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JAN 03 1991

U.S. Nuclear Regulatory Commission
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Gentlemen:

In the Matter of the Application of	)	Docket Nos. 50-390
Tennessee Valley Authority	)	50-391

WATTS BAR NUCLEAR PLANT (WBN) - NRC INSPECTION REPORT NO. 390, 391/90-15 - REPLY TO VIOLATIONS 390/90-15-03 AND 390/90-15-02

TVA has reviewed the subject inspection report and provides the enclosed responses. Enclosure 1 provides TVA's response to violation 390/90-15-03 on external corrosion of cooling system piping and the proper documentation of the condition. Additional actions being taken by TVA to address the documentation of conditions adverse to quality will be included in our response to violation 390/90-27-01, Inadequate Corrective Action Program. Enclosure 2 provides TVA's interim response to violation 390/90-15-02 addressing lack of penetration and lack of fusion identified by NRC in ASME Class 3 weldments. This will be followed by a final response on or about January 15, 1991. Enclosure 3 lists the commitments made in this submittal.

TVA discussed the delay in submitting a final report on violation 390/90-15-02 with the Region II staff on December 14, 1990, and delay in submitting 390/90-15-03 with the staff on December 20, 1990. The enclosed interim response to 390/90-15-02 details the actions taken to date.

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If there are any questions, please telephone P. L. Pace at (615) 365-1824.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

Mark O. Medford

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ENCLOSURE 1

RESPONSE TO NRC NOTICE OF
VIOLATION 390/90-15-03

Description of Violation

10 CFR 50, Appendix B Criterion III requires that measures shall be established for the selection and review for suitability of applications of materials, parts, equipment, and processes that are essential to the safety-related functions of the system. Also, Criteria XVI requires that conditions adverse to quality, such as deficiencies and nonconformances are promptly identified and corrected.

TVA's Design Guide DG-M5.2.1 requires an increase in minimum pipe wall thickness above that required for other design considerations when corrosion is expected. Also, the guide requires that the exterior surface of carbon steel piping should be protected against corrosion if it is subject to sweating or is located in a high moisture environment.

TVA's Nuclear Quality Assurance Plan, Section 10.2.1; WBN-AI-3-1; NCM-10.2; and DCM10.3 require conditions adverse to quality be promptly identified, documented, evaluated, and corrected.

Contrary to the above, (a) the licensee did not properly design for the necessary corrosion protection for the Heating, Ventilation, and Air Conditioning (HVAC) System 31 at Watts Bar 1. Design calculations did not accommodate the required corrosion allowance of .08 inches for portions of the HVAC System 31 piping, (b) the corrosion problem was identified by TVA in December 1988. The problem was not properly or promptly documented within TVA's Quality Program on a condition adverse to quality report (CAQR) until the insistence of the NRC during the nondestructive examination (NDE) inspection of September 1990.

1.0 Admission or Denial of Violation

TVA admits a violation occurred involving noncompliance with Criterion XVI of 10 CFR 50, Appendix B. However, TVA would like to provide the following clarification with respect to failure to provide proper design criteria.

TVA's design guide (NE Mechanical Design Guide DG-M 5.2.1, Revision 1) provides an external corrosion allowance for piping systems which are known to be susceptible to external corrosion. System 31 chilled water piping was not designed with a corrosion allowance because it was believed that closed cell insulation, when properly applied and maintained, protects pipe from corrosion. TVA Specification 2986 provided appropriate installation requirements. The insulation specified, Rubatex, forms a vapor barrier which prevents condensation from forming on the external surface of the pipe. However, when improperly applied over wet surfaces on carbon steel pipe, it retains the condensation against the pipe and promotes accelerated corrosion. A combination of application over wet pipe, removal for system inspection, and inadequate vapor barrier maintenance resulted in exterior corrosion not anticipated for this system.

ENCLOSURE 1

RESPONSE TO NRC NOTICE OF
VIOLATION 390/90-15-03

2.0 Reason for the Violation

TVA became aware of the corroded condition of the exterior surface of the System 31, chilled water piping, in December of 1988 during the hanger walkdown program. TVA tested and evaluated System 31 piping and bolting from December 1988 through September 1989 to fully determine the condition of the system. As a result, TVA issued a metallurgical evaluation report in September 1989 concluding that the piping still met the minimum wall thickness requirements for new pipe (albeit by a slim margin), and that the bolting still met original strength requirements. Because the piping and bolting design requirements had not been violated, a CAQR/problem reporting document (PRD) was not initiated. However, while no design criteria was found to be violated, TVA failed to evaluate reasons for the corroded condition of System 31 piping as part of the CAQ process. Had TVA done so, a CAQ report would have been issued based upon signs of abnormal degradation from the use of incorrect practices for installing insulation.

3.0 Corrective Steps Taken and Results Achieved

3.1 System 31 Chilled Water System

TVA issued CAQR WBP 900380 late in the process (August 1990) to document and resolve the corrosion issue. The corrective steps taken by TVA to address the corrosion included taking wall thickness readings at various locations. A total of 40 locations were selected by Nuclear Engineering (NE) for ultrasonic testing (UT). The following factors were used to select the areas for UT:

- Insulation that was retaining moisture.
- Damage to the exterior vapor barrier on the insulation through wear and mechanical damage.
- Sections of piping still encased in insulation representative of piping exposed to similar environmental conditions over the past 7 years.
- Piping size (number of locations for each piping size was based on the total linear feet of that particular pipe within the system).

The wall thickness of the piping checked in the areas with the most degraded appearance was found only beginning to approach the manufacturer's minimum wall thickness (87.5 percent of nominal) and was significantly above design minimum wall thickness. TVA is correcting the problem with the installed piping by removing the insulation, cleaning and drying the pipe surface, and coating the pipe. After this process is complete, TVA will insulate following the guidelines of TVA Engineering Requirements Specification ER-WBN-MEB-003.

ENCLOSURE 1

RESPONSE TO NRC NOTICE OF
VIOLATION 390/90-15-03

3.0 Corrective Steps Taken and Results Achieved (continued)

Calculations WBN-31-D053, EPM-WUC-111089 and WBN-31-D053, EPM-WUC-021290 were completed by Sargent & Lundy in December 1989 to establish the design pressure, design temperature, and minimum wall requirements for the chilled water piping in the Control Building HVAC system. The UT readings were reviewed against this calculation and found acceptable.

The following are examples of ultrasonic testing readings taken:

Chilled Water System

PIPE DIAM.	SCH	NOM WALL	MFR. MIN.	PRESS. CALC. WALL	LOWEST UT MEAS.
6	40	.280	.245	.1075	.275
6	40	.280	.245	.1075	.275
6	40	.280	.245	.1075	.270
6	40	.280	.245	.1075	.270
6	40	.280	.245	.1075	.275
6	40	.280	.245	.1075	.250
4	40	.237	.207	.0977	.208
6	40	.280	.245	.1075	.274

3.2 System 61

In addition to System 31 because of system similarities, 19 locations were selected at random by the system engineer on System 61 (Glycol) to obtain wall thickness measurements and determine the extent of exterior corrosion on the piping. The areas selected were piping segments encased in both temporary and permanent Rubatex/glass foam insulation.

All of the areas examined by UT exceeded the manufacturers minimum wall thickness (87.5 percent of nominal). Sixteen locations actually exceeded the schedule 40 nominal wall values.
The following are examples of ultrasonic testing readings taken:

Glycol System

PIPE DIAM.	SCH	NOM WALL	MFR. MIN.	LOWEST UT MEAS.
3"	40	.216	.189	.210
6"	40	.280	.245	.275
6"	40	.280	.245	.260

ENCLOSURE 1

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VIOLATION 390/90-15-03

Exterior corrosion to the System 61 piping beneath the insulation is minimal and usually isolated to heat affected zones (HAZ) when present. Various areas not entirely encased in insulation demonstrated a more advanced corrosion rate. Coating will be applied to isolated problem areas such as:

- Uninsulated areas where condensation can form.
- Areas demonstrating advanced corrosion.

4.0 Corrective Steps Taken to Avoid Further Violations

The coating system and installed insulation are expected to resolve the corrosion deficiency. To ensure this, TVA will include as part of a preventive maintenance program for System 31 an inspection attribute for the coating to determine if any new degradation is occurring. This will be remain a part of the preventive maintenance program until the adequacy of the coating is confirmed. Actions to improve the corrective action program will be included in our response to violation 390/90-27-01, Inadequate Corrective Action Program.

5.0 Date When Full Compliance Will Be Achieved

The cleaning and coating for one train of the chilled water is 98 percent complete, with the second train scheduled for completion by April 1, 1991. TVA is currently developing an acceptance criteria and frequency of inspection plan to be incorporated in a preventive maintenance program. This program will to be in place when the coating is completed.

ENCLOSURE 2
RESPONSE TO NRC NOTICE OF
VIOLATION 390/90-15-02
INTERIM RESPONSE

Description of Violation

An NRC inspection conducted during the period July 16 through July 27, 1990, and August 27 through September 6, 1990, identified a violation of NRC requirements. In accordance with the "General Statement of Policy and Procedure for NRC Enforcement Actions," 10 CFR Part 2, Appendix C (1990), this violations is set forth below.

A. 10 CFR 50, Appendix B Criteria IX requires that special processes, including welding, are controlled and accomplished by qualified personnel using qualified procedures in accordance with applicable codes, standards, specifications, criteria, and other special requirements. TVA's piping design criteria specification WB-D-40-36 and N3M-868 invokes the ASME Boiler and Pressure Vessel Code, Section III Class 3, 1971 through the Summer 1973 addenda. Paragraph ND 5212 of the ASME Code requires longitudinal weld joints in piping, pumps and valves greater than 4 inch nominal pipe size be examined by either magnetic particle, liquid penetrant or radiography. Code Interpretation III-82-19 (File NI-81-168) extends the requirement to circumferential welds. The applicable acceptance standards are those of paragraph ND-5300 for the method chosen. Paragraph ND-5321 (a) disallows any type of crack or zone of incomplete fusion or penetration when revealed by radiography while ND-5321 (b) limits any other elongated indication which has a length greater than 1/4" for thickness up to 3/4", inclusive.

Contrary to the above, the licensee failed to properly control the welding and rejectable indications in Watts Bar Class 3 piping. An NRC independent measurements inspection revealed that 50 percent of a sample of Watts Bar Unit 1, ASME Class 3 piping weldments has code rejectable lack of fusion and lack of penetration indications that extended to 80 percent of the weld length. Numerous welds displayed unacceptable ASME Code indications as determined by radiography where MT and PT had been used to accept the welds in production. This is a Severity Level IV Violation (Supplement II).

1.0 Admission or Denial of Violation

TVA admits the violation occurred, but would like to provide the following clarification.

TVA has committed to fabricate the Watts Bar Nuclear Plant Class 3 piping in accordance with the ASME Code, Section III 1971 Edition through the Summer 1973 Addenda. Subsection ND-3000 subparagraph ND-3611 (Piping Design Acceptability) refers to NC-3600 which refers to NB-3661.2 for the design of butt welds. NB-3661.2 states "butt welds shall will be made in accordance with the applicable provisions of NB-4000. Ends shall be prepared for butt-welding so that they will meet the requirements of Figure NB-4233-1 and the welds shall be full penetration welds." Figure NB-4233-1 provides the general configuration alignment tolerances in order to achieve a full penetration weld.

ENCLOSURE 2
RESPONSE TO NRC NOTICE OF
VIOLATION 390/90-15-02
INTERIM RESPONSE

Subsection ND-5000 subparagraph ND-5220 states, "all pressure retaining welds in piping, pumps, and valves greater than 4 inches nominal pipe size shall be examined by either the magnetic particle (MT), liquid penetrant (PT), or radiographic (RT) methods." TVA, in accordance with industry practice, chose to perform surface examination of Class 3 butt welds. Depending on material type, a liquid penetrant or magnetic particle examination would be performed. These surface examinations would not identify root conditions or volumetric type imperfections.

The code requires full penetration welds for Class 1, 2, and 3 systems; however, the fabrication examination requirements are less severe for Class 3 systems as compared to Classes 1 and 2 due to the fact that the system designs are for plant support systems and not high energy systems.

The ASME Code, Section III Committee recognized the problem of performing volumetric examinations on systems where only a visual or surface examination has been performed (Code Interpretation III-1-83-103). In this interpretation, conditions found to be unacceptable in subsequent volumetric examinations do not need to be repaired, but engineering judgement should be used in dispositioning such conditions. This is precisely what happened during the subject NRC inspection. It is TVA's intention to fully address all aspects of this violation, including performing any necessary analysis as well as a root cause analysis.

2.0 Reason for Violation

The apparent reason for the incomplete penetration (IP) in the class 3 system's welds is substandard craftsmanship. To evaluate this, TVA has performed several investigations addressing the reason for the violation; including a Welder Attribute Analysis, a Statistical Analysis, and a Root Cause Analysis. The results of these analyses indicate that the probable cause is the lack of a proper feedback system during welding fabrication. The nondestructive examination (NDE) in place was a surface examination, and the feedback to the welder was that his performance was appropriate if so indicated by an acceptable surface examination. An appropriate feedback system would have monitored root conditions and notified the welding organization of such deficiencies in process.

3.0 Corrective Steps Taken and Results Achieved

Corrective Actions

Condition Adverse to Quality Report (CAQR) WBP 900336 was initiated on July 23, 1990, to document the lack of penetration problem initially found in the Emergency Raw Cooling Water (ERCW) system in the annulus area. The scope was expanded to include all other ASME Class 3 piping circumferential butt welds. The 9 welds identified in violation 390, 391/90-15-02 have been reradiographed. The 2 welds which appeared to contain the worst IP have been ultrasonically examined to determine the depth of the flaw(s).

ENCLOSURE 2
RESPONSE TO NRC NOTICE OF
VIOLATION 390/90-15-02
INTERIM RESPONSE

3.0 Corrective Steps Taken and Results Achieved (continued)

During the NRC inspection, 8 ERCW system welds were radiographed by the NRC inspection team; 4 of the welds were found to contain IP. TVA's subsequent review revealed that these ERCW system welds in the annulus area had been the subject of an employee concern, WI-85-050-01. This concern had identified IP and potential loss of purge problems with the ERCW system welds. Resolution of this concern had been part of the Department of Energy/Weld Evaluation Project (DOE/WEP) review where ultrasonic examination had been utilized to disposition 26 ERCW system welds as acceptable. Ultrasonic examination techniques and results arrived at by EG&G as part of the DOE/WEP will be evaluated and documented in the closure of unresolved item (URI) 390, 391/90-20-03. Initial reviews have revealed that ultrasonic examinations were used by EG&G on a limited basis during the DOE/WEP.

In response to this new information on the ERCW system welds, TVA has recently reradiographed the balance of the 26 welds involved in the employee concern. Results of these examinations were compared with the 9 welds identified during the NRC inspection and the ultrasonic examination sizing of the 2 worst IP indications of that sample. TVA has determined that the ultrasonic examination sizing results bound any further IP found from this expanded program. Additionally, none of the welds examined have shown IP greater than 82 percent around the internal circumference. Confirmation of the ultrasonic examination and radiographic sizing procedures is being accomplished by the removal of one spent fuel cooling system weld exhibiting IP and taking physical measurements of the extent and depth of IP.

Initial evaluation utilizing both ASME Code Section III and XI methodologies with the worst-case depth of IP analyzed in the highest stressed location of the ERCW have confirmed these welds to be adequate to perform their intended function. The corrective action of this CAQR WBP 900336 to address the ASME Code Section III structural integrity issues is as follows:

° Establish a 95/95 confidence level that the Class 3 butt welds are acceptable as follows:

  - Perform a random statistical sample of all Class 3 butt welds.

  - Radiograph these sample welds and record any incomplete penetration, incomplete fusion, and/or microbiologically induced corrosion.

  - Ultrasonically size flaws on selected worst-case welds (determined by RT) to determine the depth.

ENCLOSURE 2
RESPONSE TO NRC NOTICE OF
VIOLATION 390/90-15-02
INTERIM RESPONSE

3.0 Corrective Steps Taken and Results Achieved (continued)

- Review TVA Class C calculation packages in at least 2 stainless steel piping systems and 1 carbon steel piping system anticipated to have the highest stresses to identify calculation packages with high stresses and tabulate the maximum stresses for each pipe size.

- Recalculate the maximum stresses for each pipe size using reduced section thicknesses as if the worst indications were located at the point of maximum stress using ASME Section III analysis methods.

- Determine the acceptability of worst-case indications and maximum stresses using ASME Section XI methods with Section III allowables.

- Establish a screening stress and scan calculation packages to determine any potential problem welds. Further analyze these welds and disposition as required.

Status of Sampling

In addition to the welds radiographed earlier by the NRC and TVA, a random statistical sampling of 85 butt welds has been completed. The total number of Class 3 welds which have been radiographed to date is 118. Of these welds, 48 had some degree of IP, and of these 48, 19 welds had IP which exceeded 10 percent of the circumference. From the 19 problem welds, 1 welder was identified for follow-up radiography of all of his welds. Additionally, 8 other welders are suspect until an additional sample of their welds can be obtained.

Determination of IP depth for the 118 welds was accomplished by ultrasonic examination and flaw sizing of 11 welds. These welds were evaluated as having the greatest depth of IP based upon the radiographic results. The depth data along with the circumferential extent data are being used in the structural analysis. Final evaluation will be completed and documented in a final report on or about January 15, 1991. Corrective actions ensuing from these efforts will also be identified in that report.

ENCLOSURE 2
RESPONSE TO NRC NOTICE OF
VIOLATION 390/90-15-02
INTERIM RESPONSE

4.0 Corrective Steps Which Will be Taken to Avoid Further Violation

Action Required To Prevent Recurrence

TVA has developed a random radiography requirement to assure proper feedback into the welding system during the fabrication of Class 3 systems. This requirement is that random radiography of full penetration welds will be performed on a quarterly basis as follows:

A. 10 welds or actual number of welds up to 10, as a minimum or
B. 10 percent of all welds, whichever is greater,
C. minimum of 1 weld per welder.

5.0 Date When Full Compliance Will Be Achieved

The random radiography requirement during the fabrication of Class 3 systems is now in place.

TVA has removed one of the welds exhibiting lack of penetration and is currently compiling and evaluating data to determine the number of additional welds to remove or repair. The results of this evaluation and the number of welds to be repaired or replaced will be documented in our final report on this subject January 15, 1991.

ENCLOSURE 3

LIST OF COMMITMENTS

Violation 390/90-15-03

TVA will include as part of a preventive maintenance program for System 31 an inspection attribute for the coating to determine if any new degradation is occurring. This action will be completed by April 1, 1991.

The cleaning and coating for one train of the chilled water is 98 percent complete, with the second train scheduled for completion by April 1, 1991.

Additional actions to improve the corrective action program will be included in our response to violation 390/90-27-01, Inadequate Corrective Action Program.

Violation 390/90-15-02

Final evaluation will be completed and documented in a final report on or about January 15, 1991.