UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
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ATLANTA, GEORGIA 30303-1257

November 30, 2017

Mr. George Lippard III
Vice President
Nuclear Operations
South Carolina Electric & Gas Company
Virgil C. Summer Nuclear Station
Post Office Box 88, Mail Code 800
Jenkinsville, SC 29065

SUBJECT: VIRGIL C. SUMMER NUCLEAR STATION - NRC DESIGN BASES ASSURANCE INSPECTION (TEAM) REPORT NUMBER 05000395/2017007

Dear Mr. Lippard,

On October 20, 2017, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at your Virgil C. Summer Nuclear Station, Unit 1, and on November 20, 2017, the NRC inspectors 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 three findings of very low safety significance (Green) in this report. Three of 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. Further, inspectors documented a licensee-identified violation, which was determined to be of very low safety significance (Green) in this report. The NRC is treating this violation as a non-cited violation (NCV) 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 Virgil C. Summer Nuclear Station.

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/

Shakur A. Walker, Chief
Engineering Branch 1
Division of Reactor Safety

Docket No.: 50-395
License No.: NPF-12

Enclosure:
Inspection Report 05000395/2017007,
w/Attachment: Supplemental Information

cc: Distribution via ListServ

SUBJECT: VIRGIL C. SUMMER NUCLEAR STATION - NRC DESIGN BASES ASSURANCE INSPECTION (TEAM) REPORT NUMBER 05000395/2017007

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W. Sherbin, NRR

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ADAMS: ☒ Yes ACCESSION NUMBER:_____ ☒ SUNSI REVIEW COMPLETE ☒ FORM 665 ATTACHED

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U. S. NUCLEAR REGULATORY COMMISSION

REGION II

Docket No.:	05000395
License No.:	NPF-12
Report No.:	05000395/2017007
Licensee:	South Carolina Electric & Gas (SCE&G) Company
Facility:	Virgil C. Summer Nuclear Station, Unit 1
Location:	Jenkinsville, SC 29065
Dates:	September 25 – October 20, 2017
Inspectors:	M. Riley, Acting Senior Reactor Inspector (Lead) C. Franklin, Reactor Inspector N. Morgan, Reactor Inspector D. Terry-Ward, Construction Inspector W. Sherbin, Contractor A. Della-Greca, Contractor
Approved by:	Shakur A. Walker, Chief Engineering Branch 1 Division of Reactor Safety

Enclosure

SUMMARY

Inspection Report (IR) 05000395/2017007; September 25 – October 20, 2017; Virgil C. Summer Nuclear Station, Unit 1; Design Bases Assurance Inspection (Team).

The inspection activities described in this report were performed between September 25 through October 20, 2017, by a team of four U.S. Nuclear Regulatory Commission (NRC) inspectors and two contractors. The team identified three non-cited violations. The significance of inspection findings are indicated by their color (i.e., greater than Green, or Green, White, Yellow, or Red) and determined using Inspection Manual Chapter (IMC) 0609, "Significance Determination Process," (SDP) dated April 29, 2015. Crosscutting aspects are determined using IMC 0310, "Aspects Within the Cross-Cutting Areas," dated December 4, 2014. All violations of NRC requirements are dispositioned in accordance with the NRC's Enforcement Policy dated November 1, 2016. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Rev. 6.

A violation of very low safety significance that was identified by the licensee has been reviewed by the NRC. Corrective actions taken or planned by the licensee have been entered into the licensee's corrective action program. The violation and corrective action tracking numbers are listed in Section 4OA7 of this report.

NRC-Identified and Self-Revealing Findings

Cornerstone: Mitigating Systems

- Green: The NRC identified a non-cited violation (NCV) of Title 10 of the Code of Federal Regulations (CFR) Part 50, Appendix B, Criterion III, "Design Control," for the licensee's failure to verify the emergency feedwater (EFW) pumps would be capable of taking suction from service water for an indefinite period of time as required by Updated Final Safety Analysis Report Section 10.4.9.2. The licensee entered this issue into their corrective action program (CAP) as condition report (CR) 17-05528 and performed an operability determination to verify the EFW pumps remained operable.

  The performance deficiency was determined to be more than minor because it was associated with the design control 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 to prevent undesirable consequences. Specifically, the failure to evaluate worst-case design conditions resulted in a reasonable doubt that the EFW pumps could provide cooling water to the steam generators and perform their design basis function. The team determined the finding to be of very low safety significance (Green) because the finding was a deficiency affecting the design or qualification of a mitigating structure, system, and component (SSC), and the SSC maintained its operability. The team determined that no crosscutting aspect was applicable because the finding did not reflect current licensee performance (Section 1R21.2.b.1).

- Green: The NRC identified an NCV of 10 CFR Part 50, Appendix B, Criterion XI, "Test Control," involving two examples. Specifically, the licensee (1) failed to establish a testing program to assure the adequacy of the shutdown setpoint of the safety-related inverters, and (2) failed to establish a testing program to assure the adequacy of the time

delay relay in the emergency feedwater/service water (EFW/SW) crosstie valve actuation circuitry. The licensee entered this issue into their CAP as CRs17-05534 and 17-05536, and performed an operability determination to verify that the safety-related components remained operable.

The performance deficiency was determined to be more than minor because it was associated with the design control 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 to prevent undesirable consequences. Specifically, failing to establish a testing program for the low voltage DC setpoint of inverter XIT 5904 and for the time delay relay in the EFW/SW crosstie actuation circuitry could result in undetected degradation of the equipment to perform their intended safety functions. The team determined the finding to be of very low safety significance (Green) because it was a deficiency affecting the design or qualification of a mitigating SSC, and the SSC maintained its operability. The team determined that no cross-cutting aspect was applicable because the finding did not reflect current licensee performance (Section 1R21.2.b.2).

- Green: The NRC identified an NCV of 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Actions," for the licensee's failure to identify that a deviation in equipment qualification of power shield relays in 480V switchgear XSW-1DB1 was a condition adverse to quality in their CAP. Specifically, the licensee failed to identify that Power Shield catalog #609903-T501N in purchase order NU-02SR750589 was not qualified to meet its original total integrated dose limit of 100,000 rads as stated in the Asea Brown Boveri 10 CFR Part 21 notification letter. The licensee entered this issue into their CAP as CR-17-05391 and performed an evaluation to determine there was reasonable assurance that the power shield relay in purchase order NU-02SR750589 could perform its intended safety function.

  The performance deficiency was determined to be more than minor because it was associated with the design control 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 to prevent undesirable consequences. Specifically, the failure to identify that Power Shield catalog #609903-T501N in purchase order NU-02SR750589 was not qualified to the 1,350 rad TID specified in the equipment qualification database for zone AB-72 resulted in a reasonable doubt that the qualification requirements over the relay's service life would be met. The team determined the finding to be of very low safety significance (Green) because the finding affected the design or qualification of a mitigating SSC and the SSC maintained its operability. The team determined that no crosscutting aspect was applicable because the finding did not reflect current licensee performance (Section 1R21.2.b.3).

REPORT DETAILS

1. REACTOR SAFETY

Cornerstones: Initiating Events, Mitigating Systems, Barrier Integrity

1R21 Design Bases Assurance Inspection (Team) (71111.21M)

.1 Inspection Sample Selection Process

The team selected risk-significant samples and related operator actions for review using information contained in the licensee's probabilistic risk assessment. In general, this included risk significant structures, systems, and components (SSCs) that had a risk achievement worth factor greater than 1.3 or Birnbaum value greater than 1E-6. The sample included four components selected based on risk significance, one component associated with containment large early release frequency (LERF), five modifications to mitigation SSCs, and three operating experience (OE) items.

The team performed a margin assessment and a detailed review of the selected risk-significant components and associated operator actions to verify that the design bases had been correctly implemented and maintained. Where possible, this margin was determined by the review of the design basis and Updated Final Safety Analysis Report (UFSAR). This margin assessment also considered original design issues, margin reductions due to modifications, or margin reductions identified as a result of material condition issues. Equipment reliability issues were also considered in the selection of components for a detailed review. These reliability issues included items related to failed performance test results, significant corrective action, repeated maintenance, maintenance rule status, Inspection Manual Chapter 0326 conditions, NRC Resident Inspector input regarding problem equipment, system health reports, industry OE, and licensee problem equipment lists. Consideration was also given to the uniqueness and complexity of the design, OE, and the available defense-in-depth margins. An overall summary of the reviews performed and the specific inspection findings identified is included in the following sections of the report.

.2 Component Reviews

a. Inspection Scope

Components Selected Based on Risk Significance

- 120VAC Inverter 5904 (XIT5904)
- ESF 480V Bus 1DA2 (XSW1DA2)
- Condensate Storage Tank (XTK0008)
- RHR Pump B (XPP0031B)

Components with LERF Implications

- Main Steam Isolation Valve C - (XVM02801C-MS)

Modifications to Mitigation SSCs

- ECR71221 - ESF Undervoltage Logic and Setting Calculations
- ECR50915 - Paralleling an Emergency Diesel Generator with the Alternate AC Line

- ECR50695E - Major Revision - EFW Sys Flow Control Enhancement
- ECR71571 - EDG Fuel Oil Transfer Suction Strainer D/P Pressure Switch Setpoints
- ECR71740 - ECCS HHSI Flow Balance Margin Enhancement

For the five components listed above, the team reviewed the plant technical specifications (TS), UFSAR, design bases documents, and drawings to establish an overall understanding of the design bases of the components. Design calculations and procedures were reviewed to verify that the design and licensing bases had been appropriately translated into these documents and that the most limiting parameters and equipment line-ups were used. Logic and wiring diagrams were also reviewed to verify that operation of electrical components conformed to design requirements. Test procedures and recent test results were reviewed against design bases documents to verify the adequacy of test methods and that acceptance criterion for tested parameters were supported by calculations or other engineering documents, and that individual tests and analyses served to validate component operation under accident conditions. Maintenance procedures were reviewed to ensure components were appropriately included in the licensee's preventive maintenance program, that components or sub-components were being replaced before the end of their intended service life, and that the licensee has appropriate controls in place for components that are beyond vendor recommended life. Vendor documentation, system health reports, preventive and corrective maintenance history, and corrective action program documents were reviewed (as applicable) in order to verify that the performance capability of the component was not negatively impacted, and that potential degradation was monitored or prevented. Maintenance Rule information was reviewed to verify that the component was properly scoped, and that appropriate preventive maintenance was being performed to justify current Maintenance Rule status. Component walkdowns and interviews were conducted to verify that the installed configurations would support their design and licensing bases functions under accident conditions, and had been maintained to be consistent with design assumptions.

For the five modifications listed above, the team reviewed design bases, licensing bases, and performance capability of components to ensure they have not been degraded through modifications. In addition, post-modification testing was reviewed to ensure operability was established by verifying unintended system interactions will not occur, SSC performance characteristic continue to meet the design bases, modification design assumptions are appropriate, and modification test acceptance criteria have been met. The team also verified design basis documentation was updated consistent with the design change, verified other design basis features were not adversely impacted, verified procedures and training plans affected by the modification were updated, and verified that affected test documentation was updated or initiated as required by applicable test programs. Walkdowns and interviews were conducted as necessary to verify that the modifications were adequately implemented. Documents reviewed are listed in the Attachment.

b. Findings

.1 Failure to Verify the Adequacy of Design for the Emergency Feedwater System When Supplied by Service Water

Introduction: The NRC identified a Green non-cited violation (NCV) of Title 10 of the Code of Federal Regulations (CFR) Part 50, Appendix B, Criterion III, "Design Control,"

for the licensee's failure to verify the emergency feedwater (EFW) pumps would be capable of taking suction from service water (SW) for an indefinite period of time as required by UFSAR Section 10.4.9.2. Specifically, the licensee failed to verify that cooling water flow to the EFW pumps' bearings and seal flush lines would not be blocked due to debris in the SW system, rendering the pumps incapable of taking suction from SW for an indefinite period of time.

Description: The EFW system at Virgil C. Summer Nuclear Plant consists of two electric motor-driven EFW pumps; one turbine-driven EFW pump; the condensate storage tank (CST); and the necessary piping, valves, instrumentation, and controls. UFSAR Section 10.4.9.1 states that the design basis of the EFW system is to automatically deliver a minimum total flow of 380 gallons per minute (gpm) to at least two steam generators pressurized to 1211 psig and that the system is required to deliver sufficient feedwater to the steam generators for cooldown upon loss of the normal feedwater supply. UFSAR Section 10.4.9.1 also states that the EFW system must operate until the residual heat removal (RHR) system can be placed in operation at a reactor coolant pressure and temperature of approximately 400 psig and 350°F, respectively. UFSAR Section 10.4.9.2 states that the CST, which contains clean water, provides the preferred suction source for the EFW pumps and that the SW system is a safety related backup source that the EFW pumps can take suction from for an indefinite period of time.

The SW system takes suction from a safety class impoundment adjacent to Lake Monticello. The team noted that the orifices in the motor-driven EFW and turbine-driven EFW pumps' bearing coolers and seal flush lines had cross-sectional openings sized between 0.094 and 0.125 inch, whereas the SW rotating screens openings had cross-sectional openings of approximately 0.25 inch square. The team also noted that there were no other screens or strainers in the system. The team concluded that the design of the EFW system and cross-sectional opening of the SW rotating screens could allow debris large enough to pass through the screens and clog the bearing and oil cooler lines in the EFW pumps, preventing the use of SW as an indefinite suction source for EFW as described in UFSAR 10.4.9.2. The team was particularly concerned during design basis tornado accidents. UFSAR Section 3.5 states that the CST is not protected from tornado missiles and that the loss of the CST during a tornado would not affect the capability to shut down the reactor and maintain it in a safe shutdown condition (hot standby) because SW would be available as an alternate source of makeup. The licensee provided historical data to the team, which indicated the lake water normally was virtually free of debris. However, the team was concerned that if a tornado passes through the site, which is when the SW lineup to EFW pumps' suction is needed due to tornado missile striking the CST, there would be substantially more debris in the lake than when measured with clean lake water.

The team noted calculation DC05220-048, "Determination of the Minimum Required Volume in CST for EFW", Rev. 6, stated it would take six hours of EFW operation to bring the plant to hot shutdown, assuming the plant is maintained at hot standby for two hours and then cooled down to hot shutdown in four hours. To address the team's concern, the licensee entered the issue into their corrective action program (CAP) as condition report (CR) 17-05528 on October 19, 2017, and performed an operability determination to verify the EFW system remained operable. The licensee determined that the motor-driven EFW pumps could operate for about 11 hours without cooling water to the bearings or seals, and the turbine-driven EFW pump could operate for up to

six hours without cooling water to the bearings or seals, thus ensuring EFW could operate long enough to bring the plant to hot shutdown when RHR would be available.

Analysis: The team determined that the licensee's failure to verify that cooling water flow to the EFW pumps' bearings and seal flush lines would not be blocked due to debris to ensure the EFW system could take suction from SW for an indefinite period of time as described in UFSAR Section 10.4.9.2 was a violation of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," and a performance deficiency (PD). The PD was determined to be more than minor because it was associated with the design control 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 to prevent undesirable consequences. Specifically, the failure to evaluate worst-case design conditions resulted in a reasonable doubt that the EFW pumps could provide cooling water to the steam generators and perform their design basis function.

The team 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. Since the underlying cause of the issue occurred during original design, the team determined that no crosscutting aspect was applicable because the finding was not indicative of current licensee performance.

Enforcement: Title 10 CFR Part 50, Appendix B, Criterion III, "Design Control," requires, in part, that design control measures provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculation methods, or by the performance of a suitable testing program. UFSAR Section 10.4.9.2 stated that the EFW system could take suction from the SW system for an indefinite period of time. Contrary to the above, since original design and construction, the licensee failed to verify the EFW pumps could take suction from SW for an indefinite period of time, due to potential blockage of cooling water flow to the EFW pumps' bearing and seal flush lines when aligned to SW. Loss of cooling to EFW pump's bearing and seal flush lines would adversely affect the ability of the EFW pumps to perform their design basis function. The licensee entered this issue into their CAP as CR 17-05528 and performed an operability determination to verify the EFW pumps remained operable. This violation is being treated as an NCV consistent with Section 2.3.2.a of the NRC Enforcement Policy: (NCV 05000395/2017007-01, "Failure to Verify the Adequacy of Design for the EFW system when supplied by Service Water").

.2 Failure to Establish a Testing Program for Inverter XIT5904 and for the Time Delay Relay in the Emergency Feedwater/Service Water Crosstie Valve Actuation Circuitry

Introduction: The NRC identified a Green NCV of 10 CFR Part 50, Appendix B, Criterion XI, "Test Control," involving two examples. Specifically, the licensee (1) failed to establish a testing program to assure the adequacy of the shutdown setpoint of the safety-related inverters, and (2) failed to establish a testing program to assure the adequacy of the time delay relay in the EFW/SW crosstie valve actuation circuitry.

Description: UFSAR Section 8.1 states that the licensee is committed to IEEE 308-1971. Section 6.3 of IEEE 308-1971 states that periodic tests shall be performed to (1) detect the deterioration of the system toward an unacceptable condition and (2) demonstrate that standby power equipment and other components that are not exercised during normal operation of the station are operable. The team identified the following two examples of the licensee's failure to test safety-related equipment in accordance with IEEE 308-1971.

Example 1 - Failure to Test Inverter XIT5904 Shutdown Setpoint:

Calculation DC08320-010, "Class 1E 125 Volt DC System Voltages and Voltage Drop," Rev. 18, evaluated the minimum voltage available at DC components under worst-case conditions and, in particular, at the end of the postulated four-hour mission time of the batteries. For safety-related 120 VAC Inverter XIT5904, the calculation determined that, with 58 battery cells in service, the minimum DC voltage at the inverter terminals would be 104.62 VDC. The calculation also stated that the minimum recommended operating voltage is 104 VDC and that "The inverter low dc voltage sensor will turn off the inverter at 104 VDC." Because of the small margin between the calculated minimum DC voltage and the stated shutdown setpoint of the inverters, the team asked the licensee about the inverter's low voltage DC trip setting, and the testing being done to verify that the inverters would not trip before the four hour mission time because of the trip setting drifting high. The team identified that the low voltage DC trip set point was not in the testing program and was not being tested periodically. Although the team recognized the inverter's low voltage trip setting was set at the factory, the team noted that the setting was adjustable and that installation/maintenance activities, component aging, and/or environmental conditions could affect the factory setting and result in an inadvertent loss of the inverter during design basis conditions. Also as a result of the team's questions, the licensee received communication from the vendor indicating that the trip setting was actually 103 VDC.

On October 19, 2017, the licensee entered this issue into their CAP as CR-17-05534 and verified there was reasonable assurance that the inverter remained operable. The licensee determined that both safety-related batteries, XBA1A and XBA1B, passed their most recent capacity tests with a final voltage at four hours of 111.8VDC and 114.0VDC, respectively, well above the cutout setpoint of 103VDC.

Example 2- Failure to Test Time Delay Relay in the Emergency Feedwater/Service Water Crosstie Valve Actuation Circuitry:

The automatic actuation circuitry of the EFW/SW crosstie valve consists of a CST level switch, a time delay relay, and a valve actuation circuit. The purpose of the time delay is to prevent spurious trips of the EFW pumps due to pressure spikes when starting and stopping the EFW pumps. Specifically, when the CST level switch actuates because of a loss of CST inventory, the signal goes to the time delay relay. When the relay times-out after 4.5 seconds, the crosstie valve gets a signal to open. The team noted that the time delay relay was set in 1982 and that the time delay function of the relay had not been tested since its installation date. The failure to perform periodic testing of the time delay relay could result in an undetected drift of the time delay relay, which could result in the loss of the EFW pump. On October 19, 2017, the licensee entered this issue into their CAP as CR 17-05536 and determined there was reasonable assurance that the relay could perform its intended safety function.

Analysis: The team determined the licensee's failure to establish a testing program to periodically test (1) the low voltage DC setpoint of inverter XIT5904 and (2) the time delay relay for the EFW/SW crosstie valve actuation circuitry in accordance with IEEE 308-1971, was a violation of 10 CFR Part 50, Appendix B, Criterion XI, "Test Control," and a PD. The PD was determined to be more than minor because it was associated with the design control attribute of the mitigating systems cornerstone and adversely affected the cornerstone objective of ensuring the availability, reliability, and capability of the inverters to respond to initiating events to prevent undesirable consequences. Specifically, failing to establish a testing program for the low voltage DC setpoint of inverter XIT 5904 and for the time delay relay in the EFW/SW crosstie actuation circuitry could result in undetected degradation of the equipment to perform their intended safety functions.

The team used IMC 0609, Att. 4, "Initial Characterization of Findings," issued October 7, 2016, for mitigating systems, and IMC 0609, App. A, "The SDP for Findings At-Power," issued June 19, 2012, and determined the finding to be of very low safety significance (Green) because it was a deficiency affecting the design or qualification of a mitigating SSC, and the SSC maintained its operability. Since the underlying cause of the issues occurred since original plant installation, this finding was not assigned a crosscutting aspect because the issue did not reflect current licensee performance.

Enforcement: Title 10 CFR Part 50, Appendix B, Criterion XI, "Test Control," requires in part, that "A test program shall be established to assure that all testing required to demonstrate that structures, systems, and components will perform satisfactorily in service is identified and performed in accordance with written test procedures which incorporate the requirements and acceptance limits contained in applicable design documents." UFSAR Section 8.1 stated that the licensee was committed to IEEE 308-1971. Section 6.3 of IEEE 308-1971 required periodic tests be performed to (1) detect the deterioration of the system toward an unacceptable condition and (2) demonstrate that standby power equipment and other components that are not exercised during normal operation of the station are operable. Contrary to the above, since original plant installation, the licensee failed to establish a testing program to detect the deterioration of the shutdown setpoint of inverter XIT 5904 and the time delay relay in the EFW/SW crosstie valve actuation circuitry. Failing to establish a testing program for the low voltage DC setpoint of inverter XIT 5904 and for the time delay relay in the EFW/SW crosstie actuation circuitry could result in undetected degradation of the equipment to perform their intended safety functions. The licensee entered this issue into their CAP as CRs17-05534 and 17-05536, and performed an operability determination to verify that the safety-related components remained operable. This violation is being treated as an NCV consistent with section 2.3.2.a of the NRC enforcement policy (NCV 05000395/2017007-02, "Failure to Establish a Testing Program for Inverter XIT5904 and Time Delay Relay in the EFW/SW Crosstie Valve Actuation Circuitry").

.3 Failure to Identify a Condition Adverse to Quality for Power Shield Catalog #609903-T501N in Purchase Order NU-02SR750589

Introduction: The NRC identified a Green NCV of 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Actions," for the licensee's failure to identify that a deviation in equipment qualification of power shield relays in 480V switchgear XSW-1DB1 was a condition adverse to quality in their corrective action program. Specifically, the licensee failed to identify that Power Shield catalog #609903-T501N in purchase order NU-02SR750589 was not qualified to meet the total integrated dose (TID) limit of 100,000 rads as stated in the Asea Brown Boveri (ABB) 10 CFR Part 21 notification letter.

Description: On September 27, 2013, ABB sent a 10 CFR Part 21 notification of deviation letter to the licensee stating the certificates of conformance for solid state circuit shield relays and Power Shield (K-Line) relays containing complementary metal oxide semiconductor technology incorrectly identified the relays were qualified to 100,000 rads and that the solid state relays and power shields were actually qualified to 1,000 rads. The notification letter identified 27 Power Shield catalog numbers that were affected. In 2013, the licensee entered this issue into their CAP as CRs 13-04047 and 13-03936 to address the purchase orders that contained the affected catalog numbers. CR 13-03936 stated, "Upon further review, the Part 21 letter noted that this issue arose since the reference documentation was never updated after a prior 1994 notice which specified that the affected K-line power shields are only qualified to 1000 rads rather than the 100000 rads."…"VCS response in 1994 was that the maximum any relays would see is less than or equal to 880 Rads, which is less than the 1,000 rad qualification. However, upon review of the relay's location, the power shield relays used in XSW-1DB1 will see a total integrated dose (40-year life) of 880 rad with a potential loss of coolant accident (LOCA) dose of 470 rad. This total dose of 1,350 rad is greater than the qualified 1000 rad limit. The location in question is in EQ zone AB-72 and shows a dose rate of 2.5 mR/hr (880 TID). However, discussion with health physics revealed that the room in question has been recorded at less than 0.5 mR/hr." The licensee stated that this equipment qualification (EQ) zone was mild per UFSAR Section 3.11.

The licensee submitted purchase order NU-02SR750589 for review by the team, and the team identified that this purchase order contained Power Shield catalog #609903-T501-N, which was identified as one of the affected catalog numbers in the ABB 10 CFR Part 21 notification of deviation letter. The team noted that this purchase order was omitted from CRs 13-04047 and 13-03936, and that the licensee had not evaluated if this Power Shield relay was capable of performing its intended function. The relay was also located in safety-related 480VAC switchgear XSW-1DB1. Exceeding the TID limits of the safety-related power shield relay would not ensure that the protection system equipment in switchgear XSW-1DB1 could meet its performance requirements on a continuing basis during normal and design basis events as a result of the deviation.

To address the new issue identified by the team, the licensee entered this issue into their CAP on October 12, 2017, as CR-17-05391 and performed an evaluation to determine if there was reasonable assurance that the power shield relay in purchase order NU-02SR750589 could perform their intended safety function. As part of the evaluation, the licensee reviewed survey maps of EQ zone AB-72 dating back to 2003, which showed that the dose rates of the room was less than 0.5 mR/hr. The licensee determined that upon utilizing a conservative number of 0.5 mR/hr, the TID for that area

would be less than 180 rad. With the added 470 rad from a LOCA event, the total dose the relay would see would be approximately 650 rad, which was within the 1,000 rad qualified life of the relay.

Analysis: The licensee's failure to identify that a deviation in the equipment qualification of Power Shield catalog #609903-T501N in purchase order NU-02SR750589 was a condition adverse to quality in CRs 13-04047 and 13-03936, was a violation of Title 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," and a PD. The PD was determined to be more than minor because it was associated with the design control 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 to prevent undesirable consequences. Specifically, the failure to identify that Power Shield catalog #609903-T501N in purchase order NU-02SR750589 was not qualified to the 1,350 rad TID specified in the equipment qualification database for zone AB-72 resulted in a reasonable doubt that the qualification requirements would be met over the relay's service life.

The team used IMC 0609, Att.4, "Initial Characterization of Findings," issued October 7, 2016, for mitigating systems, and IMC 0609, App. A, "The Significance Determination Process (SDP) for Findings At-Power," dated June 19, 2012, and determined the finding to be of very low safety significance (Green) because the finding affected the design or qualification of a mitigating SSC and the SSC maintained its operability. Since the underlying cause of the issue occurred on September 27, 2013, the team determined that no crosscutting aspect was applicable because the finding was not indicative of current licensee performance.

Enforcement: Title 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," requires, in part, that "Measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and non-conformances are promptly identified and corrected." Contrary to the above, since September 27, 2013, the licensee failed to establish measures to assure that a deviation related to equipment qualification of Power Shield catalog #609903-T501N in purchase order NU-02SR750589 was promptly identified. Exceeding the TID limits of the safety-related relay in 480VAC Switchgear XSW-1DB1 would not ensure that the protection system equipment could meet its performance requirements on a continuing basis. The licensee entered this issue into their CAP as CR-17-05391 and performed an operability determination to verify that the relay remained operable. This violation is being treated as an NCV consistent with section 2.3.2.a of the Enforcement Policy (NCV 05000395/2017007-03, "Failure to Identify a CAQ for Power Shield Catalog #609903-T501N in Purchase Order NU-02SR750589").

.3 Operating Experience

a. Inspection Scope

The team reviewed three operating experience issues for applicability at the Virgil C. Summer Nuclear Plant. The team performed an independent review for these issues

and, where applicable, assessed the licensee's evaluation and disposition of each item. The issues that received a detailed review by the team included:

- Westinghouse NSAL 09-8: Presence of Vapor in Emergency Core Cooling System/Residual Heat Removal System in Modes 3/4 Loss-of-Coolant Accident Conditions
- NRC Information Notice 15-13: Main Steam Isolation Valve Failure Events
- NRC Information Notice 91-13: Inadequate Testing of Emergency Diesel Generators (EDGs)

b. Findings

None

4. OTHER ACTIVITIES

4OA6 Meetings, Including Exit

On October 20, 2017, the team presented the inspection results to Mr. Don Shue and other members of the licensee's staff. On November 20, 2017, a re-exit meeting was conducted via teleconference to present the final inspection results to Mr. George Lippard III and other members of the licensee's staff. Proprietary information that was reviewed during the inspection was returned to the licensee or destroyed in accordance with prescribed controls.

4OA7 Licensee-Identified Violations

The following licensee-identified violation of NRC requirements was determined to be of very low safety significance (Green) and met the NRC Enforcement Policy criteria for being dispositioned as a non-cited violation.

- Title 10 CFR Part 50, Appendix B, Criterion III, "Design Control," requires, in part, that design control measures provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program. Contrary to the above, since 2010, the licensee failed to evaluate the loading of the emergency diesel generators at the maximum voltage and frequency allowed by TS 3/4.8.1 in Calculation DC08360-006, "Diesel Generator 1A and 1B Loading," Rev. 12, and to evaluate battery terminal voltage at the maximum battery cell-to-cell resistance allowed by TS 3/4.8.2 in Calculation DC08320-010, "Class 1E 125 Volt DC System Voltages and Voltage Drop," Rev. 18. The team determined the finding to be of very low safety significance (Green) because the finding was a deficiency affecting the design of a mitigating SSC, and the SSC maintained its operability. The licensee entered these issues into their CAP as CRs 10-02395 and 10-02033.

ATTACHMENT: SUPPLEMENTAL INFORMATION

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

Licensee Personnel:
D. Shue, Nuclear Operations Manager
R. Ray, Maintenance Manager
T. Ledbetter, Planning and Scheduling Manager
S. Zarandi, Nuclear Support Services General Manager
B. Thompson, Nuclear Licensing Manager
W. Stuart, Engineering Services General Manager
R. Haselden, Organization Effectiveness General Manager
L. Harris, Quality Systems Manager
G. Douglass, Nuclear Protection Services Manager
G. Williams, Plant Support Engineering Program Supervisor
M. Carr, Engineering
C. Calvert, Design Engineering Manager
T. Bussey, Nuclear Fuels & Analysis Supervisor)
R. Perry, Nuclear Licensing
J. Archie, Chief Nuclear Officer
M. Verrilli, Materials and Procurement
G. Lindamood, Santee Cooper
C. Boozer, Engineering Supervisor
W. Martin, Nuclear Licensing
W. Kearney, Operations
D. Edwards, Operations
J. Ward, Design Engineering
D. Dobson, Design Engineering

NRC Personnel:
J. Reece, Senior Resident Inspector
E. Hilton, Resident Inspector

LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Opened & Closed

05000395/2017007-01	NCV	Failure to Verify the Adequacy of Design for the EFW system when Supplied by SW (Section 1R21.b.1)
05000395/2017007-02	NCV	Failure to Establish a Testing Program for Inverter XIT5904 and Time Delay Relay in the EFW/SW Crosstie Valve Actuation Circuitry (Section 1R21.b.2)
05000395/2017007-03	NCV	Failure to Identify a CAQ for Power Shield Catalog #609903-T501N (Section 1R21.b.3)

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DC04240-004, RCS LTOP Analyses, Rev. 4
DC04330-081, SW Traveling Screen Maximum Debris, Rev. 0
DC04390-012, SRHB202 Analysis for the Potential of Flashing in the RHR Suction Pipes Due to Elevated Temperature Following Normal Operations, Rev. 0
DC04410-001, Calculations to Support ECCS Flow Balancing, Rev. 6
DC04410-002, Uncertainties for STP-230.006A&B, Rev. 3
DC04410-007, RHR Pump NPSH Requirements during Recirculation. Rev.6
DC04410-010, Replacement ECCS Header Flow Element Sizing, Rev.1
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DC04410-018, ECCS Flow Balance Test Uncertainties and Evaluation Models, Rev. 1
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DC-05010-034, Pressure Increase Due to Main Steam Valve Closure, Rev. 1
DC05220-048, Determination of the Minimum Required Volume in CST for EFW, Rev. 6
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DC05220-076, Proto-Flo Model of EFW System, Rev. 1
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DC08010-025, Parr Hydro Alternate Power Source System Study, status A, Rev. 0
DC08040-012, Protective Devices Coordination, Rev. 4
DC08040-012, Protective Devices Coordination, status A, Rev. 5
DC08050-002, Load Study of ESF 7.2KV and 480V Systems, Attachment 5.1, Rev. 7
DC08050-002, Load Study of ESF 7.2KV and 480V Systems, Rev. 8, Status A
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DC08200-001, ESF Undervoltage Logic and Settings, Rev. 25
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DC08220-007, Relay Setting Calculation, Emergency Feed Wtr. Pump 7.2KV Fdr. Ckts., 6/6/89
DC08220-010, 1E Fault Current Study, status A, Rev. 4
DC08220-012, XSW1DX Unit 2 and XSW1DX Unit 5, Electronic Relay Settings (Schweitzer Relays – 351S), status A, Rev. 0
DC08240-002, Feeder Cable Sizing for ESF Motor Control Centers, Rev. 1
DC08320-005, ESF Battery 1A & 1B Capacity, Rev. 5 and Rev. 14, Status A
DC08320-010, Class 1E 125 Volt DC System Voltages & Voltage Drop, Rev. 4 & Rev. 18, Status A
DC08320-016, Battery Service Test and Acceptance Criteria, Rev. 3 Status A
DC08340-002, 120V Class 1E Vital AC System Design Basis, Rev. 6, Status A
DC08360-006, Diesel Generator 1A and 1B Load Study, Rev. 12, Status A

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06-03541	12-00709	15-05461
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07-03139	14-02164	17-01853
08-03731	14-02182	17-01984
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STP-125.011, Train B Integrated Safeguards Test, Rev. 14, Change D
STP-125.013A, Diesel Generator A Semiannual Operability Test, Rev. 1, Change C
STP-125.017, Diesel Generator A Loss of Offsite Power Test, Rev. 7, Change A
STP-125.018, Diesel Generator B Loss of Offsite Power Test, Rev. 8, Change B
STP-130.004D, Main Steam Isolation Valve Full Stroke Test, Rev. 1
STP-205.004, RHR Pump and Valve Operability Test, Rev. 9
STP-220.002, Turbine Driven EFW Pump and Valve Test, Rev. 9
STP-225.001A, Diesel Generator Support Systems Pump and Valve Test, Rev. 9, Change A
STP-230.007, RHR Pump and Check Valve Full Flow Test, Rev. 4
STP-501.002, Battery Quarterly Surveillance Test, Rev. 10
STP-501-003, Battery Service Test, Rev. 12, Change C
STP-501-004, Battery Capacity Test, Rev. 13, Change F
STP-501-005, Battery Charger Service Test, Rev. 13, Change D

Self-Assessment Reports
CRP-LIA-02-003, Operating Experience, dated 4/26/02

Work Orders

0903635-001	1414449-001	1604542-001
0903635	1513485-005	1605190-00
0914353	1513485-002	1607000-002
0914543	1513485-001	1611659-001
1112620-004	1600049-013	1612025-001
1112620-002	1602828-002	1700113
1112620-001	1603195-002	1703219-001
1212138	1604403-001	1704643-001
1303228-001	1604405-001	1707074-001
1304259-002	1604406-001	1707076-001
1405130-001	1604419-001	1707430

1410966-003, -006	1604419-001	1708195-001
1410969-002	1604512-005	1708216-001
1412024-002	1604512-002	1708251-001
1412024-001	1604541-004	1708252-001
1413508-002	1604541-002	1712385-001
1414449-002	1604541-001	1713312-002

CRs Written due to this Inspection

17-04630, Corrections to address if NRC violation 0500395/200507-01 was adequate
17-05125, Correction of data in STTS #1604419-001 for XPP0008
17-05156, DC08050-002 reference DC08240-002 as the basis for sizing the cables that feed the MCC from the ESF load centers, DC08240-002 is presently voided
17-05214, an inconsistency was identified between the fault currents listed in ES DBD and calculation DC08220-010 at XSW1DA2
17-05258, Effects of Voltage and Frequency on EDG
17-05376, Inconsistent method for accounting for MCC heater loads within DC08050-002
17-05391, ESF Vendor Certificate of Conformance did not meet the specified 40-year radiation Value
17-05497, EDG Derating Factors for Ambient Temperature
17-05498, Enhancements to EFW DBD
17-05505, 2 pages (7 & 8) of data package for WO#0903635 and WO#1212139 were missing
17-05507, Voltage Specifications in STP-125.002A/B
17-05508, EOP-6.0 Instrument Accuracy
17-05526, Failure to follow procedure SAP-0159 – AOV program
17-05528, Clogging of EFW Pump bearing and seal cooling water orifices and turbine bearings
17-05534, DC Cutout Voltage of Safety Inverters not being tested
17-05535, Resolution of Non-Conservative TS Related to Inter-Cell Resistance not Timely
17-05536, 5.5 second time delay (EFW/SW) cross tie valve actuation circuitry not being tested
17-05653, 2017 NRC DBAI, NRC identified, questions related to CR-08-04135 on electric space heaters in switchgear