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June 17, 2013

ULNRC-06005

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

10 CFR 50.73(a)(2)(i)(B)
10 CFR 50.73(a)(2)(v)(B)
10 CFR 50.73(a)(2)(v)(D)

Ladies and Gentlemen:

DOCKET NUMBER 50-483
CALLAWAY PLANT UNIT 1
UNION ELECTRIC CO.
FACILITY OPERATING LICENSE NPF-30
LICENSEE EVENT REPORT 2013-002-01
DEGRADED BEARING ON 'B' ESSENTIAL SERVICE WATER (ESW)
PUMP MOTOR RENDERS 'B' ESW TRAIN INOPERABLE

On April 15, 2013, Callaway Plant submitted Licensee Event Report (LER) 2013-002-00 in accordance with 10CFR50.73(a)(2)(i)(B) to report a condition prohibited by Technical Specification 3.7.8 due to Essential Service Water (ESW) system 'B' Train inoperability, and pursuant to 10CFR50.73(a)(2)(v)(B) and 10CFR50.73(a)(2)(v)(D) due to concurrent ESW system 'A' Train inoperability.

The enclosed supplemental LER, 2013-002-01, is submitted to update the causes and corrective actions for the same condition.

This letter does not contain new commitments.

Sincerely,

Fadi M. Diya
Vice President Nuclear Operations

DRB/nls

Enclosure: LER 2013-002-00

cc: Mr. Arthur T. Howell
Regional Administrator
U. S. Nuclear Regulatory Commission
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Index and send hardcopy to QA File A160.0761

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Fort Worth, TX 76109
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NRC FORM 366 (10-2010) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 10/31/2013

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 Section (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@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 reverse for required number of digits/characters for each block)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Callaway Plant Unit 1	05000483	1 OF 6

4. TITLE
Degraded Bearing on 'B' Essential Service Water Pump Motor

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
02	13	2013	2013	- 002 -	01	06	17	2013		
									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
☐ 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

FACILITY NAME	TELEPHONE NUMBER (Include Area Code)
T.B. Elwood, Supervising Engineer, Regulatory Affairs and Licensing	314-225-1905

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	BI	MO	G080	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 2/13/2013, during surveillance testing of the 'B' Train of the ESW system, an Operations Technician noticed that the oil in the sight glass of the lower motor radial bearing appeared darker than normal. Based on analysis of the oil, the 'B' ESW pump was declared inoperable on 2/14/2013 at 0721. Required Action A.1 of TS 3.7.8 was entered. Following replacement of the pump motor due to evidence of a degraded bearing, the 'B' ESW train was restored to operable status at 1345 on 2/16/2013 such that Required Action A.1 was exited after a period of 54 hours and 24 minutes. Based on a conservative evaluation of past operability, it is estimated that the 'B' ESW pump motor would not have been capable of meeting its Operability mission time of 30 days after the August to October 2012 timeframe; therefore, this condition is currently considered reportable. This determination is based on the presence of metallic contaminants found in the oil and on recently increased motor vibration, which are indicative of bearing degradation.

The direct cause is insufficient motor shaft endplay, resulting in lower bearing failure due to excessive axial loading.

Corrective actions include establishing new preventive maintenance overhaul requirements and establishing new motor shaft endplay settings.

1. DESCRIPTION OF STRUCTURE(S), SYSTEM(S) AND COMPONENT(S):

The Essential Service Water (ESW) system provides a heat sink for the removal of process operating heat from safety-related components during a design basis accident or transient. During normal operation and shutdown, the ESW system also provides this function for various safety-related and non safety-related components and receives coolant flow from the non safety-related Service Water system.

The ESW system consists of two separate, 100% capacity, safety-related, cooling water trains. Each train consists of a self-cleaning strainer, prelube tank, one 100% capacity pump, piping, valving, and instrumentation. The pumps and valves are remote and manually aligned except in the unlikely event of a loss of coolant accident (LOCA). The pumps are automatically started upon receipt of a safety injection signal, low suction pressure to the auxiliary feedwater pumps coincident with an auxiliary feedwater actuation signal (AFAS), or loss of offsite power. Upon receipt of one of these signals, the automatically actuated essential valves are aligned to their post-accident positions as required. The ESW system also provides emergency makeup to the spent fuel pool and component cooling water system (CCW) and is the backup water supply to the auxiliary feedwater system.

The ESW system provides a support function for several supported systems such as ECCS functions (both operating and shutdown), containment spray and cooling system, auxiliary feedwater system, component cooling water (CCW) system, ultimate heat sink/cooling tower trains, reactor coolant loops, emergency diesel generators (EDGs), electrical distribution systems, and control room air conditioning system.

The principal safety-related function of the ESW system is the removal of decay heat from the reactor via the CCW system and removal of containment heat loads via the containment coolers.

2. INITIAL PLANT CONDITIONS:

On 2/14/2013, the plant was in MODE 1 at 100-percent rated thermal power. No other significant equipment was concurrently inoperable.

3. EVENT DESCRIPTION:

On 2/13/2013, the 'B' Train of the ESW system was placed into service to perform surveillance testing and the quarterly flushing of a portion of the train 'B' safety-related room coolers. The specific evolutions included performance of OSP-EF-0003B (Train 'B' UHS Cooling Tower Fans Test) and the quarterly flush of SGL11B (B TR CCW Pmp Rm Clr), SGL12B (Aux Bldg CCP B Rm Clr), SGL13B (Aux Bldg CSP B Rm Clr), and SGL15B (Aux Bldg South Elec Pen Rm Clr). While the 'B' ESW Pump (PEF01B) was in operation, an Operations Technician noticed that the lubricating oil in the sight glass of the lower motor radial bearing appeared darker than normal. Operations contacted Engineering to examine the oil in the sight glass and determine if pump

operation should continue.

The initial Engineering examination on 2/13/2013 confirmed that the lubricating oil in the motor lower bearing housing sight glass was darker than normal. Data from plant computer points EFT0099A (ESW PMP 'A' LWR Guide BRG - Temperature) and EFT0100A (ESW PMP 'B' LWR Guide BRG - Temperature) for the previous year was reviewed. In addition to temperature data, Engineering also reviewed historical vibration and oil analysis data. Engineering's Trending and Monitoring program had previously noted an increase in vibration since 10/25/2012. This resulted in the initiation of a plant corrective action document and an increase in the vibration monitoring frequency from yearly to monthly. Vibration remained elevated as evidenced by data taken on 1/16/2013 and 2/13/2013, but vibration levels were still well below the American Society of Mechanical Engineers Code for Operation and Maintenance of Nuclear Power Plants (ASME OM Code) 'Alert' limits. During the 1/16/2013 pump run, it may be noted, two engineers observed that oil in the sight glass was not discolored. Further, Engineering's review of the most recent oil analysis results from 10/23/2012 found an increased particle count in the 4 and 6 micron size ranges, but this was not viewed as being indicative of bearing degradation. Based on these preliminary reviews, Engineering concluded on 2/13/2013 that pump operation per the ongoing surveillance could continue and initiated a plant work document to sample the oil at the end of the pump run. The as-found oil condition discovered on 2/13/2013 was documented in a plant corrective action document.

Results from the analysis of the oil were received from Ameren Laboratory Services on 2/14/2013 and showed significant increases, in parts-per-million (ppm), of copper (Cu), zinc (Zn), lead (Pb), and iron (Fe). An additional sample submitted to R&G Laboratories, Inc. for an independent analysis confirmed the Ameren Laboratory Services results. Callaway Engineering determined that the presence of copper, zinc and lead particulates in the oil could be indicative of mechanical degradation to the machined brass cage in the lower motor radial guide bearing, while the presence of iron particulates could be indicative of general mechanical degradation to the bearing races and rolling elements.

Upon receipt of the oil analysis results, the 'B' ESW Pump was declared inoperable and Required Action A.1 of Technical Specification (TS) 3.7.8 (for one ESW train inoperable) was entered at 0721 on 2/14/2013. The 'B' ESW Pump was removed from service and the motor was subsequently replaced with a spare motor. The pump was returned to service at 1345 on 2/16/2013.

4. ASSESSMENT OF SAFETY CONSEQUENCES:

The ESW system is safety-related, is required to function following a Design Basis Accident (DBA), and is required to achieve and maintain the plant in a safe shutdown condition. The safety-related function of the ESW system is to remove the heat from plant components that require cooling for safe shutdown of the reactor or following a DBA. The ESW system also provides emergency makeup to the Spent Fuel Pool and Component Cooling Water system, and is the backup water supply to the Auxiliary Feed Water system. The ESW System is designed to remove heat from

components important to mitigating the consequences of a LOCA or Main Steam Line Break (MSLB) and to transfer the heat to the Ultimate Heat Sink (UHS).

As noted previously, two ESW trains are provided such that each train of the ESW system (and the associated train of the safety-related equipment served by the ESW train) is 100% capable of performing its required safety functions. This arrangement ensures that the full heat-dissipating capacity is available following an accident and an assumed single failure. ESW is part of the 30-day mission for post-accident delivery of decay heat to the UHS.

The ESW pump motors are critical components of the ESW system since they provide the motive force to operate the ESW pumps that provide cooling to critical components to reach and maintain safe shutdown of the reactor. Mechanical degradation of an ESW pump motor bearing could lead to motor failure. In an actual response to a DBA, this could result in the loss of the affected ESW train and consequent reduction in safety margin. However, operation of the 'B' ESW pump motor (with the failed lower radial guide bearing) at a vendor facility, with simulated design operating conditions, successfully demonstrated that the motor operated acceptably for at least a 48-hour continuous period and subsequent one-hour hot restart.

5. REPORTING REQUIREMENTS:

This LER is submitted pursuant to 10CFR50.73(a)(2)(i)(B) to report a condition prohibited by the Technical Specifications; as well as 10CFR50.73(a)(2)(v)(B) as an event or condition that could have prevented fulfillment of the safety function of structures or systems that are needed to remove residual heat, and 10CFR50.73(a)(2)(v)(D) as an event or condition that could have prevented fulfillment of the safety function of structures or systems that are needed to mitigate the consequences of an accident.

The ESW pump motor is subject to the requirements of Callaway TS 3.7.8, "Essential Service Water System (ESW)." Per the Limiting Condition for Operation (LCO) of this Technical Specification, both trains of ESW must be Operable during Modes 1, 2, 3, and 4. With one ESW train inoperable, Condition A applies and associated Required Action A.1 must be entered, which requires restoring the inoperable ESW train to Operable status within the specified Completion Time of 72 hours. With TS 3.7.8 Required Action A.1 and its associated Completion Time not met, Condition B applies such that Required Actions B.1 and B.2 must be entered, which directs the plant to be in Mode 3 in 6 hours and in Mode 5 within 36 hours.

With the 'B' ESW train being declared inoperable at 0721 on 2/14/2013, Required Action A.1 of TS 3.7.8 was entered, and per its specified 72-hour Completion Time, the 'B' ESW train was required to be restored to Operable status by 0721 on 2/17/2013. With this required Action and its 72-hour Completion Time not met, entry into Required Actions B.1 and B.2 for a plant shutdown would have been required. As noted previously, however, the 'B' ESW pump motor was promptly replaced such that the 'B' ESW train was restored to Operable status at 1345 on 2/16/2013. The total time required for restoration of the 'B' ESW system was 54 hours and 24 minutes.

Prior to the event described in this LER, 'B' ESW Pump vibration test data was taken on 10/25/2012. This testing indicated elevated levels, but the levels were still well below the ASME OM Code 'Alert' limits. Corrective action taken at the time included increasing the vibration test frequency to monitor for a degrading trend. Prior to the 10/25/2012 testing, vibration test data was last taken on 8/1/2012. That testing indicated normal baseline vibration readings.

In consideration of the 8/1/2012 and 10/25/2012 test results, (and notwithstanding the successful 48-hour motor run at a vendor facility) it has conservatively been concluded that the 'B' ESW pump became inoperable in the 8/1/2012 to 10/25/2012 timeframe (and was inoperable thereafter) as evidenced by the elevated vibration reading seen on 10/25/2012. Due to this extended period of unknown operability, it is concluded that the period of time that the 'B' ESW pump was inoperable exceeded the TS allowed outage time of 72 hours. The condition is thus reportable as a condition or operation prohibited by the Technical Specifications.

Investigation of the 'A' ESW pump revealed no evidence of bearing degradation for the motor associated with that pump, based on review of oil and vibration data, as well as quarterly pump performance surveillance results. However, in light of the conservatively determined period of 'B' ESW train inoperability due to the degraded motor bearing, the corresponding 'A' train equipment was reviewed for periods of inoperability (due to maintenance, testing, or other reasons) in order to assess whether concurrent train inoperability had existed or occurred. Such a review would then determine whether the inoperability of the 'B' train of ESW was also an event or condition that could have prevented fulfillment of a safety function.

Review of the 'A' train equipment history (from 8/1/2012 until the time when the 'B' ESW train was declared operable on 2/16/2013), identified several periods of inoperability.

Periods of 'A' train inoperability include the following:

9/11/2012 at 0600 to 9/13/2012 at 0018 (planned train outage)
10/10/2012 at 0435 to 10/10/2012 at 0454 (quarterly surveillance testing)
1/2/2013 at 0225 to 1/2/2013 at 0244 (quarterly surveillance testing)

Since the above noted periods of inoperability occurred during the determined period of 'B' train inoperability, the condition is reportable as an event or condition that could have prevented fulfillment of a safety function.

6. CAUSE OF THE EVENT:

The direct cause of this event is insufficient motor shaft endplay, resulting in lower bearing failure due to excessive axial loading. Insufficient motor endplay resulted in high load force conditions in the axial direction on the lower guide bearing. Inspection of the lower bearing at a vendor facility identified material fatigue of the inner bearing race, material fatigue of the outer bearing race, fracture of three rolling elements, and degradation of the bearing cage of this bearing. Analysis of

this physical evidence found that increased stress resulted in spalling metal degradation that precipitated foreign material (iron, copper, lead, zinc) that acted to speed the degradation of the bearing.

7. CORRECTIVE ACTIONS:

Corrective actions include establishing new preventive maintenance overhaul requirements and establishing new motor shaft endplay settings. In addition, Engineering and Administrative procedures will be revised to add timeliness guidelines for oil sample testing and In-Service Testing data review.

8. PREVIOUS SIMILAR EVENTS:

A review of internal Operating Experience did not find any previous examples of similar design radial bearing failure in large vertical motors at Callaway.