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Serial No: MNS-14-027

March 6, 2014

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

10 CFR 50.73

Subject: Duke Energy Carolinas, LLC
McGuire Nuclear Station, Unit 1
Docket No. 50-369
Licensee Event Report 369/2013-03, Revision 1
Problem Investigation Process Number M-13-10440

Pursuant to 10 CFR 50.73 Sections (a) (1) and (d), attached is Revision 1 to Licensee Event Report (LER) 369/2013-03, regarding Unit 1 manual reactor trip and Auxiliary Feedwater start due to dropped control rods.

This revision to LER 369/2013-03 supersedes the LER previously submitted January 13, 2014. The cause analysis has been completed, which included laboratory testing that was reviewed by a third party and confirmed the cause that was previously reported in Revision 0 of the LER. Completion of the cause analysis has not affected the original reporting criteria which was completed in accordance with 10 CFR 50.73 (a)(2)(iv)(A), "System Actuation".

Additionally, the revision did not affect the significance of the event which was considered to be of no significance with respect to the health and safety of the public. There are no regulatory commitments contained in this LER revision.

If questions arise regarding this LER, please contact P.T. Vu of Regulatory Affairs at 980-875-4302.

Sincerely,

Steven D. Capps

Attachment

IE22
NRR

www.duke-energy.com

Received @ DPC on 4/16/14

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NRC FORM 366 (02-2014) U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

(See page 2 for required number of digits/characters for each block)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
McGuire Nuclear Station, Unit 1	05000- 369	1 OF 6

4. TITLE

Manual Reactor Trip and Auxiliary Feedwater Start due to Dropped Control Rods

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
									None	
11	14	2013	2013	03-03	1	03	06	2014	FACILITY NAME None	DOCKET NUMBER

9. OPERATING MODE

1

10. POWER LEVEL

100

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*

☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☒ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ OTHER
☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	☐ Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

LICENSEE CONTACT	TELEPHONE NUMBER (Include Area Code)
P.T. Vu, Regulatory Affairs	980-875-4302

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
B	JD	RJX	A048	Y						

14. SUPPLEMENTAL REPORT EXPECTED				15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
	YES (If yes, complete EXPECTED SUBMISSION DATE)	X	NO				

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

On November 14, 2013, at 13:13, Unit 1 was manually tripped from 100% power due to 10 dropped control rods associated with Rod Control Power Cabinet 1AC. The remaining control rods fully inserted into the core following the manual reactor trip. Unit 1 was stabilized in Mode 3 at normal operating temperature and pressure. The motor-driven Auxiliary Feedwater Pumps 1A and 1B were manually started for steam generator level control. This event did not impact public health and safety.

The cause of the event was an inadequate modification, resulting in an over-voltage protection (OVP) setpoint too close to the normal output of both the primary and backup -24 VDC rod control power supplies. The design called for the OVP function to be implemented with an installed jumper configuration that set the OVP setpoint too close to the normal output voltage.

Actions were taken to replace other Unit 1 power supplies with available power supplies that will not shut down under similar conditions. Due to limited spares, immediate replacement was limited to all applicable primary supplies and two backup supplies on Unit 1. The remaining backup power supplies installed in Unit 1 and the susceptible Unit 2 power supplies will be replaced as part of the planned corrective actions.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
McGuire Nuclear Station, Unit 1	05000369	2013	- 03 -	1	2 OF 6

17. NARRATIVE

BACKGROUND

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

Rod Control System [JD](IRE):

The IRE system provides for reactor power modulation by manual or automatic control of full length control rod banks in a pre-selected sequence and for manual operation of individual banks. Alarms are provided to alert the operator in the event of a control rod deviation exceeding a preset limit. The IRE system controls the motion of the full length control rods in response to manual or automatic signals from the reactor control system. The power cabinets convert the Rod Drive Motor Generator (RDMG) alternating current (AC) supply to direct current (DC) supply required to energize the Control Rod Drive Mechanism (CRDM) coils. Circuits in the logic cabinet receive the reactor control system speed, direction, and bank selection control signals and generate the power cabinets rod group/bank sequencing (that is, multiplexing) and current regulation control signals for the shutdown and control banks. The failure detection circuits in each power cabinet include urgent alarms (for example, regulation, phase, multiplexer) and non-urgent alarms (for example, loss of redundant +24 VDC power supply). Four power supplies PS1, PS2, PS3 and PS4 constitute two redundant sets of power supplies for each power cabinet. Each power cabinet is equipped with two +24 VDC (PS1 and PS2) and two -24 VDC (PS3 and PS4) power supplies. PS1 and PS3 are main power supplies while PS2 and PS4 are auxiliary or backup power supplies for PS1 and PS3, respectively. For Unit 1, PS3 receives 120 VAC input from the RDMG via a 260/120 VAC transformer, and PS4 receives 120 VAC input from power supply KRA. Each Unit 1 power cabinet has two ventilation fans, which share 120 VAC input power with PS2 and PS4 via the same breaker of KRA.

Reactor Protection System [JC](IPE):

The IPE system automatically keeps the reactor operating within a safe region by shutting down the reactor whenever the limits of the region are approached. The safe operating region is defined by several considerations such as mechanical/hydraulic limitations on equipment and heat transfer phenomena. Therefore, the IPE system monitors process variables that are directly related to equipment mechanical limitations, such as pressure and pressurizer water level, and also on variables that directly affect the heat transfer capability of the reactor. Other parameters utilized in the IPE system are calculated from various process variables. Whenever a direct process or calculated variable exceeds a setpoint, the reactor is shut down in order to protect against either gross damage to fuel cladding or loss of system integrity, which could lead to release of radioactive fission products into the Containment. The various reactor trip circuits automatically open the reactor trip breakers whenever a condition monitored by the IPE system reaches a preset or calculated level. Station operators may elect to actuate the reactor trip switchgear manually (manual reactor trip) using either of two control board switches. One switch actuates the train A trip breaker; the other switch actuates the train B trip breaker. Operating either manual trip switch removes the voltage from the under-voltage trip coil, energizes the shunt trip coil, and trips the reactor.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
McGuire Nuclear Station, Unit 1	05000369	2013	- 03 -	1	3 OF 6

17. NARRATIVE

Auxiliary Feedwater System [BA](CA):

The CA System provides an emergency feedwater supply to the Steam Generators [SG](SG) if the respective Unit's Feedwater System [SJ](CF) is not available to maintain SG water inventory. This ensures the capability to transfer fission product decay heat and other residual heat loads from the Reactor Coolant System [AB](NC) during both normal operation and accident conditions. Each Unit's CA system contains an "A" and "B" Train motor-driven pump and a "C" Train turbine-driven pump. These pumps will automatically start upon receipt of a signal satisfying the logic for automatic start of the respective pump, or each pump can be manually started from the control room.

EVENT DESCRIPTION

On November 14, 2013, at approximately 10:20, an Instrumentation and Electrical (IAE) crew was working on an emergent Work Request for an out of service blower fan in Cabinet 1AC. Upon restoring the fuse for the fan, the control room unexpectedly received annunciator alarm "Rod Control Non-Urgent Failure." It was suspected that a fuse or power supply problem caused the alarm. Following work package preparation, control rods were placed in manual control as a precaution and the IAE crew went to Cabinet 1AC to pull the supply fuse for the suspect power supply (PS4). At approximately 13:13 on the same day, after pulling the PS4 supply fuse, the control room received various control rod related alarms and observed multiple dropped rods (Control Bank A, Group 1, 2 rods; Control Bank C, Group 1, 4 rods; and Shutdown Bank A, Group 1, 4 rods).

As directed by procedure, Operators immediately initiated a Unit 1 reactor trip at approximately 13:13 by manually tripping the reactor. The remaining control rods fully inserted into the core following the manual reactor trip. Unit 1 was stabilized in Mode 3 at normal operating temperature and pressure. At approximately 13:16, the motor-driven Auxiliary Feedwater Pumps 1A and 1B were manually started for steam generator level control. This event did not impact public health and safety.

The cause of the dropped control rods was loss of power to the control rod drive mechanism (CRDM) stationary grippers. The loss of power occurred during troubleshooting of -24 VDC power supply circuitry in Cabinet 1AC following receipt of a "Rod Control Non-Urgent Failure" alarm. Removal of the AC supply fuse for a previously shut off -24 VDC power supply (PS4) created a disturbance in the -24 VDC power supply circuitry sufficient to shut off the remaining -24 VDC power supply (PS3) on an over-voltage condition.

The relevant sequence of events on November 14, 2013 is as follows (~ indicates approximate):

~10:20	IAE replaced blower fan fuse in Cabinet 1AC and fan started
~10:20	Control room received Rod Control Non-Urgent Failure Alarm
~10:20	IAE checked Power Supply PS4 voltage and it was low
~13:13	IAE pulled supply fuse in Cabinet 1AC to troubleshoot Power Supply PS4
~13:13	Cabinet 1AC Power Supply PS3 shut off due to over-voltage protection circuit
13:13:20	Unit 1 Max Rod Deviation Shutdown Bank A
13:13:20	Unit 1 Max Rod Deviation Control Bank C

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
McGuire Nuclear Station, Unit 1	05000369	2013	- 03 -	1	4 OF 6

17. NARRATIVE

13:13:22 Unit 1 Max Rod Deviation Control Bank A
13:13:27 Unit 1 Manual Reactor Trip
13:13:27 Unit 1 Turbine Trip
~13:16 Motor-Driven CA Pumps manually started for SG level control

REPORTABILITY DETERMINATION

The Unit 1 manual reactor trip was reported per 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 manual start of the CA pumps was reported per 10 CFR 50.72 (b)(3)(iv)(A), "Any event or condition that results in valid actuation of any of the systems listed in paragraph (b)(3)(iv)(B) of this section, except when the actuation results from and is part of pre-planned sequence during testing or reactor operation.

Actuation of the RPS and CA Systems is also reportable pursuant to the requirements of 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) of this section." The systems listed in paragraph (a)(2)(iv)(B) include the RPS and CA systems.

CAUSAL FACTORS

The cause analysis has been completed, which included laboratory testing that was reviewed by a third party and confirmed the cause that was previously reported in Revision 0 of the LER.

The cause evaluation identified the cause as an inadequate modification. Modification MGMM-8765 in 1997 was initiated to replace original -24 VDC rod control Lambda (LCS-A-24-6795) power supplies with Abbott (LV24AET0.9-1-2-ER) power supplies for PS3 and PS4. The design called for the over-voltage protection (OVP) function to be implemented. The resulting installation and jumper configuration for the new Abbott power supplies added the OVP function with insufficient margin between the OVP setpoint and the required power supply output operating voltage.

The -24 VDC power supplies were placed in service with inadequate OVP setpoint margin above normal operating voltage for their required parallel/redundant function. The -24 VDC Abbott power supplies have operated well under stable conditions but are vulnerable to OVP shutdown during small voltage transients due to insufficient margin. Subsequent testing in both the field and laboratory has demonstrated that transients initiated by removing or replacing a cabinet fan supply fuse can shut off the Abbott power supply that shares power with the fan. It was observed that DC power supply fuse removal to the PS3 or PS4 power supply can shut off the redundant Abbott power supply due to the loss of margin in the OVP circuit. The Westinghouse rod control system engineer reviewed the laboratory test results and agreed with the conclusion.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
McGuire Nuclear Station, Unit 1	05000369	2013	- 03 -	1	5 OF 6

17. NARRATIVE

CORRECTIVE ACTIONS

Immediate:

1. Replaced the Abbott power supplies in Unit 1 Power Cabinet 1AC (PS3, PS4) with available spare Nuclear Logistics, Inc. (NLI) power supplies. Replaced the Abbott power supplies in Unit 1 Power Cabinets 2AC (PS3), 2BD (PS4) and SCDE (PS3) with available spare NLI power supplies to address extent of condition. Replacement of the primary (PS3) Abbott power supplies was first priority given the limited number of available NLI spares. Note that Abbott power supplies remain installed in the Unit 1 Power Cabinets but are confined to the backup power supply (PS4) function in Power Cabinets 2AC, 1BD and SCDE. These remaining Abbott power supplies will be replaced as part of the planned corrective action.

2. Performed primary/backup power supply fail-over test in all Unit 1 Power Cabinets following power supply replacements.

3. Performed power supply checks prior to Rod Cluster Control Assembly (RCCA) Movement Test via procedure IP/0/B/3211/001C.

4. Performed RCCA Movement Test for all banks via procedure PT/1/A/4600/001.

Subsequent:

1. Protected all Unit 1 and Unit 2 Rod Control Logic, DC Hold and Power Cabinets.

2. Protected KRB Regulated Power Panel Board (Unit 2 Rod Control Power Supply Auxiliary Power).

Planned:

1. Replace remaining Abbott power supplies in Unit 1 and Unit 2 Rod Control Cabinets with NLI power supplies to address extent of condition.

SAFETY ANALYSIS

The McGuire Unit 1 trip on November 14, 2013 is considered to be an uncomplicated reactor trip event with no significant impact on public health and safety. A post-trip review found no procedure or human performance issues with the operator response to the event. Therefore it is concluded that the conditional core damage probability for the Unit 1 reactor trip was very low (< 1E-6) based on quantitative analysis of similar events at McGuire and does not cause a significant increase in risk to the public. The plant responded normally to the reactor trip, and it was returned to 100% power on November 16, 2013. No equipment important to plant safety was out of service at the time of the reactor trip. There was no radioactive release to the atmosphere during this event.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
McGuire Nuclear Station, Unit 1	05000369	2013	- 03 -	1	6 OF 6

17. NARRATIVE

ADDITIONAL INFORMATION

A search of the McGuire Problem Identification Process (PIP) database was conducted to determine if this event was recurring, i.e., similar significant event with the same cause code. The search identified PIP M-10-04111. This PIP involves a unit shutdown required by Technical Specifications due to dropped control rods. The cause of the dropped rods was a degraded solder joint in a rod control system power cabinet regulation card supplied by a vendor. Therefore, this is not considered a recurring event.