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ROZELL,D.L. Wisconsin Public Service Corp.
SCHROCK,C.A. Wisconsin Public Service Corp.
RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 93-004-00:on 930318,eddy current exam identified 9 tubes in SG A & 12 tubes in SG B considered defective.Probably caused by ouside diameter intergranular attack & IGSCC.Tubes will be examined by NDE.W/930405 ltr.

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April 15, 1993 10 CFR 50.73

U. S. Nuclear Regulatory Commission
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Ladies/Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Reportable Occurrence 93-004-00

In accordance with the requirements of 10 CFR 50.73, "Licensee Event Report System," the attached Licensee Event Report for reportable occurrence 93-004-00 is being submitted.

Sincerely,

C.A. Schrock

C.A. Schrock
Manager-Nuclear Engineering

DLR/cjt

Attach.

cc - INPO Records Center
US NRC Senior Resident Inspector
US NRC, Region III

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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)
Kewaunee Nuclear Power Plant	0 5 0 0 0 3 0 5	1 OF 0 7

TITLE (4) Intergranular Attack and Intergranular Stress Corrosion Cracking Results in Both Steam Generators Being Categorized as C-2

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)
									N/A	0 5 0 0 0
0 3	1 8	9 3	9 3	0 0 4	0 0	0 4	1 5	9 3		0 5 0 0 0

OPERATING MODE (9)		THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
	N	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
POWER LEVEL (10)	0 0 0	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)	TS 4.2.b.6.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 (13)

NAME	TELEPHONE NUMBER
Dennies L. Rozell - Nuclear Engineer	AREA CODE 4 1 4 3 8 8 - 2 5 6 0

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	A B	S G	W 1 2 0	Y							

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO	N/A			

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

On March 18, 1993, with the plant in refueling shutdown, eddy current examination of the Steam Generator (SG) tubes was completed for the 1993 refueling outage. The examination found 9 tubes in SG A and 12 tubes in SG B which were considered defective. Since one or more tubes were considered defective in each steam generator, both SGs were categorized as C-2. As required by KNPP Technical Specifications (TS), this Licensee Event Report (LER) provides the required 30 day written report to the Nuclear Regulatory Commission (NRC).

The majority of the SG tube degradation at KNPP is probably caused by outside diameter intergranular attack and outside diameter intergranular stress corrosion cracking (IGA/IGSCC). In accordance with KNPP's TS, all defective tubes were plugged. This increased the overall equivalent plugging percentage from 10.06 percent to 10.37 percent for the 1993-1994 operating cycle.

During the 1993 refueling outage, portions of 3 tubes were extracted from the B SG cold leg. These tubes will be examined by non-destructive and destructive examination techniques to determine actual tube condition relative to eddy current results.

The secondary side boric acid and Morpholine addition programs will continue during the 1993-1994 operating cycle to reduce the caustic environment and corrosion/erosion on the secondary side.

Description of Event

On March 18, 1993, with the plant in refueling shutdown, steam generator [SG] tube [TRB] examination was completed for the 1993 refueling outage.

The SG tube eddy current examination program included:

1. A bobbin coil examination through the entire length of all tubes not previously plugged or sleeved.
2. A bobbin coil examination of all sleeved tubes from the top of the sleeve around the u-bend to the end of the tube (tube end cold).
3. A cross wound bobbin coil examination of 10 percent of the inservice sleeves.
4. Motorized Rotating Pancake Coil (MRPC) examination of distorted indications identified from the bobbin coil exam.
5. MRPC examination of all open row 1 U-bends and 30 row 2 U-bends per SG.

The Kewaunee Nuclear Power Plant (KNPP) Technical Specification (TS) 4.2.b.2.a requires that the initial examination include at least 3 percent of the non-repaired tubes and at least 3 percent of the repaired tubes in each SG. Since the examination included 100 percent of the unplugged, unsleeved tubes through their entire length, 100 percent of the unsleeved sections of the sleeved tubes, and 10 percent of the inservice sleeves through their entire length, the program satisfies KNPP TS requirements.

The examination found 9 tubes (0.29 percent of tubes examined) in SG A and 12 tubes (0.38 percent of tubes examined) in SG B which met the KNPP definition of defective (Single Axial Indications (SAI), Multiple Axial Indications (MAI) or tube wall degradation of greater than or equal to 50%). The SGs at KNPP are Westinghouse model 51 with mill-annealed inconel 600 tubes. Since one or more of the examined tubes were considered defective in each SG, both SGs were categorized as C-2, as defined in KNPP TS 4.2.b.2. According to the KNPP TS 4.2.b.6.a, the number of tubes requiring plugging or repairing shall be reported to the NRC within 30 days of the completed eddy current

examination. The C-2 category requires:

1. Plugging or repair of all defective tubes.
2. An examination of additional tubes in the affected areas if the sample size is less than 100 percent in the affected area.

This Licensee Event Report satisfies the 30 day reporting requirement of KNPP Technical Specification 4.2.b.6.a and as described later in this report, all defective tubes were plugged. Since 100 percent of the unsleeved, unplugged tubes were examined, 100 percent of the unsleeved sections of the sleeved tubes were examined, and 10 percent of the inservice sleeves were examined, the additional examination requirements specified by KNPP TS Table 4.2-2 were satisfied. The SGs will be reexamined during the 1994 refueling outage.

The SG tube examination results for the 1993 refueling outage are summarized in the following table:

Defect Locations, 1993 Refueling Outage

AREA	No. of Defective Tubes	
	SG A	SG B
Top of Tubesheet-Cold Leg Side	0	0
Cold Leg Support Plates	2	7
Hot Leg Support Plates	5	3
Top of Tubesheet-Hot Leg Side	0	0
Hot Leg Tubesheet Crevice	2	2
TOTAL	9	12

Note: Tubes with multiple defects were counted only once in the first applicable listed area.

Cause of Event

The majority of the SG tube degradation at KNPP is likely caused by outside diameter intergranular attack and outside diameter intergranular stress corrosion cracking (IGA/IGSCC). This assumption is based on the analysis of two tubes pulled from KNPP's SG during the 1990 outage, eddy current signals, and industry experience with similar SGs. Outside diameter IGA/IGSCC is usually associated with a restricted geometry; e.g., the tube sheet crevice, tube support plate crevice or a sludge pile, and with a caustic environment; i.e., a pH greater than ten.

During the 1990 Refueling Outage portions of two SG tubes were extracted from the B SG hot leg. The tubes were examined by non-destructive and destructive examination techniques. Both tubes had axial crack networks within the tubesheet crevice region. The cracking was caused by outside diameter intergranular stress corrosion. The crack morphology had some intergranular attack characteristics. It was concluded that an alkaline crevice environment was associated with the stress corrosion.

Analysis of Event

This report is supplied in accordance with KNPP TS 4.2.b.6.a which requires a report to be submitted to the NRC within thirty days of completing the eddy current examination.

The following table provides a historical summary of the number of SG tubes plugged and sleeved each year:

	Steam Generator A				Steam Generator B			
	Plugged Tubes		Unplugged & Sleeved (recovered) Tubes (C)	Sleeved Tubes (D)	Plugged Tubes		Unplugged & Sleeved (recovered) Tubes (C)	Sleeved Tubes (D)
	Un-Sleeved (A)	Sleeved (B)			Un-Sleeved (A)	Sleeved (B)		
1983	23				50			
1984	9				17			
1985	26				22			
1986	26				46			
1987	44				79			
1988	17			990	26			950
1989	21			883	31			815
1990	114	8		0	103	6		0
1991	63	11	150	172	77	8	246	122
1992	17	13	0	12	19	16	0	4
1993	6	3	0	0	7	5	0	0
Total Tubes Plugged[1]	251				266			
Total Tubes Sleeved[2]		2172				2102		

Notes:

1. Total Tubes Plugged = $\Sigma(A) + \Sigma(B) - \Sigma(C)$
2. Total Tubes Sleeved = $\Sigma(C) + \Sigma(D) - \Sigma(B)$

The current equivalent plugging percentage increased from 9.93 percent to 10.19 percent in SG A and from 10.2 percent to 10.55 percent in SG B. A safety evaluation, including the transient and loss of coolant accident analyses (LOCA) presented in KNPP's Updated Safety Analysis Report (USAR), assumes a plugging level of 13.94 percent of the total SG tubes. The current overall equivalent plugging level of 10.37 percent is therefore bounded by KNPP's USAR and continued operation of the plant does not represent a significant hazard to the health and safety of the public.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Kewaunee Nuclear Power Plant	0 5 0 0 0 3 0 5	9 3	— 0 0 4	— 0 0	0 6 OF 0 7

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

Corrective Actions

In accordance with KNPP's Technical Specifications, all defective tubes were plugged.

Sludge lancing was conducted during the 1993 refueling outage to reduce the amount of sludge and to remove contaminants from the tube sheet. A secondary side boric acid addition program continues to be implemented to reduce the caustic environment in the tube crevices and helps prevent tube support plate denting. The program includes boric acid soaks at low power levels and on line boric acid addition at normal power levels. Evidence indicates that boric acid may reduce the crack growth rate. Also, a secondary side morpholine addition program continues to be implemented. Morpholine addition minimizes the corrosion/erosion in the piping that carries two-phase steam. Sludge (corrosion product) transport into the steam generators is thereby minimized and results in a decreased sludge pile.

During the 1993 refueling outage, portions of 3 tubes were extracted from the B SG cold leg including a total of 5 tube support plate intersections. These tubes will be examined by non-destructive and destructive examination techniques to determine actual tube condition relative to eddy current results.

Additional Information

Equipment Failure: Westinghouse Model 51 steam generator tubes. The tubing is mill annealed inconel 600.

Similar Events:

1. LER 92-006, Intergranular Attack and Intergranular Stress Corrosion Cracking Results in Both Steam Generators Being Categorized as C-3.
2. LER 91-005, Intergranular Attack and Intergranular Stress Corrosion Cracking Results in Both Steam Generators Being Categorized as C-3.
3. LER 90-005, Intergranular Attack and Intergranular Stress Corrosion Cracking Result in Defective Steam Generator Tubes.
4. LER 89-007, Intergranular Attack and Intergranular Stress Corrosion Cracking Result in Defective Steam Generator Tubes.
5. LER 88-003, Intergranular Attack and Intergranular Stress Corrosion Cracking Result in Defective Steam Generator Tubes.
6. Letter from D.C. Hintz (WPSC) to G.E. Lear (NRC) dated April 23, 1986.
7. LER 85-06, Steam Generator Tube Plugged in Incorrect Location.
8. Letter from C.W. Giesler (WPSC) to S.A. Varga (NRC) dated May 1, 1984.