CATEGORY 1

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ACCESSION NBR:9710280148 DOC.DATE: 97/10/24 NOTARIZED: NO DOCKET #
FACIL:50-305 Kewaunee Nuclear Power Plant, Wisconsin Public Servic 05000305
AUTH.NAME AUTHOR AFFILIATION
BERNHOFT,S.L. Wisconsin Public Service Corp.
MARCHI,M.L. Wisconsin Public Service Corp.
RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 97-002-01:on 970205,determined that potential defect in process used to laser weld repair of previously sleeved SG tubes during on-going refueling outage.Caused by tubes were found to be leaking.Joints were re-insp.W/971024 ltr.

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TITLE: 50.73/50.9 Licensee Event Report (LER), Incident Rpt, etc.

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CATEGORY 1 DOCUMENT

NRC-97-113

Wisconsin Public Service Corporation
(a subsidiary of WPS Resources Corporation)
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October 24, 1997

10 CFR 50.73

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

Ladies/Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Reportable Occurrence 97-002-01

In accordance with the requirements of 10 CFR 50.73, "Licensee Event Report System," the attached Licensee Event Report (LER) for reportable occurrence 97-002-01 is being submitted.

Sincerely,

M. L. Marchi
Manager - Nuclear Business Group

SLB/jmf

Attach.

IE22

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

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NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 04/30/98

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Kewuanee Nuclear Power Plant	05000305	1 OF 7

TITLE (4)
Potential Defect in the Process Used to Perform a Laser Welded Repair of Previously Sleeved Steam Generator Tubes

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 NAME	DOCKET NUMBER
02	05	97	97	002	01	10	24	97	N/A	05000
									FACILITY NAME	DOCKET NUMBER
										05000

OPERATING MODE (9)	N
POWER LEVEL (10)	000

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

20.2201(b)	20.2203(a)(2)(v)	50.73(a)(2)(i)	50.73(a)(2)(viii)
20.2203(a)(1)	20.2203(a)(3)(i)	50.73(a)(2)(ii)	50.73(a)(2)(x)
20.2203(a)(2)(i)	20.2203(a)(3)(ii)	50.73(a)(2)(iii)	73.71
20.2203(a)(2)(ii)	20.2203(a)(4)	50.73(a)(2)(iv)	X OTHER
20.2203(a)(2)(iii)	50.36(c)(1)	50.73(a)(2)(v)	Specify in Abstract below or in NRC Form 366A
20.2203(a)(2)(iv)	50.36(c)(2)	50.73(a)(2)(vii)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Sherry L. Bernhoft	(920) 433-1416

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

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 15 single-spaced typewritten lines) (16)

On February 5, 1997, with the plant in a cold shutdown condition, plant management determined that there was a potential defect in the process used to laser weld repair a number of previously sleeved steam generator (SG) tubes during the on-going refueling outage. The refueling outage started on September 21, 1996, and was extended until June 12, 1997, due to the number of parent tube indications found in Westinghouse mechanical hybrid expansion joint (HEJ) sleeves.

During a test with the secondary side of the SGs pressurized to approximately 100 psi, a number of the laser weld repaired HEJ sleeved tubes were found to be leaking. Six (6) of the repaired HEJs were removed to perform laboratory evaluation to determine the root cause of the weld failures. This evaluation concluded that the welds mechanically sheared due to unevenly distributed stresses during the post-weld stress relief process. All the laser weld repaired joints were re-inspected and all tubes with unacceptable welds were either plugged or repaired prior to placing the SGs back into service. This LER was originally submitted in accordance with 10 CFR 50.73 (a)(2)(ii) as a potential degradation of a principal safety barrier found while the plant was shutdown; however since the defective welds were never placed in service this LER is being submitted as information only.

Description of Event

On February 5, 1997, with the plant in a cold shutdown condition, plant management determined that there was a potential defect in the process used to laser weld repair a number of previously sleeved steam generator [SG] tubes [TBG] during the on-going refueling outage. The refueling outage started on September 21, 1996, and was extended until June 12, 1997, due to the number of steam generator (SG) tubes found with indications of degradation in the Westinghouse mechanical hybrid expansion joint (HEJ) sleeved tubes. Figure 1 shows a typical HEJ sleeve as installed in the SG. The degradation is occurring in the parent tube at the upper most, or free span joint, within the lower hardroll to hydraulic expansion transition region (circled area on the Figure).

The Kewaunee Nuclear Power Plant (KNPP) has two Westinghouse model 51 SGs. The tubes are constructed of low temperature mill-annealed inconel 600 and are partially rolled for a length of 1.5 to 2.5 inches into the tubesheet. As a result of tube degradation, significant plugging and sleeving efforts have been required in each SG. Prior to the 1996 refueling outage, SG A contained 771 plugged tubes and 1702 in-service sleeved tubes (1690 Westinghouse HEJ sleeves and 12 Combustion Engineering welded sleeves). SG B contained 518 plugged tubes and 1870 in-service sleeved tubes (1866 Westinghouse mechanical HEJ sleeves and four CE welded sleeves). The combined equivalent plugging percentage for the two SGs was 21.32 percent.

On September 21, 1996, the KNPP was shut down for a refueling and SG tube inspection outage. As a part of the planned outage work scope, plugs were removed from 550 previously plugged HEJ sleeved tubes. All of the in-service and unplugged HEJs were inspected using the +point probe. The results of this eddy current inspection found 1202 HEJ sleeved tubes in SG A, and 708 HEJ sleeved tubes in SG B, with parent tube indications (PTIs) within the joint pressure boundary as defined in Technical Specification 4.2.b.4.b. Based on the number of tubes affected, KNPP elected to perform a laser welded repair and removed seven (7) of the HEJs with PTIs for structural and leakage testing. The results of the structural testing performed on four (4)

of the samples, and leakage testing performed on three (3) of the samples were presented to the NRC at a meeting on December 17, 1996, and are summarized on Tables 1 and 2. The results demonstrate that even under postulated accident conditions, leakage from the as-found joint configuration was minimal and the load bearing capacity of the joints far exceeded the three times normal operating pressure differential requirements.

A proposed TS amendment to allow the laser welded repair was submitted to the NRC on September 6, 1996, and presented at a meeting on October 10, 1996. The original amendment request specified the weld location as the approximate center of the upper HEJ hardroll (HR) expansion.

Welding in the HR region of the upper HEJ was performed in the KNPP SGs during November and early December of 1996. During the HR welding efforts difficulties were encountered with poor weld quality and conflicting eddy current results. WPSC stopped the welding efforts in early December until improvements could be made in weld quality, and the eddy current differences were resolved. The plan for addressing these issues was discussed with the NRC staff in a meeting on December 17, 1996.

During the December 1996 and early January 1997 time frame, significant resources were expended by both WPSC and Westinghouse to resolve these two issues with close to 350 weld samples being prepared to support the program. As a result of this effort, weld process changes were made and a new welding specification was qualified in accordance with the requirements of the ASME code for performing welded repairs. The most significant change to the welding process was to move the weld location from the HR expansion, to the upper hydraulic expansion (HE) region. With regard to the eddy current inspection issue, WPSC elected to use the +point probe to verify weld integrity. The results of the weld quality improvements and eddy current inspection efforts were presented to the NRC staff in a meeting on January 14, 1997. In addition, the NRC performed a follow-up visit to the Westinghouse Waltz Mill site to review the +point qualification work on January 22 and 23, 1997.

Welding in the HE location proceeded during January 1997 employing a sequence of welding, ultrasonic (UT) inspection of the weld, post-weld stress relief, and +point eddy current (ET) inspection. Based on the UT and ET data there was a high acceptance rate for the HE laser weld repairs. On January 31, 1997, the secondary side of SG B was filled in preparation for plant start-up. During tubesheet inspection four tubes with HEJs that had been laser weld repaired were noted to be either dripping water or had wetted tube ends. SG A was then filled and leak tested, and a number of laser weld repaired sleeved tubes were also noted to have indications of dripping. Video inspection of the dripping tubes showed that the leakage appeared to emanate from the annulus between the sleeve and tube; i.e., over the top rim of the sleeve inner diameter. Immediate actions were taken to re-inspect, with both UT and ET, the tubes which appeared to be dripping. This re-inspection revealed no change in the ET data, but there was a significant change in the UT data.

Based on the change in UT data, all of the tubes that received a laser welded repair in either the HE or HR location were re-inspected with UT. The results of the re-inspection showed that a number of the welds located in the HE region which were initially acceptable (UT and ET) exhibited insufficient weld width, or an apparent lack of fusion between the sleeve and tube following the post-weld stress relief application.

A number of actions were taken as a result of finding the degradation in the HE welds. A total of six (6) laser weld repaired tubes (five with HE welds and one with a HR weld) were removed to determine the leakage path, root cause of the weld failure and to validate the UT and ET data. The laser weld repair tubes pulled represented a range of UT conditions. The HR welded tube and four (4) of the HE welded tubes were destructively examined and structurally tested.

Cause of Event

The destructive examination of the pulled tubes revealed the presence of small hot cracking at the weld/sleeve/tube interface. The cracking was the result of imposed stresses at high temperature conditions possibly exacerbated by the presences of contaminants in the weld pool. In the case of the welds located in

the HR, the far-field stresses were evenly distributed across the weld and the weld remained intact during the post-weld stress relief. For the HE welds, the stress level was not evenly distributed across the weld and some of the welds mechanically sheared during the post-weld stress relief process.

The destructive examination results also showed that the UT correlated well with the actual weld condition; i.e., the UT was detecting the areas of weld shearing by indicating that insufficient weld width existed. Moreover, the structural testing demonstrated that in locations where the UT determined the weld to be acceptable, there was significant structural margin relative to the three times normal operating pressure differential of RG 1.121.

A status report on the root cause work was presented to the NRC in a meeting on March 24, 1997, and the NRC visited the Westinghouse Science and Technology Center on April 8 and 9, 1997 to review the destructive examination and structural test results in detail. The completed root cause evaluation and basis for no significant safety issues associated with placing HR and HE welded tubes in service that have acceptable UT and ET was presented to the NRC staff at a meeting on April 14, 1997. The results of the root cause evaluation were documented and submitted to the NRC on April 22, 1997, in WCAP-14685, Revision 2, Addendum 1, "Laser Welded Repair of Hybrid expansion Joint Sleeves for Kewaunee Nuclear Power Plant Addendum 1: Evaluation of Weld Repaired HEJ Sleeved Tubes."

Analysis of Event

This licensee event report was originally submitted in accordance with 10 CFR 50.73(a)(2)(ii) as a potential degradation of a principal safety barrier found while the plant was shut down; however, since the defective welds were never placed in service, this supplemental LER is being submitted as information only. All laser weld repaired tubes were inspected with both UT and ET prior to being placed into service. Based on the results of the root cause evaluation, the structural testing, the in-situ leakage testing and analytical evaluations, there are no safety issues associated with operating the KNPP with laser weld repaired tubes in

service that have acceptable UT and ET results. This information was provided to the NRC in WCAP-14685, Revision 2; Addendum 1 with KNPP proposed TS amendment request number 144b, and was approved by the NRC on June 7, 1997 as TS amendment number 135.

Corrective Actions

In accordance with KNPP's TS's, all tubes classified as defective are required to be plugged or repaired. Accordingly, all the laser weld repaired tubes were re-inspected using both UT and ET and those with unacceptable welds were either plugged or repaired prior to placing the SG in service. The details on the tube plugging and repair were reported to the NRC in LER 96-006-01, dated June 30, 1997.

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL	REVISION	
Kewaunee Nuclear Power Plant	05000305	97 --	002 --	01	7 OF 7

TEXT *(If more space is required, use additional copies of NRC Form 366A)* (17)

Westinghouse HEJ (hybrid expansion joint) Steam Generator Tube Sleeve