CATEGORY 1

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FACIL:50-389 St. Lucie Plant, Unit 2, Florida Power & Light Co. 05000389
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FREHAFER,K.W. Florida Power & Light Co.
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RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 99-003-00:on 990406,ECCS suction header leak resulted in both EECS trains being inoperable & entry into TS 3.0.3. Caused by chloride induced OD stress corrosion cracking of piping.Made Code repairs & coated piping.With 990506 ltr.

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Florida Power & Light Company, 6351 S. Ocean Drive, Jensen Beach, FL 34957

May 6, 1999

L-99-109
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: 1999-003-00
Date of Event: April 6, 1999
ECCS Suction Header Leaks Result in Both
ECCS Trains Inoperable and TS 3.0.3 Entry

The attached Licensee Event Report 1999-003 is being submitted pursuant to the requirements of 10 CFR § 50.73 to provide notification of the subject event.

Very truly yours,

J. A. Stall
Vice President
St. Lucie Nuclear Plant

JAS/EJW/KWF
Attachment

cc: Regional Administrator, USNRC Region II
Senior Resident Inspector, USNRC, St. Lucie Nuclear Plant

1/1
IE22

NRC FORM 366 (6-1998) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 06/30/2001

Estimated burden per response to comply with this mandatory information collection request: 50 hrs. Reported lessons learned are incorporated into the licensing process and fed back to industry. Forward comments regarding burden estimate to the 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. If an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

LICENSEE EVENT REPORT (LER)

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

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TITLE (4)

ECCS Suction Header Leaks Result in Both ECCS Trains Inoperable and TS 3.0.3 Entry

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
04	06	1999	1999	- 003 -	00	05	06	1999	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	1
POWER LEVEL (10)	100

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

20.2201(b)		20.2203(a)(2)(v)	X	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)	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)
Kenneth W. Frehafer, Licensing Engineer	(561) 467 - 7748

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
B	BP	N/A	N/A	NO	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

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 April 6, 1999, St. Lucie Unit 2 was in Mode 1 operation at 100 percent reactor power. While performing a periodic inspection of the Unit 2 emergency core cooling system suction piping, FPL non-licensed personnel identified evidence of through wall leakage in both ECCS trains.

Both trains of the emergency core cooling system suction piping were declared out of service at 1110 hours and a Technical Specification 3.0.3 shutdown was initiated. Based on subsequent NRC verbal agreement that Class 3 flaw evaluations can be applied to operability evaluations for moderate energy Class 2 piping, FPL declared both trains of ECCS piping operable, Technical Specification 3.0.3 was exited, and the Unit 2 downpower was terminated at approximately 28 percent reactor power at 1640 hours. On April 7, 1998, FPL submitted a formal relief request from the immediate repair/replacement requirements of Section XI of the ASME Boiler and Pressure Vessel Code. Code Repairs were completed by April 16, 1999.

The through wall piping defects were caused by chloride induced OD stress corrosion cracking of the piping.

Corrective actions include the Code repairs, pipe coatings, and periodic inspection of the subject piping until the piping is replaced during the next scheduled refueling outage.

Description of the Event

On April 6, 1999, St. Lucie Unit 2 was in Mode 1 operation at 100 percent reactor power. While performing a periodic inspection of the Unit 2 emergency core cooling system (ECCS) suction piping [EIIS:BP], FPL non-licensed personnel identified evidence of through wall leakage in both ECCS trains. The through wall leaks on both ECCS trains were located within the refueling water storage tank (RWT) trench that is open to the atmosphere. The leak rates were extremely small and not quantifiable; they were discovered by the presence of boric acid crystals on the pipe.

Since through wall leakage was identified, an operability determination was required. Generic Letter (GL) 91-18, Rev. 1, "Information to Licensees Regarding NRC Inspection Manual Section on Resolution of Degraded and Nonconforming Condition," contains guidance for resolution of degraded and nonconforming conditions and operability determination. Per this Generic Letter and the NRC Inspection Manual, Part 9900, section 6.15, Operational Leakage, leakage though Class 1, 2 or 3 pipe wall is not acceptable for continued operation (except in the case of moderate energy Class 3 piping in accordance with Generic Letter 90-05). Because of this, the Class 2 ECCS suction piping was declared inoperable. The plant declared both trains of the ECCS suction piping out of service (OOS) at 1110 hours. In accordance with TS 3.5.2, the plant had no action statement for the loss of two independent ECCS subsystems. Therefore the control room entered Applicability Specification 3.0.3, with the action to place the unit in a mode in which the specification does not apply, and a unit shutdown was initiated. A 10 CFR 50.72 phone call was made to the NRC Operations Center.

The through wall leaks were identified in piping lines I-24"-CS-3 (Train A) and I-24"-CS-2 (Train B) that are connected to a single nozzle on the RWT and provide suction for the ECCS systems. The piping design pressure is 60 psig at 300°F, with an operating pressure of 30 psig at 120°F. The pipe is 24" schedule 10 (wall thickness of 0.250"). Lines I-24"-CS-2 and -3 are designed in accordance with ASME Section III, Class 2 requirements and are constructed of ASTM A-358, Class 1, Type 304 stainless steel material.

In a subsequent phone call between the NRC and FPL, the NRC agreed that the GL 91-18 Class 2 through wall leak limitation in section 6.15 can be relaxed such that Class 3 flaw evaluations could be applied to moderate energy Class 2 piping operability evaluations (e.g., licensees could substitute the words "Class 2" for "Class 3" in piping flaw characterizations conducted in accordance with GL 90-05). Based on a bounding flaw analysis for the Class 2 moderate energy piping, FPL subsequently concluded that both ECCS trains were operable and declared both trains of ECCS back in service. Technical Specification 3.0.3 was exited and the Unit 2 downpower was terminated at approximately 28 percent reactor power at 1640 hours.

FPL committed to submit a formal relief request in 24 hours, which was submitted to the NRC on April 7, 1999 by FPL letter L-99-90. In lieu of an immediate ASME Section XI Code repair and/or replacement, FPL proposed alternative actions that applied NRC GL 91-18, NRC GL 90-05, and ASME Code Case N-513 for moderate energy Class 3 piping to the operability assessment of the ASME Class 2 ECCS suction piping. These alternative actions ensured that the subject ECCS piping met all applicable design bases structural requirements with the identified through wall leaks. Consistent with these requirements, the following actions were implemented:

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Description of the Event (cont'd)

1. To confirm analysis conditions remained bounded, augmented daily visual examinations of the affected areas of the piping were performed.
2. The flaw geometry was characterized to the extent practical by volumetric examination and physical measurement.
3. A flaw evaluation was performed to ASME Section XI, Appendix C, methods and acceptance criteria.
4. FPL committed that the required ASME Code repair/replacement activities would be completed by April 21, 1999.

The restoration work consisted of the installation of 2 and 3 inch branch connections at the locations of through wall indications. Indications that were not through wall were repaired by grinding out the indication leaving sufficient pipe wall to meet the minimum wall criteria. In accordance with the commitments that were made to the NRC in the phone call on April 6 and the terms of the formal relief request, the A train ECCS header was declared OOS and repaired between April 8 and April 10. The B train header was declared OOS on April 14, 1999 and the repairs completed on April 16, 1999.

Cause of the Event

FPL determined that the highly branched, O.D. initiated, through-wall cracks were typical of chloride induced OD stress corrosion cracking (ODSCC) of A-358, Class 1, Type 304 SS material. With any SCC mechanism, there are three requirements for cracking to occur: 1) a susceptible material, 2) a tensile stress; and, 3) an environment with a contaminant (for example, the chloride in salt air). Although chloride SCC does not typically occur at temperatures below 140°F, an elevated stress condition can lower this temperature "threshold". This explains why indications at the field welds were more severe than those in the rolled and axial welded pipe that was solution annealed.

As a countermeasure to the O. D. initiated, chloride induced stress corrosion cracking (SCC) in the Unit 2 ECCS piping (304 SS), Carboline 890 coating will be applied to the weld regions of the pipe's external surface. The application of the Carboline 890 coating to the weld regions should minimize the propagation of existing SCC flaws and prevent the initiation of new ones. The coatings should eliminate or greatly minimize the levels of chlorides, oxygen and moisture in contact with the susceptible regions of the pipe's external surface.

Analysis of the Event

NUREG-1022, Revision 1, "Event Reporting Guidelines 10 CFR 50.72 and 73," Section 3.2.2 states that entry into Technical Specification 3.0.3 is considered to be the action taken, as required, when operations or conditions required by Technical Specification LCO action statements are not met. Thus, entry into Technical Specification 3.0.3 for any reason or justification is reportable. Therefore, this event is reportable pursuant to 10 CFR 50.73(a)(2)(i)(B) as "any operation or condition prohibited by the Plant's Technical Specifications." The plant shutdown was initiated but not completed, therefore this event is not reportable under 10 CFR 50.73(a)(2)(i)(A).

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Analysis of Safety Significance

Design Bases

The subject RWT suction piping provides a flow path from the RWT to the ECCS pumps for use during the injection phase following a design basis accident. This function is safety related and is addressed in the plant's UFSAR and Technical Specifications. As discussed in Unit 2 UFSAR Section 6.3.2.2.4, the RWT is an atmospheric tank containing water borated between 1720 and 2100 ppm. Redundant lines are provided from a single nozzle on the tank to provide suction to the A and B Trains of ECCS pumps located in the reactor auxiliary building (RAB). The suction lines are routed to the RAB in a below grade trench which is open to the atmosphere.

Per Technical Specification 3.5.2, in Modes 1, 2, and 3 (with pressurizer pressure greater than or equal to 1750 psia), two independent ECCS subsystems shall be OPERABLE with independent flow paths capable of taking suction from the RWT. Per Technical Specification 3.5.3, in Mode 3 (with pressurizer pressure less than 1750 psia) and Mode 4, a minimum of one ECCS subsystem shall be OPERABLE with a flow path to the RWT.

Per Technical Specification 3.1.2.1, in Modes 5 and 6, a minimum of one boron injection flow path shall be OPERABLE which includes a flow path from the RWT via either a charging pump or a high pressure safety injection pump, meeting the requirement in Technical Specification 3.1.2.7b if only the RWT flow path is OPERABLE.

The RWT suction lines must be able to pass design flow at a design pressure of 60 psig and a design temperature of 300°F to the ECCS pumps and have the ability to maintain the pressure boundary. Operating pressures are defined by the column of water within the RWT tank and operating temperatures are defined by atmospheric conditions.

Unit 2 is currently in the Second Ten Year In-Service Inspection (ISI) Interval. The Code of record for Rules for In-Service Inspection in this interval is ASME Section XI, 1989.

Evaluation

This LER addresses through wall leaks on ECCS A Train suction line I-24"-CS-3 near a tack weld for the spool nameplate between supports 2412-23 and 2412-20 and on B Train suction line I-24"-CS-2 adjacent to supports 2407-17 and 2407-19 within the RWT trench. An additional through wall indication was later identified on Train B at FW 1 near support 2407-12. Degradation of the ECCS suction lines on both Units 1 and 2 has been previously identified and dispositioned under a number of previous Condition Reports (CRs).

An FPL evaluation was issued in November 1998 to review the condition of the Unit 2 RWT suction lines. This evaluation developed the system piping design requirements, summarized past identification of indications and examination results, and identified the failure mechanism as chloride induced O.D. stress corrosion cracking. The evaluation developed a method for accepting the identified flaws for limited continued operation based on the acceptance by evaluation rules of the ASME Section XI Code and demonstrated that the piping is suitable for operation until the Cycle 12 refueling outage.

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Analysis of Safety Significance (cont'd)

A vendor prepared analysis determined the allowable through wall flaw lengths and expected service life of ECCS supply piping subject to corrosion on the outside surface. The allowable flaw length is based on the acceptance criteria of ASME Section XI, IWB-3640 for all design loading conditions and concluded that the allowable flaw length for postulated through wall cracks is 32.2 inches for circumferential flaws and 13.6 inches for axial flaws. As a result, the structural integrity of the piping for all design loads is adequate per ASME Section XI IWC-3122.4 acceptance by evaluation criteria, provided that postulated flaws are detected prior to their length exceeding the above size criteria.

To provide for the required detection, monthly inspections of the subject piping are conducted to look for through wall leakage. Experience indicates that flaws do not grow to significant lengths relative to the critical flaw dimensions prior to their propagation through wall. Experience also indicates that through wall flaws result in small, but detectable, leaks. Accordingly, the analysis requires monthly surveillances of the subject piping runs to detect through wall leakage. It was under this inspection surveillance that the boric acid crystals were identified on both I-24"-CS-2 and I-24"-CS-3. The leak rates were extremely small and not quantifiable.

The indications identified above are bounded by the previous analyses. For an initial flaw length of 1.18 inches, for the referenced ECCS piping, the acceptable service life would be 5.4 years. The through wall crack on I-24-CS-3 was identified as a series of cracks with a total length of 1.5 inches. The indications were removed and the pipe restored with the installation of 2 inch branch connections. The maximum through wall indication length on B train was 2.75 inches. An initial flaw of this length would provide an expected service life of 1200 days which is well in excess of the time until the next refueling outage (360 days). FPL has committed to replacing this pipe at the next scheduled refueling outage.

The basis for continued operation of St. Lucie Unit 2 ECCS piping is based on the determination of the stable through wall flaw length. The analysis recognizes that the calculated stable flaw length is well in excess of any flaw length likely to be observed in the field prior to identification by leakage. Empirical evidence indicates that through wall flaws with very small, non-quantifiable leak rates are readily detected by the accumulation of boric acid crystals. To augment detection, monthly inspections of the subject piping, as required by the analysis, are performed in accordance with PM 07-9308.

The application of the Carboline 890 coating to the weld regions should minimize the propagation of existing SCC flaws and prevent the initiation of new ones. There are not any known adverse effects of the proposed coating application. The evaluation recognizes that not all axial and circumferential welds within the I-24"-CS-2 and CS-3 lines have been penetrant inspected. Should flaws be present in these areas, they are and will remain bounded by the evaluation made under Section XI criteria. An inspection will be performed after final preparation for coating to ensure that through wall leaks are not present.

The coating will not interfere with the intent of the monthly inspections. These inspections are performed tc identify through wall leaks thus verifying that a critical length flaw is not present in the ECCS suction piping. As demonstrated by

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Analysis of Safety Significance (cont'd)

the indications identified in this LER, through wall leaks act as telltale indications of pipe flaws well below the critical lengths (32.2 inches circumferential and 13.6 inches axial). Leakage due to pipe flaws significantly smaller than these critical lengths would still be visibly evident with the application of the specified coatings. If exposed to a through wall leak, the coating will blister, then crack, and allow discovery. The inspection instructions will be revised to include the presence of blisters in the pipe coating as indication of potential through wall leakage. Any blisters that do form after the initial coating will be removed and examined for indication of through wall leakage. As such, the application of coating is consistent with the actions prescribed by the analyses.

Conclusion

Based on the above, the presence of through wall leakage on the St. Lucie Unit 2 ECCS suction piping had no adverse effect on the health and safety of the public. The flaws were bounded by analysis, and the piping remained operable during the repair activities. Periodic inspections will ensure that the condition of the piping remains bounded by the current analysis.

Corrective Actions

1. The through wall pipe indications and any adjacent indications have been reworked by the installation of branch connections, and additional adjacent indications removed under work orders WO 99006555 and 99006559. The final NDE reports for the repaired areas confirmed that these repairs restored the piping to an ASME Section XI acceptable configuration.
2. Planned maintenance change requests (PMCRs) to PM 07-600 (Unit 1) and PM 07-9308 (Unit 2) were processed to revise the monthly inspection instructions to include the presence of blisters in the pipe coating as indication of potential through wall leakage. Blisters will be removed and examined for indication of through wall leakage.
3. Accessible susceptible pipe areas (e.g., welds) for CS-2 and CS-3 were coated in accordance with work order WO 99001881.
4. The subject St. Lucie Unit 2 ECCS suction piping will be replaced during the next refueling outage (SL2-12).

Additional Information

Failed Components Identified

Components: ECCS suction piping

Material: ASTM A-358, Class 1, Type 304 stainless steel

Similar Events

None