



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
REGION IV  
1600 EAST LAMAR BLVD  
ARLINGTON, TEXAS 76011-4511

December 24, 2013

ML13358A326

Mr. M.E. Reddemann  
Chief Executive Officer  
Energy Northwest  
P.O. Box 968, Mail Drop 1023  
Richland, WA 99352-0968

SUBJECT: COLUMBIA GENERATING STATION – NRC SPECIAL INSPECTION REPORT  
05000397/2013010

Dear Mr. Reddemann:

On November 21, 2013, the U.S. Nuclear Regulatory Commission (NRC) completed a special inspection at your Columbia Generating Station to evaluate the facts and circumstances surrounding several degraded conditions discovered on essential switchgear ventilation systems. Based upon the risk and deterministic criteria specified in NRC Management Directive 8.3, "NRC Incident Investigation Program," the NRC initiated a special inspection in accordance with Inspection Procedure 93812, "Special Inspection." The basis for initiating the special inspection and the focus areas for review are detailed in the Special Inspection Charter (ML13199A093; Attachment 2). The determination that the inspection would be conducted was made by the NRC on July 18, 2013, and the onsite inspection started on July 22, 2013. The enclosed report documents the inspection findings that were discussed on November 21, 2013, with Mr. W. Hettel, Vice President, Operations, and other members of your staff. Inspectors documented the results of this inspection in the enclosed inspection report.

Since 2010, a number of service water related issues have been identified on critical components such as essential ventilation systems. The causes of these issues are related to deficiencies in maintenance, inspection, and testing of service-water-supplied air-to-water heat exchangers. Despite long standing knowledge of these issues, the overall station response was insufficiently rigorous to address the root and contributing causes of these issues prior to equipment failures.

Based on the results of this inspection, five NRC-identified findings of very low safety significance (Green) were identified. All of these findings were determined to involve violations of NRC requirements. Further, two licensee-identified violations which were determined to be of very low safety significance are listed in this report. The NRC is treating these violations as non-cited violations consistent with Section 2.3.2.a of the Enforcement Policy.

If you contest these non-cited violations, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington DC 20555-0001; with copies to the Regional Administrator, Region IV; the Director, Office of Enforcement, United States Nuclear

M.E. Reddemann

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Regulatory Commission, Washington, DC 20555-0001; and the NRC Resident Inspectors at Columbia Generating 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 Inspectors at Columbia Generating Station.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's Agencywide Document 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/

Ryan Lantz, Branch Chief  
Project Branch D  
Division of Reactor Projects

Docket No.: 05000397  
License No: NPF-21

Enclosure: Inspection Report 05000397/2013010  
w/ Attachment:  
1. Supplemental Information  
2. Charter for Special Inspection

Electronic Distribution to Columbia Generating Station

**U.S. NUCLEAR REGULATORY COMMISSION**

**REGION IV**

Docket: 05000397  
License: NPF-21  
Report: 05000397/2013010  
Licensee: Energy Northwest  
Facility: Columbia Generating Station  
Location: Richland, WA  
Dates: July 22, 2013 through November 21, 2013  
Inspectors: J. Groom, Senior Resident Inspector  
G. Replogle, Senior Reactor Analyst  
Approved By: Ryan Lantz, Chief, Project Branch D  
Division of Reactor Projects

## SUMMARY OF FINDINGS

IR 05000397/2013010; 07/22/13 – 11/21/13; Columbia Generating Station; Special inspection into the discovery of multiple degraded conditions on the Division 1 critical switchgear air handling unit.

The report covered one week of onsite inspection and in-office review through November 21, 2013. A senior resident inspector performed the inspection with assistance from a senior reactor analyst. Five green non-cited violations were identified. The significance of most findings is indicated by their color (Green, White, Yellow, or Red) using Inspection Manual Chapter 0609, "Significance Determination Process." Findings for which the significance determination process does not apply may be Green or be assigned a severity level after NRC management review. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 4, dated December 2006.

### A. NRC-Identified Findings and Self-Revealing Findings

Cornerstone: Mitigating Systems

- Green. The inspectors identified a non-cited violation of 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," for the licensee's failure to perform a cause evaluation for a significant condition adverse to quality. Specifically, the licensee failed to perform a cause evaluation for degraded and nonconforming conditions identified on the Division 1 critical switchgear air handling unit. The cumulative effect of these degraded and nonconforming conditions reduced the system heat removal capability below the performance requirements specified in station calculations. The licensee entered this issue into their corrective action program as Action Request AR 298179.

This performance deficiency was more than minor because, if left uncorrected, the failure to determine the cause and take corrective action to address air- and water-side fouling of safety-related room coolers could become a more significant safety concern. The inspectors performed an initial screening of the finding in accordance with NRC Manual Chapter IMC 0609, Appendix A, "The Significance Determination Process (SDP) for Findings At-Power." Using IMC 0609, Appendix A, Exhibit 2, "Mitigating Systems Screening Questions," the inspectors determined this finding is of very low safety significance (Green) because: (1) the finding was not a deficiency affecting the design or qualification of a mitigating system; (2) the finding did not represent a loss of system and/or function; (3) the finding did not represent an actual loss of function of a single train for greater than its technical specification allowed outage time; and (4) the finding does not represent an actual loss of function of one or more non-technical specification trains of equipment designated as high safety-significant in accordance with the licensee's maintenance rule program for greater than 24 hours. This finding had a cross-cutting aspect in the area of human performance associated with the work practices component in that the licensee failed to

ensure appropriate supervisory and management oversight of work activities related to the screening of issues entered into the corrective action program [H.4(c)]. (Section 3.9)

- Green. The inspectors identified a non-cited violation of 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," for the licensee's failure to follow Procedure PPM 1.3.66, "Operability and Functionality Evaluation," Revision 25-27. Specifically, the licensee failed to evaluate extent of condition and operability of components affected by sacrificial anode degradation in service-water-supplied air-to-water heat exchangers. The licensee entered this issue into their corrective action program as Action Request AR 290553.

The performance deficiency was more than minor because it affected the equipment performance attribute of the Mitigating Systems Cornerstone objective of ensuring the reliability of systems that respond to initiating events. The inspectors performed an initial screening of the finding in accordance with NRC Manual Chapter IMC 0609, Appendix A, "The Significance Determination Process (SDP) for Findings At-Power." Using IMC 0609, Appendix A, Exhibit 2, "Mitigating Systems Screening Questions," the inspectors determined this finding is of very low safety significance (Green) because: (1) the finding was not a deficiency affecting the design or qualification of a mitigating system; (2) the finding did not represent a loss of system and/or function; (3) the finding did not represent an actual loss of function of a single train for greater than its technical specification allowed outage time; and (4) the finding does not represent an actual loss of function of one or more non-technical specification trains of equipment designated as high safety-significant in accordance with the licensee's maintenance rule program for greater than 24 hours. This finding had a cross-cutting aspect in the area of problem identification and resolution associated with the corrective action program component because the licensee failed to periodically trend and assess information related to service water cooled heat exchangers in the aggregate to identify programmatic and common cause problems [P.1(b)]. (Section 3.9)

- Green. The inspectors identified a non-cited violation of 10 CFR Part 50, Appendix B, Criterion XI, "Test Control," for the licensee's failure to maintain an adequate test program that demonstrates safety-related room coolers will perform satisfactorily in service. Specifically, recent internal operating experience revealed that macro-fouling is not appropriately accounted for in the licensee's testing methodology which uses a representative cooler to demonstrate service water system performance. The licensee entered this issue into their corrective action program as Action Request AR 291981.

The performance deficiency was more than minor because it affected the procedure quality attribute of the Mitigating Systems Cornerstone objective and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. The inspectors performed an initial screening of the finding in

accordance with NRC Manual Chapter IMC 0609, Appendix A, "The Significance Determination Process (SDP) for Findings At-Power." Using IMC 0609, Appendix A, Exhibit 2, "Mitigating Systems Screening Questions," the inspectors determined this finding is of very low safety significance (Green) because: (1) the finding was not a deficiency affecting the design or qualification of a mitigating system; (2) the finding did not represent a loss of system and/or function; (3) the finding did not represent an actual loss of function of a single train for greater than its technical specification allowed outage time; and (4) the finding does not represent an actual loss of function of one or more non-technical specification trains of equipment designated as high safety-significant in accordance with the licensee's maintenance rule program for greater than 24 hours. This finding had a cross-cutting aspect in the area of problem identification and resolution associated with the operating experience component because the licensee failed to institutionalize operating experience involving macro-fouling of service water cooling coils through changes to station processes, procedures, and testing programs [P.2(b)]. (Section 3.9)

- Green. The inspectors identified a non-cited violation of Technical Specification 5.4.1.a, "Procedures," associated with the failure of the licensee to install roll-filters in safety-related room coolers in accordance with station procedures. Consequently, the roll-filter for the Division 1 critical switchgear air handling unit WMA-AH-53A was installed incorrectly which resulted in filter degradation and fouling of the air handling unit cooling coil. The licensee entered this issue into their corrective action program as Action Request AR 286069.

The performance deficiency was more than minor because it affected the equipment performance attribute of the Mitigating Systems Cornerstone objective and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. The inspectors performed the initial significance determination using NRC Inspection Manual Chapter 0609, Appendix A, Exhibit 2, "Mitigating Systems Screening Questions." The inspectors determined that the finding required a detailed risk evaluation because it represented a potential loss of one train of safety related equipment for longer than the technical specification allowed outage time since the ventilation system supported several pieces of safety related equipment. The most limiting technical specification allowed completion time was just a few hours. A senior reactor analyst performed a risk evaluation. The analyst determined that, although potentially inoperable per the technical specifications definition, the ventilation fan remained functional and capable of performing for at least 24 hours the function credited in the licensee's probabilistic risk assessment. Therefore the finding is of very low safety significance (Green). This finding had a cross-cutting aspect in the area of human performance associated with the work practices components because the licensee failed to implement human error prevention techniques, such as holding pre-job briefings, self and peer checking, and proper documentation of activities when installing horizontal roll-filters in safety-related applications [H.4(a)]. (Section 3.9)

- Green. The inspectors identified a non-cited violation of Technical Specification 3.7.4, "Control Room Air Conditioning (AC) System," involving the licensee's failure to adequately test and maintain the control room heating, ventilation, and air conditioning (HVAC) system. The licensee entered this issue into their corrective action program as Action Request AR 279768.

The performance deficiency was more than minor because it affected the equipment performance attribute of the Mitigating System Cornerstone objective and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. The inspectors performed the initial significance determination for the failure of the Division 1 control room air conditioning unit using NRC Inspection Manual Chapter 0609, Appendix A, Exhibit 2, "Mitigating Systems Screening Questions." The inspectors determined that the ventilation fan remained functional and capable of performing the probabilistic risk assessment function for at least 24 hours. Therefore the finding is of very low safety significance (Green). This finding had a cross-cutting aspect in the area of problem identification and resolution associated with the corrective action program component because the licensee failed to thoroughly evaluate problems such that the resolutions address causes and extent of conditions, as necessary. Specifically, the licensee failed to fully evaluate the existence of degraded sacrificial anodes in safety-related room coolers such that corrective actions to address these issues were implemented in a timely manner, commensurate with their significance [P.1(c)]. (Section 3.9)

## **B. Licensee-Identified Violations**

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

## REPORT DETAILS

### 1. Basis for Special Inspection

During Refueling Outage R21, the licensee inspected the Division 1 critical switchgear room air handling unit WMA-AH-53A and discovered a large amount of dirt, debris, and fibrous material coating the air side of the cooling coil. Subsequent review revealed that the roll-filter for air handling unit WMA-AH-53A was installed in the reverse direction, such that the filter-retaining element was not correctly oriented to prevent the filter media from breaking apart and being deposited on the air-side of the cooling coil, thereby reducing the heat-removal capability of the system. Additionally, visual inspections of the service water cooling coil for air handling unit WMA-AH-53A revealed that degraded zinc anode material had become deposited in the service water supply header. At the time of discovery, the cumulative effect of the degraded conditions had reduced the heat-removal capability below those specified in station calculations and the safety analysis.

A Senior Reactor Analyst preliminarily estimated the Incremental Conditional Core Damage Probability (ICCDP) for this issue to be  $7 \text{ E-}6$ . According to the Management Directive 8.3 matrix, this value indicates that the circumstances warrant a special inspection. One of the deterministic criteria was met, in that the Division 1 critical switchgear room cooler may have experienced a potential loss of safety function. Based on the preliminary ICCDP and the review of deterministic criteria, the NRC determined that the appropriate level of response was a special inspection.

The NRC conducted the special inspection to better understand the circumstances involving the maintenance, inspection, and testing of the Division 1 critical switchgear air handling unit WMA-AH-53A and other similarly designed heat exchangers. The inspectors used NRC Inspection Procedure 93812, "Special Inspection Procedure," to conduct the inspection. The inspections included field walkdowns of equipment, interviews with station personnel and reviews of procedures, corrective action documents, and design documentation. A list of documents reviewed is provided in Attachment 1 of this report; the Charter for the Special Inspection is included as Attachment 2.

### 2. Event Description

The Division 1 critical switchgear air handling unit WMA-AH-53A is a fin-plate-and-tube air-to-water heat exchanger designed not only to maintain temperatures in several safety-related electrical equipment rooms between 55 and 104 degrees Fahrenheit during normal operation, but also to limit the temperatures below equipment operability limits during all emergency modes of operation. The air-handling unit consists of a roll filter, two water coils in-series (one safety-related cooling coil served by service water and one non-safety cooling coil served by a chilled-water system), an electric blast coil heater, and a centrifugal fan in a sheet-metal housing. The equipment supported by air handling unit WMA-AH-53A includes all Division 1 AC and DC powered switchgear.

On May 21, 2013, during Refueling Outage R21, the licensee visually inspected the Division 1 critical switchgear air handling unit WMA-AH-53A under Work Order 02008800. This work order included a conditional step to clean the coils based on the results of the visual inspection. The licensee completed the inspection portion of Work Order 02008800 satisfactorily on May 21, 2013. Based on the inspection results, the licensee concluded that no cleaning of the cooling coils was necessary.

On May 24, 2013, the licensee performed Work Order 02040998 which included internal inspections of the service-water-supplied cooling coil for air-handling unit WMA-AH-53A. During these inspections, the system engineer identified that three of twenty-two tubes of the coil were blocked with silt, sediment, and degraded anode material. The licensee initiated Action Request AR 285776 to document the indications found on the water side of the cooling coil. Although the licensee had already completed an air-side inspection satisfactorily on May 21, 2013, the system engineer performed an additional air-side inspection and identified a large amount of dirt, debris, and fibrous material coating the fins of the cooling coil. The licensee initiated Action Request AR 285720 to document these additional degraded conditions.

On May 28, 2013 and under Work Order 02040998, the licensee completed limited cleaning of air handling unit WMA-AH-53A. This cleaning consisted of vacuuming both the air-side cooling fins and the water-side supply header. Complete cleaning of the service water cooling coil was not completed during the Division 1 work window because leakage associated with the cooling coil isolation valves prevented complete isolation of the cooling coil. The licensee performed an engineering evaluation that justified operation of air-handling unit WMA-AH-53A in Modes 4 and 5 with an incomplete cleaning of the service-water-supplied cooling coil. This engineering evaluation allowed the licensee to rely on air-handling unit WMA-AH-53A during the Division 2 work window of Refueling Outage R21, which started on May 30, 2013.

Before exiting from Refueling Outage R21, the licensee entered an additional Division 1 work window which included complete cleaning of air handling unit WMA-AH-53A. This cleaning, which was completed under Work Order 02041716, included back flushes of the service-water-supplied cooling coil and steam cleaning of the air-side cooling fins. The Division 1 critical switchgear air handling unit was restored to operable status on June 10, 2013.

### 3. Inspection Results

#### 3.1 Charter Item 1: Timeline of event related to the discovery of the degraded condition on the Division 1 critical switchgear air handling unit WMA-AH-53A

##### a. Inspection Scope

The inspectors developed and evaluated a timeline of the events leading to the discovery of significant air and water side fouling on the Division 1 critical switchgear air handling unit WMA-AH-53A. The inspectors developed the timeline, in part,

through a review of work orders, actions requests, station logs, and interviews with station personnel.

b. Findings and Observations

The inspectors created the following timeline during their review of the events related to the discovery of the degraded conditions on the Division 1 critical switchgear air handling unit WMA-AH-53A.

Date	Activity
July 18, 1989	NRC issued Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment."
February 5, 1990	The licensee submitted their formal response to NRC Generic Letter 89-13.
Around 1996	The licensee replaced all sacrificial anodes in safety-related room coolers.
May 2002	The licensee inspected the cooling coil for the Division 1 critical switchgear air-handling unit. The licensee performed similar inspections in August 2003, December 2005, September 2007, September 2009, and April 2011. These inspections did not identify any dirt or debris on the coil, so cleaning was not performed.
July 2010-May 2012	High-pressure core spray pump room cooler RRA-CC-4 experienced repeated low-flow conditions. Subsequent troubleshooting revealed degraded anode material as a significant contributor to the low flow conditions.
July 12, 2012	The licensee initiated Action Request AR 266779 to document that Columbia Generating Station does not have a current maintenance task for anode inspection and replacement in service-water-supplied room coolers.
October 30, 2012	The NRC resident inspectors identified that the licensee's current testing methodology for the control room HVAC system does not meet the requirements of Technical Specification Surveillance Requirement 3.7.4.1.

Date	Activity
November 11, 2012	The licensee initiated Action Request AR 250933 to document that the roll-filter for the Division 1 critical switchgear air handling unit had reached the end of its roll.
November 15, 2012	The licensee replaced the Division 1 critical switchgear air handling unit roll-filter. During replacement, the licensee installed the filter media in the reverse direction, such that filter-retaining element is on the upstream side of the air flow.
March 3, 2013	The Division 1 control room HVAC air handling unit failed its technical-specification required thermal-performance testing.
March 7, 2013	<p data-bbox="678 884 1430 1050">Chemical cleaning of the air handling unit cooling coil was performed on March 18, 2013. Following cleaning, the Division 1 control room HVAC air handling unit was tested and passes its technical specification required thermal performance test.</p> <p data-bbox="678 1066 1430 1234">Columbia Generating Station's Corporate Nuclear Safety Review Board identified that the licensee had missed opportunities to identify and take corrective actions in response to degraded performance in the standby service water system.</p>
March 13, 2013	<p data-bbox="678 1287 1430 1486">The NRC resident inspectors questioned the operability of the Division 1 critical switchgear air handling unit, in that the component may be susceptible to the same fouling mechanism that caused the Division 1 control room HVAC air handling unit to fail thermal performance surveillance testing on March 3, 2013.</p> <p data-bbox="678 1518 1349 1583">The licensee initiated Action Request AR 280598 to document the inspector's concerns.</p>

Date	Activity
March 15, 2013	The license prepared and issued Engineering Change EC 11767 to address the concerns documented in Action Request AR 280598. This engineering change documented that no extent-of-condition concern exists for the Division 1 critical-switchgear air-handling unit, and that the coil is not experiencing the same macro-fouling as the coil for the Division 1 control-room HVAC air-handling unit.
March 19, 2013	The licensee initiated Action Request AR 280846 to document that a large amount of degraded zinc anode material was discovered in the cooling coil for the Division 1 control room HVAC air handling unit.
April 30, 2013	The licensee initiated Action Request Outage Scope Change Request OSCR 283574 to clean and inspect the Division 1 and Division 2 critical switchgear air-handling units in Refueling Outage R21.
May 11, 2013	Refueling Outage R21 begins.
May 24, 2013	During performance of Work Order 02040998, the system engineer identified a large amount of fibrous material coating the cooling coil for the Division 1 critical switchgear air handling unit. The system engineer estimated that approximately 95 percent of the air-side surface of the cooling coil was covered in thick dust/debris, and about 60 percent was covered in fibrous material.
May 29, 2013	The licensee initiated Action Request AR 286069 documenting that the roll filter for the Division 1 critical switchgear air-handling unit was installed backwards.
May 30, 2013	The licensee swapped from the Division 1 work window to the Division 2 work window during Refueling Outage R21. The divisional swap occurs without the licensee fully cleaning the Division 1 critical switchgear air-handling unit.
June 3, 2013	The licensee initiated Action Request AR 286683 documenting a large amount of degraded zinc anode in the cooling coil for the Division 2 critical-switchgear air-handling unit.

Date

Activity

June 10, 2013

The licensee completed cleaning of the Division 1 critical-switchgear air-handling unit.

- 3.2 Charter Item 2: Review operating experience involving prior fouling of service-water-supplied room coolers and evaluate if Columbia Generating Station adequately addressed applicable operating experience

a. Inspection Scope

The inspectors obtained and reviewed a list of plant corrective-action documents related to air- and water-side fouling of heat exchangers similar to the Division 1 critical-switchgear air-handling unit WMA-AH-53A. The inspectors further reviewed the licensee's incorporation of industry operating experience into the corrective action program for the issues related to fouling of service water systems.

For external operating experience, the inspectors performed several keyword searches related to service water fouling and room cooler issues. The inspectors reviewed applicable information notices, NUREG documents, and other operating experience information. As part of their review, the inspectors performed a system walkdown to determine if the licensee had incorporated applicable industry operating experience into system design and maintenance practices.

b. Findings and Observations

The inspectors noted that since 2010, several low flow conditions had been observed in service-water-supplied air-to-water heat exchangers and that in at least one instance, a component had failed to meet its required function due to blockage of service-water-supplied cooling coils. Evaluations have shown that foreign material caused by silt, sediment, and degraded anode material is the primary fouling mechanism for these cooling coils. The inspectors determined this is a relevant internal operating experience that the licensee should have trended and incorporated into their maintenance and testing programs. Further discussion involving the licensee failure to act on relevant internal operating experience is included in Sections 3.4 and 3.6 of this report.

- 3.3 Charter Item 3: Review the licensee's assessment of past operability for Division 1 critical switchgear air handling unit WMA-AH-53A

a. Inspection Scope

The inspectors reviewed the licensee's assessment of past operability on the Division 1 critical switch gear air handling unit WMA-AH-53A. The inspectors ensured that the cumulative effect of the degraded conditions identified was

accounted for in licensee evaluations to ensure technical specification operability was properly justified and that the subject component remained available, such that, no unrecognized increase in risk occurred. The inspectors compared station calculations associated with essential ventilation to design criteria in the appropriate sections of the FSAR to determine whether the components and systems were operable. As part of their review, a NRC Senior Reactor Analyst observed thermal performance testing of an identical room cooler conducted by the licensee at an independent laboratory near Chicago, Illinois. The testing occurred between October 21 and November 6, 2013 and replicated the as-found fouling observed on the Division 1 critical switchgear air handling unit WMA-AH-53A. The inspectors interviewed key station personnel from operations, engineering, and probabilistic safety analysis departments.

b. Findings and Observations

No findings or observations were identified.

3.4 Charter Items 4 and 5: Review of the licensee's root cause analysis and corrective actions

a. Inspection Scope

The inspectors reviewed the issues that had been entered into the Columbia Generating Station corrective action program related to the degraded conditions discovered on Division 1 critical switch gear air handling unit WMA-AH-53A. The inspectors' review focused on whether the licensee's actions would provide assurance that the causes of risk-significant performance issues are understood and addressed in a manner commensurate with the significance of the problem. The inspectors reviewed historical corrective-action documents to assure that the licensee had appropriately identified extent-of-condition and extent-of-cause of risk-significant performance issues. Finally, the inspectors reviewed the licensee's corrective actions for risk-significant performance issues to ensure that those actions were sufficient to address causes and prevent recurrence. The inspectors interviewed key station personnel from operations, design and system engineering, maintenance, and the corrective-action program.

b. Findings and Observations

The inspectors noted that the licensee had initiated the following action requests related to the discovery of degraded conditions on Division 1 critical switch gear air handling unit WMA-AH-53A.

- May 24, 2013, Action Request AR 285720, documenting filter degradation on the Division 1 critical switchgear air handling unit WMA-AH-53A
- May 25, 2013, Action Request AR 285776, documenting blockage in the cooling coil for the Division 1 critical switchgear air handling unit WMA-AH-53A

- May 26, 2013, Action Request AR 285811, documenting the need to evaluate operability of the Division 1 critical switchgear air handling unit WMA-AH-53A
- May 29, 2013, Action Request AR 286069, documenting that the roll-filter for the Division 1 critical switchgear air handling unit WMA-AH-53A was installed in the reverse direction
- May 30, 2013, Action Request AR 286269, documenting oil and dirt residue on the Division 1 critical switchgear air handling unit WMA-AH-53A
- June 27, 2013, Action Request AR 288871, documenting the cumulative degraded conditions identified on the Division 1 critical switchgear air handling unit WMA-AH-53A and the need to address past operability concerns

The inspectors noted that the highest significance level assigned to these issues was a Significance C1, which is defined in procedure SWP-CAP-01, "Corrective Action Program," Revision 27, as an event or condition determined to be of minor consequences.

The Columbia Generating Station corrective-action program uses the significance level assigned to an action request to determine the station's overall response to issues. Of particular importance, the significance level assigned to issues determines the level of causal evaluation performed to address the identified deficiency. That is,

- For action requests assigned a significance level of A, a root cause analysis is performed.
- For action requests assigned a significance level of B, an apparent cause analysis is performed.
- No formal causal analysis is performed for issues assigned a significance level of C1 or lower.

Because the licensee did not classify any of the issues listed above greater than a Significance Level C1, no root or apparent cause was performed.

The inspectors determined that the individual and cumulative issues involving the degraded conditions on air handling unit WMA-AH-53A cannot be considered an event or condition of minor consequence and, therefore, should not be assigned a significance of C1 within the corrective action program. The inspectors determined that the definition of a Significance Level A or Significance Level B would be more appropriate. Those significance levels were defined in SWP-CAP-01 as the following:

Significance Level A: An adverse event, condition, or trend determined to be of sufficient importance to warrant an in-depth analysis in an effort to develop corrective actions to preclude recurrence

Significance Level B: An adverse event, condition, or trend that requires further investigation to determine the probable cause and develop corrective action(s) to alleviate the problem, address extent of condition, and reduce the likelihood of recurrence

Additionally, the inspectors determined that the degraded conditions identified on the Division 1 critical switchgear air handling unit appears to meet the definition of a significant condition adverse to quality as specified in Procedure SWP-CAP-01. Specifically, a significant condition adverse to quality is defined as:

A failure, malfunction, deficiency, deviation, defective or damaged material and equipment, or nonconformance that adversely affects the safety related function of a system, structure, or component deemed significant based on actual or potential consequences that adversely affects safe operation of the facility, the health and safety of personnel or the public or the environment.

The inspectors determined that the failure to classify the action requests (involving the degraded conditions identified on air handling unit WMA-AH-53A) as a significant condition adverse to quality resulted in the failure to perform a cause evaluation. The inspectors determined that the failure to perform a cause evaluation for a significant condition adverse to quality was a performance deficiency and was contrary to the requirements specified in 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Actions." The enforcement aspects associated with this performance deficiency are discussed in Section 3.9 of this report.

While the inspectors were unable to review a casual analysis associated with the degraded conditions identified on air handling unit WMA-AH-53A, the inspectors did review a sample of action requests and work documents associated with issues identified on similarly designed service-water-supplied air-to-water heat exchangers. The inspectors reviewed several corrective action documents that describe low-flow conditions or reduced thermal performance. In most cases, the low-flow conditions were due to degraded anodes that had been left in service beyond the vendor-recommended replacement frequency. The inspectors noted that several other air-to-water heat exchangers contained anodes of similar vintage and that the operations department had not evaluated the operability of the remaining air-to-water heat exchangers with degraded anodes.

In response to the inspector's concerns, on July 24, 2013, the licensee initiated Action Request AR 290553 to document that anode degradation was system-wide. Operations performed an operability review of Action Request AR 290553 and concluded, based on the inspection results for similarly designed components, that the remaining air-to-water heat exchangers were operable. Subsequent inspections confirmed that foreign material resulting from degraded zinc anodes was present in all service-water-cooled air-to-water heat exchangers at Columbia Generating

Station. Despite long-standing knowledge that zinc anodes installed beyond the manufacturer's recommended service life creates a foreign material concern in safety-related cooling coils, the licensee failed to evaluate the operability of these components prior to the NRC's inspection. The inspectors determined that the failure to perform an operability evaluation for a known degraded or nonconforming condition is contrary to station procedures and a violation of 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures and Drawings." The enforcement aspects of this performance deficiency are discussed in Section 3.9 of this report.

3.5 Charter Items 6 and 7: Review of the licensee's Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment," program and the preventative maintenance program for WMA-AH-53A and other similarly designed heat exchangers

a. Inspection Scope

The inspectors reviewed the licensee's Generic Letter 89-13 program for service-water-supplied heat exchangers to ensure that adequate testing, inspection, and maintenance programs are in place to adequately demonstrate that the service water system will perform satisfactorily in service. Specifically, the inspectors reviewed written procedures and schedules for testing of service-water-supplied heat exchangers, correspondence documenting the licensee's commitments to the NRC regarding the service water system, corrective action documents, and applicable industry codes and standards. The inspectors interviewed key station personnel from design and system engineering, maintenance, and regulatory programs.

The inspectors also evaluated the licensee's programs and procedures for maintaining safety-related air-to-water heat exchangers at Columbia Generating Station. Specifically, the inspectors reviewed procedures and maintenance schedules associated with inspection and cleaning of service-water-supplied room coolers. The inspectors reviewed the licensee's replacement program for components with specific lifetimes such as sacrificial anodes and filters and compared the licensee's programs to applicable industry and vendor guidance. The inspectors interviewed key station personnel from operations, design, and system engineering, maintenance, and the corrective action program.

b. Findings and Observations

Air Side Maintenance

Columbia Generating Station has predefined maintenance tasks for all air-to-water heat exchangers used in safety-related applications which are documented in preventative maintenance background information document BID-FAN-1, "Air Handling Units," Revision 2. BID-FAN-1 identified a 8-year preventative maintenance task for air-side inspections. According to this document, cleaning is conducted only if air-side inspections reveal a condition that warrants corrective maintenance. The inspections outlined in BID-FAN-1 are associated with a regulatory commitment made to the NRC in Columbia Generating Station's initial

response to Generic Letter 89-13. Subject to this preventative maintenance task were 29 air-to-water heat exchangers that primarily function as room coolers for safety-related equipment. The inspectors noted that the licensee's current inspection frequency differed from the frequency originally committed to in their Generic Letter 89-13 response and from the recommended frequency documented in Electric Power Research Institute Topical Report TR-106857, "Equipment Condition Monitoring Templates," dated September 2000. Both the initial commitment made to the NRC and Topical Report TR-106857 established an annual inspection of all air handling units. The licensee originally inspected room coolers at an annual frequency but changed to a biennial inspection frequency based on internal operating experience that revealed no need for any air-side cleaning of these coolers.

On May 26, 2013, in response to the degraded condition identified on the air-side of the Division 1 critical switchgear air handling unit WMA-AH-53A, the licensee reviewed the air-side inspection procedures. During that review, the system engineer identified that the air-side inspections of the Division-1 and -2 critical-switchgear air-handling-units had not been completed in accordance with written instructions. Specifically, the licensee identified that comprehensive inspections of the cooling-coil surfaces had not been completed because the written work instructions did not require removal of the air-handling-unit roll-filter when conducting inspections. The design of these air-handling units is such that inspections cannot be performed without removal of the unit's roll-filter. A review of prior inspection work orders revealed that the licensee had not removed the roll-filters for these units since 2002. Consequently, the inspectors determined that contrary to the commitments made by the licensee in their response to Generic Letter 89-13, a comprehensive air-side inspection had not been completed for over ten years.

The inspectors determined that the licensee had appropriately identified that prior inspections of WMA-AH-53A were not accomplished in accordance with station procedures because the unit's roll-filter had not been removed. The licensee entered this issue into their corrective action program as Action Request 285811. The inspectors determined this issue is a licensee-identified violation of Technical Specification 5.4.1.a, "Procedures." The enforcement aspects of this noncompliance are discussed in Section 4OA7 of this report.

#### Water Side Maintenance

Columbia Generating Station does not have any pre-established maintenance tasks for the service water side of the coils for safety-related air handling units. Instead, the licensee uses performance monitoring and only completes cleaning of service-water-supplied room coolers based on thermal-performance testing of two heat exchangers that are used as a performance indicator for the remaining air-to-water heat exchangers. The licensee's strategy for performance monitoring is documented in Technical Memorandum 2111, "Thermal Performance Testing of the Air-to-Water Heat Exchangers in the WNP-2 SW System," Revision 0, and is used to partially fulfill the testing recommendations specified in NRC Generic Letter 89-13.

The inspectors reviewed the technical basis for the licensee's maintenance and testing program as documented in Technical Memorandum 2111 and found that recent internal operating experience demonstrated that testing of only two air-to-water heat exchangers does not sufficiently predict performance for the remaining air-to-water heat exchangers at Columbia Generating Station. Specifically, the inspectors identified several recent examples where degradation of individual room coolers was identified beyond the level of degradation experienced in the two heat exchangers used to represent system performance. Consequently, the current test methodology failed to adequately demonstrate that the service water system will perform satisfactorily in service. The inspectors determined that the inadequacies associated with the licensee's testing program for air-to-water heat exchangers were a violation of 10 CFR Part 50, Appendix B, Criterion XI, "Test Control." The enforcement aspects of this noncompliance are discussed in Section 3.9 of this report.

The inspectors also noted that the primary mechanism causing performance issues with individual air-to-water heat exchangers primarily involved macro-fouling due to silt, sediment, and degraded anode material. At Columbia Generating Station, anodes are used in 22 service-water-supplied air-to-water heat exchangers. In each of these heat exchangers, the anodes were replaced in 1996 and have remained in service without inspection or replacement. This is contrary to the vendor guidance that recommends a yearly inspection frequency. Because anodes are primarily composed of zinc material which is designed to sacrificially corrode to protect the heat exchanger material, the anodes have swelled and began to break apart due to prolonged exposure to service water. This has created a foreign material problem in the heat exchangers where the anodes are located, and has been responsible for several low-flow conditions that reduced the thermal performance of service water cooling coils. On July 12, 2012, the licensee initiated Action Request 266779 to document that Columbia Generating Station does not have a current maintenance task for anode inspection and replacement in service water room coolers. The inspectors determined the licensee's failure to establish a preventative maintenance schedule for inspection or replacement of parts that have a specific lifetime is a licensee-identified violation of Technical Specification 5.4.1.a, "Procedures." The enforcement aspects of this noncompliance are discussed in Section 4OA7 of this report.

3.6 Charter Item 8: Review of the processes and procedures for installing roll-filters in safety-related room coolers

a. Inspection Scope

The inspectors reviewed the licensee's procedures for installing roll-filters in safety-related room coolers and reviewed a sample of recent roll-filter replacements. The inspectors' review included a system walkdown with station personnel of the four air handling units that utilize a horizontal roll-filter. The inspectors interviewed key

station personnel from operations, system engineering, maintenance, and the corrective action program.

b. Findings and Observations

The process and procedures for installing horizontal roll-filters in safety-related room coolers at Columbia Generating Station is outlined in Procedure PPM 10.2.68, "Roll-filter Media Replacement," Revision 11. At the time of the inspection, PPM 10.2.68 was listed as an "Information Use" procedure. As defined in SWP-PRO-02, "Procedure and Work Instruction Use and Adherence," Revision 24, information-use procedures are those instructions that involve:

"a level of use required for activities that do not involve direct contact with plant equipment, [are] performed frequently, [have] no immediate consequences if performed improperly, and [are] within the knowledge and skill of experienced individuals."

Horizontal roll-filters are installed in four essential-ventilation subsystems at Columbia Generating Station, including the Division 1 and Division 2 critical switchgear air-handling units and the Division 1 and Division 2 cable spreading room air-handling units. A review of the work history for these components revealed that on average, about one roll-filter is replaced every year. The inspectors determined that this does not constitute a frequent activity, and that the work involving replacement of horizontal roll-filters does involve direct contact with plant equipment. Based on these observations, the inspectors determined that the level of usage currently defined for Procedure PPM 10.2.68 was not consistent with the definitions provided in Procedure SWP-PRO-02. The licensee initiated Action Request AR 290430 to document this discrepancy.

The inspectors also identified that on November 15, 2012, the licensee failed to complete the most recent roll-filter media replacement for Division 1 critical switchgear air handling unit WMA-AH-53A in accordance with station procedures. This roll-filter replacement was completed under Work Order 02033663, which directed personnel to Procedure PPM 10.2.68. The inspectors discovered that the revision of Procedure PPM 10.2.68 in effect on November 15, 2012, contained conflicting guidance with regard to the orientation of roll-filter media. Specifically, Procedure PPM 10.2.68, Step 7.I, directed personnel to, "refer to Figure 7.1c and install turn filter roll to unroll as depicted with scrim on air-leaving side of media." Because of a conflict between how the filters are rolled at the factory and an error contained in Figure 7.1c, this step cannot be completed as written. Interviews conducted by the inspectors with mechanical maintenance personnel revealed that this procedure conflict contributed to the incorrect installation of the filter for air handling unit WMA-AH-53A that occurred on November 15, 2012.

The inspectors determined that while the procedural guidance provided for in Procedure PPM 10.2.68, Step 7.I, could not be accomplished as written, the procedure included sufficient procedural steps after Step 7.I that, if completed, would

have ensured that the scrim-reinforced backing material was oriented correctly. Consequently, the inspectors determined that the licensee failed to comply with Technical Specification 5.4.1.a, "Procedures", when installing a replacement roll-filter for WMA-AH-53A on November 15, 2012. The enforcement aspects of this noncompliance are discussed in Section 3.9 of this report.

Because Procedure PPM 10.2.68, Step 7.I, could not be completed as written, the inspectors identified a concern that other horizontal roll-filters may be similarly affected and installed in an orientation that would allow for filter-media material to become dislodged and deposited on safety-related cooling-coil surfaces. To address this concern, the licensee accomplished Work Request 29107586 on July 23, 2013, which consisted of visually inspecting the roll-filters currently installed in the Division-1 and Division-2 critical switchgear air-handling units and the Division-1 and Division-2 cable-spreading room air-handling units. The inspectors accompanied the licensee during performance of this work request and found that the roll-filter media for all air handling units were oriented correctly.

- 3.7 Charter Item 9: Review the licensee's compliance with the Technical Specifications; in particular, focus on the licensee's decision to enter the Division 2 work window in Refueling Outage 21 without first cleaning WMA-AH-53A

a. Inspection Scope

The inspectors reviewed the sequence of events related to recent problems identified with the essential-ventilation system to determine if the licensee maintained compliance with the plant's Technical Specifications. The inspectors reviewed plant operating logs, corrective action documents, and work orders. Station calculations and testing were compared to the as-found conditions of specific essential ventilation systems to determine if those systems would provide the required heat-removal capability to meet the assumptions used in the station's safety analysis. The inspectors interviewed personnel from operations, engineering, and regulatory affairs departments.

b. Findings and Observations

Based on their review of the timeline documented in Section 3.1 of this report, the inspectors determined that the failure of the control room HVAC cooling coil WMA-CC-51A1, that occurred on March 2, 2013, constituted a violation of Technical Specification 3.7.4, "Control Room Air Conditioning (AC) System." This event is discussed further in Section 4OA3 of this report. The enforcement aspects associated with the violation of the plant's technical specifications are discussed in Section 3.9 of this report.

3.8 Charter Item 10: Collect data to support an independent assessment of the risk significance of the condition

a. Inspection Scope

The inspectors gathered information needed to independently assess the risk impact of the degraded conditions discovered on the Division 1 critical switchgear air handling unit WMA-AH-53A. As part of this review, the inspectors identified the length of time the equipment was susceptible to the degraded conditions and the overall impact of the air and water side fouling on the heat removal capability of the system. The inspectors also reviewed potential compensatory measures that could be implemented to address a high temperature condition in the rooms served by WMA-AH-53A. The inspectors interviewed key station personnel from operations, system engineering, and the probabilistic safety analysis staff.

b. Findings and Observations

No findings or observations were identified.

3.9 Specific findings identified during this inspection

.1 Failure to Perform Causal Evaluation for Significant Condition Adverse to Quality

Introduction. The inspectors identified a Green, non-cited violation of 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," for the licensee's failure to perform a cause evaluation for a significant condition adverse to quality. Specifically, the licensee failed to perform a cause evaluation for degraded and nonconforming conditions identified on the Division-1 critical switchgear air-handling unit.

Description. During inspections conducted in Refueling Outage R21, the licensee documented several degraded and nonconforming conditions involving the Division 1 critical switch gear air handling unit WMA-AH-53A. Specifically, the licensee initiated the following action requests:

- May 24, 2013, Action Request AR 285720 which documented filter degradation on the Division 1 critical switchgear air handling unit WMA-AH-53A
- May 25, 2013, Action Request AR 285776, which documented blockage in several service water supply tubes of cooling coil for the Division 1 critical switchgear air handling unit WMA-AH-53A
- May 29, 2013, Action Request AR 286069 which documented that the roll-filter for the Division 1 critical switchgear air handling unit WMA-AH-53A was installed in the reverse direction
- May 30, 2013, Action Request AR 286269 which documented oil and dirt residue on the Division 1 critical switchgear air handling unit WMA-AH-53A

The nature of the above referenced action requests documented conditions that reduced the heat removal capability of the system. The cumulative effect of these degradations resulted in a reduction in the heat removal capability of the system below those specified in station calculations. Based on concerns related to past operability of the Division 1 critical-switchgear air-handling unit, the licensee initiated the following condition reports:

- May 26, 2013, Action Request AR 285811 which documented the need to evaluate operability of the Division 1 critical switchgear air handling unit WMA-AH-53A
- June 27, 2013, Action Request AR 288871, which documented the cumulative degraded conditions identified on the Division 1 critical switchgear air handling unit WMA-AH-53A and the need to address past operability concerns

The inspectors reviewed all of the action requests initiated for the degraded conditions on air handling unit WMA-AH-53A and noted that the highest significance level assigned to these issues within the corrective action program was a Significance C1. Significance C1 is defined in procedure SWP-CAP-01, "Corrective Action Program," Revision 27, as an event or condition determined to be of minor consequences. The inspectors also noted that in none of the initiated action requests had the licensee identified the cumulative degraded conditions as a significant condition adverse to quality. Procedure SWP-CAP-01 defines a significant condition adverse to quality as:

"A failure, malfunction, deficiency, deviation, defective, or damaged material and equipment, or nonconformance that adversely affects the safety related function of a system, structure, or component deemed significant based on actual or potential consequences that adversely affects safe operation of the facility, the health and safety of personnel or the public or the environment."

Based on the licensee's definition of a significance condition adverse to quality, the inspectors determined that the cumulative degraded conditions identified on the Division 1 critical switchgear air handling unit in Refueling Outage R21 represented a failure of a system with potential consequences that adversely affects safe operation of the facility. Therefore, the inspectors determined that the degraded conditions constituted a significant condition adverse to quality, and thus warranted a cause evaluation.

On July 23, 2014, the licensee upgraded Action Request AR 288871 to a Significance B action request which requires an apparent cause evaluation.

Analysis. The failure to perform a causal evaluation for a significant condition adverse to quality was a performance deficiency. This performance deficiency was more than minor because, if left uncorrected, the failure to determine the cause and take corrective actions to address air- and water-side fouling of safety related room coolers could become a more significant safety concern. The inspectors initially screened the finding in accordance with NRC Manual Chapter IMC 0609, Appendix A, "The Significance Determination Process (SDP) for Findings At-Power." Using IMC 0609, Appendix A,

Exhibit 2, "Mitigating Systems Screening Questions," the inspectors determined this finding is of very low safety significance (Green) because: (1) the finding was not a deficiency affecting the design or qualification of a mitigating system; (2) the finding did not represent a loss of system and/or function; (3) the finding did not represent an actual loss of function of a single train for greater than its technical specification allowed outage time; and (4) the finding does not represent an actual loss of function of one or more non-technical specification trains of equipment designated as high safety-significant in accordance with the licensee's maintenance rule program for greater than 24 hours. This finding had a cross-cutting aspect in the area of human performance associated with the work practices component in that the licensee failed to ensure appropriate supervisory and management oversight of work activities related to the screening of issues entered into the corrective action program [H.4(c)].

Enforcement. Title 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Actions," requires, in part, that in the case of significant conditions adverse to quality, measures established by the licensee shall assure that the cause of the condition is determined and corrective action taken to preclude repetition. Contrary to the above, between May 24, 2013, and June 27, 2013, for a particular significant condition adverse to quality, the measures established by the licensee did not assure that the cause of the condition was determined and corrective action taken to preclude repetition. Specifically, the degraded or nonconforming conditions on the Division 1 critical switch gear air handling unit WMA-AH-53A constituted a significant condition adverse to quality as defined in licensee procedure SWP-CAP-01, "Corrective Action Program," Revision 2. For that significant condition adverse to quality, the licensee did not determine the cause of the condition and did not take action to preclude repetition. Following discovery of this issue, the licensee upgraded Action Request AR 288871 to requiring an apparent cause evaluation for the subject condition. Because this violation was of very low safety significance (Green) and it was entered into the licensee's corrective action program as Action Request AR 298179, this violation is being treated as a non-cited violation, consistent with the Enforcement Policy: NCV 05000397/2013010-01, "Failure to Determine Cause for a Significant Condition Adverse to Quality."

## .2 Failure to Evaluate Operability for Degraded Anodes in Safety-Related Heat Exchangers

Introduction. The inspectors identified a Green, non-cited violation of 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," for the licensee's failure to follow Procedure PPM 1.3.66, "Operability and Functionality Evaluation," Revision 25-27. Specifically, the licensee failed to evaluate extent of condition and operability of components affected by anode degradation in service-water-supplied air-to-water heat exchangers.

Description. In July 2010, the licensee received repeated low cooling water flow alarms in the control room for the high pressure core spray room cooler RRA-CC-4. While the service water flow to this cooler remained above operability limits, the low flow alarms were an indication of fouling of the service-water-supplied cooling coil. In May 2011, the licensee performed routine troubleshooting that revealed high differential pressure across cooler RRA-CC-4 confirming that the cause of the low flow was degraded service

water piping or cooler fouling. Additional troubleshooting in August 2011 identified a badly degraded anode in the room cooler but determined the degraded anode was not the cause of the low flow. During a planned maintenance outage from May 20-25, 2012, the licensee performed a service water piping replacement for the cooler RRA-CC-4 to address low flow conditions. Following the piping replacement, the low flow conditions for cooler RRA-CC-4 continued to exist. Baroscopic examinations identified that sacrificial anode debris in the cooling coil was a contributor to the low flow conditions. On May 26, 2012, the licensee performed a reverse flush of the cooler to remove the degraded anode material under Work Order 02007773. The licensee initiated Action Request AR 264261, documenting the additional rework needed to address the anode debris causing the low flow conditions on cooler RRA-CC-4.

The licensee completed an apparent cause evaluation for Action Request AR 264261 on July 2, 2012, and identified that periodic inspection and anode replacement was not included in the Columbia Generating Station preventative maintenance program. Because anodes are primarily composed of zinc materials which are designed to sacrificially corrode, the prolonged exposure to a raw water system resulted in swelling and degradation of these components that ultimately resulted in the anodes breaking apart and creating a foreign material problem. On July 12, 2012, the licensee initiated Action Request AR 266779 to document that Columbia Generating Station does not have a current maintenance task for anode inspection and replacement in service water room coolers. This action request specifically identified the need for an anode replacement schedule as an enhancement and stated that the degraded anodes do not present an operability concern. Consequently, no operations review of this action request was performed.

At Columbia Generating Station, 22 safety-related room coolers use sacrificial anodes to protect heat exchanger components from excessive corrosion. For these coolers, the licensee replaced all of their anodes in 1996. The licensee completed no additional inspection or replacement of these anodes until the low-flow conditions were received on high pressure core spray room cooler RRA-CC-4, even though the vendor-recommended maintenance included an annual inspection of sacrificial anodes. The inspectors noted that the licensee had failed to provide a technical basis for not completing the vendor recommended maintenance. The inspectors also noted that similar to the issues related to low flow on high-pressure-core-spray room cooler RRA-CC-4, the licensee had recently experienced several issues related to reduced flow or thermal performance on several safety-related air-to-water heat exchangers. Specifically, the inspectors noted the following:

- March 19, 2013, Action Request AR 280846 documented that blocked tubes were found in the cooling coil for the Division 1 control room air handling unit WMA-AH-51A. The discovery of the blocked tubes was after the component failed its thermal performance test. The blocked tubes and reduced thermal performance of this component was caused by degraded anode material that had become loose and deposited in the service water supply header.

- May 25, 2013, Action Request AR 285776 documented that blocked tubes were found during visual inspection of the cooling coil for the Division 1 critical switchgear air handling unit WMA-AH-53A. The blocked tubes on the cooling coil was due to degraded anode material that had become loose and deposited in the service water supply header.
- June 3, 2013, Action Request AR 286683 documented that during a visual inspection of the cooling coil for the Division 2 critical switchgear air handling unit WMA-AH-53B, a large amount of degraded zinc anode was discovered. The action request documented that a total of three tubes were suspected of being blocked by the macro-fouling caused by the degraded zinc anode material.

The inspectors reviewed the above referenced corrective action documents, including the licensee's causal evaluation and corrective actions. In each example, degraded anode material was identified as the direct cause of low flow or reduced thermal performance of the subject room cooler. The inspectors determined that for each example, a common concern existed related to sacrificial anodes that have been in service beyond the manufacturer's recommended inspection and replacement frequency without adequate technical justification. For each action request, the licensee's operability evaluation addressed the direct cause for each single heat exchanger affected but failed to address the related extent-of-condition and the need for an evaluation for the remaining air-to-water heat exchangers where anodes have been installed for approximately 17 years. The failure to evaluate the operability of similarly affected structures, systems, and components following identification of a degraded or nonconforming condition that could be transportable to other similarly designed equipment is contrary to the licensee's Procedure PPM 1.3.66, "Operability and Functionality Evaluation," Revision 25-27, and NRC Inspection Manual Part 9900 Technical Guidance, "Operability Determinations & Functionality Assessments for Resolution of Degraded or Nonconforming Conditions Adverse to Quality or Safety."

On July 24, 2013, in response to the inspectors' concerns, the licensee initiated Action Request AR 290553 to document that anode degradation was system-wide and that 17 additional heat exchangers had anodes installed beyond the manufacturer's recommended inspection frequency, such that anode degradation could present a foreign material concern to the subject coolers. Operations performed an operability review of Action Request AR 290553, on July 25, 2013, and concluded that based on the inspection results obtained for the similarly designed service-water-supplied cooling coils, the remaining air-to-water heat exchangers were operable.

Analysis. The failure to follow station procedures when evaluating the operability of station components was a performance deficiency. The performance deficiency was more than minor because it affected the equipment performance attribute of the Mitigating Systems Cornerstone objective of ensuring the reliability of systems that respond to initiating events. The inspectors initially screened the finding in accordance with NRC Manual Chapter IMC 0609, Appendix A, "The Significance Determination Process (SDP) for Findings At-Power." Using IMC 0609, Appendix A, Exhibit 2, "Mitigating Systems Screening Questions," the inspectors determined this finding is of

very low safety significance (Green) because: (1) the finding was not a deficiency affecting the design or qualification of a mitigating system; (2) the finding did not represent a loss of system and/or function; (3) the finding did not represent an actual loss of function of a single train for greater than its technical specification allowed outage time; and (4) the finding does not represent an actual loss of function of one or more non-technical specification trains of equipment designated as high safety-significant in accordance with the licensee's maintenance rule program for greater than 24 hours. This finding had a cross-cutting aspect in the area of problem identification and resolution associated with the corrective action program component because the licensee failed to periodically trend and assess information related to service water cooled heat exchangers in the aggregate to identify programmatic and common-cause problems [P.1(b)].

Enforcement. Title 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures and Drawings," requires, in part, that activities affecting quality shall be prescribed by documented instructions, procedures, or drawings, of a type appropriate to the circumstances and shall be accomplished in accordance with these instructions, procedures, or drawings. Contrary to the above, the licensee failed to accomplish certain activities affecting quality in accordance with written procedures. Specifically, licensee Procedure PPM 1.3.66, "Operability and Functionality Evaluation," Revision 25-27, Step 4.1.6, requires, in part, the licensee determine and document the operability status of the affected structure, system, or component. Attachment 7.5 of Procedure PPM 1.3.66 provides guidelines for information to be considered in the operability evaluation which includes specific guidance to review extent of condition. On March 19, 2013, May 25, 2013, and June 3, 2013, the licensee identified in Action Request ARs 280846, 285776, and 286683, that degraded anode material was the direct cause of low flow or reduced thermal performance of safety-related room coolers. In each instance, the licensee failed to address the extent of condition including operability impacts of degraded sacrificial anodes in safety-related room coolers as required by station procedures. The NRC identified this issue on July 23, 2013, and the licensee subsequently initiated Action Request AR 290553 to document that service water anode degradation is system-wide. Because this violation was of very low safety significance (Green) and was entered into the licensee's corrective action program as Action Request AR 290553, this violation is being treated as a non-cited violation, consistent with the Enforcement Policy: NCV 05000397/2013010-02, "Failure to Evaluate Operability of System Wide Anode Degradation in the Service Water System."

### .3 Failure to Maintain an Adequate Test Program for Safety-Related Room Coolers

Introduction. The inspectors identified a Green, non-cited violation of 10 CFR Part 50, Appendix B, Criterion XI, "Test Control," for the licensee's failure to maintain an adequate test program that demonstrates safety-related room coolers will perform satisfactorily in service.

Description. On July 18, 1989, the NRC issued Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment," to require licensees to supply information to assure the NRC that the safety functions of their respective service water

systems are being met. Recommendation II of the generic letter stated that an acceptable method for a licensee to demonstrate the capability of the service water system was to conduct a test program consisting of an initial test program and a periodic retest program to verify the heat transfer capability of all safety-related heat exchangers supplied by service water. At Columbia Generating Station, the test program used to satisfy Generic Letter 89-13, Recommendation II, for air-to-water heat exchangers consisted of a thermal performance test of a single air-to-water heat exchanger in each of the service water trains. The results of these thermal performance tests were used as a representative sample of the performance of the other heat exchangers in the system. The two coolers selected as a representative sample for the other coolers in the service water system were the Train A and B service water pump house room coolers PRA-CC-1A and PRA-CC-1B. The basis for the licensee's testing methodology is documented in Technical Memorandum TM-2111, "Thermal Performance Testing of the Air-to-Water Heat Exchangers in the WNP-2 SW System," Revision 0.

The inspectors reviewed Technical Memorandum TM-2111 and recent test data for the Train A and B service water pump house room coolers PRA-CC-1A and PRA-CC-1B. Procedures TSP-SW-A101, "Service Water Loop A Cooling Coil Heat Load Capacity Test," Revision 2 and TSP-SW-A102, "Service Water Loop B Cooling Coil Heat Load Capacity Test," Revision 2, were used to determine the thermal performance capability coolers PRA-CC-1A and PRA-CC-1B. These procedures determined the overall heat transfer coefficients for the cooling coil as a percentage of the 100 percent design overall heat transfer coefficient. The most recent performance of Procedures TSP-SW-A101 and TSP-SW-A102 completed on March 22, 2013, and February 5, 2013, yielded overall heat transfer coefficients of 73.11 percent and 73.83 percent respectively. Station calculations required at least 65 percent to meet the heat removal capabilities assumed in the station's safety analysis.

The inspectors compared the test results for these room coolers against recently obtained thermal performance data for the Division 1 control room air conditioning cooling coil WMA-CC-51A1, a similar but not identical air-to-water heat exchanger. The thermal performance data for cooling coil WMA-CC-51A1 was obtained on March 2, 2013, in response to non-cited violation NCV 05000397/2012005-04, "Failure to Perform Adequate Surveillance Testing of the Control Room Air Conditioning System." During this test, cooling coil WMA-CC-51A1 had an overall heat transfer coefficient of 62.6 percent, less than what was predicted by the representative cooling coil PRA-CC-1A and insufficient to meet required 65 percent assumed in station calculations.

Additionally, inspections of the cooling coils for the Division 1 and Division 2 critical switchgear room coolers WMA-CC-53A1 and WMA-CC-53B1 revealed waterside fouling beyond what was predicted by the test methodology established in TM-2111. A calculation performed to determine the cumulative effect of the water side fouling showed a reduction in the overall heat transfer coefficient to approximately 65 percent. Similar to the internal operating experience obtained from cooling coil WMA-CC-51A1, this reduction in efficiency resulted in performance less than what was predicted by the representative cooling coils PRA-CC-1A and PRA-CC-1B and insufficient to meet required 65 percent assumed in station calculations.

Based on the test and inspection results obtained for safety-related cooling coils WMA-CC-51A1, WMA-CC-53A1, and WMA-CC-53B1, the inspectors determined that the test methodology established in Technical Memorandum TM-2111 was inadequate as a performance indicator of all air-to-water heat exchangers installed at Columbia Generating Station. Recent operating experience has shown that foreign material caused by silt, sediment, and degraded anode material is the primary fouling mechanism of the cooling coils in air-to-water heat exchangers. This macro-fouling is not appropriately accounted for in the licensee's testing methodology and was found in several cases to exceed that of the representative cooler specified in TM-2111. At the close of the inspection, the licensee was developing plans to modify the testing and inspection program to assure that air-to-water heat exchangers would perform satisfactorily in service. This issue was entered into the licensee's corrective action program as Action Request AR 291981.

Analysis. The failure to maintain an adequate testing methodology for safety-related room coolers was a performance deficiency. The performance deficiency was more than minor because it affected the procedure quality attribute of the mitigating systems cornerstone objective and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. The inspectors performed an initial screening of the finding in accordance with NRC Manual Chapter IMC 0609, Appendix A, "The Significance Determination Process (SDP) for Findings At-Power." Using IMC 0609, Appendix A, Exhibit 2, "Mitigating Systems Screening Questions," the inspectors determined this finding is of very low safety significance (Green) because: (1) the finding was not a deficiency affecting the design or qualification of a mitigating system; (2) the finding did not represent a loss of system and/or function; (3) the finding did not represent an actual loss of function of a single train for greater than its technical specification allowed outage time; and (4) the finding does not represent an actual loss of function of one or more non-technical specification trains of equipment designated as high safety-significant in accordance with the licensee's maintenance rule program for greater than 24 hours. This finding had a cross-cutting aspect in the area of problem identification and resolution associated with the operating experience component because the licensee failed to institutionalize operating experience involving macro-fouling of service water cooling coils through changes to station processes, procedures, and testing programs [P.2(b)].

Enforcement. Title 10 CFR Part 50, Appendix B, Criterion XI, "Test Control," requires, in part, that a test program shall be established to assure that all testing required to demonstrate that structures, systems, and components will perform satisfactorily in service and are identified and performed in accordance with written test procedures. The test program shall include, as appropriate, proof tests prior to installation, preoperational tests, and operational tests during nuclear power plant operation of structures, systems, and components. Contrary to the above, prior to August 15, 2013, the test program established by the licensee did not assure that all testing required to demonstrate that structures, systems, and components will perform satisfactorily in service was identified and performed. Specifically, the test program established in

Technical Memorandum TM-2111, "Thermal Performance Testing of the Air-to-Water Heat Exchangers in the WNP-2 SW System," Revision 0, did not assure that safety-related air-to-water heat exchangers will perform satisfactorily in service because it did not test the most restrictive cooling coil as a representative sample and did not account for differences in cooling coil capability created by system macro-fouling. At the close of the inspection, the licensee was in the process of establishing a new test and inspection program for all safety-related air-to-water heat exchangers. Because this violation was of very low safety significance (Green) and it was entered into the licensee's corrective action program as Action Request AR 291981, this violation is being treated as a non-cited violation, consistent with the Enforcement Policy: NCV 05000397/2013010-03, "Failure to Perform Adequate Testing of the Service-Water-Supplied Room Coolers."

.4 Failure to Follow Station Procedures When Installing Roll-Filters in Safety-Related Room Coolers

Introduction. The inspectors identified a Green, non-cited violation of Technical Specification 5.4.1.a, "Procedures," associated with the failure of the licensee to install roll-filters in safety-related room coolers in accordance with station procedures. Consequently, the roll-filter for the Division 1 critical switchgear air handling unit WMA-AH-53A was installed incorrectly which resulted in filter degradation and fouling of the air handling unit cooling coil.

Description. On November 11, 2012, control room operators received an annunciator in the main control room indicating that the roll-filter for the Division 1 critical-switchgear air-handling-unit WMA-AH-53A had reached the end of its roll. Air-handling-unit WMA-AH-53A contains a roll-filter where filter media advancement is controlled automatically by a timer so that the filter media never becomes blocked with dirt and debris. The licensee initiated Action Request AR 250933 to document the alarm and the need for maintenance to change the roll-filter media. On November 15, 2012, the licensee completed a roll-filter replacement for air handling unit WMA-AH-53A under Work Order 02033663.

On May 24, 2013, during inspections of air handling unit WMA-AH-53A, system engineering personnel discovered a large amount of fibrous material coating the upstream face of the cooling coil. The source of the fibrous material was from the roll-filter which was discovered to be installed backwards. The licensee had installed the roll-filter on November 15, 2012, under Work Order 02033663. The roll-filters are designed such that the filter media is retained by a reinforced backing material called scrim that prevents the high volume of air flow from dislodging the filter media. On May 24, 2013, the licensee initiated Action Request AR 285720 documenting the discovery of significant air-side fouling of air handling unit WMA-AH-53A. On May 28, 2013, the licensee cleaned the cooling coil for air handling unit WMA-AH-53A under Work Order 02040998. On May 29, 2013, the licensee initiated Action Request AR 286069 documenting that the roll-filter for WMA-AH-53A was installed backwards.

On July 22, 2013, the inspectors reviewed Action Requests AR 285720 and AR 286059 and determined that no causal evaluation had been performed for the nonconforming condition involving the incorrect installation of the roll-filter for air-handling-unit WMA-AH-53A. The inspectors also reviewed Work Order 02033663 used for the most recent roll-filter replacement conducted on November 15, 2012. Step 2.2 of this work order directed mechanical maintenance to use Procedure PPM 10.2.68, "Roll-filter Media Replacement," Revision 10. Interviews with station personnel revealed that the procedure contained conflicting guidance with regard to the orientation of roll-filter media. Specifically, Procedure PPM 10.2.68, Step 7.1, directed personnel to, "refer to Figure 7.1c and install turn filter roll to unroll as depicted with scrim on air-leaving side of media." This step cannot be completed as written because of a conflict between Figure 7.1c and the configuration of the roll-filters received from the vendor. Interviews conducted with mechanical maintenance personnel revealed that this procedure conflict contributed to the incorrect installation of the filter for WMA-AH-53A on November 15, 2012. This had not previously been recognized by the licensee until the inspectors requested an interview with station personnel responsible for installing horizontal roll-filters. The licensee initiated Action Request AR 291067 to address the procedure conflict in Step 7.1.

Despite this conflict, the procedure included several additional procedural steps after Step 7.1 that, if completed, should have ensured that the scrim material was oriented correctly. Consequently, the inspectors determined that the licensee had failed to follow Procedure PPM 10.2.68 on November 15, 2012, which had resulted in incorrect orientation of the roll-filter media. The licensee initiated Action Request AR 286069 to document the failure to follow Procedure PPM 10.2.68 on November 15, 2012.

Analysis. The failure to perform roll-filter media replacement for safety-related air handling units in accordance with an approved procedure was a performance deficiency. The performance deficiency was more than minor because it affected the equipment performance attribute of the Mitigating Systems Cornerstone objective and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. The inspectors performed the initial significance determination using NRC Inspection Manual Chapter 0609, Appendix A, Exhibit 2, "Mitigating Systems Screening Questions." The inspectors determined that the finding required a detailed risk evaluation because it represented a potential loss of one train of safety related equipment for longer than the technical specification allowed outage times.

A Senior Reactor Analyst performed a risk evaluation. The analyst determined that although potentially inoperable per the technical specifications definition, the ventilation fan remained functional and capable of performing the function credited in the licensee's probabilistic risk assessment (PRA) for at least 24 hours. The analyst based this determination on the following influential assumptions:

- The HVAC unit had some remaining heat removal capability; the unit was not completely clogged and was passing air flow. This was evidenced by a non-safety-related cooling coil, which was able to maintain the room temperatures

within the temperature limits. This cooling unit was in series with the safety related cooling unit.

- The temperature-specific operability limit, as specified in the Final Safety Analysis Report, Table 9.4-1, "Main Control Room/Cable Spreading Room/Critical Switchgear Area/Major Components of HVAC Systems," varied between 110°F to 120°F. However, for PRA purposes, the analyst was most interested in the temperature at which the equipment could actually fail. The analyst used engineering judgment and industry operating experience to select 135°F for this purpose. Operating experience from another licensee had found that certain 480Vac circuit breakers had thermal-electric devices and could experience temperature-induced failures starting around 135°F. In addition, chargers and inverters could suffer temperature-induced failures but at temperatures higher than 135 °F. Large breakers, such as the 4160 Vac breakers, if already in their safety positions, should not be affected at these temperatures.
- The inspectors and the analyst performed calculations which demonstrated that, during design basis accident conditions, the safety related cooling coil could maintain the safety related areas below 135°F if total fouling was less than approximately 75%.
- The licensee performed testing of a mockup system (using the same design as the safety related unit) at a laboratory near Chicago, IL from approximately October 21 to November 6, 2013. The NRC Senior Reactor Analyst observed the testing setup and some of the testing from October 28 through November 2, 2013.
- The analyst, while separately applying 40% fouling on the internal water side, was able to verify that the overall fouling remained less than 65% total. The material that was used to foul the heat exchanger during Test-10 (the most representative test) was porous and permitted substantial air flow to enter the cooling coil. This material was similar to that identified on the safety related cooling coil in the as-found condition.

Because the cooling could perform its probabilistic risk analysis function, the finding screened to Green in accordance with Inspection Manual Chapter 0609, Appendix A, Exhibit 2, "Mitigating Systems Screening Questions." Therefore, the finding is of very low safety significance (Green).

This finding had a cross-cutting aspect in the area of human performance associated with the work practices components because the licensee failed to implement human error prevention techniques, such as holding pre-job briefings, self and peer checking, and proper documentation of activities when installing horizontal roll-filters in safety-related applications [H.4(a)].

Enforcement. Technical Specification 5.4.1.a requires, in part, that written procedures be established, implemented, and maintained as recommended in Regulatory

Guide 1.33, Revision 2, Appendix A, dated February 1978. Paragraph 9.a of Regulatory Guide 1.33, Appendix A, requires written procedures for performing maintenance that can affect the performance of safety-related equipment. Contrary to the above, on November 15, 2012, the licensee failed to implement written procedures as recommended in Regulatory Guide 1.33, Revision 2, Appendix A, dated February 1978. Specifically, on November 15, 2012, when installing a roll-filter for the Division 1 critical switchgear air handling unit WMA-AH-53A, the licensee failed to implement Procedure PPM 10.2.68, "Roll-filter Media Replacement," Revision 10, Step 7.15.x, which requires, in part, that personnel, "ensure filter media scrim (reinforced backing) is on the downstream (air leaving) side of the filter." Consequently, the licensee installed the roll-filter for WMA-AH-53A backwards such that the scrim material used to retain the filter media was oriented opposite of air flow which allowed the media to become dislodged and deposited on the face of cooling coil WMA-CC-53A.

The licensee discovered this issue on May 24, 2013, and corrected it during Refueling Outage R21. Because this finding was of very low safety significance (Green) and was entered into the licensee's corrective action program as Action Request AR 286069, this violation is being treated as a non-cited violation consistent with the Enforcement Policy: NCV 05000397/2013010-04, "Failure to Follow Procedures when Installing Roll-filters in Safety-Related Air-Handling Units."

.5 Failure to Maintain and Adequately Test Control Room HVAC System Results in Violation of Plant's Technical Specifications

Introduction. The inspectors identified a Green, non-cited violation of Technical Specification 3.7.4, "Control Room Air Conditioning (AC) System," involving the licensee's failure to adequately test and maintain the control room heating, ventilation, and air conditioning (HVAC) system.

Description. On October 30, 2012, the NRC identified that the licensee's procedures for testing of the control room heating, ventilation, and air conditioning (HVAC) were inadequate to satisfy Technical Specification Surveillance Requirement 3.7.4.1. This surveillance requirement verifies that the heat removal capability of the control room HVAC system is sufficient to remove the control room heat load assumed in the safety analyses. The inspectors brought this information to the shift manager on the afternoon of October 31, 2012. Following the inspectors' challenge, the shift manager declared Surveillance Requirement 3.7.4.1 missed for both trains of control room HVAC and applied Surveillance Requirement 3.0.3. Surveillance Requirement 3.0.3 allowed the licensee to delay declaring the limiting condition for operation not met for up to the limit of the specified frequency following the performance of a risk assessment. The risk assessment performed under Engineering Change EC 11364 allowed the licensee to delay completing the missed surveillance for 24 months. The NRC issued non-cited violation 05000397/2012005-04 on February 8, 2013, documenting the failure of the licensee to perform required surveillance testing of the control room HVAC system.

On March 2, 2013, the licensee performed Procedure TSP-CR/HVAC-B101, "Control Room AC Heat Load Capacity Test – Div 1," Revision 1, to test the heat removal

capability of the control room HVAC to comply with Technical Specification Surveillance Requirement 3.7.4.1. The licensee developed and implemented procedure TSP-CR/HVAC-B101 in response to the non-cited violation issued by the NRC. During the initial performance of this procedure, the licensee determined that the Division 1 control room HVAC cooling coil had an overall heat transfer coefficient of 62.6 percent of design, which was less than the acceptance criteria established in station calculations of 65 percent. Since the as-found heat removal capability was less than the required heat removal capability assumed in the Columbia Generating Station safety analysis, the licensee declared the Division 1 control room HVAC system inoperable and entered the applicable action statements in Technical Specification 3.7.4, "Control Room Air Conditioning (AC) System." To address the degraded condition on the Division 1 control room HVAC system, the licensee visually inspected and cleaned cooling coil WMA-CC-51A1. During these inspections, the licensee discovered degraded sacrificial anode material blocking the cooling coil supply header, which reduced the header's thermal performance capability. The licensee chemically cleaned cooling coil WMA-CC-51A1 on March 18, 2013. Following the cleaning of the coil, the licensee re-performed Procedure TSP-CR/HVAC-B101, and the results showed an improvement in the heat removal capability such that, operability of the Division 1 control room HVAC system could be assured. The licensee exited Technical Specification Action Statement 3.7.4, Condition A, on March 21, 2013.

Because the licensee had conducted the surveillance testing for the Division 1 control room HVAC cooling coil late, and because the results of the late surveillance revealed that the system was unable to meet its surveillance requirements, the licensee reported the failure of the Division 1 control room HVAC cooling coil to the NRC as a condition prohibited by the plant's technical specifications by submitting Licensee Event Report 2013-002-00, "Main Control Room Cooler Failed Surveillance," on May 1, 2013. The licensee initiated Action Request 279768 to address the failure of cooling coil WMA-CC-51A1.

Analysis. The failure to comply with the plant's technical specifications for the control room HVAC system was a performance deficiency. The performance deficiency was more than minor because it affected the equipment performance attribute of the Mitigating System Cornerstone objective and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. The inspectors performed the initial significance determination for the failure of the Division 1 control room air conditioning unit using NRC Inspection Manual Chapter 0609, Appendix A, Exhibit 2, "Mitigating Systems Screening Questions." The inspectors determined that the ventilation fan remained functional and capable of performing the probabilistic risk assessment function for at least 24 hours. Therefore the finding is of very low safety significance (Green). This finding had a cross-cutting aspect in the area of problem identification and resolution associated with the corrective action program component because the licensee failed to thoroughly evaluate problems such that the resolutions address causes and extent of conditions, as necessary. Specifically, the licensee failed to fully evaluate the existence of degraded sacrificial anodes in safety-related room

coolers such that corrective actions to address these issues were implemented in a timely manner, commensurate with their significance [P.1(c)].

Enforcement. Technical Specification 3.7.4, "Control Room Air Conditioning (AC) System," requires, in part, that two control room AC subsystems shall be operable in Modes 1, 2 and 3. Technical Specification 3.7.4, Condition A, requires that when one control room AC subsystem is inoperable, action is taken to restore the control room AC subsystem to operable status within 30 days or the unit to be placed in Mode 3 within an additional 12 hours. Contrary to the above, from October 31, 2012, until March 2, 2013, the train A control room air conditioning system was inoperable and action was not taken to either restore the system to operable status within thirty days or place the unit in Mode 3 within the following 12 hours. Upon discovery, the licensee performed cleaning and thermal performance testing of the train A control room air conditioning subsystem to restore the system to operable status. Because this violation was of very low safety significance (Green) and it was entered into the licensee's corrective action program as Action Request AR 279768, this violation is being treated as a non-cited violation, consistent with the Enforcement Policy: NCV 05000397/2013010-05, "Failure to Comply with Plant Technical Specifications for Control Room Air Conditioning System."

#### **40A3 Follow-up of Events and Notices of Enforcement Discretion (71153)**

(Closed) Licensee Event Report 05000397/2013-002-00, "Main Control Room Cooler Failed Surveillance"

On October 30, 2012, the NRC reviewed the licensee's procedures for testing the heat removal capability of the control room heating, ventilation, and air conditioning system. During that review, the inspectors determined that the testing procedures used to satisfy Technical Specification Surveillance Requirement 3.7.4.1 were inadequate because they did not test the control room AC subsystem but instead tested the service water pump house coolers. Following discovery of this issue, the licensee declared Surveillance Requirement 3.7.4.1 missed for both trains of control room HVAC and applied Surveillance Requirement 3.0.3 which allowed the licensee to delay declaring the limiting condition for operation not met for a limited period of time following the performance of a risk assessment. The enforcement aspects involving the inadequacies with the licensee's testing procedures for the control room air conditioning system are discussed in non-cited violation NCV 05000397/2012005-04, "Failure to Perform Adequate Surveillance Testing of the Control Room Air Conditioning System."

On March 2, 2013, the licensee completed testing required by Technical Specification Surveillance Requirement 3.7.4.1 and discovered that the "A" train did not meet the heat removal capability acceptance criteria. Consequently, the inoperability of the "A" train was determined to be a condition prohibited by the plant's technical specifications and reportable under 10 CFR 50.73(a)(2)(i)(B). The inspectors reviewed the licensee event report associated with this event and determined that the report adequately documented the summary of the event including the potential safety consequences and corrective actions required to address issues related to testing of the control room air conditioning system such that future technical specification violations will be avoided. The inspectors

identified an additional violation of Technical Specification 3.7.4. The enforcement aspects of this violation are listed in Section 3.9 of this report. This licensee event report is closed.

#### **40A6 Meetings, Including Exit**

##### Exit Meeting Summary

On July 26, 2013, the inspectors debriefed Mr. B. Sawatzke, Vice President Nuclear Operations and Chief Nuclear Officer, and other members of the licensee's staff. The licensee representatives acknowledged the findings presented. The inspectors asked the licensee whether any materials examined during the inspection should be considered proprietary. No proprietary information was identified.

On November 21, 2013, the inspectors conducted an exit briefing with Mr. W. Hettel, Vice President, Operations, and other members of the licensee's staff. The licensee representatives acknowledged the findings presented. The inspectors asked the licensee whether any materials examined during the inspection should be considered proprietary. No proprietary information was identified.

#### **40A7 Licensee-Identified Violations**

The following violations of very low safety significance (Green) were identified by the licensee and are violations of NRC requirements which meet the criteria of the NRC Enforcement Policy for being dispositioned as non-cited violations.

- .1 Technical Specification 5.4.1.a, "Procedures," requires, in part, that written procedures be established, implemented, and maintained as recommended in Regulatory Guide 1.33, Revision 2, Appendix A, dated February 1978. Paragraph 9.b of Regulatory Guide 1.33, Appendix A, requires, in part, that preventive maintenance schedules should be developed for inspection or replacement of parts that have a specific lifetime. Contrary to the above the licensee failed to implement written procedures as recommended in Regulatory Guide 1.33, Revision 2, Appendix A, dated February 1978. Specifically, prior to July 25, 2013, the licensee failed to establish an inspection or replacement schedule for sacrificial anodes in safety-related heat exchangers. This finding was identified by the licensee and entered in the licensee's corrective action program as Action Request AR 266779. This finding was determined to be of very low safety significance because the failure to establish an inspection or replacement program did not result in a loss of functionality of service-water-supplied heat exchangers.
- .2 Technical Specification 5.4.1.a, "Procedures," requires, in part, that written procedures be established, implemented, and maintained as recommended in Regulatory Guide 1.33, Revision 2, Appendix A, dated February 1978. Paragraph 9.a requires that maintenance that can affect the performance of safety-related equipment should be properly preplanned and performed in accordance with written procedures, documented instructions, or drawings appropriate to the circumstances. Contrary to the above, the licensee failed to implement written procedures as recommended in Regulatory

Guide 1.33, Revision 2, Appendix A, dated February 1978. Specifically, on May 13, 2002, August 9, 2003, December 2, 2005, September 28, 2007, September 21, 2009, and April 18, 2011, the licensee failed to inspect the air-side of the Division 1 critical switchgear room air handling unit WMA-AH-53A in accordance with written instructions because the air handling unit roll-filter was not removed to allow for a comprehensive inspection of the cooling coil surface. This finding was identified by the licensee and entered in the licensee's corrective action program as Action Requests AR 285811. This finding was determined to be of very low safety significance because the failure to perform a required inspection did not result in a loss of functionality of service-water-supplied heat exchangers.

## **SUPPLEMENTAL INFORMATION**

### **KEY POINTS OF CONTACT**

#### **Licensee Personnel**

C. Blake, System Engineer  
V. Bhardwaj, Manager, System Engineer  
C. England, Manager, Organization Effectiveness  
D. Gregoire, Manager, Regulatory Affairs  
D. Gregory, Principal Engineer  
B. Guldemon, Manager, Recovery  
R. Guthrie, Continuing Training Supervisor  
G. Hettel, Vice President, Operations  
A. Javorik, Vice President, Engineering  
M. Kennedy, Safety Analysis Supervisor  
B. MacKissock, Plant General Manager  
S. Nappi, Corrective Action Program Supervisor  
B. Sawatzke, Chief Nuclear Officer  
J. Slack, Component Group Manager  
P. Voordepoorte, FIN Team Supervisor  
D. Wolfgramm, Senior Licensing Engineer

#### **NRC Personnel**

M. Hayes, Resident Inspector  
G.Replogle, Senior Reactor Analyst

### **LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED**

#### **Opened and Closed**

05000397-2013010-01	NCV	Failure to Determine Cause for a Significant Condition Adverse to Quality (Section 3.9.1)
05000397-2013010-02	NCV	Failure to Evaluate Operability of System Wide Anode Degradation in the Service Water System (Section 3.9.2)
05000397-2013010-03	NCV	Failure to Perform Adequate Testing of the Service Water Supplied Room Coolers (Section 3.9.3)
05000397-2013010-04	NCV	Failure to Follow Procedures when Installing Roll-filters in Safety-related Air Handling Units (Section 3.9.4)
05000397-2013010-05	NCV	Failure to Comply with Plant Technical Specifications for Control Room Air Conditioning System (Section 3.9.5)

#### **Closed**

05000397/2013-002-00	LER	Main Control Room Cooler Failed Surveillance (Section 40A3)
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## LIST OF DOCUMENTS REVIEWED

### CALCULATIONS

<u>NUMBER</u>	<u>TITLE</u>	<u>REVISION</u>
0192-0011-CLC-001	Demonstration of Critical Switch Gear Air Handling Cooling Coil Performance	0
9.32.25	Control Building – Critical Switchgear – WMA-AH-53A	1
9.32.26	Control Building – Critical Switchgear – WMA-AH-53B	1
E/I-02-92-14	Heat Load Calculation for Electrical Equipment and Cables	5
ME-02-92-43	Calculation for Room Temperature for DG Building and R&W and SW Pumphouse Under Design Basis Accident Conditions	8
NAI-1783-001	Evaluation of WMA-CC-53A1 Operability	0

### DRAWINGS

<u>NUMBER</u>	<u>TITLE</u>	<u>REVISION</u>
7AB427	Coil Assembly	6
CVI 67-00, 213	Horizontal Automatic Roll-filter Model # HAR 6-110	0
CVI 67-00, 228	Mixing Box Frame Assembly WMA-AH-53A	3
CVI 67-00, 229	Coil Frame Ass'y WMA-AH-53A	3
CVI 67-00, 229	Fan Frame Ass'y WMA-AH-53A	2
CVI 67-00, 253	Base Ass'y and Det. For Mixing Box Section WMA-AH-53A	2
CVI 67-00, 254	Base Ass'y and Det. For Coil Section WMA-AH-53A	1
CVI 67-00, 255	Base Ass'y and Det. For Fan Section WMA-AH-53A	1
CVI 67-00, 293	Heater for Tag No. WMA-AH-53A	1
CVI 216-00, 600	WMA-AH-53A and WMA-AH-53B	1
M508-1	Flow Diagram Plant Service Water System All Buildings	125
M524-1	Flow Diagram Standby Service Water System Reactor, Radwaste, D.G. Bldg's and Yard	116
M548-1	Flow Diagram HVAC for Control and Switchgear Rooms Radwaste Building	101
M548-2	Flow Diagram HVAC for Control and Switchgear Rooms Radwaste Building	8

DRAWINGS

<u>NUMBER</u>	<u>TITLE</u>	<u>REVISION</u>
M550-1	Flow Diagram HVAC Chilled Water System Radwaste Building	36
M550-2	Flow Diagram HVAC Chilled Water System Radwaste Building	5
SW-1537-1	Supply from SW-305-4S to WMA-CC-53A1	7

PROCEDURES

<u>NUMBER</u>	<u>TITLE</u>	<u>REVISION</u>
ABN-HVAC	HVAC Trouble	10
PPM 1.3.66	Operability and Functionality Evaluation	27
PPM 10.2.68	Roll-filter Media Replacement	10-11
SWP-CAP-01	Corrective Action Program	27
SWP-CAP-06	Condition Review Group (CRG)	20
SWP-LIC-01	Regulatory Commitment Management	4
SWP-PRO-01	Procedure and Work Instruction Use and Adherence	24

ACTION REQUESTS

236249	264261	266779	266817	279768
280320	280516	280846	283574	283867
285720	285776	285811	286069	286683
288871	290410	290331	290553	

WORK ORDERS

01039451	01054220	01086055	01109659	01143345
01142657	01169554	01171658	01172096	01172759
01173055	01173470	01173917	01177999	01178000
01178001	01187049	01178064	01178491	01197637
01195715	01195716	01197638	02001311	02003088
02004011	02004831	02005214	02005709	02007113

02008395	02006334	02008396	02008800	02017908
02026800	02026929	02026930	02028640	02028641
02029531	02032254	02033542	02033663	02041716

MISCELLANEOUS DOCUMENT

<u>NUMBER</u>	<u>TITLE</u>	<u>REVISION / DATE</u>
AR-SA 276930	Focused Self Assessment Report 2013 GL 89-13 and Service Water Self-Assessment for Ultimate Heat Sink Inspection	0
EC 11364	Control Room HVAC Missed Surveillance SR 3.7.4.1	November 1, 2012
EC 11767	DES-2-11 Evaluation to Support WMA-CC-53A1 and 53B1 Operability	March 15, 2013
Information Notice No. 83-46	Common-Mode Valve Failures Degrade Surry's Recirculation Spray Subsystem	July 11, 1983
Information Notice No. 85-24	Failures of Protective Coatings in Pipes and Heat Exchangers	March 26, 1985
Information Notice No. 85-30	Microbiologically Induced Corrosion of Containment Service Water System	April 19, 1985
Information Notice No. 86-96	Heat Exchanger Fouling Can Cause Inadequate Operability of Service Water Systems	November 20, 1986
Information Notice No. 87-06	Loss of Suction to Low Pressure Service Water System Pumps Resulting from Loss of Siphon	January 30, 1987
BID FAN-1	PM Background Information Air Handling Units	
TM-2111	Thermal Performance Testing of the Air-to-Water Heat Exchangers in the WNP-2 SW System	0
	WNP-2 Heat Exchanger Data Sheet for WMA-CC-53A1	October 24, 1990



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
REGION IV  
1600 EAST LAMAR BLVD  
ARLINGTON, TEXAS 76011-4511

July 18, 2013

MEMORANDUM TO: Jeremy R. Groom, Senior Resident Inspector  
Columbia Generating Station  
Division of Reactor Projects

FROM: Kriss M. Kennedy, Director */RA/*  
Division of Reactor Projects

SUBJECT: CHARTER FOR SPECIAL INSPECTION AT COLUMBIA  
GENERATING STATION

In response to the identification of significant air-side fouling of the Division I critical switchgear room cooler WMA-AH-53A, a special inspection will be performed. You have been selected to conduct the special inspection.

A. Basis

During inspections of Division I critical switchgear room cooler WMA-AH-53A, the licensee discovered a large amount of fibrous material coating the air-side of the cooling coil. Also, the air-side had a coating of thick dust and debris. The licensee estimated that 95 percent of the air-side surface was covered in thick dust/debris and about 60 percent was covered in fibrous material. An estimate by the licensee determined that total cooling coil efficiency would be reduced to approximately 30 percent, which is less than the 65 percent coil efficiency assumed in station calculations. Subsequent review revealed that the "roll filter" for the unit was installed backwards, which caused the fibrous material in the filter to break apart and be deposited on the air-side of the cooling coil. Because the cooling coils are not tested for heat removal capability, the licensee had a 2-year preventive maintenance task to ensure the air-side is clean and free of debris. However, the licensee had not performed this preventive maintenance task for six years. Room cooler WMA-AH-53A provides cooling to several critical Division I electrical power supplies for equipment used to mitigate the consequences of an accident.

A regional Senior Reactor Analyst preliminarily estimated the Incremental Conditional Core Damage Probability for this issue to be 7 E-6, which falls in the special inspection region of the Management Directive 8.3 matrix. One of the deterministic criteria was met in that a potential loss of safety function may have occurred for the Division I critical switchgear room cooler. Thus, a special inspection will be performed.

## B. Inspection Scope

1. Develop a complete sequence of events related to the discovery of the degraded condition.
2. Review operating experience involving prior fouling of service water cooled room coolers and evaluate if Columbia Generating Station adequately addressed applicable operating experience.
3. Review the licensee's assessment of past operability for WMA-AH-53A.
4. Review the licensee's root cause analysis and determine if it was conducted to a level of detail commensurate with the significance of the problem.
5. Determine if the licensee's corrective actions have addressed the extent of condition and assess whether these actions are adequate to prevent recurrence. In particular, determine if any other air-to-water heat exchangers may be similarly fouled.
6. Review the technical basis for the licensee's inspection, cleaning, and testing of service water cooled heat exchangers to determine if it meets the guidance provided in Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment," and if the licensee followed their implementing program.
7. Examine the preventative maintenance program for WMA-AH-53A and other similarly designed heat exchangers to determine if the established cleaning intervals are adequate and if the licensee has followed their program. Compare the licensee's preventive maintenance program to established industry standards.
8. Review the processes and procedures for installing roll-filters in safety-related room coolers.
9. Review the licensee's compliance with the Technical Specifications. In particular, focus on the licensee's decision to enter the Division II work window in Refueling Outage 21 without first cleaning WMA-AH-53A.
10. Collect data to support an independent assessment of the risk significance of the condition.

## C. Guidance

Inspection Procedure 93812, "Special Inspection," will be used during this inspection. The inspection should emphasize fact-finding in its review of the circumstance surrounding this event. It is not the responsibility of the team to examine the regulatory process. Safety concerns identified that are not directly related to the event should be reported to the Region IV office for appropriate action.

The inspection is scheduled to be conducted the week of July 22, 2013. While onsite, you will provide daily status briefings to Region IV management, who will coordinate with the Office of Nuclear Reactor Regulation, to ensure that all other parties are kept informed. The inspection results will be documented in Special Inspection Report 05000397/2013010. This report will be issued within 45 days of the completion of the inspection.

This guidance may be modified should you develop significant new information that warrants review. Should you require support for the final determination of the risk significance of any issue, contact George Replogle at (817) 200-1249. Should you have any questions concerning this guidance, contact Wayne Walker at (817) 200-1148.

Docket No.: 05000397

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