Entergy Nuclear Operations, Inc.
Palisades Nuclear Plant
27780 Blue Star Memorial Highway
Covert, MI 49043
Tel 269 764 2000

Christopher J. Schwarz
Site Vice President

March 19, 2010

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

SUBJECT: Licensee Event Report 2010-001, Potential Loss of Safety Function Due to a Service Water Pump Shaft Coupling Failure
Palisades Nuclear Plant
Docket 50-255
License No. DPR-20

REFERENCES: 10 CFR 50.73

Dear Sir or Madam:

Licensee Event Report (LER) 2010-001 is enclosed. The LER describes a condition which was prohibited by the plant Technical Specifications and potentially could have prevented fulfillment of a safety function due to a service water pump shaft coupling failure.

This LER is being submitted in accordance with 10 CFR 50.73(a)(2)(i)(B), 10 CFR 50.73(a)(2)(v)(B) and 10 CFR 21.21(c).

This letter contains no new commitments and no revisions to existing commitments.

Sincerely,

CJS/TAD

Enclosure (1)

CC Administrator, Region III, USNRC
Project Manager, Palisades, USNRC
Resident Inspector, Palisades, USNRC

ENCLOSURE 1

LER 2010-001

POTENTIAL LOSS OF SAFETY FUNCTION DUE TO A SERVICE WATER PUMP SHAFT COUPLING FAILURE

3 Pages Follow

NRC FORM 366
U.S. NUCLEAR REGULATORY COMMISSION
(9-2007)

LICENSEE EVENT REPORT (LER)

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

APPROVED BY OMB NO. 3150-0104 EXPIRES 8/31/2010

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4. TITLE

Potential Loss of Safety Function Due to a Service Water Pump Shaft Coupling Failure

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
01	19	2010	2010	- 001	- 00	03	19	2010	FACILITY NAME	DOCKET NUMBER

9. OPERATING MODE

1

10. POWER LEVEL

100

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

☐ 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)
☐ 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)
☐ 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 Specify in Abstract below or in NRC Form 366A
☐ 20.2203(a)(2)(vi)	☒ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER (Include Area Code)
Terry Davis	(269) 764-2117

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	BS	CPLG	H331	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 September 29, 2009, at 0908 hours, with the plant in Mode 1 at 100% power, service water system (SWS) pump, P-7C, failed to deliver discharge pressure. Investigation into the failure revealed a broken coupling between the top line shaft and the packing shaft. As a result, a 72-hour limiting condition for operation (LCO) was entered in accordance with Technical Specification (TS) 3.7.8, due to one SWS train being inoperable.

The TS 72-hour LCO was exited after approximately 71 hours on October 2, 2009, at 0822 hours when repairs to P-7C had been completed. Subsequent metallurgical analysis determined that the coupling failed due to intergranular stress corrosion cracking (IGSCC) that was caused by the coupling being too hard.

On January 19, 2010, an Entergy Nuclear Operations Inc. evaluation concluded that, based on the failure mechanism of the coupling, P-7C would have been unable to operate satisfactorily for the required 30-day mission time. Therefore, it was inoperable. This 30-day period of inoperability corresponds to 720 hours of runtime, starting on August 23, 2009, and the failure of the coupling on September 29, 2009. Additionally, during the period P-7C was inoperable, the redundant SWS train was inoperable for a period of approximately six hours on September 2, 2009, due to routine maintenance activities on P-7B. Therefore, both SWS trains were simultaneously inoperable for a period of time not allowed by TS 3.7.8. This occurrence is reportable in accordance with 10 CFR 50.73(a)(2)(i)(B), 10 CFR 50.73(a)(2)(v)(B) and 10 CFR 21.21(c).

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EVENT DESCRIPTION

At 0908 hours on September 29, 2009, two of three service water system [BS] (SWS) pumps [P], P-7A and P-7C, were operating when several SWS alarms annunciated unexpectedly, and the standby SWS pump, P-7B, auto started. An Auxiliary Operator (AO) was dispatched to investigate the cause of the alarms. The AO observed all three service water pumps running. The discharge pressure for P-7C indicated zero, and its packing shaft was exhibiting an abnormal vibration. P-7C was immediately stopped and follow-up troubleshooting identified a packing shaft coupling [CPLG] had failed. As a result, a 72-hour limiting condition for operation (LCO) was entered in accordance with Technical Specification (TS) 3.7.8 due to one SWS train being inoperable. The TS 72-hour LCO was exited after approximately 71 hours on October 2, 2009, at 0822 hours when repairs to P-7C had been completed.

Subsequent metallurgical analysis determined that the coupling failed due to intergranular stress corrosion cracking (IGSCC) that was caused by the coupling being too hard. The couplings for P-7C are 416 stainless steel (SS) with a required hardness between 28-32 Rockwell C (Rc). The failed coupling was outside of this hardness band at approximately 37 Rc throughout the material. A hardness of 37 Rc for 416 SS, in conjunction with the corrosive environment of Lake Michigan, and being under a continual tensile stress during normal loading, makes it more susceptible to IGSCC. The stress crack propagated under normal pump operation, and pump starts accelerated crack growth.

On January 19, 2010, an Entergy Nuclear Operations Inc. (ENO) evaluation concluded that, based on the failure mechanism of the coupling, P-7C would have been unable to operate satisfactorily for the required 30-day mission time. Therefore, it was inoperable. This 30-day period of inoperability corresponds to 720 hours of runtime, starting on August 23, 2009, and the failure of the coupling on September 29, 2009. Run time is used to determine the inoperable period based on the IGSCC propagating under normal pump operation and not when the pump was idle.

Additionally, during the period P-7C was inoperable, the redundant SWS train was inoperable for a period of approximately six hours on September 2, 2009, due to routine maintenance activities on P-7B. Therefore, both SWS trains were simultaneously inoperable for a period of time not allowed by TS 3.7.8. This occurrence is reportable in accordance with 10 CFR 50.73(a)(2)(i)(B), 10 CFR 50.73(a)(2)(v)(B) and 10 CFR 21.21(c). This condition represents a safety system functional failure.

CAUSE OF THE EVENT

A root cause evaluation determined improper heat treatment caused the packing shaft coupling to be out-of-specification for hardness. Subsequently, the out-of-specification packing shaft coupling was not properly controlled during the supplier's testing and/or rework process.

A review of the Certified Material Test Reports (CMTR) from the supplier, HydroAire Services Inc., identified that the final hardness of all eight couplings delivered with P-7C was within specification. However, after the failure, the hardness of the failed coupling was tested by an independent metallurgy lab and found to be approximately 37 Rc throughout the material. A sample of both halves of the failed coupling was also provided to HydroAire for analysis. HydroAire testing results concurred with the independent metallurgy lab results obtained by Palisades, i.e., the hardness of the coupling was approximately 37 Rc.

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HydroAire Services Inc. has a quality assurance (QA) program that is compliant with the requirements of 10 CFR 50, Appendix B. Analysis of their manufacturing process and the documentation created during the manufacture of the couplings that were installed in P-7C in June 2009, showed that HydroAire test results indicated that all couplings were within the 28-32 Rc hardness range specified for the couplings.

Due to the discrepancy between the post failure hardness testing and the recorded hardness values on the CMTR, it has been determined that HydroAire Service Inc. did not properly control the in-process couplings during the testing process. This resulted in one coupling being out-of-specification that was not detected by the HydroAire Services Inc. QA process. This coupling was installed in P-7C at Palisades, and subsequently failed.

CORRECTIVE ACTIONS

ENO issued a corrective action report (CAR) to HydroAire Services Inc. QA documenting the nonconformance of the failed service water pump coupling. A source surveillance hold was placed on safety-related and critical components procured through HydroAire Services Inc.

ASSESSMENT OF SAFETY CONSEQUENCES

There was no actual safety consequences associated with this event. During the approximately 71 hours that P-7C was out of service due to the coupling failure, 100% of the post accident SWS cooling capacity was available. The risk achievement worth (RAW) score was 1.03 (green) prior to the loss of P-7C, and the RAW score remained green after the coupling failure and subsequent removal of P-7C from service. Therefore, the necessary SWS equipment to safely shut down the plant during normal, shutdown or emergency conditions was intact and available to maintain nuclear and public safety.

Given P-7C was considered inoperable to support its 30-day mission time, the pump was assumed to be unavailable for the mission time of Palisades Probabilistic Risk Assessment (PRA) model. P-7B, a pump in the redundant SWS train, was unavailable for a period of approximately six hours concurrent with the assumed unavailability of P-7C. The risk resulting from the unavailability of both pumps (P-7C and P-7B) for the approximate six hour period is considered to be of low safety significance.

PREVIOUS SIMILAR EVENTS

None