Duke Energy®

T. PRESTON GILLESPIE, JR.
Vice President
Oconee Nuclear Station

Duke Energy
ON01VP / 7800 Rochester Hwy.
Seneca, SC 29672

864-873-4478
864-873-4208 fax
T.Gillespie@duke-energy.com

February 23, 2012

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

Subject: Oconee Nuclear Station
Docket No. 50-269
Licensee Event Report 269/2011-05, Revision 1
Problem Investigation Program No.: O-11-7081

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), Duke Energy Carolinas, LLC submitted Licensee Event Report (LER) 269/2011-005, Revision 0 dated August 9, 2011, regarding the incorrect wiring of all four channels of power range nuclear instrumentation. Attached is LER 269/2011-05, Revision 1 which includes the completed cause analysis and risk information which was not available at the time Revision 0 was submitted. This report is being submitted in accordance with 10 CFR 50.73 (a)(2)(i)(B), 10 CFR 50.73 (a)(2)(v)(D), and 10 CFR 50.73 (a)(2)(vii). This event is considered to be of no consequence with respect to the health and safety of the public.

There are no regulatory commitments contained in this report. Any questions regarding the content of this report should be directed to Sandra N. Severance, Oconee Regulatory Compliance at 864-873-3466.

Sincerely,

TPGillespie
T. Preston Gillespie, Jr.
Vice President
Oconee Nuclear Site

Attachment

IE22
NRR

cc: Mr. Victor McCree
Administrator, Region II
U.S. Nuclear Regulatory Commission
Marquis One Tower
245 Peachtree Center Ave., NE, Suite 1200
Atlanta, GA 30303-1257

Mr. John Stang
Project Manager
U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, DC 20555

Mr. Andrew Sabisch
NRC Senior Resident Inspector
Oconee Nuclear Station

INPO (Word File via E-mail)

NRC FORM 366 U.S. NUCLEAR REGULATORY COMMISSION
(10-2010)

LICENSEE EVENT REPORT (LER)

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

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Oconee Nuclear Station, Unit 1	05000269	1 OF 5

4. TITLE

Reactor Protection System Overpower Flux/Flow/Imbalance Channels Inoperable

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
06	10	2011	2011	– 005	– 01	02	23	2012	FACILITY NAME	DOCKET NUMBER

9. OPERATING MODE

1

10. POWER LEVEL

048

11. 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

FACILITY NAME	TELEPHONE NUMBER (Include Area Code)
Sandra N. Severance, Licensing Engineer	(864) 873-3466

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
D	NI	IMOD	AREVA	Y						

14. SUPPLEMENTAL REPORT EXPECTED

☐ YES (If yes, complete EXPECTED SUBMISSION DATE) ☒ NO

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR

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

During Refueling Outage 1EOC26 for Oconee Unit 1, implementation of the digital Reactor Protection System/Engineered Safeguards (RPS/ES) upgrade was performed. During initial startup and after increasing power to 48 percent, site personnel questioned the unexpected response of the RPS power range nuclear instrumentation (NIs). Although appearing to respond appropriately for total reactor power, the power range NIs did not appear to be responding adequately to power imbalances compared to the incore detector indications.

Investigation into the cause of the Unit 1 NI imbalance indications determined that the triaxial cables for the top and bottom chambers of the power range nuclear instrumentation signals were reversed at the RPS Power Range Test Module for each RPS channel. At 0802 on June 10, 2011, the four channels of the RPS Flux/Flow/Imbalance parameter were declared inoperable. This resulted in a loss of safety function, operation prohibited by Technical Specifications, and a single cause resulting in multiple independent RPS channels being inoperable. This event was reported via an 8-hour notification per 10 CFR 50.72(b)(3)(v)(D) (Event Report 46947). The triaxial cable connections were corrected and the RPS channels were declared operable at 1511 on June 10, 2011.

This event is considered to have no consequence with respect to the health and safety of the public.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REV NO	
Oconee Nuclear Station, Unit 1	05000269	11	- 005 -	01	2 of 5

NARRATIVE

BACKGROUND:

The Reactor Protective System (RPS) [EIIS: JC] initiates a reactor trip to protect against violating the core fuel design limits and the Reactor Coolant System (RCS) [EIIS: AB] pressure boundary during anticipated transients. By tripping the reactor, the RPS also assists the Engineered Safeguards (ES) Systems [EIIS: JE] in mitigating accidents.

The protective and monitoring systems have been designed to assure safe operation of the reactor. This is achieved by specifying limiting safety system settings (LSSS) in terms of parameters directly monitored by the RPS, as well as the Limiting Conditions for Operation (LCOs) on other reactor system parameters and equipment performance.

The LSSS, in conjunction with the LCOs, establish the threshold for protective system action to prevent exceeding acceptable limits during accidents or transients.

During anticipated transients, which are those events expected to occur one or more times during the unit's life, the acceptable limit is:

a. The departure from nucleate boiling ratio (DNBR) shall be maintained above the Safety Limit (SL) value;

b. Fuel centerline melt shall not occur; and

c. The RCS pressure SL of 2750 psia shall not be exceeded.

Maintaining the parameters within the above values ensures that the offsite dose will be within the 10 CFR 20 and 10 CFR 100 or 10 CFR 50.67 criteria during anticipated transients. The acceptable limit during accidents is that the offsite dose shall be maintained within reference 10 CFR 100 or 10 CFR 50.67 limits. Meeting the acceptable dose limit for an accident category is considered having acceptable consequences for that event.

During the Unit 1 Refueling Outage 1EOC26, a digital RPS/ES system was installed. The RPS consists of four independent protective channels (A, B, C, and D) [EIIS: CHA]. Each RPS protective channel contains the sensor input modules [EIIS: IMOD], a protective channel computer [EIIS:CPU], output modules, four hardwired (energized during power operations) reactor trip relays (RTRs) (A, B, C, and D) [EIIS: RLY] and their associated 120 VAC contacts [EIIS: CNTR] (closed when RTR is energized). Protective channel A controls the channel A RTR and also controls the A RTR in channels B, C, and D. Likewise, channels B, C and D control the respective RTR in each of the four channels. Each energized RTR (A, B, C, and D) in each RPS channel A, B, C, and D maintains two closed 120 VAC contacts. One contact from each RTR is configured in two separate redundant output trip actuation logic schemes. Each output trip actuation logic scheme contains a contact from each of the four RTRs in the four channels. This configuration results in a two-out-of-four coincidence reactor trip logic. If any channel protective set initiates a trip signal, the respective four RTRs (one in each of the four channels) de-energize and open the respective contacts. The outputs from the RTR contacts interrupt the 120 VAC power [EIIS:EF] to the CRD (control rod drive) [EIIS:AA] trip devices.

Three of the four RPS protective channel computers (A, B, and C) [EIIS: CPU] also perform a redundant Engineered Safeguards Protective System (ESPS) logic function. Therefore, three of the four RPS protective channels calculate both RPS and ESPS functions, and the fourth RPS channel D calculates only RPS functions.

The RPS Nuclear Overpower Flux/Flow/Imbalance channels [EIIS: IG] are part of the digital RPS/ES system. The Nuclear Overpower Flux/Flow/Imbalance trip provides steady state protection for the power imbalance Safety Limits. A reactor trip is initiated prior to the core power, Axial Power Imbalance, and reactor coolant flow conditions exceeding the departure from nucleate boiling (DNB) or fuel centerline temperature limits.

This trip supplements the protection provided by the Reactor Coolant Pump (RCP) [EIIS:P] to Power trip, through the power to flow ratio, for loss of reactor coolant flow events. The power to flow ratio provides direct protection for the departure from nucleate boiling ratio (DNBR) Safety Limit for the loss of one or more RCPs and for locked RCP rotor accidents.

The power to flow ratio of the Nuclear Overpower Flux/Flow/Imbalance trip also provides steady state protection to prevent reactor power from exceeding the allowable power when the primary system flow rate is less than full four pump flow. Thus, the power to flow ratio prevents overpower conditions similar to the Nuclear Overpower trip. This protection ensures that during reduced flow conditions the core power is maintained below that required to begin DNB.

EVENT DESCRIPTION

During startup from Refueling Outage 1EOC 26 for Unit 1 on June 10, 2011, during which implementation of the digital RPS/ES upgrade was performed, inconsistencies were observed between RPS excore detector imbalance and the incore imbalance while holding at approximately 48 percent power. All four of the RPS Flux/Flow/Imbalance channels were declared inoperable.

At 25 percent power, the normal startup procedures were performed to recalibrate the RPS power range channels at approximately 2300 on June 9, 2011. At 0000 on June 10, 2011, RPS Excore NI Imbalance was approximately -1.8 average for all power range NIs. Incore imbalance was -1.45. This was within an acceptable range.

After increasing power to 48 percent as indicated by excore detectors, it was observed that RPS power range nuclear instrumentation, although appearing to respond appropriately for total reactor power, did not appear to be responding adequately to power imbalance differences. As power is increased, imbalance is expected to become more negative and this is reflected in the incore detectors response (a typical response). However, all of the power range NIs did not reflect this decreasing imbalance. At 0600 on 6/10/11 RPS Excore NI imbalance was approximately -0.76 average for all power range NIs. Incore imbalance was -4.23. This was not acceptable.

At 0802 on June 10, 2011, all four channels of the RPS Flux/Flow/Imbalance parameter were declared inoperable. This resulted in a loss of safety function per 10 CFR 50.73(a)(2)(v)(D) and operation prohibited by TS per 10 CFR 50.73(a)(2)(i)(B). Additionally, since a single cause resulted in multiple independent RPS channels being inoperable, this event is also reportable per

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REV NO	
Oconee Nuclear Station, Unit 1	05000269	11	- 005 -	01	4 of 5

NARRATIVE

10 CFR 50.73 (a)(2)(vii). Technical Specification 3.3.1, Conditions A, B, and C were entered, and this event was reported via an 8-hour notification per 10 CFR 50.72(b)(3)(v)(D) on 6/10/2011 (Event Report 46947).

Investigation of the condition was conducted on June 10, 2011, and determined that during implementation of the digital RPS/ES upgrade in Refueling Outage 1EOC26, the cables for the upper chamber NI detectors and the lower chamber NI detectors for RPS Nuclear Overpower Flux/Flow/Imbalance were reversed. The implementation work to connect the triaxial cables was performed between April 14, 2011 and April 18, 2011 using installation instructions written by the digital system project team. All four RPS channels were connected in the same reverse manner due to a drawing error in which the triaxial connectors for the upper and lower chamber signals were shown reversed. The implementation teams did not detect the design error.

The Modification Test Plan (MTP) stated that RPS input connections are verified using the Post-Maintenance Test procedures. There were no steps in the procedures that actually verified the proper physical connections of the Upper and Lower Chamber cables. The project design team misapplied a standard by crediting the use of independent verification as a post-modification test when the standard only permits this method for post-maintenance testing. It was not recognized that the test procedures deviated from the Modification Test Plan.

At approximately 48 percent power, diverging RPS power range imbalance indication was observed when compared to the incore detectors indication. Actions taken on June 10, 2011 reconnected the cables in the proper configuration using additional vendor documentation. These actions were completed by 1511. Then all four channels of RPS Overpower Flux/Flow/Imbalance were declared operable.

CAUSAL FACTORS

1. Failure to develop design drawings in accordance to site standards.

   Basis: Standards require that new Duke Energy drawings contain design details to match vendor interfaces, including requirements for providing design labels for human factors to prevent mis-positions and for the ease of maintenance. The labeling and physical orientation of the new Power Range Test Module connectors did not match the new vendor documentation.

2. Inadequate post-modification test procedures.

   Basis: Although the Modification Test Plan stated that the RPS input connections are verified using the post-modification test procedures, there were no steps in the procedures that actually verified the proper physical connections of the Upper and Lower Chamber cables. This constitutes a failure to ensure testing procedures met the objectives of the Modification Test Plan.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REV NO	
Oconee Nuclear Station, Unit 1	05000269	11	- 005 -	01	5 of 5

NARRATIVE

CORRECTIVE ACTIONS

Immediate:

Immediate corrective actions on June 10, 2011 reconnected the cables in the proper configuration using additional vendor documentation. These actions were completed by 1511 and all four channels of RPS Overpower Flux/Flow/Imbalance were declared operable.

Corrective Actions to Prevent Recurrence:

1. The NI Flux triaxial connections orientation and labeling on O-781, O-1781, and O-2781 drawing series for the RPS Engineering Changes were revised to ensure this error would not recur.

2. The MTPs and implementation procedures for Unit 3 (EC77070) have been revised to include test steps to ensure proper configuration of the NI triaxial cables. Unit 2 (EC77068) MTPs and implementation procedures will be revised to include these test steps prior to installation of the digital RPS/ES.

SAFETY ANALYSIS

There are currently no accidents initiated below 50 percent reactor thermal power (RTP) that rely on the flux/flow/imbalance trip to demonstrate no fuel damage limits are exceeded. There are some accidents initiated from zero power (Startup Accident, Rod Ejection, and Steam Line Break), but those accidents trip on high flux (Startup and Rod Ejection) or low RCS pressure (Steam Line Break). The Bank Withdrawal accident is analyzed from 20 percent RTP, but the hot full power (HFP) case is more limiting. Even so, the Bank Withdrawal from 20 percent trips on high flux. All other accidents are more limiting when initiated from HFP conditions (or in the case of three reactor coolant pump (RCP) operation, from 75 percent full power (FP).

Based on the low power level at which this configuration error was discovered and the short duration of inoperability, there was no actual impact on the health and safety of the public.

ADDITIONAL INFORMATION

A search of Oconee's Problem Investigation Program (PIP) data base found no similar events with the same or similar cause during the past five years.

Energy Industry Identification System (EIIS) codes are identified in the Text within brackets [ ]. This event is considered reportable under the EPIX program as noted in Failure Report No. 1166.

There were no releases of radioactive materials, radiation exposures or personnel injuries associated with this event.