New York, 1958.
3. TVA Drawing 1-45W727, Revision 0, "Single-Line Diagram - 6.9-kV Diesel Generators."
4. TVA Drawing 45W760-82-1, Revision 1, "Schematic Diagram - 6.9-kV Emergency Diesel Generators."
5. TVA Relay Setting Sheets 6455, 6565, 6475, and 6485, dated February 28, 1980, for device 59V of EDG's 1A-A, 1B-B, 2A-A, and 2B-B, respectively.
6. Westinghouse Industrial and Commercial Power System Applications Series Publication No. PRSC-4B, "System Neutral Grounding and Ground Fault Protection," Westinghouse Electrical Corp. Relay-Instrument Division, Coral Springs, FL, 1979.
7. FSAR, Section 8.3.1.1, "Grounding Requirements."

TVA/WBN RESPONSE:

TVA agrees with this finding although it should be noted that the diesel generator neutral grounding calculation, which was not scheduled for completion and had not been issued prior to the audit, would likely have discovered the deficiency.

Procedure Method PM86-02 (EEB) requires a calculation to demonstrate diesel generator neutral grounding transformer acceptability. This calculation was issued to comply with the requirement to analyze the safety-related neutral grounding system. This program that defined the required minimum set of calculations and studies for the electrical systems, in order to establish the technical adequacy and design basis, did not exist during the design stage.

The analysis for the diesel generator neutral grounding system, Calculation WBN EEB-MS-T102-0014, "DG Neutral Grounding Transformer Sizing," has now been issued. Its purpose was to verify the size of the neutral grounding transformers, the size of the secondary resistors, and the sensitivity of the ground overvoltage relays. The results concluded that some of the diesel generator neutral grounding equipment ratings are inadequate. Specifically, the continuous current rating of the secondary resistors is inadequate for a maximum ground fault of 5 amperes. Problem Evaluation Report (PER) WBP 900266PER documents and will provide the corrective actions to resolve these problems.

The ohmic value of 0.22 ohm shown on single line drawing 1-45W728-1 agrees with the existing installation. But the resistance value of 1.07 ohms shown on the single line diagram 1-45W727 requires revision. The change will be a part of the corrective action of WBP 900266PER.

The 7200-120V grounding transformer connection is the proper connection for the existing resistance value of 0.22 ohm, which is the result of the test documented in Maintenance Request (MR) A-617274. The connection diagrams and relay setting sheet 4949 for the additional diesel generator DG CS agree with the existing transformer connection. Therefore, no discrepancy exists between the wiring drawings and installation.

However, the transformer ratio shown on relay setting sheets 6455, 6465, and 6475, and 6485 for diesel generator DG 1A - DG 2B will be revised from 7200-240V to 7200-120V as a corrective action to resolve WBP 9100266PER.

The FSAR will be revised to change the ground fault current from 1.1 amperes to 5 amperes depicted in Section 8.3.1.1, page 8.3-26. This will be included in Amendment 67 of the FSAR.

The Design Change Notice to implement the corrective action to resolve the diesel grounding resistor failure will be design complete by December 31, 1991.

The relay setting sheets will be revised by Transmission and Customer Services (T&CS). The anticipated completion date is September 30, 1991.

DEFICIENCY D-14

FINDING TITLE: Failure to Consider Worst-Case Loading in Class 1E Battery and Charger Sizing and DC Voltage Drop Calculations

DISCUSSION:

TVA calculation (Reference 1) for vital batteries and charger sizing did not account for the potential additional loading due to the transfer of 6.9-kV shutdown board control power from the normal battery boards to the alternate feeders. Reference 2 also did not account for this additional loading in computing the voltage drop in the circuits between the station batteries and the 125-V battery boards. This failure to consider the worst-case loading is a deficiency in both calculations.

BASIS:

In the event of a design basis accident while the battery bus is supplying additional transferred loads from the other unit, the battery might not be able to supply the accident loads while maintaining minimum required load terminal voltages. Class 1E batteries and the related distribution system must be designed to support safe shut down of the plant and to successfully mitigate an accident (Reference 3). Engineering calculations, associated analysis, and tests must demonstrate that the system has adequate capacity to perform its intended design functions.

REFERENCES:

1. WBN-EEB-MS-TI11-003, Revision 1, "Class 1E Battery and Associated Charger Sizing."
2. WBN-EEB-MS-TI11-004, Revision 5, "125-V DC System Voltage Drop."
3. FSAR Section 8.3.2.1.1, "Vital 125-V DC Central Power System."

TVA/WBN RESPONSE:

TVA has not performed analyses of alternate feeder arrangements. However, the existing battery sizing calculations are conservative in the loadings used and envelop the stated concern. The calculations consider for the accident loading, that the alternating current (AC) feeders to both inverters have been lost concurrent with the accident, resulting in the addition of 40KW of load for the entire 30 minute duty cycle of the battery. In actuality, for a loss of offsite power concurrent with the accident, the inverter loads would only be on the battery for the time it takes the diesel generators supply breakers to close (approximately 11.5 seconds). The conservative addition of the inverters for the full 30 minutes far exceeds the small load (approximately 4 amps continuous load, 150 amps in- rush load) that the alternate feed to a 6.9-kV shutdown board control bus would require.

Development of the final technical specifications will require an engineering analysis of the alternate feeds to all distribution boards be complete prior to fuel loading. This will include a revision to the existing 125V DC calculations to document the effect of the additional loading and voltage drop on the battery system, due to the supplying the 125V DC alternate feeds on the 6.9-kV shutdown boards.

DEFICIENCY D-15

FINDING TITLE: Inadequate Corrective Action for Technical Audit Findings Related to Design Baseline and Verification Program

DESCRIPTION OF CONDITION:

The team reviewed results of technical audits performed to ensure the adequacy of the implementation of the Design Baseline and Verification Program (DBVP). The team found that TVA's auditing organization had identified in at least two audits dating back to April 14, 1989, that the DBVP was not being adequately implemented (see References 3 and 4). CAQRs were written documenting the specific deficiencies identified during the audits (see References 5 through 8).

Reference 4 indicated a "major area concern" was design criteria, calculations, test scoping documents, and other documents which defined the Watts Bar design basis continued to have errors and inconsistencies. The team found many of the same problems documented by TVA still persisted, i.e., the team found many deficient conditions which fell within the scope of the above major area of concern.

TVA in parallel with this inspection was conducting its own self-assessment. As a result of this additional review, TVA documented problems associated with implementation of the DBVP that also fell within scope of the above major concern (see References 9 and 10). Therefore, the team considered TVA's corrective actions to date to be inadequate in response to previous relevant design findings of TVA audits.

BASIS:

NRC regulations (Reference 11), and TVA procedures (Reference 12) require that corrective actions be identified and implemented on a timely basis to prevent recurrence of identified deficiencies,

REFERENCES:

1. Watts Bar Nuclear Plant Design Baseline and Verification Program (DBVP) Corrective Action Program Plan, Revision 3, dated July 27, 1990.
2. TVA Response to NRC Inspection Report 50-390/89-12, dated February 5, 1990.
3. Technical Audit Report No. WBT 89901, dated April 14, 1989.
4. Technical Audit Report No. WBA 89007, dated March 21, 1990.
5. CAQR WBT 890178901, Inconsistencies within design criteria and system descriptions, between design criteria and system descriptions and with source information, and some technical concerns, dated April 4, 1989.
6. CAQR WBA 900126007, Interface controls not established and corrective action not implemented, dated March 9, 1990.
7. CAQR WBA 900127007, Calculation inputs not current, correctly selected or applied, dated March 9, 1990.

8. CAQR WBA 900128007, Changes to equipment not reflected in plant documentation, dated March 9, 1990.
9. CAQR WBP 910014P, Records deficiencies noted during review of calculations and Design Change Notices (DCNs), dated January 4, 1991.
10. CAQR WBP 910055, Technical deficiencies in design calculations, dated January 11, 1991.
11. 10 CFR 50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants, Criterion XVI, Corrective Action.
12. Watts Bar Site Instruction, AI-2.8.15, Revision 0, Corrective Action.

TVA/WBN RESPONSE:

TVA agrees with the description of the deficiency. Technical audits WBT 89901 and WBA 89007 identified numerous minor errors and inconsistencies in system-related electrical and mechanical design criteria and system descriptions (DC/SD). Affected documents were identified (33 DC/SD) and a program was begun to conduct a checklist review of each DC/SD. To date, 14 reviews have been completed.

Based on the findings of this NRC inspection and TVA's engineering self-assessment, additional issues have been identified which are now included in an expanded corrective action program. The remaining electrical DC/SD will complete the original checklist reviews by November 30, 1991. The mechanical system descriptions require additional detailed review. These reviews will be accomplished through the self-assessment corrective action program described previously and will be completed by September 30, 1992.

UNRESOLVED ITEM U-1

FINDING TITLE: Space Heaters in Limitorque Valve Operators

DESCRIPTION OF CONDITION:

TVA had initiated an engineering change notice to which a significant condition report was attached (References 1 and 2), to disconnect space heaters from limit switch and motor compartments of all motorized valves using Limitorque valve operators. Of particular interest to the team were the ERCW isolation valves (Trains A and B) located in the turbine-driven AFW pump room. The minimum and maximum normal temperatures in this room were 50°F and 104°F; the normal relative humidity was 80 percent and the maximum relative humidity was 90 percent. The team asked TVA to justify the removal of space heaters from these valves and to demonstrate that the valves would perform their safety function when required after being exposed to the environment in the turbine-driven pump room. TVA responded that the heaters were removed because they were not energized during valve qualification under accident conditions. TVA stated that its qualification program required demonstration that the valves could perform their safety functions in an accident environment at the end of the equipment's qualified life in its normal environment. TVA, however, was unable to provide documentary evidence for the qualification of valves in their normal environment.

BASIS:

The ERCW motor-operated isolation valves are located in the turbine-driven AFW pump room. The valves must be qualified for the normal and accident environment in the room (Reference 3).

REFERENCES:

1. Engineering Change Notice (ECN) No. 6295.
2. Significant Condition Report WBNMEB8649, "Environmental Qualification of Electrical Equipment," April 24, 1986.
3. 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants."

TVA/WBN RESPONSE:

The finding states that TVA was unable to provide documentary evidence for the qualification of the actuators during normal operation due to the effects of humidity.

TVA implements Limitorque's recommendation which requires that the motor and limit switch compartment heaters be disconnected in order to document valve qualification. This is in accordance with Limitorque's recommendations as contained in the Nuclear Utility Group on Equipment Qualification Report on Limitorque EQ Clarifications, dated August 1989 (applicable pages attached), and is due to the heaters not having been installed in the actuators during the qualification testing. The subject valves are certified to Limitorque test Report No. B-0003, which documents qualification for normal and accident conditions. During this test, the actuator was subject to 100 percent humidity for 200 hours at elevated temperatures to simulate normal thermal aging. Electric Power Research Institute (ERPI) Report NP-6229 (applicable pages attached) further states that energized heaters can cause heat damage and accelerated aging of control and power wiring internal to the limit switch compartment or motor.

Furthermore, Federal Register Notice (48 FR 2732) was issued to address comments on humidity during the preparation on 10 CFR 50.49. It identified the effects of humidity during normal operation as being an area that could not be considered for all equipment. The commissions response was "Humidity variations during normal operation are difficult to predict. It has not been demonstrated that the time-dependent variation in humidity will produce any difference in degradation of electric equipment."

It is TVA's engineering judgment that any advantages to be realized by the addition of space heaters, in order to lessen the effects of humidity during normal operation, would be offset by the disadvantages of an unqualified electrical device internal to a qualified component; which could in fact cause degradation or even common-mode failure.

The effects of humidity, while being difficult to predict, can be minimized by a preventative maintenance program which inspects and corrects any noted deficiences. This is the approach that TVA has taken.

UNRESOLVED ISSUE U-1
ATTACHMENT 1

NUCLEAR UTILITY GROUP ON
EQUIPMENT QUALIFICATION

LIMITORQUE REPORT ON
ENVIRONMENTAL QUALIFICATION
(APPLICABLE PAGES)

L37890919825

NUCLEAR UTILITY GROUP
ON EQUIPMENT QUALIFICATION

SUITE 800
1400 L STREET, N. W.
WASHINGTON, D. C. 20005-3502
TELEPHONE (202) 371-5700

MEMORANDUM

September 7, 1989

TO: Nuclear Utility Group On Equipment Qualification

FROM: Phil Holzman

SUBJECT: ISSUANCE OF LIMITORQUE REPORT

Limitorque has finally completed its formal review and approval of the Group's Limitorque clarification report. The final Limitorque review resulted in a few minor clarifications and revisions. The final report dated August 1989, and containing Limitorque's approval is enclosed.

In order to facilitate Group member reproduction the report is provided in unbound form. On behalf of the Group, I want to thank those members who participated in the discussions with Limitorque or provided valuable comments and clarifications to the various draft revisions.

Any questions or comments regarding the report should be directed to Phil Holzman or Bill Horin.

Enclosure (1)

CLARIFICATION OF INFORMATION RELATED TO THE ENVIRONMENTAL QUALIFICATION OF LIMITORQUE MOTORIZED VALVE OPERATORS

PREPARED BY:

NUCLEAR UTILITY GROUP ON EQUIPMENT QUALIFICATION

AUGUST 1989

CLARIFICATION OF INFORMATION RELATED
TO THE ENVIRONMENTAL QUALIFICATION OF
LIMITORQUE MOTORIZED VALVE OPERATORS

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PREPARED BY:
NUCLEAR UTILITY GROUP ON EQUIPMENT QUALIFICATION

P M Holzman 8/31/89
(Prepared by/date -for NUGEQ)

APPROVED BY:
LIMITORQUE COPRORATION

D Blackburn 9-3-89
(Approved by/date for Limitorque)

9. Motor Heaters:

The motor heaters are small flat discs which are attached within the motor-end bell with leads extending into the limit-switch compartment.

Motor heaters were not included in any environmental or seismic testing conducted by Limitorque. If requested in purchase documents, they have been provided in nuclear-qualified units but should not be considered as qualified by Limitorque.

Limitorque recommends that the heaters only be energized during storage. Limitorque has not analyzed the effect that the heaters may have on environmental or seismic qualification, but offers the following perspectives:

(1) If energized, the heaters could increase the motor ambient temperature. Limitorque indicated that their practice was to size the heaters for approximately a 10°C temperature rise, however, no Limitorque data exists on the actual temperature rise experienced by the motor when the heaters are energized.6/
(2) Un-energized heaters should not affect environmental qualification due to their location and materials of construction.
(3) Seismic qualification should not be affected by the presence of the heaters due to their low mass and location.

6/ A review of B0058 suggests that for most applications an acceptable qualified life (40 years) with substantial margin should still be available for units with minor temperature increases above typical plant ambient conditions. See B0058, Section 3.2, Thermal Aging.

Technical Repair Guidelines for the Limitorque Model SMB-000 Valve Actuator

NP-6229
Research Project 2814-2

Final Report, January 1989

Prepared by

ADVANCED TECHNOLOGY ENGINEERING SYSTEMS, INC.
12005 Sunrise Valley Drive
Reston, Virginia 22091

Principal Investigators
R. F. Myers
M. L. White

Prepared for

Nuclear Maintenance Application Center

Operated by

Electric Power Research Institute
3412 Hillview Avenue
Palo Alto, California 94304

EPRI Project Managers
J. F. Lang
B. P. Brooks

Nuclear Power Division

8.9. Heaters

Heaters are devices that can be used in either the switch compartment or the motor to help drive moisture out of the equipment. The heater is generally a simple wire-wound ceramic device that produces heat through resistance heating. Heaters are not required for actuator environmental qualification and were not tested by Limitorque during environmental qualification testing. Energized heaters can cause heat damage and accelerate aging of control and power wiring internal to the limit switch compartment or motor.

8.10. Grease Relief Valve

The grease relief valve basically consists of a ball-type, spring-loaded check valve installed in the main gear case of the actuator, sometimes requiring a transition piece. Grease relief valves are required on actuators located inside the containment building. They are a means of relieving internal gear case pressurization resulting from grease expansion which might occur as a result of accident ambient temperatures inside containment.

NP-6229
EPRI TECHNICAL REPAIR GUIDELINES FOR LIMITORQUE Model
SMB-000 VALVE ACTUATOR

ENCLOSURE 2

RESPONSE TO NRC INTEGRATED DESIGN
INSPECTION ISSUES (50-390/91-201)
LIST OF COMMITMENTS

1. Self-assessment engineering corrective actions will be complete by September 30, 1992.

2. Corrective actions identified within the self-assessment review for each safety-related system will be completed prior to system turnover.

3. The Auxiliary Feedwater (AFW) System description will be revised to resolve the deficiencies cited by the NRC and also to address concerns that were identified during TVA's self-assessment program. The system description revision will be completed by December 31, 1991.

4. AFW system calculations will be reviewed and revised as required to include the condition where a loss of offsite power has shut down the essential raw cooling water pumps and the potential exists for a loss of AFW pump suction. The revisions will be issued by December 31, 1991.

5. The Final Safety analysis Report (FSAR) will be revised to clarify the statements made concerning the time requirements to deliver rated flow after receipt of an accident signal. The revision will be made by December 31, 1991.

6. TVA is evaluating, with Westinghouse, the required minimum volume of AFW to be maintained in the condensate storage tank (CST) and will revise the calculation as required. Other documents that are affected by the results of the calculations (FSAR, System Descriptions, Westinghouse documents, etc.) will be revised as required. This work will be completed by December 31, 1991.

7. The total dynamic head (TDH) calculation HCG-TBG-091981 is being revised to allow for safety valve setpoint error and 3 percent accumulation. Additionally, information from Westinghouse suggests that the AFW flow requirement can be reduced and thus restore margin in the TDH calculation for the AFW pumps to allow for pump wear and seal leakage. This reanalysis will be completed by October 24, 1991.

8. Calculation HCG-JWA-041079 will be revised to correct the deficiencies cited in NRC Inspection Report 50-390/91-201. TVA will also consult with the pump vendor to verify that the pump will tolerate the transfer as required in the safety evaluation report. This will be completed by November 30, 1991.

9. The design deficiencies identified by TVA in Reference 2 will be addressed in revisions to the calculations or will be corrected in accordance with design change notices (DCNs) by December 31, 1991.

ENCLOSURE 2

RESPONSE TO NRC INTEGRATED DESIGN
INSPECTION ISSUES (50-390/91-201)
LIST OF COMMITMENTS

10. DCN M-16269-A will relocate temperature elements TE-3-143 and TE-3-151 closer to the AFW check valves to detect and thus preclude significant steam voiding in the AFW piping. Calculation WBN APS2-024 will be revised to document the acceptability of the new temperature element locations. The DCN issue and other engineering corrective actions will be completed by November 30, 1991.

11. Significant Corrective Action Report (SCAR) WBP 910043SCA corrective actions will result in the qualification of components and revision of the appropriate documentation given a postulated main steamline break event. Engineering corrective actions will be completed by December 31, 1991.

12. TVA will evaluate the required accuracy calculation for the AFW pump flow switch function and will make appropriate revisions. The demonstrated accuracy calculation will then be revised as needed. The calculation revisions will be issued by October 15, 1991.

13. The AFW system description and required accuracy calculations will be reviewed under SCAR WBP 910055SCA and any needed changes made. The demonstrated accuracy calculation (1-FT-3-147A) will then be revised as necessary. These actions will be completed by December 31, 1991.

14. Accuracy Calculations 1-LT-3-038 and 1-LT-3-148 will be revised by December 31, 1991, to correct self-assessment errors and to reference calculation WBN OSG4-163 as the source justification for not having to consider line flashing.

15. Steam Generator Narrow Range Level Measurement Calculations will be clarified to reflect that the omission of the insulation effect on sense line flashing was intentional and resulted in conservative analysis (December 31, 1991).

16. By December 31, 1991, TVA will prepare a calculation to demonstrate that the AFW system total response time for repressurization on switchover from CST to ERCW is adequate considering all appropriate parameters.

17. By December 31, 1991, TVA will prepare a calculation to verify the adequacy of the AFW pumps actuation signals allowable time.

18. Before system turnover, TVA will prepare a calculation to demonstrate that the allowable actuation time is met by the presently designed instrumentation system.

19. The design change notice to implement the corrective action to resolve the diesel grounding resistor failure will be design complete by December 31, 1991.

ENCLOSURE 2

RESPONSE TO NRC INTEGRATED DESIGN
INSPECTION ISSUES (50-390/91-201)
LIST OF COMMITMENTS

20. Relay setting sheets will be revised by Transmission and Customer Services (T&CS). Anticipated completion date is September 30, 1991.

21. The FSAR will be revised to change the ground fault current from 1.1 amperes to 5 amperes in Section 8.3.1.1 page 8.3-26. This revision will be incorporated in Amendment 67.

22. TVA will complete an engineering analysis of the alternate feeds to the distribution boards prior to fuel loading. This will include a revision to the existing 125 V DC calculations to document the effect of the additional loading and voltage drop on the battery system due to supplying the 125 V DC alternate feeds on the 6.9-kV shutdown boards.

23. The electrical design criteria and system descriptions will complete the original checklist reviews by November 30, 1991.