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MAR 22 2017

10 CFR 50.73

Serial: BSEP 17-0022

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

Subject: Brunswick Steam Electric Plant, Unit Nos. 1 and 2
Renewed Facility Operating License Nos. DPR-71 and DPR-62
Docket Nos. 50-325 and 50-324
Licensee Event Report 1-2017-001

In accordance with the Code of Federal Regulations, Title 10, Part 50.73, Duke Energy Progress, LLC, submits the enclosed Licensee Event Report (LER). This report is being submitted in response to a Severity Level IV violation received in NRC Inspection Report 2016-004, dated February 9, 2017 (ADAMS Accession Number ML17041A010), for failure to provide a written report to the NRC within 60 days of identifying a condition which was prohibited by plant Technical Specifications. Please refer any questions regarding this submittal to Mr. Lee Grzeck, Manager – Regulatory Affairs, at (910) 457-2487.

Sincerely,

A handwritten signature in black ink, appearing to read "W. Gideon", written over a faint horizontal line.

William R. Gideon

SWR/swr

Enclosure: Licensee Event Report 1-2017-001

cc (with enclosure):

U. S. Nuclear Regulatory Commission, Region II
ATTN: Ms. Catherine Haney, Regional Administrator
245 Peachtree Center Ave, NE, Suite 1200
Atlanta, GA 30303-1257

U. S. Nuclear Regulatory Commission
ATTN: Ms. Michelle P. Catts, NRC Senior Resident Inspector
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U. S. Nuclear Regulatory Commission
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LICENSEE EVENT REPORT (LER)

(See Page 2 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/>)

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.

1. FACILITY NAME Brunswick Steam Electric Plant (BSEP) Unit 1	2. DOCKET NUMBER 05000325	3. PAGE 1 OF 5
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4. TITLE
Speed and Frequency Oscillations Result in Inoperable Emergency Diesel Generator

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	07	2016	2017	001	00	03	22	2017	Brunswick Unit 2	05000324
									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	<input type="checkbox"/> 20.2201(b)	<input type="checkbox"/> 20.2203(a)(3)(i)	<input type="checkbox"/> 50.73(a)(2)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(viii)(A)
	<input type="checkbox"/> 20.2201(d)	<input type="checkbox"/> 20.2203(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(ii)(B)	<input type="checkbox"/> 50.73(a)(2)(viii)(B)
	<input type="checkbox"/> 20.2203(a)(1)	<input type="checkbox"/> 20.2203(a)(4)	<input type="checkbox"/> 50.73(a)(2)(iii)	<input type="checkbox"/> 50.73(a)(2)(ix)(A)
	<input type="checkbox"/> 20.2203(a)(2)(i)	<input type="checkbox"/> 50.36(c)(1)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)
10. POWER LEVEL 088	<input type="checkbox"/> 20.2203(a)(2)(ii)	<input type="checkbox"/> 50.36(c)(1)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(v)(A)	<input type="checkbox"/> 73.71(a)(4)
	<input type="checkbox"/> 20.2203(a)(2)(iii)	<input type="checkbox"/> 50.36(c)(2)	<input type="checkbox"/> 50.73(a)(2)(v)(B)	<input type="checkbox"/> 73.71(a)(5)
	<input type="checkbox"/> 20.2203(a)(2)(iv)	<input type="checkbox"/> 50.46(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(v)(C)	<input type="checkbox"/> 73.77(a)(1)
	<input type="checkbox"/> 20.2203(a)(2)(v)	<input type="checkbox"/> 50.73(a)(2)(i)(A)	<input checked="" type="checkbox"/> 50.73(a)(2)(v)(D)	<input type="checkbox"/> 73.77(a)(2)(i)
	<input type="checkbox"/> 20.2203(a)(2)(vi)	<input checked="" type="checkbox"/> 50.73(a)(2)(i)(B)	<input type="checkbox"/> 50.73(a)(2)(vii)	<input type="checkbox"/> 73.77(a)(2)(ii)
	<input type="checkbox"/> 50.73(a)(2)(i)(C)	<input type="checkbox"/> OTHER	Specify in Abstract below or in NRC Form 366A	

12. LICENSEE CONTACT FOR THIS LER

LICENSEE CONTACT Lee Grzeck, Manager - Regulatory Affairs	TELEPHONE NUMBER (Include Area Code) (910) 457-2487
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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

14. SUPPLEMENTAL REPORT EXPECTED <input type="checkbox"/> YES (If yes, complete 15. EXPECTED SUBMISSION DATE) <input checked="" type="checkbox"/> NO	15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR

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

On February 7, 2016, at 1312 Eastern Standard Time (EST), Unit 1 was in Mode 1 (i.e., Run) at 88 percent of rated power in end-of-cycle coastdown. At that time, an event occurred which resulted in a loss of offsite power (LOOP) on Unit 1. Emergency diesel generators EDG-1 and EDG-2 started and tied to their respective Unit 1 emergency buses. During diesel operation, EDG-1 exhibited oscillations in engine speed and bus frequency. These oscillations had no adverse effect on equipment supplied by the bus, and all supplied loads continued to perform their safety functions without interruption and without need for operator intervention. However, due to the speed and frequency oscillations, EDG-1 was deemed after the fact to have been inoperable. Following extensive testing and evaluation, the cause of the oscillations has not been determined. The governor system for EDG-1 was replaced on March 6, 2016, as part of a planned upgrade to EDG-1. Since that time, the oscillations have not recurred. Based on the fact that the governor replacement eliminated the oscillations, it's concluded that the oscillations resulted from a deficiency in the governor system. Since the cause of the inoperability has been eliminated, no further corrective actions are planned.



**LICENSEE EVENT REPORT (LER)
CONTINUATION SHEET**

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1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
Brunswick Steam Electric Plant (BSEP) Unit 1	05000-325	2017	- 001	- 000

NARRATIVE

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

Background

Inspection Report 2016-004, dated February 9, 2017 (ADAMS accession number ML17041A010), includes a Severity Level IV non-cited violation for failure to submit a Licensee Event Report (LER) due to inoperability of Emergency Diesel Generator 1 (EDG-1). This LER fulfills the requirement of 10 CFR 50.73(a)(1) pertaining to that violation.

On February 7, 2016, during a loss of offsite power (LOOP) event, oscillations of the EDG-1 fuel rack were observed. During the event, maximum bus frequency oscillations of +/- 0.4 Hz were observed. According to recorded electronic data, at the highest loading during the event, the load was oscillating by approximately +/-300 kW. Loads supplied by EDG-1 continued to perform their safety functions without interruption and without need for operator intervention.

However, it was determined after the fact that the observed speed and frequency oscillations rendered EDG-1 inoperable, due to the uncertainty of the effect of the oscillations on EDG-1 at full load.

Duration of EDG 1 Inoperability

Based on data gathered by electronic monitoring, the oscillations commenced at approximately 1404 Eastern Standard Time (EST) on February 7, 2016. Prior to this time, there was no indication of frequency, speed, or power oscillations on EDG-1. Without firm evidence to the contrary, this is assumed to be the start time for EDG-1 inoperability.

On March 2, 2016, at 1458 EST, EDG-1 was removed from service for governor replacement. Work associated with this modification corrected the condition causing the oscillations. EDG-1 was declared operable following the governor replacement and associated testing on March 9, 2016, at 0151 EST.

Based on the above, EDG-1 was inoperable from February 7, 2016, at 1404 EST until March 9, 2016, at 0151 EST (i.e., approximately 30 days, 11 hours, 47 minutes).

Concurrent Inoperability of EDG-2, EDG-3, and EDG-4

EDG-2

February 19 from 2025 EST to 2053 EST (i.e., 28 minutes) for barring.

February 19 from 2104 EST to February 20 at 0014 EST (i.e., 3 hours, 10 minutes) for surveillance testing.



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EDG-3

February 7 at 2211 EST to March 4 at 1834 EST (i.e., approximately 25 days, 20 hours, 23 minutes). This inoperability was caused by a faulty fuse holder and was reported in LER 1-2016-02, Revision 1, dated August 8, 2016 (ADAMS accession number ML16230A236). During this event, EDG-3 remained capable of being manually loaded.

EDG-4

February 15 from 1235 EST to 1434 EST (i.e., 1 hour, 59 minutes) for surveillance testing.

February 18 from 2106 EST to 2140 EST (i.e., 34 minutes) for barring.

February 18 from 2154 EST to February 19 at 0119 EST (i.e., 3 hours, 25 minutes) for surveillance testing.

Reportability Criteria

This event is reportable in accordance with 10 CFR 50.73(a)(2)(i)(B) as operation prohibited by the plant's Technical Specifications (TSs) for both Unit 1 and 2. EDGs 1 and 3 were simultaneously inoperable from February 7, 2016, at 2211 EST to March 4, 2016, at 1834 EST. Required Action G.1 of TS 3.8.1, "AC Sources - Operating," requires restoration of all but one EDG to operable status within 2 hours. If this is not completed, then Required Action H.1 requires that an operating unit be in Mode 3 within 12 hours. Therefore, Unit 2 should have been in Mode 3 by 1211 EST on February 8, 2016, and failure to do so constituted entry into a condition prohibited by the TS. On February 12, 2016, at 2357 EST, Unit 1 entered Mode 2 from Mode 4. This constituted a violation of Limiting Condition for Operation (LCO) 3.0.4.

This event is also reportable in accordance with 10 CFR 50.73(a)(2)(v)(D), as an event or condition that could have prevented the fulfillment of a safety function needed to mitigate the consequences of an accident. Brunswick EDG capacity is such that any three of the four diesels can supply the required loads for the safe shutdown of one unit and a design basis accident on the other unit without offsite power. Thus, with EDG-1 and EDG-3 inoperable, a loss of safety function also occurred. It has been determined that EDGs 2 and 4 were also inoperable, at various times, for surveillance testing and associated activities. These conditions are encompassed by the simultaneous inoperability of EDG-1 and EDG-3 and, as such, do not constitute separate conditions that could have prevented the fulfillment of a safety function.

Event Description

On February 7, 2016, at 1312 EST, BSEP Unit 1 was in Mode 1 during end-of-cycle coastdown. At that time, an event occurred, as reported in Brunswick LER 1-2016-001 (ADAMS accession number ML16104A391), which resulted in a loss of offsite power (LOOP) to Unit 1 and the start of all four emergency diesel generators (EDGs) [EK] on both units. Diesels EDG-1 and EDG-2 then tied to Unit 1 emergency buses [EB] E1 and E2 as designed. The LOOP did not exist on Unit 2, so its EDGs did not tie



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to Unit 2 emergency buses. Unit 1 loads supplied from E1 and E2 were powered successfully until normal power was restored at 1628 EST on February 7, 2016.

During operation of EDG-1, oscillation in the fuel rack was noted. Maintenance and Engineering personnel observed the EDG and drew the preliminary conclusion that the oscillations were not out of the acceptable range for a partially loaded EDG operating in isochronous mode (i.e., operating independently of the grid such that engine speed and bus frequency are controlled solely by the engine governor system). Later, it was noted that the oscillations appeared to increase as load increased and stopped when EDG-1 was shifted into the droop mode (i.e., able to be operated in parallel with the electric power grid) just before being shut down.

Following the event, operating data showed that EDG-1 had started and loaded within the required 10 seconds. It successfully supplied the loads on its emergency bus throughout the LOOP event. The frequency oscillations on the E1 bus were found to be between 59.7 Hz and 60.5 Hz which is well within the TS limits of 58.8 Hz to 61.2 Hz. Loads supplied by EDG-1 had performed their safety function, and no intervention by operators was needed at any time. The oscillations were still considered to be within the range of acceptable behavior for a partially loaded EDG. Therefore, based on the actual performance of EDG-1 during the LOOP, it was initially concluded that the EDG had remained fully capable of fulfilling its safety function and was therefore operable. Consequently, no action was taken at that time to identify a problem and to correct the oscillations.

On March 2, 2016, a surveillance was performed which tests the EDG-1 response to a simulated LOOP and a loss of coolant accident (LOCA). During this test, EDG-1 is operated in isochronous mode, and speed and frequency oscillations were again observed. The oscillations were of the same magnitude as before and stopped when control was shifted into the droop mode prior to shutting down the EDG. It was observed that bus voltage and frequency operated within parameters required by TS 3.8.1.

On March 6, 2016, a newly installed governor system was tested on EDG-1, following installation as part of a preplanned upgrade of the EDG controls. With the new governor installed, speed and frequency oscillations were eliminated and have not recurred. The system was declared operable at 0151 EST on March 9, 2016.

Due to the uncertainty of the postulated effect of the speed and frequency oscillations on EDG-1 at full load, EDG-1 has been determined to be inoperable.

Event Cause

The cause of this event has not been conclusively determined. Since the governor replacement eliminated the speed/frequency oscillations, it's concluded that the cause was located within the governor system. However, examination by on-site personnel and extensive testing by the manufacturer of the governor have not been able to determine a failure within the governor that could account for the behavior of the system. The other three EDGs at BSEP have not exhibited similar speed and frequency oscillations.



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Safety Assessment

Speed and frequency oscillations in EDG-1 were first observed during a LOOP event on February 7, 2016, when emergency busses E1 and E2 were being powered by EDG-1 and EDG-2. Only EDG-1 exhibited oscillations. The two EDGs supply power to independent buses and therefore do not affect each other. The magnitude of the oscillations on EDG-1 was observed to be between 59.7 Hz and 60.5 Hz, which was well within the bounds of TS Surveillance Requirement 3.8.1.2 of greater than or equal to 58.8 Hz and less than or equal to 61.2 Hz. EDG-1 successfully powered all required loads during the actual LOOP event, up to a peak loading during the event of 2650 KW. No intervention by operators was needed at any time to control the oscillations or to protect any equipment powered by EDG-1. During the LOOP/LOCA test conducted on March 2, 2016, the loading on the bus was approximately the same as that experienced during the actual LOOP event of February 7, 2016. Nonetheless, the magnitude of the oscillations remained approximately +/-0.4 Hz and remained within a peak power value of approximately 2840 KW. By comparison, the EDG is designed for continuous operation at a maximum of 3500 KW, and for up to 2000 hours of operation at 3850 KW. Consequently, safe operating limits for EDG-1 were never challenged, and EDG-1 was shown by both testing and an actual event response to be capable of powering loads expected in the event of an LOOP/LOCA event. In the event that an additional source of standby onsite alternating current (AC) power had been needed, the site's supplemental emergency diesel generator was available throughout the entire event.

Based on this analysis, this event had no adverse impact on the health and safety of the public.

Corrective Actions

The governor for EDG-1 was replaced on March 6, 2016, as part of a planned upgrade. The governor system replacement included in its scope all of the speed control components and connections which are suspected of being capable of producing the oscillations that were observed. Since the oscillations have not recurred since that time, it is concluded that the source of the control instability has been eliminated by the replacement and no further corrective actions are planned.

Previous Similar Events

No events have occurred in the past three years in which an emergency diesel generator was made inoperable because of a problem with its governor system.

Commitments

This report contains no new regulatory commitments.