UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
245 PEACHTREE CENTER AVENUE NE, SUITE 1200
ATLANTA, GEORGIA 30303-1257

December 6, 2013

Mr. George T. Hamrick
Site Vice President
Brunswick Steam Electric Plant
8470 River Road SE
Southport, NC 28461-0429

SUBJECT: BRUNSWICK STEAM ELECTRIC PLANT - NRC COMPONENT DESIGN BASES INSPECTION REPORT 05000325/2013007 and 05000324/2013007

Dear Mr. Hamrick:

On October 24, 2013, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at your Brunswick Steam Electric Plant Units 1 and 2 and discussed the results of this inspection with you and other members of your staff. Inspectors documented the results of this inspection in the enclosed inspection report.

NRC inspectors documented six findings of very low safety significance (Green) in this report. All of these findings involved violations of NRC requirements. The NRC is treating these violations as non-cited violations (NCVs) consistent with Section 2.3.2.a of the Enforcement Policy.

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

If you disagree with a cross-cutting aspect assignment in this report, you should provide a response within 30 days of the date of this inspection report, with the basis for your disagreement, to the Regional Administrator, Region II; and the NRC resident inspector at the Brunswick plant.

In accordance with Title 10 of the *Code of Federal Regulations* 2.390, “Public Inspections, Exemptions, Requests for Withholding,” 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

Rebecca L. Nease, Chief
Engineering Branch 1
Division of Reactor Safety

Docket Nos.: 05000325, 05000324
License Nos.: DPR-71, DPR-62

Enclosure:
Inspection Report 05000325/2013007, 05000324/2013007
w/ Attachment: Supplementary Information

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Letter to George T. Hamrick from Rebecca L. Nease dated December 6, 2013.

SUBJECT: BRUNSWICK STEAM ELECTRIC PLANT - COMPONENT DESIGN BASES INSPECTION REPORT 05000325/2013007 AND 05000324/2013007

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U. S. NUCLEAR REGULATORY COMMISSION

REGION II

Docket Nos.:	50-325, 50-324
License Nos.:	DPR-71, DPR-62
Report Nos.:	05000325/2013007, 05000324/2013007
Licensee:	Duke Energy Progress Inc.
Facility:	Brunswick Steam Electric Plant, Units 1 and 2
Location:	8470 River Road, SE Southport, NC 28461
Dates:	September 9, 2013, through October 24, 2013
Inspectors:	E. Stamm, Senior Reactor Inspector (Lead) M. Catts, Senior Resident Inspector (Brunswick) N. Coovert, Reactor Inspector J. Eargle, Senior Reactor Inspector G. Ottenberg, Senior Reactor Inspector M. Riley, Reactor Inspector G. Skinner, Contractor (Electrical) M. Yeminy, Contractor (Mechanical)
Approved by:	Rebecca L. Nease, Chief Engineering Branch 1 Division of Reactor Safety

SUMMARY

IRs 05000325/2013007 and 05000324/2013007; 9/9/2013 – 10/24/2013; Brunswick Steam Electric Plant, Units 1 and 2; Component Design Bases Inspection.

This inspection was conducted by a team of five Nuclear Regulatory Commission (NRC) inspectors from Region II, one NRC senior resident inspector, and two NRC contract personnel. Six Green non-cited violations (NCVs) were identified. The significance of inspection findings is indicated by their color (Green, White, Yellow, Red) using the NRC Inspection Manual Chapter (IMC) 0609, "Significance Determination Process," dated June 2, 2011. Cross-cutting aspects are determined using IMC 0310, "Components Within the Cross Cutting Areas," dated October 28, 2011. All violations of NRC requirements are dispositioned in accordance with the NRC's Enforcement Policy, dated January 28, 2013. 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.

<u>NRC identified and Self-Revealing Findings</u>

Cornerstone: Mitigating Systems

- <u>Green</u>: The team identified a non-cited violation of 10 CFR Part 50, Appendix B, Criterion XI, "Test Control," for the licensee's failure to incorporate adequate acceptance criteria in the Class 1E station battery service test procedures. This failure to incorporate adequate acceptance criteria was a performance deficiency. The licensee entered this issue into their corrective action program as nuclear condition reports 632998 and 630621. The licensee performed a prompt determination of operability to verify that the batteries would be capable of supplying the necessary voltage to safety-related direct current loads at the required time intervals specified in design bases calculations.

  The performance deficiency was determined to be more than minor because it was associated with the Design Control attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Specifically, using an acceptance criterion of 105 volts direct current during the service test could result in incorrectly declaring a Class 1E station battery operable when greater terminal voltages, as specified in design bases calculations, were necessary for safety-related equipment to operate during the first minute of a design basis accident. The team determined the finding to be of very low safety significance (Green) because the finding was a deficiency affecting the design or qualification of a mitigating structure, system, or component which maintained its operability or functionality. The team determined that no cross-cutting aspect was applicable because the finding was not indicative of current licensee performance. (Section 1R21.2.b.i)

- <u>Green</u>: The team identified a non-cited violation of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," with three examples, for the licensee's failure to properly incorporate the design and licensing bases for the 125 volt direct current system into design calculations. This failure to properly incorporate the design and licensing bases for the 125 volts direct current system into design calculations was a performance deficiency. The licensee entered these issues into their corrective action program as nuclear condition reports 632998, 630621, 633538, and 633889. The licensee conducted a combination of

prompt determinations of operability and engineering evaluations which provided reasonable expectation of operability of the direct current system pending final resolution.

The performance deficiency was determined to be more than minor because it was associated with the Design Control attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Specifically, there was reasonable doubt as to whether direct current system components would have adequate voltage to operate during design basis accidents. The team determined the finding to be of very low safety significance (Green) because the finding was a deficiency affecting the design or qualification of a mitigating structure, system, or component which maintained its operability or functionality. The team determined that no cross-cutting aspect was applicable because the finding was not indicative of current licensee performance. (Section 1R21.2.b.ii)

- Green: The team identified a non-cited violation of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," for the licensee's failure to verify the adequacy of the service water intake structure ventilation design through calculational methods. This failure to verify the adequacy of the service water intake structure ventilation design was a performance deficiency. The licensee entered this issue into their corrective action program as nuclear condition report 627708. The licensee performed a prompt determination of operability and implemented a number of compensatory actions to ensure safety-related components in the intake structure would not fail under the worst case high temperature conditions.

  The performance deficiency was determined to be more than minor because it was associated with the Design Control attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Specifically, there was reasonable doubt as to whether safety-related components in the service water intake structure would be operable under design temperatures. The team determined the finding to be of very low safety significance (Green) because the finding was a deficiency affecting the design or qualification of a mitigating structure, system, or component which maintained its operability or functionality. The team determined that no cross-cutting aspect was applicable because the finding was not indicative of current licensee performance. (Section 1R21.2.b.iii)

- Green: The team identified a non-cited violation of 10 CFR 50.65(b)(1), for the licensee's failure to scope the safety-related service water intake structure exhaust fan dampers into the Maintenance Rule program. This failure to scope safety-related service water intake structure exhaust fan dampers was a performance deficiency. The licensee entered this issue into their corrective action program as nuclear condition reports 630922, 627708, 630553, and 630993. The licensee has subsequently implemented corrective actions to include the dampers within the scope of the Maintenance Rule program.

  The performance deficiency was determined to be more than minor because it was associated with the Equipment Performance attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective of ensuring availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Specifically, numerous dampers were found in degraded conditions such that effective control of performance or condition through appropriate preventive maintenance under 10

CFR 50.65(a)(2) could not be demonstrated. The team determined the finding to be of very low safety significance (Green) because the finding did not result in an actual loss of function of at least a single service water system train for greater than its technical specifications allowed outage time. The team determined that no cross-cutting aspect was applicable because the finding was not indicative of current licensee performance. (Section 1R21.2.b.iv)

- Green: The team 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 plant procedures specifying requirements for preventive maintenance of safety-related dampers. This failure to follow plant procedures was a performance deficiency. The licensee entered this issue into their corrective action program as nuclear condition reports 631376, 628132, 633710, and 631711. The licensee performed an immediate determination of operability to verify the as-found condition of the dampers did not affect operability of equipment inside the diesel generator building and implemented corrective actions to complete the missed preventive maintenance on the dampers.

  The performance deficiency was determined to be more than minor because it was associated with the Equipment Performance attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective of ensuring availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Specifically, the programmatic failure to perform preventive maintenance on the nine dampers resulted in decreased availability and reliability of the dampers such that multiple dampers were found in degraded conditions. The team determined the finding to be of very low safety significance (Green) because the finding did not result in an actual loss of function of at least a single emergency diesel generator for greater than its technical specifications allowed outage time. The team determined that this finding was associated with the cross-cutting aspect of Supervisory Oversight in the Work Practices component of the Human Performance area because Brunswick supervisors did not enforce the scheduled preventive maintenance nor did they ensure a justification for not performing preventive maintenance on safety-related components. [H.4(c)] (Section 1R21.2.b.v)

- Green: A self-revealing non-cited violation of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," was identified for the licensee's failure to verify or check the adequacy of design of the Unit 2 A residual heat removal heat exchanger bypass valve 2-E11-F048A. This failure to verify or check the adequacy of design of the bypass valve was a performance deficiency. The licensee entered this issue into their corrective action program as nuclear condition report 598294. The licensee's corrective actions included replacing the four valve yoke to bonnet hold down studs and initiating long term corrective actions to perform a design change to reduce vibration on the valve.

  The performance deficiency was determined to be more than minor because, if left uncorrected, it could become a more significant safety concern. Specifically, continued fatigue of the studs could have resulted in a more degraded state than the actual as-found condition, which could have affected the ability of the valve to operate for its safety-related function. The team determined the finding to be of very low safety significance (Green) because the finding was a deficiency affecting the design or qualification of a mitigating structure, system, or component which maintained its operability. The team determined that no cross-cutting aspect was applicable because the finding was not indicative of current licensee performance. (Section 1R21.2.b.vi)

Licensee-Identified Violations

None

REPORT DETAILS

1. REACTOR SAFETY

Cornerstones: Initiating Events, Mitigating Systems, Barrier Integrity

1R21 Component Design Bases Inspection (71111.21)

.1 Inspection Sample Selection Process

The team selected risk-significant components and related operator actions for review using information contained in the licensee's probabilistic risk assessment. In general, this included components and operator actions that had a risk achievement worth factor greater than 1.3 or Birnbaum value greater than 1E-6. The sample included 15 components, one of which was associated with containment large early release frequency (LERF), and four operating experience (OE) items.

The team performed a margin assessment and a detailed review of the selected risk-significant components and operator actions to verify that the design bases had been correctly implemented and maintained. Where possible, this margin was determined by the review of the design basis and Updated Final Safety Analysis Report (UFSAR) response times associated with operator actions. This margin assessment also considered original design issues, margin reductions due to modifications, or margin reductions identified as a result of material condition issues. Equipment reliability issues were also considered in the selection of components for a detailed review. These reliability issues included items related to failed performance test results, significant corrective action, repeated maintenance, maintenance rule status, Regulatory Issue Summary 05-020 (formerly Generic Letter 91-18) conditions, NRC resident inspector input regarding problem equipment, system health reports, industry OE, and licensee problem equipment lists. Consideration was also given to the uniqueness and complexity of the design, OE, and the available defense-in-depth margins. An overall summary of the reviews performed and the specific inspection findings identified is included in the following sections of the report.

.2 Component Reviews

a. Inspection Scope

Components

- Units 1 and 2 nuclear service water (NSW) pump A(B) discharge valves, 1(2)-SW-V19 and 1(2)-SW-V20
- Emergency diesel generator (EDG) jacket water cooler service water inlet valves SW-V681 and SW-V682
- Units 1 and 2 high pressure coolant injection (HPCI) steam admission valves, 1(2)-E41-F001
- Reactor core isolation cooling (RCIC) turbine steam supply control system
- Direct current (DC) switchboards 2A and 2B
- 480V motor control center (MCC) 1PA
- 125/250V DC batteries 1A-1 and 1B-2
- NSW pump 125V DC control power, 4160V Switchgear E1 Compartment AF9

- Battery chargers 1B-1, 1B-2, 2B-1, and 2B-2
- 2-SAMA-Diesel-1
- EDG excitation systems
- Units 1 and 2 main HPCI pumps
- NSW pump 2A and 2B motors
- NSW pump 2A and 2B

<u>Components with LERF Implications</u>
- Unit 2 residual heat removal (RHR) heat exchanger bypass valve, 2-E11-F048A

For the 15 components listed above, the team reviewed the plant technical specifications (TS), UFSAR, design bases documents (DBDs), and drawings to establish an overall understanding of the design bases of the components. Design calculations and procedures were reviewed to verify that the design and licensing bases had been appropriately translated into these documents. Test procedures and recent test results were reviewed against DBDs to verify that acceptance criteria for tested parameters were supported by calculations or other engineering documents, and that individual tests and analyses served to validate component operation under accident conditions. System modifications, vendor documentation, system health reports, preventive and corrective maintenance history, and corrective action program documents were reviewed (as applicable) in order to verify that the performance capability of the component was not negatively impacted, and that potential degradation was monitored or prevented. Maintenance Rule information was reviewed to verify that the component was properly scoped, and that appropriate preventive maintenance was being performed to justify current Maintenance Rule status. Component walkdowns and interviews were conducted to verify that the installed configurations would support their design and licensing bases functions under accident conditions and had been maintained to be consistent with design assumptions.

Additionally, the team performed the following component-specific reviews:

- The team reviewed the design basis analyses and supporting calculations of the nuclear service water to vital header supply valves, SW-V117 and SW-V111, to verify that, during a design basis accident with a single failure of SW-V117, the resulting loss of room cooling to the emergency core cooling system (ECCS) pumps had been evaluated in accordance with licensing documents for the first ten minutes of the potential event.
- The team reviewed service water cooling to the RHR pump seal coolers to determine the pump and system function impacts during applicable modes of operations; and to verify the licensee had adequate processes in place to respond to a loss of seal cooling.
- The team observed a simulator scenario involving low-margin time critical operator actions to manually initiate ECCS following a complete loss of decay heat removal to verify the actions could be accomplished as relied upon in design assumptions.
- The team observed a simulator scenario of an anticipated transient without scram event with successful standby liquid control injection, requiring the use of the HPCI system to control reactor water level at a low level to verify the required control actions could be accomplished within the required times.
- The team observed local manual time critical actions required to strip the DC buses of non-required loads to extend the battery's capability during a postulated dual unit

station blackout event to verify the actions could be accomplished within the assumed timeframe. The team interviewed individuals qualified to the task to ensure training was sufficient to accomplish the task, and reviewed the procedures to ensure sufficient guidance was provided to properly complete the task.

- The team observed local manual time critical actions required to cross-connect service water discharge headers between the two units following a postulated failure of one of the unit's service water discharge valves into the closed position. The team interviewed individuals qualified to the task to ensure training was sufficient to accomplish the task, verified the required access keys and processes were in place to allow for the action to be accomplished, and reviewed the procedure to ensure sufficient guidance was provided to the operator to properly complete the task.
- The team reviewed the results of room heat-up calculations under postulated loss of room cooling conditions and environmental qualification reports for the Units 1 and 2 HPCI steam admission valves, 1(2)-E41-F001, and for the Unit 2 RHR heat exchanger bypass valve, 2-E11-F048A, to ensure the equipment would remain within qualified limits under postulated accident scenarios.
- The team reviewed the molded case circuit breaker preventative maintenance and testing program to verify breakers on the electrical alternating current (AC) and DC distribution systems were reviewed for adverse aging affects.
- The team reviewed whether any abnormal thermography results had been identified for MCC 1PA to verify that the licensee was monitoring the MCC for degradation.
- The team reviewed service water intake structure ventilation fan electrical control schemes.
- The team reviewed the service water intake building ventilation system to verify the design could support all normal and emergency pump line-ups considering the most limiting ambient conditions. The team also performed a review of maintenance procedures, maintenance activities, Maintenance Rule compliance and the adequacy of corrective actions.
- The team reviewed the ventilation system of the EDG building which included the ventilation design and maintenance of the switchgear and MCCs.
- The team reviewed the service water flow rate to the jacket water heat exchanger of EDG #3. This included review of calculations, manufacturer's data, and records of heat exchanger inspection, testing, and maintenance.
- The team reviewed an analysis of potential flooding in the reactor building, EDG building, and service water building.
- The team reviewed the emergency operating procedures with respect to the HPCI pump's net positive suction head limits and vortex limits.

b. <u>Findings</u>

i <u>Inadequate Acceptance Criteria for the Class 1E Station Battery Service Capacity Test Procedure</u>

<u>Introduction</u>: The team identified a Green non-cited violation (NCV) of 10 CFR Part 50, Appendix B, Criterion XI, "Test Control," for the licensee's failure to incorporate adequate acceptance criteria in the Class 1E station battery service test procedures.

<u>Description</u>: Surveillance test procedure 1MST-BAT11AR, "125 VDC Battery 1A-1 Service Capacity Test," Rev. 3, was to be performed every 24 months in accordance with TS surveillance requirement 3.8.4.6. This test was required to meet TS 3.8.4 which

required the licensee to verify the Class 1E station battery had adequate capacity to supply, and maintain in operable status, the required emergency loads for the design duty cycle when subjected to a battery service test. Section 6.1.6 of the procedure contained acceptance criteria which required the station battery to have adequate capacity to maintain battery terminal voltage greater than or equal to 105 VDC during the service test. The team noted that the 105 VDC acceptance criterion contained in the service test procedure differed from voltage requirements contained in design bases calculations.

Design basis calculation BNP-E-6.121, “Electrical Analysis for Safety-Related DC Circuits,” Rev. 1, established minimum DC voltage requirements at 4160 VAC emergency buses E1-E4 to ensure proper operation of emergency bus circuit breakers during a loss of coolant accident/loss of offsite power event. The team noted that these voltages were compared to the available battery voltage from calculation BNP-E-6.120, “125/250VDC System Battery Load Study,” Rev. 4, for each second of the first minute of the event and that several loads in calculation BNP-E-6.121 required battery terminal voltages greater than the 105 VDC acceptance criterion used in the service test procedure for design bases accidents. Upon further review, the team also noted that required battery terminal voltages greater than 105 VDC were included in calculations BNP-E-6.062, “125/250 VDC System Voltage Drop Calculation Unit 1,” Rev. 4F, and BNP-E-6.071, “125/250 VDC System Voltage Drop Calculation Unit 2,” Rev. 3F, which were revised in 2008 and 2006 respectively. For those safety-related loads which required greater than 105 VDC at the battery terminals, the team noted that the acceptance criterion contained in test procedure 1MST-BAT11AR would not ensure the Class 1E station battery had adequate voltage to supply these loads during the first minute of a design basis accident. Furthermore, although the calculations evaluated the voltage each second of the first minute, the test only evaluated the voltage at the 30-second point. The team noted that the acceptance criteria contained in the service test procedure could allow the licensee to declare the station batteries operable when greater terminal voltages were required as specified in the design bases calculations. This condition existed in test procedures for both units on all four Class 1E station batteries. The licensee entered this issue into their corrective action program as nuclear condition reports (NCRs) 632998 and 630621. The licensee also performed a prompt determination of operability which required an engineering evaluation of calculations and previously completed surveillance tests to verify that the batteries would be capable of supplying the necessary voltage to safety-related equipment during the first minute of a design basis accident.

<u>Analysis</u>: The licensee’s failure to incorporate adequate acceptance criteria in the Class 1E station battery service test procedures, as required by 10 CFR Part 50, Appendix B, Criterion XI, was a performance deficiency. The performance deficiency was determined to be more than minor because it was associated with the Design Control attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Specifically, using an acceptance criterion of 105 VDC during the service test could result in incorrectly declaring a Class 1E station battery operable when greater terminal voltages, as specified in design bases calculations, were necessary for safety-related equipment to operate during the first minute of a design basis accident. The team used IMC 0609, Att. 4, “Initial Characterization of Findings,” issued June 19, 2012, for Mitigating Systems, and IMC 0609, App. A, “The Significance Determination Process (SDP) for Findings At-

Power," issued June 19, 2012, and determined the finding to be of very low safety significance (Green) because the finding was a deficiency affecting the design or qualification of a mitigating structure, system, or component (SSC), and the SSC maintained its operability or functionality. The team determined that no cross-cutting aspect was applicable because the finding was not indicative of current licensee performance.

Enforcement: Title 10 CFR Part 50, Appendix B, Criterion XI, "Test Control," requires, in part, that a test program shall be established to assure that all testing required to demonstrate that structures, systems, and components will perform satisfactorily in service is identified and performed in accordance with written test procedures which incorporate the requirements and acceptance limits contained in applicable design documents. Contrary to the above, since 2006, the licensee failed to assure that test procedures incorporated the requirements and acceptance limits contained in design documents. Specifically, TS surveillance procedures for the Class 1E station batteries did not incorporate the requirements and acceptance limits for required battery terminal voltage contained in design bases calculations. The license performed a prompt determination of operability to verify that the batteries would be capable of supplying the necessary voltage to safety-related DC loads at the required time intervals specified in design bases calculations. This violation is being treated as an NCV, consistent with Section 2.3.2 of the Enforcement Policy. The violation was entered into the licensee's corrective action program as NCRs 632998 and 630621. (NCV 05000325/2013007-01; 05000324/2013007-01, Inadequate Acceptance Criteria for the Class 1E Station Battery Service Capacity Test Procedure)

ii Inadequate DC System Calculations – Three Examples

Introduction: The team identified a Green NCV of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," with three examples, for the licensee's failure to properly incorporate the design and licensing bases for the 125VDC system into design calculations.

Description: The team identified deficiencies in DC system calculations as follows:

- Example 1 - Failure to Update Voltage Drop Calculations to Incorporate More Restrictive Loading and Voltage Data
  Voltage drop calculations BNP-E-6.062, "125/250 VDC System Voltage Drop Calculation Unit 1," Rev. 4F, and BNP-E-6.071, "125/250 VDC System Voltage Drop Calculation Unit 2," Rev. 3F, referenced superseded calculations for DC system loading data. The team was concerned that calculations BNP-E-6.062 and BNP-E-6.071 were non-conservative with respect to the superseded calculations for DC system loading which could result in lower available voltages than originally assumed in these calculations. The team found that the current calculation of record for loading, BNP-E-6.120, "125/250VDC System Battery Load Study," Rev. 4, showed higher equipment loading and slightly lower available voltage at some DC panels than was used in the original voltage drop calculations completed in 2006. The licensee entered this issue into their corrective action program as NCR 632998 and following extensive evaluation, concluded, based in part on available voltage from recent service tests, that all circuits would have adequate voltage to operate.

In addition, calculations BNP-E-6.062 and BNP-E-6.071 included analyses for the 4kV and 480V switchgear. These switchgear analyses were superseded by calculation BNP-E-6.121, "Electrical Analysis for Safety-Related DC Circuits," Rev. 1, but there was no notation to this effect in the original calculations. In order to demonstrate reasonable expectation of operability, this issue was evaluated in Engineering Change (EC) 93816 associated with NCR 630621 which was prepared to evaluate battery service testing discrepancies.

- Example 2 - Failure to Consider Effect of Non-safety Related Uninterruptible Power Supply (UPS) Loading on Class 1E Batteries
  Non-safety related UPSs are connected to both a 480VAC input, as well as the safety-related 125VDC system. Calculation BNP-E-6.120 assumed that if 480VAC power was available, then the UPS units would not impose a load on the 125VDC system. However, the team noted that when AC voltage was considered available, voltage could decrease below the required input rating of the UPS units even when grid voltage was within its expected range, and also during the voltage dips caused by starting large motors during accidents. Low AC input voltage can cause the UPS units to transfer to their DC sources. The team also noted that, in order for the UPS loads to transfer back to the AC source, proper functioning of the non-safety related automatic transfer circuits would have to be credited. The team was concerned that the additional loading of the UPS units unto the 125VDC system could reduce the available battery terminal voltage below the minimum required to ensure operation of safety-related equipment during a design bases accident. This issue has existed since initial plant operation.

  In response to the team's concerns, the licensee entered this issue into their corrective action program as NCR 633538. In order to demonstrate reasonable expectation of operability, the licensee developed engineering evaluation EC 93932 to verify whether the station batteries would be capable of performing their required safety function. EC 93932 evaluated additional battery loading based on field measurements, rather than values provided in existing design basis calculation BNP-E-6.120, and concluded that the additional loading would not cause battery voltage to decline below its minimum required voltage during a design bases accident. In addition, NCR 633538 required revision to EC 93816, which concluded that the additional voltage drop associated with UPS loading would not result in unacceptable voltage, based on actual battery voltage derived from recent service tests.

- Example 3 – Failure to Properly Analyze Voltage Requirements for DC MOVs
  Technical Report 0BNP-TR-006, "Motor Operated Valve (MOV) Design Basis Information – GL 89-10 & GL 96-05," Rev. 3, issued in 2010, showed that MCC voltage used in torque calculations for some DC MOVs that operate after the one minute battery duty cycle was based on battery charger float voltage. The team noted that the battery charger can only produce full float voltage if DC system current demand is less than its vendor-specified current limit output of 375 amps. The team was concerned that during the operation of large DC MOVs, the battery charger could be in current limit, and as a result, MCC voltage could be lower than analyzed. DC system current could be higher than analyzed and could exceed the battery charger current limit value, due to the following factors:
  - the failure to account for non-safety related UPS loads as discussed in Example 2, above;

- o the transient current demand for starting large DC MOVs was not considered; and
- o the current limit setting of the battery chargers is not formally controlled except at >250 amps in order to satisfy TS surveillance requirements.

In response to the team's concerns, the licensee again had to revise EC 93816 which analyzed the capability of the as-built DC system to support the voltage requirements based on field measured UPS loading, in lieu of the loading calculated in BNP-E-6.120, and other loading reductions based on expected plant conditions during an accident. EC 93816 required crediting of measured battery voltages based on recent service tests, and adjusted them for the reduced loading described above. Using these measures, the licensee determined that the DC MOVs required to operate after the one minute duty cycle would have adequate voltage to start and satisfy their stroke time requirements. The lack of formal controls on battery charger minimum current output was addressed in NCR 633889.

Analysis: The licensee's failure to properly incorporate the design and licensing bases for the 125VDC system into design calculations, as required by 10 CFR Part 50, Appendix B, Criterion III, was a performance deficiency. The performance deficiency was determined to be more than minor because it was associated with the Design Control attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Specifically, there was reasonable doubt as to whether DC system components would have adequate voltage to operate during design basis accidents and the licensee conducted extensive evaluations to demonstrate past and present operability. The team used IMC 0609, Att. 4, "Initial Characterization of Findings," issued June 19, 2012, for Mitigating Systems, and IMC 0609, App. A, "The Significance Determination Process (SDP) for Findings At-Power," issued June 19, 2012, and determined the finding to be of very low safety significance (Green) because the finding was a deficiency affecting the design or qualification of a mitigating SSC, and the SSC maintained its operability or functionality. The team determined that no cross-cutting aspect was applicable because the finding was not indicative of current licensee performance.

Enforcement: Title 10 CFR Part 50, Appendix B, Criterion III, "Design Control," requires, in part, that design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program. Contrary to the above, from 2006 for Example 1, from initial plant operation for Example 2, and from 2010 for Example 3, to September 9, 2013, the licensee failed to verify or check the adequacy of the design of the safety-related DC electrical system. Specifically, the licensee failed to update voltage calculations to reflect superseded inputs, failed to properly account for non-safety related UPS loading, and failed to properly analyze voltage available to DC MOVs. The licensee conducted a combination of prompt determinations of operability and engineering evaluations which provided reasonable expectation of operability of the DC system. This violation is being treated as an NCV, consistent with Section 2.3.2 of the Enforcement Policy. The violation was entered into the licensee's corrective action program as NCRs 632998, 630621, 633538, and 633889. (NCV 05000325/2013007-02; 05000324/2013007-02, Inadequate DC System Calculations – Three Examples) iii Failure to Verify Adequacy of the Service Water Intake Structure Ventilation System

Introduction: The team identified a Green NCV of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," for the licensee's failure to verify the adequacy of the service water intake structure ventilation design through calculational methods.

Description: The heat is removed from the service water intake structure by means of two operating fans (one designated for each unit) drawing air across the room and discharging it outdoors. During a review of design calculation 9527-6-VAI-1-F, "Determine Heat Loads and Ventilation Requirements," dated April 20, 1971, the team identified issues with regard to the design heat load of the system and its ability to remove the heat during a design basis accident. In the event that one fan failed, the team determined the remaining fan's design flow rate was insufficient for removal of the design heat load and for maintaining the intake structure at or below its design temperature of 104 degrees F. Calculation 9527-6-VAI-1-F assumed that both fans were operating in order to remove the design heat load. This did not account for a single active failure. Furthermore, each fan is equipped with a damper. A single failure of a damper to open will block the air flow through the fan and resulting in the air flow rate through the other fan being insufficient to maintain the intake structure at or below its design temperature. Moreover, the calculation did not include all heat loads in the intake structure and limited the head load from the screen wash pumps to 10 percent of rated heat load. The calculation used a total heat load of 432,300 Btu/hr. The team also questioned the testing program for the ventilation system and determined that the testing only verified operation of the components, and did not verify design heat removal. After the team questioned the adequacy of this calculation, the licensee performed a prompt determination of operability to evaluate all heat loads. This resulted in a total heat load of 794,565 Btu/hr., an increase of 83.8 percent. The licensee is addressing this issue as NCR 627708 and has implemented compensatory measures until long term corrective actions can be implemented.

Analysis: The licensee's failure to verify the adequacy of the service water intake structure ventilation design through calculational methods, as required by 10 CFR Part 50, Appendix B, Criterion III, was a performance deficiency. The performance deficiency was determined to be more than minor because it was associated with the Design Control attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Specifically, there was reasonable doubt as to whether safety-related components in the service water intake structure would be operable under design temperatures. The team used IMC 0609, Att. 4, "Initial Characterization of Findings," issued June 19, 2012, for Mitigating Systems, and IMC 0609, App. A, "The Significance Determination Process (SDP) for Findings At-Power," issued June 19, 2012, and determined the finding to be of very low safety significance (Green) because the finding was a deficiency affecting the design or qualification of a mitigating SSC, and the SSC maintained its operability or functionality. The team determined that no cross-cutting aspect was applicable because the finding was not indicative of current licensee performance.

Enforcement: Title 10 CFR Part 50, Appendix B, Criterion III, "Design Control," requires, in part, that design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program. Contrary to the above, since initial plant operation, the licensee's design control measures failed to verify the adequacy of the design of the service water intake structure ventilation system. Specifically, the intake structure ventilation design calculation did not provide for a single failure of a safety-related component and did not include all the heat loads associated with equipment operating in the service water intake structure. The licensee performed a prompt determination of operability and implemented a number of compensatory actions to ensure safety-related components in the intake structure would not fail under the worst case high temperature conditions. This violation is being treated as an NCV, consistent with Section 2.3.2 of the Enforcement Policy. The violation was entered into the licensee's corrective action program as NCR 627708. (NCV 05000325/2013007-03; 05000324/2013007-03, Failure to Verify Adequacy of the Service Water Intake Structure Ventilation System)

iv Failure to Scope Safety-related Components in the Maintenance Rule Program

Introduction: The team identified a Green NCV of 10 CFR 50.65(b)(1), for the licensee's failure to scope the safety-related service water intake structure exhaust fan dampers into the Maintenance Rule program.

Description: On September 10, 2013, as part of the review of the service water intake structure ventilation, the team found the Unit 2 service water intake structure exhaust fan damper at 20 percent open (air flow through damper restricted to 20 percent of design) with its associated fan running. The licensee issued NCR 627708 to document the issue. A prompt determination of operability was performed, calculating service water intake structure temperatures based on numerous different conditions such as outside temperature, number of pumps operating, number of fans operating, etc. The intake structure's design temperature is 104 degrees F. With 93 degrees F maximum outdoor temperature, the licensee calculated the intake structure's equilibrium temperature to be 111 degrees F with two fans operating and 130 degrees F with one fan operating. Taking credit for heat losses through the intake structure's floor and walls, the equilibrium temperature still exceeded design temperature. Based on the above estimates, the licensee determined that the temperature in the service water intake structure would not exceed design temperature with two fans operating, considering the lower ambient temperatures (maximum 83 degrees F outdoors) expected between September 20, 2013, and May 31, 2014. To ensure two fans are operating, and that design temperature is not exceeded, the licensee implemented several compensatory measures to monitor temperature and fan status and take corrective actions if needed. Long-term corrective actions will be taken prior to May 31, 2014, in order to ensure continued operability.

On September 24, 2013, the team re-inspected the service water intake structure's exhaust fans and dampers and found the Unit 2 fan not operating while its damper was fully open. As a result, the fan was reverse rotating at about 150 RPM, short circuiting the air intake and risking the fan's restart because it was rotating backwards. The team was concerned that if the fan associated with the stuck open damper failed (a single failure), then the stuck open damper would draw the hot air (exhausted from the adjacent fan) back into the intake structure. Even with both fans operating, there would be a lag between the temperature set points of the two fans, which would cause reverse rotation and recycling of the exhaust air back through the stuck open damper. The licensee issued NCR 630553 to document the deficiency. The licensee implemented a compensatory measure that changed the fan switch from AUTO to ON, thereby assuring that both fans operate continuously to prevent the reverse rotation of a de-energized fan.

A historical review of the exhaust fan dampers revealed two other instances where the dampers were found to be out of position. On May 28, 2013, the Unit 1 damper was found “partially open” while the Unit 2 damper was found “practically closed,” with both fans running. This failure was described in NCR 608733 but was not characterized as a functional failure. To correct the problem, Brunswick lubricated the dampers’ mechanisms and adjusted the counterweights to assist the opening function. After the team questioned the characterization of the failure, the licensee determined that this was a functional failure and issued NCR 630922 to document the deficiency. Additionally, on August 28, 2013, the Unit 2 service water intake structure damper was found stuck open. Brunswick did not characterize the failure as a functional failure and did not issue an NCR to document the failure. After lubricating the damper, it still didn’t close; so on August 29, 2013, the damper’s counterweight was adjusted to assist the closing function.

The team determined that these dampers were not included in the scope of the licensee’s Maintenance Rule program for the service water intake structure. The Maintenance Rule requires that the scope of the monitoring program include safety-related SSCs that are relied upon to remain functional during and following design basis events. Since the dampers’ failures to open or failures to close can prevent the successful operation of the service water intake structure ventilation, they should have been included within the scope of the program. The failure to scope the dampers into the Maintenance Rule program was captured as NCR 630993 and the licensee implemented corrective actions to ensure the dampers will be included in the scope.

<u>Analysis</u>: The licensee’s failure to scope safety-related service water intake structure exhaust fan dampers into the Maintenance Rule program, as required by 10 CFR 50.65(b)(1), was a performance deficiency. The performance deficiency was determined to be more than minor because it was associated with the Equipment Performance attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective of ensuring availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Specifically, numerous dampers were found in degraded conditions such that effective control of performance or condition through appropriate preventive maintenance under 10 CFR 50.65(a)(2) could not be demonstrated. The team used IMC 0609, Att. 4, “Initial Characterization of Findings,” issued June 19, 2012, for Mitigating Systems, and IMC 0612, App. A, “The Significance Determination Process (SDP) for Findings At-Power,” issued June 19, 2012, and determined the finding to be of very low safety significance (Green) because the finding did not result in an actual loss of function of at least a single service water system train for greater than its TS allowed outage time. The team determined that no cross-cutting aspect was applicable because the finding was not indicative of current licensee performance.

<u>Enforcement</u>: Title 10 CFR 50.65(b)(1), requires, in part, that the scope of the monitoring program specified in paragraph (a)(1) of this section shall include safety-related SSCs that are relied upon to remain functional during and following design basis events to ensure the integrity of the reactor coolant pressure boundary and the capability to shut down the reactor and maintain it in a safe shutdown condition. Contrary to the

above, since initial implementation of the Maintenance Rule program, the licensee failed to scope the safety-related service water intake structure exhaust fan dampers into the Maintenance Rule program. The licensee subsequently corrected the current conditions of the dampers and implemented corrective actions to include the dampers within the scope of the Maintenance Rule program. This violation is being treated as an NCV, consistent with Section 2.3.2 of the Enforcement Policy. The violation was entered into the licensee's corrective action program as NCRs 630922, 627708, 630553, and 630993. (NCV 05000325/2013007-04; 05000324/2013007-04, Failure to Scope Safety-related Components in the Maintenance Rule Program)

v <u>Failure to Follow Plant Procedure Directing the Performance of Preventive Maintenance on Safety-related Dampers</u>

<u>Introduction</u>: The team identified a Green NCV of 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," for the licensee's failure to follow plant procedures OMMM-053 "Equipment Lubrication Application Guidance and Lubricant Listing," Rev. 88, and ADM-NGCC-0104 "Work Implementation and Completion," Rev. 45, for specifying requirements for preventive maintenance of safety-related dampers.

<u>Description</u>: The diesel generator building is ventilated to maintain the temperatures in all areas below their design limit. The ventilation system also removes noxious fumes that develop as a result of normal operation of equipment. The ventilation system for the diesel generator building consists of four supply fans which provide maximum ventilation during the most severe conditions. Each EDG cell is equipped with exhaust fans and dampers. The switchgear rooms contain individual control systems and exhaust fans to maintain proper ventilation and maintain each room within its allowable design temperature range. The control and power distribution system is divisionalized, providing the required electrical separation as required by the design basis.

The team identified that the licensee had failed to perform required preventive maintenance on nine safety-related dampers located in the diesel generator building ventilation system in March 2012. The grace period passed with no preventive maintenance and no justification for the missed maintenance. A year later, in March 2013, the licensee again failed to perform required preventive maintenance for the same dampers and the date and grace period again passed with no justification provided by the licensee. This condition was entered into the licensee's corrective action program as NCRs 628132 and 631376.

Procedure OMMM-053 provides instructions to perform preventive maintenance on the EDG building dampers. Procedure ADM-NGCC-0104, Section 9.3(b), requires justification to be provided for a missed preventive maintenance activity. The team conducted a walkdown of four of these dampers, which are located in the diesel generator building switchgear rooms, and found that two of the dampers were nearly closed while their fans were operating while a third damper was partially open while its fan was not operating and as a result, the fan was reverse rotating. These additional conditions were captured as NCRs 633710 and 633711. The licensee conducted an immediate determination of operability and determined that although the dampers had restricted the normal ventilation flow path in the room, an alternate flow path provided adequate ventilation and maintained the switchgears operable and below design temperatures. Corrective actions were also taken to correct the damper positions.

Analysis: The failure to follow the instructions of plant procedures OMMM-053 and ADM-NGCC-0104 for specifying requirements for preventive maintenance of safety-related dampers was a performance deficiency. The performance deficiency was determined to be more than minor because it was associated with the Equipment Performance attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective of ensuring availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Specifically, the repetitive failure to perform preventive maintenance on the nine safety-related dampers resulted in decreased availability and reliability of the dampers, such that multiple dampers were found in degraded conditions. The team used IMC 0609, Att. 4, "Initial Characterization of Findings," issued June 19, 2012, for Mitigating Systems, and IMC 0612, App. A, "The Significance Determination Process (SDP) for Findings At-Power," issued June 19, 2012, and determined the finding to be of very low safety significance (Green) because the finding did not result in an actual loss of function of at least a single EDG for greater than its TS allowed outage time. The team determined that this finding was associated with the cross-cutting aspect of Supervisory Oversight in the Work Practices component of the Human Performance area because Brunswick supervisors did not perform the scheduled preventive maintenance nor did they ensure a justification for not performing preventive maintenance on safety-related components. [H.4(c)]

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 and shall be accomplished in accordance with these instructions, procedures, or drawings. Procedure OMMM-053, "Equipment Lubrication Application Guidance and Lubricant Listing," Rev. 88, provides instructions to perform preventive maintenance on the EDG building dampers. Procedure ADM-NGCC-0104, "Work Implementation and Completion," Rev. 45, Section 9.3(b), requires justification to be provided for a missed preventive maintenance activity. Contrary to the above, from March 2012 through September 2013, the licensee did not accomplish activities affecting quality in accordance with procedures. Specifically, the licensee did not follow the directions provided in procedure OMMM-053, to perform preventive maintenance on the EDG building dampers, nor did the licensee provide justification as required by procedure ADM-NGCC-0104, for the missed preventive maintenance. The licensee performed an immediate determination of operability to verify the as-found condition of the dampers did not affect operability of equipment inside the diesel generator building and implemented corrective actions to complete the missed preventive maintenance on the dampers and correct their positions. This violation is being treated as an NCV, consistent with Section 2.3.2 of the Enforcement Policy. The violation was entered into the licensee's corrective action program as NCRs 631376, 628132, 633710, and 631711. (NCV 05000325/2013007-05; 05000324/2013007-05, Failure to Follow Plant Procedure Directing the Performance of Preventive Maintenance on Safety-related Dampers)

vi Inadequate Evaluation of Vibration on 2A RHR Heat Exchanger Bypass Valve

Introduction: A Green self-revealing NCV of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," was identified for the licensee's failure to verify or check the adequacy of design of the Unit 2 A RHR heat exchanger bypass valve 2-E11-F048A.

Description: On March 29, 2013, during a Unit 2 refueling outage, maintenance personnel were planning to repack the 2A RHR heat exchanger bypass valve 2-E11-F048A. A member of the maintenance crew hit one of the four yoke to bonnet hold down 1¾-inch studs with his foot and the stud sheared off at the nut. A second yoke hold down stud sheared off at the nut when maintenance personnel tried to remove the nut. The valve hand wheel key was also broken. Prior to discovery, operations personnel last stroked the valve closed on March 7, 2013, while placing the system in shutdown cooling. The licensee determined that the most limiting loads placed on the studs are the motor operated valve thrust forces experienced while closing the valve. The two failed studs underwent metallurgical analyses to determine the failure mode. The failure mechanism of the two studs was low stress, high cycle fatigue caused by vibration of the valve during throttling operations, which occurs during the shutdown cooling mode (non-safety related operating mode) of operation of the RHR system. Following the identification of the stud failures, the licensee performed a root cause evaluation in NCR 598294, and determined the root cause to be a “long term failure to fully understand the source of vibration in the RHR system and a failure to prevent vibration-related failure mechanisms with an adequate system design.” The licensee replaced the four studs and initiated plans to perform a design change to reduce vibration on the valve.

The 2-E11-F048A valve is a motor-operated 20-inch Anchor Darling globe valve with a design basis function to open for low pressure coolant injection (LPCI) and a design basis function to close and/or throttle for various other operating modes of the system (suppression pool cooling / containment (torus and drywell) cooling / shutdown cooling). Also, the valve packing acts as a boundary to ensure no release of radiation bypasses containment. The licensee performed an evaluation assuming the two remaining studs were intact. Using data from valve diagnostic testing, the licensee determined that the thrust force exerted by the valve motor operator would have caused the allowable stresses of the two remaining studs to be exceeded. The licensee further evaluated this potential to exceed the allowable stresses of the studs for its impact on operation of the valve during design basis events and for the potential to damage the valve packing. The licensee concluded that the valve would only need to close once during its mission time and would not be required to throttle for its safety-related function. The licensee also concluded, following a finite element analysis of the valve, that the deformation of the valve would be minimal and the valve would be able to successfully close the required one time. Further, the licensee determined that the valve packing would have maintained its integrity following valve closure. The team reviewed the licensee’s evaluations and determined that they were adequate.

The team reviewed the history of cavitation/vibration and/or erosion issues due to throttling of the following valves: 1/2-E11-F048A(B), RHR heat exchanger bypass valves; 1/2-E11-F003A(B), RHR heat exchanger shell side outlet valves; 1/2-E11-F017A(B), LPCI outboard injection valves; and 1/2-E11-F024A(B), suppression pool cooling isolation valves. From 1993-1995, preventive maintenance work orders 90-034 and 90-035 were implemented to replace the F003 and F024 valves with caged flow control valves. The licensee also changed throttling from the F017 valves and placed more throttling duties on the F003 and F048 valves. However, no actions other than operational procedure changes were taken to minimize cavitation of the F048 valves. In 1998, due to a number of loss of shutdown cooling events attributed to improper use of F003 as a throttle valve (LER 88-033-01), Brunswick Nuclear Plant received a violation and made commitments to the NRC to replace the F003 valve with an appropriately designed throttle valve. During maintenance on the other valve used for throttling at the time, 1-E11-F017B, two significant localized erosion areas were identified in the valve body above the valve seat due to cavitation. At the time, Anchor Darling provided a memo regarding “Globe Valves in ‘Throttling’ Service,” and stated, “[The design of E11-F048] could have damage due to cavitation and high flow velocities. All these valves have Quick Open type plugs. For this type plug, at the condition given, the valve should not be used at less than 20 percent open and the differential pressure limited to 140psi.” The licensee generally throttled this valve around 10 percent open. The 2-E11-F048A valve was required to throttle in ways it was not designed for, resulting in the stud failures discovered on March 29, 2013.

Analysis: The licensee’s failure to verify or check the adequacy of design of the Unit 2 A RHR heat exchanger bypass valve 2-E11-F048A, as required by 10 CFR Part 50, Appendix B, Criterion III, was a performance deficiency. The performance deficiency was determined to be more than minor because, if left uncorrected, it could become a more significant safety concern. Specifically, continued fatigue of the studs could have resulted in a more degraded state than the actual as-found condition, which could have affected the ability of the valve to perform its safety-related function. The team used IMC 0609, Att. 4, “Initial Characterization of Findings,” issued June 19, 2012, for Mitigating Systems, and IMC 0609, App. A, “The Significance Determination Process (SDP) for Findings At-Power,” issued June 19, 2012, and determined the finding to be of very low safety significance (Green) because the finding was a deficiency affecting the design or qualification of a mitigating SSC, and the SSC maintained its operability. The team determined that no cross-cutting aspect was applicable because the finding was not indicative of current licensee performance.

Enforcement: Title 10 CFR Part 50, Appendix B, Criterion III, “Design Control,” requires, in part, that design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program. Contrary to the above, from 1993, when the RHR heat exchanger bypass valve began to be used for throttling, until 2013, the licensee failed to verify or check the adequacy of design of the Unit 2 A RHR heat exchanger bypass valve, 2-E11-F048A. Specifically, engineering personnel failed to evaluate the effects of vibration on valve 2-E11-F048A when the valve was used for throttling. The licensee’s corrective actions included replacing the four studs and initiating long term corrective actions to perform a design change to reduce vibration on the valve. This violation is being treated as an NCV consistent with section 2.3.2 of the Enforcement Policy. The violation was entered into the licensee’s corrective action program as NCR 598294. (NCV 05000324/2013007-06, Inadequate Evaluation of Vibration on 2A RHR Heat Exchanger Bypass Valve)

.3 Operating Experience

a. Inspection Scope

The team reviewed four operating experience issues for applicability at Brunswick Steam Electric Plant, Units 1 and 2. The team performed an independent review of these issues and, where applicable, assessed the licensee’s evaluation and dispositioning of each item. The issues that received a detailed review by the team included:

- NRC Information Notice (IN) 1983-70, “Vibration-Induced Valve Failures,” dated October 25, 1983

- NRC IN 2011-12, “Reactor Trips Resulting From Water Intrusion Into Electrical Equipment,” dated June 16, 2011

- NRC IN 2012-11, “Age-related Capacitor Degradation,” dated July 23, 2012

- NRC IN 2013-05, “Battery Expected Life and Its Potential Impact on Surveillance Requirements,” dated March 19, 2013

b. Findings

No findings were identified.

4OA5 Other Activities

.1 (Closed) Unresolved Item (URI) 05000324/2013003-09: Residual Heat Removal A Heat Exchanger Bypass Valve 2-E11-F048A Stud Failure (ML13221A073)

a. Inspection Scope

During routine inspection, NRC inspectors reviewed the circumstances regarding the failure of yoke to bonnet hold down studs on the Unit 2 RHR A heat exchanger bypass valve, 2-E11-F048A. On March 29, 2013, during a Unit 2 refueling outage, while preparing to repack 2-E11-F048A, a maintenance worker hit one of the four valve yoke to bonnet hold down 1¾” studs with his foot and the stud sheared off at the nut. A second yoke hold down stud sheared off at the nut when maintenance personnel tried to remove the nut. Following review of the licensee’s root cause, the inspectors determined that the performance deficiency associated with this issue was the failure of the licensee to evaluate the effects of vibration on valve 2-E11-F048A when the valve was used for throttling, which resulted in the two studs sheering. Further inspector review of additional licensee evaluations was required to determine if the performance deficiency was more than minor. The team reviewed additional evaluations performed by the licensee.

b. Findings

The enforcement aspects of this issue are documented in section 1R21.2.b.vi. This URI is closed.

4OA6 Meetings, Including Exit

On October 24, 2013, the team presented the inspection results to Mr. George Hamrick and other members of the licensee’s staff. The inspectors verified that no proprietary information was documented in this report.

ATTACHMENT: SUPPLEMENTARY INFORMATION

SUPPLEMENTARY INFORMATION

KEY POINTS OF CONTACT

Licensee personnel:
G. Hamrick, Vice President
K. Allen, Design Engineering Manager
J. Anderson, I&C Design Supervisor
M. Braden, Licensing
J. Brady, Corporate Lead Licensing Specialist
M. Corman, Operations
D. Goins, Mechanical Design Supervisor
L. Grzeck, Licensing Supervisor
J. Nolin, Engineering Director
A. Pope, Organizational Effectiveness Manager
T. Powers, Electrical Design Engineer
J. Price, Engineering Director
S. Reed, Licensing
H. Sanders, Civil Design Supervisor
A. Sasser, Licensing
T. Sherrill, Licensing
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K. Strouzas, Electrical Design Engineer
E. Wills, Director of Site Operations
B. Zambo, Licensing

NRC personnel
M. Schwieg, Resident Inspector, Division of Reactor Projects, Brunswick Resident Office
R. Bernhard, Senior Risk Analyst, Division of Reactor Projects
G. Hopper, Chief, Projects Branch 4, Division of Reactor Projects

LIST OF ITEMS OPENED, CLOSED, DISCUSSED, AND UPDATED

Opened and Closed

05000325, 324/2013007-01	NCV	Inadequate Acceptance Criteria for the Class 1E Station Battery Service Capacity Test Procedure [Section 1R21.2.b.i]
05000325, 324/2013007-02	NCV	Inadequate DC System Calculations – Three Examples [Section 1R21.2.b.ii]
05000325, 324/2013007-03	NCV	Failure to Verify Adequacy of the Service Water Intake Structure Ventilation System [Section 1R21.2.b.iii]

05000325, 324/2013007-04	NCV	Failure to Scope Safety-related Components in the Maintenance Rule Program [Section 1R21.2.b.iv]
05000325, 324/2013007-05	NCV	Failure to Follow Plant Procedure Directing the Performance of Preventive Maintenance on Safety-related Dampers [Section 1R21.2.b.v]
05000324/2013007-06	NCV	Inadequate Evaluation of Vibration on 2A RHR Heat Exchanger Bypass Valve [Section 1R21.2.b.vi]

Closed

05000324/2013003-09	URI	Residual Heat Removal A Heat Exchanger Bypass Valve 2-E11-F048A Stud Failure [Section 4OA5.1]

LIST OF DOCUMENTS REVIEWED

Procedures

00903679 01, Perform 0MST-BAT11R 1A-1 Batteries, 125vdc Service Capacity Test, dated 4/8/08
01411436 01, Perform 1MST-BAT11CFY 1A-2 Batteries, 125vdc Performance Capacity Test, dated 3/10/12
01411437 01, Perform 1MST-BAT11DFY 1B-2 Batteries, 125vdc Performance Capacity Test, dated 3/14/12
01411438 01, Perform 1MST-BAT11BFY 1B-1 Batteries, 125vdc Performance Capacity Test, dated 3/13/12
01614666 01, Perform 2MST-BAT11DFY Battery Performance Capacity Test on 2-2B-2-125VDC-BAT, dated 4/28/13
01614667 01, Perform 2MST-BAT11BFY Battery Performance Capacity Test on 2-2B-1-125VDC-BAT, dated 4/28/13
01614668 01, Perform 2MST-BAT11CFY Battery Performance Capacity Test on 2-2A-2-125VDC-BAT, dated 4/8/13
01614669 01, Perform 2MST-BAT11AFY Battery Performance Capacity Test on 2-2A-1-125VDC-BAT, dated 3/24/13
01938779 02, Perform Dg-4 Loading Test, dated 4/18/13
0AOP-18, Nuclear Service Water System Failure, Rev. 30
0AOP-18.0, Nuclear Service Water System Failure, Rev. 30
0CM-VGB500, Maintenance Instruction for the Anchor (Bolted Bonnet) Globe and Globe Stop Check Valves, Rev. 10
0ENP-16.1, IST Pump and Valve Data, Rev. 31
0ENP-17, Pump and Valve Inservice Testing (IST), Rev. 37
0ENP-2705, Service water Heat Exchanger Thermal Performance Testing, Rev. 6
0MST-DG14R, DG-4 Loading Test, Rev. 16
0MST-HPCI42R, HPCI Auto Actuation and Isolation Logic System Functional Test
0OI-01.01, BNP Conduct of Operations Supplement, Attachments 1-5, 7, 14, Rev. 52
0OI-03.4, General Checks, Rev. 157
0PIC-BYC002, Calibration of Power Conversion Model 3md-130-300 Battery Chargers When Connected to Battery and Load Bank, Rev. 17
0PIC-FS002, Calibration of Magnetrol Series B, C, D, O, and S Flow Switch Mechanisms (Model F503A and F501), Rev. 10
0PM-BKR001, ITE 4 KV Breaker and Compartment Checkout, Rev. 42
0PM-BKR001, ITE 4Kv Breaker and Compartment Checkout, Rev. 42
0PM-BKR005, PM on GE DC MCC and Switchboard Compartments, Rev. 14
0PM-BKR008, PM-Functional Testing of Molded Case Circuit Breakers, Rev. 48
0PM-MCC002, PM of GE Motor Control Centers and Switchboards, Rev. 23
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0PT-10.1.1, RCIC System Operability Test, dated 6/1/13
0PT-10.1.3, RCIC System Operability Test-Flow Rates at 150 psig, dated 5/6/13
0PT-10.1.8, RCIC System Valve Operability Test, dated 10/24/12

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M-89-0008, Heat Balance on EDG Jacket Water Cooler, Rev. 1
M-89-0021, HPCI/RCIC NPSH with Suction from the CST, Rev. 0

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SD-43, System Description, Service Water System, Rev. 25

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008677	318607	428809	526340	604452
017653	327349	429541	549265	607394
020008	332328	429541	550385	608604
020022	337377	440108	553147	608733
020819	354940	453361	554488	610788
029244	366485	453364	558850	610942
055265	366663	455265	578279	617349
064754	368668	455758	580562	618011
102456	403460	458958	588742	619212
278455	404009	476673	594822	624434
278487	422171	484430	598294	
278664	426810	494931	599535	
303428	427745	519703	600575	
310502	427745	523554	600850	

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00030883-01, 1-SW-FSL-825 1D RHR Pump Seal Cooler, dated 03/08/01
00156653-01, 1-SW-FSL-835 1B RHR Pump Seal Cooler, dated 11/08/01
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00539459, 1SW-V20 De-Clutch Lever is Not Attached, dated 06/12/12
00785247-02, PMT TR I&C Perform 2MST-SW12Q, dated 9/19/09
00883160-03, PM Breaker 1-E2-AG9-52, dated 7/8/08
00901889-01, Perform 0MST-BATT11R 1B-2, dated 3/21/08
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01098372 02, 2-DG-1_90M-POT Master EC 67310 Acceptance Test, dated 6/5/09
01164503 43, (Pre-Outage) Diesel-1 Generator Load Test, dated 2/23/09
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01164503 48, (Pre-Outage) Test Transfer Switches, dated 2/23/09
01164503 66, (PREOUTAGE) TEST 2-FO-V5002, dated 2/19/09
01164503 67, Test XFER-SW Output to 2-SAMG-DGI-D ISQCK-IA-1-M &2-M, dated 2/15/09
01324182 01, 1-1B-1-125VDC-CHRGR Replace Amp Board Inspect/Replace R1, R, dated 4/17/10
01329724-01, 2-DG3-ENG, Perform 72 Month MST IAW 0MST-DG501R3, dated 4/12/10
01388483-01, Perform RCIC Turbine Inspection/Teardown, dated 3/5/11
01411437-01, 1MST-BAT11DFY Batteries, 125 VDC 1B-2, dated 3/17/12
01411439-01, 1MST-BAT11AFY Batteries, 125 VDC 1A-1, dated 3/14/12
01414476-01, Perform 0MST-BATT11R 1B-2, dated 3/25/10
01417000-01, Perform 0MST-BATT11R 1A-1, dated 3/08/10
01455398-02, 1-SW-V682 Cycle IAW 2MST-SW12Q, dated 10/18/10
01555522-01, RCIC Speed Indicator and Governor Check, dated 11/25/10
01583257-02, Refurb PM 2-E3-AI2-52, dated 3/2/11
01616839-11, 2-DG3-ENG Output Breaker Tripped, dated 1/24/12
01623569-01, Perform 0MST-RCIC 42R. RCIC Auto-Actuation and Isolation Logic, dated 3/23/11
01645231, Calibrate 2-SW-PDSH-270, dated 9/13/11
01738055-01, 1-VA-1A-EF-SWIS Fan Backdraft Damper, Preventive Maintenance, dated 9/11/13
01773452-20, 1-SW-V19, Electrical Determ and Reterm Operator, dated 3/20/12
01773452-21, 1-SW-V19-MO, MNT-NGGC-0010 for Teledyne Testing, dated 3/18/12
01773452-21, 1-SW-V20-MO, MNT-NGGC-0010 for Teledyne Testing, dated 3/16/12
01773452-23, 1-SW-V20, Electrical Determ and Reterm Operator, dated 3/15/12
01796116-01, Unit 1 RCIC Speed indicator and Governor Check, dated 6/25/12
01818779-01, 0MST-HPCI42R HPCI Logic Auto Actuation and Isolation Logic System, dated 7/2/12
01932192-01, Unit 2 RCIC Speed Indicator and Governor Check, dated 11/22/12
01952711-01, 2-VA-2A-EF-SWIS: Lube Check on the 2A-EF-FAN Motor Bearings, dated 12/27/12
01952713-01, 1-VA-1A-EF-SWIS: Lubrication Check of Motor Bearings, dated 12/27/12
01973818-01, 1-SW-V19, Clean Weld Neck Flange for UT Examination, dated 7/03/13
01981682-01, 2-SW-V20, Clean Weld Neck Flange for UT Examination, dated 8/21/13
02008690 01, Test DG3 Excitation System Shunt-Regulating SCR'S, dated 11/16/12
02048596-01, 1MST-BAT11AQ & 1MST-BAT11CQ for 1A-1, dated 1/4/13

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02052916-01, 1-SW-V20: Lower Flange Needs Weld Repair, dated 3/16/12
02062214-01, PMID 79322-01, Diesel Building Equipment 1 year inspection and re-grease, dated 1/31/13
02091017-01, 1MST-BAT11AQ & 1MST-BAT11CQ for 1A-1, dated 4/8/13
02093855-02, 1MST-BAT11BQ & 1MST-BAT11DQ for 1B-2, dated 4/29/13
02094834 01, Test DG2 Excitation System Shunt-Regulating SCR'S, dated 6/12/13
02129696-01, 1MST-BAT11AQ & 1MST-BAT11CQ for 1A-1, dated 7/2/13
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02138329-01, RCIC Reactor High Water Level Trip Unit Chan Cal, dated 7/24/13
02142542-01, 1-VA-1A-EF-SWIS Fan Backdraft Damper, Preventive Maintenance, dated 9/11/13
02309096 01, 2-DG2-90M-POT Preset Light Did Not T, dated 11/8/11
0605969-01, 1-E11-F048A-MO Perform 0PM-MO009 and Conduct Diagnostic Test, dated 3/18/09
1324184-01, PM Work Order Instructions for 1-1A-1-125VDC-CHRGR
1324538-01, Perform 0PM-MO-009 on the 1-E41-F001-MO HPCI Stm Supply V, dated 6/30/09
1618629-01, 2-E41-F001 Indicates Dual With the Valve Closed, dated 9/12/09
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0ENP-43.5, Motor operated Valve Program, Rev. 1
522-004, Specification for Procurement of ECCS Pump Area Room Cooler Replacement Coils, Rev. 3
75-651, Motor Operated Strainer Differential Pressure Alarm Setpoint, dated 10/29/82
9527-01-522-3, Specification for ECCS Pump Area Cooling Units, Rev. 6
99-00474, Evaluation Of Fire Door 2-DGB-DR-EL023-104, dated 10/2/00
BC-6011-50, Orifice Bore Calculation Liquid flow, dated 5/19/73
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FP-82393, Valves – Check, Rev. D
FP-84460, Heat Exchangers Borg-Warner Corp Vendor Manual, Revs. B and C
FP-84480, Areva Ball Screw Assembly, Rev. B
FP-84867, Service Water Pumps, Rev. D
LAP-83-564, U2 Amendment Request, dated 12/7/83
LAP-83-575, U2 RAI response, dated 12/16/83
LAP-83-581, U2 RAI response, dated 12/20/83
Lesson Plan LOI-CLS-LP-300-K, Supplemental Emergency Procedures (SEP's), Rev. 4
Maintenance Rule Scoping And Performance Criteria For Service Water
Memorandum M.B. Bailey Limitorque to S. Roberts CP&L, MOV Data, dated 5/6/93
MPR-3946, Brunswick Nuclear Plant Service Water Building Flooding Evaluation Test Report, Rev. 0
NGG-PMB-PWR-01, NGG Equipment Reliability Template – DC Power Supplies, Rev. 1
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NRC Information Notice 2012-11, Age-related Capacitor Degradation
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Purchase Order 00545104, dated 4/13/11
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QDP-29c, Limitorque Motor Operated Valves (MOVs) with Class B. Class H (Type RH), and Class H Insulated AC Motors, Rev. 20
RCI-05.2, RCI Regulatory Compliance Action Item Assignment and Response, dated 11/3/83
Rising Stem Static Test Analysis, As-left test for 1-E41-F001, dated 4/20/10
Specification 137-002, Specification for 125V Battery Chargers, Rev. 7
Specification 248-152, Motor Operated Valve Actuators, Rev. 3
Standing Instructions Form, 13-054, 13-055, and 13-056, dated 09/25/13
System Health Report 2095 – High Pressure Coolant Injection, 3Q12, 4Q12, 1Q13, and 2Q13
System Health Report 2045 – Residual Heat Removal, 2Q13
System Health Report 2100 – Reactor Core Isolation Cooling, 2Q13
System Health Report 4060 – Service Water, 1Q13 and 2Q13
System Health Report 5175/5170 – AC Distribution, 2Q13 and 3Q13
System Health Report 5320/5240/5245 – 125/250 VDC Distribution, 1Q13 and 2Q13
TS Section 1.1, Definitions, Amendment No. 233
TS 3.5.1, Emergency Core Cooling Systems (ECCS) – Operating, Amendment No. 260
TS 3.6.2.3, RHR Suppression Pool Cooling, Amendment No. 203

<u>Corrective Action Documents Written Due to this Inspection</u>
DRR 627542, SD-43 error discovered during CDBI inspection
NCR 627443, Safety concern – pinch point identified in SW Building

NCR 627526, Failure to identify equipment impacts resulting from ongoing concrete work in SW Building
NCR 627708, SW Building damper found to be only partially open with fan running
NCR 627827, Portable fan in SW Building not properly stored
NCR 627829, Housekeeping in SW Building found unsat during CDBI walkdown
NCR 627856, Leak tag still hanging on 1-E41-F001 with work complete
NCR 627858, Unattended ladder found in U1 North RHR -17’
NCR 627966, Oil liquid found in an unlabeled bottle during NRC walkdown
NCR 628023, Fire extinguisher vendor stamping
NCR 628119, Service Water Building ventilation calculation problems
NCR 628132, PM Work Order completed without addressing N/P coding
NCR 628144, Clean DG Building dampers of unidentified black material
NCR 628158, Door 2-DGB-DR-EL023-104 has a deficiency/gap
NCR 628203, DP in BNP-MECH-E11-F048A/B has not been updated
NCR 628205, 125/250 VDC battery duty cycle concern
NCR 628648, DBD reference could not be found during inspection
NCR 628906, MREV 608733-11 not identified as a Maintenance Rule Functional Failure
NCR 628931, IST acceptance criteria for SW discharge check valves
NCR 629064, SW Building flood inspection aggregate eval results
NCR 629266, 0-FP-03102 not updated to fully reflect past evaluations
NCR 629649, TS Bases 3.8.4 needs clarification (CDBI)
NCR 630521, Inadequate APP for RHR seal cooler low flow
NCR 630553, Service Water Bldg backdraft damper open with exhaust fan off
NCR 630621, Battery surveillance discrepancy
NCR 630713, Erroneous reference in DBD-43
NCR 630753, Error in 0BNP-TR-006 with regard to the discussion of current limit
NCR 630763, UFSAR discrepancies for the SW Building Ventilation System
NCR 630922, No CR written for SW Bldg backdraft damper issue on 08/28/13
NCR 630993, Service Water Building HVAC MR Function incorrect
NCR 631300, 2-E11-F048A EC 93152 insufficient evaluation
NCR 631304, Testing of sump pumps credited for PMH flood
NCR 631376, Required maintenance not performed on safety-related equipment
NCR 631389, Incorrect assumption BNP-E-8.013/014
NCR 631401, Possible issue regarding vital header operation
NCR 631427, Simulator modeling for ECCS room temperature issue
NCR 631442, Functionality assessments not performed
NCR 632825, Battery charger spare part failure
NCR 632910, Clarify 4th paragraph of UFSAR 8.3.2.1.2
NCR 632998, Non-conservative data in voltage drop calc
NCR 633482, PM on RHR pump seal cooler flow switches
NCR 633538, Effect of non-safety UPS failure on DC system
NCR 633559, #244 Battery cell jumpering
NCR 633565, No stem lube degradation allowance in MOV calc
NCR 633710, E6 DG building fan backdraft damper open with fan off
NCR 633711, E8 room fan damper closed with fan running
NCR 633803, Possible mismatch on leakage rates and source term
NCR 633889, Battery charger minimum current acceptance value
NCR 634054, Battery charger voltage adequacy
NCR 634139, MOV transient voltage capability
NCR 634734, Concern with 1/2-E11-F008 min voltage
PRR 630716, Change management actions for new procedure PD-EP-ALL-0401

PRR 630752, EGR-NGGC-0101 SEC 9.2.12 does not address the effect of MOV self heating
PRR 632125, 0PT-34.2.2.1 DG Doors procedure revision
PRR 632517, 1APP-A-02 Revision
PRR 632532, 2APP-A-02 Revision
PRR 632635, Perform 2 obs per month focusing on procedure review
PRR 633567, 1MST-BAT11AFY