NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/88

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Beaver Valley Power Station Unit 2	0 5 0 0 0 4 1 2	1 OF 0 4

TITLE (4)

Expansion Joint Liner Failures for Component Cooling Pumps

EVENT DATE (5)			LER NUMBER (6)				REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR		SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
											0 5 0 0 0
0 1	1 6	8 9	8 9	–	0 0 6	– 0 0	0 3	3 0	8 9		0 5 0 0 0

OPERATING MODE (9)	POWER LEVEL (10)	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
1	1 0 0	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
		20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	X OTHER (Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
		20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	10CFR Part 21
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
Mr. Thomas P. Noonan, General Manager of Nuclear Operations	AREA CODE 4 1 2 — 6 4 3 - 1 2 5 8

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	
B	C C	E X J	P 0 9 0								

SUPPLEMENTAL REPORT EXPECTED (14)

		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

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

On 1/16/89 at 0133 hours, with the Unit at 100% power and the "A" and "C" Component Cooling Pumps (2CCP*P21A and C) running, 2CCP*P21C exhibited a sudden loss of flow and was immediately secured. Investigation revealed that a weld on the internal liner to an expansion joint located at the pump suction had failed, allowing the liner to separate and be drawn into the pump impeller. Further analysis has indicated that the liner failure was caused by cyclic fatigue induced by the system hydraulic conditions resulting from the design of the system (the expansion joint was between an elbow/pipe reducer and the pump suction nozzle). All three Component Cooling Water Pumps have a similar suction piping configuration and so could be subject to the same failure mechanism. This event was reviewed by the Licensing and Engineering Groups and it was determined to be reportable under 10CFR21. The safety consequences to the public were mitigated because two CCP pumps remained available in accordance with Technical Specifications. The liners for all three pump suction expansion joints were replaced with thicker models without welds. In addition, Operations had been operating only one CCP pump and leaving two pumps available until the repair of the expansion joints was completed. These measures reduce the probability of additional fatigue failures.

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FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
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TEXT (If more space is required, use additional NRC Form 366A's) (17)

This report is being submitted as the written notification of a design defect at Beaver Valley Unit 2 in accordance with 10 21.21.b.2.

Description of Event:

On 1/16/89 Beaver Valley Unit 2 was operating at 100% Reactor Power. Two of the three Component Cooling Water Pumps (2CCP-P21A and 2CCP-P21C) were running in accordance with normal Unit operating practice based on system conditions; 2CCP-P21B was in a standby mode. At 0133 hours, the current on both running pumps immediately increased, with the current on the "A" pump (2CCP*P21A) at a higher value, indicating increased flow. Thus 2CCP-P21C was immediately secured.

Investigation by Site Maintenance into the cause of the problem revealed that the metal liner to the expansion joint (2CCP-EJM-214C) located at the suction nozzle of 2CCP-P21C, had separated from the joint. The liner to the joint had previously been removed for inspection (on 12/13/88) and had exhibited evidence of cracking, which was repaired. The liner for 2CCP-EJM-214C was reinstalled on 1/9/89, and the pump was returned to service until the failure on 1/16/89. The original liner was sent to the Westinghouse Research and Development Division for a failure analysis.

After the second failure, it was decided to replace the liners on all three pumps with a thicker model that is attached by a flange rather than welded. These replacements were completed by 2/2/89.

Apparent Cause of Event:

Analysis of the inspections following the report of damage on 1/4/89 and the event of 1/16/89 indicated that vibration induced cyclic fatigue caused the weld joining the liner to 2CCP-EJM-214C to fail. The vibration was caused by the flow conditions inherent in the design of the Component Cooling System piping. This configuration has the expansion joint located adjacent to a reducing elbow and immediately next to the suction of 2CCP-P21C. Upon failure of the liner the failed pieces were drawn into the suction of the pump causing binding and a loss of flow. The problem can be considered to be common to all three pumps since they have similar piping arrangements. The design of the system considers the vibration which will be

experienced by the pump under normal flow conditions. Since the expansion joint is directly coupled to the pump suction nozzle, this vibration is also transmitted to the expansion joint. Under low flow conditions, additional flow turbulence, the elbow/pipe reducer arrangement, and the normally present harmonic vibration all combine to increase the amplitude of the vibrations and aggravate the cyclic fatigue effect on the expansion joint liner.

Analysis and Reportability:

This event had no consequences to the health and safety of the public because two Component Cooling Water (CCP) pumps were always available to perform their design functions in accordance with Technical Specification (TS) 3.7.3.1. Following the failure of 2CCP-P21C, the system continued operating with one pump running and a second in standby. A Justification for Continued Operation (JCO), prepared on 1/16/89, concluded that this configuration should be maintained during the duration of the joint/liner repairs. Such operation would reduce the number of cycles to which the backup pump(s) would be exposed and thus reduce the probability of its failure when needed.

According to the UFSAR, Section 9.2.2.1.3, the Component Cooling Water System is not needed to mitigate the short term consequences of an accident. The Appendix R analysis for Beaver Valley Unit 2 states that the CCP system is needed to maintain Hot Shutdown status, with an approach to Cold Shutdown 72 hours thereafter. The CCP System is required to provide cooling water to the Residual Heat Removal (RHR) System in order to enable the station to reach Cold Shutdown conditions from Hot Shutdown. Section 9.2.2.1.3 of the UFSAR states that in the event of a system piping rupture, at least one CCP pump could be restored to service in 36 hours. As TS 3.7.3.1 allows a total of 108 hours to reach Cold Shutdown in the event that less than two CCP pumps are operable (72 hours to attempt to repair the pump then 36 more hours to shut down), at least one pump should be restored well within any time limit regardless of the failure mode. Furthermore, although the design condition and cycling greatly increases the probability of CCP pump failure, it cannot be concluded that this failure mechanism would definitely disable two pumps at the same time.

The pattern of operation at Beaver Valley Unit 2 supports this conclusion, since, with two pumps operating and the third used as a periodic replacement an uneven pattern of cyclic fatigue is imposed. Therefore, it has been concluded that this event alone could not have prevented safe shutdown of the reactor as specified in 10CFR 50.73.a.2.v.A.

In addition, the CCP system is isolated during a Design Basis Accident (DBA) as a result of a Containment Isolation Phase B (CIB) signal. System loss is not discussed in the Accident Analysis Section (15) of the UFSAR. Thus this condition is neither unanalyzed, as discussed in the previous paragraph, or beyond the design basis of the plant. This problem is therefore also not reportable under 10CFR50.73a.2.ii.A or B. No Licensee Event Report (LER) is required.

A 10CFR21 Evaluation Report was prepared following the return of the first damaged liner from the Westinghouse Research and Development Division. In the report, Duquesne Light Nuclear Engineering concluded that a report under 10CFR21 was justified because the CCP system is necessary to reach safe shutdown conditions and hence is a "basic component" as defined in 10CFR21.3.a.1. In addition, it was determined that a "deviation", as defined in 10CFR21.3.e existed because the designers of the system did not sufficiently consider the effect the system piping configuration would have on the liners. Furthermore, it was concluded that the problem experienced by Beaver Valley Unit 2 could occur at any plant with a similar piping/expansion joint design and arrangement. It was determined that this event was reportable under 10CFR21.21. The Nuclear Regulatory Commission was notified at 1540 hours on 3/30/89.

Corrective Actions:

1. The expansion joints were replaced as part of a Beaver Valley Design Change Package Program (DCP). The manufacturer of the joints, Pathway Bellows, Inc., fabricated a new model liner made of 1/8 inch thick 304 Stainless Steel (as opposed to the previous version, which was 1/16 in. thick). This model liner is held in position by a clamped flange rather than welded. Spare liner inserts can be easily installed. The modified expansion joints were all installed by 2/2/89.

2. As stated in the JCO written on 1/16/89, only one CCP pump would be normally running, with two available backups, during the period in which the expansion joint was repaired.

Both of these corrective actions will greatly reduce the affect of flow induced cyclic fatigue on the CCP Pump suction expansion joints, and will reduce the probability of failure for those components.

Duquesne Light

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April 4, 1989
ND3MNO:1853

Beaver Valley Power Station, Unit No. 2
Docket No. 50-412, License No. NPF-73
LER 89-006-00

United States Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Gentlemen:

In accordance with Appendix A, Beaver Valley Technical Specifications, the following Licensee Event Report is submitted:

LER 89-006-00, 10 CFR 21.21.b.3., "Expansion Joint Liner Failures For Component Cooling Pumps".

Very truly yours,

T. P. Noonan
General Manager
Nuclear Operations

vhy

Attachment

RGN 5 4r Encl
RGN 2 " "
RGN 3 " "
RGN 4 " "
Add: NRR/DRIS/VIB " "
NRR/Crutchfield " "
NRR, Varga S. " "

IE22

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