



DEC 26 2018

L-2018-236
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: 2018-001-00
Date of Event: October 29, 2018
Feedwater Heater Level Control Malfunctions Resulted In Lowering
Steam Generator Water Level and Manual Reactor Trip

Licensee Event Report 2018-001 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, reading 'Daniel DeBoer', is positioned below the word 'Respectfully,'.

Daniel DeBoer
Site Director
St. Lucie Plant

DD/KWF

Attachment

cc: St. Lucie NRC Senior Resident Inspector
St. Lucie NRC Program Manager



LICENSEE EVENT REPORT (LER)

(See Page 2 for required number of digits/characters for each block)

(See NUREG-1022, R.3 for instruction and guidance for completing this form
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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 Infocollections.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 4

4. TITLE

Feedwater Heater Level Control Malfunctions Resulted In Lowering Steam Generator Water Level and Manual Reactor Trip

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
10	29	2018	2018	001	0	12	26	2018	n/a	05000
									n/a	05000

9. OPERATING MODE

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

1	<input type="checkbox"/> 20.2201(b)	<input type="checkbox"/> 20.2203(a)(3)(i)	<input 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 checked="" type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)
100	<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 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, Licensing Engineer

TELEPHONE NUMBER (Include Area Code)

(772) 467-7748

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO ICES	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO ICES
X	SM	LC	F130	Y	E	SM	LC	F130	Y

14. SUPPLEMENTAL REPORT EXPECTED

☐ YES (If yes, complete 15. EXPECTED SUBMISSION DATE) ☒ NO

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR

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

On October 29, 2018, St. Lucie Unit 1 was in Mode 1 at 100 percent reactor power. At 1258 hours the control room was alerted to abnormal water levels in the 4B feedwater heater. Troubleshooting was unable to determine the cause and at 1304 hours the 1B steam generator water level began to decrease. The operators initiated a rapid downpower at 1308 hours. At 1317 hours the operators executed a manual reactor scram due to 1B steam generator water level approaching procedural limits.

Malfunctioning feedwater heater system controllers caused the inadequate main feedwater flow and loss of steam generator water level. Legacy foreign material was removed from the 4B feedwater heater normal drain valve controller restoring that component to service; remaining susceptible controllers will be visually inspected for foreign material. Preventative maintenance practices allowed abnormal wear on the normally closed 4B feedwater alternate drain valve controller and the controller was replaced; preventative maintenance practices are being revised to account for this failure mechanism.

The operators and plant responded as trained and designed for the feedwater system failures. The resultant trip was uncomplicated and plant risk remained green. There was no adverse effect on the health and safety of the public.

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

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1. FACILITY NAME		2. DOCKET		6. LER NUMBER		
St. Lucie Unit 1		05000335		YEAR	SEQUENTIAL NUMBER	REV NO.
				2018	- 001	- 0

NARRATIVEDescription

On October 29, 2018, St. Lucie Unit 1 was in Mode 1 at 100 percent reactor power. At 0930 hours, the 1A moisture separator reheater (MSR) [EIS:MSR] and its associate drain collector tank [EIS:TK] were placed on the alternate level control [EIS:LCV] valve to facilitate calibration of instrumentation within the high pressure portion of the non-nuclear safety feedwater heater vent and drain (HVD) system [EIS:SN]. After the maintenance was complete at 1239 hours, the 1A MSR and 1A drain collector tank were returned to the normal level control valve using plant procedures. During the evolution operations department personnel monitored the 1A MSR and the 5B high pressure feedwater heater (FWH) [EIS:HX] parameters to ensure proper operation of the HVD system. By 1248 hours the 1A MSR and the 5B high pressure FWH parameters had normalized and the local field operators were released.

At 1258 hours the Unit 1 control room received annunciator F-26, "4B Feedwater Heater Level High/Low." The annunciator response procedure (ARP) was utilized and operators were dispatched to determine what conditions existed at the 4B low pressure [EIS:SM] feedwater heater. The 4B low pressure FWH level was reported to be oscillating. The normal level control valve appeared to be modulating but was not opening greater than 30-50 percent. The alternate level control valve was reported to be cycling directly between open and closed. At approximately 1303 hours the 1B main feedwater regulating valve (MFRV) [EIS:SJ:FCV] reached full open and at 1304 hours the 1B steam generator (SG) [EIS:SG] level began to slowly lower. Field operators were still relaying information on the 4B FWH at this time. Subsequently the unit supervisor and shift manager reached a decision and entered the rapid downpower procedure. At 1308 hours the instruction was given to commence emergency boration. At 1315 hours the rapid downpower was in effect and power was lowering. The 1B SG level continued to lower and at 1317 hours the 1B SG reached 50 percent narrow range level, at which point the reactor was manually tripped in accordance with procedure.

The reactor trip was uncomplicated and all safety systems operated as designed. The plant was stabilized in Mode 3 while the HVD system malfunction investigation continued.

The 4 hour NRC ENS notification for the actuation of the reactor protection system (RPS) while critical was completed at 1647 hours.

Cause of the Event

The reduced feedwater flow and lowering steam generator level was caused by the simultaneous malfunction of the 4B low pressure FWH normal and alternate level valve controllers [EIS:LC].

- The direct cause for the failure of the 4B FWH normal drain valve controller was legacy foreign material within in the level column. This foreign material obstructed the float arm and prevented proper level indication that ultimately affected the operation of the 4B FWH normal drain valve. The foreign material was removed, the level column was reinstalled, and proper operation of the valve controller was verified.
- The direct cause for the failure of the 4B FWH alternate drain valve controller was wear on the controller nozzle and flapper that prevented the controller from modulating as designed. The 4B FWH alternate drain valve controller was replaced. The #4 FWH control valve calibration preventative maintenance (PM) frequency was recently extended in 2015 based on its low duty cycle. However, this characterization failed to account for wear on the flapper and nozzle due to lack of modulation on a normally closed valve.

Analysis of the Event

This event is reportable under 10 CFR 50.73(a)(2)(iv)(A) as the manual actuation of the RPS.

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NARRATIVE

The non-nuclear safety HVD system has no safety functions and is designed to increase plant efficiency by increasing the temperature of the feedwater entering the steam generators. This is accomplished by pre-heating the condensate/feedwater using a series of heat exchangers called feedwater heaters. There are two FWH trains, each train has 5 FWHs. The feedwater heaters are tube and shell heat exchangers with sub-cooled condensate/feedwater flowing through the tubes and a saturated steam/water mixture on the shell side. The heat given up to the feedwater causes the steam to condense and collect in the bottom of the heater shell where it then "drains" to the next lower pressure heater. The drain flow is not contiguous from high temperature to low temperature heater and into the condenser. It is split in the middle of each train, with condensate from heaters #5, #4 and the drain cooler all being returned to the feedwater (tube-side) by the heater drain pumps. The condensate from heaters #3, #2, and #1 all ends up in the main condenser(s).

Heater level control is accomplished by the operation of level control valves specified as the normal and alternate drain valves. The normal drain valves maintain heater level by routing heater shell-side condensate to a downstream heater, or in the case of the #4 FWH, to its associated drain cooler tank. On above normal level, the alternate drain valves open and dump excess condensate directly into the main condenser.

The malfunction of the 4B FWH normal level controller prevented the normal level control valve from fully opening, reducing the drain cooler effluent flow to the main feedwater system. Additionally, as the 4B FWH shell side condensate level increased, the malfunction of the 4B FWH alternate level controller did not allow the alternate level control valve to modulate flow, so the valve went from full open to full close as the water level approached the water level control setpoints. The diversion of drain cooler flow from the feedwater system to the condenser resulted in the lowering SG water level.

The extent of condition evaluation results conclude that the Unit 1 and Unit 2 #1, #2, #3, and #4 FWHs use the same level controllers. The #1, #2, and #3 FWHs do not have a significant impact on heater drain pump performance or main feedwater pump performance and therefore, would not cause a similar result if they were to fail. The Unit 1 and Unit 2 #5 FWHs and the MSR drain collectors use digital controllers and are not susceptible to the same failure modes. Therefore the MSR, #5, #3, #2, and #1 FWH level controls are excluded from the extent of cause evaluations for the identified failure modes.

Based on the cause of the normal valve controller failure mode internal visual inspections of the normal level control valve controller level column for the Unit 1 4A FWH, Unit 2 4A FWH, and Unit 2 4B FWH will be performed to check for latent foreign material. Interim procedural controls are in place to enhance operator awareness of the issue until the inspections are complete.

Based on the cause of the alternate valve controller failure mode for the normally closed #4 FWH alternate drain valves, controller preventative maintenance calibration and overhaul frequencies have been increased from every 4 refueling outages to 1R (calibration) and 3R (overhaul).

Safety Significance

When the low pressure 4B FWH normal level control valve could not maintain level in the heater, the alternate level control valve oscillations diverted flow from the 4B heater drain pump directly to the condenser. This resulted in decreased feedwater flow and decreasing steam generator level. The lowering level quickly reached the 50 percent narrow range operating limit, necessitating a manual trip of Unit 1 per procedure. The trip was uncomplicated. The Unit 1 risk remained Green. Unit 1 remained offline for approximately 1 day to complete troubleshooting and recovery.

The HVD and the main feedwater systems do not perform a safety function in the delivery of feedwater flow and are not required to mitigate the consequences of a design basis accident. The auxiliary feedwater (AFW)

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NARRATIVE

system provides feedwater for accident mitigation and low power conditions. SG level was maintained post-trip such that AFAS did not actuate.

All safety related systems functioned as designed. There were no safety systems actuations as a result of the trip. Given the response of the plant and the actions taken, the health and safety of the public was not affected by this event.

Corrective Actions

1. Foreign material was removed from the 4B FWH normal drain valve controller and the calibration check was performed satisfactorily.
2. The 4B FWH alternate drain valve controller was replaced.
3. Internal visual inspections of the Unit 1 4A and Unit 2 4A and 4B FWRs normal drain valve controller level columns are scheduled.
4. Interim procedural controls are in place to enhance operator awareness of the issue until the inspections are complete.
5. Additional PM tasks on the Unit 1 and 2 #4 FWH alternate drain valve controllers will be added to perform the #4 FWH alternate level control valve controller calibration PM on a 1R frequency and overhaul PM on a 3R frequency.

Failed Components Identified

Tags: LC-11-18B1, (normal) level controller for LP heater 4B
LC-11-18B2, (alternate) level controller for LP heater 4B

Manufacturer: Fisher Controls

Model No.: 2502-259B

Similar Events

None