NRC FORM 366 (04-2018) | U.S. NUCLEAR REGULATORY COMMISSION | APPROVED BY OMB: NO. 3150-0104 EXPIRES: 03/31/2020

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/)

1. Facility Name	2. Docket Number	3. Page
Quad Cities Nuclear Power Station Unit 1	05000254	1 OF 5

4. Title

Loss of Safety Bus and Automatic Actuation of a Safety System During Undervoltage Relay Surveillance

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
									n/a	05000
10	24	2018	2018	- 005	- 01	11	21	2019	Facility Name: n/a	Docket Number: 05000

9. Operating Mode	11. This Report is Submitted Pursuant to the Requirements of 10 CFR §: *(Check all that apply)*			
1	☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
	☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
	☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
	☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☒ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
10. Power Level	☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
100	☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☒ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
	☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(C)	☐ 73.77(a)(1)
	☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(D)	☐ 73.77(a)(2)(i)
	☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(vii)	☐ 73.77(a)(2)(ii)
		☐ 50.73(a)(2)(i)(C)	☐ Other (Specify in Abstract below or in NRC Form 366A)	

12. Licensee Contact for this LER

Licensee Contact	Telephone Number (Include Area Code)
Richard Swart – Regulatory Assurance	309-227-2810

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	EB	27	G080	Y					

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

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

On 10/24/18 at 0901 CDT, during performance of the "Functional Test of Unit 1 Second Level Undervoltage," a loss of Bus 13-1 and Bus 18 occurred. The 1/2 Emergency Diesel Generator (EDG) automatically started due to a valid actuation on loss of power to Bus 13-1, but did not load due to surveillance test alignments. The loss of Bus 13-1 caused the loss Bus 18, resulting in a loss of logic power to both loops of Low Pressure Coolant Injection (LPCI). Additional equipment was also lost.

This notification is being made in accordance with 10 CFR 50.73(a)(2)(iv)(A), "Any event or condition that results in manual or automatic actuation of any of the systems listed in paragraph (a)(2)(iv)(B)," because the 1/2 EDG auto started due to the loss of power condition. This notification is also being made in accordance with 10 CFR 50.73(a)(2)(v)(B), "Any event or condition that could have prevented fulfillment of the safety function of structures or systems that are needed to remove residual heat," because both loops of LPCI were inoperable for a short time period.

The most probable cause is concurrent direct current (DC) grounds resulting in actuation of relay logic to trip Bus 13-1 and start the 1/2 EDG. Additional Q1R25 refuel outage troubleshooting was completed and did not reveal any additional causes.

1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
Quad Cities Nuclear Power Station Unit 1	05000254	2018	- 005	- 01

NARRATIVE

PLANT AND SYSTEM IDENTIFICATION

General Electric - Boiling Water Reactor, 2957 Megawatts Thermal Rated Core Power

Class 1E 4.16 KV Bus 13-1 [EB] Undervoltage Protection [JE]

Low Pressure Coolant Injection System [BO]

Core Spray System [BM]

Emergency Diesel Generator [EK]

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

EVENT IDENTIFICATION

Loss of Safety Bus and Automatic Actuation of a Safety System During Undervoltage Relay Surveillance

A. CONDITION PRIOR TO EVENT

Unit: 1 Event Date: October 24, 2018 Event Time: 0901 hours CDT
Reactor Mode: 1 Mode Name: Power Operation Power Level: 100%

There were no structure, systems, or components out of service or inoperable that contributed to the event.

B. DESCRIPTION OF EVENT

On October 24, 2018, at 0901 hours CDT, during performance of a second level undervoltage surveillance, Class-1E 4.16 KV Bus 13-1 [EB] tripped on an Undervoltage Protection [JE] inadvertent signal. The loss of the safety bus caused the 1/2 Emergency Diesel Generator (EDG)[EK] to start automatically, although it did not load to the bus due to surveillance testing alignments. The loss of Bus 13-1 also causes a loss Bus 18, which causes a loss of logic leading to a loss of both loops of RHR Low Pressure Coolant Injection (LPCI) function.

The loss of Bus 13-1 also caused a loss of the 1A Core Spray (CS)[BM] pump and the 1A and 1B Residual Heat Removal Pumps (RHR)[BO]. The 1/2 Diesel Generator Cooling Water Pump did not start due to the loss of Bus 18.

The following inadvertent actuations also occurred: Reactor Building Ventilation [VA] system tripped and Standby Gas Treatment System [BH] auto started; 1A Reactor Protection System [JD] power swapped; a full Group III Reactor Water Clean Up [CE] isolation occurred.

All other plant equipment responded as expected to this bus transient. Full power operation was maintained. The affected busses were restored at 0911 hours CTD on October 24, 2018. Additional equipment recovery continued into the following day.

During the ten minutes where LPCI was unavailable, Unit 1 was in the following Technical Specification (TS) LCOs:

3.5.1 Condition A for the A and B RHR Pumps

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3.5.1 Condition B for the A and B Low Pressure Coolant Injection (LPCI) sub-systems and the A Core Spray sub-system.

3.5.1 Condition E for two LPCI sub-systems

3.5.1 Condition K for A and B LPCI sub-systems and CS sub-system

3.0.3 as directed by 3.5.1 Condition K

3.5.3 Condition A for Reactor Core Isolation Cooling (RCIC) System due to Room Cooler

3.8.1 Condition A for off-site line unavailable to Bus 13-1

3.8.1 Condition D for off-site line and the 1/2 EDG unavailable

3.8.7 Condition A for Bus 13-1 and Bus 18

Unit 1 also remained in TS LCO 3.8.1(b) until the 1/2 EDG was restored.

This event was reported under 10 CFR 50.72(b)(3)(iv), 'Event or Condition that results in valid actuation of any of the systems listed in paragraph (b)(3)(iv)(B),' because the 1/2 EDG auto started due to the loss of power condition, and 10 CFR 50.72(b)(3)(v)(B), 'Event or Condition that Could Have Prevented Fulfillment of a Safety Function,' because both loops of LPCI were inoperable for a short time period.

C. CAUSE OF EVENT

The most probable cause of the event was a testing-induced ground on a surveillance related terminal in conjunction with a DC system ground that actuated two auxiliary relays associated with the undervoltage monitoring function.

A short duration (approximately 1.5 seconds) U1 125 VDC Ground alarm on the positive battery rail was received roughly 23 seconds prior to the loss of Bus 13-1. The magnitude of the ground decreased below the alarm threshold, but did not fully dissipate for an hour after the alarm.

The undervoltage surveillance already in progress had installed a jumper into a banana jack at a terminal point designated YG8, but the other end of the jumper had not yet been installed into a banana jack. A review of the sequence of events recorder indicates that only two of four parallel relays picked up momentarily, likely caused by the positive rail DC ground condition, and the YG8 jumper causing a momentary short to ground on the negative side of these relay coils. Relay 1X3 pick up caused a Low Voltage alarm and initiated the trip of the feed breaker to Bus 13-1. Relay 1X4 pick up caused a start signal to the 1/2 EDG. The two parallel relays, 1X1 and 1X2, did not appear to pick up based on the lack of equipment status changes related to these two relays.

Troubleshooting following the event did not reveal any human performance issues nor any equipment issues. A subsequent re-performance of the test did not result in any unexpected equipment issues.

Additional inspections and troubleshooting completed during refuel outage Q1R25 did not reveal any additional causes.

D. SAFETY ANALYSIS

System Design

Bus 13-1 is the Division I 4KV AC supply to the Division 1 Emergency Core Cooling System (ECCS) loads on Unit 1. It can be fed by an EDG if the normal feed from the Reserve Auxiliary Transformer is lost. Bus 18 is a

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480 V essential services (ESS) bus. Undervoltage protection is provided to protect equipment from sustained degraded voltage, and for the ECCS related busses, to start the applicable EDG.

Safety Impact

No Division II ECCS equipment was impacted by this event.

Bus 13-1 was unavailable for approximately 10 minutes. No significant plant transients took place during this time period.

The trip of Bus 13-1 took place during surveillance testing on the undervoltage trip circuit. The subsequent surveillance test was completed satisfactorily with additional circuits isolated to preclude inadvertent tripping of Bus 13-1. No further testing will be performed on this protective relaying circuit until the next refuel outage.

The 1/2 EDG started, but did not load to the bus as a result of intentional test configurations. Following the surveillance, logic was returned to a normal configuration, and post maintenance testing was satisfactorily performed on the 1/2 EDG.

DC system grounds are routinely monitored per station procedures.

Based on this, no significant safety impact exists.

Risk Insights

A plant Probabilistic Risk Assessment (PRA) review was performed to evaluate Bus 13-1 and Bus 18 being de-energized, and also evaluated the 1/2 EDG cooling water pump failure to start despite the EDG starting.

While risk-significant functions were impacted, the condition lasted only a few minutes. A model reflecting plant conditions resulted in Core Damage Frequency and Large Early Release Frequency both well below the 1E-07 threshold for significance.

This is a Maintenance Rule Functional Failure.

In conclusion, the overall safety significance and impact on risk of this event were minimal.

E. CORRECTIVE ACTIONS

Immediate:

1. Bus 13-1, Bus 18, and other equipment was recovered.
2. The surveillance was re-performed with satisfactory results utilizing temporary revised procedural guidance to block trip signals to the bus by opening knife switches.

Follow-up:

1. Completed troubleshooting and verifications of Bus 13-1 Cubicle 2 during the refuel outage Q1R25. No additional causes were identified.
2. Implement permanent procedure revisions to open knife switches prior to relay testing to preclude similar bus trips in the future.

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F. PREVIOUS OCCURRENCES

The station events database and LERs were reviewed for similar events at Quad Cities Nuclear Power Station in the last 10 years. One LER, 265/2011-001-00, described a loss of the Unit 2 ESS Bus due to inadvertent contact with the bus feed breaker local trip pushbutton by a station employee during unrelated work in the areas. While both events resulted in the loss of an important bus, there is no apparent connection or unresolved vulnerabilities identified between the two events.

G. COMPONENT FAILURE DATA

No equipment failure has been identified. Information below is for the relays that were inadvertently actuated.

Equipment: HFA Multicontact Auxiliary Relay
Component Manufacturer: General Electric
Component Model Number: HFA
Component Part Number: 12HFA151A2F

This event has been reported to ICES.