NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/85

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
North Anna Unit 1	0 5 0 0 0 3 3 8	1 OF 0 4

TITLE (4)
Recirculation Spray Cooler Lap Ring Cracking

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 9	0 1	8 4	8 4	—	0 0 8	—	0 0	0 9	2 7	8 4	North Anna Unit 2	0 5 0 0 0 3 3 9
												0 5 0 0 0

OPERATING MODE (9)	5	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10)	0 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)	
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
	AREA CODE
E. Wayne Harrell	7 0 3 — 8 9 4 - 5 1 5 1

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	
X	B E	H X	0 0 1 5	Y							

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)

ABSTRACT

During performance of the North Anna Unit 1 Type 'A' (ILRT) test the Recirculation Spray Coolers were suspected as a possible source of air leakage. Upon investigation the heat exchanger lap rings, which serve as the lower supportive surface for heat exchanger covers, were found to have radial flaws in the outer 5/8" region of the 1" thick ring. The lap rings are constructed of stainless steel type 304L and indications of crevice corrosion were evident at the source of crack propagation. The cracks propagated in the region of high tensile stress. Tensile stresses are a result of applied stress and residual stress from the manufacturing process. Based on a fracture mechanics analysis the lap rings were determined to be acceptable for continued operation with the flaws as found. The cracking was probably due to chloride induced stress corrosion cracking. A stainless steel type 316L cladding was installed at the point of lap ring-diaphragm interface to minimize further crevice corrosion and the heat exchangers returned to service. This report is being submitted as a voluntary report since it was determined by analysis that at no time were the heat exchangers subject to failure. The Recirculation Spray Coolers are used as the cooling interface for containment recirculated sump water during a Design Base Accident.

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

This report is being submitted to document a Crevice Corrosion and Stress Corrosion Cracking condition which exists on the lower lap rings of the Recirculation Spray (EIIS System Identifier BE) Coolers (EIIS Component Identifier HX) (heat exchangers) of North Anna Unit 1. This is a voluntary report. The integrity of the vessels was not impaired by the flaws as determined by a conservative fracture mechanics analysis. The Recirculation Spray Coolers are used as the cooling interface between recirculated containment sump water and the service water system (EIIS System Identifier BS) (heat sink) during a Design Basis Accident.

During the 1984 North Anna Unit 1 Type 'A' Containment Pressurization Test, the Recirculation Spray Coolers were suspected as a possible air leakage source. After removal of the 'D' Recirculation Spray Cooler diaphragm from the lower lap ring and subsequent examination of the lap ring by L.P. visual examination, surface flaws caused by crevice corrosion became evident. Subsequent excavation in the area of the flaws revealed radial cracking initiating from the point of crevice corrosion pitting to the outside diameter of the lap ring. The lap ring is a welded extension to the cooler shell. The bottom of the lap ring is a 1" thick by 5/8" high flange against which a diaphragm is welded along the outer edge as shown in the attached figure. A ring flange (free floating) rests on the outside edge of the lap ring and bolts to a bottom end plate or cover plate. The lap ring is employed as the pressure boundary wall and a bearing surface for compression of the diaphragm. The lap ring and diaphragm are made of stainless steel type 304L.

The crevice corrosion which existed on the lap ring was caused by contact with service water at a concentration of 12 to 50 ppm chloride, and subsequent concentrating of the chlorides in the crevice area between the diaphragm and the lap ring. (The service water is treated with Hypochlorite). The radial cracking, which extended from the crevice corrosion pitting to the lap ring outer diameter, was caused by chloride concentration in conjunction with a relatively high tensile stress region which was induced during lap ring manufacturing. At no point did cracking extend into the inner 3/8" thickness of the lap ring which is under compressive stresses induced by manufacturing, and the bolted joint design.

From information obtained from excavation of the 'D' Recirculation Spray Cooler, which had more severe crevice corrosion pitting than the other Recirculation Spray Coolers, a fracture mechanics analysis was performed using assumptions of failure due to unstable crack growth and net section collapse caused by flaw induced stress intensity and elastic-plastic failure flaw evaluation. These analysis were performed using the general approach of both ASME XI Appendix A and ASME Section XI IWB 3640, 1983 Addendum.

Both analysis, indicated that existing flaws are acceptable and do not degrade the vessel below design. The fracture mechanics analyses performed were extremely conservative; stresses in the lap ring were assumed to be material yield stress when in actuality the stresses thought to exist in the lap ring are significantly below yield.

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In order to preclude further lap ring degradation a cladding of stainless steel Type 316L was applied to the lap ring surface in contact with the diaphragm. The diaphragms were also replaced with 316L. This was done to all four heat exchanger lower lap rings. Inspection will be made of the Unit 2 Recirculation Spray Coolers during the current Unit 2 refueling outage.

During the investigation of lap ring cracking it was noted that the diaphragms of the heat exchanger were not designed for a containment pressure greater than the heat exchanger internal pressure. During the initial stage of a Design Basis Accident the containment pressure could initially exceed the heat exchanger internal pressure. Analysis by Stone & Webster Engineering Corporation (AE) showed that the diaphragms would not fail and the design oversight did not have safety implications. A silicone rubber sealant was installed between the diaphragm and cover to prevent exposure to external pressure. Prior to obtaining the Stone & Webster analysis which showed that the design oversight did not have safety implications, this discovery was reported to the NRC under 10CFR50.72 (b) (2) (iii) (D). Based on the Stone and Webster analysis, the event was reclassified as nonreportable.

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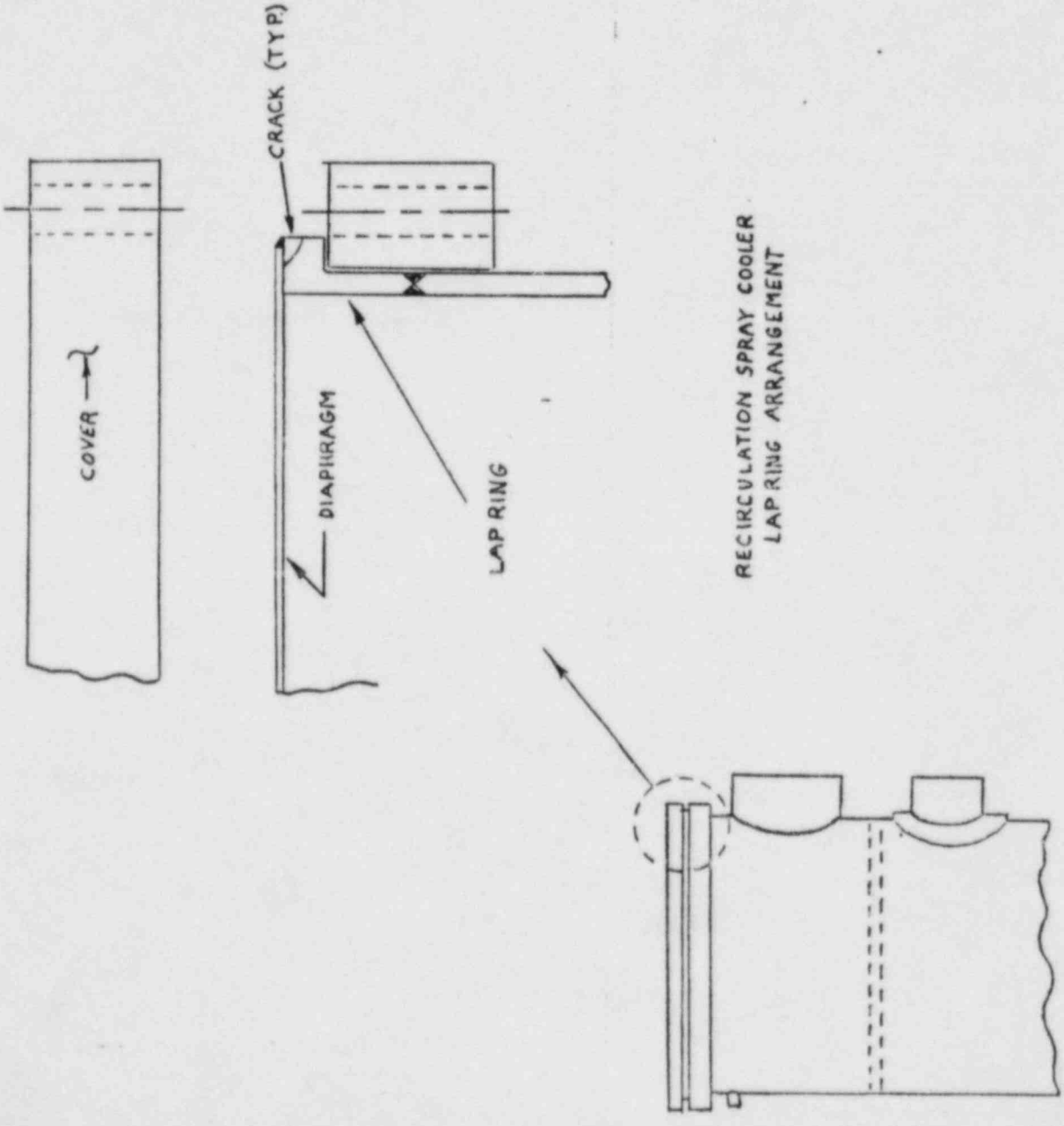
TEXT (If more space is required, use additional NRC Form 366A's) (17)

Figure 1



Vepco

VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION
P. O. BOX 402
MINERAL, VIRGINIA 23117

September 27, 1984

U. S. Nuclear Regulatory Commission
Document Control Desk
016 Phillips Building
Washington, D.C. 20555

Serial No. N-84-016
NO/CLF: bkp
Docket No. 50-338

License No. NPF-4

Dear Sirs:

The Virginia Electric and Power Company hereby submits the following License Event Report applicable to North Anna Unit No. 1.

Report No. LER 84-008

This report has been reviewed by the Station Nuclear Safety and Operating Committee and will be forwarded to Safety Evaluation and Control for their review.

Very Truly Yours,

E. Wayne Harrell
Station Manager

Enclosures (3 copies)

cc: Mr. James P. O'Reilly, Regional Administrator
U. S. Nuclear Regulatory Commission
Region II
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