Exelon Generation

10CFR 50.73

CCN: 21-64

June 24, 2021

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

Peach Bottom Atomic Power Station (PBAPS) Unit 2
Subsequent Renewed Facility Operating License No. DPR-44
NRC Docket No. 50-277

Subject: Licensee Event Report (LER) 2021-001-00 High Pressure Coolant Injection System Inoperable Due to Inverter Failure

References: ENS# 55224

This report is being submitted in accordance with 10 CFR 50.73(a)(2)(v)(D) for an event or condition that at the time of discovery could have prevented the fulfillment of the safety function of structures or systems that are needed to mitigate the consequences of an accident.

There are no commitments contained in this letter. If you have any questions, please contact the Peach Bottom Regulatory Assurance Manager, Matthew K. Rector at (717) 456-4351.

Respectfully,

Matthew J. Herr
Site Vice President
Peach Bottom Atomic Power Station

Enclosure

cc: US NRC, Administrator, Region I
US NRC, Senior Resident Inspector, Peach Bottom
W. DeHaas, Commonwealth of Pennsylvania
S. Seaman, State of Maryland
B. Watkins, PSE&G, Financial Controls and Co-Owner Affairs

NRC FORM 366 (08-2020) | U.S. NUCLEAR REGULATORY COMMISSION | APPROVED BY OMB: NO. 3150-0104 | EXPIRES: 08/31/2023

LICENSEE EVENT REPORT (LER)

(See Page 3 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/)

1. Facility Name	2. Docket Number	3. Page
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4. Title
High Pressure Coolant Injection System Declared Inoperable Due to Instrument Power Inverter Failure

5. Event Date			6. LER Number			7. Report Date			8. Other Facilities Involved	
Month	Day	Year	Year	Sequential Number	Revision No.	Month	Day	Year	Facility Name	Docket Number
04	29	2021	2021	- 001 -	00	06	24	2021		05000
									Facility Name	Docket Number
										05000

9. Operating Mode	10. Power Level
1 - Run	100

11. This Report is Submitted Pursuant to the Requirements of 10 CFR §: *(Check all that apply)*

10 CFR Part 20	☐ 20.2203(a)(2)(vi)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(A)	**10 CFR Part 73**
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.69(g)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(4)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(i)	**10 CFR Part 21**	☐ 50.73(a)(2)(i)(B)	☒ 50.73(a)(2)(v)(D)	☐ 73.77(a)(1)(i)
☐ 20.2203(a)(2)(ii)	☐ 21.2(c)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)	☐ 73.77(a)(2)(i)
☐ 20.2203(a)(2)(iii)	**10 CFR Part 50**	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)	☐ 73.77(a)(2)(ii)
☐ 20.2203(a)(2)(iv)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)	
☐ 20.2203(a)(2)(v)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)	

☐ **OTHER** (Specify here, in abstract, or NRC 366A)

12. Licensee Contact for this LER

Licensee Contact	Phone Number (Include area code)
Matthew K. Rector, Regulatory Assurance Manager	7174564351

13. Complete One Line for each Component Failure Described in this Report

Cause	System	Component	Manufacturer	Reportable to IRIS		Cause	System	Component	Manufacturer	Reportable to IRIS
X	BJ	JX	NLI	Y						

14. Supplemental Report Expected		15. Expected Submission Date	Month	Day	Year
☒ No	☐ Yes (If yes, complete 15. Expected Submission Date)				

16. Abstract (Limit to 1560 spaces, i.e., approximately 15 single-spaced typewritten lines)

On April 29, 2021 at 2354 ET with Unit 2 plant operating conditions at 100% rated thermal power, the "High Pressure Coolant Injection (HPCI) system inverter circuit failure" alarm was received on a Main Control Room panel. This alarm indicates a loss of AC power from the HPCI inverter, and is caused by either a loss of DC power to, or a failure of, the inverter. Operations personnel immediately noticed the erratic performance of HPCI system instruments, digital recorders, and a loss of expected status display on the HPCI flow controller. Subsequent investigation into the HPCI inverter circuit failure alarm revealed the inverter was cycling on and off. In the event of a valid HPCI initiation signal, the erratic loss of power to the HPCI flow controller would have resulted in a loss of HPCI function. On April 30, 2021 at 0023 ET Operations personnel declared HPCI inoperable. At 0023 ET, at the direction of Shift supervision, the inverter power supply fuses were removed to arrest the inverter cycling on and off. The HPCI inverter was subsequently removed from service, replaced in kind, and then tested satisfactorily.

The loss of the HPCI function was due to the inverter failure. There were no actual safety consequences as a result of this event. This report is made pursuant to 10 CFR 50.73(a)(2)(v)(D) for an event or condition that at the time of discovery could have prevented the fulfillment of the safety function of structures or systems that are needed to mitigate the consequences of an accident.

1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
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Plant Conditions:

Peach Bottom Atomic Power Station Unit 2 (PB2) was operating at approximately 100 percent power in MODE 1. There were no structures, systems, or components that were inoperable at the start of the event and contributed to the identified condition.

Failed component information:

Assembly/Part Number: NLI-072034-CSI-K-5-A
Model Number: CSI-K-B-Q9573
Serial Number: 31A7 1002.
Description: Rack Mount 1000 VA Inverter Assembly
Manufacturer: PARAGON ENERGY SOLUTIONS, formerly Nuclear Logistics Incorporated
Type: Power Supply

Description:

On April 29, 2021 at 2354 ET, the "High Pressure Coolant Injection (HPCI) System Inverter Circuit Failure" alarm was received on a Main Control Room panel. Operations personnel immediately noticed erratic performance of HPCI system pressure instruments and a loss of expected status display on the HPCI flow controller. Examination of the HPCI rack-mounted inverter revealed the power indicator light was cycling on and off. Inspection of the HPCI panel back plane revealed that the logic bus power monitoring relay was chattering/cycling on and off. There were no other indications of equipment degradation. In the event of a valid HPCI initiation signal, the erratic power supply to the HPCI flow controller would have resulted in a loss of HPCI function (a single train system).

On April 30, 2021 at 0023 ET, Operations Shift supervision directed that the inverter power supply fuses be removed to arrest the inverter cycling on and off and HPCI was declared inoperable.

Station Instrument and Controls Maintenance staff were mobilized to perform investigation and repairs. Simple troubleshooting confirmed inverter supply power and protective fuses were performing satisfactorily. Inverter output voltage readings were out of the specified performance range and an apparent cause could be determined.

On April 30, 2021 at 0738 ET, in accordance with 10 CFR 50.72(b)(3)(v)(D), a non-emergency eight-hour notification to the NRC was completed due to the PB2 HPCI inverter failure and HPCI being declared inoperable (a single train system) resulting in a condition that could have prevented fulfillment of a safety function of structures or systems that are needed to mitigate the consequences of an accident. (Reference ENS# 55224)

A new like-for-like inverter unit was obtained from station stores and bench calibrated. The degraded inverter was removed and replaced, and the downstream instrument functional checks were completed satisfactorily.

On April 30, 2021 at 1434 ET, all repairs were completed, full function was restored, the system satisfactorily tested and HPCI was declared operable. The duration the train was rendered inoperable was approximately 15 hours.

Event Cause Analysis:

The failed inverter was examined in the station Instrument and Control Maintenance shop by restoring the input power supply. The output voltage was below required specifications and visual examination of the accessible inverter

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internals revealed no obvious signs of a failed sub-component or defective piece-parts. The unit was quarantined and shipped to the manufacturer (Paragon Energy Solutions) for detailed failure analysis.
Event Cause Analysis (continued):

The inverter undergoes routine preventive maintenance calibration and functional checks every two years and is replaced with a new inverter every ten years based on vendor life cycle recommendations. The failed inverter was installed during the most recent PB2 refueling outage in October of 2020. The inverter had been in-service approximately five months. The early life-cycle failure is most likely attributed to a random sub-component failure. The inverter output is continuously monitored and annunciated in the Main Control Room. Station alarm response procedures direct actions to identify and mitigate potential causes of identified alarms. The impact was immediately recognized by Operations staff through the performance of alarm response actions that validated observations of the pressure indicators and the digital flow controller display. There were no other instruments or Emergency Core Cooling System (ECCS) impacted by this inverter failure.

Station staff are conducting a causal evaluation and have solicited a detailed failure analysis from the manufacturer. The timeframe for this report exceeds the 60-day event reporting requirement. However, the failure analysis report will not significantly change the course, significance, implications, or consequences of the event as assessed below. (Reference IRIS #498696)

Assessment of Safety Consequence:

This event is reportable per 10 CFR 50.73(a)(2)(v)(D) due to an event or condition that could have prevented the fulfillment of the safety function of a structure or system that is needed to mitigate the consequences of an accident. The HPCI system is a single-train system that is designed to ensure that the reactor is adequately cooled to limit fuel-cladding temperature in the event of a small break in the nuclear system and a loss of coolant does not result in a rapid reactor pressure vessel depressurization. The HPCI system will continue to operate until the Reactor Pressure Vessel (RPV) is below the pressure at which either operation of the Low Pressure Coolant Injection (LPCI) mode of the Residual Heat Removal (RHR) system or the Core Spray (CS) system will maintain core cooling.

Upon a small break in the nuclear system which results in a Loss of Coolant Accident (LOCA), HPCI provides sufficient inventory to prevent the core from becoming uncovered. In the event that HPCI is unavailable or inoperable, the Automatic Depressurization System (ADS) is credited to depressurize the RPV to enable operation of the low pressure ECCS systems, i.e., CS or LPCI. Reactor Core Isolation Cooling (RCIC) is also available to restore and maintain water level.

Although HPCI was declared inoperable, ADS, CS, LPCI, and RCIC were operable and available to provide core cooling in the event of a small break LOCA or a Design Basis Accident (DBA) LOCA . Therefore, based on the ability of the station to mitigate the consequences of a loss of the HPCI system combined with a small break LOCA, this event is considered to have very low safety significance.

Corrective Actions:

The degraded HPCI inverter was removed from service and replaced, and the new inverter functionally tested satisfactorily. The proximate cause of inverter failure has not yet been not determined. The station will perform an equipment causal analysis in coordination with the original equipment manufacturer to determine the direct cause of the random early life-cycle failure.

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Previous Similar Events:

Review of station historic reportable events revealed similar instances of the loss of HPCI system function attributed to different electronic component failures in the turbine control logic scheme:

LER 2015-001-00 Loss of High Pressure Coolant Injection System Function as a Result of Failed Flow Controller Signal Converter

LER 2005-001-00 Loss of High Pressure Coolant Injection System Function as a Result of Inoperable Flow Controller