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Serial No: RA-22-0125  
April 19, 2022

10 CFR 50.73

U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555  
ATTENTION: Document Control Desk

Subject: Duke Energy Carolinas, LLC  
McGuire Nuclear Station, Unit 2  
Docket No. 05000370  
Renewed License No. NPF-9, NPF-17  
Licensee Event Report 2022-01, Revision 0  
Nuclear Condition Report Number 02416694

Pursuant to 10 CFR 50.73 Section (a)(2)(iv)(A), attached is Unit 2 Licensee Event Report (LER) 2022-01, Revision 0, regarding valid actuations of the Unit 2 Reactor Protection System and Auxiliary Feedwater System.

This event is considered to have no significance with respect to the health and safety of the public. There are no regulatory commitments contained in this LER.

If questions arise regarding this LER, please contact Jeff Thomas at 980-875-4499.

Sincerely,

A handwritten signature in black ink that reads "Edward R. Pigott". The signature is fluid and cursive, with the first letters of the first and last names being capitalized and prominent.

Edward R. Pigott  
Duke Energy  
McGuire Nuclear Station  
Site Vice President

Attachment

U.S. Nuclear Regulatory Commission  
RA-22-0125  
Page 2

cc: Laura A. Dudes  
Administrator Region II  
U.S. Nuclear Regulatory Commission  
Marquis One Plaza  
245 Peachtree Center Avenue  
NE Suite 1200, 30303-1257

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Andy Hutto  
NRC Senior Resident Inspector  
McGuire Nuclear Station



## LICENSEE EVENT REPORT (LER)

(See Page 3 for required number of digits/characters for each block)

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1. Facility Name McGuire Nuclear Station, Unit 2	4 05000-370	3. Page 1 OF 6
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4. Title  
Valid Actuation of the Unit 2 Reactor Protection System and Auxiliary Feedwater System

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	18	2022	2022	- 001 -	00	4	19	2022	Facility Name	Docket Number
										05000
										05000

9. Operating Mode 1	10. Power Level 100
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11. This Report is Submitted Pursuant to the Requirements of 10 CFR §: (Check all that apply)				
<b>10 CFR Part 20</b>	<input type="checkbox"/> 20.2203(a)(2)(vi)	<input type="checkbox"/> 50.36(c)(2)	<input checked="" type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)
<input type="checkbox"/> 20.2201(b)	<input type="checkbox"/> 20.2203(a)(3)(i)	<input type="checkbox"/> 50.46(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(v)(A)	<b>10 CFR Part 73</b>
<input type="checkbox"/> 20.2201(d)	<input type="checkbox"/> 20.2203(a)(3)(ii)	<input type="checkbox"/> 50.69(g)	<input type="checkbox"/> 50.73(a)(2)(v)(B)	<input type="checkbox"/> 73.71(a)(4)
<input type="checkbox"/> 20.2203(a)(1)	<input type="checkbox"/> 20.2203(a)(4)	<input type="checkbox"/> 50.73(a)(2)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(v)(C)	<input type="checkbox"/> 73.71(a)(5)
<input type="checkbox"/> 20.2203(a)(2)(i)	<b>10 CFR Part 21</b>	<input type="checkbox"/> 50.73(a)(2)(i)(B)	<input type="checkbox"/> 50.73(a)(2)(v)(D)	<input type="checkbox"/> 73.77(a)(1)(i)
<input type="checkbox"/> 20.2203(a)(2)(ii)	<input type="checkbox"/> 21.2(c)	<input type="checkbox"/> 50.73(a)(2)(i)(C)	<input type="checkbox"/> 50.73(a)(2)(vii)	<input type="checkbox"/> 73.77(a)(2)(i)
<input type="checkbox"/> 20.2203(a)(2)(iii)	<b>10 CFR Part 50</b>	<input type="checkbox"/> 50.73(a)(2)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(viii)(A)	<input type="checkbox"/> 73.77(a)(2)(ii)
<input type="checkbox"/> 20.2203(a)(2)(iv)	<input type="checkbox"/> 50.36(c)(1)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(ii)(B)	<input type="checkbox"/> 50.73(a)(2)(viii)(B)	
<input type="checkbox"/> 20.2203(a)(2)(v)	<input type="checkbox"/> 50.36(c)(1)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(iii)	<input type="checkbox"/> 50.73(a)(2)(ix)(A)	
<input type="checkbox"/> Other (Specify here, in Abstract, or in NRC 366A).				

12. Licensee Contact for this LER	
Licensee Contact Jeff Thomas	Phone Number (Include Area Code) (980) 875-4499

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
B	JJ	CBD	B455	Y					

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

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

On 2/18/2022, at 0449 hours, McGuire Nuclear Station Unit 2 Digital Electro-Hydraulic Control System (DEH) experienced a component failure causing a spurious rapid turbine load rejection and un-demanded closure of Throttle Valves (TV) #2 and #4. During the event, the DEH system reverted to manual control, reactor power decreased, and plant systems responded as expected. Due to plant stability concerns, the reactor was manually tripped at 0459. Following the reactor trip, steam generator (SG) levels decreased to the Auxiliary Feedwater System (AFW) autostart setpoint and all AFW pumps started as expected and began providing feedwater to the SGs. This additional SG input lowered reactor coolant average temperature and resulted in a Feedwater Isolation as designed. The reactor trip was uncomplicated with all systems responding normally post-trip.

Subsequent analyses determined that an electrical disturbance, originating from within the DEH control system cabinet caused DEH to react in an unexpected manner and produce un-demanded turbine valve movement. A contributing factor is that some DEH circuit cards had embedded batteries operating past their expected service life. These cards did not retain control logic and did not reconfigure as expected when reenergized. Corrective actions included hardening the DEH system by performing power-to-ground audits and replacing failed controller modules, cabinet power supplies, and a subset of circuit cards with embedded batteries. A DEH replacement project is currently in the design phase scheduled for implementation in Fall 2024 (Unit 2) and Spring 2025 (Unit 1).





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

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1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
McGuire Nuclear Station, Unit 2	05000-370	2022	- 001	- 00

**NARRATIVE**

**BACKGROUND**

The following information is provided to assist readers in understanding the event described in this LER. Applicable Energy Industry Identification [EII] system and component codes are enclosed within brackets.

Reactor Protection System [JC]:

The Reactor Protection System (RPS) keeps the Reactor operating within a safe operating range by automatically shutting down the Reactor whenever the limits of the operating range are approached by monitoring process variables. Whenever a direct or calculated process variable exceeds a setpoint the Reactor is automatically tripped to protect against fuel cladding damage or loss of RCS integrity. Station operators may elect to manually actuate the reactor trip switchgear (manual reactor trip) using either of two control board switches.

Engineering Safety Feature Actuation System [JE]:

The Engineering Safety Feature Actuation System (ESFAS) initiates necessary safety systems, based on the values of selected unit parameters, to protect against violating core design limits and the RCS pressure boundary, and to mitigate accidents.

Feedwater System [SJ]:

The Feedwater System takes treated Condensate System water, heats it further to improve the plant's thermal cycle efficiency, and delivers it at the required flow rate, pressure, and temperature to the steam generators (SGs). The Feedwater System is designed to maintain proper vessel water levels with respect to reactor power output and turbine steam requirements.

An Automatic Feedwater Isolation (FWI) signal will occur if any of the following conditions occur: (1) Safety Injection actuation, (2) Hi Hi SG level (83% Narrow Range on 2/3 channels on 1/4 SGs), and (3) Reactor trip with low Tave (P-4 and < 553 degrees Fahrenheit (F) on 2/4 loops).

Digital Electro-Hydraulic Control System [JJ]:

The purpose of the Digital Electro-Hydraulic (DEH) Control System is to control the speed and load of the turbine generator by positioning the throttle and governor valves to control steam flow to the turbine.

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**BACKGROUND (continued)****Auxiliary Feedwater System [BA]:**

The Auxiliary Feedwater System (AFW) automatically supplies feedwater to the SGs to remove decay heat from the RCS upon the loss of normal feedwater supply. The AFW mitigates the consequences of any event with loss of normal feedwater. The design basis of the AFW is to supply water to the SGs to remove decay heat and other residual heat by delivering at least the minimum required flow rate to the SGs.

The AFW is designed to start automatically for any event requiring emergency feedwater.

The AFW Motor Driven Pumps will automatically provide feedwater when initiated on any of the following conditions:

1. Trip of both main feedwater pumps
2. AMSAC Actuation (AMSAC - Anticipated Transient Without Scram (ATWS) Mitigation System Activation Circuitry)
3. Two out of four (2/4) low-low level alarms in any one SG
4. Initiation of a safety injection signal
5. Loss of power to the 4160V essential bus (Blackout)

The AFW Turbine Driven Pump will automatically provide feedwater when initiated on any of the following conditions:

1. Two out of four (2/4) low-low level alarms in any two SGs
2. Loss of power to the 4160V essential bus (Blackout)
3. 1/1 detector from Standby Shutdown Facility (SSF) SG Wide Range Low-Low Level on 2/4 SGs (72%)

**EVENT DESCRIPTION**

On 2/18/2022, at 0449 hours, McGuire Nuclear Station Unit 2 Digital Electro-Hydraulic Control System (DEH) experienced a component failure causing a spurious rapid turbine load rejection and un-demanded closure of Throttle Valves (TV) #2 and #4. During the event, the DEH system reverted to manual control, reactor power decreased, and plant systems responded as expected. The DEH graphical display and control board megawatt output display indicated full power values and did not update as expected in response to changes in governor and throttle valve positions.

Due to plant stability concerns, the reactor was manually tripped at 0459. Following the reactor trip, SG levels decreased to the AFW autostart setpoint (17 percent narrow range level) and all AFW pumps (i.e., the 2A AFW Motor Driven Pump, 2B AFW Motor Driven Pump, and Unit 2 AFW Turbine Driven Pump) started as expected and began providing feedwater to the SGs. This additional SG input lowered reactor coolant average temperature to less than 553 degrees F on 2/4 loops and resulted in a Feedwater Isolation as designed. The reactor trip was uncomplicated with all systems responding normally post-trip.



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**EVENT DESCRIPTION (continued)**

Provided below is a sequence of key events obtained from Control Room Logs and Operator Aid Computer (OAC) alarms. All times are approximate.

**Sequence of Events on 2/18/2022:**

04:49:29 - U2 COND SYSTEM IN LOAD REJECTION - ALARM  
04:49:29 - U2 DEH IN MANUAL - ALARM  
04:49:53 - U2 TURB GOVERNOR VLV 3 - CLOSED  
04:49:53 - U2 TURB GOVERNOR VLV 4 - CLOSED  
04:49:54 - U2 TURB GOVERNOR VLV 1 - CLOSED  
04:53:13 - U2 TURB THROTTLE VLV 2 - CLOSED  
04:59:03 - U2 TURB THROTTLE VLV 4 - CLOSED  
04:59:17 - U2 TRAIN A MANUAL REACTOR TRIP - ALARM  
04:59:17 - U2 TRAIN B MANUAL REACTOR TRIP - ALARM  
04:59:17 - U2 TURBINE TRIP - ALARM  
05:02:00 - 2A Motor Driven AFW Pump Start (Automatic start on low-low SG level)  
05:02:00 - 2B Motor Driven AFW Pump Start (Automatic start on low-low SG level)  
05:02:00 - #2 Turbine Driven AFW Pump Start (Automatic start on low-low SG level)  
05:10:19 - FEEDWATER ISOLATION - INITIATING SIGNAL (Reactor Trip with Low Tave)

The governor valve positions shown above are remote position indications only. Post event simulator runs with a similar DEH response indicate that the governor valves moved rapidly to throttled positions lower than expected for a load rejection but did not fully close based on steam flow to the main turbine. The simulator runs were able to mimic the load rejection, throttle valve response, and other conditions observed by operators during the event.

**REPORTABILITY DETERMINATION**

The Unit 2 RPS actuation while critical was a valid actuation and initially reported, as required, under 10 CFR 50.72 (b)(2)(iv)(B), "Any event or condition that results in actuation of the Reactor Protection System (RPS) when the reactor is critical except when the actuation results from and is part of a pre-planned sequence during testing or reactor operation." The event also resulted in the valid actuation of the TDCA pump and MDCA pumps and was initially reported, as required, under 10 CFR 50.72(b)(3)(iv)(A). This LER satisfies the corresponding written reporting criteria in 10 CFR 50.73 (a)(2)(iv)(A), "Any event or condition that resulted in manual or automatic actuation of any of the systems listed in paragraph (a)(2)(iv)(B)." The applicable 10 CFR 50.73(a)(2)(iv)(B) systems include the Reactor Protection System and the Auxiliary Feedwater System.

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**CAUSAL FACTORS**

Subsequent analyses determined that an electrical disturbance, originating from within the DEH control system cabinet, caused DEH to react in an unexpected manner and produce un-demanded turbine valve movement. A contributing factor is that some DEH circuit cards had embedded batteries operating past their expected service life. When these circuit cards reenergized after the electrical disturbance, they lost their memory and did not reconfigure as expected. For example, the DEH graphical display and control board megawatt output display indicated full power values and did not update as expected in response to changes in governor and throttle valve positions.

**CORRECTIVE ACTIONS**

Immediate actions included hardening DEH by replacing the failed controller modules, cabinet power supplies, and a subset of circuit cards with embedded batteries. Power-to-ground audits were performed before and after replacement of the cabinet power supplies. Furthermore, DEH cabinet ground checks, DC control voltage power quality checks, and the DEH outage preventive maintenance testing procedure were performed.

Additional actions, which include the following, will be performed in the next scheduled outage for each unit:

- Perform full cabinet energized cable/termination checks/testing
- Cabinet/card thermography
- Replace controller modules with manufacturer refurbished/tested units, including new battery-backed memory chips
- Replace cabinet power supply chassis and power monitoring module
- Perform cabinet power quality and grounding testing

A DEH replacement project is currently funded and in the design planning phase scheduled for replacement in Fall 2024 (Unit 2) and Spring 2025 (Unit 1).

**SAFETY ANALYSIS**

Following the reactor trip, SG levels decreased to the AFW autostart setpoint and all AFW pumps started as expected and began providing feedwater to the SGs. This additional SG input lowered reactor coolant average temperature and resulted in a Feedwater Isolation as designed. Operators manually tripped the reactor in accordance with plant operating procedures. The reactor trip was uncomplicated with no impact to the health and safety of the public.

A post-trip review found no procedural or human performance issues with the operator response. Furthermore, there was no equipment out of service or safety significant activities in progress at the time of the event that contributed to the event. Excluding the DEH malfunction, plant systems responded as expected. Therefore, it is concluded that the impact on core damage risk was very small, and the event had no impact on public health and safety.





# LICENSEE EVENT REPORT (LER) CONTINUATION SHEET

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## ADDITIONAL INFORMATION

A review of the McGuire corrective action program was conducted to determine if this was a recurring event (i.e., similar event with the same cause or same failure mode). No previous similar events were identified within the past three years associated with a reactor trip caused by failure of the DEH system. Therefore, this is not considered a recurring event.