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

June 22, 2018

William R. Gideon
Site Vice President
Brunswick Steam Electric Plant
8470 River Rd. SE (M/C BNP001)
Southport, NC 28461

SUBJECT: BRUNSWICK STEAM ELECTRIC PLANT - NRC DESIGN BASES ASSURANCE INSPECTION (PROGRAMS) REPORT NUMBER 05000325/2018011 AND 05000324/2018011

Dear Mr. Gideon:

On May 10, 2018, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at your Brunswick Steam Electric Plant Units 1 and 2 and the NRC inspectors discussed the results of this inspection with you and other members of your staff. On June 21, 2018, the inspectors re-exited the inspection results with you and other members of your staff. The results of this inspection are documented in the enclosed report.

NRC inspectors documented two findings of very low safety significance (Green) in this report. These findings involved violations of NRC requirements. The NRC is treating these violations as non-cited violations (NCVs) consistent with Section 2.3.2.a of the Enforcement Policy.

If you contest the violations or significance of these NCVs, 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 the Brunswick Steam Electric Plant.

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/

Marvin D. Sykes, Chief
Engineering Branch 1
Division of Reactor Safety

Docket Nos. 50-325, 50-324
License Nos. DPR-71, DPR-62

Enclosure:
Inspection Report 05000325/2018011
and 05000324/2018011

cc: Distribution via ListServ

SUBJECT: BRUNSWICK STEAM ELECTRIC PLANT - NRC DESIGN BASES ASSURANCE INSPECTION (PROGRAMS) REPORT NUMBER 05000325/2018011 AND 05000324/2018011

Distribution:
Teh-Chiun Su, RII
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E. Stamm, RII
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ADAMS: ☒ Yes ACCESSION NUMBER:_____ ☐ SUNSI REVIEW COMPLETE ☐ FORM 665 ATTACHED

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SIGNATURE	TXS2 EMAIL	TNF1	EJS2	MDS1			
NAME	T. Su	T. Fanelli	E. Stamm	M. Sykes			
DATE	6/18/2018	6/21/2018	6/21/2018	6/22/2018			
E-MAIL COPY?	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO

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U.S. NUCLEAR REGULATORY COMMISSION
Inspection Report

Docket Numbers:	50-325, 50-324
License Numbers:	DPR-71, DPR-62
Report Numbers:	05000325/2018011 and 05000324/2018011
Enterprise Identifier:	I-2018-011-0019
Licensee:	Duke Energy Progress, LLC
Facility:	Brunswick Steam Electric Plant, Units 1 and 2
Location:	Southport, NC
Inspection Dates:	April 23, 2018, to May 10, 2018
Inspectors:	E. Stamm, Senior Reactor Inspector (Lead) T. Fanelli, Senior Reactor Inspector T. Su, Reactor Inspector
Approved By:	Marvin D. Sykes, Chief Engineering Branch 1 Division of Reactor Safety

SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) continued monitoring Duke's performance at Brunswick Steam Electric Plant, Units 1 and 2, by conducting a design bases assurance inspection (programs) 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. NRC and self-revealed findings, violations, and additional items are summarized in the table below.

List of Findings and Violations

Failure to Justify Qualified Life Extension of ASCO Solenoid Operated Valves			
Cornerstone	Significance	Cross-cutting Aspect	Report Section
Mitigating Systems	Green NCV 05000325/2018011, 05000324/2018011-01 Closed	Not Applicable	71111.21N-Design Bases Assurance Inspection (Programs)
The NRC identified a Green finding and associated non-cited violation of 10 CFR 50.49(e)(5) for the licensee's failure to justify life extensions of ASCO solenoid operated valves (SOVs).			

Failure to Evaluate Effects of MOV Space Heaters on Qualified Life			
Cornerstone	Significance	Cross-cutting Aspect	Report Section
Mitigating Systems	Green NCV 05000325/2018011, 05000324/2018011-02 Closed	Not Applicable	71111.21N-Design Bases Assurance Inspection (Programs)
The NRC identified a Green finding and associated non-cited violation of 10 CFR 50.49(e)(5) for the licensee's failure to evaluate the effects of additional heat rise on the qualified life of Limitorque controls.			

Additional Tracking Items

Unresolved Item (Open)	"Potential Unjustified Activation Energy for Rosemont Transmitters" URI 05000325,05000324/2018011-03	71111.21N-Design Bases Assurance Inspection (Programs)

INSPECTION SCOPES

Inspections were conducted using the appropriate portions of the inspection procedure (IP) 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, performed walk downs, 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 by reviewing the following components from April 23 – 27, 2018, and May 7 – 10, 2018:

Environmental Qualification (EQ) Program Components (9 Samples)

(1) 0-CABLE-10, Raychem Flamtrol cable for 2-E41-F004-MO (insulation and jacket material)
(2) 0-TB-EB5-71, General Electric EB-5 terminal block for 1-SGT-1B-RB (non-metallic insulating phenolic base and metallic points)
(3) 1-1XDA-B11, high pressure coolant injection turbine auxiliary oil pump motor control center compartment (250VDC MCC, subcomponents including transformer, wire, starter, contactor, and various relays)
(4) 1-CAC-LT-2601, suppression pool level transmitter (electronic components, e.g. capacitors, transistors, diodes, etc.)
(5) 1-E11-F009-A, alternate feed contactor for shutdown cooling inboard suction throttle valve (Siemens-Allis contactors and Cutler-Hammer contactors, auxiliary contacts, auxiliary relays, and mechanical interlocks)
(6) 2-B21-TS-N010B, reactor building main steamline tunnel area high temperature switch B (Fenwall temperature switch lead wire insulation and enclosure)
(7) 2-CAC-SV-V7, inboard suppression pool purge exhaust valve solenoid operated valve (solenoid coils and elastomers)
(8) 2-E11-C001C-M, residual heat removal service water booster pump 2C motor (General Electric (GE) Class F, form wound motors, Mobile DTE 797, and motor lead wires)
(9) 2-E41-F004-MO, high pressure coolant injection pump suction from condensate storage tank valve motor operator (torque/limit switches, wiring, and terminal blocks)

EQ Program Components Inside Primary Containment (1 Sample)

(1) 1-1B21-F022A-LS-2, inboard main steam isolation valve closed position switch (contact block, contact carrier, conduit seal, cover gasket, and o-ring)

INSPECTION RESULTS

Failure to Justify Qualified Life Extension of ASCO Solenoid Operated Valves			
Cornerstone	Significance	Cross-cutting Aspect	Report Section
Mitigating Systems	Green NCV 05000325/2018011, 05000324/2018011-01 Closed	Not Applicable	71111.21N-Design Bases Assurance Inspection (Programs)

The NRC identified a Green finding and associated non-cited violation of 10 CFR 50.49(e)(5) for the licensee's failure to justify life extensions of ASCO solenoid operated valves (SOVs).

Description:

The licensee's Updated Final Safety Analysis Report (UFSAR), Section 3.11, Environmental Design of Mechanical and Electrical Equipment, subsection 3.11.0 General, commited Brunswick to Category 1 requirements, which are specified in 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," and Regulatory Guide 1.89, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants," Rev. 1.

The IEEE standard, Section 5.3, Qualification by Analysis, stated, in part, "*Qualification by analysis shall require the construction of a valid mathematical model of the electric equipment to be qualified, in which the performance characteristics of the equipment are the dependent variables and the environmental influences are the independent variables. The validity of the mathematical model shall be justified by test data, operating experience, or physical laws of nature. Qualification shall consist of a quantitative analysis of the mathematical model of the electric equipment that shall logically prove that the performance characteristics of the equipment meet or exceed the equipment design specifications when the equipment is subjected to the design basis event environment.*

Qualified life shall be determined from the time dependent effects of the environmental influences by quantitatively demonstrating that the performance characteristics of the equipment meet or exceed the design specifications of the equipment after a design basis event, preceded by a time period during which the equipment is subjected to its normal design environment."

The inspectors identified two examples where the licensee did not justify changes to the qualified life of ASCO SOVs with a valid mathematical model with verifiable test data that logically proved that the performance characteristics of the equipment met the equipment design specifications. The mathematical model in question was the Arrhenius model used for accelerated aging. The verifiable test data in question was the temperature recorded for the accelerated aging and the activation energy used to determine the extrapolated end of life for the SOVs. The environmental influences are the individual plant conditions experienced in the field.

Example One

The NRC issued Information Notice (IN) 89-66, "Qualification Life of Solenoid Valve," that identified unexpected SOV failures of some normally energized NP-1 series SOVs from additional heat rise in actual plant conditions. The additional heat rise from plant conditions was not adequately addressed in the original service condition input to the mathematical models for qualified life. In response to IN 89-66, ASCO issued a field notice dated October 27, 1989, that addressed the conditions identified in the IN. The field notice provided data tables with heat rise information resulting from different possible plant ambient temperatures.

The ASCO field notification stated, in part, "*thermal qualified life values may vary depending on the method used for determination as well as the data used in thermal life calculations. ...ASCO programs used Arrhenius calculations but were based on ambient temperatures rather than actual component temperatures. Since there are many variables that must be considered in qualified life calculations and since the NRC has not endorsed any single thermal qualified life calculation method, ASCO leaves it to each individual user to determine the appropriate qualified life calculation method for each specific application.*"

In 1989, the licensee changed the temperature recorded for accelerated aging in ASCO qualification report (AQR-67368), the SOV qualification of record. However, the inspectors noted that AQR-67368 did not document the heat rise internal to the SOVs during qualification and did not document the accelerated aging oven's manufacturer, serial number, specifications, or calibration records. The licensee added the static heat rise to the accelerated aging temperature input and to the service condition temperature input used in the mathematical model without documentation to correlate the new heat rise data to the qualification records. The inspectors determined that the change to the accelerated aging input to the mathematical model was unverified, unvalidated, and unjustified.

In addition, the inspectors reviewed new information provided by the licensee to resolve this issue, the licensee stated, "*airflow internal to the solenoid valve body is considered to be static/stagnant, and the body and housing cover of the solenoid valve are exposed to the maintained temperature value of the oven. During the oven tests to develop the FV-series drawings and data* [ASCO heat rise data]*, the sample materials were subjected to natural recirculation effects within the oven.*" The inspectors noted the actual temperature internal to the solenoid valve body during qualification was not recorded and could not be correlated to the changes in the mathematical model. The licensee claim of natural recirculation was an unverifiable assumption, and thus quantifying these assumed effects was unsupportable. The ASCO field notice specified that non-circulating/static ovens were used.

Example Two

The licensee changed the activation energy used in ASCO's original mathematical model based on a trip report from Nine Mile Point Nuclear Station, dated July 22, 1987. The activation energies were changed from 1.0 eV to 1.32 eV, without verifiable test data to demonstrate that the original ASCO mathematical model was unrealistic or invalid. ASCO used a variety of similar components from various manufactures to assemble the SOVs. These components, although similar, had significantly different activation energies. When the coil components were bonded together, the bonds appeared to affect the overall activation energy of the unit. The ASCO qualification report AQR-67368 specified the most limiting activation energies for the various subcomponents that could be installed in the SOVs. The report AQR-67368, Appendix B, "Activation Energy Values for ASCO Catalog NP-1 Valve Components," stated, in part, "*based on the information summarized herein, ASCO has*

conservatively chosen to apply the following activation energy values in all Arrhenius calculation used in connection with ASCO Catalog NP-1 valves:

- *All Ethylene Propylene Terpolymer (EPDM) Elastomers, 0.94 eV*
- *Viton Elastomers (except Bulletin NP8316 Viton Diaphragms), 1.04 eV*
- *Viton Diaphragms in Bulletin NP8316 Valves, 0.96 eV*
- *All Solenoid Coils, 1.00 eV.*"

The trip documented in the Nine Mile report occurred between April 15 and 16, 1987. This trip report was incorporated into the qualification data package for the ASCO SOVs. The inspectors noted that the date of the trip report was many months after the fact, it was not peer reviewed, and was not an Appendix B quality document with appropriate approvals. In the trip report topic for activation energy, item (a), the writer attempted to discredit the more limiting activation energy of 1.0 eV established for the mica impregnated core bobbin that was assigned to the coil assembly. The writer questioned the failure modes of the coil materials. The writer noted that the predominant failure mode was interturn shorts of the magnet wire while the bobbin isolates the magnet wire from the ground plane, which limited circuit failures. However, the trip report noted that the magnet wire, the bobbin, and the mandrel are coated with varnish and then baked until the components are bonded into a solid mass (coils assembly). Being bonded into one solid mass, each constituent component has the ability to affect the other. Failures in the bobbin and magnet wire bonds can cause magnet wire insulation delamination, thus interturn shorts. The inspector determined that ASCO's selection of 1.0 eV was valid and excluding it unjustifiably extended the qualified life of the SOVs. The qualified lives of the SOVs are more limited when the qualified activation energies from the 1983 report are used and many are beyond their qualified lives. The inspectors noted that the trip report and a corporate calculation (DPC-1381.05-00-0067 see below), included raw ASCO coil assembly test data that contradicted the licensee's contention that 1.0 eV was an unrealistically low activation energy. The test data indicated activation energies of 0.559 eV in one set of test data to 0.82 eV in another set of test data.

In addition, in item (b), the writer stated, "*the data base is incomplete, as the UL report lists 13 different wires that could be on coils already delivered. Supplement 3 asserts a minimum of 1.16 eV* [activation energy]*, but the reference to 1.16 eV is a Dow Corning report about silicone. Since the insulation is not silicone, this is erroneous data and must be deleted. The next highest eV is 1.32 based on DuPont data, and that is now justified as the lowest verifiable.*" However, the writer stated in Item (c) that "*for the new ASCO valves currently in test, the activation energy will be 1.15 eV.*" The writer did not dispute that the 1.15 eV material was used in their SOVs, in fact, the writer stated, that "*the UL report lists 13 different wires that could be on coils already delivered.*" The ASCO qualification records AQR-67368, Appendix B indicated that several different materials were used interchangeably in the construction of SOV coils. In addition, the trip report stated that ASCO will continue to use 1.15 eV for magnet wire, which confirmed that the original 1.16 eV activation energy was realistic. There was no ASCO confirmation for excluding the 1.16 eV, no supporting test report for context, and ASCO did not issue a correction to their qualification report. The inspectors determined that the lower activation energy for the wire was realistic, thus using a less limiting activation energy was not justified, and using it invalidated the mathematical model.

The licensee provided calculation DPC-1381.05-00-0067, "Environmental Qualification (EQ) Review & Validation Of NUGEQ Activation Energy Evaluation Supporting ASCO Solenoid Valves," to resolve this issue; however, the calculation reused previous information that was

found to be unjustified. As mentioned above, test data presented in this calculation indicated significantly lower activation energies that did not support the calculation conclusions.

As a result of overestimating the qualified lives with an invalid mathematical model of these ASCO SOVs, the SOV coils and many elastomers are currently beyond their realistic qualified lives established in AQR-67368. This appeared to include SOVs that are normally energized as well as some SOVs that have been energized as low as ten percent of their 40 year installed life.

Corrective Actions: The licensee entered this issue into the corrective action program and an initial determination of operability determined the components to be operable.

Corrective Action Reference: CR 2214510

Performance Assessment:
Performance Deficiency: The failure to base the qualification of ASCO SOVs on a valid mathematical model in accordance with IEEE 323-1974 was a performance deficiency (PD).

Screening: The PD was determined to be more than minor because it adversely affected the Equipment Performance attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events. Specifically, the failure to ensure that the ASCO SOVs can meet their performance specifications under the harsh service conditions throughout the plant life adversely affected the reliability of the Containment Vent/Purge Subsystem.

Significance: The inspectors used inspection manual chapter (IMC) 0609, Att. 4, "Initial Characterization of Findings," issued December 7, 2016, for mitigating systems, and IMC 0609, App. A, "The Significance Determination Process (SDP) for Findings At-Power," issued June 19, 2012, and determined the finding to be of very low safety significance (Green) because the finding was a deficiency affecting the qualification of a mitigating structure, system, and component (SSC), and the SSC maintained its operability.

Cross-cutting Aspect: Since the underlying cause of the issue occurred in October 1996, no cross-cutting aspect was assigned to this finding because the inspectors determined the finding did not reflect present licensee performance.

Enforcement:
Violation: Title 10 CFR 50.49(e)(5) requires, in part, that "Equipment qualified by test must be preconditioned by natural or artificial (accelerated) aging to its end-of-installed life condition. Consideration must be given to all significant types of degradation which can have an effect on the functional capability of the equipment. If preconditioning to an end-of-installed life condition is not practicable, the equipment may be preconditioned to a shorter designated life. The equipment must be replaced or refurbished at the end of this designated life unless ongoing qualification demonstrates that the item has additional life."

Contrary to the above, since October 1996, the licensee failed to replace or refurbish equipment at the end of its designated life or demonstrate that the item had additional life.

Enforcement Actions: This violation is being treated as a non-cited violation, consistent Section 2.3.2 of the Enforcement Policy.

Failure to Evaluate Effects of MOV Space Heaters on Qualified Life			
Cornerstone	Significance	Cross-cutting Aspect	Report Section
Mitigating Systems	Green NCV 05000325/2018011, 05000324/2018011-02 Closed	Not Applicable	71111.21N-Design Bases Assurance Inspection (Programs)

The NRC identified a Green finding and associated non-cited violation of 10 CFR 50.49(e)(5) for the licensee's failure to evaluate the effects of additional heat rise on the qualified life of Limitorque controls.

Description:
The licensee's Updated Final Safety Analysis Report (UFSAR), Section 3.11, Environmental Design of Mechanical and Electrical Equipment, subsection 3.11.0 General, commited Brunswick to Category 1 requirements, which are specified in IEEE 323-1974, as supplemented by NUREG 0588, and Regulatory Guide 1.89, Rev. 1.

The IEEE standard, Section 5. Principles of Qualification, stated, in part, "*Principles and procedures for demonstrating the qualification of Class 1E equipment include:*
(1) Assurance that the severity of the qualification methods equal or exceed the maximum anticipated service requirements and conditions,
(2) Assurance that any extrapolation or inference be justified by allowances for known potential failure modes and the mechanism leading to them."

Limitorque provided 25-watt space heaters in motor operated valve (MOV) limit switch compartments and in the motor end bells. Limitorque specified that these heaters were to prevent moisture intrusion while the MOVs were in storage, thus Limitorque did not include the effects of the space heaters in the environmental qualification. An NRC Information Notice 86-71, "Recent Identified Problems with Limitorque Motor Operators," identified that, "*although the heater is not a seismically or environmentally qualified part and is intended for use only during storage, its use has been shown to cause serious degradation of environmentally qualified internal wiring [and that] … three of the four operators were found to contain burnt internal wiring. One type SMB-00 operator also was inspected and was found to contain wiring susceptible to damage.*" This indicated that significant tempertures were present that could significantly affect the life of components even before the burn damage became obvious. The Brunswick inspection sample is an SMB-00 with a somewhat smaller limit switch compartment than the SMB-000 identified in IN 86-71. The Brunswick heaters were in service much longer than the one that caused the damage documented in IN 86-71.

The licensee placed these MOVs in operation with the space heaters energized continuously from approximately 1974 to 1997 (23 years). The licensee did not quantify or include the additional heat rise in their qualified life mathematical model. Therefore, the licensee did not provide assurance that the severity of the qualification methods equaled or exceeded the maximum anticipated service requirements and conditions. The limit switch compartment for the SMB-00 MOV at Brunswick contained several components that could experience significant degradation from the heat generated by the space heaters. These components included potting compound, wiring, terminal blocks, and torque/limit switches. As a result, the inspectors identified that some of these components may currently be beyond their qualified life. For instance, Limitorque qualified the phenolic Marathon 300 terminals, in accordance with IEEE 382-1972, for a 40-year life at 140 ºF. As a rule of thumb, for every 18 ºF (10 ºC)

increase in temperature the life of a component is cut in half. This is known as the 10 ºC rule. With the addition of the space heaters, the qualified lives of the components are in question. The licensee did not have an analysis that determined what actual heat rise for each component would be. The inspectors noted that the NUGEQ report specified that surface temperature of the 25-watt heaters can reach at least 250 ºF (see next paragraph). The ambient temperature was 110 ºF per the licensee. Given the facts outlined in IN 86-71, these temperatures could substantially affect the qualified life of components in the limit switch compartment.

The inspectors reviewed licensee information provided during inspection. The licensee indicated that an 18 ºF heat rise above ambient was specified by their Appendix B vendor. Because they were Appendix B, 18 ºF is all they should have to consider. The licensee indicated that the ambient temperature in the MOV was 110 ºF, which included 104 ºF room temperature and 6 ºF from process fluid. The inspectors noted that a NUGEQ report credited by the licensee in their qualification documentation, stated, in part, that "*the heaters provided by Limitorque are principally of a wire-wound/ceramic construction, although some are of a carbon-film/ceramic construction. The heaters are stud mounted with wiring bolted to two contact ears located at the opposite ends of the resistor. Limitorque noted that the heaters are typically sized to provide a 10 ºC temperature rise in the LSC* [limit switch compartment]. *However, the actual temperature rise will vary based on the LSC configuration, orientation, and installed components. In November 1978, a Limitorque test was conducted by applying proper voltage to a Ward Leonard space heater allowing the surface temperature to stabilize (measured at 250 degrees F),…*

Limitorque recognizes some utility interest in utilizing energized heaters to minimize the effects of moisture related degradation and corrosion. However, no additional Limitorque test information supporting the qualification and use of heaters is available. The use of heaters should address 1) the heat rise and associated impact on qualified life of LSC components, 2) subfusing of unqualified heaters to prevent propagation of electrical failures to safety related LSC components and other circuits, and 3) failure modes and effects analysis of unqualified heaters to demonstrate that hypothesized environmental failures will not affect actuator performance." The licensee qualification records did not indicate that use of heaters in MOV limit switch compartments was addressed.

Corrective Actions: The licensee entered this issue into the corrective action program and an initial determination of operability determined the components to be operable.

Corrective Action Reference: CR 2214514

Performance Assessment:
Performance Deficiency: The failure to address the degrading effects of space heaters in Limitorque MOVs was a performance deficiency (PD).

Screening: The PD was determined to be more than minor because it adversely affected the Equipment Performance attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events. Specifically, the failure to ensure that MOVs can meet their performance specifications under the harsh service conditions throughout the plant life adversely affected the reliability of the high pressure coolant injection pump suction and condensate storage tank isolation valve.

Significance: The inspectors used inspection manual chapter (IMC) 0609, Att. 4, "Initial Characterization of Findings," issued December 7, 2016, for mitigating systems, and IMC 0609, App. A, "The Significance Determination Process (SDP) for Findings At-Power," issued June 19, 2012, and determined the finding to be of very low safety significance (Green) because the finding was a deficiency affecting the qualification of a mitigating structure, system, and component (SSC), and the SSC maintained its operability.

Cross-cutting Aspect: Since the underlying cause of the issue occurred in 1997, no cross-cutting aspect was assigned to this finding because the inspectors determined the finding did not reflect present licensee performance.

Enforcement:
Violation: Title 10 CFR 50.49(e)(5) requires, in part, that "Equipment qualified by test must be preconditioned by natural or artificial (accelerated) aging to its end-of-installed life condition. Consideration must be given to all significant types of degradation which can have an effect on the functional capability of the equipment. If preconditioning to an end-of-installed life condition is not practicable, the equipment may be preconditioned to a shorter designated life. The equipment must be replaced or refurbished at the end of this designated life unless ongoing qualification demonstrates that the item has additional life."

Contrary to the above, since 1997, the licensee failed consider all significant types of degradation on Limitorque MOV components.

Enforcement Actions: This violation is being treated as a non-cited violation, consistent Section 2.3.2 of the Enforcement Policy.

Unresolved Item (Open)	"Potential Unjustified Activation Energy for Rosemont Transmitters" URI 05000325,05000324/2018011-03	71111.21N-Design Bases Assurance Inspection (Programs)

Description:
The licensee used 0.78 eV as the limiting activation energy for Rosemount transmitters. The activation energy was based upon an academic paper documenting experimental work performed for the early space program and first published in 1965. The paper cautioned the reader that the methods used were experimental and were not validated. A 0.5 eV activation energy for electronics was documented by the Electric Power Research Institute (EPRI) report NP-1558, which attributed it to electron migration of aluminum. Reports published by the Institute of Electrical and Electronics Engineers (IEEE) indicated that activation energies for various electronics and their failure modes could range from 0.5-0.66 eV. The licensee did not document an independent failure modes and effects analysis to justify the activation energy that they used. In addition, the licensee chose to use less limiting activation energies that were not proven to be justified. Finally, the licensee was unable to demonstrate acceptable margins for extrapolation confidence.

The IEEE standard 323-1974, section 6.5.2, Mathematical Modeling, stated, "the first step in the qualification by analysis is generally the construction of a valid mathematical model of the electric equipment to be qualified. 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."

Planned Closure Actions: The team must determine whether the activation energy used for the transmitters was appropriate and, if not, whether the licensee had the responsibility to verify the information provided by their vendors and contractors. The region is discussing this issue with NRC headquarters to find a resolution to this issue.

Licensee Actions: N/A

Corrective Action References: CR 2205534

EXIT MEETINGS AND DEBRIEFS

The inspectors confirmed that proprietary information was controlled to protect from public disclosure.

- On May 10, 2018, the inspectors presented the inspection results to Mr. Randy Gideon, and other members of the licensee staff.
- On June 21, 2018, the inspectors re-exited the inspection results to Mr. Randy Gideon, and other members of the licensee staff.

DOCUMENTS REVIEWED

Corrective Action Documents Written as a Result of the Inspection
CR 2200899, 2018 NRC EQ Inspection – Ethernet Cable on 1XDA
CR 2200900, 2018 NRC EQ Inspection – Loose Pipe Caps-Couplings
CR 2201041, 1-E11-F009-A Alt Feed Electrical Box Has Missing Clip
CR 2201161, 2018 EQ Inspection – Flex Conduit At MCC-2-2XA-2 Has Bulge
CR 2201392, Food and Drink Storage
CR 2201993, 2018 DBAI EQ Program NRC Inspection – QDP 71 Discrepancy
CR 2205534, 2018 NRC EQ DBAI Inspection URI Rosemount Transmitter
CR 2205537, 2018 BNP NRC EQ DBA Inspection – ASCO Ae Value URI
CR 2205541, 2018 NRC EQ DBAI Inspection URI MOV Heaters
CR 2205543, 2018 BNP NRC EQ DBAI – ASCO Aging URI
CR 2214510, NRC EQ Inspection Violation for ASCO SOV's
CR 2214514, NRC EQ Inspection Violation for Limitorque Heater Evaluation
WR 20106086, 2018 EQ Program DBAI Replace Mechanical Clip for Box

Procedures
AD-MN-ALL-0002, Foreign Material Exclusion, Rev. 9
EGR-NGGC-0156, Environmental Qualification of Electrical Equipment Important to Safety, Rev. SUP
OAI-114, House Keeping/Material Condition Program. Rev. 43
OSPP-SEA001, Installation of Equipment Seals for EQ Electrical Equipment, Rev. 22

Drawings
0-FP-82217, Units 1 & 2, Enclosure Details Model NO CPL-2133-1, Sh. 3 Rev. A
0-FP-82217, Units 1 & 2, Wiring Diagram Interlock Contactor, Sh. 8, Rev. 0

Calculations
BNP-EQ-3.002, Reactor Building MCC Component Temperature Responses During a HELB, Rev. 0

Corrective Action Documents
CR 97-02682

Work Orders
11117541-01
13363006-03
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