

# ACCELERATED DISTRIBUTION DEMONSTRATION SYSTEM

## REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR: 9404180036      DOC. DATE: 94/04/11      NOTARIZED: NO      DOCKET #  
 FACIL: 50-389 St. Lucie Plant, Unit 2, Florida Power & Light Co.      05000389  
 AUTH. NAME      AUTHOR AFFILIATION  
 HARMON, J.W.      Florida Power & Light Co.  
 SAGER, D.A.      Florida Power & Light Co.  
 RECIP. NAME      RECIPIENT AFFILIATION

SUBJECT: LER 94-002-00: on 940316, identified trace amounts of boric acid on exterior of pressurizer steam nozzle durin insp. Cause was fabrication deficiencies. Corrective action: description of event will be shared W/industry. W/940411 ltr.

DISTRIBUTION CODE: IE22T      COPIES RECEIVED: LTR 1 ENCL 1 SIZE: 6  
 TITLE: 50.73/50.9 Licensee Event Report (LER), Incident Rpt, etc.

**NOTES:**

	RECIPIENT ID CODE/NAME	COPIES LTR ENCL	RECIPIENT ID CODE/NAME	COPIES LTR ENCL
	PD2-2 PD	1 1	NORRIS, J	1 1
INTERNAL:	ACRS	1 1	AEOD/DOA	1 1
	AEOD/DSP/TPAB	1 1	AEOD/ROAB/DSP	2 2
	NRR/DE/EELB	1 1	NRR/DE/EMEB	1 1
	NRR/DORS/OEAB	1 1	NRR/DRCH/HHFB	1 1
	NRR/DRCH/HICB	1 1	NRR/DRCH/HOLB	1 1
	NRR/DRIL/RPEB	1 1	NRR/DRSS/PRPB	2 2
	NRR/DSSA/SPLB	1 1	NRR/DSSA/SRXB	1 1
	REG FILE 02	1 1	RES/DSIR/EIB	1 1
	RGN2-FILE 01	1 1		
EXTERNAL:	EG&G BRYCE, J.H	2 2	L ST LOBBY WARD	1 1
	NRC PDR	1 1	NSIC MURPHY, G.A	1 1
	NSIC POORE, W.	1 1	NUDOCS FULL TXT	1 1

NOTE TO ALL "RIDS" RECIPIENTS:

PLEASE HELP US TO REDUCE WASTE! CONTACT THE DOCUMENT CONTROL DESK, ROOM P1-37 (EXT. 20079) TO ELIMINATE YOUR NAME FROM DISTRIBUTION LISTS FOR DOCUMENTS YOU DON'T NEED!

FULL TEXT CONVERSION REQUIRED  
 TOTAL NUMBER OF COPIES REQUIRED: LTR 28 ENCL 28

A04

R  
I  
D  
S  
/  
A  
D  
D  
S  
/  
A  
D  
D  
S



FPL

P.O. Box 128, Ft. Pierce, FL 34954-0128

April 11, 1994

L-94-083  
10 CFR 50.73

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

Re: St. Lucie Unit 2  
Docket No. 50-389  
Reportable Event: 94-002  
Date of Event: March 16, 1994  
Pressurizer Instrument Nozzle Weld Cracking  
due to Fabrication Defects

The attached Licensee Event Report is being submitted pursuant to the requirements of 10 CFR 50.73 to provide notification of the subject event.

Very truly yours,

*DASager*  
D. A. Sager  
Vice President  
St. Lucie Plant

DAS/JWH/kw

Attachment

cc: Stewart D. Ebnetter, Regional Administrator, USNRC Region II  
Senior Resident Inspector, USNRC, St. Lucie Plant

DAS/PSL #1095-94

150001

94041B0036 940411  
PDR ADCK 05000389  
S PDR

an FPL Group company

IE22  
11

**LICENSEE EVENT REPORT (LER)**

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

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNB 7714), 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.

FACILITY NAME (1) <b>St. Lucie Unit 2</b>	DOCKET NUMBER (2) <b>05000389</b>	PAGE (3) <b>1 OF 5</b>
--	--------------------------------------	---------------------------

TITLE (4) **Pressurizer instrument nozzle weld cracking due to fabrication defects.**

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
03	16	94	94	--002--	0	04	11	94	N/A	
									N/A	

OPERATING MODE (9) <b>6</b>	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)									
POWER LEVEL (10) <b>0</b>	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)	OTHER						
	20.405(a)(1)(iii)	X 50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	(Specify in Abstract below and in Text, NRC Form 366A)						
	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 <b>John W. Harmon, Shift Technical Advisor</b>	TELEPHONE NUMBER (Include Area Code) <b>(407) 465-3550</b>
--	---

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE
B	AB	NZL	---	---					

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 16 March, 1994 Unit 2 was in mode 6 during a refueling outage. FPL Engineering personnel identified trace amounts of boric acid on the exterior of the Pressurizer steam space C instrument nozzle during an inspection. Subsequently, Quality Control (QC) personnel performed interior dye penetrant examination and identified unacceptable indications at the A, B and C steam space instrument nozzle welds. The D instrument nozzle weld was acceptable. The unacceptable weld indications were in the "J" weld between the alloy 690 nozzle and the clad on the inside of the Pressurizer.

The probable root causes of the condition include: 1) Usage of the Shielded Metal Arc welding process and I-182 filler material which is susceptible to Primary Water Stress Corrosion Cracking. 2) High residual stresses due to multiple nozzle rework and replacements performed in 1987 and 1993. 3) Less than optimum conditions for the welding process during interior Pressurizer repairs performed in 1993. Adverse conditions increased the likelihood of slag inclusions and lack of weld fusion.

The corrective actions: 1) FPL Engineering performed a root cause analysis on the condition. 2) A more suitable weld material will be used in repairing the steam space nozzles prior to unit restart. 3) The nozzle repair method will relocate the welds to the exterior of the pressurizer and away from the high residual stress zones. 4) An automated welding machine will be used in the repair efforts. 5) Mechanical Maintenance will coordinate the inspections and repair efforts performed by a contractor with experience in this technique.

**LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION**

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), 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.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
St. Lucie Unit 2	05000389	94	--002--	0	2 OF 5

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

**DESCRIPTION OF THE EVENT**

On 16 March, 1994, Unit 2 was in mode 6 during a scheduled refueling outage. On that day, FPL Engineering personnel identified trace amounts of boric acid on the exterior of the Pressurizer (EIIS:AB) steam space C instrument nozzle during an unrelated inspection of the Pressurizer safety valve nozzles. To further investigate the source of the boric acid, Utility and Contractor Quality Control (QC) personnel performed dye penetrant examinations and identified unacceptable indications at the A, B and C steam space instrument interior nozzle welds. The unacceptable weld indications were randomly oriented in "J" welds between the alloy 690 nozzle and the cladding on the inside of the Pressurizer. The D instrument nozzle "J" weld was found to be acceptable. Only the C instrument nozzle was noted to exhibit signs of through wall leakage.

The Pressurizer consists of a carbon steel vessel with a 304 stainless steel inner clad. These Pressurizer instrument nozzles are alloy 690 with a stainless steel safe end. The steam space nozzles were replaced with alloy 690 nozzles in 1993 due to the discovery of axial cracking in the previously used alloy 600 nozzles. The interior end of the nozzle was welded on the inside of the Pressurizer with a I-182 weld buttering over the exposed shell of the Pressurizer for compatibility. The weld process and material used during the 1993 nozzle replacement was a manual restoration of the interior J weld using a Shielded Metal Arc welding process with covered nickel base electrodes (I-182). The 1993 replacement was performed by Combustion Engineering with FPL oversight of the project. These steam space nozzles were also previously replaced in 1987 in response to the discovery of cracked nozzles at San Onofre in 1986.

**CAUSE OF THE EVENT**

The probable root causes of the through wall leakage for the C instrument nozzle weld and unacceptable indications in the A, B, and C welds were fabrication deficiencies which encompass slag inclusions and lack of fusion in combination with Primary Water Stress Corrosion Cracking (PWSCC) of the weld material. Specifically: 1) The Shielded Metal Arc welding process and I-182 filler material (alloy 600 equivalent) used during the 1993 repairs are susceptible to PWSCC. However, this was the only weld process available from Combustion Engineering during the 1993 repairs. 2) There were high residual stresses in the nozzle area due to multiple nozzle rework and replacements performed in 1987 and 1993. During the repair in 1993 the initial weld installation had to be reworked. 3) Less than optimum working conditions existed during repairs inside the Pressurizer performed in 1993. The Pressurizer is a confined space and required preheating of the nozzle areas resulted in high temperatures and high humidity. The general area radiation field was 50 millirem per hour and the workers were utilizing bubble hoods and respirators during the repair. These adverse environmental factors increase the likelihood for fabrication defects such as slag inclusion and lack of weld fusion.

NRC FORM 366A (5-92)

**LICENSEE EVENT REPORT (LER)**  
**TEXT CONTINUATION**

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), 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.

FACILITY NAME (1)		DOCKET NUMBER (2)		LER NUMBER (6)			PAGE (3)
St. Lucie Unit 2		05000389		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	3 OF 5
				94	--002--	0	

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

**ANALYSIS OF THE EVENT**

The leakage at the C instrument nozzle weld material is conservatively estimated to have been present prior to the scheduled refueling outage of Unit 2. The nozzle weld leak is considered Reactor Coolant System (RCS) (EIIS:AB) Pressure Boundary Leakage. Therefore, this event is reportable as any operation or condition prohibited by Technical Specifications under 10CFR50.73.a.2.i.B. Technical Specification 3.4.6.2 does not allow continued operations with any Pressure Boundary Leakage. The leakage at the C instrument nozzle weld was extremely small. RCS inventory balances performed during unit operation since the 1993 refueling outage documented less than 1 gallon per minute unidentified leakage which is within Technical Specification limits. The leakage was not present immediately after the 1993 repair as demonstrated by final dye penetrant examinations of the J welds and an acceptable in service leak test.

Three alloy 600 nozzles remain installed in the water space of the Pressurizer in Unit 2, and four steam space and three water space alloy 600 nozzles remain in the Pressurizer in Unit 1. These I-182 nozzle welds are considered to be much less susceptible to PWSCC failure for the following reasons. The Unit 1 Pressurizer nozzle welds are all original factory installations and are subject to lower residual stresses due to high temperature annealing and hydrostatic testing. Two of the Unit 2 Pressurizer water space nozzle welds are shop installations with the same benefits as the Unit 1 Pressurizer. The remaining water space nozzle was previously replaced with an outside surface repair using an automatic Gas Tungsten Arc welding process with an I-82 weld metal (with greater resistance to PWSCC than I-182).

The instruments associated with the C nozzle tap includes the C Reactor Protection System (RPS) (EIIS:JC) RCS pressure channel, the C Engineering Safety Features (EIIS:JE) RCS pressure instrumentation and various control grade instrumentation. The quantity of the leakage was not significant enough to adversely affect the operability of any of these instruments as compared in daily channel checks to the three other independent instrument channels.

FPL Engineering has affirmed that Combustion Engineering Owners Group's (CEOG) evaluation (CEOG Task No. 634) bounds this type of weld cracking. The analysis concludes that PWSCC will be confined to slowly increasing leak rates in the fraction of a gallon per minute range. A progressive leak would be detected by routine RCS inventory balance, various RCS leak detection systems, or by refueling outage inspections. Circumferential cracking of the nozzle would be of greater concern as it could lead to a guillotine break or nozzle ejection. However, in this case the observed weld indications in the nozzles would not allow nozzle ejection because significant portions of the weld material would remain attached to the nozzle and would provide a mechanical restraint preventing nozzle ejection through the close tolerance fit Pressurizer shell penetration.

Therefore the health and safety of the public were not affected by this event.

LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

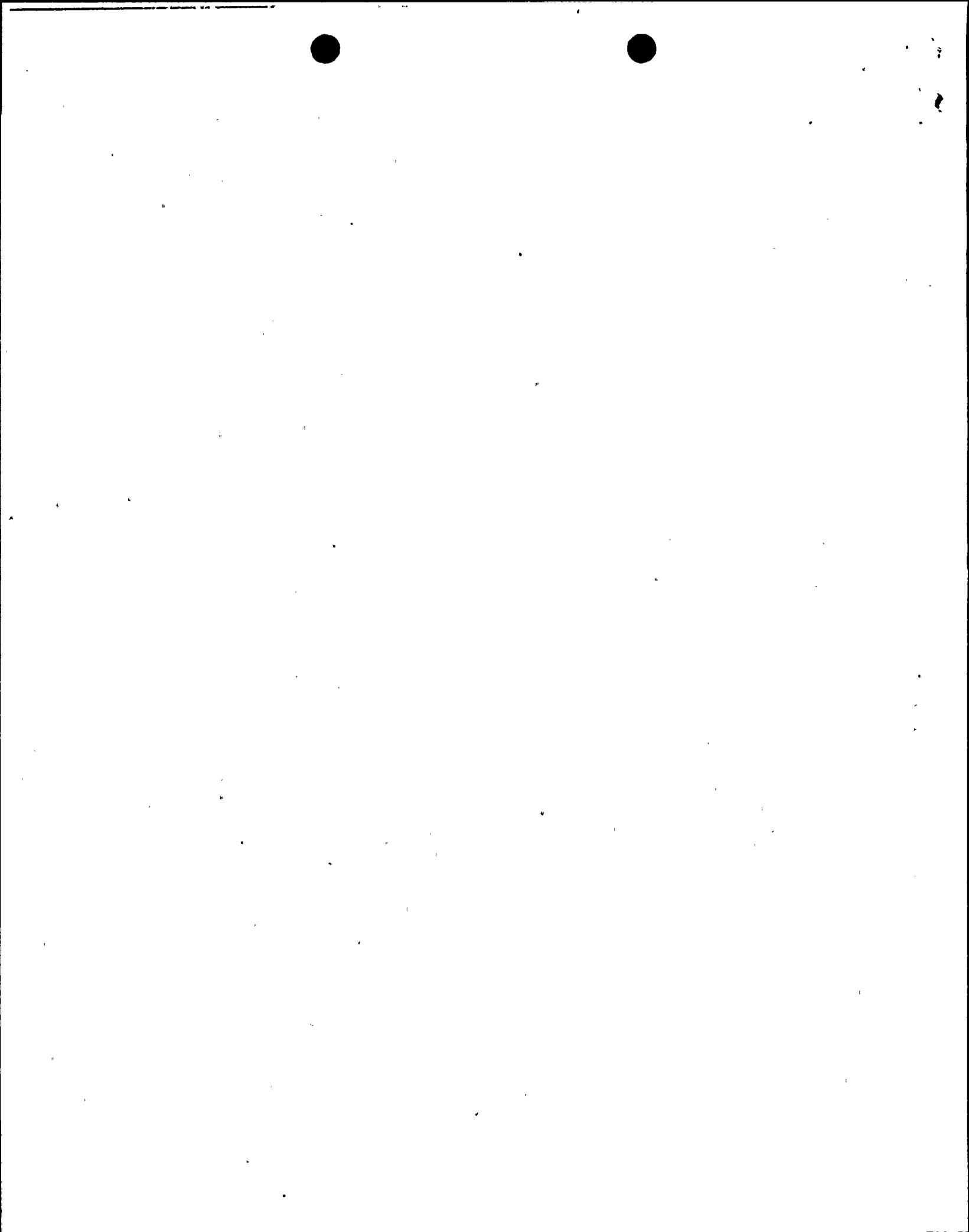
ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
St. Lucie Unit 2	05000389	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	4 OF 5
		94	--002--	0	

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

CORRECTIVE ACTIONS

- 1) FPL Engineering performed a root cause analysis on the weld defects, the conclusions of which are included in this LER.
- 2) FPL Engineering developed Plant Change Modification (PCM) 038-294 for the repair of all four steam space instrument nozzles. These modifications will be completed prior to the startup of Unit 2.
- 3) Repairs will be made using an automated Gas Tungsten Arc welding process with a EN-52 weld metal. (ASME Code Case 2142.) EN-52 is an alloy 690 equivalent and is resistant to PWSCC. This process should provide a slag free weld with less tendency for lack of fusion as compared to the manual Shielded Metal Arc weld process.
- 4) Mechanical Maintenance will coordinate the inspections and repair efforts performed by contractor personnel, Welding Services Inc.
- 5) An alternate design will be used in the repair which relocates the four steam space instrument nozzle weld joints to the pressurizer outside surface. The weld joints were previously on the inside surface. An outside surface weld will not be subject to the high residual stress zones on the interior surface caused by previous nozzle replacements in 1987 and 1993. This technique has been successfully employed on a previous repair to Pressurizer water space and RCS nozzles.
- 6) The outside surface repair will address the poor environmental conditions present during the interior Pressurizer shell repair in 1993. By virtue of an outside repair, radiation exposure, heat and humidity will be reduced for the personnel performing the repair. Additionally, the automated welding machine will further minimize personnel exposure to these elements and minimize the likelihood of weld fabrication defects.
- 7) The modification will result in the instrument nozzles in the penetrations being in two segments. The existing internal J welds and split nozzle segments are not being removed. This separation of the nozzles will allow for thermal expansion.
- 8) FPL Engineering performed a Fracture Mechanics Analysis to ensure the acceptability of interior weld cracking for the next fuel cycle of operation. The internal J weld will no longer be part of the Pressurizer pressure boundary. Instead, the external weld repair on all four of the instrument nozzles will be the new pressure boundary.
- 9) FPL Engineering will continue with the RCS nozzle inspection program on both units, and review that program for possible enhancements. During this Unit 2 refueling outage, 64 RCS and Pressurizer alloy 600 nozzles were visually inspected and found to be satisfactory.



LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNNB 7714), 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.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)		PAGE (3)
St. Lucie Unit 2	05000389	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER
		94	--002--	0
5 OF 5				

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

CORRECTIVE ACTIONS (continued)

10) A description of this event will be shared with the industry via an entry onto the INPO Nuclear Network.

ADDITIONAL INFORMATION

Failed Component

Component: 1" Instrument nozzle "J" weld  
 Location: Upper Pressurizer Steam Space  
 Material Type: I-182 filler material (alloy 600 equivalent)  
 Weld Process: Shielded Metal Arc, temper bead (manual)  
 Interior Clad: 304 Stainless Steel  
 Nozzle Material: Alloy 690

Previous Similar LERs

LER 389-93-004 "Pressurizer Instrument Nozzle Leakage due to Primary Water Stress Corrosion Cracking"



