



Tennessee Valley Authority, Knoxville, Tennessee 37901

Jack L. Wilson
Tennessee Valley Authority

May 22, 1991

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

Gentlemen:

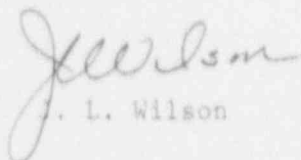
TENNESSEE VALLEY AUTHORITY - SEQUOYAH NUCLEAR PLANT UNIT 1 - DOCKET
NO. 50-327 - FACILITY OPERATING LICENSE DPR-77 - LICENSEE EVENT REPORT
(LER) 50-327/91007

The enclosed LER provides details concerning an entry into Limiting
Condition for Operation (LCO) 3.0.3 when both trains of control room
emergency ventilation (CREV) were declared inoperable. The Train 'A'
CREV was declared inoperable when the shaft of the Train 'A' main control
room (MCR) air handling unit (AHU) failed. The Train 'B' MCR AHU had
been previously declared inoperable in support of maintenance activities.

This event is being reported in accordance with 10 CFR 50.73 (a)(2)(i)(B)
as an operation prohibited by technical specifications and
10 CFR 50.73 (a)(2)(ii)(B) as a condition that was outside the design
basis of the plant.

Very truly yours,

TENNESSEE VALLEY AUTHORITY


J. L. Wilson

Enclosure

cc: See page 2

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U.S. Nuclear Regulatory Commission
May 22, 1991

cc (Enclosure):

INPO Records Center
Institute of Nuclear Power Operations
1100 Circle 75 Parkway, Suite 1500
Atlanta, Georgia 30339

Mr. D. E. LaBarge, Project Manager
U.S. Nuclear Regulatory Commission
One White Flint, North
11555 Rockville Pike
Rockville, Maryland 20852

NRC Resident Inspector
Sequoyah Nuclear Plant
2600 Igou Ferry Road
Soddy Daisy, Tennessee 37379

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

(6-89)

Expires 4/30/92

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)

Sequoyah Nuclear Plant, Unit 1

DOCKET NUMBER (2) | PAGE (3)

050003 12 17 11 01 6

TITLE (4) Limiting Condition for Operation 3.0.3 entered when both trains of control room emergency ventilation were declared inoperable; when the 'A' train AHU failed and the 'B' train AHU was out-of-service for maintenance.

EVENT DAY (5) | LER NUMBER (6) | REPORT DATE (7) | OTHER FACILITIES INVOLVED (8)

MONTH | DAY | YEAR | YEAR | SEQUENTIAL | REVISION | MONTH | DAY | YEAR | FACILITY NAMES | DOCKET NUMBER(5)

0 | 4 | 2 | 2 | 9 | 1 | 9 | 1 | 0 | 0 | 7 | 0 | 0 | 0 | 5 | 1 | 9 | 1 | Sequoyah, Unit 2 | 050003 12 18

0 | 4 | 2 | 2 | 9 | 1 | 9 | 1 | 0 | 0 | 7 | 0 | 0 | 0 | 5 | 1 | 9 | 1 | 050003 11

OPERATING | THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR 5:

MODE | (Check one or more of the following)(11)

(9) | 1 | 20.402(b) | 20.405(c) | 50.73(a)(2)(iv) | 73.71(b)

POWER | 20.405(a)(1)(i) | 50.36(c)(1) | 50.73(a)(2)(v) | 73.71(c)

LEVEL | 20.405(a)(1)(ii) | 50.36(c)(2) | 50.73(a)(2)(vii) | OTHER (Specify in

(10) | 1 | 0 | 0 | 20.405(a)(1)(iii) | XX 50.73(a)(2)(i) | 50.73(a)(2)(viii)(A) | Abstract below and in

20.405(a)(1)(iv) | XX 50.73(a)(2)(ii) | 50.73(a)(2)(viii)(B) | Text, NRC Form 366A)

20.405(a)(1)(v) | 50.73(a)(2)(iii) | 50.73(a)(2)(ix)

LICENSEE CONTACT FOR THIS LER (12)

NAME | TELEPHONE NUMBER

AREA CODE |

Russell R. Thompson, Compliance Licensing Engineer | 6 | 1 | 5 | 8 | 4 | 3 | - | 7 | 4 | 7 | 0

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE | SYSTEM | COMPONENT | MANUFACTURER | TO NPRDS | CAUSE | SYSTEM | COMPONENT | MANUFACTURER | TO NPRDS

B | V | 1 | A | H | U | E | 3 | 2 | 2 | Y

SUPPLEMENTAL REPORT EXPECTED (14)

EXPECTED | MONTH | DAY | YEAR

SUBMISSION |

YES (if yes, complete EXPECTED SUBMISSION DATE) | X | NO | DATE (15) |

ABSTRACT (limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

On April 22, 1991, at 1848 Eastern daylight time (EDT) with Units 1 and 2 in Mode 1

(100 percent power), Limiting Condition for Operation (LCO) 3.0.3 was entered when both

trains of control room emergency ventilation were declared inoperable. Train 'A' was

declared inoperable when the shaft of the Train 'A' main control room (MCR) air

handling unit (AHU) failed from fatigue. The Train 'B' MCR AHU had been previously

declared inoperable to support maintenance activities. Train 'B' MCR AHU was returned

to service at 2100 EDT on April 22, and LCO 3.0.3 was exited.

(6-89)

Expires 4/30/92

LICENSEE EVENT REPORT (LER)

TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)		
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER			
Sequoyah Nuclear Plant Unit 1	1015101013 12 17	9 11	-- 0 0 4 --	0 0 0	2 OF	0 1	6

TEXT (If more space is required, use additional NRC Form 366A's) (17)

DESCRIPTION OF EVENT

On April 22, 1991, at 1848 Eastern daylight time (EDT) with Units 1 and 2 operating in Mode 1 (100 percent reactor power, reactor coolant system [RCS] pressure at 2,235 pounds per square inch gauge [psig], and RCS average temperature at 578 degrees Fahrenheit [F]), Limiting Condition for Operation (LCO) 3.0.3 was entered when both trains of control room emergency ventilation (CREV) (EIIIS Code VI) were declared inoperable. Train 'A' was declared inoperable when the shaft of the Train 'A' main control room (MCR) air handling unit (AHU) failed from fatigue. The Train 'B' MCR AHU had been declared inoperable at 0010 EDT on April 22, 1991, to support maintenance activities. The MCR AHUs are attendant equipment required for CREV operability. LCO 3.7.7 requires two independent CREV systems to be operable in all modes of reactor operation. With one train inoperable, power operation may continue, provided the system is returned to operable status within seven days. Because LCO 3.7.7 does not provide specific guidance for both trains of CREV being inoperable while at power, the action provisions of LCO 3.0.3 must be applied.

On April 22, 1991, at approximately 1845 EDT, the MCR AHU Train 'A' (O-AHU-031-20) was in operation when loud noises, detected from the MCR, prompted an operator to inspect the AHU and stop the fan. It was determined that it took approximately three minutes from the time the noise started to the time the fan was tripped.

In parallel with efforts to determine the cause of the failure of the Train 'A' MCR AHU, actions were initiated to return the Train 'B' MCR AHU to service. At approximately 2100 EDT the Train 'B' MCR AHU was returned to operation, LCO 3.0.3 was exited, and plant operation continued within the action provisions of LCO 3.7.7.

At approximately 1930 EDT, the system engineer and other personnel inspected the AHU and determined that the shaft was broken at the inboard bearing. No other damage was visible and the fan rotor was in place. The shaft was found to have broken at 10 and 1/16 inches from the inboard end at approximately 1/16 inch inside the fan inboard bearing (see attached Figure).

The broken shaft was found to be bowed 0.010 inch. This condition may have been introduced by the breaking of the shaft, although it is difficult to ascertain as records of the shaft's original condition were not maintained.

A new shaft and extension shaft were manufactured and coupled in the shop to check for alignment. The coupling was found to be 0.010 inch out-of-alignment. The misalignment was corrected by machining the face of the coupling. The final shaft misalignment (measured in the shop) was less than 0.004 inch.

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LICENSEE EVENT REPORT (LER)

TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)	PAGE (3)
		SEQUENTIAL YEAR NUMBER	REVISION NUMBER
Sequoyah Nuclear Plant Unit 1	050101312171911	004	01030106

TEXT (If more space is required, use additional NRC Form 366A's) (17)

DESCRIPTION OF EVENT

Following shop alignment, the shaft was reinstalled with new bearings (pillow blocks only). During reinstallation, it was found that the shaft could not be aligned because of interference between the flange bearing and the AHU housing stiffener. A design change package was issued to allow for machining the bearing flange. This interference prompted the investigation of the fan assembly to determine if it had moved relative to the AHU structure. It was identified that one bolt that held the fan in the housing was missing and one was loose, and two stiffener bolts were also missing. It was also noted that the structure was distorted causing the bearing interference. Missing bolts were replaced and the fan was tightened to the AHU structure.

The belts were adjusted until the shaft deflected 0.0045 inch as directed by the cognizant engineer. The fan was started and checked for belt slippage and no slippage was noted. A postmaintenance vibration analysis was done and the fan was rebalanced.

At approximately 1300 EDT on April 27, 1991, the Train 'A' AHU was returned to operation and LCO 3.7.7 was exited.

CAUSE OF EVENT

Based on the lab results and discussions with the vendor, the cause of the shaft failure is because of operating conditions that caused a bending load to be added to the torsional (rotation) loads on the shaft. Vibrations or alignment could have caused such bending loads.

During reinstallation of the shaft, it was determined that the shaft could not be aligned because of interference between the flange bearing and unit structural members. This interference was removed by machining the flange of the bearing. However, this condition prompted further investigation of the MCR AHU structural integrity, and it was identified that several bolts that connect the fan assembly to the unit housing were missing or loose.

It is postulated that during operation, the combination of high belt tension and shaft misalignment caused the bolts supporting the fan to the AHU to loosen. Fan vibration subsequently increased which introduced high stress fatigue to the shaft. When the shaft fatigue crack reached the approximately 75 percent of the shaft area, the fan began to move up and down in a large vertical motion that caused the loud noise and the ultimate failure of the shaft.

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LICENSEE EVENT REPORT (LER)

TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)	PAGE (3)
Sequoyah Nuclear Plant Unit 1		SEQUENTIAL	REVISION
		YEAR	NUMBER

105101013 12 17 9 11 -- 0 0 4 -- 0 0 0 4 OF 0 6

TEXT (If more space is required, use additional NRC Form 366A's) (17)

ANALYSIS OF THE EVENT

This event is being reported in accordance with 10 CFR 50.73 (a)(2)(i)(B) as an operation prohibited by technical specifications and 10 CFR 50.73 (a)(2)(ii)(B) as a condition that was outside the design basis of the plant.

As described in Sequoyah Nuclear Plant (SQN) Updated Final Safety Analysis Report (UFSAR), Section 9.4.1, the main control room habitability system is designed and operated to provide comfort and safety to personnel and for the protection of instrumentation. These conditions are maintained for both normal operations and accident conditions.

The MCR AHUs support the CREV system by circulating the air processed by the emergency air clean-up system and by helping to maintain a slight positive pressure in the MCR.

The loss of either of the trains of MCR AHUs does not impact this ability, as either train has 100 percent capacity to maintain the required environment. Compliance with the action provisions of LCO 3.7.7 ensures that the environment is maintained in safe, habitable manner, and that normal system redundancy is restored in a timely manner.

For the period in which both trains were inoperable, the applied action provisions of LCO 3.0.3 provides guidance on placing the plant in a safe condition if the initiating event cannot be rectified. The remaining train was returned to service within the time allotted by LCO 3.7.7.

Because the action provisions of LCOs 3.0.3 and 3.7.7 were complied with, it is concluded that this event did not impact the health and safety of the public or plant personnel.

CORRECTIVE ACTION

The immediate corrective actions for this event included the entry into LCO 3.0.3 to provide the necessary guidance for both CREV trains being inoperable. Additionally, the Train 'B' MCR AHU was expeditiously returned to service, allowing LCO 3.0.3 to be exited.

The Train 'A' MCR AHU was reassembled with a new shaft, employing enhanced methods for shaft alignment and belt tensioning. The loose and missing bolts in the AHU housing were tightened and replaced. Testing was completed, and the Train 'A' AHU declared operable and LCO 3.7.7 exited at 1300 EDT on April 27, 1991.

To prevent recurrence, an enhanced shaft alignment and belt tensioning methodology will be incorporated into plant procedures by October 1, 1991. Also, appropriate preventive maintenance procedures will be revised by August 2, 1991, to include periodic inspection of the AHU assembly bolts.

As a result of this event, the MCR AHUs have been incorporated into periodic vibration monitoring programs.

(6-89)

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LICENSEE EVENT REPORT (LER)

TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)				PAGE (3)			
			SEQUENTIAL		REVISION				
Sequoyah Nuclear Plant Unit 1		YEAR	NUMBER		NUMBER				
	05100013 2 17	9 1	--	0 0 4	--	0 0 0	5 0 1	0 6	

TEXT (If more space is required, use additional NRC form 366A's) (17)

ADDITIONAL INFORMATION

There have been no similar LERs previously reported.

A previous failure of the Train 'A' MCR AHU shaft occurred on January 23, 1991. The cause of the previous shaft failure was identified as low cycle fatigue. Although the two failures were similar, the contributing factors were concluded to be different. As such, the most recent event is not considered to have been preventable based on the lessons learned from the January failure.

COMMITMENTS

1. The enhanced shaft alignment and belt tensioning methodology will be incorporated into plant procedures by October 1, 1991.
2. Appropriate preventive maintenance procedures will be revised by August 2, 1991, to include periodic inspection of the AHU assembly bolts.

