



UNITED STATES
NUCLEAR REGULATORY COMMISSION

REGION II
SAM NUNN ATLANTA FEDERAL CENTER
61 FORSYTH STREET, SW, SUITE 23T85
ATLANTA, GEORGIA 30303-8931

August 3, 2006

Carolina Power and Light Company
ATTN: Mr. James Scarola
Vice President
Brunswick Steam Electric Plant
P. O. Box 10429
Southport, NC 28461

SUBJECT: BRUNSWICK STEAM ELECTRIC PLANT - NRC SUPPLEMENTAL
INSPECTION REPORT NO. 05000324/20060007

Dear Mr. Scarola:

On July 5, 2006, the U.S. Nuclear Regulatory Commission (NRC) completed a supplemental inspection at your Brunswick Plant, Unit 2, facility. The enclosed report documents the inspection findings, which were discussed on June 8 and July 6, 2006, with Mr. Tim Cleary and other members of your staff.

As required by the NRC Reactor Oversight Process Action Matrix, this supplemental inspection was performed in accordance with Inspection Procedure 95001. The purpose of the inspection was to examine the causes for and actions taken related to the Unplanned Power Changes per 7,000 Critical Hours Performance Indicator crossing the threshold from Green (very-low risk significance) to White (low-to-moderate risk significance) for Unit 2 in the fourth quarter of 2005. This supplemental inspection was conducted to provide assurance that the root causes and contributing causes of the events resulting in the White performance indicator are understood, to independently assess the extent of condition, and to provide assurance that the corrective actions for risk significant performance issues are sufficient to address the root causes and contributing causes and to prevent recurrence. The inspection consisted of selected examination of representative records and interviews with personnel.

Based on the results of this inspection, no findings of significance were identified. The inspector determined that, in general, the problem identification, root cause and corrective actions were adequate.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be available electronically for public inspection in the NRC Public Document

CP&L

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Sincerely,

/RA/

Paul E. Fredrickson, Chief
Reactor Projects Branch 4
Division of Reactor Projects

Docket No.: 50-324
License No: DPR-62

Enclosure: Inspection Report 05000324/2006007
w/Attachment: Supplemental Information

cc w/encl: (See page 3)

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Distribution w/encl: (See page 4)

Letter to James Scarola from Paul E. Fredrickson dated August 3, 2006

SUBJECT: BRUNSWICK STEAM ELECTRIC PLANT - NRC SUPPLEMENTAL
INSPECTION REPORT NO. 05000324/20060007

Distribution w/encl:

B. Mozafari, NRR
RIDSNRRDIRS
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U.S. NUCLEAR REGULATORY COMMISSION

REGION II

Docket No: 50-324

License No: DPR-62

Report No: 05000324/2006007

Licensee: Carolina Power and Light (CP&L)

Facility: Brunswick Steam Electric Plant, Unit 2

Location: 8470 River Road SE
Southport, NC 28461

Dates: June 5, 2006 - July 5, 2006

Inspector: R. Musser, Senior Resident Inspector, Shearon Harris

Approved by: Paul Fredrickson, Chief
Reactor Projects Branch 4
Division of Reactor Projects

Enclosure

SUMMARY OF FINDINGS

IR 05000324/2006-007; 06/5/2006 - 7/5/2006; Brunswick Steam Electric Plant, Unit 2; Supplemental inspection IP 95001 for a White performance indicator in the initiating events cornerstone.

This inspection was conducted by a senior resident inspector. No violations of regulatory requirements were identified. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 3, dated July 2000.

A. NRC-Identified and Self-Revealing Findings

Cornerstone: Initiating Events

This supplemental inspection was conducted in accordance with Inspection Procedure 95001, to assess the licensee's evaluation associated with a Unit 2 performance indicator in the initiating events cornerstone. The Unplanned Power Changes per 7000 Critical Hours Performance Indicator crossed the threshold from Green (very-low risk significance) to White (low-to-moderate risk significance) in the fourth quarter of 2005. Specifically, the licensee experienced two unplanned power changes in the second quarter of 2005, one unplanned power change in the third quarter of 2005, and four unplanned power changes in the fourth quarter of 2005. The first unplanned power change, which occurred on April 20, was the result of a downpower initiated to remove the 2B reactor feed pump from service following an impeller failure which occurred on April 19. The second unplanned power change, which occurred on June 25, was the result of a downpower initiated to stabilize condenser vacuum following the trip of the 2B circulating water pump. The third unplanned power change, which occurred on August 5, was the result of placing Unit 2 in cold shutdown due to declaring all site emergency diesel generators (EDGs) inoperable. The fourth, fifth and sixth unplanned power changes, which occurred on November 8, 14, and 25, respectively, were the result of downpowers initiated to effect repairs on condenser tube leaks. The seventh unplanned power change, which occurred on December 13, was the result of a downpower caused by tripping of the 2B recirculation pump.

The licensee's problem identification, root cause and extent-of-condition evaluations, and corrective actions for the seven downpowers were adequate.

B. Licensee-Identified Violations

None.

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REPORT DETAILS

01 INSPECTION SCOPE

The purpose of this supplemental inspection was to assess the licensee's evaluation associated with a performance indicator (PI) for Unit 2 that crossed the threshold from Green to White in the Initiating Events Cornerstone of the Reactor Safety Strategic Performance Area. Specifically, the licensee experienced two unplanned power changes in the second quarter of calendar year (CY) 2005, one unplanned power change in the third quarter of CY 2005, and four unplanned power changes in the fourth quarter of CY 2005. The cumulative effect of these unplanned power changes was to cause the Unplanned Power Changes per 7,000 Critical Hours PI to cross the threshold from Green to White in the fourth quarter of CY 2005. The inspectors reviewed the licensee's actions associated with these seven events and conducted interviews with licensee personnel to ensure that the root and contributing causes of the events were identified, understood, and appropriate corrective actions were initiated. The seven unplanned power changes reviewed were as follows;

1. April 20, 2005 - Downpower initiated due to removing the 2B reactor feed pump from service following a failure of the pump's impeller.
2. June 25, 2005 - Downpower initiated to stabilize condenser vacuum following the trip of the 2B circulating water pump.
3. August 5, 2005 - Downpower initiated to place the unit in cold shutdown due to declaring all site EDGs inoperable. This matter was reviewed in detail by an NRC special inspection and documented in inspection report 05000325,324/2005010.
4. November 8, 2005 - Downpower initiated to effect repairs on tubes leaking in the main condenser.
5. November 14, 2005 - Downpower initiated to effect repairs on tubes leaking in the main condenser.
6. November 25, 2005 - Downpower initiated to effect repairs on tubes leaking in the main condenser.
7. December 13, 2005 - Downpower initiated by the tripping of the 2B recirculation pump.

Throughout the report enclosure, these unplanned power changes will be referred to by their numerical designator listed above.

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02 EVALUATION OF INSPECTION REQUIREMENTS

02.01 Problem Identification

- a. Determination of who identified the issue and under what conditions.
The inspector noted that the first, second, fourth, fifth, sixth, and seventh unplanned power changes were the result of self-revealing events which occurred during the course of normal operational conditions. The third unplanned power change was the result of a licensee identified issue regarding a degraded condition associated with the EDGs. The licensee's evaluations for these unplanned power changes appropriately determined who, and under what conditions the issues were identified.
- b. Determination of how long the issue existed, and prior opportunities for identification.

The inspector noted that the first unplanned power change, a downpower to remove the 2B reactor feed pump from service, was the result of a fracturing of that pumps impeller. The impeller was in service only a few weeks when the failure occurred. The licensee determined that the failure was the result of improper manufacturing in that certain dimensions (shroud wall thickness and vane trailing edge radius) were not in accordance with design requirements. The licensee determined that the condition existed since the component was manufactured and that the condition could have been detected subsequent to being manufactured by proper inspections.

The second unplanned power change, a downpower initiated to stabilize condenser vacuum following the trip of the 2B circulating water pump, was the result of a gracilaria (seaweed-like macroalgae) build up on pumps trash rack, ultimately resulting in the trash racks failure. Gracilaria then built up on the pumps traveling water screen, creating a differential pressure condition resulting in a designed trip of the pump. The licensee determined that gracilaria has been a potential problem at the plant since 2000.

The third unplanned power change, a downpower initiated to place the unit in cold shutdown due to declaring all site EDGs inoperable, was the result of a historical equipment deficiency related to 87DP differential current relays installed in 1982. The licensee determined that there were prior opportunities for identification.

The fourth, fifth, and sixth unplanned power changes were downpowers initiated to effect repairs on tubes leaking in the main condenser. The tube leaks were caused by lagging (stainless steel sheet metal) becoming dislodged from feedwater heaters within the main condenser, falling onto and creating through wall leaks on the top and outer rows of condenser tubes. The exact time frame for how long the condition existed was not determined.

The seventh unplanned power change, a downpower initiated by the tripping of the 2B recirculation pump, was the result of an increasing voltage output from the tach generator associated with recirculation pump's motor generator set. The time at which the tach generator began to fail (approximately 5.5 hours prior to the pump's tripping) was determined through review of the plant's computer data. Although this presented

prior opportunity for identification, it was initially determined that the observed conditions (recirculation pump motor generator set speed inconsistent with recirculation pump speed) were the result of a computer point malfunction.

The inspector determined that the licensee had identified, as appropriate and when able, how long the above discussed conditions existed, and any prior opportunities for identification.

- c. Determination of the plant-specific risk consequences (as applicable) and compliance concerns associated with the issues.

The inspector noted that the licensee's review of the above unplanned power changes determined that plant-specific risk consequences were low. The unplanned power change resulting from the inoperability declaration of all plant EDGs was reviewed in detail by an NRC Special Inspection and documented in Inspection Report 05000325,324/2005010. A finding, with two examples, was issued as a Green NCV (05000325,324/2005010-02) for failure to identify a condition adverse to quality. The report indicated that the performance deficiency did not have a major impact on EDG performance.

02.02 Root Cause and Extent-of-Condition Evaluation

- a. Evaluation of methods used to identify root causes and contributing causes.

The inspector noted that the licensee used combinations of different methods to identify root and contributing causes for the seven unplanned power changes; equipment performance analysis, support/refute methodology, event and causal factor charting, cause and effect analysis, barrier analysis, human performance analysis, and fault tree analysis. The methods and combinations of methods used to identify root and contributing causes were appropriate.

For the first unplanned power change, the licensee utilized equipment performance analysis and support/refute methodology to identify the root and contributing causes for the 2B reactor feed pump impeller failure.

For the second unplanned power change, the licensee utilized event and causal factor charting, cause and effect analysis, and barrier analysis to identify the root and contributing causes for the tripping of the 2B circulating water pump.

For the third unplanned power change, the licensee utilized equipment and human performance analysis, fault tree analysis with support/refute evidence to identify the root and contributing causes related to the decision to declare all plant EDGs inoperable.

For the fourth, fifth and sixth unplanned power changes, the licensee utilized support/refute, fault tree analysis techniques and equipment inspection to identify the root and contributing causes related to the three instances of condenser tube leakage.

For the seventh unplanned power change, the licensee utilized support/refute and fault tree analysis techniques to identify the root and contributing causes related to the tripping of the 2B recirculation pump.

b. Level of detail of the root cause evaluation.

For the seven unplanned power changes, the inspector determined that the root cause evaluations were of sufficient detail to support the identified root and contributing causes.

For the first unplanned power change, the licensee determined the root cause of the 2B reactor feed pump impeller failure was the result of improper manufacturing in that certain dimensions (shroud wall thickness and vane trailing edge radius) were not in accordance with design requirements. In addition, the inspection of the new impeller was also determined to be inadequate.

For the second unplanned power change, the licensee determined the root cause of the 2B circulating pump trip to be that the site response to high vulnerability conditions (such as lunar tides and gracilaria intrusions) at the intake were not adequate.

For the third unplanned power change, the licensee determined the root cause of the issue to be a historical equipment deficiency related to 87DP differential current relays installed in 1982. The relays were replaced with a vendor recommended equivalent model without a confirmation that the trip setting was appropriate. In addition, the licensee identified that a "group think" mentality prevented a previous opportunity to identify the issue.

For the fourth, fifth, and sixth unplanned power changes, the licensee determined the root cause of the condenser tube leaks to be lagging (stainless steel sheet metal) becoming dislodged from feedwater heaters within the main condenser, falling onto and creating through wall leaks on the top and outer rows of condenser tubes.

For the seventh unplanned power change, the licensee determined the root cause of the tripping of the 2B recirculation pump, was the result of an increasing voltage output from the tach generator associated with recirculation pump's motor generator set due to carbon buildup causing increased resistance. The increased voltage caused the current through the tach generator to decrease and the field excitation of the generator to increase. The increased excitation resulted in an increased generator output voltage and a corresponding increase in current through the excitation transformer. Ultimately, the increasing current caused a fuse to clear which resulted in loss of the exciter field and the tripping of the 2B recirculation pump.

c. Consideration of prior occurrences of the problem and knowledge of prior operating experience.

The inspector determined that the root cause evaluations for the seven unplanned power changes had considered prior occurrences of similar problems, where applicable.

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- d. Consideration of potential common causes and extent of condition of the problem.

The inspector noted that the licensee had performed a common cause analysis associated with the seven unplanned power changes, and had concluded that no global causes could be identified.

The inspector's review of the seven unplanned power changes verified that there were no equipment or system related common causes which could be linked to the failures. Although three of the unplanned power changes were the result of tube leaks within the main condenser, which had a common cause, no causal linkage could be made with the four other unplanned power changes.

02.03 Corrective Actions

- a. Appropriateness of corrective actions

The inspector determined that the licensee took prompt corrective actions to repair the equipment failures related to the unplanned power changes. Comprehensive corrective actions to address root and contributing causes, where appropriate, were performed or scheduled to be performed.

For the first unplanned power change, the licensee replaced the fractured impeller and returned the 2B reactor feed pump to service. Approximately 34 percent of the fractured impeller pieces were recovered from the feed water system (B feedwater heaters). The licensee informed the inspector that plans were in place to inspect, in April 2007, the 2A reactor feed pump impeller for potential degradation, and also the A feedwater heaters downstream of the two reactor feed pumps for additional foreign material.

For the second unplanned power change, the licensee repaired the 2B trash rack, secured the trash racks more securely, and restored the 2B circulating pump to service. In addition, the licensee established Procedure 0AI-146, Plant Response to Degraded Conditions at the Intake Structure, to provide actions, guidance, and supporting information needed to effectively respond to predicted, potential or actual degraded conditions at the diversion or intake structures caused by equipment malfunction or unusual environmental conditions.

For the third unplanned power change, the licensee replaced the 87DP differential current relays with solid state relays with increased margin to operating current. Additionally, an emergent/off normal check list was developed to provide for a structured approach to significant equipment failure problem solving.

For the fourth, fifth, and sixth unplanned power changes, the licensee plugged the leaking tubes. During a May 2006 outage, the licensee performed interim repairs to the feedwater heater lagging inside the condenser. The licensee informed the inspector that plans were in place to perform the permanent repairs in April 2007, to include potentially removing the lagging from the feedwater heaters and installing grating in the

upper portions of the condenser to protect tubes from falling debris or steam impingement

For the seventh unplanned power change, the licensee replaced the tach generator associated with the 2B recirc motor generator set. In addition, the licensee initiated a preventive maintenance task to change the tach generators every other refueling outage.

b. Prioritization of corrective actions.

The inspector determined that the corrective actions for the seven unplanned power changes were appropriately prioritized with one exception. In relation to the first unplanned power change, the licensee had yet to inspect the A train of feedwater heaters downstream of the reactor feed pumps for foreign material. The licensee had inspected the B train of feedwater heaters, and found approximately 34 percent of the missing pieces from the fractured 2B reactor feed pump impeller. The potential concern is that some of the fragments could be in the A train of feedwater heaters, eventually entering the reactor as foreign material and impacting the fuel assemblies. The licensee informed the inspector that plans were in place to inspect the A train of feedwater heaters in April 2007.

c. Establishment of a schedule for implementing and completing the corrective actions

The inspector verified that the licensee's corrective action program identified assigned individuals, completion dates, and reference numbers to ensure that individual corrective actions would be completed in accordance with their priority.

d. Establishment of quantitative or qualitative measures of success for determining the effectiveness of the corrective actions to prevent recurrence.

The inspector determined that effectiveness reviews had been completed or were scheduled for the causes of the seven unplanned power changes.

04 MANAGEMENT MEETINGS

The inspector presented the results of the supplemental inspection to Mr. T. Cleary and other members of licensee management and staff on June 8 and July 6, 2006. The inspector confirmed that any proprietary information provided or examined during the inspection would be returned.

ATTACHMENT: SUPPLEMENTAL INFORMATION

Enclosure

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

Licensee Personnel

M. Arcaro, Lead Engineer - Engineering
L. Beller, Supervisor - Licensing/Regulatory Programs
E. Black, Supervisor - Nuclear Assessment
T. Cleary, Director - Site Operations
J. Ferguson, Manager - E & RC
M. Grantham, Manager (Acting) - Engineering
L. Grzeck, Senior Engineer - Licensing
S. Howard, Manager - Maintenance
R. Ivey, Superintendent - Support Services
C. Jones, System Engineer, Engineering
K. Strouzas, Lead Engineer, Engineering
B. Waldrep, Plant General Manager
K. Ward, Superintendent - Engineering Technical Services
S. Williams, Senior Engineer, Engineering
K. Woodard, Lead Engineer, Engineering

NRC Personnel

E. DiPaolo, NRC Senior Resident Inspector
J. Austin, NRC Resident Inspector

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened or Closed

None.

Discussed

None.

LIST OF DOCUMENTS REVIEWED

Procedures

0AI-146, Plant Response to Degraded Conditions at the Intake Structure

Action Requests (AR)

AR 156829 Reactor Feed Pump Divergence
AR 161964 U2 Power Reduction - 2B CWIP Trip
AR 165042 Unplanned LCO Entry - EDG #4 Locked Out / Unavailable
AR 175458 Condenser Tube Leaks
AR 178734 Trip of 2B Recirc MG Set

Miscellaneous

GE Drawing 44D209845
Emergent Issue Response Check List
Calculation 2B11-0033 - Reactor Feed Pump 2B Lost Parts Analysis
NRC Inspection Report 05000325, 324/2005010