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

DEC 0 4 1995

10 CFR 50.55(e)

CDR-50-390/95-07

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

Gentlemen:

In the Matter of the)
Tennessee Valley Authority)

Docket Nos. 50-390

WATTS BAR NUCLEAR PLANT (WBN) - CONSTRUCTION DEFICIENCY REPORT (CDR) 50-390/95-07 - COOLER FAN SHAFT DAMAGE

The purpose of this letter is to provide a final report for the subject deficiency in accordance with 10 CFR 50.55(e). The subject deficiency was initially reported to the NRC Operations Center on November 3, 1995, as Incident Investigation (II)-W-95-017.

The enclosure to this letter contains a final report for the subject deficiency. No new commitments are made in this letter.

If there are any questions, please contact P. L. Pace at (423) 365-1824.

Sincerely,

D. V. Kehoe
Nuclear Assurance
and Licensing Manager

Enclosure
cc: See page 2

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cc (Enclosure):

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ENCLOSURE

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1
COOLER FAN SHAFT DAMAGE
INCIDENT INVESTIGATION (II)-W-95-017
CONSTRUCTION DEFICIENCY REPORT (CDR) 50-390/95-07
FINAL REPORT

DESCRIPTION OF DEFICIENCY

The deficiency identifies fan shaft wear damage on safety-related cooler fans.

Cooler 1-PMCL-30-191-B in the Auxiliary Building, Elevation 713, was being inspected on October 9, 1995, under Work Order (WO) 95-23253-00 to correct a high vibration condition. The fan shaft and flange bearing were damaged and grooving was observed on the shaft at the inboard flange (driver end) bearing area adjacent to the belt drive.

Two days later on October 11, 1995, Cooler 1-PMCL-30-175-A for the RHR Pump Room was inspected under WO 95-23568-00 to correct a high vibration condition. The fan shaft and flange bearings were similarly damaged.

Problem Evaluation Report (PER) WBPER950600 was initiated to evaluate this adverse condition. This PER was escalated to an Incident Investigation (II) to determine the root cause and evaluate adverse impact on fuel load readiness.

A maintenance history review of 104 safety-related belt driven air handling units identified multiple examples of shaft grooving caused by shaft turning inside the bearing inner race. Damage of this type was limited to fans manufactured by Ellis and Watts (E&W) in all but one case. That one case appears to be isolated because of differences in the basic design. The E&W units have flange bearings mounted on sheet metal housings, while other fan units of this type have pillow block bearings mounted on structural framing, which makes the fans less susceptible to vibration and provides more rigid configurations.

Inspections were performed on the 38 safety-related E&W fan units identified as required for Unit 1 operation. These units are listed below with inspection results:

COMPONENTS WHICH WERE REPAIRED	
1-PMCL-030-175-A (1A-A RHR Pump Room Cooler at El. 676')	1-CLR-030-195-B (1B-B Unit 1 Penetration Room Cooler at El. 737')
1-PMCL-030-177-A (1A-A Containment Spray Pump Room Cooler at El. 676')	1-CLR-030-197-B (1B-B Penetration Room Cooler at El. 713')
1-PMCL-030-183-A (1A-A Centrifugal Charging pump Room cooler at El. 692')	2-COND-031-289 (480V Electrical Board Room 2B Condenser)
1-PMCL-030-191-B (B-B Component Cooling System and Unit 1 Auxiliary Feedwater Pump Room Cooler at El. 713')	1-CLR-30-187-B(1B-B Penetration Room Cooler at El. 692')
2-CLR-030-195-B (2B-B Unit 2 Penetration Room Cooler at El. 737')	1-CLR-030-186-A (1A-A Penetration Room Cooler at El. 692')
1-CLR-030-196-A (1A-A Penetration Room Cooler at EL. 713')	

COMPONENTS WHICH DID NOT REQUIRE REPAIR	
0-AHU-031-0030B-A (Electrical Board Room Air Handling Unit A-A	0-PMCL-030-193-B (B-B Component Cooling System Pump and Thermal Barrier Booster Pump, Spent Fuel Pit Pump Space Cooler at El. 737')
0-AHU-031-0030D-A (Electrical Board Room Air Handling Unit B-A)	1-CLR-030-194-A (1A-A Unit 1 Penetration Room Cooler at El. 737')
0-AHU-031-0031B-B (Electrical Board Room Air Handling Unit C-B)	2-CLR-030-194-A (2A-A Unit 2 Penetration Room Cooler at El. 737')
0-AHU-031-0031D-B (Electrical Board Room Air Handling Unit D-B)	2-CLR-030-200-A (A-A Emergency Gas Treatment Room Cooler at El. 757')
1-PMCL-030-178-B (1B-B Containment Spray Pump Room cooler at El. 676')	2-CLR-030-207-B (B-B Emergency Gas Treatment Room Cooler at El. 757')
1-PMCL-030-179-B (1B-B SIS Pump Room Cooler at El. 692')	1-CLR-030-201-A (1A-A Pipe Chase Space Cooler at El. 692')
1-PMCL-030-180-A (1A-A SIS Pump Room Cooler at El. 692')	1-CLR-030-202-B (1B-B Pipe Chase Space Cooler at El. 692')
2-PMCL-030-185-B (B-B Boric Acid Transfer Pumps and Unit 2 Auxiliary Feedwater Pump Room Cooler at El. 713')	1-FAN-031-475 (480V Electrical Board Room 1B Air Conditioning Unit Fan)
0-PMCL-030-192-A (A-A Component Cooling System Pump and Thermal Barrier Booster Pump, Spent Fuel Pit Pump Space Cooler at El. 737')	2-FAN-031-475 (480V Electrical Board Room 2B Air Conditioning Unit Fan)
1-FAN-031-461 (480V Electrical Board Room 1A Air Conditioning Unit Fan)	2-FAN-031-461 (480V Electrical Board Room 2A Air Conditioning Unit Fan)
2-COND-031-290 (480V Electrical Board Room 2A Condenser)	1-COND-031-289 (480V Electrical Board Room 1B Condenser)
1-COND-031-290 (480V Electrical Board Room 1A Condenser)	1-PMCL-030-176-B (1B-B RHR Pump Room Cooler at El. 676')
1-PMCL-030-182-B (1B-B Centrifgal Charging pump Room cooler at El. 692')	2-PMCL-030-184-A (A-A Boric Acid Transfer Pumps and Unit 2 Auxiliary Feedwater Pump Room Cooler at El. 713')
1-PMCL-030-190-A (A-A Component Cooling System and Unit 1 Auxiliary Feedwater Pump Room Cooler at El. 713')	

SAFETY IMPLICATIONS

These units are required to maintain area temperatures for operability of associated equipment. The maximum post-loss of coolant accident (LOCA) safe shutdown time period for equipment required for event mitigation is 100 days in accordance with American National Standard (ANS) N18.2-1973 and WB-DC-40-64, "Design Basis Events Design Criteria." This 100 days safe shutdown time period could not be assured for E&W safety-related room and area coolers with the as-found fan shaft damage. However, the fans had not failed prior to removal from service for repairs.

CAUSE OF THE DEFICIENCY

The cause of the E&W cooler fan shaft damage was over tensioning of the fan belts. Contributing causes were (1) loose bearing to shaft fit, (2) improper alignment of shafts, (3) flexible bearing support mounts, and (4) shaft material susceptible to deflection and grooving by contact with harder materials. Maintenance Instruction (MI)-0.16, "Maintenance Guidelines For Belt Driven Equipment," initiated in 1988, provided a belt tensioning method based on belt deflection using Browning Belt Manufacture guidance. The belt tensioning prior to MI-0.16 and the method resulting from MI-0.16 now appear to have been excessive for the E&W fans, and eventually the adjacent flange bearing set screws broke free from the shaft. This allowed for relative motion between the fan shaft and the inner bearing race. The softer fan shaft metal was then slowly grooved by the harder bearing inner race surface.

Personnel performed the fan alignments, bearing installations, and belt tensioning in accordance with plant approved procedures. The work order process was followed for the performance of the work and identification of problems. Plant personnel performed as expected.

CORRECTIVE ACTIONS

The repairs for the units noted above have been made. Repairs included (1) shaft and bearing replacements, and in some cases, where minor scoring had occurred, the bearing surface was moved to an unused part of the shaft as a conservative measure; (2) spot drilling the fan shafts 1/8 inch to provide a better seating surface of the flange bearing set screws; (3) match marking the flange bearings to the fan shafts to check for slippage; and (4) the application of a shaft deflection method for belt tensioning.

As a preliminary indicator to determine the effectiveness of changes made, Cooler 1-PMCL-30-191-B was started ten times and operated 48 hours continuously to evaluate the effectiveness of the repair and changes implemented to MI-0.16. The cooler was then operated continuously for more than two weeks to confirm that no bearing to shaft slippage had occurred by checking match marks on inboard flange bearings. Test results were satisfactory. For a broader indicator, periodic inspection of E&W fan shaft to flange bearing matchmarks to identify slippage and the collection of vibration data for trending purposes are included in the Watts Bar Preventative Maintenance (PM) Program. These PM activities have been scheduled on a continuing basis until satisfactory performance has been confirmed.

Changes to MI-0.16 now include the implementation of (1) spot drilling fan shafts for better seating surfaces for the flange bearing set screws; (2) the shaft deflection method for belt tensioning; (3) the requirement of matchmarking fan shafts to inboard flange bearings; and (4) guidance to ensure fan shaft alignment is properly performed.

Vendor manuals/drawings have been changed where appropriate to define new fan shaft material requirements and machining tolerances for fan shaft diameters and fan shaft drilling requirements for bearing set screws.

All actions for this item have been completed for WBN Unit 1.