



UNITED STATES
NUCLEAR REGULATORY COMMISSION

REGION II
SAM NUNN ATLANTA FEDERAL CENTER
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ATLANTA, GEORGIA 30303-8931

June 27, 2006

Tennessee Valley Authority
ATTN: Mr. K. W. Singer
Chief Nuclear Officer and
Executive Vice President
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

SUBJECT: WATTS BAR NUCLEAR PLANT - NRC SUPPLEMENTAL INSPECTION
REPORT NO. 05000390/2006010

Dear Mr. Singer:

We indicated in our Final Significance Determination Letter dated April 7, 2006, that we planned to conduct NRC Supplemental Inspection Procedure 95001 at Watts Bar Unit 1 in accordance with the NRC's Action Matrix response to a White inspection finding. On June 2, 2006, the NRC completed this supplemental inspection at your Watts Bar Nuclear Power Plant. The enclosed report documents the inspection findings which were discussed on June 2, 2006, with Mr. J. Laughlin and other members of your staff.

This supplemental inspection was an examination of the root cause analysis, extent of cause and extent of condition determinations, and corrective actions associated with the White finding identified in the Barrier Integrity Cornerstone. The finding was related to the failure to implement shutdown procedures which resulted in multiple actuations of pressurizer PORVs on February 22, 2005.

Based on this inspection, we have concluded that your root cause evaluation was adequate and effectively identified the primary and contributing causes for this event. The completed and proposed corrective actions, including actions to prevent recurrence, appropriately addressed the results of your root cause evaluation and your implementation schedule was consistent with the overall safety significance of the problem. As such, the inspection objectives of Inspection Procedure 95001, "Inspection For One Or Two White Inputs In A Strategic Performance Area," have been satisfied. Given your acceptable performance in addressing the problems associated with this event, the White finding associated with this issue will only be considered in assessing plant performance for a total of four quarters in accordance with the guidance in Inspection Manual Chapter (IMC) 0305, "Operating Reactor Assessment Program."

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 Room or from the Publicly Available Records (PARS) component of the NRC's document 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/

Malcolm T. Widmann, Chief
Reactor Projects Branch 6
Division of Reactor Projects

Docket Nos.: 50-390
License Nos.: NPF-90

Enclosure: NRC Supplemental Inspection Report 05000390/2006010
w/Attachment: Supplemental Information

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Report to K. W. Singer from Malcolm Widmann dated June 27, 2006.

SUBJECT: WATTS BAR NUCLEAR PLANT - NRC SUPPLEMENTAL INSPECTION
REPORT NO. 05000390/2006010

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U. S. NUCLEAR REGULATORY COMMISSION

REGION II

Docket No.: **50-390**

License No.: **NPF-90**

Report No.: **05000390/2006010**

Licensee: Tennessee Valley Authority

Facility: Watts Bar Nuclear Power Plant

Location: 1260 Nuclear Plant Road
Spring City, TN 37381

Dates: May 31 - June 2, 2006

Inspector: Brian C. Anderson
Resident Inspector, Vogtle Electric Generating Plant

Approved by: **Malcolm T. Widmann**, Chief
Reactor Projects Branch 6
Division of Reactor Projects

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SUMMARY OF FINDINGS

IR 05000390/2006010; 05/31/2006 - 06/02/2006; Tennessee Valley Authority (TVA), Watts Bar Nuclear Power Plant. Supplemental inspection for a White finding related to the failure to implement shutdown procedures which resulted in multiple actuations of pressurizer power operated relief valves (PORVs).

This inspection was conducted by a resident inspector from Vogtle Electric Generating Plant. No findings of significance were identified. The Nuclear Regulatory Commission's (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.

Cornerstone: Barrier Integrity

This supplemental inspection was performed by the NRC to assess Tennessee Valley Authority's evaluation and corrective actions associated with a White finding related to the failure to implement shutdown procedures which resulted in multiple actuations of pressurizer PORVs. The performance issue for the finding was previously characterized as having low to moderate risk significance (White) in the NRC Final Significance Determination letter (IR 05000390/2006007), dated April 7, 2006.

During this supplemental inspection, which was performed in accordance with Inspection Procedure 95001, "Inspection for One or Two White Inputs In a Strategic Performance Area," the NRC concluded that the licensee's problem identification and root cause analysis was **acceptable. The licensee determined that the root cause of the event was attributable to personnel lack of sensitivity to and failure to recognize the hazards associated with the approach to solid water operations. Further contributing to this event were the failure to correct a long standing equipment performance problem and operating under plant conditions that exacerbated the effects of that equipment performance problem. The completed and proposed corrective actions, including actions to prevent recurrence, have adequately addressed the results of the root cause evaluation.**

Given the licensee's acceptable performance in addressing the problems with this event, the White finding associated with this issue will only be considered in assessing plant performance for a total of four quarters in accordance with the guidance in IMC 0305, "Operating Reactor Assessment Program." Implementation of the licensee's corrective actions will be reviewed during a future inspection.

A. NRC-Identified and Self-Revealing Findings

No findings of significance were identified.

B. Licensee-Identified Violations

None.

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REPORT DETAILS

01 Inspection Scope

This supplemental inspection was performed by the NRC to assess the Tennessee Valley Authority's evaluation and corrective actions associated with a low-to-moderate risk significant (White) finding applicable to Watts Bar Unit 1. The White finding was in the Barrier Integrity Cornerstone in the reactor safety strategic performance area. The performance issues associated with this finding were initially characterized in NRC Inspection Report (IR) 05000390/2005002 as an unresolved item (URI), subsequently as "greater than Green" in NRC IR 05000390/2005013, and later characterized as White in the NRC Final Significance Determination letter (IR 05000390/2006007), dated April 7, 2006. The inspection involved a review of the licensee's problem identification, root cause analysis and corrective actions associated with this White finding.

The inspector assessed the adequacy of the licensee's root cause analysis, determined if appropriate corrective actions were specified and scheduled commensurate with risk, and determined if the proposed actions were sufficient to prevent recurrence. This assessment included a review of the licensee's Problem Evaluation Reports (PERs); root cause and apparent cause analyses; completed and scheduled corrective actions; programmatic and operational procedures; related drawings and documents; and interviews with key plant personnel.

02 Evaluation of Inspection Requirements

02.01 Problem Identification

- a. Determination of who identified the issue and under what conditions

On February 22, 2005, while transitioning to solid water operations, both pressurizer power operated relief valves (PORVs), **1-RFV-63-340A and 1-RFV-63-334D, actuated** multiple times during a two hour period. The block valve for PORV 1-RFV-63-340A had been closed to reduce containment gas problems via leakage from the valve packing. Thus this PORV did not actually relieve pressure during a total of seven actuations. However, PORV 1-RFV-63-334D actuated a total of five times to reduce pressure.

This self-revealing issue was documented by the licensee and was addressed through a root cause evaluation in PER 77176 and an apparent cause evaluation in PER 79910. The White finding associated with this event was documented in NRC IR 05000390/2006007.

- b. Determination of how long the issue existed and prior opportunities for identification

The normal charging flow control valve, 1-FCV-62-93, is an air-operated valve that controls the centrifugal charging pump (CCP) flow rate. Documented in the licensee's corrective action program since September 2000, 1-FCV-62-93 operates erratically when a high differential pressure (dP) exists across the charging line (i.e., the high

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discharge pressure of the CCP to the lower pressure of the reactor coolant system). This high dP operating condition normally occurs during plant startups and shutdowns. In December 2004, the licensee approved a design change to reduce the erratic operation of 1-FCV-62-93 during high dP conditions. This design change was scheduled to be implemented concurrent with the transition to solid water operations as part of the next refueling outage, scheduled for February 2005. On February 22, 2005, licensee staff made inappropriate operational decisions during the transition to solid water operations. After returning the charging control valve to service following the implementation of the design change, procedural requirements were exceeded when 1-FCV-62-93 exhibited erratic operation. This erratic operation occurred following activities to transfer from bypass to normal charging and when operators transferred back to bypass charging.

Erratic operation of 1-FCV-62-93 had been documented in the licensee's corrective action program since September 2000. A design change was being implemented to address the erratic operation of this valve. However, opportunities existed during design change scheduling and during operational decision-making to identify the potential problems that resulted in multiple actuations of pressurizer PORVs.

- c. Determination of the plant-specific risk consequences and compliance concerns associated with the issue

The NRC IR 05000390/2006007, dated April 7, 2006, stated that the preliminary estimated delta core damage frequency (CDF) for this event was approximately $7\text{E-}5$ per year. The NRC staff recognized that this value was based on a conservative assumption and conducted a reassessment using multiple approaches, both quantitative and qualitative. The reassessed quantitative CDF results were determined to be within the range of $1\text{E-}6$ to $1\text{E-}5$ per year. Therefore, based on the risk increase over the baseline scenario being between $1\text{E-}6$ and $1\text{E-}5$, the finding was characterized as White.

The licensee identified that the plant evolutions most susceptible to the event that occurred are plant startups and plant shutdowns. The licensee also recognized that inappropriate operational decisions were a key contributor to this event. Training and procedural modifications specifically addressed these aspects of the event.

- d. Assessment

The problems associated with the erratic operation of the normal charging flow control valve, 1-FCV-62-93, were documented in the licensee's corrective action program. A design change to correct this problem was being implemented at the time of the event. Additionally, the licensee had established a PER that tracked operations performance

weaknesses. The inspector determined that the licensee adequately identified all attributes related to the problems which led to multiple actuations of the pressurizer PORVs.

02.02 Root Cause, Extent of Condition, and Extent of Cause Evaluations

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

The inspector reviewed the methodology and results of the licensee's root cause analysis as documented in the PER 77176; "COPS pickup" and the licensee's apparent cause analysis as documented in PER 79910; "Solid water OPS." The analyses used several formal systematic processes to identify root and contributing causes of the problems which led to multiple actuations of the pressurizer PORVs. These methodologies included Events and Causal Factors analysis and Common Cause Analysis in addition to less-formal, programmatically controlled analysis techniques. The root cause analyses were conducted using the guidance contained in BP-250; "Corrective Action Program Handbook." The analyses appropriately considered human performance, and process and hardware issues that contributed to the problems which led to this event. The analyses contained in the two PER's identified **one root cause** for this issue which resulted in the multiple pressurizer PORV actuations. **The licensee determined that the root cause of the event was attributable to personnel lack of sensitivity to and failure to recognize the hazards associated with the approach to solid water operations. Further contributing to this event were the failure to correct a long standing equipment performance problem and operating under plant conditions that exacerbated the effects of that equipment performance problem.** This root cause and related contributing causes were documented in the root cause analyses performed by the licensee. Corrective actions were developed to address the causes and to prevent recurrence.

b. Level of detail of the root cause evaluation

The inspector's review of the licensee's root cause and apparent cause analyses determined that they had been performed to a level of depth commensurate with the significance of the issue and provided reasonable assurance that the root causes and contributing causes had been identified.

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

The inspector determined that during the root cause analysis conducted under PER 77176 and the apparent cause analysis conducted under PER 79910, the licensee reviewed both industry and internal operating experience to determine if any similar problems had been previously identified to aid in the resolution of the issues related to this event. This review included operating experience from within TVA's nuclear fleet and from other nuclear utilities.

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

The licensee's root cause analysis considered, in part, activity scheduling, training, procedural guidance, and evolutions involving solid water operations to determine potential common causes and extent of condition. The inspector determined that the analysis did examine multiple disciplines, human performance, and different types of equipment and plant systems. Common cause considerations were focused on extent of condition. Extent of cause evaluation, associated with long standing equipment issues, mainly addressed valves with high differential pressure conditions and systems that operate under solid plant operations. Corrective actions were implemented to address procedural and training deficiencies identified as part of the consideration of common cause and extent of condition. The inspector concurred that the licensee's actions properly identified and addressed common cause failures and the extent of condition.

- e. Assessment

The licensee's root cause and apparent cause analyses associated with the problems that led to multiple actuations of the pressurizer PORVs and resulted in a White finding were adequate and identified both root and contributing causes for this event. Corrective actions have been developed to address each of these causes in the PERs containing the root cause and apparent cause analyses documentation.

02.03 Corrective Actions

- a. Appropriateness of corrective actions

The inspector reviewed all completed and pending corrective actions associated with this finding. The licensee identified nine corrective actions to address the root cause and contributing causes of this event. The corrective actions can be generally categorized as procedural enhancements, training, scheduling process improvements, and the repair or replacement of the normal charging flow control valve 1-FCV-62-93.

The licensee analysis also included corrective actions for the other TVA nuclear plants to conduct reviews of the PERs that describe this event. Browns Ferry Nuclear Plant and Sequoyah Nuclear Plant will conduct reviews to evaluate for any generic implications and to determine the effectiveness of completed corrective actions to prevent recurrence. The inspector determined that the corrective actions were clearly defined and appropriate for all identified causes of this event.

- b. Prioritization of corrective actions

The inspector determined that the corrective actions associated with this event have been appropriately prioritized based on risk significance.

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

The inspector verified that all corrective actions associated with this finding are captured in the electronic corrective action program system. All pending corrective actions assign responsible individuals, identify completion dates and contain sufficient detail to ensure they are tracked and completed commensurate with their relative priority.

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

The licensee plans to use their normal corrective action process to determine the effectiveness of the corrective actions to prevent recurrence.

- e. Assessment

The inspector determined that all corrective actions were clearly defined and did not create new or different problems. The inspector noted that most of the corrective actions involved procedural changes and implementation of training. Procedural changes and initial training were adequate and were completed in a timely manner. In addition, a separate pending corrective action of just-in-time training is scheduled to take place immediately prior to the next scheduled refueling outage. The inspector considered this appropriate in order to properly emphasize the shutdown plant conditions under which this event occurred. The inspector concluded that the licensee's completed and pending corrective actions adequately addressed the root and contributing causes identified for this event.

03 Management Meetings

Exit Meeting Summary

The inspector presented the inspection results to Mr. J. Laughlin, Plant Manager, and other members of licensee management on June 2, 2006. The inspector confirmed that proprietary information was not provided or examined during the inspection.

ATTACHMENT: SUPPLEMENTAL INFORMATION

Enclosure

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

Licensee

C. Allen, Mechanical Engineering
M. DeRoche, Nuclear Assurance Manager
J. Frisco, Engineering Manager
J. Laughlin, Plant Manager
L. McCormick, Design Manager Site Engineering
P. Pace, Licensing and Industry Affairs Manager
S. Robertson, Design Engineering
P. Salkeld, Operations Support Superintendent
M. Skaggs, Site Vice President, Watts Bar Nuclear Plant
R. Stockton, Licensing Engineer Watts Bar Licensing
D. Voeller, Maintenance and Modifications Support Manager
D. White, Operations Manager

NRC

J. Bartley, Senior Resident Inspector
M. Widmann, Chief, Reactor Projects Branch 6, Division of Reactor Projects, RII

ITEMS OPENED AND CLOSED

Opened

None

Closed

None

LIST OF DOCUMENTS REVIEWED

Procedures

ARI-88-94; Annunciator Response Instructions
BP-250; Corrective Action Program Handbook
GO-6, Revision 33; Unit Shutdown from Hot Standby to Cold Shutdown
GO-10, Revision 30; Reactor Coolant System Drain and Fill Operations
OPDP-1, Conduct of Operations
Outage Schedule Desktop Guide, Revision 1
SOI-62.01, Revision 53; CVCS - Charging and Letdown
SPP-3.1; Corrective Action Program
TPI-201.1, Revision 8; TVA Nuclear Training Instruction
3-OT-SRT0059A, Revision 7; Watts Bar Nuclear Operator Training

Corrective Action Documents

PER 77176; COPS pickup

PER 79910; Solid water OPS

PER 84169; Operations Fundamentals

PER 2130; Request engineering evaluation of erratic response of 1-FCV-62-89 & 1-FCV-62-93

PER 12828; Performance of 1-SI-62-907, appendix 'O'

Other Documents

Events and Causal Factors chart associated with PER 77176; COPS pickup

Why Staircase Chart associated with PER 79910; Solid water OPS

Investigation of Increased Letdown Flow, Revised 4/29/2005

Work Order 03-000743-000

Work Order 03-019848-000

Work Order 03-017997-000

LIST OF ACRONYMS USED

CCP - Centrifugal Charging Pump

CDF - Core Damage Frequency

dP - Differential Pressure

IR - Inspection Report

NRC - Nuclear Regulatory Commission

PER - Problem Evaluation Report

PORV - Power Operated Relief Valve

TVA - Tennessee Valley Authority

URI - Unresolved Item