DUKE ENERGY.

Benjamin C. Waldrep
Vice President
Harris Nuclear Plant
5413 Shearon Harris Road
New Hill NC 27562-9300

919.362.2000

10 CFR 50.73

August 20, 2015
Serial: HNP-15-071

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 2015-004-01

Ladies and Gentlemen:

Duke Energy Progress, Inc. submits the enclosed Licensee Event Report 2015-004-01 in accordance with 10 CFR 50.73 for Shearon Harris Nuclear Power Plant, Unit 1. This report is a supplement to LER 2015-004-00 submitted on July 1, 2015. This report describes a condition where the 'A' train Emergency Service Water pump mechanically failed during the performance of safety injection surveillance testing.

This document contains no regulatory commitments. Please refer any questions regarding this submittal to John Caves at (919) 362-2406.

Sincerely,

Benjamin C. Waldrep

Enclosure: Licensee Event Report 2015-004-01

cc: Mr. J. D. Austin, NRC Sr. Resident Inspector, HNP
Ms. M. Barillas, NRC Project Manager, HNP
Mr. V. M. McCree, NRC Regional Administrator, Region II

Benjamin C. Waldrep
Vice President
Harris Nuclear Plant
5413 Shearon Harris Road
New Hill NC 27562-9300

919.362.2000

10 CFR 50.73

August 20, 2015
Serial: HNP-15-071

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 2015-004-01

Ladies and Gentlemen:

Duke Energy Progress, Inc. submits the enclosed Licensee Event Report 2015-004-01 in accordance with 10 CFR 50.73 for Shearon Harris Nuclear Power Plant, Unit 1. This report is a supplement to LER 2015-004-00 submitted on July 1, 2015. This report describes a condition where the 'A' train Emergency Service Water pump mechanically failed during the performance of safety injection surveillance testing.

This document contains no regulatory commitments. Please refer any questions regarding this submittal to John Caves at (919) 362-2406.

Sincerely,

Benjamin C. Waldrep

Enclosure: Licensee Event Report 2015-004-01

cc: Mr. J. D. Austin, NRC Sr. Resident Inspector, HNP
Ms. M. Barillas, NRC Project Manager, HNP
Mr. V. M. McCree, NRC Regional Administrator, Region II

NRC FORM 366 (02-2014) U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

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

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Shearon Harris Nuclear Power Plant, Unit 1	05000400	1 OF 4

4. TITLE

Failure of 'A' Train Emergency Service Water Pump

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
									None	
05	04	2015	2015	- 004 -	01	08	20	2015	None	

9. OPERATING MODE	11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*			
5	☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)
	☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
	☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
	☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
10. POWER LEVEL	☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
	☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
000	☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☒ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
	☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ OTHER
	☐ 20.2203(a)(2)(vi)	☒ 50.73(a)(2)(i)(B)	☒ 50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

LICENSEE CONTACT	TELEPHONE NUMBER *(Include Area Code)*
John Caves, Manager, Regulatory Affairs	919.362.2406

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
X	BI	P	INGERSOLL -RAND	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 May 4, 2015, while Harris Nuclear Plant, Unit 1 was shut down for a scheduled refueling outage in mode 5, the Operations Surveillance Test for Safety Injection, Engineered Safety Feature Response Time on Train B, was being performed. During this test the 'A' Emergency Service Water (ESW) pump failed, resulting in a loss of flow and pressure to the 'A' ESW header. The probable root cause of this event was determined to be a misalignment stemming from a combination of potential factors. The contributing cause of this event was determined to be that performance monitoring was not rigorous enough to identify potential pump issues prior to failure. Immediate corrective action was taken to secure the corresponding charging/safety injection pump and emergency diesel generator and to realign the Normal Service Water to the 'A' ESW header. The 'A' ESW pump was rebuilt with new couplings, coupling fasteners, and bearings prior to plant startup that commenced on May 13, 2015. Planned corrective actions include a procedure revision to implement a process for performing vertical alignment checks during ESW pump installation and modifications to improve ESW coupling design.

NARRATIVE

Energy Industry Identification System (EIIS) and component codes are identified in the text as [XX].

BACKGROUND

On May 4, 2015, while Harris Nuclear Plant, Unit 1 (HNP) was shut down for a scheduled refueling outage in mode 5, at 0% power, the Operations Surveillance Test for Safety Injection, Engineered Safety Feature Response Time on Train B, was being performed. Prior to the event, both Emergency Service Water (ESW) trains (A and B) [BI] were in service and equipment actuation had been completed. The 'A' ESW train was the protected train. There were no systems, structures, or components that were inoperable at the start of the event that contributed to the event.

This event is reportable under 10 CFR 50.73(a)(2)(v), "Any event or condition that could have prevented the fulfillment of the safety function of structures or systems that are needed to:"… "(B) Remove residual heat;"… "(D) Mitigate the consequences of an accident." This event is also reportable under 10 CFR 50.73(a)(2)(i)(B), "Any operation or condition which was prohibited by the plant's Technical Specifications."

EVENT DESCRIPTION

While performing the surveillance test, a failure of the 'A' ESW pump (1SW-E005) [P] occurred, resulting in a loss of flow and pressure on the 'A' ESW header. The 'A' ESW pump, an Ingersoll Rand model 35 LKX 2 stage, had been running for approximately 40 minutes. Immediate action was taken by the operators to stop the corresponding 'A' charging/safety injection pump [P] and emergency diesel generator [DG], to secure the critical cooling loads. Approximately ten minutes following the 'A' ESW pump failure, Normal Service Water (NSW) [BI] was realigned to the 'A' ESW header in accordance with the plant abnormal operating procedure. It was subsequently determined by attempting to rotate the pump shaft by hand that the 'A' ESW pump had mechanically failed. When the vertical 2-stage centrifugal pump was inspected, it was found that the shaft coupling halves [CPLG] had separated at one of the line shaft joints due to the failure of all 12 coupling capscrew fasteners. This resulted in shaft separation and loss of motive force to the pump impellers. There is evidence that some of the capscrews failed some time earlier than the loss of flow and pressure. Therefore, the degraded coupling and increased bending stress existed for an indeterminate amount of time prior to discovery.

ESW and NSW are the primary interconnected subsystems of the Service Water System [BI], which provides cooling water to remove heat from plant auxiliary systems and equipment. The ESW portion of the system removes essential plant heat loads associated with reactor auxiliary components for dissipation in the plant ultimate heat sink during emergency operation. During normal plant operation, including startup and shutdown, NSW provides all cooling water requirements to the ESW portion of the system. ESW primarily provides cooling water to emergency diesel generators (EDG) as well as component cooling water [CC], which then cools the residual heat removal (RHR) system [BP].

A calculation of runtime for the 'A' ESW pump determined it had run for approximately 264 hours since HNP entered mode 5 for the refueling outage. The runtime calculation for the 'A' ESW pump is less than its established 30-day mission time for mitigating the consequences of an accident. In addition to the event on May 4, 2015, there were periods of time during the refueling outage where the 'B' ESW pump was inoperable for planned maintenance and 'B' emergency diesel generator (EDG) was inoperable for planned maintenance. During these times, the 'A' ESW train was being relied upon as a

support system to meet the requirements of HNP Technical Specification (TS) 3.9.8.1 and TS 3.9.8.2 for RHR and coolant circulation and TS 3.8.1.2 for an operable diesel generator. Therefore, the safety functions of the RHR system and the diesel generator may not have been fulfilled with the 'A' ESW train being inoperable due to the inoperability of the 'A' ESW pump coincident with 'B' ESW train being inoperable due to planned maintenance.

CAUSAL FACTORS

No one potential factor could be identified as the sole cause of the 'A' ESW pump failure. As such, the probable root cause was identified as misalignment, stemming from a combination of potential factors. These factors include a lack of a torque schedule to ensure proper preloading of the support bolting of the coupling, a coupling design that relies heavily on proper preloading of the support bolting, rigid restraints (discharge flange, base plate bolt holes) that limit installation alignment capabilities, and corrosion fatigue.

The contributing cause of this event was determined to be that performance monitoring was not rigorous enough to identify a potential pump issue prior to failure.

SAFETY ANALYSIS

The ESW pumps have a 30 day mission time to support the residual heat removal function. A review of historical data reveals that 30 days (720 hours) of 'A' ESW pump runtime goes back to 7/8/2014. Although the causal evaluation was unable to determine the time when the second line shaft coupling capscrews began to fail due to corrosion fatigue, the 'A' ESW pump was successfully started over 50 times between 7/8/2014 and 5/4/2015. Based on this information, there is reasonable expectation that the 'A' ESW pump would have been operable for its 30 day mission time for an event initiated prior to 7/8/2014.

If an accident had been initiated in modes 1 through 4 between 7/8/2014 and the entry into mode 5 during the refueling outage on 4/2/2015, based upon the operating hours prior to failure, the pump would have started and provided its safety function for at least 264 hours prior to failure, as this is the amount of time the pump operated in RFO-19 after exiting mode 4 and prior to failure. Operation for 264 hours would be sufficient to shutdown and cooldown the reactor and enter mode 5. Upon the loss of the ESW pump flow, normal service water would have been available to perform all safety functions for the actual conditions where offsite power was always available. If a loss of offsite power (LOOP) occurred following the 264 hours described above, the loss of ESW flow would have required operators to secure the 'A' EDG. The 'B' ESW and EDG systems would have provided the design safety functions. In the event an accident occurred with 'B' EDG or other 'B' train equipment out of service, the expected run time of the 'A' ESW pump (>264 hours) would have allowed sufficient time to restore 'B' train equipment.

If an event occurred during the outage, the primary safety concern is the ability to provide (1) cooling to the 'A' EDG during the periods that it was credited, and (2) cooling to the 'A' RHR pump during the periods where it was credited as the RHR pump capable of being powered from the operable EDG. During RFO-19, the pump successfully started five times and ran approximately 29 hours between 4/30/15 – 5/1/15 and 16 hours between 5/2/15 – 5/3/15 just prior to the last start and failure of the 'A' ESW pump on 5/4/15. During this time window, the inoperability of the 'A' ESW pump did not impact operability of the 'A' RHR system since the 'B' EDG and RHR systems were credited for the emergency power function and the normal service water supply provides the cooling support function for 'A' RHR when the 'A' EDG is not credited.

NARRATIVE

During the refueling outage that commenced on 4/1/15, there was a period of time from 4/4/15 through 4/10/15 when the 'A' ESW pump and 'A' EDG were credited for Technical Specification operability, and the 'B' EDG was not available due to maintenance. During this period, a loss of offsite power would have resulted in the use of the 'A' ESW pump and 'A' EDG to provide cooling to the 'A' RHR system. Again, the 'A' ESW pump would have been expected to operate for at least 45 hours. If the LOOP extended beyond 45 hours within this window, the 'A' EDG would not have had the required cooling to perform its safety function until the 'B' ESW pump and EDG became available on 4/14/15.

CORRECTIVE ACTIONS

Completed Actions

1) The 'A' ESW pump was restored to an operable status. It was completely rebuilt with new couplings, coupling fasteners, and bearings. Maintenance and Engineering personnel applied additional rigor and verifications during the pump reinstallation to minimize any lateral stresses on the pump which could adversely affect the alignment. Post-maintenance testing was performed to ensure the maintenance was well executed and pump performance met acceptance criteria.
2) An engineering evaluation was completed prior to return to mode 4 that addressed the preliminary cause of the 'A' ESW pump failure and the potential impact on reliability of the new 'A' ESW pump and the existing 'B' ESW pump.
3) Revised procedure OP-148, "Essential Services Chilled Water System," to change the service water header temperature at which ESW pump start is required to reduce the required number of ESW pump starts and run time.
4) Operations issued Standing Instruction 2015-027 to minimize the amount of run time for the ESW pumps.

Planned Actions

1) Revise procedure CM-M0223, "(ESW) Ingersoll – Dresser Pump (Model 35LKX2) Disassembly and Maintenance," to implement a process for performing vertical alignment checks during ESW pump installation. The new process should include: a method for performing checks, tolerances for the results, a final validation of data, and compensatory measures to be used if pump is outside of tolerances.
2) Implement an engineering change to modify the current ESW coupling design to improve overall performance.
3) Complete an engineering change to enlarge the mounting holes on the motor mounting plate to allow sufficient lateral movement of the pump assembly in order to achieve proper alignment with the discharge piping flange and prevent column deflection.
4) Develop and implement into the ESW installation procedure a torque schedule and sequence, supported by feeler gauges, for the ESW shaft split coupling.
5) Complete an engineering change to replace the Greene Tweed AR-1 bearings and the shaft snap rings in the pump bowl with a more suitable design, and to implement vibration monitoring along the ESW pump shaft.

PREVIOUS EVENTS

There have been no related reportable events at HNP within the past five years.

COMMITMENTS

This report contains no regulatory commitments.