



**UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II**

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ATLANTA, GEORGIA 30303-1257

May 9, 2017

EA-17-007

Mr. Daniel G. Stoddard
President and Chief Nuclear Officer
Innsbrook Technical Center
5000 Dominion Boulevard
Glen Allen, VA 23060

**SUBJECT: NORTH ANNA POWER STATION – NRC INTEGRATED INSPECTION
REPORT 05000338/2017001 AND 05000339/2017001 AND EXERCISE OF
ENFORCEMENT DISCRETION**

Dear Mr. Stoddard:

On March 31, 2017, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at your North Anna Power Station, Units 1 and 2. On April 20, 2017, the NRC inspectors discussed the results of this inspection with Mr. L. Lane and other members of your staff. Inspectors documented the results of this inspection in the enclosed inspection report.

NRC inspectors documented one NRC-identified finding of very low safety significance (Green) in this report. The finding involved a violation of NRC requirements. The NRC is treating the violation as a non-cited violation (NCV) consistent with Section 2.3.2.a of the Enforcement Policy.

If you contest the violation or significance of the NCV, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-001; with copies to the Regional Administrator Region II; the Director, Office of Enforcement, United States Nuclear Regulatory Commission, Washington, DC 20555-0001; and the NRC Resident Inspector at the North Anna Power Station.

If you disagree with a cross-cutting aspect assignment in this report, you should provide a response within 30 days of the date of this inspection report, with the basis for your disagreement, to the Regional Administrator, Region II, and the NRC Resident Inspector at the North Anna Nuclear Power Station.

In addition, a violation of Technical Specification 3.6.8, Chemical Addition System, would normally be considered at Severity Level III in accordance with Enforcement Policy section 6.1.c. Because the violation was not associated with a licensee performance deficiency and it was not reasonably foreseeable and preventable by the licensee's Quality Assurance measures or management controls, I am authorized, after consultation with the Director of the Office of

D. Stoddard

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Enforcement and the Regional Administrator, to exercise enforcement discretion (Enforcement Action (EA)-17-007) in accordance with Section 3.10 of the Enforcement Policy. The violation will not be considered in the assessment process or the NRC's Action Matrix.

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/

Joel T. Munday, Director
Division of Reactor Projects

Docket Nos.: 05000338, 05000339

License Nos.: NPF-4, NPF-7

Enclosure:

IR05000338/2017001 and 05000339/2017001

w/Attachment: Supplemental Information

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U.S. NUCLEAR REGULATORY COMMISSION

REGION II

Docket Nos: 50-338, 50-339

License Nos: NPF-4, NPF-7

Report No: 05000338/2017001 and 05000339/2017001

Licensee: Virginia Electric and Power Company (VEPCO)

Facility: North Anna Power Station, Units 1 & 2

Location: Mineral, Virginia 23117

Dates: January 1, 2017 through March 31, 2017

Inspectors: G. Croon, Senior Resident Inspector
S. Cuadrado de Jesus, Resident Inspector
D. Merzke, Acting Senior Resident Inspector

Reviewed by: Anthony D. Masters, Chief
Reactor Projects Branch 5
Division of Reactor Projects

Approved by: Joel T. Munday, Director
Division of Reactor Projects

Enclosure

SUMMARY

IR 05000338/2017001, 05000339/2017001; January 1, 2017 – March 31, 2017; North Anna Power Station, Units 1 and 2. Followup of Events and Notice of Enforcement Discretion.

The report covered a three-month period of inspection by resident inspectors. One NRC-identified finding was identified and was determined to be a non-cited violation (NCV). The significance of most findings is indicated by their color (Green, White, Yellow, Red) using Inspection Manual Chapter (IMC) 0609, "Significance Determination Process" (SDP), dated April 29, 2015. The cross-cutting aspects were 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," Revision 6.

Initiating Events Cornerstone

- Green. A self-revealing Green NCV of 10 CFR 50, Appendix B, Criterion III, "Design Control," was identified for the failure to correctly translate applicable regulatory requirements and the design basis into specifications, drawings, procedures, and instructions. Specifically, the licensee failed to include the pipe support (2-FPH-CH-416-11) in the scope of design change (DC) NA-13-01059, Unit 2 Reactor Coolant Pump Seal Replacement, which resulted in a large mean stress on the socket weld due to the 1.5-inch controlled bleed-off line piping not being properly aligned in the downstream pipe support, and therefore not allowing for the thermal growth of the reactor coolant system (RCS). As a result of the large mean stress, a crack initiated at a small defect (lack of fusion) in the toe of the socket weld and propagated through the weld due to normal cyclic vibration from the Unit 2 'C' reactor coolant pump (RCP). This finding was entered into the licensee's corrective action program as Condition Report (CR) 1043540.

The finding was more than minor because it was associated with the design control attribute of the Initiating Events and Barrier Integrity cornerstones and adversely affected the cornerstone objective to provide reasonable assurance that physical design barriers protect the public from radio-nuclide releases caused by accidents or events. Specifically, the inadequate design control of the piping support following Unit 2 RCP Seal Replacement resulted in an un-isolable through wall leak in the controlled bleed-off line piping and was identified as RCS pressure boundary leakage. The inspectors evaluated the finding in accordance with Manual Chapter 0609.04, "Initial Characterization of Findings," Table 2, dated October 7, 2016, and the inspectors screened the finding using Inspection Manual Chapter (IMC) 0609, Appendix A, "Significance Determination Process (SDP) for Findings at-Power," dated June 19, 2012. The finding screened out in the review of the Barrier Integrity cornerstone as the performance deficiency (PD) was not related to pressurized thermal shock; therefore, the finding will be addressed under the Initiating Events cornerstone. Since the issue affected multiple cornerstones and because the licensee classified the leakage as RCS pressure boundary leakage, the NRC performed a detailed risk evaluation for the PD. The detailed risk evaluation was performed by a regional SRA in accordance with the NRC IMC 0609 Appendix A utilizing the NRC North Anna SPAR model. The PD was modelled as an increase in the small loss of coolant accident frequency given a failure of the RCP seal. The dominant sequence was a rupture in the controlled bleed off line leading to a small loss of coolant accident due to RCP seal failure with failure of

containment sump recirculation leading to loss of core heat removal and core damage. The risk was mitigated by the RCP seal failure probability and the remaining mitigation. The detailed risk evaluation estimated that the PD resulted in an increase in core damage frequency of $< 1.0 \text{ E-6/year}$, a GREEN finding of very low safety significance.

The finding had a cross-cutting aspect in the area of human performance, work management H.5, because the licensee failed to include the pipe support (2-FPH-CH-416-11) in the scope of the design change by engineering information bulletin (EIB) # N10-002 requirements. (Section 4OA3.1)

REPORT DETAILS

Summary of Plant Status

Unit 1 began the inspection period at approximately 100 percent rated thermal power (RTP), and operated at RTP for the remainder of the inspection period.

Unit 2 began the period at approximately RTP. On February 3, 2017, the unit was reduced to 7 percent RTP to replace a switch on the main transformer. Unit 2 began increasing power on February 4, returned to RTP on February 10, and operated at RTP for the remainder of the inspection period.

1. REACTOR SAFETY

Cornerstones: Initiating Events, Mitigating Systems, and Barrier Integrity

1R01 Adverse Weather Protection

.1 External Flooding

a. Inspection Scope

The inspectors assessed the external flood vulnerability of the North Anna station for the auxiliary feedwater pump house. The inspectors also reviewed applicable station procedures and design documents to assess proper surveillance and maintenance for external flood protection features.

b. Findings

No findings were identified.

.2 Seasonal Susceptibilities

a. Inspection Scope

The inspectors reviewed the licensee's adverse weather preparations for cold weather operations specified in 0-GOP-4, "Cold Weather Operations," Rev. 56, 0-GOP-4.2, "Extreme Cold Weather Operations", Rev. 36, and 0-GOP-4.2A, "Extreme Cold Weather Daily Checks", Rev. 8, as well as the licensee's corrective action data base for cold weather-related issues. The inspectors walked down the risk-significant areas listed below on three occasions to verify compliance with procedural requirements and to verify that the specified actions provided the necessary protection for the applicable structures, systems, or components (SSCs). The inspectors reviewed the licensee's corrective action program (CAP) database to verify that weather related problems due to temperature were being identified at the appropriate level, entered into the CAP, and appropriately resolved.

- Station Blackout (SBO) Diesel on March 9, 2017, with anticipated weather in the teens for March 11, 2016.
- Unit 1 & 2 Aux Feedwater Pump House on March 10, 2017, with anticipated winter storm warning and icing conditions.

b. Findings

No findings were identified.

.3 Impending Adverse Weather Conditionsa. Inspection Scope

The inspectors performed a site-specific weather-related inspection due to anticipated adverse weather conditions. On March 10, 2017, the inspectors reviewed the licensee response to winter storm warnings, with ice conditions and wind warnings of 40 miles an hour for the area. Specifically, the inspectors reviewed licensee adverse weather response procedures, including 0-AP-41, "Severe Weather Conditions", Rev. 61, and site preparations including work activities that could impact the overall maintenance risk assessments.

b. Findings

No findings were identified.

1R04 Equipment AlignmentPartial Walkdownsa. Inspection Scope

The inspectors conducted three equipment alignment partial walkdowns, listed below, to evaluate the operability of selected redundant trains or backup systems with the other train or system inoperable or out of service. The inspectors reviewed the functional systems descriptions, Updated Final Safety Analysis Report (UFSAR), system operating procedures, and Technical Specifications (TS) to determine correct system lineups for the current plant conditions. The inspectors performed walkdowns of the systems to verify the operability of a redundant or backup system/train or a remaining operable system/train with a high risk significance for the current plant configuration (considering out-of-service, inoperable, or degraded condition); or a risk-significant system/train that was recently realigned following an extended system outage, maintenance, modification or testing; or a risk-significant single-train system. The inspector conducted the reviews to ensure that critical components were properly aligned, and to identify any discrepancies which could affect operability of the redundant train or backup system.

- Partial walkdown of Waterhouse 5 fire pumps 1-FP-P-10 and 1-FP-P-11 while 1-FP-P-1 (fire suppression water system) and 1-FP-TK-2 (fire protection pressure maintenance system) were out of service.
- Partial walkdown of SBO building/system to confirm breaker alignment for removal of 0-AAC-MCC-0M1 (480V MCC) to support SBO DG being out of service for maintenance.
- Partial walkdown of 1-CH-P-1B hours prior to surveillance (1-PT-14.1) of 1-CH-P-1A while 1-CH-P-1C was running.

b. Findings

No findings were identified.

1R05 Fire ProtectionQuarterly Fire Protection Walkdownsa. Inspection Scope

The inspectors conducted focused tours of the four areas listed below that are important to reactor safety to verify the licensee's implementation of fire protection requirements as described in fleet procedures CM-AA-FPA-100, "Fire Protection/Appendix R (Fire Safe Shutdown) Program," Rev. 10, CM-AA-FPA-101, "Control of Combustible and Flammable Materials," Rev. 8, and CM-AA-FPA-102, "Fire Protection and Fire Safe Shutdown Review and Preparation Process and Design Change Process," Rev. 5. The inspectors evaluated, as appropriate, conditions related to: (1) licensee control of transient combustibles and ignition sources; (2) the material condition, operational status, and operational lineup of fire protection systems, equipment, and features; and, (3) the fire barriers used to prevent fire damage or fire propagation. Documents reviewed are listed in the Attachment.

- Unit 2, Emergency switchgear room,
- Unit 1, Cable vault,
- Unit 1-2, Service water valve house,
- Unit 1-2, control room ventilation room

b. Findings

No findings were identified.

1R06 Flood Protection MeasuresInternal Flood Areasa. Inspection Scope

The inspectors assessed the internal flooding vulnerability of the one flood area listed below with respect to adjacent safety-related areas to verify that the flood protection barriers and equipment were being maintained consistent with the UFSAR. The licensee's corrective action documents were reviewed to verify that corrective actions with respect to flood-related items identified in condition reports were adequately addressed. The inspectors conducted a field survey of the selected areas to evaluate the adequacy of flood barriers, and floor drains to protect the equipment, as well as their overall material condition. Documents reviewed are listed in the Attachment.

- Safety-related switchgear room

b. Findings

No findings were identified.

1R07 Heat Sink Performance

System Heat Exchangers

a. Inspection Scope

The inspectors selected the risk significant Unit 1 'A' charging pump lube oil heat exchangers for the 1B gear box lube oil cooler and reviewed inspection records, test results, maintenance work orders, and other documentation to ensure that deficiencies which could mask or degrade performance were identified and corrected. The test procedures and records were also reviewed to verify that they were consistent with Generic Letter 89-13 licensee commitments, and Electric Power Research Institute (EPRI) Heat Exchanger Performance Monitoring Guidelines. In addition, the inspectors reviewed inspection documentation of the related service water piping to assess general material condition and to identify any degraded conditions. Documents reviewed included Virginia Power Administrative Procedure (VPAP) -0811, "Service Water Inspection and Maintenance Program," Rev. 6, and licensee procedure ER-AA-HTX-1003, "Heat Exchanger Monitoring and Assessment," Rev. 6.

b. Findings

No findings were identified.

1R11 Licensed Operator Regualification Program and Licensed Operator Performance

.1 Resident Inspector Quarterly Review

a. Inspection Scope

The inspectors reviewed a licensed operator performance on March 27, 2017, during a simulator scenario. The scenario required classifications and notifications that were counted for NRC performance indicator (PI) input. The inspectors observed the following elements of crew performance in terms of communications: (1) ability to take timely and proper actions; (2) prioritizing, interpreting, and verifying alarms; (3) correct use and implementation of procedures, including the alarm response procedures; (4) timely control board operation and manipulation, including high-risk operator actions; and (5) oversight and direction provided by the shift supervisor, including the ability to identify and implement appropriate TS actions.

b. Findings

No findings were identified.

.2 Quarterly Control Room Operator Performance Observations

a. Inspection Scope

During the inspection period, the inspectors conducted three observations of licensed reactor operators actions and activities to ensure that the activities were consistent with the licensee procedures and regulatory requirements. These observations took place during both normal and off-normal plant working hours. As part of this assessment, the inspectors observed the following elements of operator performance: (1) operator compliance and use of plant procedures including technical specifications; (2) control board/in-plant component manipulations; (3) use and interpretation of plant instruments, indicators and alarms; (4) documentation of activities; (5) management and supervision of activities; and (6) communication between crew members.

The inspectors observed and assessed licensed operator performance during the following events:

- March 7, 2017, observed control room activities/response to U2 Powdex System leakage
- March 16, 2017, observed control room activities/response during normal operating conditions
- March 28, 2017, observed control room performance of 2-PT-52.2A "Reactor Coolant System Leak Rate (Computer Calculation)" for Unit 2 while in AL 1 for RCS UID leakage

b. Findings

No findings were identified.

1R12 Maintenance Effectiveness

a. Inspection Scope

For the three equipment issues listed below, the inspectors evaluated the effectiveness of the respective licensee's preventive and corrective maintenance. The inspectors performed walkdowns of the accessible portions of the systems, performed in-office reviews of procedures and evaluations, and held discussions with licensee staff. The inspectors compared the licensee's actions with the requirements of the Maintenance Rule (10 CFR 50.65), and licensee procedure ER-AA-MRL-10, "Maintenance Rule Program," Rev. 6. Documents reviewed are listed in the Attachment.

- WO591031922, 0-FH-DG-1 ISFSI diesel generator repairs
- CR1057447, Unit 2 "J" EDG bacteria causing level rise in coolant overflow tank
- CR10607983, Unit 2 "A" S/G oscillations due to lagging response of control system

b. Findings

No findings were identified.

1R13 Maintenance Risk Assessments and Emergent Work Control

a. Inspection Scope

The inspectors evaluated, as appropriate, the four activities listed below for the following: (1) effectiveness of the risk assessments performed before maintenance activities were conducted; (2) management of risk; (3) appropriate and necessary steps taken to plan and control the resulting emergent work activities upon identification of an unforeseen situation; and (4) adequate identification and resolution of maintenance risk assessments and emergent work problems. The inspectors reviewed these maintenance activities to verify that the licensee was in compliance with the requirements of 10 CFR 50.65 (a)(4) and the data output from the licensee's safety monitor associated with the risk profile of Units 1 and 2. The inspectors reviewed the corrective action program to verify that deficiencies in risk assessments were being identified and properly resolved.

- Maintenance activities during performance of repairs to 1-EP-BKR-15610
- Maintenance activities during the inadvertent activation of the deluge fire system on U2 service transformer
- Work week schedule during the removal of 1-CW-P-1B for refurbishment
- Maintenance activities during the replacement of 1-CM-MUX-PCS-1A20, remote plant process computer I/O multiplexer power supply.

b. Findings

No findings were identified.

1R15 Operability Determinations and Functionality Assessments

Operability and Functionality Review

a. Inspection Scope

The inspectors reviewed five operability determinations (OD) and functionality assessments, listed below, affecting risk-significant mitigating systems, to assess, as appropriate: (1) the technical adequacy of the evaluations; (2) whether continued system operability was warranted; (3) whether other existing degraded conditions were considered as compensatory measures; (4) whether the compensatory measures, if involved, were in place, would work as intended, and were appropriately controlled; and (5) where continued operability was considered unjustified, the impact on TS Limiting Conditions for Operation and the risk significance in accordance with the SDP. No samples of operator work arounds (OWA) were reviewed because there were no OWAs existing for either unit during the calendar year 2016. The inspectors' review included a verification that ODs were made as specified by procedure OP-AA-102, "Operability Determination," Rev. 13. Documents reviewed are listed in the Attachment.

- Review of U1 Fuel oil line operability arising from discovery of degraded condition
- Review of CR1061681 CA 3051921, Degraded electrical cable
- Review of CA 5050237, 2-FW-P-1B foreign material from degraded impeller
- Review of CR1059401, 2-MS-TV-201A Main steam trip valve
- Review of CR, Warehouse 5 fire pump excess seal leakage

b. Findings

No findings were identified.

1R19 Post Maintenance Testinga. Inspection Scope

The inspectors reviewed seven post-maintenance test procedures and/or test activities, listed below, for selected risk-significant mitigating systems to assess whether: (1) the effect of testing on the plant had been adequately addressed by control room and/or engineering personnel; (2) testing was adequate for the maintenance performed; (3) acceptance criteria were clear and adequately demonstrated operational readiness consistent with design and licensing basis documents; (4) test instrumentation had current calibrations, range, and accuracy consistent with the application; (5) tests were performed as written with applicable prerequisites satisfied; (6) jumpers installed or leads lifted were properly controlled; (7) test equipment was removed following testing; and (8) equipment was returned to the status required to perform in accordance with VPAP-2003, "Post Maintenance Testing Program", Rev. 14. Documents reviewed are listed in the Attachment.

- 1-PT-57.1B Low head safety injection pump increased seal leakage during operation
- 1A Fuel oil line underground degradation repairs
- 2A Fuel oil line underground degradation repairs
- WO59101714178, 1-VSW-S-2, vent stack fan switch replacement
- WO59102885362, RCP charging seal filter replacement
- WO59103057737, 1-DA-LT-113A Unit-1 light troubleshoot and replacement
- WO59103061336, Unit-2 Control Room ventilation troubleshoot

b. Findings

No findings were identified.

1R22 Surveillance Testinga. Inspection Scope

For the four surveillance tests listed below, the inspectors examined the test procedures, witnessed testing, or reviewed test records and data packages, to determine whether the scope of testing adequately demonstrated that the affected equipment was functional and operable, and that the surveillance requirements of TS were met. The inspectors also determined whether the testing effectively demonstrated that the systems or components were operationally ready and capable of performing their intended safety functions. Documents reviewed are listed in the Attachment.

IST Pump or Valve Test:

- 1-PT-14.3, Unit 1 "C" Charging pump operability test

Other Surveillance Tests:

- 1-PT-82.2B, "1J Diesel Generator Test (Simulated Loss of Off-Site Power)", Rev. 59
- 1-PT-71.14, "Loss of Offsite Power – Train A Operational Test for Auxiliary Feedwater Pumps," Rev. 7
- 2-PT-82.4B, 2J EDG Slow Start

b. Findings

No findings were identified.

1EP6 Drill EvaluationEmergency Preparedness (EP) Drilla. Inspection Scope

On March 9, 2017, the inspectors reviewed and observed the performance of a drill that involved a General Area Emergency where an earthquake led to a large break LOCA. The inspectors assessed emergency procedure usage, emergency plan classification, notifications, and the licensee's identification and entrance of any problems into their corrective action program. This inspection evaluated the adequacy of the licensee's conduct of the drill and performance critique. Exercise issues were captured by the licensee in their corrective action program as CRs. Requalification training deficiencies were captured within the operator training program. Documents reviewed are listed in the Attachment.

On August 12, 2016, the inspectors reviewed and observed the performance of an emergency drill that involved a General Area Emergency. Inspectors also conducted a simulator based drill evaluation. These two observations were inadvertently omitted from the North Anna 2016003 Integrated Inspection Report and are included here.

b. Findings

No findings were identified.

4. OTHER ACTIVITIES

Cornerstones: Initiating Events, Mitigating Systems, Barrier Integrity

4OA1 Performance Indicator (PI) Verificationa. Inspection Scope

The inspectors performed a periodic review of the three Unit 1 and 2 PIs listed below to assess the accuracy and completeness of the submitted data and whether the performance indicators were calculated in accordance with the guidance contained in Nuclear Energy Institute (NEI) 99-02, "Regulatory Assessment Performance Indicator Guideline," Rev 7. The inspection was conducted in accordance with NRC inspection procedure 71151, "Performance Indicator Verification." Specifically, the inspectors

reviewed the Unit 1 and Unit 2 data reported to the NRC for the period April 1, 2015 through March 31, 2016. Documents reviewed included applicable NRC inspection reports, licensee event reports, operator logs, station performance indicators, and related CRs.

- Unplanned Scrams per 7000 Critical Hours (IE01)
- Unplanned Transients per 7000 Critical Hours (IE03)
- Unplanned Scrams with Complications

b. Findings

No findings were identified.

4OA2 Problem Identification and Resolution

.1 Review of Items Entered into the Corrective Action Program

As required by NRC inspection procedure 71152, "Identification and Resolution of Problems," and in order to help identify repetitive equipment failures or specific human performance issues for followup, the inspectors performed a daily screening of items entered into the licensee's CAP. This review was accomplished by reviewing daily CR report summaries and periodically attending daily CR Review Team meetings.

.2 In Depth Review: Review of Licensee Electrolytic Capacitor Aging Program

a. Inspection Scope

The inspectors performed a review regarding the licensee's program arising from NRC Information Notice 2012-11, Age Related Capacitor Degradation. The inspectors, through document review and interviews with licensee, reviewed the establishment and effectiveness of a licensee program in addressing the degradation of electrolytic capacitors.

b. Findings and Observations

No findings were identified. In general, the inspectors verified that the licensee had identified problems at an appropriate threshold and entered them into the CAP database, and had proposed or implemented appropriate corrective actions.

4OA3 Followup of Events and Notice of Enforcement Discretion

.1 (Closed) Licensee Event Report (LER) 05000339 /2016-001-00, Technical Specification Required Shutdown Due to Reactor Coolant System Leak

a. Inspection Scope

The LER documented that the North Anna Unit 2 TS required the unit to be shut down due to RCS pressure boundary leakage on July 29, 2016. The inspectors reviewed the LER and the associated corrective action document (CR 1043540) to verify the accuracy and completeness of the LER and the appropriateness of the licensee's corrective actions. The inspectors also reviewed the LER and CR to identify any licensee

performance deficiencies associated with the issue. Documents reviewed are listed in the Attachment.

b. Findings

Introduction: A self-revealing Green NCV of 10 CFR 50, Appendix B, Criterion III, "Design Control," was identified for the failure to adequately verify piping supports were not affected by design changes (modifications).

Description: On July 29, 2016, reactor coolant system (RCS) unidentified leakage was identified to take a 0.05 gpm step increase coincident with similar increase in U2 containment sump in-leakage. Abnormal procedure 2-AP-16 was entered on July 29, 2016, and containment entries were initiated to determine the source of the leakage. On July 30, 2016, it was determined that there was an un-isolable through wall leak in the 1.5-inch controlled bleed-off piping associated with the RCP seal for 2-RC-P-1C. Technical Specification 3.4.13.B was entered for reactor coolant pressure boundary leakage and a unit shutdown was initiated at 1237. NRC notification was completed IAW 10CFR50.72 (b)(2) on July 30, 2016, for "The initiation of any nuclear plant shutdown required by the plant's Technical Specifications" and 10CFR50.72(b)(3)(ii)(A) for "any event or condition that results in the condition of the nuclear plant including its principal safety barrier being seriously degraded."

A design change (DC), NA-13-01059, was implemented to replace the Westinghouse RCP seals with Flowserve RCP seals during the fall 2014 and spring 2016 refueling outages (RFOs) on Unit 2. A separate Design Change for Unit 1 (DC NA-12-01110) has been implemented for two of the three RCPs, with the remaining RCP scheduled for the spring 2018 RFO.

The licensee's root cause analysis (RCA) for the RCS leak determined that the boundaries used in the implementation of the DC for replacement of the Unit 2 Reactor Coolant Pump seals were insufficient. This prevented personnel from considering and including pipe supports outside of the modification boundary in the work scope. Therefore, Engineering and the implementing craft missed opportunities to identify and inspect downstream pipe supports for proper alignment and configuration. The failure to include the pipe support (2-FPH-CH-416-11) in the scope of design change (DC) NA-13-01059, Unit 2 Reactor Coolant Pump Seal Replacement, resulted in a large mean stress on the socket weld due to the 1.5 inch controlled bleed-off line piping not being properly aligned in the downstream pipe support, and therefore did not allow for the thermal growth of the reactor coolant system (RCS). As a result of the large mean stress, a crack initiated at a small defect (lack of fusion) in the toe of the socket weld and propagated through the weld due to normal cyclic vibration from the Unit 2 'C' reactor coolant pump (RCP).

The immediate corrective action was to replace the controlled bleed-off piping associated with the RCP seal for 2-RCP-1C. Other welds on the seal injection and seal return lines of all three Unit 2 RCPs were inspected with no signs of cracks or defects. A natural frequency (or bump test) and/or vibration data collection was performed on all three seal return lines to determine if a resonance condition exists with no issues found. Additional corrective actions include reviewing a sample set of design changes for Unit 1 and Unit 2 that involve modifications to piping, piping components, and pipe supports, particularly those near rotating equipment. During the appropriate refueling outage, a

walkdown will be conducted of the sampled modifications to verify correct pipe and pipe support configuration, paying particular attention to supports outside of the modification boundary. Actions to prevent recurrence include revising procedures GMP-M-149, GMP-150, GMP-152, and 0-MCM-1801-01, to ensure that at least two supports upstream and downstream of the work scope are addressed for work on or near piping or piping components unless otherwise approved by engineering. Engineering Information Bulletin (EIB) # N10-002, Interim Requirements for Maintaining Piping Supports, was issued on September 8, 2010, to address non-functional piping supports on a variety of different piping systems of all safety classifications as part of corrective actions associated with CR 376197 dated April 12, 2010. This EIB was an interim measure for identified weaknesses in the design change process until a permanent corrective action could be implemented into fleet processes. In this EIB, specific criteria were in place to ensure that an adequate DC scope was determined. For example, "Consider the supports that are directly attached to the DC scope of work and at least two supports upstream/downstream, outside of the DC." The inspectors determined that these specific criteria have not been incorporated into all appropriate plant procedures. But several plant procedures such as GMP-M-149, Fabrication and Installation of non-safety related pipe/tube/instrument supports and GMP-M-150, Fabrication and Installation of Safety Related/Seismic/Fire Protection Supports and Structures have incorporated these criteria since 2013. The inspectors determined that had this guidance been applied to this event, the pipe support (2-FPH-CH-416-11) would have been included within the scope of DC NA-13-01059 and included in project walkdowns and inspections.

Analysis: The failure to include the pipe support (2-FPH-CH-416-11) in the scope of design change (DC) NA-13-01059, Unit 2 Reactor Coolant Seal Replacement, which resulted in an un-isolable through wall leak in the controlled bleed-off piping associated with the RCP seal for 2-RC-P-1C was a performance deficiency (PD).

The finding was more than minor because it was associated with the design control attribute of the Initiating Events and Barrier Integrity cornerstones and adversely affected the cornerstone objective to provide reasonable assurance that physical design barriers protect the public from radio-nuclide releases caused by accidents or events. Specifically, the inadequate design control of the piping support following Unit 2 RCP Seal Replacement resulted in an un-isolable through wall leak in the controlled bleed-off line piping and was identified as RCS pressure boundary leakage. The inspectors evaluated this finding in accordance with Manual Chapter 0609.04, "Initial Characterization of Findings," Table 2, dated October 7, 2016, and the inspectors screened the finding using Inspection Manual Chapter (IMC) 0609, Appendix A, "Significance Determination Process (SDP) for Findings at-Power," dated June 19, 2012. The finding screened out in the review of the Barrier Integrity cornerstone as the PD was not related to pressurized thermal shock; therefore, the finding will be addressed under the Initiating Events cornerstone. Since the issue affected multiple cornerstones and because the licensee classified the leakage as RCS pressure boundary leakage, the NRC performed a detailed risk evaluation for the PD as described in NRC IMC 0609 Appendix A, section 5.0. The detailed risk evaluation was performed by a regional SRA in accordance with IMC 0609, Appendix A, utilizing the NRC North Anna SPAR model. The PD was modelled as an increase in the small loss of coolant accident frequency given a failure of the RCP seal. The dominant sequence was a rupture in the controlled bleed off line leading to a small loss of coolant accident due to RCP seal failure with failure of containment sump recirculation leading to loss of core heat removal and core

damage. The risk was mitigated by the RCP seal failure probability and the remaining mitigation. The detailed risk evaluation estimated that the PD resulted in an increase in core damage frequency of $< 1.0 \text{ E-6/year}$, a GREEN finding of very low safety significance. The finding had a cross-cutting aspect in the area of human performance, work management H.5, because the licensee failed to include the pipe support (2-FPH-CH-416-11) in the scope of the design change by engineering information bulletin (EIB) # N10-002 requirements.

Enforcement: 10 CFR Part 50, Appendix B, Criterion III, "Design Control," states, in part, that design control measures shall be established to assure that applicable regulatory requirements and the design basis are correctly translated into specifications, drawings, procedures, and instructions. The design control measures shall provide for verifying the adequacy of the design.

EIB # N10-002, Interim Requirements for Maintaining Piping Supports, issued on September 8, 2010, was in place as one of the measures to ensure that an adequate DC scope was determined and correctly translated into specifications, drawings, procedures, and instructions and stated, in part, "Consider the supports that are directly attached to the DC scope of work and at least two supports upstream/downstream, outside of the DC."

Contrary to the above, the licensee failed to correctly translate applicable regulatory requirements and the design basis into specifications, drawings, procedures, and instructions. Specifically, the licensee failed to include the pipe support (2-FPH-CH-416-11) in the scope of design change (DC) NA-13-01059, Unit 2 Reactor Coolant Seal Replacement, in 2013 in accordance with EIB #N10-002 requirements. Because this finding is of very low safety significance and has been entered into the licensee's corrective action program as CR1043540, this violation is being treated as an NCV 05000339/20160-004-01, Inadequate Design Control of 2-RC-P-1C Piping Supports.

.2 (Closed) Licensee Event Report (LER) 05000338, 339 /2016-002-00, Chemical Addition System Outside of Technical Specification Due to Excessive Unseating Thrust on MOVs

a. Inspection Scope

The LER documented that North Anna failed to maintain the full design bases functionality of its Sodium Hydroxide (NAOH) injection for both units as required by TS 3.6.8. The inspectors reviewed the LER and the associated corrective action document (CR 1029674) to verify the accuracy and completeness of the LER and the appropriateness of the licensee's corrective actions. The inspectors also reviewed the LER and CR to identify any licensee performance deficiencies associated with the issue.

b. Findings

Description: On March 9, 2016, with Unit 1 (U1) at 100 percent power in Mode 1 and Unit 2 (U2) in Mode 6 for a scheduled refueling outage, 2-QS-MOV-202B failed to stroke open during testing due to excess unseating thrust. An extent of condition review and engineering evaluation determined that 2-QS-MOV-202A maintained its safety function. An extent of condition review and engineering evaluation of the U1 valves determined that 1-QS-MOV-102B maintained its function but 1-QS-MOV-102A did not. While only one of the valves is needed in order for the system to perform its safety function,

TS 3.6.8 requires both valves to function in order to be considered operable. A failure of these valves would result in a loss of redundant safety function and inability to perform an emergency operating procedure or to prevent mitigating the consequences of accidents that would result in potential offsite exposure in excess of 10 CFR Part 100 limits.

These valves were originally installed in September 2010 (U1) and September 2011 (U2). These valves are stroked every refueling outage per the IST and monitored by the motor operated valve (MOV) program every six refueling outages. The licensee's investigation determined that all appropriate testing per the MOV program and design changes have been applied. No previous failure of these valves were identified. No human errors were found during initial valve set up or maintenance and no design errors were identified. The licensee's apparent cause evaluation (ACE) concluded that the cause of 2-QS-MOV-202B exhibiting excessive unseating thrust, resulting in a failure to open during functional testing, was due to mechanical binding internal to the valve body and/or actuator. This was also considered to be the cause for the excessive unseating thrust exhibited in 1-QS-MOV-102A. Valves 2-QS-MOV-202A and 1-QS-MOV-102B also exhibited mechanical binding, but not to the same degree and did not fail. The licensee implemented corrective actions to ensure the chemical addition tank isolation MOVs do not bind again, Design Changes (DC NA-16-00023 for U1 and DC NA-16-00021 for U2) were implemented to change the actuator gear set to provide more unseating capability for the valves. In addition, the valve stroke was changed to position limit switch controlled verses torque controlled seating, allowing valve seating to be adjusted to lighter loads providing even more margin. As an interim compensatory measure, these valves will be stroked every six months in addition to every cold shutdown. Stroking the valves verifies capability and reduces the pull-out-force required for the next stroke. Valve stroke frequency will be reviewed based on data collection and may support revision to the operability determination currently in place for Units 1 and 2.

Based on review of the licensee's ACE, the historical industry operating experiences, and previous MOV test data and IST stroke time data, the inspectors determined that there was no performance deficiency associated with this issue because the cause of failed the TS surveillance tests was not reasonably within the licensee's ability to foresee and correct.

Enforcement: The inspectors determined a violation of TS occurred because of failure to maintain the full design basis functionality of the Chemical Addition System. North Anna TS Limiting Condition for Operation (LCO) 3.6.8 requires the Chemical Addition System to be operable when in Modes 1, 2, 3 and 4. The associated action statement requires, in part, that with the Chemical Addition System inoperable, Restore Chemical Addition System to OPERABLE status within 72 hours and if Required Action and associated Completion Time is not met, the unit be in Hot Standby within 6 hours and in Cold Shutdown within 84 hours. Contrary to the above, on March 9, 2016, the licensee determined that the Chemical Addition System was inoperable on U1 for more than 72 hours while the unit was in Modes 1, 2, 3 and 4; and U1 was not placed in Hot Standby within 6 hours and in Cold shutdown within 84 hours. Later, through an extent of condition review, the licensee concluded that the U2 Chemical Addition System was also inoperable.

Although a violation of the TS occurred, the violation was not reasonably foreseeable and preventable by the licensee's QA measures or management controls. Therefore, the violation of TS 3.6.8 was not associated with a licensee performance deficiency. The inspectors concluded that the violation would normally be considered at Severity Level III in accordance with Enforcement Policy section 6.1.c. However, the inspectors utilized available risk-informed tools to more accurately assess the safety significance of this issue. Since the chemical addition system is considered a part of containment system, the inspectors evaluated this issue in accordance Manual Chapter 0609.04, "Initial Characterization of Findings," Table 2, dated October 7, 2016 and the finding was determined to adversely affect the Barrier Integrity Cornerstone. The inspectors screened the finding using Inspection Manual Chapter (IMC) 0609, Appendix A, "Significance Determination Process (SDP) for Findings at-Power," dated June 19, 2012, and determined that the finding screened as low safety significance (Green) because it did not represent an actual open pathway in the physical integrity of reactor containment (valves, airlocks, etc.), containment isolation system (logic and instrumentation), and heat removal components; and it did not involve an actual reduction in function of hydrogen igniters in the reactor containment. This issue represented a degradation of the radiological barrier function provided for the reactor building.

However, because the violation was not associated with a licensee performance deficiency and it was not avoidable by reasonable licensee QA measures or management controls, the NRC is exercising enforcement discretion (EA-17-007) in accordance with Section 3.10 of the Enforcement Policy. The violation will not be considered in the assessment process or the NRC's Action Matrix. This issue was documented in the licensee's corrective action program as CR1029674.

4OA5 Other Activities

Temporary Instruction (TI) 2515/192, "Inspection of the Licensee's Interim Compensatory Measures Associated with the Open Phase Condition Design Vulnerabilities in Electric Power Systems."

a. Inspection Scope

The objective of this performance-based Temporary Instruction is to verify implementation of interim compensatory measures associated with an open phase condition design vulnerability in electric power system for operating reactors. The inspectors conducted an inspection to determine if the licensee had implemented the following interim compensatory measures. These compensatory measures are to remain in place until permanent automatic detection and protection schemes are installed and declared operable for open phase condition design vulnerability. The inspectors verified the following:

- The licensee identified and discussed with plant staff the lessons learned from the open phase condition events at U.S. operating plants including the Byron Station open phase condition and its consequences. This included conducting operator training for promptly diagnosing, recognizing consequences, and responding to an open phase condition.

- The licensee updated plant operating procedures to help operators promptly diagnose and respond to open phase conditions on off-site power sources credited for safe shutdown of the plant.
- The licensee established and implemented periodic walkdown activities to inspect switchyard equipment such as insulators, disconnect switches, and transmission line and transformer connections associated with the offsite power circuits to detect a visible open phase condition.
- The licensee ensured that routine maintenance and testing activities on switchyard components have been implemented and maintained. As part of the maintenance and testing activities, the licensee assessed and managed plant risk in accordance with 10 CFR 50.65(a) (4) requirements.

Documents reviewed are listed in the Attachment.

b. Findings

No findings were identified.

4OA6 Meetings, Including Exit

On April 20, 2017, the resident inspectors presented the quarterly inspection results to Mr. L. Lane and other members of the staff. The licensee acknowledged the results of these inspections. The inspectors verified no proprietary information was retained by the inspectors or documented in this report.

ATTACHMENT: SUPPLEMENTAL INFORMATION

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

Licensee personnel:

M. Becker, Manager, Nuclear Outage and Planning
L. Lane Site Vice President
B. Gaspar, Manager, Nuclear Site Services
R. Hanson, Manager, Nuclear Protection Services
E. Hendrixson, Director, Nuclear Site Engineering
L. Hilbert, Plant Manager
J. Jenkins, Manager, Nuclear Maintenance
J. Leberstien, Technical Advisor, Licensing
J. Plossl, Supervisor, Nuclear Station Procedures
J. Schleser, Manager, Nuclear Organizational Effectiveness
J. Slattery, Manager, Nuclear Operations
W. Standley, Director, Nuclear Station Safety & Licensing
D. Taylor, Manager, Station Licensing
B. Thompson, Manager, Nuclear Training
M. Whalen, Technical Advisor, Licensing

LIST OF ITEMS OPENED, CLOSED AND DISCUSSED

Opened and Closed

05000339/2017-001-01	NCV	Inadequate Design Control of 2-RC-P-1C Piping Supports (Section 4OA3.1)
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Closed

<u>05000338,339/2016-002-00</u>	LER	05000339, 339 /2016-002-00, Chemical Addition System Outside of Technical Specification Due to Excessive Unseating Thrust on MOVs (Section 4OA3.2)
05000339/2016-001-00	LER	05000339 /2016-001-00, Technical Specification Required Shutdown Due to Reactor Coolant System Leak (Section 4OA3.1)

LIST OF DOCUMENTS REVIEWED

Section 1R05: Fire Protection

Procedures, Guidance Documents, and Manuals

0-FPMP-2.12, Dry Chemical Fire Extinguisher Maintenance, Revision 3
0-FPMP-2.6, Fire Extinguisher and Hose Station Inspection – Aux Buildings, Fuel Building, Clean Change, Health Physics, and Units 1 and 2 Instrument Shop, Revision 2
CM-AA-FPA-10, Fire Protection/Appendix R (Fire Shutdown) Program, Revision 2
1-FS-S-3, Unit 1 Emergency Switchgear Instrument Rack and Air Conditioning Rooms Service Building, Elev. 254 ft (S-54) Safe Shutdown Equipment, Revision 13
North Anna Ignition Source Permit for Hot Work in Auxiliary Building, 8/1/2016-8/5/2016
1-FS-AB-1, Auxiliary Building Firefighting Strategy Safe Shutdown Equipment, Revision 6
1-AP-20, Operation from the Auxiliary Shutdown Panel, Revision 27
1-FS-S-3, Unit 1 Emergency Switchgear Instrument Tack and Air Conditioning Rooms Service Building Elev. 254 Safe Shutdown Equipment, Revision 13
NAPS Appendix R Report, Table 7-1 Exemption Request Status, Revision 38
1-FS-S-4, Fire Fighting Preplan for Unit 1 & 2 Normal Switchgear Rooms Service Building Elev. 307", Revision 5
1-FS-SWVH-1, Firefighting Strategy Service Water Valve House, Revision 0
CM-AA-FPA-101, Control of Combustible and Flammable Materials, Revision 8

Section 1R06 Flood Review

Procedures, Guidance Documents, and Manuals

2-AR-D-G7, Turb Bldg Flood Alarm Trouble, Rev. 0
0-MCM-1305-01, Removal and Installation of Removable Flood Walls for Chiller Rooms and Emergency Switchgear, Rev. 7
NF-AA-PRA-370, Probabilistic Risk Assessment Procedures and Methods: MRule (a)(4) Risk Monitor Guidance, Rev. 16

Section 1R12: Maintenance Effectiveness

Corrective Action Documents

CA 5050237 CR1057447, CR10607983

Work Order

WO591031922

Section 1R15: Operability Determinations and Functionality Assessments

Procedures, Guidance Documents, and Manuals

ER-NA-APJ-318, 10 CFR 50 Appendix J Program (Containment Leakage), Revision 3
WM-AA-301, Operational Risk Assessment, Revision 13

Corrective Action Documents

CR1061681 CA3051921 CR1059401

Section 1R19: Post Maintenance Testing

Work Orders

WO59102885362, WO59103061336, WO59103057737, WO59101714178

Procedures, Guidance Documents, and Manuals

1-PT-57.1B, "Emergency Core Cooling Subsystem - Low Head Safety Injection Pump (1-SI-P-1B)," Revision 56

Section 1R22: Surveillance TestingProcedures, Guidance Documents, and Manuals

1-PT-82.2B, "1J Diesel Generator Test (Simulated Loss of Off-Site Power)," Revision 59
 1-PT-71.14, "Loss of Offsite Power - Train A Operational Test for Auxiliary Feedwater Pumps,"
 Revision 7
 1-PT-14.3, "Charging Pump 1-CH-P-1C," Revision 58
 2-PT-82.4B, 2J EDG Slow Start, Revision

1EP6 Drill Evaluation

NMAR17EPD, "Emergency Preparedness North Anna EP Drill" dated March 09, 2017

Section 4OA3.1: Follow-up of Events and Notices of Enforcement DiscretionCorrective Action Documents

CR 1043540

Procedures, Guidance Documents, and Manuals

(LER) 05000339 /2016-001-00, Technical Specification Required Shutdown Due to Reactor
 Coolant System Leak
 Root Cause Evaluation CA3037190, Socket Weld Failure on Unit 2 'C' Reactor Coolant Pump
 Return Line
 Engineering Information Bulletin North Anna, Interim Requirements for Maintaining Piping
 Supports, Dated September 8, 2010
 GMP-M-149, Fabrication and Installation of non-safety related pipe/tube/instrument supports,
 Revision 2
 GMP-M-150, Fabrication and Installation of Safety Related/Seismic/Fire Protection Supports,
 and Structures, Revision 15

Section 4OA5: Other ActivitiesCorrective Action Documents

CA240327 CA243743 CA240323 CA246731 CA240338 CR518138

Performance Improvement Detail Report

PIR1054952

Engineering Technical Evaluation

CM-AA-ETE-101

Work Order

WO59102617461

Procedures, Guidance Documents, and Manuals

Procedure 2-PT-52.2A, "Reactor Coolant System Leak Rate (Computer Calculation),"
 Revision 45

Other

Operating Experience Fleet Evaluation Report, IER Level 2 2-14, Revision 1
 Letter 12-519, Response to Bulletin 2012-01 Design Vulnerability in Electric Power System
 Letter 12-519A, Response to Bulletin 2012-01 Design Vulnerability in Electric Power System,
 Items 1 and 2.d
 Letter 13-678, Response to Request for Additional Information Regarding Initial Response to
 NRC Bulletin 2012-01 Design Vulnerability in Electric Power System