



**UNITED STATES
NUCLEAR REGULATORY COMMISSION**
REGION II
245 PEACHTREE CENTER AVENUE NE, SUITE 1200
ATLANTA, GEORGIA 30303-1257

January 22, 2014

Mr. Scott L. Batson
Site Vice President
Duke Energy Corporation
Oconee Nuclear Station
7800 Rochester Highway
Seneca, SC 29672-0752

**SUBJECT: OCONEE NUCLEAR STATION UNIT 2 – REACTOR PROTECTIVE
SYSTEM/ENGINEERED SAFEGUARDS PROTECTIVE SYSTEM DIGITAL
MODIFICATION – NRC INSPECTION REPORT 05000270/2013009**

Dear Mr. Batson:

On December 12, 2013, the U. S. Nuclear Regulatory Commission (NRC) completed an inspection at your Oconee Nuclear Station, Unit 2 reactor facility. The enclosed inspection report documents the inspection results that were discussed on December 12, 2013, with you and other members of your staff.

The inspection was performed in accordance with Inspection Procedure 52003, "Digital Instrumentation and Control Modification Inspection," and focused on the list of recommended "Site Inspection Follow-Up Items" outlined in the Reactor Protective System/Engineered Safeguards Protective System Safety Evaluation dated January 28, 2010, (ADAMS Accession Number ML100220016). The inspection examined activities conducted under your license as they relate to safety, compliance with the Commission's rules and regulations, and with the conditions of your license. The team reviewed selected procedures and records, observed activities, and interviewed personnel. Based on the results of the inspection, no findings were identified.

In accordance with Title 10 of the *Code of Federal Regulations* 2.390 of the NRC's "Rules of Practice," a copy of this letter, its Enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Document Room, or from the Publicly

Available Records (PARS) component of the NRC's Agencywide Documents Access and Management System (ADAMS), which is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

Sincerely,

RA

Rebecca L. Nease, Chief
Engineering Branch 1
Division of Reactor Safety

Docket No. 50-270
License No. DPR-47

Enclosure:
Inspection Report 05000270/2013009,
w/Attachment: Supplementary Information

cc: Distribution via Listserv

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U. S. NUCLEAR REGULATORY COMMISSION

REGION II

Docket No: 50-270

License No: DPR-47

Report No: 05000270/2013009

Licensee: Duke Energy Carolinas, LLC

Facility: Oconee Nuclear Station, Unit 2

Location: Seneca, SC 29672

Dates: October 21, 2013 – December 12, 2013

Inspectors: M. Riley, Reactor Inspector, RII DRS (Lead)
S. Walker, Senior Reactor Inspector, RII DRS
J. Kent, Construction Inspector, RII DCP

Approved by: Rebecca L. Nease, Chief
Engineering Branch 1
Division of Reactor Safety

SUMMARY

Inspection Report (IR) 05000270/2013009; 10/21/2013 – 12/12/2013; Oconee Nuclear Station, Unit 2; Digital Instrumentation and Control Modification Inspection.

This inspection was conducted by a team of three U.S. Nuclear Regulatory Commission (NRC) inspectors from the Region II office over an 8-week period. No findings were identified. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 4, dated December 2006.

REPORT DETAILS

Background Information

On January 31, 2008, Duke Energy Carolinas submitted a first-of-a-kind license amendment request (LAR) to upgrade the Oconee Nuclear Station to a digital Reactor Protective System (RPS) and Engineered Safeguards Protective System (ESPS). The proposed amendment would allow replacement of the existing Bailey Meter Company analog, solid-state design, RPS/ESPS with a digital computer-based TELEPERM XS (TXS) platform at Oconee Units 1, 2, and 3. The digital RPS/ESPS would provide signal processing, signal validation, and protection logic function for these systems.

The Office of Nuclear Reactor Regulation (NRR) approved the LAR and issued a safety evaluation report (SER) dated January 28, 2010, (ML100220016). The NRR staff conducted an evaluation of the LAR as part of the normal review process. This included a review of the design and capabilities of the modification. Regional inspectors were tasked with performing documentation and functionality reviews in accordance with Inspection Procedure 52003 after the new RPS/ESPS system left the vendor.

In addition, the SER discussed inspection activities (Section 3.14. "Regional Activities") for the digital RPS/ESPS that would be addressed by the NRC regional office during site acceptance testing, installation, startup testing, and operation of the system. The activities, referred to as inspection follow-up items, were intended to verify licensee activities that were not part of the licensing process but were related to the safe operation of the digital RPS/ESPS system. The bases for the inspection activities were derived from Chapter 7 of the Standard Review Plan and explained in detail throughout the SER.

Region II developed a site-specific inspection plan to select and review the activities associated with the major phases of the digital instrumentation and control (I&C) modification. Region II inspectors observed portions of testing, installation, and operation of the RPS/ESPS modification on Unit 1 in 2011. This included a sample of inspection requirements involving four major areas of effort: (1) developing an understanding of the modification design; (2) documentation verification; (3) review of testing, operations, and training; and (4) a review of plans for maintenance and repair efforts. The results of the Unit 1 inspection were documented in Inspection Report 05000269/2011011 (ML12069A088).

For the review of the Unit 3 RPS/ESPS modification, which was completed in 2012, the site-specific inspection plan included an emphasis on (1) review of corrective action program (CAP) documents to ensure lessons learned and operating experience had been properly captured and implemented; and (2) licensee activities that included new or different management controls, were being managed/controlled in a different manner, or implemented with new techniques. The results of the Unit 3 inspection were documented in Inspection Report 05000287/2012013 (M12366A264 and ML13022A362).

This report documents the inspection results for the RPS/ESPS modification on Unit 2. The site-specific inspection plan for Unit 2 was similar to that of the Unit 3 inspection with a focus on corrective action documents to ensure issues were appropriately identified and resolved, and an additional focus was placed on activities or modifications pertaining to RPS/ESPS that differed from previous inspections. Because the SER was applicable to all three units, many of the inspection follow-up items that were previously reviewed during the Unit 1 and Unit 3 inspection efforts were not reviewed during this inspection.

4. OTHER ACTIVITIES

4OA5 Other Activities – Digital Instrumentation and Control Modification Inspection (52003)

.1 Design Review

.1.1 Full Scope Modification

a. Inspection Scope

The team reviewed all the documentation required to gain a working knowledge of the digital I&C modification including, but not limited to: the staff's SER; licensing commitment documents; manufacturer's literature on the hardware and software being installed; and applicable drawings and schematics. In addition, the team reviewed design specification attributes including design architecture, input consolidations, isolation and interface devices, effected indicators, and the credited function of the system to verify proper system requirements were met and/or maintained during installation.

The team discussed changes the licensee made during the Unit 1 and Unit 3 installations to verify that they were appropriately captured in the Unit 2 scope. The team also reviewed the Unit 2 modification project plan to determine if any changes, following installation on Unit 1 and Unit 3, were appropriately evaluated.

b. Observations and Findings

No findings were identified. The team noted that the changes made during the installation of the RPS/ESPS modification on Unit 2 were minimal when compared to the previous Unit 3 installation completed in 2012. The team determined that the licensee adequately implemented the full-scale design.

1.2 Modification Schedule

a. Inspection Scope

The team reviewed the licensee's proposed schedule for implementation to verify the licensee properly evaluated any associated shutdown risk due to modification implementation and emergent changes to the schedule. The team reviewed the licensee's modification plan to verify whether the implementation would be done in conjunction with shutdown risk activities, such as a complete core offload or mid-loop operations. The team reviewed and assessed the emergent issues to evaluate the potential impact on the overall implementation and testing schedule.

b. Observations and Findings

No findings were identified. The team determined the licensee adequately scheduled installation, maintenance, and testing appropriate to the circumstances. As emergent issues arose, the team determined that the licensee properly prioritized issues utilizing safety and risk insights. The team

determined the licensee incorporated lessons learned from the previous installations on Unit 1 and Unit 3 which provided for more effective scheduling.

.2 Documentation Review

.2.1 Procedure Review

a. Inspection Scope

The team performed, on a sampling basis, a review of the licensee procedures affected by the modification of the RPS/ESPS system. The team reviewed the licensee's procedures to verify that surveillance, abnormal operating, emergency operating, and annunciator response procedures had been updated and correctly reflected the current system attributes. The procedure review also included verifying that procedures adequately reflected requirements in technical specifications (TS), applicable licensee standards, and vendor recommendations. The team reviewed the licensee's cable routing scheme to verify cables were mixed, ran, and terminated consistent with the licensee's procedures, the SER, manufacturer recommendations, and applicable industry standards. The team reviewed several problem investigation program (PIPs) reports that were written as a result of various issues discovered during the Unit 1 and Unit 3 installations of the RPS/ESPS system. The team reviewed the PIPs to verify that any affected procedures that were listed in the PIPs were updated to resolve the issues.

b. Observations and Findings

No findings were identified.

Procedures:

The team determined that the RPS/ESPS maintenance, testing, and operation procedures reviewed for Unit 2 were adequate and consistent with the design capability, plant specifications, and Unit 1 and Unit 3 implementation. The team determined that any modifications that were made on Unit 2 that differed from the other units were reflected in the Unit 2 procedures. The team also determined that the implementation of the TS, applicable licensee standards, and vendor recommendations were appropriately integrated in the sampled calibration procedures.

Configuration Management:

During the Unit 1 installation, the licensee improperly wired the nuclear instrumentation (NI) Power Range detector cables which affected all four RPS channels (LER 05000269/2011-05-01). The licensee took appropriate actions to correct this issue and prevent this issue from occurring during the Unit 3 RPS/ESPS modification. The team reviewed the design drawings used for the connection of the NI cables to ensure that the licensee took appropriate actions to prevent this issue from occurring during the Unit 2 RPS/ESPS modification. The licensee showed the connection points in more detail in the drawings to prevent improper wiring of NI Power Range detector cables during the Unit 2

installation. The team inspected cabinet 2PPSCA0001 to verify that the power range connection for 2NI-5 was performed according to drawing O-1781, Rev. 14I. The team also inspected cabinet 2PPSCA0005 to verify that the power range connection for 2NI-7 was performed according to drawing O-1781-B, Rev.15H. The team determined that the connections for power range instruments 2NI-5 and 2NI-7 were wired in accordance with the drawings.

Bend Radius:

During the Unit 1 and Unit 3 inspections, the inspection team identified examples of terminated wires that exceeded the allowable bend radius. The licensee implemented installation specification OSS-0218.00-00-0008, "Guide for Training and Bending of Cables and Conductors," Revision (Rev.) 1A, to provide proper guidelines for bending and training of cables and conductors. During the Unit 2 installation, the licensee conducted a walkdown to identify any wires that exceeded the allowed bend radius in the procedure. The team inspected cabinets 2PPSCA0001, 2PPSCA0005, 2PPSCA0014, and 2PPSCA0018 and did not identify any wires that exceeded the bend radii acceptance criteria. The team determined that the licensee had implemented proper oversight of the installation of the cables and conductors to identify and correct issues associated with bend radius. Wires that exceeded the bend radius criteria were identified by the licensee and corrected before placing in service. Because the cables identified by the licensee were not considered degraded at the time of discovery, the system was not returned to service, and the licensee took immediate corrective actions, the team considered issues associated with the bend radius of cable and conductors to be appropriately resolved.

Panel Wiring:

The team inspected a sample of RPS and ESPS cabinets to verify cable terminations were being performed according to the drawings. The team inspected the following cabinets and drawings:

- For RPS cabinet 2PPSCA0001, the team looked at all of the terminal blocks and compared them with drawing O-1781, Rev. 14I (Connection Diagram Nuclear Instrumentation and Reactor Protection System Cabinet 2PPSCA0001)
- For RPS cabinet 2PPSCA0005, the team looked at all of the terminal blocks and compared them with drawing O-1781-B, Rev. 15H (Connection Diagram Nuclear Instrumentation and Reactor Protection System Cabinet 2PPSCA0005)
- For ESPS cabinet 2PPSCA0014, the team looked at all of the terminal blocks and compared them with drawing O-1757-J, Rev. 13D (Connection Diagram Engineering Safeguards Cabinet 2PPSCA0014)
- For ESPS cabinet 2PPSCA0018, the team looked at all of the terminal blocks and compared them with drawing O-1757-H-002, Rev. B (Connection Diagram Engineering Safeguards Cabinet 2PPSCA0018)

The inspectors did not identify any wiring issues in the above cabinets.

.2.2 Design Bases Document Review

a. Inspection Scope

The team conducted sample reviews of the Updated Final Safety Analysis Report (UFSAR), design basis documents, TS, and plant drawings to verify that design basis documents were adequately updated to reflect the replacement RPS/ESPS system.

b. Observations and Findings

No findings were identified. Because the RPS/ESPS modification was installed on each of the units in phases, the team noted that the UFSAR revision in place during the inspection did not specifically denote which unit was modified; rather it generically addressed units as either a unit with the RPS installed or not installed. The team also noted that design bases documents, TS, and plant drawings adequately reflected the RPS/ES system.

.3 Testing, Operations, and Training

.3.1 Software Testing Plan

a. Inspection Scope

The team reviewed the installation and startup test procedures for the RPS/ESPS systems to assess whether the procedures ensured that the as-installed modifications were consistent with the SER, the design drawings, and the licensee's commitments. Any changes or deviations from previous installations were noted and discussed with the licensee to understand the purpose of any changes, and to ensure the design and licensing bases were maintained. The team performed field reviews of the modification of the digital RPS/ESPS system, which was in the process of being installed and tested on Unit 2. The team observed portions of the installation testing, including component checks and functional testing to verify the testing plan was adequate in identifying proper design implementation. The team assessed whether the procedures were clear and sufficiently detailed enough to allow site personnel to perform the tests.

b. Observations and Findings

No findings were identified. The team observed a sample of RPS/ESPS continuity checks, RPS/ESPS functional testing, and ESPS voter Go/No-Go testing to verify the testing was adequately performed and the test procedures were followed. The team found that the test plans assured adequate controls were in place to implement the modification. The team found that the licensee addressed potential issues identified during testing according to their safety and risk significance. The team determined the licensee adequately performed

testing in accordance with the Unit 2 testing procedures and that the testing procedures were detailed and clear.

3.2 Personnel Training

a. Inspection Scope

The team reviewed training documents and interviewed personnel to verify that operators, technicians, and system engineers had been adequately trained and had an understanding of the system commensurate with their responsibilities.

b. Observations and Findings

No findings were identified. The team determined the licensee underwent appropriate training in preparation for implementation of the RPS/ESPS modification. Specifically, the team reviewed training documents related to PIP O-11-07081 to address the wiring error on the NI power range detector cables that were identified during Unit 1 installation. The team also reviewed training presentations given to technicians related to procedure use and adherence in preparation for the RPS/ES modification. The team determined that the licensee took appropriate actions to correct and prevent issues identified during the previous RPS/ESPS modifications.

3.3 Hardware and Software Failures

a. Inspection Scope

The team reviewed PIPs to verify the licensee was appropriately capturing hardware and software failures that occurred in previous installations (Unit 1 and Unit 3), and that the issues were properly resolved.

b. Observations and Findings

No findings were identified. The team determined the licensee utilized an appropriate threshold for entering issues into the CAP. The team followed up on several PIPs identified during the Unit 1 and Unit 3 installations and found them to have been adequately resolved. The team noted that the licensee appropriately documented issues related to the implementation of the system, categorized each issue based on its significance, proposed appropriate corrective actions, and documented the resolution(s). The issues were appropriately entered into the CAP as PIPs. The licensee also reviewed the issues to determine mode applicability to ensure design basis limits and commitments (i.e., TS Limiting Conditions for Operability) were maintained.

3.4 Indication and Annunciation

a. Inspection Scope

The team reviewed procedures, performed walkdowns, and observed testing to verify indication and annunciation for system failures and system bypasses were functional and met the licensing basis as stated in the SER.

b. Observations and Findings

No findings were identified. Based on review of PIP O-11-04841, the team questioned if the manual bypass annunciators for the ESPS voter cabinets met the licensing basis requirements of standard IEEE 603-1998, Section 5.8.3. Section 5.8.3 of IEEE 603 states in part, "If the protective actions of some part of a safety system have been bypassed or deliberately rendered inoperative for any purpose other than an operating bypass, continued indication of this fact for each affected safety group shall be provided in the control room." The team was concerned that this requirement would not be met if certain equipment was out of service during maintenance activities. Based on interviews with knowledgeable personnel and subsequent information provided during the inspection, the team concluded that the current design for the Unit 2 manual bypass annunciators for the ESPS voter cabinets met the requirements of Section 5.8.3 of IEEE 603, and does not affect the voter manual bypass key switch design function of providing the capability to disable automatic actuation from the voter. The licensee revised the PIP to reflect the information provided during the inspection and to support closing of the issue. The team reviewed the PIP and considered the issue to be appropriately resolved.

4OA6 Meetings, Including Exit Meeting

Exit Meeting Summary

On December 12, 2013, the team presented the inspection results to Mr. Scott Batson and other members of the licensee's staff. The inspectors verified that no proprietary information was retained by the inspectors or documented in this report.

ATTACHMENT: SUPPLEMENTARY INFORMATION

SUPPLEMENTARY INFORMATION

KEY POINTS OF CONTACT

Licensee personnel

J. Bryan, OMP Senior Engineer
B. Shingleton, OMP Senior Engineer
B. Loftis, RPS/ES Subject Matter Expert

NRC personnel

R. Stattel, Senior Technical Reviewer, NRR

LIST OF ITEMS OPENED, CLOSED, DISCUSSED, AND UPDATED

None

LIST OF DOCUMENTS REVIEWED

Procedures

EP/2/A/1800/001, Enclosures 5.1 – 5.16, Rev. 040
IP/2/A/0315/005A, TXS Plant Protective Cabinets ON2PPSCA0001 and ON2PPSCA002
Troubleshooting, Analysis, and Maintenance, Rev.000
IP/2/A/0315/011A, TXS RPS NI-5 Power Range Instrument Calibration, Rev. 000
IP/2/A/0315/011C, TXS RPS NI-7 Power Range Instrument Calibration, Rev. 000
IP/2/A/0315/019A, TXS RPS Channel A and ES Channel A1 Cyber Security
Test, Rev. 000
IP/2/A/0315/022B, TXS RPS Channel B Functional Test, Rev. 000
IP/2/A/0315/032B, TXS RPS Channel B RCS Flow Transmitter Calibration, Rev. 000
OP/2/A/1105/014, Control Room Instrumentation Operation and Information, Rev. 035
OP/2/A/6102/001, Alarm Response Guide 2SA-01, Rev. 016
PJ/2/A/0600/001B, Instrument Surveillance Prior to Mode Change, Rev. 038

Codes and Standards

IEEE Std. 603-1998, Standard for Safety Systems for Nuclear
Power Generating Stations
RG 1.152, Criteria for Digital Computers in Safety Systems of Nuclear Power Plants

Completed Procedures

TN/2/A/77067/001, ES Continuity Checks, 11/07/13
 TN/2/A/77067/002, ESPS Odd Voter Functional Test, 12/9/13
 TN/2/A/77068/001, RPS Continuity Checks, 11/07/13

Drawings

O-1757-H-002, Connection Diagram Engineered Safeguards Cabinet
 2PPSCA0018, Rev. B
 O-1757-J, Connection Diagram Engineered Safeguards Cabinet
 2PPSCA0014, Rev. 13D
 O-1781, Connection Diagram Nuclear Instrumentation and Reactor Protective System
 Cabinet 2PPSCA0001, Rev. 14I
 O-1781-B, Connection Diagram Nuclear Instrumentation and Reactor Protective System
 Cabinet 2PPSCA0005, Rev. 15H

Miscellaneous Documents

A/R Number 413688, RPS/ES 50.59 screen
 EC0000077067, Unit 2 ES Replacement, Rev. 1
 EC0000077068, Unit 2 RPS Upgrade, Rev. 2
 ES Bend Radius Check-off, 11/10/13
 OM 1201.N-0038.001, Unit 2 RPS/ESFAS SAT Summary Test Report, Rev 0
 OSS-0218.00-00-0008, Guide for Training and Bending of Cables and Conductors,
 Rev. 1A
 OSS-0218.00-00-0019, Cable and Wiring Separation Criteria, Rev. 16
 RPS Bend Radius Check-off, 11/10/13
 Training Presentation for PIP O-11-07081, 10/22/13
 Training Presentation for PIP O-12-04580, 10/22/13

Problem Investigation Program Reports Reviewed

O-10-10361, Inconsistent GSM results, 12/07/10
 O-10-10815, Improper GSM screen status information for the RPS/ES project, 12/16/10
 O-11-01081, NI Lesson Plan, 9/19/13
 O-11-04841, Loss of Manual Bypass Stat Alarm, 4/22/11
 O-11-06402, 1EC26 RPS/ES Testing Issue: Unanticipated interaction between DHPIAS
 testing and KHU generation closed SK-2, 05/25/11
 O-11-07865, Statalarm 1SA-5/C-5 1C RPS Trouble Actuated, 07/02/11
 O-12-13282, Calculation OSC-2634 RCS Pressure Control Uncertainty was not updated
 for installation of RPS-ES TXS equipment, 11/13/12
 O-13-12769, Unexpected open circuit in 2ESTC3 found during
 continuity checks, 11/5/13
 O-13-12985, 2NI-5 Trip Setpoint Out of Tolerance while Performing IP/2/A/0315/022A
 O-13-13056, No Power at 2 RC-PT-0021P Transmitter, 11/10/13
 O-13-13202, ES/RPS Related – Wiring Error on 2LPSW15, 11/12/13
 O-13-13205, ES/RPS Related – 2HP 21 Valve Indication, 11/12/13
 O-13-13243, RPS/ES Related – Wiring Error on 2LPSW06, 11/13/13