



MAY 0 2 2017

L-2017-084
10 CFR 50.73

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

Re: St. Lucie Unit 1
Docket No. 50-335
Reportable Event: 2017-001-01
Date of Event: January 31, 2017
Reactor Coolant Pressure Boundary Leak on the 1B2 Reactor Coolant
Pump Lower Seal Heat Exchanger

Revision 1 to Licensee Event Report 2017-001 is being submitted pursuant to the requirements of 10 CFR 50.73 to provide notification of the subject event.

Respectfully,

A handwritten signature in blue ink that reads "Daniel DeBoer".

Daniel DeBoer
Site Director
St. Lucie Plant

DD/KWF

Attachment

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



LICENSEE EVENT REPORT (LER)
(See Page 2 for required number of digits/characters for each block)

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the FOIA, Privacy and Information Collections Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to Infocollects.Resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose 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.

1. FACILITY NAME St. Lucie Unit 1	2. DOCKET NUMBER 05000335	3. PAGE 1 Of 3
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4. TITLE
Reactor Coolant Pressure Boundary Leak on the 1B2 Reactor Coolant Pump Lower Seal Heat Exchanger

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
1	31	2017	2017	001	1	05	02	2017	FACILITY NAME	DOCKET NUMBER
										05000
										05000

9. OPERATING MODE **11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)**

3	<input type="checkbox"/> 20.2201(b)	<input type="checkbox"/> 20.2203(a)(3)(i)	<input checked="" type="checkbox"/> 50.73(a)(2)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(viii)(A)
	<input type="checkbox"/> 20.2201(d)	<input type="checkbox"/> 20.2203(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(ii)(B)	<input type="checkbox"/> 50.73(a)(2)(viii)(B)
	<input type="checkbox"/> 20.2203(a)(1)	<input type="checkbox"/> 20.2203(a)(4)	<input type="checkbox"/> 50.73(a)(2)(iii)	<input type="checkbox"/> 50.73(a)(2)(ix)(A)
	<input type="checkbox"/> 20.2203(a)(2)(i)	<input type="checkbox"/> 50.36(c)(1)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)
10. POWER LEVEL 0	<input type="checkbox"/> 20.2203(a)(2)(ii)	<input type="checkbox"/> 50.36(c)(1)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(v)(A)	<input type="checkbox"/> 73.71(a)(4)
	<input type="checkbox"/> 20.2203(a)(2)(iii)	<input type="checkbox"/> 50.36(c)(2)	<input type="checkbox"/> 50.73(a)(2)(v)(B)	<input type="checkbox"/> 73.71(a)(5)
	<input type="checkbox"/> 20.2203(a)(2)(iv)	<input type="checkbox"/> 50.46(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(v)(C)	<input type="checkbox"/> 73.77(a)(1)
	<input type="checkbox"/> 20.2203(a)(2)(v)	<input type="checkbox"/> 50.73(a)(2)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(v)(D)	<input type="checkbox"/> 73.77(a)(2)(i)
	<input type="checkbox"/> 20.2203(a)(2)(vi)	<input checked="" type="checkbox"/> 50.73(a)(2)(i)(B)	<input type="checkbox"/> 50.73(a)(2)(vii)	<input type="checkbox"/> 73.77(a)(2)(ii)
		<input type="checkbox"/> 50.73(a)(2)(i)(C)	<input type="checkbox"/> OTHER Specify in Abstract below or in NRC Form 366A	

12. LICENSEE CONTACT FOR THIS LER

LICENSEE CONTACT K. W. Frehafer	TELEPHONE NUMBER (Include Area Code) (772) 467-7748
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13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
B	AB	HX	N383	Y					

14. SUPPLEMENTAL REPORT EXPECTED <input type="checkbox"/> YES (If yes, complete 15. EXPECTED SUBMISSION DATE) <input checked="" type="checkbox"/> NO	15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

On January 31, 2017, while St. Lucie Unit 1 was shut down in Mode 3, technicians identified reactor coolant pressure boundary leakage within the 1B2 reactor coolant pump (RCP) lower seal heat exchanger. At 1200 hours, St. Lucie Unit 1 entered Technical Specification 3.4.6.2 Action a. and the plant was maneuvered to Mode 5 to affect repairs.

The most probable cause was determined to be a deficiency in the lower seal heat exchanger design which permitted stresses that approached or exceeded the yield strength of the assembly tubing during torqueing of the CCW flanges. The resultant plastic deformation and associated flaw formation caused low stress high cycle fatigue failure of the weld joint.

The flaw was removed and the weld repair was completed. St. Lucie Unit 1 was subsequently returned to service on February 7, 2017.

All remaining in-service and a spare RCP lower seal heat exchangers have since been inspected and no defects have been found. This event had no impact on the health and safety of the public.



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

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the FOIA, Privacy and Information Collections Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to Infocollects.Resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose 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.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER		
St. Lucie Unit 1	05000335	YEAR	SEQUENTIAL NUMBER	REV NO.
		2017	- 001	- 1

NARRATIVE

Description

On January 31, 2017, St. Lucie Unit 1 was shut down in Mode 3 for a maintenance outage to investigate and repair the source of reactor coolant system (RCS) [EIS:AB] leakage coming from the vicinity of the 1B2 reactor coolant pump [EIS:P] (RCP) seal [EIS:SEAL] package. At 1200 hours, technicians determined that the leak was located in the RCP lower seal heat exchanger [EIS:HX] and that the leakage was classifiable as reactor coolant pressure boundary leakage. St. Lucie Unit 1 entered Technical Specification (TS) 3.4.6.2 Action a. and the plant was maneuvered to Mode 5 to affect repairs. The 10 CFR 50.72(b)(3)(ii) notification was made at 1539 hours.

The flaw was removed and the weld repair was completed. St. Lucie Unit 1 was subsequently returned to service on February 7, 2017.

Cause of the Event

The most probable cause was determined to be a deficiency in the lower seal heat exchanger design which permitted stresses that approached or exceeded the yield strength of the assembly tubing during torquing of the CCW flanges. The resultant plastic deformation and associated flaw formation caused low stress high cycle fatigue failure of the weld joint.

All of the in-service and spare St. Lucie Unit 1 and 2 RCP lower seal heat exchangers have been inspected. These inspections did not find any deficiencies.

Analysis of the Event

This condition is being reported in accordance with 10 CFR 50.73(a)(2)(i)(B) as an operation or condition prohibited by TSSs, and 10 CFR 50.73(a)(2)(ii)(A) as a degraded or unanalyzed condition. Remote video analysis at power was inconclusive whether the leak was RCS pressure boundary. However, close visual inspection following unit shutdown determined the leak to be a small flaw in a RCS pressure boundary component (i.e. RCP seal cooler) which was a degraded condition prohibited by Technical Specifications.

The rotating assembly, the pump cover, and integral lower seal heat exchanger for the 1B2 RCP had been replaced during the previous refueling outage in the fall of 2016. The 1B2 RCP has an integral tube-in-tube heat exchanger which is permanently attached to the pump cover. This heat exchanger surrounds the labyrinth seal and provides cooling of the RCS water prior to entering the seal. This heat exchanger is comprised of two rows of six coils circling the RCP seal. The inner tube of the tube-in-tube configuration carries the high pressure RCS water. The outer tube carries the low pressure component cooling water (CCW) [EIS:CC]. RCS fluid enters the coils at the bottom of the assembly and exits the coils at the top of the assembly (one from the inside coil and one from the outside coil). The outlet of the coils is directed thru a machined elbow fitting welded to a short length of 1.5 inch diameter pipe, which carries the RCS flow to the seal housing and seal cartridge

The leak was located in the tube material near the toe of the partial penetration weld that joins the seal cooler inner tube and ring.

A review of the Unit 1 containment atmosphere particulate monitor and reactor cavity leakage flow instrument data indicates that RCS leakage from the 1B2 RCP lower seal heat exchanger was initiated on November 9-10, 2016, approximately 1 week after the 1B2 RCP had been started during startup from the fall 2016 refueling outage. The Unidentified RCS leak rate was closely monitored while a maintenance outage was planned to repair or replace the newly installed RCP seal package.



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NARRATIVE

Safety Significance

This condition was determined to be of very low safety significance for the following reasons:

- The maximum Unidentified RCS leak rate of 0.17 gpm was well within the capacity of the three charging [EII:CB] pumps (44 gpm each) [EII:P] which make up water volume to the RCS. RCS leak balances are normally calculated at once per day. Real time RCS leakage indications are detected through containment particulate radiation monitoring and cavity sump detection and may drive more frequent leakage calculations.
- The indication of RCS leakage approximately one week after pump start indicates that fatigue crack initiation and propagation through the inner tubing (0.125-inch min wall) occurred quite rapidly after pump start. Crack propagation appears to have slowed or arrested quickly as the total flaw length had only reached 15% of the inner tube's outer circumference approximately three months later. Such fatigue crack behavior is consistent with the postulated reduction in fatigue strength due to the presence of a residual stress. As the crack propagated, the residual stress was relieved and the positive mean stress reduced or eliminated. The applied cyclic loads associated with pump operation were insufficient to support continued crack propagation across the entire tubing cross section. The Unidentified RCS leak rate plateau during this period of time validates this observation. A Finite Element Analysis calculation was performed to confirm that the observed through wall crack would not propagate and leakage would remain within the capacity of the charging pumps.

Therefore, this event had no impact on the health and safety of the public.

Corrective Actions

1. The 1B2 RCP lower seal heat exchanger leak was repaired during the maintenance outage.
2. All remaining St. Lucie Unit 1 and 2 RCP lower seal heat exchangers were inspected and no other flaws were identified.
3. FPL is developing methods to reduce the stress on the RCP lower seal heat exchanger tubing during installation activities.

Failed Components Identified

Flowserve supplied RCP lower seal heat exchanger

Additional Information

The weld repair required relief from ASME Code requirements, and those details are documented in FPL letter L-2017-017 dated Feb 2, 2017, titled "In-service Inspection Plan Fourth Ten-Year Interval Unit 1 Relief Request No. 14, Revision 0," ADAMS accession number ML17033A151.