FPL

SEP 2 8 2017

L-2017-167
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: 2017-002-00
Date of Event: July 31, 2017
Inadequate Hot Leg Injection Procedure Results in Unanalyzed Condition

Licensee Event Report 2017-002 is being submitted pursuant to the requirements of 10 CFR 50.73 to provide notification of the subject event.

Respectfully,

Daniel DeBoer
Site Director
St. Lucie Plant

DD/KWF

Attachment

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

NRC FORM 366 (06-2016) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 10/31/2018

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.

LICENSEE EVENT REPORT (LER)

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

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
St. Lucie Unit 1	05000335	1 of 4

4. TITLE

Inadequate Hot Leg Injection Procedure Results in Unanalyzed Condition

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
										05000
7	31	2017	2017	002	0	09	28	2017	FACILITY NAME	DOCKET NUMBER 05000

9. OPERATING MODE	11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*			
1	☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
	☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☒ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
	☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
	☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
10. POWER LEVEL	☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
	☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
	☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(C)	☐ 73.77(a)(1)
100	☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(D)	☐ 73.77(a)(2)(i)
	☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(vii)	☐ 73.77(a)(2)(ii)
		☐ 50.73(a)(2)(i)(C)	☐ OTHER Specify in Abstract below or in NRC Form 366A	

12. LICENSEE CONTACT FOR THIS LER

LICENSEE CONTACT	TELEPHONE NUMBER *(Include Area Code)*
K. W. Frehafer – Licensing Engineer	(772) 467-7748

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
P	BP	NA	NA	Y					

14. SUPPLEMENTAL REPORT EXPECTED	15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
☐ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ☒ NO				

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

On July 31, 2017, FPL determined that the proceduralized manual actions to mitigate postulated electrical single failures in the St. Lucie Unit 1 hot leg injection (HLI) flow path were inadequate. Manual actions previously developed based on failure modes and effect analysis (FMEA) failed to identify the need to override open permissive interlocks in the HLI flowpath. The procedures were revised to account for the oversight, and a detailed FMEA was performed and enhancement opportunities were identified to be evaluated under the site corrective action program.

The safety significance for the additional jumper scope was bounded by previous evaluations. Therefore, this event had no significant impact on the health and safety of the public.

NARRATIVE

Description of the Event

On July 31, 2017, with St. Lucie Unit 1 in Mode 1 at 100 percent reactor power, it was determined that the proceduralized manual actions to mitigate postulated electrical single failures in the St. Lucie Unit 1 hot leg injection (HLI) flow path were inadequate. The existing procedures lacked actions to address the installation of jumpers required to defeat the reactor coolant system (RCS) pressure interlocks for valves V3481 and V3652 [EIIS:BP:V] when aligning the plant for HLI. The procedures were immediately revised to include the instructions necessary to restore power to the affected valves. The required 8-hour NRC ENS notification was completed at 1832 hours.

A more detailed failure modes and effects analysis (FMEA) was completed to assure no other issues; although enhancements to improve margin were identified, there were no further issues identified that would preclude HLI flow for all strategies.

Cause of the Event

The reason the HLI initiation procedures were inadequate was that the previous FMEA to open V3481 and V3652 to provide hot leg injection was incomplete. This cause is a legacy human performance error associated with the level of detail and rigor in the evaluation and documentation of the capability to provide hot leg injection. A contributing factor was that the control circuits for valves V3481 and V3652 are not typical; the interlocks that prevent opening the valves are not powered from the MCC for the valve actuator.

Analysis of the Event

Reporting Criteria

This condition is reportable pursuant to 10 CFR 50.73(a)(2)(ii)(B) as any event or condition that resulted in the nuclear power plant being in an unanalyzed condition that potentially degraded plant safety.

Background

Long-term core cooling and boron precipitation was identified during the initial licensing of St. Lucie Unit 1. Because the St. Lucie Unit 1 original design did not provide dedicated hot leg injection paths, St. Lucie Unit 1 was licensed to develop HLI procedures that utilized the existing low pressure safety injection (LPSI) and/or high pressure safety injection (HPSI) flow paths for hot leg injection.

There are five potential paths for implementing HLI. The preferred HLI flow path is to direct the discharge of one LPSI pump [EIIS:BP:P] through the 2-inch shutdown cooling (SDC) warm-up line to the opposite pump's suction line, and "backwards" through the suction line into the hot leg. The cold leg injection is via the normal HPSI pump [EIIS:BQ:P] operation. This flow path requires the opening of two motor operated valves (MOVs) in series to be successful; each valve is powered from a different electric bus.

Valves V3481 and V3652 are the cross-train powered SDC return isolation valves for the respective 1A and 1B SDC cooling loops. Loss of power scenarios were

mitigated by the contingency use and installation of staged electrical jumpers to provide power for these valves from the opposite train motor control center (MCC). However, the previous FMEA failed to identify that these valves' control circuits contain open permissive interlocks to prevent subjecting the lower pressure portion of the SDC system to the higher reactor coolant system (RCS) pressure. The FMEA performed for the 2011 LER failed to identify the need to defeat this interlock by installation of low voltage jumpers in the control room.

This condition is not applicable to St. Lucie Unit 2 as it has a dedicated HLI flow path as part of its original design.

Analysis of Safety Significance

The mechanism for potential boron precipitation is described in Unit 1 UFSAR Chapter 6 Appendix C. For a hot leg break, the injection flow passes from the cold legs, through the core, into the hot legs, and out the break. For a hot leg break, core heat removal is via forced flow of the injection water. In contrast, for a cold leg break, after the reflooding is completed, the hydraulic balance will cause most of the injection flow to spill out of the break - the only flow into the core will be that required to make-up for the boil-off in the core that removes the core decay heat. The boron problem arises only during a cold leg break; as borated injection flow enters the core, and only pure water (as steam) leaves the core, the boron concentration in the core region will continue to increase. Once the boron concentration exceeds the solubility limit the boron will precipitate and potentially challenge long-term core cooling capability. The solution to the potential problem is to achieve subcooled flow through the core: when boron in equals boron out, the concentration will not be increasing.

St. Lucie uses simultaneous hot and cold leg injection as the method to achieve forced flow through the core for long-term post-LOCA cooling. With simultaneous hot and cold leg injection, the recirculated sump fluid is injected into the hot legs as well as the cold legs. Regardless of break location, sufficient flow is delivered to provide heat removal and flush the core to prevent the concentration of boron from reaching the solubility limit.

The operators are procedurally required to initiate HLI within four to six hours post-accident.

If the loss of an electrical bus required the use of the proceduralized jumpers, the emergency response organization (ERO) problem solving teams in the technical support center (TSC) and emergency operation facility (EOF) would most likely diagnose and mitigate the open permissive interlock and initiate HLI within the required timeframe. The 2011 LER evaluated the safety significance for the use of knowledge-based instead of rule-based jumper installation, and the additional low voltage control circuit jumper scope identified in this LER does not materially affect the conclusions of the previous LERs. Based on these considerations, this event had no significant impact on the health and safety of the public.

LICENSEE EVENT REPORT (LER) CONTINUATION SHEET

1. FACILITY NAME	2. DOCKET	6. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
St. Lucie Unit 1	05000335	2017	- 002	- 0

NARRATIVE

Corrective Actions

The corrective actions listed have been entered into the site corrective action program (CAP). Any changes to the actions below will be processed in accordance with the CAP.

1. The additional jumper scope was added to the proceduralized manual actions for bypassing the de-energized interlocks for SDC suction valves.
2. A more detailed FMEA was completed and additional enhancements to improve margin were identified. These enhancements are being tracked in CAP.

Identified Failed Components

None

Additional Information

St. Lucie Unit 1 LERs 2011-003-00 (ADAMs accession number ML12023A003) and 2011-003-01 (ADAMs accession number ML12081A282) reported the use of unproceduralized manual actions to accomplish HLI.