UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
1600 E. LAMAR BLVD.
ARLINGTON, TX 76011-4511

May 10, 2017

Richard L. Anderson, Site Vice President
Arkansas Nuclear One
Entergy Operations, Inc.
1448 SR 333
Russellville, AR 72802-0967

SUBJECT: ARKANSAS NUCLEAR ONE – NRC INSPECTION REPORT 05000313/2017001 and 0500368/2017001

Dear Mr. Anderson:

On March 31, 2017, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at your Arkansas Nuclear One facility, Units 1 and 2. On April 4, 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. All of these findings involved violations of NRC requirements. Further, inspectors documented licensee-identified violations which were determined to be of very low safety significance in this report. The NRC is treating these violations as non-cited violations (NCVs) consistent with Section 2.3.2.a of the Enforcement Policy.

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

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 U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001; with copies to the Regional Administrator, Region IV; and the NRC resident inspector at Arkansas Nuclear One.

In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 2.390, “Public Inspections, Exemptions, Requests for Withholding,” a copy of this letter, its enclosure, and your response (if any) will be made available electronically for public inspection in the NRC’s Public Document Room or the NRC's Agencywide Documents Access and Management System (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. To the extent possible, your response, if any, should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction.

Sincerely,

/RA/

Neil O’Keefe, Branch Chief
Project Branch E
Division of Reactor Projects

Docket Nos. 50-313 and 50-368
License Nos. DRP-51 and NPF-6

Enclosures:
Inspection Report 05000313/2017001
and 0500368/2017001
w/ Attachments:
1. Supplemental Information
2. Request for Information
3. Detailed Risk Evaluation

ARKANSAS NUCLEAR ONE – NRC INSPECTION REPORT 05000313/2017001 and 0500368/2017001 – May 10, 2017

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U.S. NUCLEAR REGULATORY COMMISSION

REGION IV

Docket:	05000313; 05000368
License:	DPR-51; NPF-6
Report:	05000313/2017001; 05000368/2017001
Licensee:	Entergy Operations, Inc.
Facility:	Arkansas Nuclear One, Units 1 and 2
Location:	Junction of Highway 64 West and Highway 333 South Russellville, Arkansas
Dates:	January 1, 2017 through March 31, 2017
Inspectors:	B. Tindell, Senior Resident Inspector M. Tobin, Resident Inspector M. Kirk, Resident Inspector J. Choate, Project Engineer B. Correll, Project Engineer E. Uribe, Reactor Inspector
Approved By:	Neil O'Keefe Chief, Project Branch E Division of Reactor Projects

Enclosure

SUMMARY

IR 05000313/2017001; 05000368/2017001; 01/01/2017 – 03/31/2017; Arkansas Nuclear One, Units 1 and 2, Integrated Inspection Report; Operability Determinations and Functionality Assessments, Problem Identification and Resolution.

The inspection activities described in this report were performed between January 1 and March 31, 2017, by the resident inspectors at Arkansas Nuclear One and inspectors from the NRC's Region IV office. Three findings of very low safety significance (Green) are documented in this report. All of these findings involved violations of NRC requirements. Additionally, NRC inspectors documented in this report two licensee-identified violations of very low safety significance. The significance of inspection findings is indicated by their color (i.e., Green, greater than Green, White, Yellow, or Red), determined using Inspection Manual Chapter 0609, "Significance Determination Process," dated April 29, 2015. Their cross-cutting aspects are determined using Inspection Manual Chapter 0310, "Aspects within the Cross-Cutting Areas," dated December 4, 2014. Violations of NRC requirements are dispositioned in accordance with the NRC Enforcement Policy. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," dated July 2016.

Cornerstone: Initiating Events

- Green. Inspectors documented a Green self-revealing finding and associated non-cited violation of Unit 1 Technical Specification 5.4.1.a. Specifically, the licensee failed to properly pre-plan and perform maintenance of the integrated control system equipment that can affect the performance of safety-related equipment. The licensee failed to plan and perform post-maintenance testing on newly installed integrated control system cards before returning the system to service. As a result, the licensee failed to detect a failed card. When the associated controller was placed into automatic mode, the system responded to a false demand signal that resulted in an inadvertent rod withdrawal that required prompt operator action to terminate the power increase and restore power to the original level. To correct the failed card, the licensee installed a new card that had been tested and validated prior to installation. The licensee documented this issue in Condition Report CR-ANO-1-2016-05551.

  Inspectors concluded that the failure to perform a post-maintenance test prior to placing a component in service is a performance deficiency. Specifically, the work order for replacing the steam generator reactor demand circuit card did not include a verification that the system was functioning properly after the replacement card was installed in the plant. The performance deficiency is more than minor because if left uncorrected, the performance deficiency has the potential to become a more significant safety concern. Specifically, if the operator had not taken prompt action to mitigate the event, it could have resulted in a more significant plant transient and could have challenged plant equipment. In accordance with Inspection Manual Chapter 0609, Attachment 4, "Initial Characterization of Findings," issued October 7, 2016, and Exhibit 1 of IMC 00609, Appendix A, "The Significance Determination Process (SDP) for Findings At-Power," Issued June 19, 2012, the inspectors determined the finding to be of very low safety significance (Green) because the finding is associated with the initiating events cornerstone and did not cause a reactor trip. The finding was determined to have a cross-cutting aspect in the area of human performance associated with Work Management, because the licensee did not ensure that they followed a process of planning, controlling, and executing the work activities in a formalized manner, allowing the

work order to not have complete instructions for a post-maintenance test. [H.5] (Section 4OA2)

Cornerstone: Mitigating Systems

- Green. The inspectors documented a self-revealing finding and associated non-cited violation of Unit 1 Technical Specification 5.4.1.a, for the failure to properly perform maintenance on the Unit 1 suction valve to the emergency core cooling system B and containment spray B. Specifically, the licensee failed to identify a damaged electrical lug on the valve actuator during maintenance. The lug subsequently failed and the valve failed to stroke fully open after being returned to service. The licensee repaired the lug and restored the valve to service. The licensee documented this issue in Condition Report CR-ANO-1-2017-00270.

  The licensee failed to identify a damaged electrical lug on a motor-operated valve during maintenance, which is a performance deficiency. The performance deficiency is more than minor because it is associated with the human performance attribute of the mitigating systems cornerstone and adversely affected the cornerstone objective to ensure the reliability of systems that respond to initiating events to prevent undesirable consequences. Specifically, the performance deficiency resulted in the failure of a suction valve for one train of emergency core cooling systems and containment spray systems after the valve was returned to service from the maintenance. Using Inspection Manual Chapter 0609, Appendix A, "The Significance Determination Process (SDP) for Findings At-Power," dated June 19, 2012, Exhibit 2, "Mitigating Systems Screening Questions," the inspectors determined that the finding required a detailed risk evaluation because the finding represented an actual loss of function of a single train for greater than its technical specification allowed outage time. The analyst determined in a detailed risk evaluation that by combining internal and external event inputs yielded an estimate of the total increase in core damage frequency of 8.5E-7/year, or of very low safety significance (Green). The finding was determined to have a cross-cutting aspect in the area of human performance associated with Avoid Complacency because the primary cause of the performance deficiency involved the failure to plan for the possibility of mistakes and use appropriate error reduction tools. [H.12] (Section 1R15.1)

- Green. The inspectors identified a finding and an associated non-cited violation of 10 CFR 50, Appendix B, Criterion V, Instructions, Procedures, and Drawings, for failure to evaluate the impact of all the required safety functions for operability when the valve failed to fully open during a valid demand. Specifically, the licensee failed to evaluate the operability impact on the safety function to close for the Unit 1 motor-operated borated water storage tank outlet valve CV-1408 before de-energizing and locking open the valve and declaring it operable. After the inspectors questioned this decision, the licensee declared the valve inoperable and repaired the valve operator. The licensee documented this issue in Condition Report CR-ANO-1-2017-00324.

  The failure to evaluate the operability impact of all required safety functions for Unit 1 motor-operated valve, CV-1408, before de-energizing and locking open the valve is a performance deficiency. The performance deficiency is more than minor because it is associated with the equipment performance attribute of the mitigating systems cornerstone and adversely affected the cornerstone objective to ensure the availability of systems that respond to initiating events to prevent undesirable consequences. Specifically, by locking the valve open, the licensee prevented Train B of the emergency core cooling system from being able

to be remotely isolated from the borated water storage tank during the containment recirculation phase of a potential loss of coolant accident, which could have allowed air binding of the pumps. Using Inspection Manual Chapter 0609, Appendix A, "The Significance Determination Process (SDP) for Findings At-Power," dated June 19, 2012, Exhibit 2, "Mitigating Systems Screening Questions," the issue screened as having very low safety significance (Green) because it was not a design or qualification deficiency; did not represent a loss of system; did not result in the actual loss of function of a train of technical specification equipment for greater than its allowed outage time; and did not screen as potentially risk significant due to seismic, flooding, or severe weather. The inspectors determined that this finding has a cross cutting aspect in the human performance area of Consistent Process, because the performance deficiency was caused by not following a consistent, systematic approach to making a decision concerning operability of the affected train. [H.13] (Section 1R15.2)

Licensee-Identified Violations

Violations of very low safety significance that were identified by the licensee have been reviewed by the inspectors. Corrective actions taken or planned by the licensee have been entered into the licensee's corrective action program. These violations and associated corrective action tracking numbers are listed in Section 4OA7 of this report.

PLANT STATUS

Unit 1 began the inspection period at full power. On January 12, 2017, operators reduced power to 38 percent and removed main feedwater pump B from service due to a leak from a downstream drain pipe weld that had cracked. The licensee completed repairs on the weld, restarted the feedwater pump, and reached full power on January 15, 2017.

Unit 2 began the inspection period at full power. On January 2, 2017, operators reduced power to 75 percent due to elevated steam generator sodium levels from condenser tube leaks. The licensee completed repairs on the condenser tubes and reached full power on January 5, 2017. On January 7, 2017, operators reduced power to 50 percent due to elevated steam generator sodium levels from condenser tube leaks. The licensee completed repairs on the condenser tubes and reached full power on January 10, 2017. On January 27, 2017, the motor for circulating water pump B failed, so operators reduced power to 96 percent to control condenser vacuum. Operators reduced power again on January 29, 2017, to 81 percent as higher ambient temperatures raised circulating water temperatures. The licensee completed repairs on the circulating water pump motor and reached full power on February 13, 2017. On March 1, 2017, operators reduced power to 82 percent to maintain heater drain pump differential pressure within limits due to tube leaks in a feedwater heater. On March 3, 2017, the feedwater heater tube leaks worsened, so operators reduced power to 48 percent. On March 29, 2017, operators shut down the unit to begin refueling outage 2R25.

REPORT DETAILS

1. REACTOR SAFETY

Cornerstones: Initiating Events, Mitigating Systems, and Barrier Integrity

1R04 Equipment Alignment (71111.04)

Partial Walk-Down

a. Inspection Scope

The inspectors performed partial system walk-downs of the following risk-significant systems:

- March 16, 2017, Unit 2 containment spray train A
- March 21, 2017, Unit 2, high pressure safety injection train B
- March 29, 2017, Unit 2, containment spray and low pressure safety injection to refueling water tank recirculation and test line

The inspectors reviewed the licensee's procedures and system design information to determine the correct lineup for the systems. They visually verified that critical portions of the systems were correctly aligned for the existing plant configuration.

These activities constituted three partial system walk-down samples as defined in Inspection Procedure 71111.04.

b. Findings

No findings were identified.

1R05 Fire Protection (71111.05)

.1 Quarterly Inspection

a. Inspection Scope

The inspectors evaluated the licensee's fire protection program for operational status and material condition. The inspectors focused their inspection on five plant areas important to safety:

- February 21, 2017, Unit 2, Fire Zone 2136-I, health physics area
- February 21, 2017, Unit 2, Fire Zone 2097-X, east dc equipment room
- February 21, 2017, Unit 2, Fire Zone 2099-W, west dc equipment room
- March 2, 2017, Unit 2, Fire Zone 2102-Y, east battery room
- March 29, 2017, Unit 1, Fire Zone 160-B, computer and control rod drive equipment room

For each area, the inspectors evaluated the fire plan against defined hazards and defense-in-depth features in the licensee's fire protection program. The inspectors evaluated control of transient combustibles and ignition sources, fire detection and suppression systems, manual firefighting equipment and capability, passive fire protection features, and compensatory measures for degraded conditions.

These activities constituted five quarterly inspection samples, as defined in Inspection Procedure 71111.05.

b. Findings

No findings were identified.

.2 Annual Inspection

a. Inspection Scope

On February 7 and March 15, 2017, the inspectors completed their annual evaluation of the licensee's fire brigade performance. This evaluation included observation of the following fire drill and live fire training:

- February 7, 2017, live fire training at licensee's training facility
- March 15, 2017, Unit 1, unannounced drill at auxiliary building sump pump breaker cubicle

During these activities, the inspectors evaluated the capability of the fire brigade members, the leadership ability of the brigade leader, the brigade's use of turnout gear and fire-fighting equipment, and the effectiveness of the fire brigade's team operation. The inspectors also reviewed whether the licensee's fire brigade met NRC requirements for training, dedicated size and membership, and equipment.

These activities constituted one annual inspection sample, as defined in Inspection Procedure 71111.05.

b. Findings

No findings were identified.

1R11 Licensed Operator Requalification Program and Licensed Operator Performance (71111.11)

.1 Review of Licensed Operator Requalification

a. Inspection Scope

On January 31, 2017, the inspectors observed Unit 1 simulator training for an operating crew. The inspectors assessed the performance of the operators and the evaluators' critique of their performance. The inspectors also assessed the modeling and performance of the simulator during the requalification activities.

On February 3, 2017, the inspectors observed Unit 2 simulator training for an operating crew. The inspectors assessed the performance of the operators and the evaluators' critique of their performance. The inspectors also assessed the modeling and performance of the simulator during the requalification activities.

These activities constituted completion of two quarterly licensed operator requalification program samples, as defined in Inspection Procedure 71111.11.

b. Findings

No findings were identified.

.2 Review of Licensed Operator Performance

a. Inspection Scope

The inspectors observed the performance of on-shift licensed operators in the plant's main control room. At the time of the observations, the plant was in a period of heightened activity or risk. The inspectors observed the operators' performance of the following activities:

- February 23, 2017, Unit 1, decay heat pump and component quarterly test
- March 1, 2017, Unit 2, power reduction to 82 percent
- March 3, 2017, Unit 2, power reduction to 48 percent

In addition, the inspectors assessed the operators' adherence to plant procedures, including the conduct of operations procedure and other operations department policies.

These activities constituted completion of three quarterly licensed operator performance samples, as defined in Inspection Procedure 71111.11.

b. Findings

No findings were identified.

1R12 Maintenance Effectiveness (71111.12)

Routine Maintenance Effectiveness

a. Inspection Scope

On February 1, 2017, the inspectors reviewed one instance of degraded performance or condition of a safety-significant structure, system, and component (SSC), specifically the Unit 1 feedwater system's failure of the isolation valves to close. See the attachment for the documents reviewed concerning this issue. .

The inspectors reviewed the extent of condition of possible common cause SSC failures and evaluated the adequacy of the licensee's corrective actions. The inspectors reviewed the licensee's work practices to evaluate whether these may have played a role in the degradation of the SSCs. The inspectors assessed the licensee's characterization of the degradation in accordance with 10 CFR 50.65 (the Maintenance Rule), and verified that the licensee was appropriately tracking degraded performance and conditions in accordance with the Maintenance Rule.

These activities constituted completion of one maintenance effectiveness sample, as defined in Inspection Procedure 71111.12.

b. Findings

No findings were identified.

1R13 Maintenance Risk Assessments and Emergent Work Control (71111.13)

a. Inspection Scope

The inspectors reviewed three risk assessments performed by the licensee prior to changes in plant configuration and the risk management actions taken by the licensee in response to elevated risk:

- January 25, 2017, Units 1 and 2, startup transformer 2 outage during electric driven fire pump outage

- February 28, 2017, Unit 2, temporary spent fuel pool cooling system placed in service while normal heat exchanger maintenance was performed

- March 30, 2017, Unit 2, containment equipment hatch closure drill during refueling outage

The inspectors verified that these risk assessments were performed timely and in accordance with the requirements of 10 CFR 50.65 (the Maintenance Rule) and plant procedures. The inspectors reviewed the accuracy and completeness of the licensee's risk assessments and verified that the licensee implemented appropriate risk management actions based on the result of the assessments.

Additionally, on January 26, 2017, the inspectors observed portions of one emergent work activity that had the potential to affect the functional capability of a mitigating system. Specifically, the inspectors observed the licensee troubleshoot the failed borated water storage tank outlet valve B. The inspectors verified that the licensee appropriately developed and followed a work plan for these activities. The inspectors verified that the licensee took precautions to minimize the impact of the work activities on unaffected SSCs.

These activities constituted completion of a total of four maintenance risk assessments and emergent work control inspection samples, as defined in Inspection Procedure 71111.13.

b. Findings

No findings were identified.

1R15 Operability Determinations and Functionality Assessments (71111.15)

a. Inspection Scope

The inspectors reviewed five operability determinations that the licensee performed for degraded or nonconforming SSCs:

- January 26, 2017, Unit 1, operators locked open the train B borated water storage tank outlet valve when it failed to fully stroke
- January 27, 2017, Unit 1, service water pump B motor preventative maintenance exceeding due date
- February 23, 2017, Unit 1, emergency feedwater initiation and control channel B while the opto-isolator was failed
- March 2, 2017, Unit 1, service water pump C with degraded flow due to a hose partially blocking the pump suction
- March 26, 2017, Unit 1, emergency feedwater initiation and control channel D compensation module test jack failure

The inspectors reviewed the timeliness and technical adequacy of the licensee's evaluations. Where the licensee determined the degraded SSC to be operable, the inspectors verified that the licensee's compensatory measures were appropriate to provide reasonable assurance of operability. The inspectors verified that the licensee

had considered the effect of other degraded conditions on the operability of the degraded SSC.

These activities constituted completion of five operability and functionality review samples, as defined in Inspection Procedure 71111.15.

b. Findings

.1 Failure to Identify Damaged Lugs

Introduction. The inspectors documented a Green self-revealing non-cited violation of Technical Specification 5.4.1.a, for failure to properly perform maintenance on the Unit 1 suction valve to the emergency core cooling system B and containment spray B. Specifically, the licensee failed to identify a damaged electrical lug on the valve actuator during maintenance. The lug subsequently failed and the valve failed to stroke fully open after being returned to service.

Description. During surveillance testing on January 26, 2017, the borated water storage tank (BWST) outlet motor-operated valve to train B, CV-1408, failed to fully open. The valve was designed to be normally closed and opened when needed to supply water to train B of the emergency core cooling and containment spray pumps. Operators declared the valve inoperable. Maintenance personnel discovered a broken electrical lug crimped on a wire associated with the torque switch and damage on the rest of the torque switch lugs from improper crimping or improper wire cutting. To repair the valve actuator, the licensee replaced the lugs and stroked the valve successfully.

The licensee documented the issue in Condition Report CR-ANO-1-2017-00270 and performed a causal evaluation. The licensee determined that the lugs had been installed in 1990, and that the damage likely occurred at installation because no maintenance since that time had required cutting or recrimping the lugs. The licensee further determined that the damage had been visible as a cut mark and that maintenance personnel should have identified the damage during actuator inspections performed on January 19, 2017. On that date, maintenance personnel performed a cleaning and inspection of the valve actuator in accordance with Procedure EN-MA-141, “Limitorque Valve Operator Model SMB/SB/SBD-000 Through 5 MOV and HBC Periodic Inspection,” Revision 8. Step 5.11[4] of that procedure required technicians to inspect all wiring and terminations for damaged or improperly installed lugs. However, the maintenance technicians failed to identify the damaged lugs. After the maintenance, the maintenance personnel re-installed the actuator limit switch cover and operators stroked the valve successfully the same day. The licensee determined that the lug broke either during the January 19, 2017, maintenance from the inspection, or during the post-maintenance test valve stroke from vibration. Therefore, the inspectors concluded that the valve was inoperable for approximately seven days.

The inspectors reviewed the impact of the failure on the emergency core cooling system train B. The gate valve had opened to 30 percent and then failed. The licensee determined that the broken electrical connection was out of the control circuit until the valve reached 30 percent open, at which time the broken connection caused the control circuit to stop valve motion due to a false excessive torque signal. The licensee performed a flow evaluation for the failed valve position and concluded that the valve could have passed sufficient flow for emergency core cooling during a potential small

break loss of coolant accident, but the licensee did not analyze whether the valve would pass the higher flow rates required to respond to a large break loss of coolant accident. The inspectors noted that emergency operating procedures directed operators to stop the pumps if the valve failed to open, but the valve actually partially opened. Therefore, the inspectors evaluated the procedure guidance and indications available to control room operators to be able to assess the actual condition and determine an appropriate response. The inspectors determined that operators would have indications of pressure and flow rate from each of the affected pumps, and valve position for the failed valve indicated an intermediate position so the cause of abnormal indications could be readily identified. The inspectors determined that operators were trained to identify abnormal pump discharge pressures and flow rates, and had guidance allowing them to identify when it would be necessary to secure a pump because flow rate was too low for safe pump operation. In addition, the inspectors determined that the valve was accessible to be manually opened, and there was adequate guidance and time for an operator to manually open the valve and restart the pumps prior to core damage if the operators stopped the train B pumps due to the failure during a potential small break loss of coolant accidents.

Through interviews with maintenance personnel, the inspectors determined that inattention to detail was the most significant contributor for failure to identify the damaged lugs. In addition, the inspectors noted that this valve was in a location that could make it difficult to fully inspect the lugs due to the limited space for maintenance personnel to view the inside of the limit switch enclosure where the damaged wire was located. Therefore, the inspectors determined that other tools may be necessary to perform the inspections, such as mirrors, boroscopes, or cameras.

Analysis. The licensee failed to identify a damaged electrical lug on a motor-operated valve during maintenance, which is a performance deficiency. The performance deficiency is more than minor because it adversely affected the human performance attribute of the mitigating systems cornerstone and adversely affected the cornerstone objective to ensure the reliability of systems that respond to initiating events to prevent undesirable consequences. Specifically, the performance deficiency resulted in the failure of a suction valve for one train of emergency core cooling systems and containment spray systems after the valve was returned to service from the maintenance. Using Inspection Manual Chapter 0609, Appendix A, “The Significance Determination Process (SDP) for Findings At-Power,” dated June 19, 2012, Exhibit 2, “Mitigating Systems Screening Questions,” the inspectors determined that the finding required a detailed risk evaluation because the finding represented an actual loss of function of a single train for greater than its technical specification allowed outage time. See Attachment 3 of this report for the detailed risk evaluation. The analyst determined that this finding was of very low safety significance (Green). The inspectors determined this finding has a cross-cutting aspect in the human performance area of H.12, Avoid Complacency, because the primary cause of the performance deficiency involved the failure to plan for the possibility of mistakes and use appropriate error reduction tools.

Enforcement. Unit 1 Technical Specification 5.4.1.a requires, in part, that written procedures shall be established, implemented, and maintained covering the applicable procedures recommended in Regulatory Guide 1.33, “Quality Assurance Program Requirements,” Revision 2, Appendix A, February 1978. Regulatory Guide 1.33, Appendix A, Section 9.a, states, in part, that maintenance that can affect the performance of safety-related equipment should be properly pre-planned and performed

in accordance with written procedures, documented instructions, or drawings appropriate to the circumstances. Procedure EN-MA-141, “Limitorque Valve Operator Model SMB/SB/SBD-000 Through 5 MOV and HBC Periodic Inspection,” Revision 8, Step 5.11[4] required maintenance technicians, in part, to inspect all wiring and terminations for damaged or improperly installed lugs. Contrary to the above, on January 19, 2017, during maintenance to motor operated valve CV-1408, the licensee failed to inspect all wiring and terminations for damaged or improperly installed lugs. Specifically, the licensee failed to identify damaged electrical lugs in a safety-related motor operated valve, the lug subsequently failed, and the valve failed to fully stroke open. To correct the issue, the licensee repaired the damaged lugs and satisfactorily tested the valve. Because this finding is of very low safety significance and was entered into the corrective action program as Condition Report CR-ANO-1-2017-00270, this violation is being treated as a non-cited violation, consistent with Section 2.3.2 of the NRC Enforcement Policy: NCV 05000313/2017001-01, "Failure to Identify Damaged Lugs."

.2 Failure to Evaluate All Required Functions for Operability

Introduction. The inspectors identified a Green finding and an associated non-cited violation of 10 CFR 50, Appendix B, Criterion V, Instructions, Procedures and Drawings, for failure to evaluate the impacts of a valve failure on all the required safety functions for operability of train B of the emergency core cooling system. Specifically, the licensee failed to evaluate the operability impact on the safety function to close of Unit 1 motor-operated, BWST outlet valve, CV-1408, before de-energizing and locking open the valve and declaring it operable.

Description. During surveillance testing on January 26, 2017, the motor-operated, BWST outlet valve to Train B, CV-1408, failed to fully open. See Section 1R15.1 of this report for further information about the equipment failure and associated enforcement aspects. The valve is designed to open automatically during an accident to supply water to Train B of the emergency core cooling and containment spray pumps and then be closed remotely from the control room when required to shift from injection mode to recirculation mode during a loss of coolant accident. Failure to open would result in no emergency core cooling system injection from Train B, and failure to close could result in draining the BWST and air binding of the pumps.

After the failure, the licensee declared the valve inoperable and entered the 72 hour technical specification action statements for Train B of the emergency core cooling (LCO 3.5.2, Action A) and containment spray system (LCO 3.6.5, Action A). Operators subsequently de-energized and locked open valve CV-1408. Operators used Procedure OP-1104.004, “Decay Heat Removal Operating Procedure,” Revision 124, to evaluate the operability impact. Procedure OP-1104.004 stated, in part, that if valve CV-1408 failed to close when transferring emergency core cooling pump suction from the borated water storage tank to the containment sump, the check valve in series was credited as providing the required isolation, and to dispatch an operator to manually close the valve. Based on this information, the operators declared the de-energized and locked open valve operable and exited the associated technical specification action statements.

For operability assessment purposes, two decisions were made. Operators first concluded that because of the failure of valve CV-1408, Train B was not capable of performing at least one of its specified safety functions and declared the associated train

inoperable. Next, operators then decided to manually open the valve and ensured that it stayed open by using a chain and padlock with the intent of restoring the train to operable status without performing an evaluation to demonstrate that all required functions could be met.

The inspectors noted that the licensee had previously designated the operator action to close valve CV-1408 as time critical in order to prevent air ingestion to the downstream pumps. The inspectors also noted that the licensee did not have any analysis to show that operators could complete the manual action prior to draining the BWST and injecting air into the emergency core cooling pumps under accident conditions when the valve was de-energized and locked open. After the inspectors communicated their concern to the licensee, operators declared the valve inoperable and re-entered the applicable technical specification action statements. The licensee documented the inspectors' concerns in Condition Report CR-ANO-1-2017-00324. The licensee corrected the equipment failure, successfully tested the valve, and exited the technical specification action statement on the same day as the failure.

Procedure EN-OP-104, Revision 11, "Operability Determination Process," includes the process to assess the operability and functionality when degraded or nonconforming conditions affecting SSCs are identified. Step 5.3.[1].(d) of EN-OP-104, stated, in part, to determine the impact of the degraded or non-conforming condition on the SSC or the specified safety function. The inspectors concluded that operators failed to evaluate the operability impact on the safety function to close for Unit 1 valve CV-1408 before de-energizing and locking open the valve. As a result, operators exited a 72-hour action statement that requires restoring the train to operable status within 72 hours, and a failure to meet this action would require a unit shutdown. The inspectors noted that by doing so, there was no longer any time limit in place to ensure that this safety-significant train was promptly restored to a condition which would fulfill all of its required safety functions.

The inspectors determined that the licensee had previously locked open valve CV-1408 and declared it operable multiple times to perform maintenance. Guidance in Procedure OP-1104.004 incorrectly implied, but did not actually state, that this action would allow the train to be declared inoperable. The inspectors determined that operators relied on this guidance to implement the action to lock the valve open when the valve failed to fully open, rather than using the procedure EN-OP-104 steps required to conduct a proper evaluation of the impact of the failed component on all the the specified safety functions the valve was required to support. Therefore, the inspectors concluded that the cause for the performance deficiency was the failure to use a consistent, systematic approach to make decisions concerning operability. Further, continued use of the guidance in OP-1104.004 would eliminate the time limit for restoring the function required in the Unit 1 technical specifications, allowing maintenance or repair to be delayed resulting in a more significant safety impact.

Analysis. The failure to evaluate the operability impact on all specfied safety functions for Unit 1 valve CV-1408 before de-energizing and locking open the valve is a performance deficiency. The performance deficiency is more than minor because if left uncorrected, it could become a more significant safety concern because it would allow an indefinite delay in restoring the shut function of the valve. It is also associated with the equipment performance attribute of the mitigating systems cornerstone and adversely affected the cornerstone objective to ensure the reliability of systems that

respond to initiating events to prevent undesirable consequences because the licensee increased the likelihood of air-binding and failure of Train B of the emergency core cooling system during a potential loss of coolant accident. Using Chapter 0609, Appendix A, “The Significance Determination Process (SDP) for Findings At-Power,” dated June 19, 2012, Exhibit 2, “Mitigating Systems Screening Questions,” the issue screened as having very low safety significance (Green) because it was not a design or qualification deficiency; did not represent a loss of system function; did not result in the actual loss of function of a train of technical specification equipment for greater than its allowed outage time; and did not screen as potentially risk significant due to seismic, flooding, or severe weather. The inspectors determined that this finding has a cross cutting aspect in the human performance area of H.13, Consistent Process, because the performance deficiency was caused by not following a consistent, systematic approach to making a decision concerning operability of the affected train.

Enforcement. Title 10 CFR Part 50, Appendix B, Criterion V, Instructions, Procedures, and Drawings, requires, in part, that activities affecting quality shall be accomplished in accordance with documented instructions, procedures, or drawings of a type appropriate to the circumstances. Procedure EN-OP-104, “Operability Determination Process,” Revision 11, a quality-related procedure intended to meet this requirement, provided instructions for assessing the operability of safety-related systems, structures, and components (SSCs). Procedure EN-OP-104, Step 5.3.[1].(d), stated, in part, to determine the impact of the condition on the specified safety function. Contrary to the above, on January 26, 2017, the licensee failed to determine the impact of the condition on the specified safety function. Specifically, the licensee failed to evaluate the impact of de-energizing and locking open valve CV-1408 on the safety function to close and incorrectly declared the system operable. Immediate corrective actions included re-evaluation of the valve safety functions and subsequently declaring the associated systems inoperable. Because this finding is of very low safety significance and was entered into the corrective action program as Condition Report CR-ANO-1-2017-00324, this violation is being treated as a non-cited violation, consistent with Section 2.3.2 of the NRC Enforcement Policy: NCV 05000313/2017001-02, "Failure to Evaluate All Required Functions for Operability."

1R18 Plant Modifications (71111.18)

a. Inspection Scope

The inspectors reviewed one temporary plant modifications that affected risk-significant SSCs. On March 6, 2017, the inspectors reviewed the Unit 2 temporary spent fuel pool cooling system. The inspectors verified that the licensee had installed and removed this temporary modification in accordance with technically adequate design documents. The inspectors verified that this modification did not adversely impact the operability or availability of affected SSCs. The inspectors reviewed design documentation and plant procedures affected by the modification to verify the licensee maintained configuration control.

These activities constituted completion of one sample of temporary modifications, as defined in Inspection Procedure 71111.18.

b. Findings

No findings were identified.

1R19 Post-Maintenance Testing (71111.19)

a. Inspection Scope

The inspectors reviewed three post-maintenance testing activities that affected risk-significant SSCs:

- February 28, 2017, Unit 2, low pressure safety injection valve, 2CV-5017-1, stroke following motor maintenance
- March 11, 2017, Unit 2, charging pump 2P-36C run after maintenance on suction and discharge piping
- March 21, 2017, Unit 2, spent fuel pool cooling pump, 2P-40A, run after maintenance on pump

The inspectors reviewed licensing- and design-basis documents for the SSCs and the maintenance and post-maintenance test procedures. The inspectors observed the performance of the post-maintenance tests to verify that the licensee performed the tests in accordance with approved procedures, satisfied the established acceptance criteria, and restored the operability of the affected SSCs.

These activities constituted completion of three post-maintenance testing inspection samples, as defined in Inspection Procedure 71111.19.

b. Findings

No findings were identified.

1R20 Refueling and Other Outage Activities (71111.20)

a. Inspection Scope

During the Unit 2 refueling outage that began on March 29, 2017, the inspectors evaluated the licensee's outage activities. The inspectors verified that the licensee considered risk in developing and implementing the outage plan, appropriately managed personnel fatigue, and developed mitigation strategies for losses of key safety functions. This verification included the following:

- Review of the licensee's outage plan prior to the outage
- Monitoring of shut-down and cool-down activities
- Verification that the licensee maintained defense-in-depth during outage activities
- Observation and review of lowered inventory activities

These activities constituted completion of one refueling outage and outage activities sample, as defined in Inspection Procedure 71111.20.

b. Findings

No findings were identified.

1R22 Surveillance Testing (71111.22)

a. Inspection Scope

The inspectors observed five risk-significant surveillance tests and reviewed test results to verify that these tests adequately demonstrated that the SSCs were capable of performing their safety functions:

In-service tests:

- February 23, 2017, Unit 1, decay heat removal train B quarterly test

Other surveillance tests:

- January 31, 2017, Unit 1, emergency feedwater initiation and control channel A opto-isolator testing
- February 2, 2017, Unit 2, inspection and lubrication of door DR-355, electric driven emergency feedwater pump room watertight door
- March 16, 2017, Unit 2 containment spray pump B offline motor testing
- March 30, 2017, Unit 1, diesel driven fire pump monthly test

The inspectors verified that these tests met technical specification requirements, that the licensee performed the tests in accordance with their procedures, and that the results of the tests satisfied appropriate acceptance criteria. The inspectors verified that the licensee restored the operability of the affected SSCs following testing.

These activities constituted completion of five surveillance testing inspection samples, as defined in Inspection Procedure 71111.22.

b. Findings

No findings were identified.

Cornerstone: Emergency Preparedness

1EP6 Drill Evaluation (71114.06)

.1 Emergency Preparedness Drill Observation

a. Inspection Scope

The inspectors observed an emergency preparedness drill on March 1, 2017, to verify the adequacy and capability of the licensee's assessment of drill performance. The inspectors reviewed the drill scenario, observed the drill from the emergency operations

facility and simulator, and reviewed the post-drill critique. The inspectors verified that the licensee's emergency classifications, off-site notifications, and protective action recommendations were appropriate and timely. The inspectors verified that any emergency preparedness weaknesses were appropriately identified by the licensee in the post-drill critique and entered into the corrective action program for resolution.

These activities constituted completion of one emergency preparedness drill observation sample, as defined in Inspection Procedure 71114.06.

b. Findings

No findings were identified.

.2 Training Evolution Observation

a. Inspection Scope

On January 31, 2017, and February 2, 2017, the inspectors observed simulator-based licensed operator requalification training that included implementation of the licensee's emergency plan. The inspectors verified that the licensee's emergency classifications, off-site notifications, and protective action recommendations were appropriate and timely. The inspectors verified that any emergency preparedness weaknesses were appropriately identified by the evaluators and entered into the corrective action program for resolution.

These activities constituted completion of two training observation samples, as defined in Inspection Procedure 71114.06.

b. Findings

No findings were identified.

4. OTHER ACTIVITIES

Cornerstones: Initiating Events, Mitigating Systems, Barrier Integrity, Emergency Preparedness, Public Radiation Safety, Occupational Radiation Safety, and Security

4OA1 Performance Indicator Verification (71151)

.1 Unplanned Scrams per 7000 Critical Hours (IE01)

a. Inspection Scope

The inspectors reviewed licensee event reports (LERs) for the period of January 1, 2016, through December 31, 2016, to determine the number of scrams that occurred. The inspectors compared the number of scrams reported in these LERs to the number reported for the performance indicator. The inspectors used definitions and guidance contained in Nuclear Energy Institute Document 99-02, "Regulatory Assessment Performance Indicator Guideline," Revision 7, to determine the accuracy of the data reported.

These activities constituted verification of the unplanned scrams per 7000 critical hours performance indicator for Units 1 and 2, as defined in Inspection Procedure 71151.

b. Findings

No findings were identified.

.2 Unplanned Power Changes per 7000 Critical Hours (IE03)

a. Inspection Scope

The inspectors reviewed operating logs, corrective action program records, and monthly operating reports for the period of January 1, 2016, through December 31, 2016, to determine the number of unplanned power changes that occurred. The inspectors compared the number of unplanned power changes documented to the number reported for the performance indicator. The inspectors used definitions and guidance contained in Nuclear Energy Institute Document 99-02, "Regulatory Assessment Performance Indicator Guideline," Revision 7, to determine the accuracy of the data reported.

These activities constituted verification of the unplanned power outages per 7000 critical hours performance indicator for Units 1 and 2, as defined in Inspection Procedure 71151.

b. Findings

No findings were identified.

.3 Unplanned Scrams with Complications (IE04)

a. Inspection Scope

The inspectors reviewed the licensee's basis for including or excluding in this performance indicator each scram that occurred between January 1, 2016, and December 31, 2016. The inspectors used definitions and guidance contained in Nuclear Energy Institute Document 99-02, "Regulatory Assessment Performance Indicator Guideline," Revision 7, to determine the accuracy of the data reported.

These activities constituted verification of the unplanned scrams with complications performance indicator for Units 1 and 2, as defined in Inspection Procedure 71151.

b. Findings

No findings were identified.

4OA2 Problem Identification and Resolution (71152)

.1 Routine Review

a. Inspection Scope

Throughout the inspection period, the inspectors performed daily reviews of items entered into the licensee's corrective action program and periodically attended the

licensee's condition report screening meetings. The inspectors verified that licensee personnel were identifying problems at an appropriate threshold and entering problems into the corrective action program for resolution. The inspectors verified that the licensee developed and implemented corrective actions commensurate with the significance of the problems identified. The inspectors also reviewed the licensee's problem identification and resolution activities during the performance of the other inspection activities documented in this report.

b. Findings

No findings were identified.

.2 Semiannual Trend Review

a. Inspection Scope

The inspectors reviewed the licensee's corrective action program, performance indicators, system health reports, and other documentation to identify trends that might indicate the existence of a more significant safety issue. The inspectors verified that the licensee was taking corrective actions to address identified adverse trends.

These activities constituted completion of one semiannual trend review sample, as defined in Inspection Procedure 71152.

b. Observations and Assessments

The inspectors reviewed examples of operability and functionality evaluations to assess their quality. Additionally, the inspectors reviewed licensee trend data on operability evaluation quality.

The inspectors identified the following examples where operability evaluations lacked adequate supporting information:

- Condition Report CR-ANO-1-2017-00297 documented that the preventative maintenance for the Unit 1 service water pump B motor would be going late due to an outage conflict and lack of operations support. The initial operability evaluation did not describe the late maintenance activity, the required frequency, when it was last performed, or address the effects that missing the maintenance activity would have on the ability of the pump to operate. The licensee provided a follow-up operability that addressed and evaluated the missing information. This was not a safety concern because the motor was able to perform its required safety function.

- Condition Report CR-ANO-1-2017-00277 documented that the licensee discovered conduit with a missing flood seal that was required as a flood barrier. The initial operability evaluation did not identify which SSCs, if any, could potentially be affected by a flood. The licensee initiated a revision to include the potentially affected SSCs in the operability evaluation and determined that the degraded condition would not affect the safety related functions of the SSCs. The conduit was connected to a sealed junction box that would have limited flow

into the auxiliary building and the SSCs would have remained operable. The licensee also corrected the identified degraded condition.

- Condition Report CR-ANO-1-2017-00270 documented that CV-1408, a borated water storage tank outlet valve for the train B emergency core cooling systems and reactor building spray, failed to stroke fully open. For enforcement aspects, please see Section 1R15 of this report. Following the failure, the licensee locked open the valve and declared it operable without evaluating all of the functions required to demonstrate operability. Specifically, the licensee did not identify that with the valve locked open, the valve could not be closed from the control room at the start of the recirculation phase during a potential loss of coolant accident as required by the design basis. Subsequently, the licensee declared the system inoperable and entered the appropriate technical specifications when the valve has been locked open.

The licensee has previously identified issues with the overall quality of operability and functionality evaluations. They have implemented several corrective actions and adopted new tools to continually improve and assess the quality of condition reports, such as an operability template for prompt identification of safety functions and effects on SSCs, a designated on-shift senior reactor operator for performing operability evaluations, and weekly internal assessments conducted by senior management that grade a sample of operability evaluations and provide feedback. The inspectors reviewed the licensee's internal assessment data and noted that the licensee was identifying trends similar to the isolated incidents above and have been providing feedback to operators. The inspectors concluded that operability evaluation quality and consistency can sometimes be lacking necessary information and decision-making. Overall, the licensee's operability evaluations have been satisfactory and trends have been appropriately address when identified.

c. Findings

No findings were identified.

.3 Annual Follow-up of Selected Issues

a. Inspection Scope

On December 15, 2016, Unit 1 had an inadvertent reactor power increase of approximately six percent due to a failed integrated control system card. The inspectors assessed the licensee's problem identification threshold, cause analyses, extent of condition reviews and compensatory actions. The inspectors verified that the licensee appropriately prioritized the planned corrective actions and that these actions were adequate to correct the condition.

These activities constituted completion of one annual follow-up sample as defined in Inspection Procedure 71152.

b. Findings

Introduction. Inspectors documented a Green self-revealing finding and associated non-cited violation of Unit 1 Technical Specification 5.4.1.a for the failure to properly pre-

plan maintenance of the integrated control system, which can affect the performance of safety related equipment. Specifically, the licensee failed to perform post-maintenance testing on newly installed integrated control system cards before returning the system to service. As a result, the licensee failed to identify a failed card in the integrated control system, which resulted in an inadvertent control rod withdrawal.

Description. On December 15, 2016, during plant startup, operators placed the steam generator reactor demand controller into automatic per Procedure OP-1102.002, "Plant Startup," Revision 106. When placed into automatic, the system started withdrawing control rods to achieve a false 50 percent power demand sensed by the controller. Control room operators identified the problem, returned the controller switch to manual within two seconds and took control of the reactor by inserting rods within 16 seconds, but power rose approximately 6 percent from 23 percent to 29 percent power before manual actions could restore power levels.

The licensee identified through their apparent cause evaluation, Condition Report CR-ANO-1-2016-05551, that the inadvertent power increase was due to installing a failed control card into the system during the planned Unit 1 refueling outage. Maintenance personnel calibrated and tested the card prior to the start of the outage, and then completed a "burn-in" of the component by keeping the card powered until installation in the plant. The burn-in is designed to give cards run time prior to installation in the plant to identify early failures. In this case, the manufacturer had installed a capacitor backwards on the card, but the capacitor functioned long enough to pass the initial calibration and testing prior to installation. The licensee installed the card in the plant without performing any post-maintenance testing, and since it had failed at some point in time during the burn in, it led to a latent condition where the card would not function as designed.

The licensee identified that the engineer had a non-formalized expectation that the cards would be re-tested prior to putting it in service, but the work order did not reflect that expectation. In addition to this failure, there were several other missed opportunities to identify this issue. Indications on the plant data system showed that this card was not functioning correctly but operators and maintenance personnel did not verify these indications prior to placing it in service. The licensee did not validate the card configuration to ensure that components with a sensitivity to incorrect polarity had been installed correctly, and failed to identify visible burn marks on the card prior to installation in the plant.

The licensee performed an extent of condition review and determined that there were no other cards that have been released for general use in the system that had the potential for a capacitor or other polarity sensitive component installed backwards. The licensee successfully replaced the failed card with a new card that was tested and the configuration validated prior to being placed into the plant on December 15, 2016.

Analysis. The failure to perform a post-maintenance test prior to placing a component in service is a performance deficiency. Specifically, work order 52608647 for replacing the steam generator reactor demand integrated control system card did not include a post-maintenance test to ensure that the card was functioning properly following installation in the plant. The performance deficiency is more than minor because if left uncorrected, the performance deficiency had the potential to become a more significant safety concern. Specifically, if the operator had not taken prompt action to mitigate the event, it

would have resulted in a more significant plant transient and could have challenged plant equipment. In accordance with IMC 0609, Attachment 4, “Initial Characterization of Findings,” issued October 7, 2016, and Exhibit 1 of IMC 00609, Appendix A, “The Significance Determination Process (SDP) for Findings At-Power,” Issued June 19, 2012, the inspectors determined the finding to be of very low safety significance (Green) because the finding is associated with the initiating events cornerstone and did not cause a reactor trip. The finding was determined to have a cross-cutting aspect in the area of human performance in the area of Work Management, because the licensee did not ensure that they followed a process of planning, controlling, and executing the work activities in a formalized manner, which allowed the work order to not have complete instructions for a post-maintenance test.

Enforcement. Unit 1 Technical Specification 5.4.1.a, requires, in part, that procedures shall be established, implemented, and maintained covering the applicable procedures recommended in Appendix A of Regulatory Guide 1.33, Revision 2. Section 9.a of Appendix A to Regulatory Guide 1.33, Revision 2, requires that maintenance that can affect the performance of safety-related equipment should be properly pre-planned and performed in accordance with written procedures, documented instructions, or drawings appropriate to the circumstances. Contrary to the above, on December 15, 2016, maintenance to the integrated control system, an activity that affected the performance of safety-related equipment, was not properly pre-planned. Specifically, the licensee failed to properly pre-plan Work Order 52608647 to include adequate post-maintenance testing prior to placing the integrated control system into service. As a result, the integrated control system inappropriately withdrew control rods and affected safety related equipment by increasing reactor power and challenging safety-related systems to respond to the power change. The licensee restored compliance by replacing the failed card and changing the work orders to require a post-maintenance test prior to declaring the system functional. Because this finding is of very low safety significance and was entered into the corrective action program as Condition Report CR-ANO-1-2016-05551, this violation is being treated as a non-cited violation, consistent with Section 2.3.2 of the NRC Enforcement Policy: NCV 05000313/2017001-03, "Inadvertent Reactivity Addition."

4OA5 Other Activities

.1 Temporary Instruction 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 was 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 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 the US operating plants including the Byron

Station open phase condition event 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 and transformer yard 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.

b. Findings and Observations

No findings were identified.

.2 World Association of Nuclear Operators Plant Assessment Review

The inspectors reviewed the final report for the World Association of Nuclear Operators' plant assessment for Arkansas Nuclear One conducted in 2016. The inspectors reviewed the report to ensure that issues identified were consistent with the NRC perspectives of licensee performance and to verify if any significant issues were identified that required further NRC followup.

4OA6 Meetings, Including Exit

Exit Meeting Summary

On January 27, 2017, the inspectors presented the inspection results for Temporary Instruction 2515/192 to Mr. Terry Evans, General Manager of Plant Operations, and other members of the licensee staff. The licensee acknowledged the issues presented. No proprietary information was identified.

On April 4, 2017, the inspectors presented the resident inspection results to Mr. Rich Anderson, Site Vice President, and other members of the licensee staff. The licensee acknowledged the issues presented. The licensee confirmed that any proprietary information reviewed by the inspectors had been returned or destroyed.

On May 11, 2017, the inspectors conducted a supplemental exit meeting with Mr. T. Evans, General Manager of Plant Operations and other members of the licensee staff in order to change the characterization of the finding in Section 1R15.2. No proprietary information was identified.

4OA7 Licensee-Identified Violations

The following licensee-identified violations of NRC requirements were determined to be of very low safety significance or Severity Level IV and meet the NRC Enforcement Policy criteria for being dispositioned as Non-Cited Violations:

- The licensee identified that four seal injection check valves to the Unit 1 reactor coolant pumps (RCPs), which functioned as containment isolation valves, were missing internal springs required per original design. Due to the vertical orientation of the valves, the valves needed these springs to ensure that the valve disc would seat properly during reverse flow. The licensee also identified they had failed to test these ASME Code Class C check valves' close safety function in accordance with ASME Code for Operation and Maintenance of Nuclear Power Plants (OM) Code. The licensee had been testing the close function by manually closing the check valves with their handwheels.

  Title 10 CFR Part 50.55a.(f)(4)(ii), requires in part, that ASME Code Class 3 pumps and valves must meet the inservice test requirements of ASME Code for Operation and Maintenance of Nuclear Power Plants (OM Code). The 2003 Addenda to the 2001 ASME OM Code, Subsection ISTC, "Inservice Testing of Valves in Light-Water Reactor Nuclear Power Plants," Section ISTC-5220, "Check Valves," Subsection ISTC-5221, "Valve Obturator Movement," Paragraph (a)(1), states in part, that check valves shall be exercised by verifying that on cessation or reversal of flow, the obturator has traveled to the seat. Contrary to the above, prior to November 29, 2016, the inservice tests to verify operational readiness of RCP seal injection check valves did not comply with the applicable version of the ASME OM Code requirement to exercise check valves by verifying that on cessation or reversal of flow, the obturator has traveled to the seat. Specifically, the licensee was manually closing these stop check valves in accordance with their test procedure to satisfy inservice testing. The licensee immediately installed springs for these valves as required and wrote a test procedure to test these valves in accordance with ASME OM Code. The licensee documented the issue in their corrective action program as Condition Report CR-ANO-2016-05149.

  Using NRC Inspection Manual Chapter 0609, Appendix A, "The Significance Determination Process (SDP) For Findings At-Power," dated June 19, 2012, the inspectors determined the finding to be of very low safety significance (Green) because the finding did not represent an actual open pathway in the physical integrity of reactor containment, containment isolation system and heat removal components.

- On January 16, 2017, Unit 1 operators noticed reduced pressure and flow from service water pump C while placing it in service. The licensee declared the pump inoperable, found and removed approximately 10 feet of ½-inch polymer tube that was obstructing the suction path of the pump, and completed a successful test and inspection of the pump before returning it to service. The licensee determined that the hose was inadvertently introduced while the service water bay was open for maintenance during the fall 2016 Unit 1 refueling outage. The inspectors reviewed the licensee's evaluation of pump functionality and concluded that the pump could produce enough flow and pressure to fulfill its safety function, and that the pump could withstand fully ingesting the hose without significant damage to the pump or system.

Title 10 CFR Part 50, Appendix B, Criterion V, “Instructions, Procedures, and Drawings,” requires, in part, that activities affecting quality shall be accomplished in accordance with documented instructions, procedures, or drawings of a type appropriate to the circumstances. Licensee Procedure EN-MA-118, “Foreign Material Exclusion,” Revision 10, an Appendix B quality-related procedure, provides instructions for controlling foreign material, an activity affecting quality. Procedure EN-MA-118, Step 5.4, requires, in part, that only necessary material be allowed in the foreign material exclusion zone. Contrary to the above, between September 14, and November 25, 2016, the licensee failed to only allow necessary material in the foreign material exclusion zone. Specifically, when the Unit 1 service water pump C bay was open for maintenance, a hose was unnecessarily introduced and then left in the bay after the maintenance. The licensee documented the issue in the licensee’s corrective action program as Condition Report CR-ANO-1-2017-00164. To correct the issue, the licensee removed the hose, inspected and tested the pump, and inspected all other potentially affected service water bays to verify no foreign material was present.

Using NRC Inspection Manual Chapter 0609, Appendix A, "The Significance Determination Process (SDP) For Findings At-Power,” dated June 19, 2012, the inspectors determined the finding to be of very low safety significance (Green) because the degraded pump would still be able to perform its safety function, despite the flow capability reduction.

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

Licensee Personnel

R. Anderson, Site Vice President
P. Butler, Design and Program Engineering Manager
R. Carey, Manager, Emergency Preparedness
T. Chernivec, Outage Manager
C. Couser, Fire Protection Engineer
B. Davis, Engineering Director
G. Doran, Specialist, Radiation Protection
T. Evans, General Manager of Plant Operations
M. Hall, Licensing Specialist
C. Heinzen, Engineer, Fire Protection
D. James, Director, Regulatory Affairs and Recovery
B. Lynch, Manager, Radiation Protection
B. Miller, Electrical Design Engineer
N. Mosher, Licensing Specialist, Regulatory Assurance
J. Mott, Engineer, Fire Protection
D. Pehrson, Unit 1 Assistant Operations Manager
R. Penfield, Regulatory and Performance Improvement Director
S. Pyle, Manager, Regulatory Assurance
F. Shewmake, Unit 2 Assistant Operations Manager
B. Short, Senior Licensing Specialist
C. Walker, Supervisor, Engineering Programs
T. Whisler, ALARA Supervisor, Radiation Protection

LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Opened and Closed

05000313/2017-01	NCV	Failure to Identify Damaged Lugs (Section 1R15.1)
05000313/2017-02	NCV	Failure to Evaluate All Required Functions for Operability (Section 1R15.2)
05000313/2017-03	NCV	Inadvertent Reactivity Addition (Section 4OA2.3)

Closed

2515/192	TI	Inspection of the Licensee's Interim Compensatory Measures Associated with the Open Phase Condition Design Vulnerabilities in Electric Power Systems (Section 4OA5.1)

LIST OF DOCUMENTS REVIEWED

Section 1R04: Equipment Alignment

Procedures

Number	Title	Revision
2104.005	Containment Spray	076
2104.039	HPSI System Operation	081
2104.004	Shutdown Cooling System	059

Condition Reports (CRs)

CR-ANO-2-2016-04249 CR-ANO-2-2017-00125

Drawings

Number	Title	Revision
M-2236 Sh. 1	P&ID Containment Spray System	095
M-2232 Sh. 1	P&ID Safety Injection System	121

Section 1R05: Fire Protection

Procedures

Number	Title	Revision
2A-386-2136-I	Health Physics Area	003
2A-372-2097-X	East DC Equipment Room	004
2A-372-2099-W	West DC Equipment Room	004
2A-372-2102-Y	East Battery Room	004
1A-404-160-B	Computer and CRD Equipment Room	005

Miscellaneous

Number	Title	Revision
PFP-U1	Unit 1 Pre-Fire Plans	019
FP-2103 SH1	Fire Zones Intermediate Floor Plan EL. 368’-0” and 372’-0”	034

Section 1R11: Licensed Operator Requalification Program and Licensed Operator Performance

Procedures

Number	Title	Revision
1104.004	Low Pressure Injection/Decay Heat Pump (P-34B) & Components Quarterly Test	124
2102.004	Power Operation	062

Miscellaneous

Number	Title	Revision
AISPGLOREVAL1703	As Found Performance Mode	001
AISPGLOR170304	NNI/ICS	001
A2SPGLOR170302	Loss of Offsite Power	000

Condition Reports (CRs)

CR-ANO-1-2016-01043	CR-ANO-C-2017-00716	CR-ANO-C-2017-00744
CR-ANO-C-2017-00745		

Section 1R12: Maintenance Effectiveness

Procedures

Number	Title	Revision
EN-DC-205	Maintenance Rule Monitoring	005

Miscellaneous

Number	Title	Revision
Maintenance Rule Database	Unit 1 Feedwater System Screening Criteria from 2014 through 2016	000

Condition Reports (CRs)

CR-ANO-1-2015-04188	CR-ANO-1-2015-04178	CR-ANO-1-2016-02981
CR-ANO-1-2016-03096	CR-ANO-1-2016-05115	CR-ANO-1-2016-04391
CR-ANO-1-2016-05200	CR-ANO-1-2016-05204	CR-ANO-1-2016-05517
CR-ANO-1-2016-05204		

Section 1R13: Maintenance Risk Assessments and Emergent Work Control

Procedures

Number	Title	Revision Date
EN-MA-125	Troubleshooting Control of Maintenance Activities	020
OP-1403.038	Maintenance of Limitorque SB and SMB Actuators	033
OPS-151A	SU2 Outage Checklist – Unit 1 – 72-Hour TC	November 13, 2012
OPS-151B	SU2 Outage Checklist – Unit 2 – 72-Hour TC	April 13, 2012

Condition Reports (CRs)

CR-ANO-1-2017-00270	CR-ANO-C-2016-03379

Section 1R15: Operability Determinations and Functionality Assessments

Procedures

Number	Title	Revision
1104.004	Decay Heat Removal Operating Procedure	123
EN-OP-104	Operability Determination Process	011
1412.001	Preventative Maintenance of Limitorque SB/SMB Motor Operators	049
EN-MA-141	Limitorque Valve Operator Model SMB/SB/SBD-000 Through 5 MOV and HBC Periodic Inspection	008

Condition Reports (CRs)

CR-ANO-1-2017-00270	CR-ANO-1-2017-00297	CR-ANO-1-2017-00530
CR-ANO-1-2015-02032	CR-ANO-1-2015-02350	

Calculations

Number	Title	Revision
CALC-97-E-0212-01	BWST Draindown Analysis	004
ULD-1-SYS-08	ANO-1 Emergency Feedwater Isolation and Control System	006
CALC-89-E-0054-01	ANO-1 AFW Delay Justification	001

Calculations

Number	Title	Revision
CALC-87-E-0059-02	ANO-1 LOFW Event with 20 PCT Tube Plugging	000
CALC-A1-NE-2005-04	ANO-1 Mark-B-HTP & Mark-B9 LOCA Summary Report (EOTSG)	002
CALC-A1-NE-2005-005	ANO-1 Revised EFIC Low Level Setpoint Summary Report	000

Work Orders (WOs)

52609431	412996

Section 1R18: Plant Modifications

Procedures

Number	Title	Revision
2203.002	Spent Fuel Pool Emergencies	014

Engineering Changes

Number	Title	Revision
EC-65672	Evaluation of a Temporary Spent Fuel Pool (SFP) Cooling System	000

Condition Reports (CRs)

CR-ANO-C-2017-00751	CR-ANO-2-2017-00726

Section 1R19: Post-Maintenance Testing

Procedures

Number	Title	Revision
OP-1412.001	Preventive Maintenance of Limitorque SB/SMB Motor Operators	049
OP-2104.040	LPSI System Operations	069
OP-2104.002	Chemical Volume and Control	083
OP-2402.033	Charging Pump Suction Dampener and Discharge Dampener Maintenance	006

Condition Reports (CRs)

CR-ANO-2-2016-02197	CR-ANO-2-2016-02198	CR-ANO-2-2016-03073

Work Orders (WOs)

52665648	286966-05

Section 1R20: Refueling and Other Outage Activities

Procedures

Number	Title	Revision
2102.004	Power Operation	062
2102.010	Plant Cooldown	053

Section 1R22: Surveillance Testing

Procedures

Number	Title	Revision Date
MWO 86833-01	Panel C37-1	January 7, 2014
1304.205	Unit 1 EFIC Channel A Monthly Test, SG Pressure Greater than 750 PSIG	030
1104.004	Low Pressure Injection/Decay Heat Pump (P-34B) & Components Quarterly Test	124
1402.100	Watertight Door Maintenance	008
1104.032	Fire Protection Systems	086

Drawings

Number	Title	Revision
E-597, Sh. 9	EFIC Fiber Optic Interconnection	001
APL58526-238	EFIC Generic Arrangement and Marking	000

Work Orders (WO)

52676715	52643650	52676663-03

Condition Reports (CRs)

CR-ANO-1-2017-00339	CR-ANO-2-2016-01268	CR-ANO-2-2016-01272

Condition Reports (CRs)

CR-ANO-2-2016-03632	CR-ANO-C-2016-5435

Miscellaneous

Number	Title	Revision
SEP-ANO-1-IST-1	ANO-1 Inservice Testing Bases Document	002
SEP-ANO-1-IST-2	ANO-1 Inservice Testing Plan	003

Section 1EP6: Drill Evaluation

Miscellaneous

Number	Title	Revision
SES-2-039	Dynamic Exam Scenario	006

Section 4OA2: Problem Identification and Resolution

Procedures

Number	Title	Revision
OP-1102.002	Plant Startup	106
OP-1105.004	Integrated Control System	032

Condition Reports (CRs)

CR-ANO-1-2017-00277	CR-ANO-1-2017-00297	CR-ANO-1-2017-00270
CR-ANO-1-2017-00324	CR-ANO-1-2016-05551	

Section 4OA5: Other Activities

Procedures

Number	Title	Revision Date
1203.012B	Annunciator K02 Corrective Action	044
2203.012A	Annunciator 2K01 Corrective Action	047
OPS-A2	Unit 1 Outside AO	September 12, 2016
OPS-B31	Unit 2 Outside AO	October 30, 2014
OPS-B45	Switchyard Log	

Drawing

Number	Title	Revision
E-3, Sh. 1	Single Line Meter and Relay Diagram 6900 Volt System	023

Miscellaneous

Number	Title	Revision Date
	1R26 Newsletter	October 27, 2016
0CAN021401	Response to Request for Additional Information (RAI) Regarding Response to Bulletin 2012-01	February 3, 2014
0CAN101201	90-Day Response to Bulletin 2012-01, Design Vulnerability in Electric Power System	October 25, 2012
A1LPOPSDC17O1	Design Changes	000
A1LPOPSTEAR1605	Tear Admin OE	
TEAR-ANO-2015-473	EC48708 - Open Phase Detection and Protection for Start-up Transformer 3	
TEAR-ANO-2015-475	EC48770 - STM 1-32 . STM 2-32-1 . STM 2-32-2 . A1LP-AO-ELECD . A1LP-RO-ELECD . A2LP-AO-EDSYD . A2LP-AO-EDHVD . A2LP-RO-EDSYD . A2LP-RO-EDHVD . A2LP-RO-ESBO	
TEAR-ANO-2015-501	EC48771 - Open Phase Detection and Protection for Start-up Transformer 1	

Condition Reports (CRs)

CR-ANO-C-2012-00343 CR-ANO-C-2015-00900 CR-ANO-C-2017-00343

Work Orders

00146388-01 00146399-01 00146608-01

Section 4OA7: Licensee-Identified Violations

Procedures

Number	Title	Revision
EN-MA-118	Foreign Material Exclusion	010
OP-1203.025	Natural Emergencies	062
OP-1203.030	Loss of Service Water	025
OP-1104.029	Service Water and Auxiliary Cooling System	114

Drawing

Number	Title	Revision
M-231, SH1	P&ID Makeup & Purification System	116
M-218, SH1	Small Pipe Isometric RCP P32A Seal Injection	010
M-217, SH1	Small Pipe Isometric RCP P32B Seal Injection	008
M-216, SH1	Small Pipe Isometric RCP P32C Seal Injection	008
M-208, SH1	Small Pipe Isometric RCP P32D Seal Injection	011
TDV085 0030 1	Velan Installation & Operation Manual for forged steel valves bolted bonnet gate, globe, piston, ball & swing check valves welded bonnet gate, globe and check valves NPS ¼-2”	009

Miscellaneous	Title	Revision
SEP-ANO-1-IST-1	ANO-1 Inservice Testing Bases Document	002
SEP-ANO-1-IST-2	ANO-1 Inservice Testing Plan	003

Condition Reports (CRs)

CR-ANO-1-2017-00164 CR-ANO-C-2016-05149 CR-ANO-1-2016-05022

CR-ANO-1-2016-05052

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Information Request
January 4, 2017
Notification of Inspection and Request for Information
Arkansas Nuclear One
NRC Inspection Report 05000313/2017001 and 05000368/2017001

INSPECTION DOCUMENT REQUEST

Inspection Dates: January 23, 2017 (Approximate Date)
Inspector: Eduardo Uribe

Documents Requested:

1. Response to NRC Bulletin 2012-01

2. Corrective action documents (in full detail) of the interim corrective actions

3. Corrective action documents (in summary) of the final corrective actions (for my awareness)

4. Any supporting documents for those interim corrective action (e.g. Ops Procedures, Maintenance Procedures, Work Orders and/or Updated Training Modules).

Detailed Risk Evaluation

Arkansas Nuclear One, Unit 1

Valve CV-1408 Failure to Fully Open

The exposure time was assumed to be best derived using the "t + repair time" method. The "t" period was assumed to be seven days as the Train B BWST outlet valve CV-1408 was successfully operated seven days earlier than the failure during a post-maintenance test. Maintenance personnel repaired the valve and it was returned to service within one day (repair time), so the analyst added that repair time to the "t" period to derive an eight day exposure time.

In the evaluation, the analyst assumed that Valve CV-1408 failed to open and that the same valve on the redundant train, valve CV-1407, was subject to increased potential for common cause failure. The analyst set the failure to open basic event for Valve CV-1408 to TRUE to model this condition.

During postulated events, the analyst considered that operators could diagnose that valve CV-1408 did not fully open and could have time to locally manually open (or recover) the valve such that the function of the train of emergency core cooling systems could be restored. To reflect this, the analyst modelled a human reliability analysis recovery event using SPAR-H methodology to fully open valve CV-1408. The recovery included operators diagnosing that the valve was only 30 percent opened and dispatching an operator to locally, manually open valve CV-1408.

For the diagnosis portion of the SPAR-H analysis, the analyst judged that stress and available time would have been performance drivers. Stress was assumed to be high because the consequences of failing at the task would represent a threat to plant safety. Available time was assumed to be barely adequate after apportioning the total time available between action and diagnosis, factoring in the time needed to locally, manually open valve CV-1408. Applying these performance shaping factor assumptions yielded a diagnosis failure probability of 2.0E-1.

For the action portion of the analysis, the analyst judged that stress, complexity, experience/training, and procedures would the performance drivers. Stress was assumed to be high because the consequences of failing at the task would represent a threat to plant safety. Complexity was assumed to be moderate because manually opening the valve was assumed somewhat difficult to perform. Experience/training was assumed to be low because the level of training did not provide adequate practice in opening this particular valve. Procedures were assumed to be incomplete because information to explicitly direct manually opening the valve is only implied and not contained in the procedure. Applying these performance shaping factor assumptions yielded an action failure probability of 2.4E-1. Combining this failure probability with the diagnosis failure probability yielded a total estimate for the failure probability of locally, manually opening the valve of 4.4E-1.

The analyst then applied this recovery basic event to the ANO SPAR model by changing the sub fault tree logic from failure of valve CV-1408 to open to requiring valve CV-1408 failing to open along with failure of the recovery basic event. The analyst used the Version 8.19 of the Arkansas Nuclear One, Unit 1, SPAR model, ran on SAPHIRE, Version 8.1.5, to estimate the increase in core damage frequency. After applying the assumptions and this model

modification, the analyst estimated that the increase in core damage frequency for valve CV-1408 failing to open was 7.3E-7/year from internal events.

Valve CV-1408 also has a function to be closed later in a postulated event. Using the Arkansas Nuclear One, Unit 1, SPAR model and setting the basic event for valve CV-1408 failing open over an 8 day exposure time, the analyst estimated the increase in core damage frequency to be 1.2E-9/year. The total increase in core damage frequency from internal events was tabulated by adding the increase in core damage frequency from failures to open and close and was estimated to be 7.3E-7/year.

The analyst reviewed the IPEEE and Arkansas Nuclear One, Unit 1, NFPA-805 documentation to determine if external events would be a significant contributor to the increase in core damage frequency. Seismic and high wind events were screened out due to their significantly lower initiating event frequencies relative to the loss of offsite power initiating event frequency in the internal events model. The analyst reviewed the internal event results and the licensee's fire model to choose risk significant fires. From this review, the analyst evaluated fires in switchgear A1, A2, A3, A4, and 2A9; startup transformers 1 and 2; and the main control board. These postulated fires occurring in the exposure time with the performance deficiency present represented an increase in core damage frequency of 1.2E-7/year. Combining internal and external event inputs yielded an estimate of the total increase in core damage frequency of 8.5E-7/year, or of very low safety significance (Green). Dominant core damage sequences were losses of switchgear A3, small loss of coolant accidents, and reactor coolant pump seal loss of coolant accidents which were mitigated by the redundant trains of reactor coolant injection and the main and emergency feedwater systems.

The analyst reviewed the dominant sequences and compared them to Manual Chapter 0609, Appendix H, "Containment Integrity Significance Determination Process." A review was conducted using the large early release screening criteria to determine that steam generator tube rupture sequences were the only potential significant contributor to large early release frequency. Since the increase in core damage frequency from steam generator tube rupture sequences for this finding was 2.8E-8/year (below 1.0E-7/year) the analyst screened the significance of the finding from large early release frequency to Green (very low safety significance).