DUKE ENERGY®

David S. Hoffman
Plant Manager
Shearon Harris Nuclear Power Plant
5413 Shearon Harris Road
New Hill, NC 27562-9300

10 CFR 50.73

June 28, 2022
Serial: RA-22-0154

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Shearon Harris Nuclear Power Plant, Unit 1
Docket No. 50-400/Renewed License No. NPF-63

Subject: Licensee Event Report 2022-003-00

Ladies and Gentlemen:

Duke Energy Progress, LLC, submits the enclosed Licensee Event Report 2022-003-00 in accordance with 10 CFR 50.73 for Shearon Harris Nuclear Power Plant, Unit 1 (HNP). On April 29, 2022, with HNP in Mode 1, the reactor was manually tripped due to degrading condenser vacuum. This event had no significance with respect to the health and safety of the public.

There are no regulatory commitments contained within this report.

Please refer any questions regarding this submittal to Sarah McDaniel at (984) 229-2002.

Sincerely,

David S. Hoffman

Enclosure: Licensee Event Report 2022-003-00

cc: J. Zeiler, NRC Senior Resident Inspector, HNP
M. Mahoney, NRC Project Manager, HNP
NRC Regional Administrator, Region II

NRC FORM 366 (08-2020) U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

(See Page 3 for required number of digits/characters for each block)
(See NUREG-1022, R.3 for instruction and guidance for completing this form
http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1022/r3/)

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 08/31/2023

1. Facility Name	2. Docket Number	3. Page
Shearon Harris Nuclear Power Plant, Unit 1	05000 400	1 OF 3

4. Title
Manual Reactor Trip due to Degrading Condenser Vacuum

5. Event Date			6. LER Number			7. Report Date			8. Other Facilities Involved	
Month	Day	Year	Year	Sequential Number	Revision No.	Month	Day	Year	Facility Name	Docket Number
04	29	2022	2022	- 003 -	00	06	28	2022		05000
									Facility Name	Docket Number
										05000

9. Operating Mode	10. Power Level
1	100

11. This Report is Submitted Pursuant to the Requirements of 10 CFR §: *(Check all that apply)*

10 CFR Part 20	☐ 20.2203(a)(2)(vi)	☐ 50.36(c)(2)	☑ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(A)	**10 CFR Part 73**
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.69(g)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(4)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(i)	**10 CFR Part 21**	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	☐ 73.77(a)(1)(i)
☐ 20.2203(a)(2)(ii)	☐ 21.2(c)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)	☐ 73.77(a)(2)(i)
☐ 20.2203(a)(2)(iii)	**10 CFR Part 50**	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)	☐ 73.77(a)(2)(ii)
☐ 20.2203(a)(2)(iv)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)	
☐ 20.2203(a)(2)(v)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)	

☐ **OTHER** (Specify here, in abstract, or NRC 366A).

12. Licensee Contact for this LER

Licensee Contact	Phone Number (Include area code)
Sarah McDaniel, Regulatory Affairs Engineer	(984) 229-2002

13. Complete One Line for each Component Failure Described in this Report

Cause	System	Component	Manufacturer	Reportable to IRIS		Cause	System	Component	Manufacturer	Reportable to IRIS
X	SH	ISV	C665	Y		B	SH	V	K116	Y

14. Supplemental Report Expected		15. Expected Submission Date	Month	Day	Year
☑ No	☐ Yes (If yes, complete 15. Expected Submission Date)				

16. Abstract (Limit to 1560 spaces, i.e., approximately 15 single-spaced typewritten lines)

On April 29, 2022, at 04:05 Eastern Daylight Time, with Shearon Harris Nuclear Power Plant, Unit 1 (HNP), in Mode 1 at 100 percent power, the reactor was manually tripped due to degrading condenser vacuum approaching the turbine trip setpoint. The trip was not complex, with all systems responding normally post-trip. The Reactor Protection System and Auxiliary Feedwater System actuated as designed. A monthly swap of the Main Condenser Air Removal System vacuum pumps (CVPs) was in progress at the time of this event. When the 'B' CVP was secured, the suction isolation valve, 1AE-16, and the 'B' CVP discharge check valve, 1AE-19, failed to close, resulting in a rapid decrease in condenser vacuum. The rate of vacuum degradation did not allow time for manual isolation prior to the manual reactor trip. The root cause of this event is the combination of two simultaneous equipment failures, resulting in a large volume of main condenser air-in-leakage. The 1AE-16 failure cause is indeterminate; however, the likely cause is an intermittent malfunction of the control relay associated with the solenoid operated valve (SOV) that controls 1AE-16 actuator operation. The 1AE-19 failure cause is attributed to poor valve construction with the disk arm not being centered, resulting in contact between the disc and valve body. Corrosion product buildup along this contact surface caused valve binding. The CVP operating procedure was revised to close the CVP manual suction isolation valve prior to securing the CVP. Control relays and a circuit breaker mechanism operated cell assembly for 1AE-16 were replaced. 1AE-19 was replaced. The 1AE-16 SOV and the 'A' CVP discharge check valve will be replaced.

LICENSEE EVENT REPORT (LER) CONTINUATION SHEET

(See NUREG-1022, R.3 for instruction and guidance for completing this form http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1022/r3/)

1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
Shearon Harris Nuclear Power Plant, Unit 1	05000-400	2022	- 003	- 00

NARRATIVE

Note: Energy Industry Identification System (EIIS) codes are identified in the text within brackets [].

A. Background

Prior to the event, Shearon Harris Nuclear Power Plant, Unit 1 (HNP), was operating in Mode 1 at approximately 100 percent power. There were no structures, systems, or components that were inoperable at the time of this event that contributed to the event. This event is reportable per 10 CFR 50.73(a)(2)(iv)(A) as "Any event or condition that resulted in manual actuation or automatic actuation of any of the systems listed in paragraph (a)(2)(iv)(B) of [10 CFR 50.73]…" due to actuation of the Reactor Protection System (RPS) [JC] and Auxiliary Feedwater System (AFWS) [BA]. All actuated safety systems functioned as designed.

The Main Condenser Air Removal System [SH] vacuum pumps (CVPs) [P] are designed to establish and maintain condenser vacuum and to remove non-condensable gases during plant operation. Condenser vacuum is normally maintained at approximately 2 to 4 inches of mercury (Hg) absolute to minimize condenser back pressure. Operating with high back pressure may cause overheating of the turbine [TRB] elements, which could lead to distortion of the rotor and/or turbine blading.

There are two 100 percent capacity two-stage liquid ring type CVPs that require seal water to function. The seal water provides inlet spray at the inlet of the pump first stage which condenses vapors before they enter the main pump body. Airflow passes from the compression stages into the moisture separator [SEP] tank [TK]. The moisture separator tank allows the air to separate from the water in the discharge of the CVPs. Air is discharged to the Turbine Building vent stack. The water remains in the moisture separator tank and serves as a reservoir for the seal water supply.

Each CVP has an air-operated suction valve [ISV] that isolates the CVPs from the condenser. Each of the suction valves will open with the start of the associated CVP and will close when the CVP is secured. There is a check valve [V] on the outlet of each moisture separator tank that prevents reverse flow when the CVP is shut down. This check valve provides a backup to the CVP suction valve to prevent reverse flow through the moisture separator tank and CVP.

The air-operated suction valve is an air-to-open, spring-to-close butterfly valve with a piston actuator. The air supplied to the valve actuator is controlled by a solenoid-operated valve (SOV) [SOL]. When the CVP is in operation, the SOV is energized and supplying air to the actuator that opens the valve to provide a path to the condenser for drawing a vacuum. When the CVP is off, the SOV is de-energized, which vents the air from the actuator, allowing the actuator spring to close the valve.

B. Event Description

On April 29, 2022, at 04:05 Eastern Daylight Time, the reactor was manually tripped due to degrading condenser vacuum approaching the turbine trip setpoint. The trip was not complex, with all systems responding normally post-trip. The RPS and AFWS actuated as designed. A monthly swap of the CVPs was in progress at the time of this event. Prior to the pump swap, the 'B' CVP was in operation with condenser pressure in the normal range of 3-4 inches Hg absolute and stable.

To begin the CVP swap sequence, the 'A' CVP was started at 03:59. Condenser pressure remained normal and stable following the pump start. Approximately 2 minutes later, at 04:01, the 'B' CVP was secured and CVP effluent flow began to increase within 5 seconds. When the 'B' CVP was secured, the operator noted that the 'B' CVP suction isolation valve, 1AE-16, did not close as expected. The operator then proceeded to close 1AE-53, 'B' CVP discharge isolation valve when the manual reactor trip occurred.

LICENSEE EVENT REPORT (LER) CONTINUATION SHEET

(See NUREG-1022, R.3 for instruction and guidance for completing this form http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1022/r3/)

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 08/31/2023

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, Library, and Information Collections Branch (T-6 A10M), U. S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to Infocollects.Resource@nrc.gov, and the OMB reviewer at: OMB Office of Information and Regulatory Affairs, (3150-0104), Attn: Desk Officer for the Nuclear Regulatory Commission, 725 17th Street NW, Washington, DC 20503; e-mail: oira_submission@omb.eop.gov. The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless the document requesting or requiring the collection displays a currently valid OMB control number.

1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
Shearon Harris Nuclear Power Plant, Unit 1	05000-400	2022	- 003	- 00

NARRATIVE

Within 25 seconds of securing the 'B' CVP, the CVP effluent flow rate had exceeded the flow rate indicator range of 100 standard cubic feet per minute. Within 35 seconds of securing the 'B' CVP, condenser shell pressures begin to increase at a rate of approximately 2.6 inches Hg per minute. Then, less than a minute later, the 'B' CVP's separator tank low-low level alarm was received. The large increase in effluent flow combined with 1AE-16 failing to shut and this low-low level alarm indicate that the 'A' CVP was pulling water out of the 'B' CVP separator tank along with air through the 'B' CVP due to the 'B' CVP discharge check valve, 1AE-19, not being closed.

After the CVP separator tank low-low level alarm was received, with condenser pressure continuing to increase, operations personnel attempted to start the 'B' CVP. 'B' CVP failed to start and the alarm for B CVP trip was received. At 04:03, two minutes after the 'B' CVP was secured, the low condenser vacuum alarm was received that has a set point of 6.5 inches Hg absolute. Condenser pressures continued to increase and reached 8.5 inches Hg absolute, which is the pre-established limit to result in a manual reactor trip in accordance with procedural guidance. At 04:04, the reactor trip was manually initiated by operations personnel.

C. Causal Factors

The root cause of this event is the combination of two simultaneous equipment failures, resulting in a large volume of main condenser air-in-leakage. When the 'B' CVP was secured, the suction isolation valve, 1AE-16, and the 'B' CVP discharge check valve, 1AE-19, failed to close, resulting in a rapid decrease in condenser vacuum and a manual reactor trip. The 1AE-16 failure cause is indeterminate; however, the likely cause is an intermittent malfunction of the control relay [RLY] associated with the SOV that controls 1AE-16 actuator operation. The 1AE-19 failure cause is attributed to poor valve construction with the disk arm not being centered, resulting in contact between the disc and valve body. Corrosion product buildup along this contact surface caused valve binding. Over-reliance by plant personnel on risk mitigation actions instead of an elimination strategy during evolutions was also identified as a cause associated with this event.

D. Corrective Actions

The procedure used for CVP operation was revised to close the CVP manual suction isolation valve prior to securing the CVP being removed from service. Control relays and a circuit breaker [72] mechanism operated cell assembly for 1AE-16 were replaced; forensic analysis on these removed components will be completed to identify any additional actions needed to improve reliability. 1AE-19 was replaced. The 1AE-16 SOV will be replaced; forensic analysis on the removed component will be completed to identify any additional actions needed to improve reliability. The 'A' CVP discharge check valve will be replaced. Personnel will identify any normal operating procedural guidance that contains steps with the words "immediately" or "immediate" and will revise applicable procedural guidance to incorporate acceptable completion times.

E. Safety Analysis

The manual reactor trip had no impact on public health and safety. The failure of the condenser vacuum system valves that resulted in degraded condenser vacuum and led to the manual trip did not affect the post-trip response of the feedwater and condensate systems. There was no loss in function of safety systems, structures, or components. There were no significant equipment abnormalities. The condition did not result in a safety system functional failure and had no adverse impact on the health and safety of the public.

F. Additional Information

There have been no events at HNP similar to the event documented in this LER in the past three years.