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

May 2, 2019

Ms. Tanya Hamilton
Site Vice President
Duke Energy Carolinas, LLC
Shearon Harris Nuclear Power Plant
M/C HNP01
New Hill, NC 27562-0165

SUBJECT: HARRIS UNIT 1 – NRC DESIGN BASES ASSURANCE INSPECTION (PROGRAMS) REPORT 05000400/2019010

Dear Ms. Hamilton:

On March 22, 2019, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at your Harris Unit 1 and discussed the results of this inspection with you and other members of your staff. The results of this inspection are documented in the enclosed report.

NRC inspectors documented one finding of very low safety significance (Green) in this report. This finding involved a violation of NRC requirements.

If you contest the violation or significance or severity of the violation documented in this inspection report, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001; with copies to the Regional Administrator, Region II; the Director, Office of Enforcement; and the NRC resident inspector at Harris.

This letter, its enclosure, and your response (if any) will be made available for public inspection and copying at http://www.nrc.gov/reading-rm/adams.html and at the NRC Public Document

Room in accordance with 10 CFR 2.390, “Public Inspections, Exemptions, Requests for Withholding.”

Sincerely,

/RA/

Jonathan M. Montgomery, Acting Chief
Engineering Branch 1
Division of Reactor Safety

Docket No.: 05000400
License No.: NPF-63

Enclosure:
Inspection Report 05000400/2019010

Cc: Distribution via Listserv

SUBJECT: HARRIS UNIT 1 – NRC DESIGN BASES ASSURANCE INSPECTION (TEAM) REPORT 05000400/2019010 dated May 2, 2019

DISTRIBUTION:
T. Fanelli, RII, DRS
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J. Montgomery, RII, DRS

* See previous page for concurrence

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ADAMS: ☐ Yes ACCESSION NUMBER: **ML 19122A434** ☐ SUNSI REVIEW COMPLETE ☐ FORM 665 ATTACHED

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SIGNATURE	TNF1	BJD4	JMM9 for TXS2	JMM2	LFP1	JMM2
NAME	T. Fanelli	B. Davis	T. Su	J. Montgomery	L. Pressley	J. Montgomery
DATE	5/2/2019	5/2/2019	5/2/2019	5/2/2019	5/2/2019	5/2/2019
E-MAIL COPY?	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO

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U.S. NUCLEAR REGULATORY COMMISSION

Inspection Report

Docket Number(s):	05000400
License Number(s):	NPF-63
Report Number(s):	05000400/2019010
Enterprise Identifier:	I-2019-010-0026
Licensee:	Duke Energy Carolinas, LLC
Facility:	Harris, Unit 1
Location:	New Hill, NC 27562
Inspection Dates:	March 04, 2019 to March 22, 2019
Inspectors:	B. Davis, Sr. Reactor Inspector T. Fanelli, Sr. Reactor Inspector T. Su, Reactor Inspector
Approved By:	Jonathan M. Montgomery, Acting Chief Engineering Branch 1 Division of Reactor Safety

Enclosure

SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) continued monitoring the licensee's performance by conducting a Design Bases Assurance Inspection at Harris Unit 1 in accordance with the Reactor Oversight Process. The Reactor Oversight Process is the NRC's program for overseeing the safe operation of commercial nuclear power reactors. Refer to https://www.nrc.gov/reactors/operating/oversight.html for more information. Findings and violations being considered in the NRC's assessment are summarized in the table below.

List of Findings and Violations

Three Examples of Failure to Develop a Valid Mathematical Model for ASCO Solenoid Valves			
Cornerstone	Significance	Cross-cutting Aspect	Report Section
Mitigating Systems	Green NCV 05000400/2019010-01 Open/Closed	None (NPP)	71111.21N
The inspectors identified a Green finding and associated Non-cited Violation (NCV), with three examples, of 10 CFR 50.49(e)(5) for the licensee's failure to model the effects of thermal insulation, oven characteristics, and differences between nitrogen and air on Automatic Switch Company (ASCO) Nuclear Power (NP) valves in accordance with the licensee's environmental qualification requirements.			

INSPECTION SCOPE

Inspections were conducted using the appropriate portions of the inspection procedures (IPs) in effect at the beginning of the inspection unless otherwise noted. Currently approved IPs with their attached revision histories are located on the public website at http://www.nrc.gov/reading-rm/doc-collections/insp-manual/inspection-procedure/index.html. Samples were declared complete when the IP requirements most appropriate to the inspection activity were met consistent with Inspection Manual Chapter (IMC) 2515, "Light-Water Reactor Inspection Program - Operations Phase." The inspectors reviewed selected procedures and records, observed activities, and interviewed personnel to assess licensee performance and compliance with Commission rules and regulations, license conditions, site procedures, and standards.

REACTOR SAFETY

71111.21N - Design Bases Assurance Inspection (Programs)

The inspectors evaluated Environmental Qualification program implementation through the sampling of the following components:

Select Sample Components to Review - Primary Containment (Inside Containment) (IP Section 02.01) (2 Samples)

(1) Barton 351 Pressure Transmitter – PT-01CT-0951IIW:002
(2) Westinghouse Electrical Penetration – 1AB-S1230

Select Sample Components to Review - Risk Significant/Low Design (Inside/Outside Containment) (IP Section 02.01) (5 Samples)

(1) Kerite cable to pressurizer and RHR MOV
(2) Limitorque MOV on Aux Feed Isolation Valve – 1AF-143
(3) ASCO Solenoid on MSIV – 1MS-80:006
(4) 3150-N Series Rosemount Transmitter for Pressurizer Level – LT-01RC-0460IIW
(5) WEED RTD – Delta Tavg – TE-01RC-0412B1

INSPECTION RESULTS

Three Examples of Failure to Develop a Valid Mathematical Model for ASCO Solenoid Valves			
Cornerstone	Significance	Cross-cutting Aspect	Report Section
Mitigating Systems	Green NCV 05000400/2019010-01 Open/Closed	None (NPP)	71111.21N

The inspectors identified a Green finding and associated Non-cited Violation (NCV), with three examples, of 10 CFR 50.49(e)(5) for the licensee's failure to model the effects of thermal insulation, oven characteristics, and differences between nitrogen and air on Automatic Switch Company (ASCO) Nuclear Power (NP) valves in accordance with the licensee's environmental qualification requirements.

Description: The inspectors reviewed the qualification of an ASCO solenoid operated valve (SOV), 1-MS-80-006, which provides the air that opens the main steam isolation valves (MSIVs). This supports the function of the MSIV to limit uncontrolled flow of steam from the associated steam generator. The environmental qualification (EQ) was documented in ASCO reports AQS-21678/TR, "Qualification Tests of Solenoid Valves by Environmental Exposure to Elevated Temperature, Radiation, Wear Aging, Seismic Simulation, Vibration Endurance, Accident Radiation and Loss-of-Coolant Accident (LOCA) Simulation, dated July 1979, Rev. A," and AQR-67368, "Report on Qualification of Automatic Switch Co. (ASCO) Catalog NP-1 Solenoid Valves for Safety-Related Applications in Nuclear Power Generating Stations, dated 8/19/83 Rev. 1."

ASCO qualified the SOV to EQ requirements specified in the Institute of Electrical and Electronics Engineers (IEEE) 323-1974, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations" as supplemented by NUREG-0588, "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment," Rev. 1. The licensee is committed to the standard and NUREG to meet 10 CFR 50.49, and used them to verify the qualification compliance with the rule.

Standard IEEE 323-1974, Section 6.5.2, Mathematical Modeling, required, in part, "…The mathematical model shall be based upon established principles, verifiable test data, or operating experience data. The mathematical model shall be such that the performance of the electric equipment is a function of time and the pertinent environmental parameters. All environmental parameters listed in the equipment specification must be accounted for in the construction of the mathematical model unless it can be shown that the effects of the parameter of interest are dependent on the effects of the remaining environmental parameters."

The licensee's mathematical model used to determine the qualified life of the ASCO valves was based on test data from the qualification, as well as actual plant environmental conditions. The inspection-identified disparities in the model that would reduce the qualified life of the SOV from approximately 4.12 years to less than 2.6 years, as stated by the following examples:

Example 1: The licensee installed a layer of insulation around the ASCO valve to prevent steam damage to the valve seat. The qualified life model did not credit the increased seat temperature caused by the insulation when the valve is under load. Thus, the model was not a function of time and the pertinent environmental parameter for the valve's actual seat temperature when insulated. The insulation blanket would limit any heat dissipation from the valve body. A minimal increase in the temperature (e.g. 4°C) would reduce the seat's qualified life, and affect the replacement schedule of the valve.

Example 2: In response to NRC Information Notice (IN) 89-66, "Qualification Life of Solenoid Valves," dated 9/11/1989, ASCO released a field notice, "Field Notification Concerning the Qualified Life of ASCO Catalog NP-1 Valves," dated 10/27/1989. The IN informed licensees of a condition where the seats in these valves exhibited evidence of having reached an end of life condition prematurely. The IN stated, in part, "regardless of the material used, the qualified life will be adversely affected by higher temperatures and may be significantly less than the initially determined qualified life and possibly even less than the actual operating time." Industry calculations at the time, for normally energized valves, had determined that valve seats had a substantial period of qualified life remaining. Their models assumed lower temperatures at the seats. ASCO's field notification identified that their valves had higher temperatures at the seats in static (no airflow) conditions than were previously assumed in the industry qualified life models.

The licensee used the ASCO field notice to modify the accelerated aging oven variable of their mathematical model. However, the licensee did not verify that the accelerated aging test used a calibrated static air oven. The oven used by ASCO for original qualification testing was a forced-air oven design, but ASCO could not verify if the fans were on. In addition, there were no records of the oven's make and model, the oven's calibration, or the variability in valve temperatures in the oven. The change in the model produced an unsubstantiated qualified life for the SOV. The change did not address the oven configuration, its calibration, or the plausible variations in valve temperatures. Thus, the model was not a function of time and the pertinent environmental parameter for the valve's actual seat temperature in the accelerated aging oven test.

Example 3: Both of the ASCO qualification tests used pure nitrogen as the process gas to operate the valves. The tests used the nitrogen gas for the accelerated aging and LOCA testing. However, oxygen is the process gas used to operate the valves at Harris. The use of the nitrogen gas during the qualification testing prevented oxidation of the seats. The licensee used this test data in their qualified life model. The use of the nitrogen test data in a qualified life model that determines end of life in an air environment invalidated its intended use. The licensee's environmental condition manual (DBD-1000) identified similar concerns with the use of inert atmospheres. It stated, in part, "The degradation mechanism is critically dependent on the presence of oxygen, as testing in an inert atmosphere produces no demonstrable degradation." The licensee's model was not a function of time and the pertinent environmental parameter of gas composition. The disparity in the model affected the replacement schedule of the elastomers.

Corrective Action(s): The licensee performed an IDO and determined that the MSIV solenoids were operable.

Corrective Action Reference(s): NCR 2262549 - EQDP-0315 Insulation Heat Rise
AR 2264394 - Mathematical Model

Performance Assessment:

Performance Deficiency: The licensee's failure to model the effects of thermal insulation, oven characteristics, and differences between nitrogen and air on ASCO NP valves in accordance with IEEE 323-1974, Section 6.5.2, "Mathematical Modeling" was a performance deficiency.

Screening: The inspectors determined the performance deficiency was more than minor because it was associated with the Design Control attribute of the Mitigating Systems cornerstone. Specifically, the failure to model the effects, of thermal insulation, oven characteristics, and differences between nitrogen and air on ASCO valves adversely affected the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences.

Significance: The inspectors assessed the significance of the finding using Appendix A, "The Significance Determination Process for Findings for At - Power". The inspectors determined the finding was of very low safety significance (Green) because the finding was a deficiency affecting the qualification of a mitigating structure, system, or component (SSC) and the SSC maintained its operability.

Cross-cutting Aspect: No cross cutting aspect was assigned to this finding because the inspectors determined the finding did not reflect present licensee performance.

Enforcement:

Violation: 10 CFR 50.49(e)(5), "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants," required in part, consideration must be given to all significant types of degradation which can have an effect on the functional capability of the equipment.

Contrary to the above, since May 6, 2015, the licensee failed to consider all significant types of degradation which can have an effect on the functional capability of the equipment. Specifically, the site failed to consider significant degradation from insulated valve bodies, from oxidative air environments, and from differences in the accelerated aging temperatures.

Enforcement Action: This violation is being treated as an Non-Cited Violation, consistent with Section 2.3.2 of the Enforcement Policy.

EXIT MEETINGS AND DEBRIEFS

The inspectors verified no proprietary information was retained or documented in this report.

- On March 22, 2019, the inspector presented the DBAI Programs (EQ) inspection results to Tanya Hamilton and other members of the licensee staff.

DOCUMENTS REVIEWED

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
71111.21N	Calculations	PRA-F-E-002	Steam Tunnel Flooding Analysis	Rev. 5
	Drawings	1364-044977	Containment Pressure Transmitter Installation	Rev. 3
		1364-046575 Sheet 1	Interconnecting Wiring Diagram CAB 02 NSSS Unit 1	Rev. 19
		1364-094279	4" CS Flex Wedge 900lb Gate Valve	Rev. 2
		1364-096914, Sheet 1	N9004 Fast Time Response RTD with Bayonet Connector Assembly	Rev. 0
		1364-2062	32IN 92LB CS Main-Steam Isolation Valve, 30-1A64R 23H	Rev. 11
		CAR 2166-B-401, Sheet 1	Control Wiring Diagram for RCS Tavg Delta T	Rev. 9
	Miscellaneous	ANSI/ASTM D2436-1968	Standard Specification for Forced-Convection Laboratory Ovens for Electrical Insulation	
		DBD-1000-V02	Environmental Qualification Design Basis Document	Rev. 10
		Environmental Qualification Documentation Package (EQDP)-0315	Qualification of Automatic Switch Company (ASCO) NP Series Solenoid Valves	Rev. 13
		Environmental Qualification Documentation Reference (EQDR)- 030201	Test Report No. AQR-67368/Rev. 1, Report on Qualification of Automatic Switch Co. (ASCO) Catalog,NP-1 Solenoid Valves for Safety-Related Applications in Nuclear Power Generating Stations," dated 8/19/83	Rev. 0
		EQDP-0303	Limitorque Motor Operators	Rev. 31
		EQDP-0315	Qualification of Automatic Switch Company (ASCO) Np Series Solenoid Valves	Rev. 13
		EQDP-0604	Kerite Power and Control Cables	Rev. 10
		EQDP-0807	3150-N Series Rosemount Transmitters	Rev. 1
		EQDP-0824	ITT Barton Model 351 Pressure Sensor	Rev. 10
		EQDP-1501	Westinghouse Electrical Penetrations	Rev. 14

71111.21N	Miscellaneous	EQDP-3916	Weed RTD/EGS QDC	Rev. 7
		EQDR 030303	Nuclear Power Station Qualification Type Test Report Limitorque Valve Actuators sith Type LR Motor for Westinghouse PWR	Rev. 0
		EQDR No. 030301	Limitorque Valve Actuator Qualification for Nuclear Power Station Service	Rev. 0
		EQDR No. 391601	Effects of Ambient and Process Temperatures on the Epoxy Area of Weed Model N9004 RTD Assembly	Rev. 0
		EQDR No. 391602	Review of the Weed Resistance Temperature Detector Qualification for use in Nuclear Power Plants	Rev. 0
		EQDR- 030202	Test Report No. AQS21678/TR - Revision A, Qualification Tests of Solenoid Valves by Environmental Exposure to Elevated Temperature, Radiation, Wear Aging, Seismic Simulation, Vibration Endurance, Accident Radiation and Loss-of-Coolant Accident (LOCA) Simulation, dated July 1979	Rev. 0
		EQDR- 030204	ASCO Temperature Profile Data	Rev. 1
		EQDR-060414	Kerite Company report, Qualification Documentation for Kerite FR2/FR Control Cables	Rev. 0
		EQDR-060415	Kerite Company report, Qualification Documentation for Kerite FR3/FR Control Cables	Rev. 0
		EQDR-080701	D2013003, Rev. B IEEE Qualification Report of Rosemount 3154N Pressure Transmitters Dated 3-20-15	Rev. 1
		EQDR-080702	D2013004 REV. A IEEE Qualification Report of Rosemount 3153N Pressure Transmitters	Rev. 1
		EQDR-080703	D2010015 REV. C IEEE Qualification Report of Rosemount 3152N Pressure Transmitters	Rev. 1
		EQDR-150101	The Qualification of Modular Type Electric Penetrations Following the Requirement of IEEE STD 317-1976 and 323-1974 for Use In PWR and BWR	Rev. 0
		EQDR-150103	Predicting the Thermal Life of Modular Penetration	Rev. 0
		IEEE 323-1971	IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations	

71111.21N	Miscellaneous	IEEE 98-1972	IEEE Standard for the Preparation of Test Procedures for the Thermal Evaluation of Solid Electrical Insulating Materials	
		NUREG/CR 5141	Aging and Qualification Research on Solenoid Operated Valves	
		OST-1021	Daily Surveillance Equipment Daily Interval Mode 1, 2	Rev. 110
		PRI PO3000984	Purchase Receipt Inspection PO3000984	10/12/2016
		PRI PO784595	Receipt Inspection Package PO784595	5/6/2015
		Purchase Order (PO) 03000984	Rosemount Nuclear Instruments	7/8/2015
		Test Report No. AQR-67368	Report on Qualification of Automatic Switch Co. (ASCO) Catalog,NP-1 Solenoid Valves for Safety-Related Applications in Nuclear Power Generating Stations	8/19/83
		Test Report No. AQS21678/TR	Qualification Tests of Solenoid Valves by Environmental Exposure to Elevated Temperature, Radiation, Wear Aging, Seismic Simulation, Vibration Endurance, Accident Radiation and Loss-of-Coolant Accident (LOCA) Simulation	, dated July 1979
		VM-ONY-V01	Barton Instrument Systems	Rev. 24
	Procedures	EOP-E-0	Emergency Operating Procedure, Reactor Trip or Safety Injection Volume 3 Part 4	Rev. 012
		NSCD-311	Nuclear Supply Chain Process Manual Directive	Rev. 1
		OP-169	Containment Cooling and Ventilation	Rev. 28