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

May 11, 2016

EA-13-110
EA-15-140

Mr. William F. Maguire
Site Vice President
Entergy Operations, Inc.
River Bend Station
5485 U.S. Highway 61N
St. Francisville, LA 70775

SUBJECT: RIVER BEND STATION - NRC INTEGRATED INSPECTION REPORT 05000458/2016001 AND FINAL SIGNIFICANCE DETERMINATION OF GREEN FINDING; NRC INSPECTION REPORT 05000458/2016008

Dear Mr. Maguire:

On March 31, 2016, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at your River Bend Station, Unit 1. On April 14, 2016, the NRC inspectors discussed the results of this inspection with Mr. C. Rich, General Manager, Plant Operations, and other members of your staff. Inspectors documented the results of this inspection in the enclosed inspection report.

This letter also provides you the final significance determination of the preliminary Greater than Green finding identified in NRC Inspection Report 05000458/2015010 (ML16047A268), dated February 16, 2016. A detailed description of the finding is contained in Section 2.6.a of that report. The finding was associated with the failure to adequately assess the increase in risk of operating the control building chilled water system chillers in various single-failure vulnerable configurations.

At your request, a Regulatory Conference was held on April 4, 2016, to discuss your position on the preliminary Greater than Green finding and to present new information based on testing conducted by your staff. A copy of your presentation provided at the Regulatory Conference is attached to the summary of the Regulatory Conference (ML16119A342), dated April 27, 2016. In your presentation, you discussed information important to characterize the safety significance of the finding associated with the control building chilled water system. Specifically, you presented methodologies used by Entergy to determine realistic control room heat loads and develop an estimate of the control room heatup rate, taking into account control room habitability for operators and equipment design temperature limits.

After considering the information reviewed during our inspections and the information you provided at the Regulatory Conference, the NRC has concluded that the finding is appropriately characterized as Green, a finding of very low safety significance. See Section 4OA5 of this report for additional information.

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

If you contest the violation or significance of this NCV, 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, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; and the NRC resident inspector at the River Bend 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 IV; and the NRC resident inspector at the River Bend Station.

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 available electronically for public inspection in the NRC's Public

Document Room or from the Publicly Available Records (PARS) component of the NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Sincerely,

***/RA/***

Gregory G. Warnick, Chief
Project Branch C
Division of Reactor Projects

Docket No. 50-458
License No. NPF-47

Enclosure:
Inspection Report 05000458/2016001
w/ Attachments:
1. Supplemental Information
2. Request for Information for the Occupational Radiation Safety Inspection
3. Final Detailed Risk Evaluation

cc w/ encl: Electronic Distribution for
River Bend Station

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See next page

**ADAMS ACCESSION NUMBER: ML16132A144**

| ☒ SUNSI Review By: CHY | | ADAMS ☒ Yes ☐ No | ☒ Non-Sensitive ☐ Sensitive | | ☒ Publicly Available ☐ Non-Publicly Available | | Keyword: NRC-002 |
|---|---|---|---|---|---|---|---|
| OFFICE | SRI:DRP/C | ASRI:DRP/C | ARI:DRP/C | SPE:DRP/C | RI:DRP/A | C:DRS/PSB2 | C:DRS/EB1 |
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| SIGNATURE | /RA/ | /RA/ | /RA/ | /RA/ | /RA/ | /RA/ | /RA/ |
| DATE | 5/4/16 | 5/5/16 | 5/4/16 | 5/4/16 | 5/4/16 | 5/4/16 | 5/4/16 |
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Letter to William F. Maguire from Gregory G. Warnick, dated May 11, 2016

SUBJECT: RIVER BEND STATION - NRC INTEGRATED INSPECTION REPORT 05000458/2016001 AND FINAL SIGNIFICANCE DETERMINATION OF GREEN FINDING; NRC INSPECTION REPORT 05000458/2016008

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**U.S. NUCLEAR REGULATORY COMMISSION**

**REGION IV**

| | |
|---|---|
| Docket: | 05000458 |
| License: | NPF-47 |
| Report: | 05000458/2016001 |
| Licensee: | Entergy Operations, Inc. |
| Facility: | River Bend Station |
| Location: | 5485 U.S. Highway 61N<br>St. Francisville, LA 70775 |
| Dates: | January 1 through March 31, 2016 |
| Inspectors: | J. Sowa, Senior Resident Inspector<br>S. Makor, Acting Senior Resident Inspector<br>B. Parks, Acting Resident Inspector<br>L. Brandt, Project Engineer<br>J. Mateychick, Senior Reactor Inspector<br>J. O'Donnell, CHP, Health Physicist<br>M. Phalen, Senior Health Physicist<br>G. Guerra, CHP, Emergency Planning Inspector<br>D. Bradley, Resident Inspector, Columbia Generating Station<br>R. Deese, Senior Reactor Analyst |
| Approved By: | G. Warnick, Chief<br>Project Branch C<br>Division of Reactor Projects |

## SUMMARY

IR 05000458/2016001; 01/01/2016 – 03/31/2016; River Bend Station; Other Activities.

The inspection activities described in this report were performed between January 1 and March 31, 2016, by the resident inspectors at River Bend Station and inspectors from the NRC's Region IV office. One finding of very low safety significance (Green) is documented in this report. This finding involved a violation of NRC requirements. The significance of inspection findings is indicated by their color (Green, White, Yellow, or Red), which is determined using Inspection Manual Chapter 0609, "Significance Determination Process." Their cross-cutting aspects are determined using Inspection Manual Chapter 0310, "Aspects within the Cross-Cutting Areas." 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."

**Cornerstone: Mitigating Systems**

Green. The inspectors identified a non-cited violation of 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," paragraph (a)(4), for the licensee's failure to adequately assess the increase in risk that may result from proposed maintenance activities before performing maintenance activities. Specifically, prior to March 30, 2015, the risk assessment performed by the licensee for plant maintenance failed to account for certain safety significant structures, systems, and components that were concurrently out of service. On multiple occasions, the licensee failed to adequately assess the risk of operating the control building chilled water system (HVK) chillers in various single failure vulnerable configurations. As a result of this deficiency, the station reduced the reliability and availability of systems contained in the main control room and failed to account for the significant, uncompensated impairment of the safety functions of the associated systems. In response to the NRC's conclusions, the licensee initiated Condition Report CR-RBS-2016-00095. The licensee also completed engineering analyses to evaluate alternate cooling methods, including cross-connecting service water and the HVK chiller systems, in order to provide cooling to spaces housing electrical components and mitigate a loss of HVK event.

This performance deficiency is more than minor, and therefore a finding, because it is associated with the configuration control attribute of the Mitigating Systems Cornerstone, and adversely affected the associated cornerstone objective to ensure availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Specifically, the licensee's failure to account for a loss of all HVK cooling scenario, either quantitatively or qualitatively, resulted in uncompensated impairment to all systems associated within the main control room. A loss of cooling to the control room could lead to multiple systems exceeding their equipment qualification temperatures and impact control room habitability. The finding was evaluated using Inspection Manual Chapter (IMC) 0609, Appendix K, "Maintenance Risk Assessment and Risk Management Significance Determination Process." Using Inspection Manual Chapter 0609, Appendix K, the finding was determined to require additional NRC management review using risk insights where possible because the quantitative probabilistic risk assessment (PRA) tools are not well suited to analyze failures from control room heat-up events.

A Region IV senior reactor analyst performed a detailed risk evaluation. This evaluation yielded a maximum incremental core damage probability deficit of 3.2E-7. The analyst applied this result to Flowchart 1, "Assessment of Risk Deficit," of Appendix K. In applying Flowchart 1, the

analyst determined that because the maximum incremental core damage probability deficit was less than 1.0E-6, the finding was of very low safety significance (Green).

The team determined the most significant contributing cause of the licensee failing to adequately assess the increase in risk from proposed maintenance activities was inadequate procedural guidance in Procedure ADM-0096, “Risk Management Program Implementation and On-line Maintenance Risk Assessment,” Revision 316.  This finding has a resources cross-cutting aspect within the human performance area because leaders failed to ensure that personnel, equipment, procedures, and other resources are available and adequate to support nuclear safety [H.1].  (Section 4OA5.2)

## PLANT STATUS

River Bend Station began the inspection period at 100 percent reactor thermal power. It departed from full power as follows:

- On January 9, 2016, a reactor scram from 100 percent power occurred due to an electrical transient experienced during a severe thunderstorm. The station returned the unit to 100 percent power on February 7, 2016.

- On February 13, 2016, the station reduced power to 20 percent to change in-service steam jet air ejectors. The station returned the unit to 100 percent power on February 15, 2016.

- On February 17, 2016, the station conducted a shutdown in order to repair a crack in a joint between a drain line and the main condenser which impacted the ability to maintain condenser vacuum. The station returned the unit to 100 percent power on March 7, 2016.

Power remained at or near 100 percent for the remainder of the inspection period.

## REPORT DETAILS

### 1. REACTOR SAFETY

**Cornerstones: Initiating Events, Mitigating Systems, and Barrier Integrity**

### 1R01 Adverse Weather Protection (71111.01)

Readiness for Impending Adverse Weather Conditions

a. Inspection Scope

On January 21, 2016, the inspectors completed an inspection of the station's readiness for impending adverse weather conditions. The inspectors reviewed plant design features, the licensee's procedures to respond to tornadoes and high winds, and the licensee's planned implementation of these procedures. The inspectors evaluated operator staffing and accessibility of controls and indications for those systems required to control the plant.

These activities constitute one sample of readiness for impending adverse weather conditions, as defined in Inspection Procedure 71111.01.

b. Findings

No findings were identified.

**1R04 Equipment Alignment (71111.04)**

.1 Partial Walkdown

a. Inspection Scope

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

- March 10, 2016, Division I residual heat removal system
- March 11, 2016, Division I standby service water
- March 28, 2016, Division II 125 volt dc power system

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 constitute three partial system walkdown samples, as defined in Inspection Procedure 71111.04.

b. Findings

No findings were identified.

.2 Complete Walkdown

a. Inspection Scope

On March 10, 2016, the inspectors performed a complete system walkdown inspection of the standby liquid control system. The inspectors reviewed the licensee's procedures and system design information to determine the correct system lineup for the existing plant configuration. The inspectors also reviewed outstanding work orders, open condition reports, in-process design changes, temporary modifications, and other open items tracked by the licensee's operations and engineering departments. The inspectors then visually verified that the system was correctly aligned for the existing plant configuration.

These activities constitute one complete system walkdown sample, as defined in Inspection Procedure 71111.04.

b. Findings

No findings were identified.

**1R05 Fire Protection (71111.05)**

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 six plant areas important to safety:

- March 1, 2016, auxiliary building 141' elevation, fire area AB-15/Z-4
- March 1, 2016, auxiliary building 141' elevation, fire area AB-1/Z-4
- March 10, 2016, auxiliary building, residual heat removal pump room A, fire area AB-5
- March 11, 2016, containment building, standby liquid control system area, fire area RC-4/Z-4
- March 11, 2016, standby cooling tower pump room A, fire area PH-1/Z-1
- March 11, 2016, standby cooling tower pump room B, fire area PH-2/Z-1

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 constitute six quarterly inspection samples, as defined in Inspection Procedure 71111.05.

b. Findings

No findings were identified.

**1R06 Flood Protection Measures (71111.06)**

a. Inspection Scope

On March 13, 2016, the inspectors completed an inspection of the station's ability to mitigate flooding due to internal causes. After reviewing the licensee's flooding analysis, the inspectors chose one plant area containing risk-significant structures, systems, and components (SSCs) that was susceptible to flooding:

- Division I residual heat removal pump room AB-070-2

The inspectors reviewed plant design features and licensee procedures for coping with internal flooding. The inspectors walked down the selected areas to inspect the design features, including the material condition of seals, drains, and flood barriers. The

inspectors evaluated whether operator actions credited for flood mitigation could be successfully accomplished.

In addition, on March 15, 2016, the inspectors completed an inspection of underground bunkers susceptible to flooding. The inspectors selected two underground electrical manholes that contained risk-significant or multiple-train cables whose failure could disable risk-significant equipment:

- Electrical manhole 1EMH101
- Electrical manhole 1EMH613

The inspectors observed the material condition of the cables and splices contained in the electrical manholes and looked for evidence of cable degradation due to water intrusion. The inspectors verified that the cables and vaults met design requirements.

These activities constitute completion of one flood protection measures sample and one bunker/manhole sample, as defined in Inspection Procedure 71111.06.

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 March 10, 2016, the inspectors observed a portion of an annual requalification test for licensed operators. 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 constitute completion of one quarterly licensed operator requalification program sample, as defined in Inspection Procedure 71111.11.

b. Findings

No findings were identified.

.2 Review of Licensed Operator Performance

a. Inspection Scope

On January 30, 2016, 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 due to conducting a reactor startup following a forced outage.

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

These activities constitute completion of one quarterly licensed operator performance sample, as defined in Inspection Procedure 71111.11.

b. Findings

No findings were identified.

**1R12 Maintenance Effectiveness (71111.12)**

a. Inspection Scope

The inspectors reviewed two instances of degraded performance or condition of safety-related SSCs:

- March 23, 2016, standby switchgear air handling unit 2B, functional failure review
- March 30, 2016, reactor protection system, functional failure review

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 constitute completion of two maintenance effectiveness samples, 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 four 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 5, 2016, green risk condition while residual heat removal system A was out of service for maintenance concurrent with the low pressure core spray pump out of service

- February 3, 2016, green risk condition following a failed surveillance test on control room air conditioning fan HVC-ACU1A

- March 16, 2016, green risk condition while residual heat removal system B was out of service for maintenance concurrent with standby gas treatment B out of service

- March 21, 2016, yellow risk condition while the Division III diesel generator was out of service for maintenance

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 March 3, 2016, the inspectors observed portions of one emergent work activity, work on trip unit B-21ESN670E requiring disabling Division I alternate depressurization system (ADS) actuation logic that had the potential to affect the functional capability of mitigating systems.

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 constitute completion of five 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 four operability determinations that the licensee performed for degraded or nonconforming SSCs:

- January 6, 2016, operability determination of agastat relays that provide trip signals to the reactor feedwater pumps and turbine on a reactor vessel high level condition (CR-RBS-2015-09109)

- March 14, 2016, operability determination of high auxiliary building pressure indications (CR-RBS-2016-00065)

- March 22, 2016, operability determination of lowering scram valve current indications during diesel generator operations (CR-RBS-2016-00024)

- March 22, 2016, operability determination of battery room 1B fans and dampers (CR-RBS-2014-03221)

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.

The inspectors reviewed operator actions taken or planned to compensate for degraded or nonconforming conditions. The inspectors verified that the licensee effectively managed these operator workarounds to prevent adverse effects on the function of mitigating systems and to minimize their impact on the operators' ability to implement abnormal and emergency operating procedures.

These activities constitute completion of five operability and functionality review samples, which included one operator work-around sample, as defined in Inspection Procedure 71111.15.

b. Findings

No findings were identified.

## 1R18 Plant Modifications (71111.18)

a. Inspection Scope

The inspectors reviewed two permanent plant modifications that affected risk-significant SSCs:

- February 22, 2016, motor generator A voltage regulator modification
- February 22, 2016, motor generator B voltage regulator modification

The inspectors reviewed the design and implementation of the modifications. The inspectors verified that work activities involved in implementing the modifications did not adversely impact operator actions that may be required in response to an emergency or other unplanned event. The inspectors verified that post-modification testing was adequate to establish the functionality of the SSCs as modified.

These activities constitute completion of two samples of permanent 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 seven post-maintenance testing activities that affected risk-significant SSCs:

- January 25, 2016, work order (WO) 00436165, “Troubleshoot Div III Voltage Regulator,” following Reactor Protection System (RPS) motor generator (MG) modification

- January 28, 2016, WO 00435379, “Spurious E-40 Trip Code on Main Steam Tunnel High Ambient Temperature. Replace E31-N604D,” following high temperature indication in main steam tunnel

- January 30, 2016, WO 00436558, “C71-S003A Would Not Close When Placing MG Set In Service,” following RPS motor generator modification

- February 24, 2016, WO 00438672, “C51-JEN002D Troubleshoot Indication CR16-1612,” following replacement of intermediate range monitor D detector driven gear box and limit switch adjustments

- February 29, 2016, WO 00438973, “EJS-SWG2A ACB36 Remove the Close Signal Upon Breaker Closure,” following identified issues potentially affecting Masterpact circuit breakers

- March 1, 2016, WO 00438978, “EJS-SWG2B ACB65 Remove the Close Signal Upon Breaker Closure,” following identified issues potentially affecting Masterpact circuit breakers

- March 8, 2016, WO 00439318, “Replace Gear Box & Perform, Insert & Retract Test for IRM D,” following intermediate range monitor D rod block

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 constitute completion of seven 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

Following a reactor scram on January 9, 2016, the station placed shutdown cooling in service and cooled the plant down to Mode 4. The station’s forced outage concluded on January 26, 2016.

Following a loss of condenser vacuum on February 17, 2016, the station conducted a shutdown, placed shutdown cooling in service, and cooled the plant down to Mode 4 for repairs. The station’s forced outage concluded on March 4, 2016.

During the station's forced maintenance outages, the inspectors evaluated the licensee's outage activities. The inspectors verified that the licensee considered risk in developing and implementing the outage plan and developed mitigation strategies for losses of key safety functions. This verification included the following:

- Monitoring of shutdown and cooldown activities
- Verification that the licensee maintained defense-in-depth during outage activities
- Monitoring of heat-up and start-up activities
- Observation and review of fuel handling activities

These activities constitute completion of two outage activities samples, as defined in Inspection Procedure 71111.20.

b. Findings

In response to a loss of shutdown cooling that occurred on January 10, 2016, following an automatic reactor scram on January 9, 2016, a Special Inspection was performed by the NRC. Issues of concern associated with these activities were incorporated into the charter for the Special Inspection team that was onsite on February 8, 2016, and were dispositioned during the course of their inspection activities.

**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:

Reactor coolant system leak detection tests:

- January 27, 2016, STP-050-0702, "Refueling Outage Reactor Pressure Vessel Inservice Leakage Test"

Other surveillance tests:

- January 25, 2016, STP-309-0203, "Division III Diesel Generator Operability Test"

- January 30, 2016, STP-508-1700, "Division I C71-S003A & C Electrical Protection Assembly Channel Functional Test"

- February 2, 2016, STP-0514217, "Main Steam Line Isolation Channel Calibration Test and Logic System Functional Test," performed on January 29, 2016

- March 12, 2016, STP-256-6304, "Standby Service Water B Loop Quarterly Pump and Valve Operability Test"

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

These activities constitute 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)**

Training Evolution Observation

a. Inspection Scope

On March 17, 2016, 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 constitute completion of one training observation sample, as defined in Inspection Procedure 71114.06.

b. Findings

No findings were identified.

**2. RADIATION SAFETY**

**Cornerstones: Public Radiation Safety and Occupational Radiation Safety**

**2RS2 Occupational ALARA Planning and Controls (71124.02)**

a. Inspection Scope

The inspectors assessed licensee performance with respect to maintaining individual and collective radiation exposures as low as is reasonably achievable (ALARA). The inspectors performed this portion of the attachment as a post-outage review. During the inspection the inspectors interviewed licensee personnel, reviewed licensee documents, and evaluated licensee performance in the following areas:

- Radiological work planning, including work activities of exposure significance, and radiological work planning ALARA evaluations, initial and revised exposure estimates, and exposure mitigation requirements. The inspectors also verified that the licensee's planning identified appropriate dose reduction techniques, reviewed any inconsistencies between intended and actual work activity doses, and determined if post-job (work activity) reviews were conducted to identify lessons learned.

- Verification of dose estimates and exposure tracking systems including the basis for exposure estimates, and measures to track, trend, and if necessary reduce occupational doses for ongoing work activities. The inspectors evaluated the licensee's method for adjusting exposure estimates and reviewed the licensee's evaluations of inconsistent or incongruent results from the licensee's intended radiological outcomes.

- Problem identification and resolution for ALARA planning and controls. The inspectors reviewed audits, self-assessments, work-in-progress and post-job ALARA reviews, and corrective action program documents to verify problems were being identified and properly addressed for resolution.

These activities constitute completion of two of the five required samples of occupational ALARA planning and controls, as defined in Inspection Procedure 71124.02.

**2RS4 Occupational Dose Assessment (71124.04)**

a. Inspection Scope

The inspectors evaluated the accuracy and operability of the licensee's personnel monitoring equipment, verified the accuracy and effectiveness of the licensee's methods for determining total effective dose equivalent, and verified that the licensee was appropriately monitoring occupational dose. The inspectors interviewed licensee personnel, walked down various portions of the plant, and reviewed licensee performance in the following areas:

- External dosimetry accreditation, storage, issue, use, and processing of active and passive dosimeters

- The technical competency and adequacy of the licensee's internal dosimetry program

- Adequacy of the dosimetry program for special dosimetry situations such as declared pregnant workers, multiple dosimetry placement, and neutron dose assessment

- Audits, self-assessments, and corrective action documents related to dose assessment since the last inspection

These activities constitute completion of five samples of occupational dose assessment, as defined in Inspection Procedure 71124.04.

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 for the period of January 1, 2015, through December 31, 2015, to determine the number of scrams that occurred. The inspectors compared the number of scrams reported in these licensee event reports to the number reported for the performance indicator. Additionally, the inspectors sampled monthly operating logs to verify the number of critical hours during the period. 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 constitute verification of the unplanned scrams per 7000 critical hours performance indicator, 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, 2015, through December 31, 2015, 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. Additionally, the inspectors sampled monthly operating logs to verify the number of critical hours during the period. 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 constitute verification of the unplanned power changes per 7000 critical hours performance indicator, 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 from January 1, 2015, through December 31, 2015. 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 constitute verification of the unplanned scrams with complications performance indicator, 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 these 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 Annual Follow-up of Selected Issues

a. Inspection Scope

The inspectors selected one issue for in-depth follow-up:

- On January 9, 2016, a lightning induced voltage transient resulted in a phase to phase fault on the line from Big Cajun to Fancy Point Switchyard and caused a reactor scram. As a result of this scram, the inspectors performed an in-depth assessment of the station's switchyard and sensitive equipment controls in order to assess the fault mechanism and evaluate the response of the reactor protection system. Specifically, 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. The inspectors discussed with licensee personnel and reviewed established administrative controls, methods for reviewing and scheduling activities, and responsibilities for maintenance and operation of the switchyard and transformer yard.

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

b. Findings

No findings were identified.

**4OA3 Follow-up of Events and Notices of Enforcement Discretion (71153)**

(Closed) Licensee Event Report (LER) 05000458/2015-004-00: Potential Loss of Safety Function of Onsite AC/DC Distribution Systems Due to Postulated Main Control Building Heat-up Following Loss of Ventilation Cooling System

This LER describes the discovery of design basis calculation errors associated with the heat-up of certain building areas following the postulated failure of the heating, ventilation, and cooling (HVAC) system. The error failed to account for the additional heat load generated by upgraded AC/DC inverters installed in 2009. These calculation errors were reviewed during a special inspection that examined impacts on control room habitability and equipment functionality following a postulated loss of control building cooling. The results of this inspection are contained in NRC Inspection Report 05000458/2015010 (ADAMS ML16047A268). LER 05000458/2015-004-00 is closed.

These activities constitute completion of one event follow-up sample, as defined in Inspection Procedure 71153.

**4OA5 Other Activities**

.1 VIO 05000458/2013007-01, Failure to Resolve Noncompliances Associated with Multiple Spurious Operations in a Timely Manner (EA-13-110) (Closed)

During an NRC inspection completed on December 30, 2013, the team identified a Green violation of License Condition 2.C.(10) for the failure to implement and maintain in effect all provisions of the approved fire protection program associated with multiple spurious operations concerns. Specifically, the licensee failed to implement all of the required corrective actions for multiple spurious operations concerns prior to November 2, 2012, which marked the expiration of enforcement discretion for multiple spurious operations contained in Enforcement Guidance Memorandum 09-002. Three scenarios were identified that negatively impacted the credited safe shutdown pumps, which take suction from the suppression pool and thereby reduced the volume of water available for safe shutdown.

The licensee performed Calculation G13.18.12.2-143, "MSO [Multiple Spurious Operations] Scenario LPCI-A-4: Estimating Upper Pool Volume and Evaluating ECCS Pumps for Adequate NPSH," Revision 0, which confirmed that this multiple spurious operations scenario would not adversely impact the plant's ability to achieve post-fire safe shutdown. The licensee performed Calculation G13.18.12.2-142, "MSO Scenario

RCIC-2: Estimating Percent of Suction Flow From CST Versus Suppression Pool," Revision 0, which confirmed that this multiple spurious operations scenario would not adversely impact the plant's ability to achieve post-fire safe shutdown. The licensee evaluated the multiple spurious operations scenario involving spurious operation of a residual heat removal pump without a minimum flow discharge path. The licensee took actions to establish the time available for operators to identify and respond to the spurious operation before increased pump seal leakage would be a concern; confirmed the fire areas in the plant where the scenario was possible; and incorporated appropriate guidance for the control room operators in Procedure AOP-0052, "Fire Outside The Main Control Room In Areas Containing Safety Related Equipment," Revision 25. The inspector's review confirmed that the licensee's actions were appropriate and complete. Therefore, this violation is closed.

.2 Failure to Adequately Assess Risk During Chiller Unavailability

a. Inspection Scope

This finding was documented in NRC Inspection Report 05000458/2015010 (AV 05000458/2015010-02, Section 2.6.a) as an apparent violation with potential Greater than Green significance (EA-15-140). The Special Inspection Team (team) reviewed the licensee's corrective action documents, design calculations, and external engineering audit results. Additionally, the team reviewed control room heat load test results, performed in November 2015 and February 2016, by the licensee to demonstrate realistic heat loads. The team also reviewed the licensee's procedures, testing methodology, sensitivity analysis, and conclusions to better inform the risk evaluation of a control room heat-up scenario, such as during a loss of all control building chilled water system (HVK) chillers event.

b. Findings

Introduction. The inspectors identified a Green, non-cited violation of 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," paragraph (a)(4), for the licensee's failure to adequately assess the increase in risk that may result from proposed maintenance activities before performing maintenance activities. Specifically, prior to March 30, 2015, the risk assessment performed by the licensee for plant maintenance failed to account for certain safety significant structures, systems, and components that were concurrently out of service. On multiple occasions, the licensee failed to adequately assess the risk of operating the control building chilled water system (HVK) chillers in various single failure vulnerable configurations. As a result of this deficiency, the station reduced the reliability and availability of systems contained in the main control room and failed to account for the significant, uncompensated impairment of the safety functions of the associated systems.

Description. The team reviewed the operational history of the HVK system and the licensee's actions related to implementation of technical specifications for various HVK system configurations. This chilled water system supplies water during normal, shutdown, and design basis accident (DBA) conditions to the cooling coils in the main control room air conditioning units, standby switchgear rooms' air conditioning units, and chiller equipment rooms' air conditioning units. Chilled water is supplied by two independent trains, either one of which is capable of meeting the total chilled water

demand. Each train contains two 100-percent capacity electric motor-driven, centrifugal liquid chillers (HVK chillers), two 100-percent capacity chilled water recirculation pumps, two 100-percent capacity condenser cooling water pumps, and one chilled water compression tank. The service water systems provide the chiller condenser cooling water. Any one running HVK chiller is sufficient to meet 100 percent of the total chilled water demand. The division I HVK chillers are labeled 1A and 1C. The division II HVK chillers are labeled 1B and 1D. The station typically operates with only one chiller running and the other three in a standby status.

The team noted that when an entire division of HVK chillers is out of service, such as chillers 1A and 1C for division I, the licensee would only enter the Technical Specification (TS) 3.7.3, “Control Room Air Conditioning (AC) System,” action statement for the condition of one control room AC subsystem being inoperable (condition A). The licensee did not enter TS action statements associated with inoperability of other components cooled by HVK chillers, such as the AC switchgear, DC switchgear, and vital inverters. An unresolved item, URI 05000458/2015010-01, “Technical Specification Allowed Outage Time During Loss of Non-Technical Specification Supported Systems,” was opened to resolve TS questions associated with the HVK system. Further discussion of the URI is included in Section 2.2.b of NRC inspection report 05000458/2015010.

The team then reviewed the licensee’s practices for assessing and managing risk, when removing HVK chillers from service, per 10 CFR 50.65(a)(4) and as described in the bases for TS 3.0.6. The River Bend Station utilizes a quantitative, level-1 probabilistic safety analysis (PSA) computer model named, “Equipment Out of Service Monitor (EOOS).” Licensee procedure ADM-0096, “Risk Management Program Implementation and On-line Maintenance Risk Assessment,” Revision 316, implements the requirements of 10 CFR 50.65(a)(4) and provides guidance on how and when to perform risk assessments using quantitative and qualitative tools.

Section 5.3 of procedure ADM-0096, “Risk Assessment Overview,” states the following regarding use of the EOOS computer model:

> *The Risk Assessment Program is a “Risk-Informed Program”, not a “Risk Tool Based Program.” This means that the quantitative results provided by the EOOS software must be blended with the qualitative guidance, in order to provide a complete risk picture of the situation. Decisions should never be made based on the EOOS quantitative results alone…Qualitative factors (such as industry operating experience, personnel judgment, etc.) must also be used for fully assessing the effects of equipment out of service on plant risk.*

The team noted that HVK chillers were modeled in EOOS and that the licensee would, using the computer program, disable the affected HVK chillers for a given maintenance period to yield a quantitative risk value.

The team then assessed the application of procedure ADM-0096 to specific work periods where multiple HVK chillers were removed from service simultaneously. For example, starting on December 15, 2014, the licensee removed HVK chillers 1A, 1B, and 1D from service for 41.5 hours. During this work window, only the 1C chiller was available to provide cooling for both divisions of control room air conditioning, both divisions of AC switchgear, both divisions of DC switchgear, and both divisions of vital

inverters. The licensee had assessed risk as 7.9 (Yellow) which included the quantitative tool (EOOS) and some qualitative factors for fire scenarios.

The team discovered that EOOS, however, did not model a control room heat-up scenario, such as during a loss of all HVK chillers event. The subsequent effects of failures of numerous control room components across multiple safety systems were, therefore, also not modeled due to the complexity of the event. The team reviewed procedure ADM-0096 for guidance on limitations of the PRA model and noted section 5.2.3 stated the following:

> *When the quantitative assessment tool is not available or the assessment scope is outside the scope of the EOOS risk monitor, qualitative assessments shall be performed.*

The team also reviewed NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," Revision 4A. Section 11.3.7.1 of NUMARC 93-01 discusses establishing action thresholds based on qualitative considerations.

> *…This [qualitative] approach typically involves consideration of the following factors from the assessment:*
> - *Duration of out-of-service condition, with longer duration resulting in increased exposure time to initiating events…*
> - *The number of remaining success paths (redundant systems, trains, operator actions, recovery actions) available to mitigate the initiating events…*
>
> *The above factors can be used as the basis for establishment of a matrix or list of configurations and attendant risk management actions.*

The team determined that the licensee did not consider the listed factors for qualitative assessments for a loss of control room cooling event. Specifically, the licensee did not establish a more limiting duration for placing control building chilled water system chillers in single-failure vulnerable configurations and, instead, relied upon the associated TS allowed outage time of 30 days. Further, the licensee did not consider the remaining success path, cross-connecting the HVK chillers with service water, and apply, as an example, just-in-time training or daily control room briefings on the procedure during single-failure vulnerable configurations with the potential to lose control room air conditioning.

The team noted that procedure ADM-0096 does not provide further guidance on how to qualitatively assess risk of a loss of all HVK cooling. Interestingly, attachment 7 of procedure ADM-0096 describes how to qualitatively assess and manage risk for removing non-TS auxiliary building cooling (HVR) due to EOOS limitations:

> *Auxiliary Building unit coolers HVR-UC11A(B) are non-Technical Specification equipment that provide cooling for safety-related equipment in the AB141 and AB170 locations. Each of these unit coolers are capable of providing the required cooling for both safety-related divisions. These unit coolers do not impact quantitative risk as determined using the EOOS risk monitor. To qualitatively address risk if HVR-UC11A(B) are unavailable, the following actions should be taken if one of HVR-UC11A(B) will be out of service…[bulleted list of 13 actions].*

Ultimately, the team determined that the licensee failed to adequately assess the risk of operating the control building chilled water system chillers in various single-failure vulnerable configurations. As a result of this deficiency, the station reduced the reliability and availability of systems contained in the main control room and failed to account for the significant, uncompensated impairment of the safety functions of the associated systems.

The licensee, in the example starting December 15, 2014, did not perform a qualitative risk assessment for a complete loss of control room cooling due to the inadequate procedural guidance in procedure ADM-0096. With an inadequate risk assessment of HVK system maintenance, the licensee did not appropriately determine the duration of the maintenance activity as described in the bases for TS 3.0.6.

To understand the exposure time for inadequate risk assessments, the team reviewed maintenance and TS data from control room logs. The team determined that the licensee operated in single-failure vulnerable configurations for the HVK system for 591 hours over a 12 month period or approximately 6.7 percent of a year.

In response to the NRC's conclusions, the licensee initiated Condition Report CR-RBS-2016-00095. The licensee also contracted for an engineering analysis to credit alternate cooling methods, including cross-connecting service water and the HVK chiller systems, in order to cool vital electrical components and mitigate a loss of HVK event.

Analysis. The team determined that the licensee's failure to adequately assess the risk of operating the control building chilled water system chillers in various single-failure vulnerable configurations was a performance deficiency. This performance deficiency is more than minor, and therefore a finding, because it is associated with the configuration control attribute of the Mitigating Systems Cornerstone, and adversely affected the associated cornerstone objective to ensure availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. As a result of this deficiency, the station reduced the reliability and availability of systems cooled by control building chilled water system chillers by not determining an appropriate duration of maintenance activities.

The team noted that, from section 7 of IMC 0612 Appendix E, "Examples of Minor Issues," that discusses the Maintenance Rule, the performance deficiency is more than minor since the risk assessment failed to account for (at least qualitatively) the loss or significant, uncompensated impairment of a key operating or shutdown safety function. Specifically, the licensee's failure to account for a loss of all HVK cooling scenario, either quantitatively due to EOOS model limitations or qualitatively due to procedure inadequacies, represents a significant impairment to all systems associated with the main control room. A loss of cooling to the control room could lead to multiple systems exceeding their equipment qualification temperatures and lead to subsequent failures. A loss of cooling to the control room could also impact control room habitability. The team also reviewed NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," Revision 4A. Section 11.3.7.1 of NUMARC 93-01 discusses establishing action thresholds based on qualitative considerations.

> *…This [qualitative] approach typically involves consideration of the following factors from the assessment:*

- *Duration of out-of-service condition, with longer duration resulting in increased exposure time to initiating events…*
- *The number of remaining success paths (redundant systems, trains, operator actions, recovery actions) available to mitigate the initiating events…*

*The above factors can be used as the basis for establishment of a matrix or list of configurations and attendant risk management actions.*

The team determined that the licensee did not consider the listed factors for qualitative assessments for a loss of control room cooling event. This conclusion further supports the IMC 0612 Appendix E examples of more than minor performance deficiencies associated with the Maintenance Rule.

The finding was evaluated using Inspection Manual Chapter (IMC) 0609, Appendix K, "Maintenance Risk Assessment and Risk Management Significance Determination Process." Using Inspection Manual Chapter 0609, Appendix K, the finding required additional internal NRC management review using risk insights where possible because the quantitative probabilistic risk assessment (PRA) tools were not well suited to analyze failures from control room heat-up events. Thus, the analyst evaluated the safety significance posed by the heat-up of components cooled by control building chilled water (HVK) chillers using Appendix K, Flowchart 1, "Assessment of Risk Deficit," to the extent practical, with additional risk insights by internal NRC management review in accordance with Inspection Manual Chapter 0612, "Power Reactor Inspection Reports." In accordance with Step 4.1.2 of Appendix K, the analyst performed a detailed risk evaluation for the Greater than Green Flowchart 1 result. The detailed risk evaluation resulted in a preliminary determination of White (low to moderate safety significance).

After considering information presented at the Regulatory Conference conducted April 4, 2016, a Region IV senior reactor analyst performed a final detailed risk evaluation. See Attachment 3 of this report, "Final Detailed Risk Evaluation," for further information. This evaluation yielded a maximum incremental core damage probability deficit of 3.2E-7. The analyst applied this result to Flowchart 1, "Assessment of Risk Deficit," of Appendix K, "Maintenance Risk Assessment and Risk Management Significance Determination Process," of Manual Chapter 0609. In applying Flowchart 1, the analyst determined that because the maximum incremental core damage probability deficit was less than 1.0E-6, the finding was of very low safety significance (Green).

The team determined the most significant contributing cause of the licensee failing to adequately assess the increase in risk from proposed maintenance activities involved inadequate procedural guidance in procedure ADM-0096. This finding has a resources cross-cutting aspect within the human performance area because leaders failed to ensure that personnel, equipment, procedures, and other resources are available and adequate to support nuclear safety [H.1].

<u>Enforcement</u>. 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," paragraph (a)(4), requires, in part, that before performing maintenance activities (including but not limited to surveillance, post-maintenance testing, and corrective and preventive maintenance) the licensee shall assess and manage the increase in risk that may result from the proposed maintenance activities. Contrary to the above, prior to March 30, 2015, before performing maintenance activities, the licensee failed to adequately assess the increase in risk that

may result from proposed maintenance activities. Specifically, the risk assessment performed by the licensee for plant maintenance failed to account for certain safety significant structures, systems, and components that were concurrently out of service. On multiple occasions, the licensee failed to adequately assess the risk of operating the control building chilled water system chillers in various single-failure vulnerable configurations. As a result of this deficiency, the station reduced the reliability and availability of systems contained in the main control room and failed to account for the significant, uncompensated impairment of the safety functions of the associated systems. In response to the NRC's conclusions, the licensee initiated Condition Report CR-RBS-2016-00095. The licensee also contracted for an engineering analysis to credit alternate cooling methods, including cross-connecting service water and the HVK chiller systems, in order to cool vital electrical components and mitigate a loss of a HVK event. Because this finding was of very low safety significance and has been entered into the licensee's corrective action program, this violation is being treated as a non-cited violation consistent with Section 2.3.2.a. of the NRC Enforcement Policy: NCV 05000458/2015010-02, "Failure to Adequately Assess Risk During Chiller Unavailability."

**4OA6 Meetings, Including Exit**

Exit Meeting Summary

On January 15, 2016, the inspector presented the results associated with the closure of Violation 0500458/2013007-01 via phone to Mr. J. Clark, Manager, Regulatory Assurance. The licensee acknowledged the issues presented.

On January 21, 2016, the inspectors presented the radiation safety inspection results to Mr. D. Burnett, Acting Director, Regulatory and Performance Improvement and Mr. S. Vazquez, Director, Engineering, and other members of the licensee staff. On April 27, 2016, the inspector presented the inspection results to Mr. J. Clark, Manager, Regulatory Assurance, 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 April 14, 2016, the inspectors presented the inspection results to Mr. C. Rich, General Manager, Plant Operations, 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 2, 2016, the Special Inspection Team conducted a telephonic exit to present the final significance determination results for AV 05000458/2015010-02, "Failure to Adequately Assess Risk During Chiller Unavailability," to Mr. W. Maguire, 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.

## SUPPLEMENTAL INFORMATION

### KEY POINTS OF CONTACT

Licensee Personnel

D. Burnett, Director, Emergency Planning, Entergy South
M. Chase, Director, Regulatory & Performance Improvement
J. Clark, Manager, Regulatory Assurance
B. Cole, Senior Manager, Fleet Radiation Protection
R. Conner, Manager, Nuclear Oversight
R. Cook, Manager, Security
K. Crissman, Senior Manager, Maintenance
L. Dautel, Supervisor, ALARA, Radiation Protection
D. Fletcher, Manager, Supply Chain
B. Ford, Senior Manager, Fleet Regulatory Assurance
T. Gates, Manager, Operations Support
J. Henderson, Manager, Systems & Components Engineering
B. Hite, Supervisor, Radiation Protection
K. Huffstatler, Senior Licensing Specialist, Regulatory Assurance
R. Leasure, Superintendent, Radiation Protection
P. Lucky, Manager, Performance Improvement
W. Maguire, Site Vice President
L. Meyer, Health Physics and Chemistry Specialist, Radiation Protection
C. Miller, Manager, Site Projects and Maintenance Services
J. Morgan, Senior HP/Chemistry Specialist, Chemistry
P. O'Conner, Manager, Training
S. Peterkin, Manager, Radiation Protection
J. Reynolds, Senior Manager, Operations
C. Rich, General Manager, Plant Operations
D. Sandlin, Manager, Design & Program Engineering
T. Schenk, Manager, Emergency Preparedness
S. Vazquez, Director, Engineering
T. Venable, Assistant Manager, Operations
J. Vukovics, Supervisor, Reactor Engineering
J. Wieging, Senior Manager, Production
J. Wilson, Manager, Chemistry

## LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Closed

| | | |
|---|---|---|
| 05000458/2015-004-00 | LER | Potential Loss of Safety Function of Onsite AC/DC Distribution Systems Due to Postulated Main Control Building Heat-up Following Loss of Ventilation Cooling System (Section 4OA3) |
| 05000458/2013007-01 | VIO | Failure to Resolve Noncompliances Associated with Multiple Spurious Operations in a Timely Manner (Section 4OA5.1) |
| 05000458/2015010-02 | NCV | Failure to Adequately Assess Risk During Chiller Unavailability (Section 4OA5.2) |

## LIST OF DOCUMENTS REVIEWED

### Section 1R01: Adverse Weather Protection

Condition Reports (CRs)

CR-RBS-2015-00703 CR-RBS-2015-07264

Procedures

| Number | Title | Revision |
|---|---|---|
| AOP-0029 | Severe Weather Operation | 37 |
| OSP-0002 | Shift Relief and Turnover | 47 |

### Section 1R04: Equipment Alignment

Calculation

| Number | Title | Revision |
|---|---|---|
| G13.18.5.0-008 | Determination of the Maximum SLC Test Tank Boron Concentration to Allow Draining to Suppression Pool | 0 |

Condition Reports (CRs)

| | | | |
|---|---|---|---|
| CR-RBS-2015-02189 | CR-RBS-2015-02283 | CR-RBS-2015-03611 | CR-RBS-2015-03701 |
| CR-RBS-2015-03762 | CR-RBS-2015-03763 | CR-RBS-2015-04279 | CR-RBS-2015-05810 |
| CR-RBS-2015-06267 | CR-RBS-2015-06368 | CR-RBS-2015-06369 | CR-RBS-2015-06370 |
| CR-RBS-2015-06371 | CR-RBS-2015-06913 | CR-RBS-2015-08519 | CR-RBS-2016-02146 |

Drawings

| Number | Title | Revision |
|---|---|---|
| PID-27-07A | System 204 Residual Heat Removal – LPCI | 38 |
| PID-27-07B | System 204 Residual Heat Removal – LPCI | 42 |
| PID-27-07C | System 204 Residual Heat Removal – LPCI | 28 |
| PID-27-16A | System 201 Standby Liquid Control System | 14 |

Procedures

| Number | Title | Revision |
|---|---|---|
| SOP-0028 | Standby Liquid Control (SYS #201) | 017 |
| SOP-0031 | Residual Heat Removal (SYS #204) | 329 |
| SOP-0042 | Standby Service Water System (SYS #256) | 041 |
| SOP-0049 | 125 Vdc System (SYS #305) | 035 |

Training Documents

| Number | Title | Revision/Date |
|---|---|---|
| R-STM-0201 | Standby Liquid Control | 8 |
| R-STM-0204.012 | Residual Heat Removal System (RHR) | December 9, 2014 |

**Section 1R05: Fire Protection**

Condition Reports (CRs)

CR-RBS-2015-01469 CR-RBS-2015-02110 CR-RBS-2015-02816

Procedures

| Number | Title | Revision |
|---|---|---|
| AB-070-502 | RHR Pump A Room Fire Area AB-5 | 4 |
| AB-141-529 | Pre-Fire Plan Mezzanine Area East Fire Area AB-1/Z-4 | 4 |
| AB-141-533 | Pre-Fire Plan Mezzanine Area East Fire Area AB-15/Z-4 | 4 |
| RB-141-008 | SLC Area Fire Area RC-4/Z-4 | 3 |
| SP-118-450 | Standby Cooling Tower Pump A Room Fire Area PH-1/Z-1 | 3 |

Procedures

| Number | Title | Revision |
|---|---|---|
| SP-118-451 | Standby Cooling Tower Pump B Room Fire Area PH-2/Z-1 | 3 |

**Section 1R06: Flood Protection Measures**

Calculations

| Number | Title | Revision |
|---|---|---|
| PN-317 | Max Flood Elevations for Moderate Energy Line Cracks in Cat I Structures | 1 |
| PN-317 | Max Flood Elevations for Moderate Energy Line Cracks in Cat I Structures | Addendum 02 |

Condition Reports (CRs)

| | | | |
|---|---|---|---|
| CR-RBS-1999-00993 | CR-RBS-2011-02984 | CR-RBS-2011-03156 | CR-RBS-2011-03272 |
| CR-RBS-2015-08941 | CR-RBS-2016-02065 | CR-RBS-2016-02192 | CR-RBS-2016-02193 |

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

Condition Reports (CRs)

CR-RBS-2016-01013 CR-RBS-2016-01031

**Section 1R12: Maintenance Effectiveness**

Condition Reports (CRs)

| | | | |
|---|---|---|---|
| CR-RBS-2015-01830 | CR-RBS-2015-02732 | CR-RBS-2015-04153 | CR-RBS-2015-05511 |
| CR-RBS-2015-08218 | CR-RBS-2015-08463 | CR-RBS-2016-00210 | CR-RBS-2016-02585 |

Procedures

| Number | Title | Revision |
|---|---|---|
| EN-DC-203 | Maintenance Rule Program | 3 |
| EN-DC-204 | Maintenance Rule Scope and Basis | 3 |
| EN-DC-205 | Maintenance Rule Monitoring | 5 |
| EN-DC-206 | Maintenance Rule (A)(1) Process | 3 |
| EN-DC-345 | Critical Component Failure Determination | 3 |

Work Order (WO)

WO 00411304

Other Document

| Title | Date |
|---|---|
| System Health Report – RBS Unit 1 402 and 410 – HVAC – Control Building and Chilled Water | Q4-2015 |

**Section 1R13: Maintenance Risk Assessments and Emergent Work Control**

Condition Reports (CRs)

CR-RBS-2016-01152 CR-RBS-2016-01157 CR-RBS-2016-01224

Procedures

| Number | Title | Revision |
|---|---|---|
| ADM-0096 | Risk Management Program Implementation and On-Line Maintenance Risk Assessment | 317 |
| EN-WM-104 | On Line Risk Assessment | 12 |
| STP-402-4203 | HVC-ACU1A (Division I) Performance Monitoring | 0 |
| STP-402-4204 | HVC-ACU1B (Division II) Performance Monitoring | 0 |

**Section 1R15: Operability Determinations and Functionality Assessments**

Condition Reports (CRs)

CR-RBS-2014-03221 CR-RBS-2015-09082 CR-RBS-2015-09109 CR-RBS-2016-00024
CR-RBS-2016-00065 CR-RBS-2016-00086 CR-RBS-2016-02204 CR-RBS-2016-02207
CR-RBS-2016-02447

Drawings

| Number | Title | Revision |
|---|---|---|
| PID-00-02A | Engineering P&I Diagram Drawing Symbols & General Notes | 4 |
| PID-22-09C | Engineering P&I Diagram System 402 HVAC-Control Building | 10 |

Procedures

| Number | Title | Revision |
|---|---|---|
| EN-DC-153 | Preventive Maintenance Component Classification | 12 |
| EN-FAP-OM-012 | Prompt Investigation, Notifications and Duty Manager Responsibilities | 9 |
| EN-FAP-OP-006 | Operator Aggregate Impact Index Performance Indicator | 2 |
| EN-OP-104 | Operability Determination Process | 10 |
| EN-OP-115 | Conduct of Operations | 16 |
| EN-OP-117 | Operations Assessment Resources | 9 |
| EOP-0003 | Emergency Operating Procedure – Secondary Containment and Radioactive Release Control | 017 |
| SOP-0065 | HVAC – Auxiliary Building (SYS #409) | 016 |
| STP-000-0001 | Daily Operating Logs | 079 |

Other Document

| Number | Title | Revision |
|---|---|---|
| SDC-402/410 | System Design Criteria – Control Building HVAC System | 3 |

**Section 1R18: Plant Modifications**

Condition Reports (CRs)

| | | | |
|---|---|---|---|
| CR-RBS-2012-00949 | CR-RBS-2014-06233 | CR-RBS-2014-06336 | CR-RBS-2015-08463 |

Drawings

| Number | Title | Revision |
|---|---|---|
| GE-944E981 | Elementary Diagram RPS MG Set Control System | 11 |
| GE-828E531AA | Elementary Diagram Reactor Protection System | 25 & 32 |

Procedures

| Number | Title | Revision |
|---|---|---|
| SDC-508 | Reactor Protection System Design Criteria | 2 |
| SOP-0079 | Reactor Protection System | 33 |

Work Orders (Wos)

| | |
|---|---|
| WO 00428094 | WO 00432594 |

Other Documents

| Number | Title | Revision |
|---|---|---|
| 60371 | Temporary Installation of Power-Tronics Voltage Regulator Components XR500D, SE350, and AFM500X in C71-S001A PS Motor Generator Logic Circuit | --- |
| 61901 | Temporary Installation of Power-Tronics Voltage Regulator Components XR500D, SE350, and AFM500X in C71-S001B PS Motor Generator Logic Circuit | --- |

**Section 1R19: Post-Maintenance Testing**

Condition Reports (CRs)

| | | | |
|---|---|---|---|
| CR-RBS-2011-08981 | CR-RBS-2014-01417 | CR-RBS-2014-02575 | CR-RBS-2014-04655 |
| CR-RBS-2014-05577 | CR-RBS-2015-00830 | CR-RBS-2016-00584 | CR-RBS-2016-00749 |
| CR-RBS-2016-00770 | CR-RBS-2016-00774 | CR-RBS-2016-00792 | CR-RBS-2016-00851 |
| CR-RBS-2016-00890 | CR-RBS-2016-00896 | CR-RBS-2016-00900 | CR-RBS-2016-01002 |
| CR-RBS-2016-01013 | CR-RBS-2016-01014 | CR-RBS-2016-01045 | CR-RBS-2016-01053 |
| CR-RBS-2016-01054 | CR-RBS-2016-01139 | CR-RBS-2016-01834 | CR-RBS-2016-01835 |
| CR-RBS-2016-01877 | CR-RBS-2016-01612 | CR-RBS-2016-01829 | |

Procedures

| Number | Title | Revision |
|---|---|---|
| EN-MA-118 | Foreign Material Exclusion | 10 |
| MCP-1134 | Functional Testing of Auxiliary Relays | 23 |
| STP-207-4204 | NSSS Isolation – Main Steam Tunnel Temperature High Channel Calibration and LSFT (E31-N604D) | 304 |
| STP-309-0203 | Division III Diesel Generator Operability Test | 323 |
| STP-508-1700 | Division I C71-S003A & C Electrical Protection Assembly Channel Functional Test | 20 |

Work Orders (Wos)

| | | | |
|---|---|---|---|
| WO 00415323 | WO 00436165 | WO 00436356 | WO 00436558 |
| WO 00438672 | WO 00438966 | WO 00438973 | WO 00438978 |
| WO 00439318 | WO 52669026 | | |

**Section 1R20: Refueling and Other Outage Activities**

Condition Reports (CRs)

| | | | |
|---|---|---|---|
| CR-RBS-2015-03361 | CR-RBS-2016-00180 | CR-RBS-2016-00187 | CR-RBS-2016-00192 |
| CR-RBS-2016-00202 | CR-RBS-2016-00202 | CR-RBS-2016-00210 | CR-RBS-2016-01167 |
| CR-RBS-2016-01249 | CR-RBS-2016-01387 | CR-RBS-2016-01475 | |

Drawings

| Number | Title | Revision |
|---|---|---|
| G7187S02 | Fancy Point 500/230kV Substation | 29 |
| EE-001AC | Start Up Electrical Distribution Chart | 54 |

Procedures

| Number | Title | Revision |
|---|---|---|
| AOP-0003 | Automatic Isolations | 34 |
| AOP-0010 | Loss of One RPS Bus | 21 |
| EN-FAP-OM-021 | Critical Decision Procedure | 2 |
| EN-OP-115 | Conduct of Operations | 16 |
| EN-WM-104 | On Line Risk Assessment | 12 |
| GOP-0001 | Plant Startup | 86 |
| GOP-0003 | SCRAM Recovery | 26 |
| R-STM-0508 | Reactor Protection System | 6 |

Work Orders (Wos)

| | | | |
|---|---|---|---|
| WO 00392188 | WO 00392763 | WO 00432594 | WO 04289094 |

**Section 1R22: Surveillance Testing**

Condition Reports (CRs)

| | | | |
|---|---|---|---|
| CR-RBS-2011-08981 | CR-RBS-2014-01417 | CR-RBS-2014-02575 | CR-RBS-2014-04655 |
| CR-RBS-2014-05577 | CR-RBS-2015-00830 | CR-RBS-2015-01981 | CR-RBS-2015-02348 |
| CR-RBS-2016-00560 | CR-RBS-2016-00770 | CR-RBS-2016-00774 | CR-RBS-2016-00797 |
| CR-RBS-2016-00890 | CR-RBS-2016-01045 | CR-RBS-2016-01053 | CR-RBS-2016-01054 |
| CR-RBS-2016-02146 | | | |

Procedures

| Number | Title | Revision |
|---|---|---|
| GOP-0001 | Plant Startup | 88 |
| STP-050-0700 | RCS Pressure/Temperature Limits Verification | 306 |
| STP-050-0702 | Refueling Outage Reactor Pressure Vessel Inservice Leakage Test | 20 |
| STP-051-4217 | Main Steam Line Isolation – Main Steam Line Pressure – Low Channel Calibration Test and Logic System Functional Test | 10B |
| STP-256-6304 | Standby Service Water B Loop Quarterly Pump and Valve Operability Test | 303 |
| STP-309-0203 | Division III Diesel Generator Operability Test | 323 |
| STP-508-1700 | Division I C71-S003A & C Electrical Protection Assembly Channel Functional Test | 20 |

Work Orders (Wos)

| | | | |
|---|---|---|---|
| WO 00415323 | WO 00420140 | WO 00421577 | WO 00436165 |
| WO 00436558 | WO 52345876 | WO 52350743 | WO 52506248 |
| WO 52663652 | WO 52669026 | | |

**Section 1EP6: Drill Evaluation**

Procedure

| Number | Title | Revision |
|---|---|---|
| RDRL-EP-1104 | Site Drill Scenario | 02 |

## Section 2RS2: Occupational ALARA Planning and Controls

Audits and Self-Assessments

| Number | Title | Date |
|---|---|---|
| LO-RLO-2015-00055 | Pre-NRC Inspection ALARA Planning and Control Snapshot Assessment | July 29, 2015 |

Condition Reports (CRs)

| | | | |
|---|---|---|---|
| CR-RBS-2013-01330 | CR-RBS-2015-01238 | CR-RBS-2015-01453 | CR-RBS-2015-01771 |
| CR-RBS-2015-02131 | CR-RBS-2015-02199 | CR-RBS-2015-02306 | CR-RBS-2015-02397 |
| CR-RBS-2015-04969 | CR-RBS-2015-05870 | | |

Procedures

| Number | Title | Revision |
|---|---|---|
| EN-RP-101 | Access Control for Radiologically Controlled Area | 011 |
| EN-RP-105 | Radiological Work Permits | 014 |
| EN-RP-110 | ALARA Program | 013 |
| EN-RP-110-01 | ALARA Initiative Deferrals | 001 |
| EN-RP-110-02 | Elemental Cobalt Sampling | 000 |
| EN-RP-110-03 | Collective Radiation Exposure (CRE) Reduction Guidelines | 004 |
| EN-RP-110-04 | Radiation Protection Risk Assessment Process | 005 |
| EN-RP-110-05 | ALARA Planning and Controls | 002 |

Radiation Work Permits ALARA Review Packages, In-Progress and Post-Job Reviews

| Number | Title | Revision |
|---|---|---|
| 2015-1709 | Scaffolding Activities in the Reactor Building | 00 |
| 2015-1710 | Insulation Activities in the Reactor Building | 00 |
| 2015-1715 | Emergent Work Activities in Reactor Building | 00-04 |
| 2015-1726 | MOV Activities in the Reactor Building RWCU Room | 00 |
| 2015-1736 | Low Risk Installation/Removal of Temporary Shielding Activities in RWCU Heat Exchanger Room | 00 |
| 2015-1745 | Emergent Work Activities on FAC 737 | 00-01 |
| 2015-1800 | RF-18 Refuel Floor Activities | 00 |

Radiation Work Permits ALARA Review Packages, In-Progress and Post-Job Reviews

| Number | Title | Revision |
|---|---|---|
| 2015-1917 | High Risk DW Under-vessel Activities | 00 |
| 2015-1953 | RF-18 Bio-Shield Activities | 00 |

Other Documents

| Number | Title | Revision/Date |
|---|---|---|
| Refuel Outage 18 | Post Outage ALARA Report | --- |
| Refuel Outage 18 | Outage Control Center (OCC) Logs | --- |
| Refuel Outage 18 | Radiation Protection Department Logs | --- |
| Forced Outage16-01 | Daily Turnover | January 21, 2016 |
| Forced Outage16-01 | Daily RP Outage Report | January 21, 2016 |
| --- | Daily Plant Status Report (Radiation Safety) | Selected Dates 2015-2016 |
| --- | River Bend 5 Year Exposure Reduction Plan 2016-2020 | 00 |

**Section 2RS4: Occupational Dose Assessment**

Audits and Self Assessments

| Number | Title | Date |
|---|---|---|
| LO-RLO-2015-00161 | Focused Self-Assessment for Occupational Dose Assessment (NRC IP 71124.04) | January 8, 2016 |

Condition Reports (CRs)

| | | | |
|---|---|---|---|
| CR-RBS-2014-00839 | CR-RBS-2014-02249 | CR-RBS-2014-04047 | CR-RBS-2014-04069 |
| CR-RBS-2015-00908 | CR-RBS-2015-01108 | CR-RBS-2015-01233 | CR-RBS-2015-01711 |
| CR-RBS-2015-02709 | CR-RBS-2015-02710 | CR-RBS-2015-04086 | CR-RBS-2015-04691 |
| CR-RBS-2015-05331 | CR-RBS-2015-05989 | CR-RBS-2015-06897 | CR-RBS-2015-06911 |
| CR-RBS-2015-09103 | CR-RBS-2016-00005 | | |

Procedures

| Number | Title | Revision |
|---|---|---|
| ADM-0098 | Radiation Protection Administrative Procedure | 011 |

Procedures

| Number | Title | Revision |
|---|---|---|
| EN-RP-131 | Air Sampling | 014 |
| EN-RP-201 | Dosimetry Administration | 004 |
| EN-RP-202 | Personnel Monitoring | 009 |
| EN-RP-203 | Dose Assessment | 007 |
| EN-RP-204 | Special Monitoring Requirements | 009 |
| EN-RP-205 | Prenatal Monitoring | 003 |
| EN-RP-208 | Whole Body Counting and In-Vitro Bioassay | 006 |
| RBNP-024 | Radiation Protection Plan | 302 |

Other Documents

| Title | Date |
|---|---|
| Position Paper on the Establishment of Background Dose for Personnel DLRs at River Bend Station | November 25, 2014 |
| Part 61 Analysis for DAW Scaling Factors | March 5, 2015 |
| Multipack TLD Assignments Between February 22, 2015 and March 29, 2015 | January 14, 2016 |
| National Voluntary Laboratory Accreditation Program (NVLAP) Certificate of Accreditation for Landuaer, Inc. NVLAP LAB Code: 100518-0 | January 1, 2015 |

**Section 4OA1: Performance Indicator Verification**

Procedures

| Number | Title | Revision |
|---|---|---|
| EN-LI-114 | Performance Indicator Process | 6 |
| NEI 99-02 | Regulatory Assessment Performance Indicator Guideline | 7 |

**Section 4OA2: Problem Identification and Resolution**

Condition Reports (CRs)

| | | | |
|---|---|---|---|
| CR-RBS-1999-01727 | CR-RBS-2014-06284 | CR-RBS-2016-01702 | CR-RBS-2016-01712 |

Procedures

| Number | Title | Revision |
|---|---|---|
| EN-OP-104 | Operability Determination Process | 7 |
| OSP-0048 | Switchyard, Transformer Yard and Sensitive Equipment Controls | 28 |

Work Orders (Wos)

| | | | |
|---|---|---|---|
| WO 00078489 | WO 00078495 | WO 00078503 | WO 00078515 |
| WO 00078519 | WO 00241070 | WO 00400308 | WO 00400314 |
| WO 00400323 | WO 00400324 | WO 00400325 | WO 00400326 |
| WO 00400327 | WO 00400328 | WO 00400331 | WO 00400335 |

**Section 4OA5: Other Activities**

Calculations

| Number | Title | Revision |
|---|---|---|
| G13.18.12.2-142 | MSO Scenario LPCI-A-4: Estimating Upper Pool Volume and Evaluating ECCS Pumps for Adequate NPSH | 0 |
| G13.18.12.2-143 | MSO Scenario RCIC-2: Estimating Percent of Suction Flow From CST Versus Suppression Pool | 0 |

Condition Report (CR)

CR-RBS-2013-04654

Procedure

| Number | Title | Revision |
|---|---|---|
| AOP-0052 | Fire Outside The Main Control Room In Areas Containing Safety Related Equipment | 025 |

Other Documents

| Title | Date |
| --- | --- |
| Discussion of Main Control Room (MCR) Temperature Measurement Techniques, Accuracies and the MCR Heat Load Measurements of November 10 2015 and February 2, 2016 | |
| Supply and Return Temperatures on November 10, 2015, Location EB-039D | |

Drawings

| Number | Title | Revision |
| --- | --- | --- |
| EB-039D | Ventilation & Air Conditioning Plan EL 135' – 0" Control Building | 9 |

Engineering Reports

| Number | Title | Revision |
| --- | --- | --- |
| Add. 1 RBS-ME-15-00036 | Addendum 1 to RBS-ME-15-00036 | 0 |
| RBS-ME-16-0004 | Steady-state Analysis and Benchmark of River Bend Station Main Control Room GOTHIC Model | 0 |
| RBS-ME-16-00003 | Evaluation of Main Control Room Realistic Heat Load Based on Measured Data | 0 |

**The following items are requested for the**
**Occupational Radiation Safety Inspection**
**at River Bend Station**
**January 19-22, 2016**
**Integrated Report 2016001**

Inspection areas are listed in the attachments below.

Please provide the requested information on or before **January 4, 2016**.

Please submit this information using the same lettering system as below. For example, all contacts and phone numbers for Inspection Procedure 71124.0**1** should be in a file/folder titled "**1**- A," applicable organization charts in file/folder "**1**- B," etc.

If information is placed on *ims.certrec.com*, please ensure the inspection exit date entered is at least 30 days later than the onsite inspection dates, so the inspectors will have access to the information while writing the report.

In addition to the corrective action document lists provided for each inspection procedure listed below, please provide updated lists of corrective action documents at the entrance meeting. The dates for these lists should range from the end dates of the original lists to the day of the entrance meeting.

If more than one inspection procedure is to be conducted and the information requests appear to be redundant, there is no need to provide duplicate copies. Enter a note explaining in which file the information can be found.

If you have any questions or comments, please contact Marty Phalen at (817) 200-1158 or Martin.Phalen@nrc.gov.

**2. Occupational ALARA Planning and Controls (71124.02)**
Date of Last Inspection: **March 2, 2015**

A. List of contacts and telephone numbers for ALARA program personnel

B. Applicable organization charts

C. Copies of audits, self-assessments, and LERs, written since date of last inspection, focusing on ALARA

D. Procedure index for ALARA Program

E. Please provide specific procedures related to the following areas noted below. Additional Specific Procedures may be requested by number after the inspector reviews the procedure indexes.
1. ALARA Program
2. ALARA Committee
3. Radiation Work Permit Preparation

F. A summary list of corrective action documents (including corporate and sub-tiered systems) written since date of last inspection, related to the ALARA program. In addition to ALARA, the summary should also address Radiation Work Permit violations, Electronic Dosimeter Alarms, and RWP Dose Estimates

NOTE: The lists should indicate the <u>significance level</u> of each issue and the <u>search criteria</u> used. Please provide in document formats which are "searchable" so that the inspector can perform word searches.

G. List of work activities greater than 1 rem, since date of last inspection
Include original dose estimate and actual dose.

H. Site dose totals and 3-year rolling averages for the past 3 years (based on dose of record)

I. Outline of source term reduction strategy

J. If available, provide a copy of the ALARA outage report for the *most recently* completed outages for each unit

K. Please provide your most recent Annual ALARA Report.

## 4. Occupational Dose Assessment (Inspection Procedure 71124.04)

Date of Last Inspection: **January 13, 2014**

A. List of contacts and telephone numbers for the following areas:
   1. Dose Assessment personnel

B. Applicable organization charts

C. Audits, self-assessments, vendor or NUPIC audits of contractor support, and LERs written since date of last inspection, related to:
   1. Occupational Dose Assessment

D. Procedure indexes for the following areas
   1. Occupational Dose Assessment

E. Please provide specific procedures related to the following areas noted below. Additional Specific Procedures will be requested by number after the inspector reviews the procedure indexes.
   1. Radiation Protection Program
   2. Radiation Protection Conduct of Operations
   3. Personnel Dosimetry Program
   4. Radiological Posting and Warning Devices
   5. Air Sample Analysis
   6. Performance of High Exposure Work
   7. Declared Pregnant Worker
   8. Bioassay Program

F. List of corrective action documents (including corporate and sub-tiered systems) written since date of last inspection, associated with:
   1. National Voluntary Laboratory Accreditation Program (NVLAP)
   2. Dosimetry (TLD/OSL, etc.) problems
   3. Electronic alarming dosimeters
   4. Bioassays or internally deposited radionuclides or internal dose
   5. Neutron dose

   NOTE: The lists should indicate the <u>significance level</u> of each issue and the <u>search criteria</u> used. Please provide in document formats which are "searchable" so that the inspector can perform word searches.

G. List of positive whole body counts since date of last inspection, names redacted if desired

H. Part 61 analyses/scaling factors.

I. The most recent National Voluntary Laboratory Accreditation Program (NVLAP) accreditation report or, if dosimetry is provided by a vendor, the vendor's most recent results

## Final Detailed Risk Evaluation

### Significance Determination

The preliminary significance was estimated to be White. After reviewing new information provided during the April 4, 2016, Regulatory Conference, the significance is now estimated to be Green.

The exposure time was defined by the time in one year where the inspectors determined the control building chilled water system chillers were operated in various single-failure vulnerable configurations. Therefore, the maximum permissible exposure window allowed by the Risk Assessment Standardization Project (RASP) Manual of one year was used. To determine this exposure time the inspectors reviewed historical data in order to determine the worst case timeframe for combinations of times when two and three chillers were out of service. The inspectors determined this timeframe was Calendar Year 2014.

### Background – Original Detailed Risk Evaluation:

The finding was evaluated using Inspection Manual Chapter (IMC) 0609, Appendix K, "Maintenance Risk Assessment and Risk Management Significance Determination Process." Using Inspection Manual Chapter 0609, Appendix K, the finding was determined to require additional internal NRC management review using risk insights where possible because the quantitative PRA tools are not well suited to analyze failures from control room heat-up events. Thus, the analyst evaluated the safety significance posed by the heat-up of components cooled by control building chilled water (HVK) chillers using Appendix K, Flowchart 1, "Assessment of Risk Deficit," to the extent practical, with additional risk insights by internal NRC management review in accordance with IMC 0612, "Power Reactor Inspection Reports." The significance of the finding was initially determined to be Yellow, therefore, the analyst performed a detailed risk evaluation.

The analyst performed the detailed risk evaluation, including additional internal NRC management review, using risk insights where possible, as directed by IMC 0609, Appendix K. The result of the detailed risk evaluation was a preliminary White finding (low to moderate safety significance). The analyst bounded the change in core damage frequency (CDF) and large early release frequency (LERF) as no higher than Yellow (substantial safety significance).

The bounding estimate quantified the CDF associated with the control room reaching temperatures that would significantly impact operations to be 3.1E-5/year. The analyst determined that if the licensee successfully avoided core damage under these conditions at least 67 times out of 100, the increase in CDF estimate would fall in the White range. Further, the analyst determined the licensee would have to be successful in avoiding core damage under these conditions more than 97 times out of 100 for the issue to be Green.

Application of the risk insights through internal NRC management review led the NRC to conclude that operators would successfully and safely shut down and maintain stable shutdown of the reactor for 67 to 97 percent of these cases despite the adverse effects on equipment and operators. This yielded a result of low to moderate safety significance (White).

**Final Detailed Risk Evaluation:**

During the Regulatory Conference held on April 4, 2016, the licensee introduced new information regarding the realistic and design heat loads in the control room which lessened the rate and extent of postulated control room heat-up which had been previously used by inspectors.

After review of this new information, the inspectors concluded that more time was available under the newly revised design heat load conditions than was previously considered. Additionally, inspectors concluded that even more time was available beyond design heat load conditions when realistic heat loads were used. The inspectors reviewed the test data from two tests and reports used to estimate the realistic heat loads. One test performed in November 2015 estimated realistic heat loads as approximately 64 percent of design heat loads and another test performed in February 2016 estimated realistic heat loads as approximately 57 percent of design heat loads. The licensee described the February 2016 test as more precise, but inspectors did not completely agree based on uncertainties associated with the testing. Additionally, the inspectors considered that the test was performed in February and represented ambient conditions favorable to lower heat loads due to conditions such as lower solar incidence than an average condition. As a result, the inspectors considered that the heat loads for the control room would fall between the 64 percent realistic load estimate and the revised design heat load estimate and used this as their basis for further significance determination.

This revised heat-up estimate served to allow operators to be more successful in mitigating the loss of control room cooling by giving them more time to diagnose and respond since the control room would not get as hot as fast. Consideration of this additional time led to a maximum increase in core damage frequency of 3.2E-7/year. Application of this estimate into Flowchart 1 of Appendix K yielded a significance of very low (Green).

**Influential Assumptions**

1. Affected systems, structures, or components. The licensee did not adequately assess risk for the inoperable chillers. Therefore, the control building, the control room, and their contents were exposed to conditions where random plant events and failures would make the plant configuration more safety significant.

2. Exposure Time. The analyst determined the exposure time by taking the year (2014) with the most out of service time since 2011. The following table summarizes the amount of out of service time for HVK chillers during 2014:

| Chillers Which Were Out of Service | Time Chillers Were Out of Service |
|---|---|
| Chillers 1A, 1B, and 1D | 94.33 hours |
| Chillers 1A, 1C, and 1D | 18.13 hours |
| Chillers 1B and 1D | 135.7 hours |
| Chillers 1A and 1C | 343.8 hours |

3. Alternate Ventilation in the Control Building. Alternate ventilation (the practice of opening switchgear room and DC equipment room doors upon a loss of control building cooling) provides adequate cooling for AC and DC electrical equipment in the control building. The analyst assigned a failure probability of 2.1E-4 for alternate ventilation.

4. Use of Service Water Cooling. The analyst assigned a failure probability of 5.1E-2 for the use of service water to supply the cooling water to the coils of the control building and control room air handling units in lieu of chilled water. Low experience/training, poor procedure quality, and the decision not to employ this contingency on March 9, 2015, influenced the failure probability. “Extra” time was credited in the SPAR-H analysis after consideration of new information on design and realistic heat loads supplied by the licensee at the Regulatory Conference. The analyst had previously identified “Nominal” time in the original detailed risk evaluation. The licensee derived a failure probability of 2.8E-3 for this event using realistic heat loads for their analysis.

5. Starting of a fan in the main control room. The analyst assigned a failure probability of 5.3E-2 for starting an air handling unit fan or a smoke removal fan to minimize the increase in main control room temperature. Low experience/training and poor quality procedures to diagnose the need for starting a fan influenced the failure probability. “Extra” time was credited in the SPAR-H analysis after consideration of new information on design and realistic heat loads supplied by the licensee at the Regulatory Conference. The analyst had previously identified “Nominal” time in the original detailed risk evaluation. The licensee derived a failure probability of 5.12E-2 for this event using realistic heat loads for their analysis.

6. Operating History. The analyst assumed the plant operated at power or at shutdown conditions above those which necessitated operation of the residual heat removal system for decay heat removal. This allowed the analyst to use the at-power SPAR model for the entire exposure time.

**Quantitative Appendices**

**Uncertainty Analyses:** The analyst quantitatively bounded the increase in CDF at 3.2E-7 (Green) and LERF at 6.4E-8 (Green). This bounding increase in CDF value assumed that once the control room reached temperatures which would significantly challenge operations, operators would always fail at averting core damage. This increase came predominantly from scenarios involving control room equipment and staff.

The following uncertainties were identified when quantifying the bounding estimate:

1. Control Room. The analyst did not model the increase in CDF from elevated control room temperatures. The analyst used qualitative assumptions to determine the bounding and best estimate results.

2. Non-conservatisms. The analyst identified numerous non-conservatisms that were not applied to the bounding estimate, which if they were applied would have made the bounding estimate of increase in CDF higher. These non-conservatisms are discussed in their respective sections and are summarized below:

    a. Common cause failures. Some common cause failures were not fully modeled for HVAC equipment. Based on the results from common cause failures in the

existing SPAR model the analyst concluded only a slight (less than 5 percent) increase in the bounding and best estimate results would occur.

b. Dependency of actions in human reliability analysis of service water. The analyst did not apply the dependency of having the same crew in the same time frame that would be lining up service water to an air handling unit while attempting to recover a chiller.

c. Application of high stress in two human reliability analyses. The analyst did not apply elevated stress in the human reliability analyses for aligning service water and starting a control room fan. Though appropriate for the analysis, the application would give no credit for the actions.

These non-conservatisms were qualitatively and quantitatively assessed after review of the new information provided at the regulatory conference and were assessed as not significant enough to change the maximum change in CDF to White (above 1.0E-6/year).

**Quantitative Risk Insights:** The analyst determined that the effects of a loss of cooling to the control building alone resulted in very low safety significance (Green). The high success rate for alternate ventilation drove this result.

The inspectors determined that the control room temperatures would significantly impact operations during a loss of control building cooling event. This impact led the analyst to bound risk quantitatively by deriving a bounding frequency at which the control room would reach the high temperatures and then apply internal NRC management review using risk insights to qualitatively inform a final estimate for increase in CDF. With the new estimate derived after the regulatory conference, internal NRC management review using risk insights was not needed because the frequency at which the control room temperatures would significantly impact operations was so low that the estimate of increase in CDF would always be Green.

The analyst used the quantitative results from the probabilistic risk assessment for the loss of cooling to the control building equipment to determine the initiating scenarios which would result in a loss of control room cooling. Many of these were an initiator combined with a random loss of the operating train of cooling when the chillers associated with the performance deficiency were out of service for maintenance. The analyst then applied recovery events for aligning service water to the control room air handling units, recovering a chiller, and starting a fan in the control room with their human reliability analysis values derived from the SPAR-H methodology.

The analyst applied less credit for recovery of chillers and air handling units because their breakers were subject to a failure mechanism which complicated recovery. The lower recovery value of the chiller basic event was applied to both the base and performance deficiency cases because the condition of the MasterPact breakers existed for years as part of the plant configuration.

Fires in the running division of control building ventilation also contributed to the overall estimate of the probability of elevated control room temperatures. These fires comprised the only significant external event contributors.

**Licensee’s Perspectives/Analyses:** The licensee's final estimate of the increase in CDF for the loss of cooling to the equipment in the control building credited service water and alternate ventilation, and resulted in a negligible change in CDF (much less than 1.0E-9/year).

The licensee performed a revision to their probabilistic risk assessment model giving additional credit for the extra time afforded by use of realistic heat loads in their calculations.  The licensee estimate also does not consider the loss of a Class 1E electrical bus as an initiator, does not include any increase in CDF from external events, and gives nominal credit for recovery of a train of control building air conditioning.

**Qualitative Appendices**

Because the frequency at which the control room would reach temperatures which would impact operations in the control room was so low (3.2E-7/year) application of qualitative insights was not needed to conclude the increase in CDF was less than 1.0E-6/year (Green).