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10 CFR 50.73

May 23, 2019

Serial: RA-19-0220

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

Subject: Brunswick Steam Electric Plant, Unit No. 1
Renewed Facility Operating License No. DPR-71
Docket No. 50-325
Licensee Event Report 1-2019-002

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 fulfills the requirement for a written report within sixty (60) days of a reportable occurrence.

This document contains no regulatory commitments.

Please refer any questions regarding this submittal to Mr. Jerry Pierce, Manager – Nuclear Support Services, at (910) 832-7931.

Sincerely,

A handwritten signature in blue ink, appearing to read "WRG", written over a light blue circular stamp.

William R. Gideon

SBY/sby

Enclosure: Licensee Event Report

U.S. Nuclear Regulatory Commission

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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: Mr. Gale Smith, NRC Senior Resident Inspector
8470 River Road
Southport, NC 28461-8869

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11555 Rockville Pike
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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 Information Services Branch (T-2 F43), 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 3
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4. Title
Degraded Principal Safety Barrier, Technical Specification Shutdown, and Automatic System Actuation

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
03	28	2019	2019	- 002	- 00	05	23	2019	Facility Name	05000
									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 checked="" 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 checked="" type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)
10. Power Level	<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)
100	<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 checked="" type="checkbox"/> 50.73(a)(2)(i)(A)	<input 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 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 Jerry Pierce, Manager – Nuclear Support Services	Telephone Number (Include Area Code) (910) 832-7931
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13. Complete One Line for each Component Failure Described in this Report

Cause	System	Component	Manufacturer	Reportable to ICES	Cause	System	Component	Manufacturer	Reportable to ICES
X	AD	CPLG	R098	Y					

14. Supplemental Report Expected	15. Expected Submission Date	Month	Day	Year
<input type="checkbox"/> Yes (If yes, complete 15. Expected Submission Date) <input checked="" type="checkbox"/> No				

Abstract (Limit to 1400 spaces, i.e., approximately 14 single-spaced typewritten lines)

At 14:19 Eastern Daylight Time (EDT) on March 28, 2019, with Unit 1 in Mode 1 at approximately 100 percent power, drywell pressure and floor drain leakage began to increase. Operators proceeded with a controlled shutdown per procedures. The reactor was scrammed at 16:03 EDT to complete the shutdown. At 16:54 EDT, following the scram, Primary Containment Isolation System (PCIS) actuation occurred, closing the outboard Main Steam Isolation Valves (MSIVs) due to low condenser vacuum. Subsequently, Reactor Protection System (RPS) actuation occurred due to low reactor water level. The safety function of the MSIVs and RPS had already been completed. There was no impact on the health and safety of the public or plant personnel.

This event was a result of a steam leak in the drywell caused by the failure of a 1-inch cryogenic pipe coupling. The failure was due to hydrogen embrittlement from long-term exposure to high temperature and elevated hydrogen levels. A Unit 1 and Unit 2 extent of condition evaluation was performed; susceptible cryogenic couplings were replaced with welded fittings.

As a result of the Technical Specification-required shutdown, the valid actuations of PCIS and RPS, and the degradation of a principal safety barrier, this event is being reported in accordance with 10 CFR 50.73(a)(2)(i)(A), 10 CFR 50.73(a)(2)(iv)(A), and 10 CFR 50.73(a)(2)(ii)(A) respectively.



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

(See NUREG-1022, R.3 for instruction and guidance for completing this form
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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	05000325	2019	- 002	- 00

NARRATIVE

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

Background

Initial Conditions

At the time of the event, Unit 1 was in Mode 1 (i.e., Power Operation), at approximately 100 percent rated thermal power.

Reportability Criteria

This event is being reported in accordance with 10 CFR 50.73(a)(2)(i)(A) because a Technical Specification-required shutdown was completed. Technical Specification Action 3.4.4.A, Unidentified Reactor Coolant System (RCS) [AD] leakage increase not within limit, requires RCS leakage to be reduced to within limits within 8 hours. The shutdown was required because the leakage would not have been reduced to within limits within the required Technical Specification Completion Time.

In addition, this event is being reported in accordance with 10 CFR 50.73(a)(2)(iv)(A) because, subsequent to the shutdown, with the Unit in Mode 3 at 0 percent power, it involved actuation of systems listed in 10 CFR 50.73(a)(2)(iv)(B). Specifically, the outboard MSIVs [JM] automatically closed, per design, in response to low condenser vacuum, and RPS [JC] actuation occurred, per design, in response to low reactor water level.

This event is also being reported in accordance with 10 CFR 50.73(a)(2)(ii)(A) because it was the result of a degraded principal safety barrier (i.e., the RCS pressure boundary [AD]). The steam leak in the drywell was caused by the failure of a 1-inch cryogenic pipe coupling located on the steam side of the reference leg for the N004B reactor level instruments which is part of the RCS pressure boundary.

During this event the Unit 1 unidentified RCS leakage was greater than 10 gallons per minute (gpm) for greater than or equal to 15 minutes and, as a result, an Unusual Event (UE) was declared. The NRC was notified of this per 10 CFR 50.72(a)(1)(i) via Event Notification number 53961 at 15:07 EDT on March 28, 2019.

Event Description

At 14:19 EDT on March 28, 2019, while operating at approximately 100 percent reactor power, the Brunswick Nuclear Plant Unit 1 N004B narrow range reactor water level instrument (1-C32-LI-R606B) failed high, and drywell pressure and drywell floor drain leakage began to increase. Operators vented the drywell and proceeded with a controlled shutdown in accordance with procedures. The reactor was scrammed at 16:03 EDT to complete the shutdown.

At 16:54 EDT, during implementation of post scram actions, actuation of PCIS occurred, closing the outboard MSIVs due to low condenser vacuum. The MSIVs had been manually closed, per procedure, during the shutdown evolution to control reactor pressure and were in the process of being reopened when actuation occurred. The inboard MSIVs had not been reopened when the isolation occurred. Subsequently, at 16:58 EDT, a RPS actuation occurred due to reactor water level dropping below the actuation setpoint due to the increased steam demand associated with equalizing and opening MSIVs. All control rods were already inserted at the time of the actuation. The safety function of both the MSIVs and RPS had already been completed.

During the shutdown, the unidentified RCS leakage was greater than 10 gpm for greater than or equal to 15 minutes and a UE was declared in accordance with Brunswick Emergency Action Level SU 5.1. The UE was terminated at 02:59 EDT on March 29, 2019, once RCS leakage was reduced to less than 10 gpm.

Event Cause

Investigation revealed that a 1-inch cryogenic (Cryofit) pipe coupling on the steam side of the reference leg for the N004B reactor level instruments experienced a 360 degree circumferential separation at the approximate center of the coupling. This opened a path for steam from the reactor to leak into the drywell.



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Brunswick Steam Electric Plant (BSEP), Unit 1	05000325	2019	- 002	- 00

NARRATIVE

Cryofit couplings are devices used to connect small bore piping (i.e., 1-inch nominal pipe size and less). Cryofit couplings are fabricated from a shape memory alloy material composed primarily of Nickel-Titanium-Iron (Tinel) which experiences a phase change at cryogenic temperatures. The Cryofit coupling design allows for in an interference fit that does not require welding.

Examination of the failed coupling was conducted at the McGuire Island Metallurgical lab. Microhardness testing, visual microscopy, and scanning electron microscopy were used to characterize the failed material. The conclusion from these examinations is that the failure was caused by hydrogen embrittlement. This is supported by the transgranular cleavage on the fracture surface, high hardness values in the region exposed to the process fluid, and a hydrogen rich environment, which are all consistent with hydrogen embrittlement.

The root cause of this event was that the selection of Tinel was inappropriate for long term application in a high temperature process that contains elevated hydrogen. The potential for hydrogen embrittlement of Cryofit couplings was not recognized when they were selected to be installed in reactor water level instrument lines (i.e., steam to condensing chamber). Information on the vulnerability of Tinel to hydrogen embrittlement was not available when the fittings were selected, which was in the 1980s. Accordingly, this is an historical (legacy) issue.

Safety Assessment

There was minimal safety consequence associated with this event. The reactor was safely shutdown in accordance with plant procedures, the RCS inventory level was not challenged, primary containment pressure was maintained below the Alert threshold, and the radiological release associated with venting containment was within Technical Specification limits.

Corrective Actions

The failed Unit 1 Cryofit coupling was replaced with a welded fitting. In addition, an evaluation was performed to address the couplings installed on both Unit 1 and Unit 2. Couplings exposed to reactor steam for many years may be susceptible to hydrogen embrittlement; therefore, couplings in these locations were removed and replaced with welded fittings.

In addition to the aforementioned completed corrective actions, the following corrective actions are currently planned.

- The Brunswick piping specification will be revised to restrict the use of Cryofit couplings to locations that are not subject to high temperatures and elevated hydrogen levels. This action is scheduled to be completed by July 25, 2019.
- Hydrogen embrittlement of Cryofit couplings will be added to the Brunswick License Renewal Aging Management Program. This action is scheduled to be completed by September 26, 2019.

Also, a procedure enhancement, associated with reopening MSIVs, has been initiated to address the automatic PCIS and RPS actuations.

Any changes to corrective actions or completion schedules will be made in accordance with the site's corrective action program.

Previous Similar Events

No events have occurred within the past three years in which inappropriate material selection resulted in a LER.

Commitments

No regulatory commitments are contained in this report.