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JUL 31 1991

WBRD-50-390/91-18
WBRD-50-391/91-18

10 CFR 50.55(e)

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) 50-391

WATTS BAR NUCLEAR PLANT (WBN) UNITS 1 AND 2 - REACTOR VESSEL HEAD VENT SYSTEM (RVHVS) OPERATING MODES EVALUATION - WRBD-50-390/91-18 AND WBRD-50-391/91-18 - FINAL REPORT

The subject deficiency was initially reported to NRC Region II on April 16, 1991, in accordance with 10 CFR 50.55(e), as Significant Corrective Action Report (SCAR) WBSCA 910202. An interim report was submitted relative to this issue on May 22, 1991. Subsequently, TVA determined the deficiency to be applicable to Unit 2. SCAR WBSCA 910239 as been initiated to document the deficiency for Unit 2. Enclosure 1 is TVA's final report.

Enclosure 2 contains the commitments made in this report.

If there are any questions, please telephone 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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ENCLOSURE 1

WATTS BAR NUCLEAR PLANT (WBN) UNITS 1 AND 2
REACTOR VESSEL HEAD VENT SYSTEM OPERATING MODES EVALUATION
SIGNIFICANT CORRECTIVE ACTION REPORTS (SCARs)
WBSCA 910202 AND WBSCA 910239
WBRD-50-390/91-18 AND WBRD-50-391/91-18

FINAL REPORT

DESCRIPTION OF CONDITION

The Reactor Coolant System (RCS) operating modes calculations do not address the required operation of the Reactor Vessel Head Vent System (RVHVS) for mitigation of the Design Basis Events (DBEs) delineated in Watts Bar Design Criteria WB-DC-40-64, "Design Basis Events Criteria."

During emergency or abnormal situations, the RVHVS functions as a reactor vent to remove gases which may potentially impair natural circulation. Additionally, Design Criteria WB-DC-40-64 requires operation of the RVHVS to provide RCS letdown to accommodate boration for mitigation of numerous DBEs. Many of these events are postulated to occur in plant operating Mode 1, during which the reactor would be at full temperature and pressure for power operation. If the RVHVS were called upon for event mitigation soon after occurrence of a DBE, the RVHVS piping could experience temperatures in excess of those used in the associated piping stress analyses.

The RVHVS piping merges with the pressurizer power operated relief valve discharge line upstream of the pressurizer relief tank. Four solenoid operated valves are installed in the RVHVS (FSV-68-394, -395, -396, and -397); FSV-68-394 and -395 are in parallel (isolation valves) while FSV-68-396 and -397 are in parallel (position throttle valves).

Contrary to the operating conditions of the above described modes, the current system-based RCS operating modes calculations and resulting pipe stress analyses were performed for temperatures less than those which sections of the Unit 1 and Unit 2 RVHVS piping would be expected to experience. The current system-based RCS operating modes calculations and resulting stress analyses were basically performed as follows:

- For Unit 1, piping from the reactor vessel, up to and including isolation valves FSV-68-394 and -395, was analyzed for a temperature of 618 degrees Fahrenheit (F). Piping between the isolation and throttle valves was analyzed for 327 degrees F. The remaining piping was analyzed for 350 degrees F.

- For Unit 2, piping from the reactor vessel through isolation valves FSV-68-394 and -395, up to and including position throttle valves FSV-68-396 and -397, was analyzed for a temperature of 650 degrees F. The remaining piping was analyzed for 358 degrees F.

The original RCS operating modes calculations were generated between October 1988 and January 1989, in parallel with the development of the design basis events mitigation requirements of WB-DC-40-64.

ROOT CAUSE

The above condition involves two deficiencies. Each deficiency is associated with a unique set of circumstances involving the RCS operating modes calculations which caused the end result. Each deficiency is addressed separately for clarity.

1. The alternate letdown mode (during boration) usage of the RVHVS was not included as an operating mode in the pipe stress analyses. The root cause for this deficiency was the failure to maintain design input documents in a current status. Without current design information, the preparer of the RCS operating modes calculations had insufficient information to assure that all design functions for the RVHVS were considered. As Westinghouse provided new information on the RVHVS, it was not incorporated in the design documents, either through temporary change memoranda or by formal document revisions.

2. The primary mode of operation of the RVHVS (i.e, venting steam or noncondensables from the head) was not included as an operating mode in the pipe stress analyses. The root cause for this deficiency was the lack of a common understanding of the term "transient." The preparer of the RCS operating modes calculations considered the venting mode to be a short-term transient, rather than a steady state mode of operation, and that the temperature data to be used in the piping analysis would be obtained from another input source. This was an error since the piping would be expected to reach temperature equilibrium during venting (i.e., steady state). The preparer further assumed that the Piping Analysis Input Data document would have the information or that the piping analyst would know to obtain temperature information from another source. This was also an error since the piping analyst was expecting to obtain operating temperature information he needed from the RCS operating modes calculations.

   The mechanical discipline engineers involved interpreted the term "transient" to mean all nonsteady state conditions. The civil discipline engineers responsible for the pipe stress analysis use the same term in two ways, both of which have specific meanings. The first meaning is associated with rapid temperature fluctuations. The pipe stress analyst uses this information only for Class 1 pipe analysis (for fatigue effects). The second use of the term "transient" by the pipe stress analyst is associated with hydraulic transients. These events are usually very short duration, highly energetic dynamic loads (e.g., water hammer). Operating modes for Class 2 or Class 3 pipe analysis that involve thermal equilibrium temperature in the pipe wall are considered by the pipe stress analyst to be "steady state" and should be included in the operating modes input.

Because the RCS operating modes calculations preparer understood one definition of "transient" and the pipe stress analyst was using another, a communication gap existed. As a result of this miscommunication, the operating modes calculations were performed only to the mechanical interpretation of steady state conditions where both isolation valves were closed (i.e, no venting). With both isolation valves closed and no pipe fluid flow, the worst ambient temperature of 327 degrees F following a steam line break inside containment was assumed to bound the temperature for the piping between the isolation valves and throttle valves. This was in error for the reasons described above.

EXTENT OF CONDITION

The first deficiency, omission of the letdown mode, is unique to this system. The second deficiency, the inadequate treatment of the vent mode, could possibly occur with the pressurizer relief valve line. The analysis for this line was reviewed and found to have been performed properly.

SAFETY IMPLICATIONS

A sample review of the Safety Injection, Reactor Coolant, Containment Spray, and Residual Heat Removal Systems' functions, specified in WB-DC-40-64 as being required to mitigate DBE, revealed no other modes of system operation with the potential to invalidate the pipe stress analysis.

A 3/8-inch flow restrictor exists at the connection of the RVHVS piping to the RCS. This flow restrictor limits the flow through the RVHVS to a rate less than the capability of the reactor coolant makeup system should a break occur downstream of the flow restrictor. Should the RVHVS piping fail during venting operations for the reactor or during letdown operations following a DBE, and assuming that a significant pipe crack or pipe break were to occur, a suitable flow path would exist for venting and letdown. Components in the area which perform a primary safety function are protected from the resulting water spray environment. Failure of this piping in such a way as to essentially isolate the RVHVS (a complete crimping of the pipe) is considered to be highly unlikely. If this were to occur, the requirement to function as a vent or redundant letdown path following a DBE would be lost.

CORRECTIVE ACTION

1. The RCS operating modes calculations will be revised to properly specify operating temperatures for the RVHVS piping. The rigorous pipe stress analyses will be qualified using the updated operating modes. Pipe supports will be redesigned, if necessary. Corrective actions will be performed no later than Group 4 system completion for Unit 1 and Unit 2.

2. System Description N3-68-4001, "Reactor Coolant System," will be revised by October 1, 1991, to clearly identify RCS venting and letdown for inventory control as operating conditions for the RVHVS.

3. Watts Bar Engineering Procedure (WBEP)-5.10, "Maintenance of Design Basis Document," states that the engineering disciplines are responsible for revising design criteria and system description documents. Changes are to be effected through the use of design change notices in accordance with WBEP-5.03, "Design Change Notices." WBEP-5.10 also states that the lead engineer assures that the design document changes are made as they are identified. Additionally, the TVA engineering manager has issued a memorandum to emphasize the importance of proper and timely handling of information that impacts design input documents. Any such information that impacts system design or operation, whether or not hardware changes are involved, must be promptly incorporated in appropriate design input documents.

4. Only one other system was found to be vulnerable to the same potential condition. The pressurizer relief valve piping was handled properly in the piping analysis. However, to eliminate the root cause so that future design additions or modifications are not similarly affected, Mechanical Design Standard DS-M5.1.1, "Operational Modes Analysis for Piping Systems," will be revised by October 1, 1991, to clarify the definition of "transient" operation to ensure that operating conditions which result in an increase in piping temperature are included in operating modes calculations.

ENCLOSURE 2

LIST OF COMMITMENTS

1. The Reactor Coolant System (RCS) operating modes calculations will be revised to properly specify operating temperatures for the Reactor Vessel Head Vent System (RVHVS) piping. The RVHVS rigorous pipe stress analyses will be qualified using the updated RCS operating modes calculations. Pipe supports will be redesigned, if necessary. Corrective actions will be performed no later than Group 4 system completion for Unit 1 and Unit 2.

2. Design Standard DS-M5.1.1 will be revised by October 1, 1991, to clarify the definition of "transient" operation to ensure that operating conditions which result in an increase in piping temperature are included in operating modes calculations.

3. System Description N3-68-4001, "Reactor Coolant System," will be revised by October 1, 1991, to clearly identify RCS venting and letdown for inventory control as operating conditions for the RVHVS.