TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401

5N 157B Lookout Place

JUN 29 1990

WBRD-50-390/86-49
WBRD-50-391/86-46

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 - DISCREPANCIES AFFECTING RADIATION MONITORING SYSTEM - WBRD-50-390/86-49 AND WBRD-50-391/86-46 - FINAL REPORT

The subject deficiency was initially reported to NRC Inspector Gordon Hunegs on April 2, 1986, in accordance with 10 CFR 50.55(e) as Nonconforming Condition Report (NCR) WBN 6750 for Unit 2. NCR W-390-P documented the deficiency for Unit 1. Interim reports were submitted on May 20, 1986, November 23, 1987, and October 6, 1989. Enclosure 1 is the final report on this deficiency.

As stated in the initial interim report on this subject, dated May 20, 1986, TVA considers 10 CFR Part 21 applicable to the deficiencies with the shield building exhaust vent radiation monitor. The 10 CFR 21 reporting requirements were satisfied by that report.

Ken Barr was notified on May 18 and May 31, 1990, of delays in submittal of this report. Herb Livermore was notified on June 14, 1990, of an additional delay to June 27, 1990.

If there are any questions, please telephone P. L. Pace at (615) 365-8527.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

R. H. Shell

for E. G. Wallace, Manager
Nuclear Licensing and
Regulatory Affairs

Enclosures
cc: See page 2

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U.S. Nuclear Regulatory Commission

JUN 29 1990

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

INPO Record Center
1100 Circle 75 Parkway, Suite 1500
Atlanta, Georgia 30339

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

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2
DISCREPANCIES AFFECTING RADIATION MONITORING SYSTEM
WBRD 50-390/86-49 AND WBRD 50-391/86-46
NONCONFORMING CONDITION REPORTS (NCRs)
WBN 6750, W-390-P, AND OTHERS
10 CFR 50.55(e)

FINAL REPORT

Description of Deficiencies

Discrepancies impacting the adequacy, functionality, and reliability of the Radiation Monitoring System (RMS) have been identified.

1. Sample lines were constructed in such a way as to render their effectiveness in obtaining a representative sample questionable. Specific deficiencies discovered include:

   - excessive length of sample lines
   - incomplete heat tracing
   - minimum bend radius violations
   - incorrect slope
   - violation of minimum sample line separation to redundant monitors.

2. Design and documentation deficiencies that place the performance of the RMS equipment in question have been identified as follows:

   - Multiple design and documentation deficiencies in the sample flow control equipment for the vent stack monitors in the shield building, auxiliary building, and service building.

   - The design of some radiation monitors does not provide for purge capability following an accident, or for shutdown of the equipment pumps upon containment isolation initiation.

   - Fluorocarbons (teflon tape) were used in radiation monitor skids.

   - Lack of analysis, location, and mounting details for area process (shine) monitors.

   - Undocumented modifications have been made to RMS ratemeters.

   - Damage to ratemeter cables.

3. Difficulty in establishing traceability to unambiguous primary calibration records lends doubt to the accuracy of transfer calibrations.

Safety Implications

Radiation monitoring provides information to the operator necessary for appropriate response in accident conditions and for determination of accident severity and resulting release rates.

The most significant safety implications of the various deficiencies reported against the Radiation Monitoring System are as follows:

1. Multiple deficiencies, including noncompliance to piping class requirements, documentation discrepancies and lack of documentation, and functional defects in the sample flow control equipment for the shield building vent stack monitor, the auxiliary building vent stack monitors, and the service building vent stack monitor were reported originally on NCRs W-390-P and 6750. These deficiencies resulted in the initial 50.55(e) and finally in the programmatic approach to corrective actions for the Radiation Monitoring System. The safety implications of this deficiency fall into two categories - indication and automatic action.

   a. The shield building vent stack monitor and the auxiliary building vent stack monitor are post accident monitoring (PAM) instruments which provide indication of radioactivity release to the environment. The auxiliary building vent stack is isolated following an accident but the shield building vent stack is not. Inaccurate sampling due to functionality defects in the flow control equipment could result in inaccurate determinations of release to the environment and could result in unidentified releases above the 10 CFR 20 limit.

   b. Faulty flow information could cause the auxiliary building vent stack monitor to fail to isolate the auxiliary building normal ventilation pathway and fail to initiate the auxiliary building gas treatment system.

   Problems with this sampling system were also reported in Significant Condition Report (SCR) WBN EEB 8724, Condition Adverse to Quality Report (CAQR) WBP 870892, CAQR WBP 890402, CAQR WBP 871094, and CAQR WBP 870908. The Unit 2 CAQs mentioned herein are required for Unit 1 since the Unit 2 shield building vent stack monitor is required for Unit 1 operation.

2. Condensation in the condenser vacuum vent monitor sample lines could result in excessive moisture in the filter assemblies and sample chambers, causing detector assembly failure. This could result in incorrect measurement of radioactive release to the environment, possibly exceeding 10 CFR 20 limits. This potential problem was reported in SCR WBN EEB 8724 and CAQR WBP 871094. These monitors are also PAM instruments and monitor a release path which is used after an accident. Because the amount of release from this path is very small compared to the shield building exhaust stack, this inaccuracy would be far less significant than that noted in Item 1 above.

3. The transfer calibration accuracy for the General Atomic equipment onsite is in question because of the inability to secure unambiguous traceability to the primary calibration documentation. This problem is the subject of CAQR WBP 890396 and CAQR WBP 890445. Inaccurate transfer calibration results in erroneous detector/electronics alignment and therefore inaccurate indication of exposure levels and/or effluent release rates. This may result in exposures or releases to the environment in excess of 10 CFR 20 limits. The amount of inaccuracy is indeterminate because the specific deviation is not known.

4. Violation of minimum sample line separation for redundant, safety-related containment purge air exhaust monitors was discovered during walkdown and evaluation of the sample lines. A common mode failure affecting both sample lines could render these monitors incapable of performing their safety indication and alarm function and could result in failure to initiate containment vent isolation. This path is sampled again by the shield building vent stack monitor before release to the atmosphere. (Note that the sample line separation problem originally reported in SCR WBN EEB 8724 was based on a perceived problem with separation of the sample lines to the containment atmosphere monitors. These monitors are not primary safety-related monitors and the sample lines do not require separation.)

Corrective Action

Since the last interim report, walkdowns of the Unit 1 sample lines have been completed, except for the Unit 2 shield building vent stack monitor. Walkdowns of the Unit 1 RMS equipment are being completed. Evaluations based on walkdown information, conditions adverse to quality (CAQs) reports, design requirements, and regulatory commitments have been completed for the Unit 1 sample lines and are being completed for the Unit 1 equipment. Unit 2 equipment required for Unit 1 operation has been included in the walkdowns and evaluations unless stated otherwise in this document.

Walkdowns of Unit 2 sample lines and equipment will be completed where Unit 1 results cannot be applied or where Unit 1 results indicate unique problems affecting the quality of the representative sample. Evaluations of Unit 2 sample lines and Unit 2 equipment will be based on Unit 1 results except where Unit 1 results indicate that sample line or monitor specific evaluations are required.

Corrective actions are presently being worked or planned for the Radiation Monitoring System deficiencies. These include calculations to demonstrate acceptability; addition of valves, heat trace, and chillers; design criteria revisions and/or exceptions; and modification to existing monitors as described below.

Sample Line Deficiencies.

NCR W-409-P, NCR 6797, and NCR 6914 concern violations of sample line minimum bend radius requirements. The specific problems noted on the NCRs involved sample lines for the shield building vent stack monitors. The requirements violated were specifications on the design output drawings.

The corrective action for this deficiency includes completion of the sample line walkdown information evaluations and completion of transmission factor and particle loss calculations for the gaseous sample lines. Field-verified data will be compared to data used in the transmission factor calculations to verify that the transmission factor calculations are valid. Completion of the corrective actions for the Unit 2 shield building vent stack monitor is required for Unit 1 operation.

In addition to bend radius deficiencies; restrictions, traps, excessively long lines, slope, lack of heat tracing, and separation are cited as potential problems in SCR WBN EEB 8724 and CAQR WBP 871094. For Unit 1, walkdowns of the sample lines were conducted and the evaluations are now complete. The results of the transmission factor calculations and particle loss calculations have proven that the configuration of the Unit 1 sample lines is adequate to provide representative samples to the gas monitors. Plateout is not a serious concern in liquid sample lines. For those Unit 1 concerns determined in the evaluations to have the potential to degrade the representative sample capability, design change notices (DCNs) have been initiated. Examples of corrective actions include increasing valve size or type, decreasing line size to reduce response time, adding heat trace or chillers, and resolving classification conflicts (most of which were determined to be documentation errors only). In the case of violation of minimum sample line separation for the safety-related containment purge air exhaust monitors, serious threats to single failure criteria would be introduced by any other placement of the sample lines. An exception to the design criteria was written to justify leaving the sample lines in their as-installed and most protected location.

Corrective actions for Unit 2 will also include walkdowns and evaluations except where a high degree of confidence exists that data generated in Unit 1 walkdowns and evaluations can be applied to Unit 2. Conditions determined to be deficient as a result of Unit 2 evaluations will be corrected.

SCR WBN EEB 8724 and CAQR WBP 871094 identify the potential for degradation of functionality of the condenser vacuum pump exhaust monitors due to collection of moisture in the filters and sample chambers resulting from condensation in the sample lines. Chillers and heat trace will be added to the inlet sample lines to eliminate moisture.

Design Deficiencies

NCRs W-390-P and 6750 detail deficiencies in the sample flow control equipment supplied by Air Monitor Corporation for a representative sample to the shield building vent stack monitors and the auxiliary building vent stack monitor. The collective effect of the several deficiencies was to challenge the credibility of the system to function to requirements of Technical Specification 3/4.11.2 and Regulatory Guide (RG) 1.97. Examples of the deficiencies were design defects causing overheating in the electronic boards, failure to meet contract accuracy requirements, board components which did not meet those specified on the drawings supplied with the contract, changes which were made on verbal instructions from Air Monitor representatives, and substandard sample line material.

The flow control equipment and substandard sample line material will be replaced. A specification for the equipment was written to assure compliance with applicable requirements. The equipment which will be installed has a proven record in the nuclear industry.

SCR WBN EEB 8724 and CAQR WBP 871094 identify an undocumented manifold assembly in the steam generator blowdown monitor sample inlet/outlet line. The return line will be removed from the steam generator blowdown monitor manifold, insuring that the inlet sample is not mixed with the return.

SCR WBN EEB 8724 and CAQR WBP 871094 also identify that the containment building upper and lower compartment radiation monitors have several potential problems, including sample line deficiencies which have been discussed in Item 1 above. Other problems cited included a lack of purge capability, inadequate separation of the sample lines, and failure of the pumps to shut down on containment isolation which could result in damage to the pumps. A discrepancy in the installed qualification level of the equipment and that required by the Q-List is also cited. Unit 1 evaluations identified that heat tracing is required and it is being added for the monitor's sample lines. Purge can be accomplished by use of the grab sample valves. Separation of the sample lines and stringent qualification levels erroneously indicated by the Q-List are not required because the monitors are not primary safety-related. The potential for pump damage on containment isolation is being resolved by the "bleed air fix," a modification which will resolve several problems on gas, area particulate, and particulate/iodine/gas monitors. In this fix, flow will be controlled by a mass flow controller, and vacuum relief will be added for the pump.

A lack of analysis, location, and mounting details for area process (shine) monitors was identified on SCR WBN EEB 8724 and CAQR WBP 871094. The equipment walkdowns will establish the location of the Unit 1 detectors. Correct mounting details will be verified with the vendor. The locations and mounting details will be incorporated onto the as-constructed drawings for each unit according to the unit's respective schedule. Correct mounting will be field verified for seismic 1 instruments. Locations will be verified appropriate, and the analysis of detector geometry will be incorporated by the demonstrated range and accuracy calculations in proving the adequacy of the detector to perform its intended function. (Two of the detectors are being deleted from the design.)

Potential contamination of sample chambers documented on CAQR WBP 870892 concerns the potential for contamination of sample chambers for those monitors which are expected to normally be exposed to radioactive contaminants. The sample line evaluations addressed this item, and for those monitors which are anticipated to normally be exposed to significant radiation, purge capability was verified or purge valves are being added to assure flushing and purging capability.

CAQRs WBP 870892 and WBP 870908 also identified that an improper sequence of valve closures could result in overpressurization and failure of steam generator blowdown monitors 1-RE-90-120 and -121 because orifice plates were used for pressure reduction rather than pressure regulators. TVA will add proper pressure reduction to the inlet lines of these monitors to eliminate the problem.

CAQR WBP 870908 identified bend radius problems on Unit 2 equipment required for Unit 1 operation (Unit 2 shield building vent stack monitor) which is covered adequately under SCR WBN EEB 8724 and CAQR WBP 870892. Other bend radius problems deemed severe enough to degrade the representative sample by the future Unit 2 evaluations will be corrected by DCNs at that time.

CAQR WBP 890402 describes a violation of design criteria WB-DC-40-24 in the inability of the flow control equipment for the service building vent monitor, the auxiliary building vent monitor, and th shield building vent monitors to provide an isokinetic sample to the monitors. Because of the numerous problems with the existing sample flow control equipment, the equipment is being replaced. Both Unit 1 and Unit 2 shield building vents are required for Unit 1 operation.

The subject of CAQR WBP 890422 is damage to cables which connect to the ratemeters inside area particulate, gas, and particulate/iodine/gas monitors. The damage occurs when the ratemeter is withdrawn and the attached cable is pulled across a rough, unfinished edge. This could lead to monitor analyzer failure. A DCN has been initiated to correct the cause of the damage for Unit 1. The rough edge will be refinished or covered, or a rear frame mounted connector will be installed for a "plug in" arrangement similar to that existing in the NIM bins in the main control room. A similar DCN will be written for the Unit 2 monitors.

SCR WBN EEB 8724 and CAQR WBP 871094 identify that it is General Atomic's standard practice to use teflon as a thread lubricant in the assembly of threaded sample line connections in the radiation monitoring cabinets. The problem is with the potential disintegration of the teflon into the sample medium and the possible resulting chemistry change. It has been determined by calculation that this is a significant problem only for radiation levels greater than 10,000 rads or temperatures greater than 300°F, and for lines which return to the reactor coolant. For the radiation monitoring system these conditions are only met for the reactor coolant letdown monitor (1/2-RE-90-104) and the boric acid evaporator monitor (1/2-RE-90-170). The teflon will be removed from the monitor piping assemblies for these monitors.

Documentation Discrepancies

SCR WBN EEB 8724 and CAQR WBP 871094 note deficiencies in the documentation for the Air Monitor Corporation equipment and for the General Atomic equipment. The discrepancies are within documents and between documents and the supplied or modified equipment. Cited examples are those noted in NCRs W-390-P and 6750, which were discussed above, General Atomic vendor change documents which were not incorporated into the vendor manual, and discrepancies between the TVA control drawings and the vendor drawings.

Documentation errors on TVA or vendor drawings affecting functional configuration, operation, or maintenance of the monitors will be corrected based on the walkdowns and the evaluations for Unit 1. Unit 2 walkdowns and evaluations will be performed where Unit 1 results cannot be used, and necessary corrective actions will be taken.

CAQR WBP 890192 identified that undocumented modifications were made to the Radiation Monitoring System ratemeters. The change added a trip inhibit feature. Since it was not correctly documented in contract files or on drawings, proper repairs cannot now be made to the modules. The modifications made are functionally desirable; however, due to their undocumented nature, as well as the age of such components as electrolytic capacitors, and the problem of replacing obsolete parts, the ratemeters will be upgraded and requalified or they will be replaced.

Calibration issues

CAQRs WBP 890396 and WBP 890445 describe a lack of documentation and conflicting documentation relating primary calibration curves to transfer calibration curves. This violates the contract specification. The result is uncertainty as to the validity of radiation monitor calibration and thus uncertainty as to the level of radioactivity being indicated or alarmed by the monitor. New primary calibrations will be performed for detectors with questionable primary to transfer calibration documentation.

SCR WBN EEB 8724 and CAQR WBP 871094 document uncertainties introduced in the reactor coolant letdown monitor transfer calibration because of a lack of appropriate baseline data following a change in detector geometry to decrease sensitivity due to Xe(133) saturation. Proper transfer calibration for this monitor will be assured during resolution of the generic calibration issue, documented in CAQR WBP 890396 and CAQR WBP 890445. Corrective action will include establishing nonambiguous primary to transfer calibration documentation, or reperforming primary calibration for those cases which cannot be satisfactorily resolved.

All corrective actions necessary for proper qualification, operation, and maintenance of the radiation monitoring system at Watts Bar Nuclear Plant will be completed before startup for each unit. For Unit 1, corrective actions will be complete before July 15, 1991. The Unit 2 schedule will be developed as part of the overall Unit 2 scheduling effort.

Root Cause and Recurrence Control

Lack of adequate design basis document:

The most significant underlying root cause of the Radiation Monitoring System deficiencies was determined to be the lack of an adequate design basis document. This root cause was identified by several CAQs, including SCR WBN EEB 8724 (by similarity to CAQR WBP 871094), NCR 6750, CAQR WBP 871094, CAQR WBP 890402, CAQR WBP 870892, and CAQR WBP 870908. The action to prevent recurrence for this root cause is complete as of issuance of Design Criteria WB-DC-40-24, Revision 1, "Radiation Monitoring."

Inadequate control of design input/output activities:

The second most commonly identified root cause was inadequate design control. Among the CAQs identifying this problem are CAQR WBP 880409 (which supercedes NCR W-390-P), NCRs W-409-P, 6797, and 6914.. The preventive action for this root cause is also complete with issuance of Nuclear Engineering Procedure (NEP)-3.1, "Calculations"; NEP-3.2, "Design Input"; NEP-3.3, "Internal Interface Control"; NEP-5.1, "Design Output"; NEP-5.2, "Review"; NEP-5.3, "External Interface Control"; NEP 5.5, "Engineering Requirements Specifications"; and NEP-6.1, "Change Control."

Design configuration not maintained following field modifications:

The root cause of CAQR WBP 890192 was determined to be inadequate procedures to control field modifications such that design configuration control was maintained. The recurrence control action is complete with issuance of Administrative Instruction (AI)-8.8, Revision 17, "Control of Modifications Work After Transfer."

Inadequate control of records needed for testing:

CAQR WBP 890396 and CAQR WBP 890445 have a root cause of inadequate control of records needed by site organizations for testing of equipment. Issue of WBEP 8.02, "Preop and Noncritical Systems Testing"; NEP-5.1, "Design Output"; and AI-3.1, "Administering Site Procedures/Instructions," complete recurrence control for this root cause.

ENCLOSURE 2

LIST OF COMMITMENTS

1. Sample line and equipment deficiencies determined by evaluations to have the potential to degrade the representative sample capability will be corrected.

2. TVA will add chillers and heat trace to the condenser vacuum pump exhaust monitor inlet sample lines to eliminate moisture.

3. The shield building flow control equipment and substandard sample line material will be replaced.

4. The return line will be removed from the steam generator blowdown monitor manifold, insuring that the inlet sample is not mixed with the return.

5. For containment building upper and lower compa tment radiation monitors, add heat trace to the sample lines, and implement the "bleed air fix" modification to prevent pump damage.

6. Locations for area process (shine) monitors will be verified appropriate, and the analysis of detector geometry will be incorporated by the demonstrated range and accuracy calculations in proving the adequacy of the detector to perform its intended function.

7. For those monitors which are anticipated to normally be exposed to significant radiation, purge capability was verified or purge valves are being added to assure flushing and purging capability.

8. Add pressure reduction to the inlet lines of the steam generator blowdown monitors.

9. The service building vent and the auxiliary building vent automatic sample flow control equipment will be replaced.

10. The rough edge will be refinished or covered, or a rear frame mounted connector will be installed for a "plug in" arrangement to prevent damage to cables which connect to the ratemeters inside area particulate, gas, and particulate/iodine/gas monitors.

11. Teflon will be removed from the monitor piping assemblies for the reactor coolant letdown monitor and the boric acid evaporator monitor.

12. Documentation errors on TVA or vendor drawings affecting functional configuration, operation, or maintenance of the monitors will be corrected based on the walkdowns and the evaluations for Unit 1. Unit 2 walkdowns and evaluations will be performed where Unit 1 results cannot be used, and necessary corrective actions will be taken.

13. Radiation Monitoring System ratemeters will be upgraded and requalified or they will be replaced.

14. New primary calibrations will be performed for detectors with questionable primary to transfer calibration documentation.