



UNITED STATES  
NUCLEAR REGULATORY COMMISSION

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

April 7, 2006

EA-05-169

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: FINAL SIGNIFICANCE DETERMINATION FOR A WHITE FINDING AND  
NOTICE OF VIOLATION (Watts Bar Nuclear Power Plant - NRC Inspection  
Report No. 05000390/2006007)

Dear Mr. Singer:

The purpose of this letter is to provide you with the Nuclear Regulatory Commission's (NRC) final significance determination for a finding involving a challenge to reactor coolant system (RCS) integrity by multiple pressurizer power-operated relief valve (PORV) actuations and a challenge to RCS inventory control by the loss of RCS coolant via the open PORVs which occurred on February 22, 2005, during transition to solid plant operations.

The finding was documented in NRC Inspection Report No. 05000390/2005013, dated September 7, 2005, and was assessed under the significance determination (SDP) process as a preliminary "greater than Green" issue (i.e., an issue of at least low to moderate safety significance which may require additional NRC inspection). The cover letter to the inspection report informed the Tennessee Valley Authority (TVA) of the NRC's preliminary conclusion, provided TVA with an opportunity to request a regulatory conference on this matter, and forwarded the details of the NRC's preliminary estimate of the change in core damage frequency (CDF) for this finding. At TVA's request, an open regulatory conference was conducted on October 25, 2005, to discuss TVA's position on this issue. The enclosures to this letter include the list of attendees at the regulatory conference and material presented by TVA.

During the conference, TVA presented the results of its estimate of the increase in CDF due to the performance deficiency, including influential assumptions and its analysis methodology. TVA concluded that the finding was of very low safety significance (Green). TVA's analysis included the following five key differences between its evaluation and the NRC's preliminary evaluation: (1) the number of PORV lifts totaled five instead of the seven lifts used in the NRC's event tree, (2) TVA concluded that a more rigorous mathematical treatment of each successive PORV lift was warranted, (3) the Residual Heat Removal (RHR) suction relief valve reliability to open was greater than that assumed in the NRC's preliminary estimate, (4) TVA's analysis included two additional RHR discharge relief valves to relieve increasing RCS pressure which were not included in the NRC's evaluation, and (5) TVA contended that secondary plant cooling was available to prevent core damage. TVA agreed with the NRC's characterization of

the finding as a violation of plant procedures. At the regulatory conference, the NRC requested that TVA provide the basis for its RHR system relief valve reliability, the availability of emergency core cooling system sump during the event, and the basis for its human error probabilities used in risk calculations for the event. In addition, TVA agreed to perform a simulator run to assess the likelihood of success by operators in establishing secondary plant cooling with the RHR system isolated and the RCS closed without exceeding the pressure and temperature limits report (PTLR). TVA also agreed to provide the results of this activity to the NRC. This information was subsequently transmitted to the NRC by TVA's letter dated December 27, 2005.

The information provided by TVA caused the NRC to change the event tree that described the finding. TVA's simulator results indicated that when the operators isolated the RHR system to stop the leak from a stuck open RHR relief valve, an over pressurization event will occur. In addition, this resulted in a reduction in the importance of the five key differences that TVA presented at the conference as they no longer have a major impact on the dominant risk sequence and the NRC's final risk characterization.

After considering the information developed during the inspection, the information TVA provided at the conference, and supplemental information as discussed above, the NRC has concluded that the final inspection finding is appropriately characterized as White in the barrier integrity cornerstone.

As part of the NRC's final risk characterization, the dominant risk sequence included an assumption that plant procedures required isolation of the RHR system in response to an RHR relief valve that fails to close during the scenario. The NRC's risk characterization also considered 12 challenges to the PORVs. This value is based on the total demands seen by the PORV circuitry during the scenario. The NRC's evaluation also assumed both PORV block valves to be open instead of the actual condition that existed during the event. This assumption is consistent with the NRC's SDP methodology in which the failure probability of mitigating equipment is determined based on the average condition of the equipment.

These assumptions resulted in a dominant risk sequence that involves the over pressurization of the RCS. The dominant risk sequence would progress with the subsequent unavailability of the PORVs to relieve pressure in the low temperature overpressure protection mode, the subsequent challenge of the RHR relief valves, and the failure of the relief valves to reclose. Subsequent to this, the sequence would progress with successful operator action to isolate the RHR system in accordance with plant procedures which would cause a pressure spike that would exceed the reactor vessel's material limits as specified in the PTLR. This could induce a consequential reactor vessel failure from brittle fracture resulting in subsequent core damage. The staff's preliminary risk assessment assumed the failure probability of the reactor vessel, given this scenario, to be 1.0 which resulted in an estimated delta CDF of approximately  $7E-5$  per year (Yellow). The staff recognized that the reactor vessel failure probability of 1.0 was based on a conservative assumption and conducted a reassessment using multiple approaches, both quantitative and qualitative, to assess the importance of the low temperature overpressure sequence.

The quantitative results were used as inputs to a qualitative risk evaluation. This evaluation also considered defense-in-depth concepts and the uncertainties of the different numerical

methods used in the sensitivity screening analysis. The qualitative analysis was used for the final risk determination reassessment.

During the reassessment, the NRC used multiple approaches to assess the importance of the low temperature overpressure sequence. Low temperature overpressure prevention and mitigation is most critical during RCS water-solid conditions which correlates to the plant conditions of the Watts Bar performance deficiency. Quantitative delta CDF results were within the range of 1E-6 to 1E-5 per year. For the quantitative assessment, the staff performed several sensitivity cases. These cases included application of a vessel failure probability screening value supported by engineering expert opinion regarding the vessel's robustness and, separately, use of previous agency regulatory work for resolution of Generic Safety Issue 94, Additional Low Temperature Overpressure Protection Requirements.

The NRC's preliminary significance determination for the performance deficiency, as transmitted in our letter of September 7, 2005, did not specifically address the change in large early release frequency (LERF), in part, because of the complexities and rigor that would be necessary to quantify an estimate. However, the staff has subsequently conducted a qualitative assessment of the change in LERF and considers this to be non-trivial due, in part, to the potential for the containment to be open to support outage work and the relevant mode of operations. From a defense-in-depth perspective, unlike most other accident initiators that can lead to core damage, a low temperature overpressure event could result in the reactor pressure vessel being unavailable for either subsequent recovery of the reactor core or as an additional barrier for fission product retention. The consequences of such an event can be significant as a result of containment bypass or failure of containment isolation following vessel failure.

Overall, given the above considerations taken in the aggregate, the staff concluded that the finding should be characterized as White in the barrier integrity cornerstone.

You have 10 calendar days from the date of this letter to appeal the staff's determination of significance for the identified finding. Such appeals will be considered to have merit only if they meet the criteria given in NRC Inspection Manual Chapter 0609, Attachment 2.

The NRC also determined that a violation of Technical Specification 5.7.1.1 and Procedure GO-6, Unit Shutdown from Hot Standby to Cold Shutdown, occurred in that TVA personnel failed to slowly raise charging flow to fill the pressure at less than 30 gallons per minute as required by procedure. The violation is set forth in the enclosed Notice of Violation.

You are not required to respond to this letter unless the description herein does not accurately reflect your position or if you choose to provide additional information. For administrative purposes, this letter is issued as a separate NRC Inspection Report (No. 05000390/2006007) and the above violation is identified as VIO 05000390/2006007-01, White Finding - Failure to Implement Shutdown Procedures which Resulted in Pressurizer PORV Actuations. Accordingly, Apparent Violation (AV) 05000390/2005013-01, Failure to Implement and Maintain Shutdown Procedures which Resulted in Pressurizer PORV Actuations, is closed.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosures, and your response (should you choose to provide one) will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (ADAMS) which is accessible from the NRC Web site at

<http://www.nrc.gov/reading-rm/adams.html>. To the extent possible, any response should not include any personal privacy, proprietary, classified, or safeguards information so that it can be made available to the Public without redaction. The NRC also includes significant enforcement actions on its Web site at [www.nrc.gov](http://www.nrc.gov); select **What We Do, Enforcement**, then **Significant Enforcement Actions**.

Should you have any questions regarding this letter, please contact Mr. Charles A. Casto, Director, Division of Reactor Projects, at (404)562-4500.

Sincerely,

/RA/

William D. Travers  
Regional Administrator

Docket No.: 50-390  
License No.: NPF-90

Enclosures:

1. Notice of Violation
2. List of Attendees
3. Material presented by TVA

cc w/encl: (See next page)

cc w/encls:

Ashok S. Bhatnagar  
Senior Vice President  
Nuclear Operations  
Tennessee Valley Authority  
Electronic Mail Distribution

Larry S. Bryant, Vice Present  
Engineering and Technical Services  
Tennessee Valley Authority  
Electronic Mail Distribution

Michael D. Skaggs  
Site Vice President  
Watts Bar Nuclear Plant  
Tennessee Valley Authority  
Electronic Mail Distribution

Robert J. Beecken, Vice President  
Nuclear Support  
Tennessee Valley Authority  
Electronic Mail Distribution

General Counsel  
Tennessee Valley Authority  
Electronic Mail Distribution

John C. Fornicola, Manager  
Nuclear Assurance and Licensing  
Tennessee Valley Authority  
Electronic Mail Distribution

Glenn W. Morris, Manager  
Corporate Nuclear Licensing and  
Industry Affairs  
Tennessee Valley Authority  
Electronic Mail Distribution

Paul L. Pace, Manager  
Licensing and Industry Affairs  
Watts Bar Nuclear Plant  
Tennessee Valley Authority  
Electronic Mail Distribution

Jay Laughlin, Plant Manager  
Watts Bar Nuclear Plant  
Tennessee Valley Authority  
Electronic Mail Distribution

County Executive  
Rhea County Courthouse  
375 Church Street, Suite 215  
Dayton, TN 37321-1300

County Mayor  
P. O. Box 156  
Decatur, TN 37322

Lawrence E. Nanney, Director  
TN Dept. of Environment & Conservation  
Division of Radiological Health  
Electronic Mail Distribution

Ann Harris  
341 Swing Loop  
Rockwood, TN 37854

James H. Bassham, Director  
Tennessee Emergency Management  
Agency  
Electronic Mail Distribution

Distribution w/encls:

L. Reyes, EDO  
 J. Dyer, NRR  
 S. Richards, NRR  
 M. Tschiltz, NRR  
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 J. Moore, OGC  
 E. Julian, SECY  
 B. Keeling, OCA  
 Enforcement Coordinators  
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 M. Franovich, NRR  
 R. Gibbs, NRR  
 R. Pascarelli, NRR  
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 L. Trocine, OE  
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 K. Clark, RII  
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NAME	CEVANS	CCASTO	RPASCARELLI	CNOLAN		
DATE	3/24/06	3/24/06	03/30/06	04/04/06		
E-MAIL COPY?	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO

## NOTICE OF VIOLATION

Tennessee Valley Authority  
Watts Bar Nuclear Plant  
Unit 1

Docket No. 50-390  
License No. NPF-90  
EA-05-169

During an NRC inspection completed on April 6, 2005, a violation of NRC requirements was identified. In accordance with the NRC Enforcement Policy, the violation is listed below:

Technical Specification 5.7.1.1 requires that written procedures be implemented and maintained covering the activities in the applicable procedures recommended by Regulatory Guide 1.33, Revision 2, Appendix A, February 1978, of which Part 2.j requires a procedure for hot standby to cold shutdown. Procedure GO-6, Unit Shutdown from Hot Standby to Cold Shutdown, Section 5.5, Step [1] [e] states, "Slowly RAISE charging to fill Pressurizer at less than 30 gpm."

Contrary to the above, on February 22, 2005, the licensee failed to follow procedure GO-6, Section 5.5, Step [1] [e], in that net charging flow was raised to a rate that exceeded the 30 gpm procedural specification.

This violation is associated with a White significance determination process finding for Unit 1 in the barrier integrity cornerstone.

The NRC has concluded that information regarding the reason for the violation, the corrective actions taken and planned to correct the violation and prevent recurrence, and the date when full compliance was achieved is already adequately addressed on the docket and in the information provided by TVA at the conference (Enclosure 3). However, you are required to submit a written statement or explanation pursuant to 10 CFR 2.201 if the description therein does not accurately reflect your corrective actions or your position. In that case, or if you choose to respond, clearly mark your response as a "Reply to a Notice of Violation - EA-05-169," and send it to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555, with a copy to the Regional Administrator, Region II, within 30 days of the date of the letter transmitting this Notice of Violation (Notice).

If you contest this enforcement action, you should also provide a copy of your response with the basis for your denial to the Director, Office of Enforcement, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

If you choose to respond, your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (ADAMS). To the extent possible, it should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction. ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request withholding of such material, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim of withholding (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for

withholding confidential commercial or financial information). If safeguards information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21.

In accordance with 10 CFR 19.11, you may be required to post this Notice within 2 working days.

Dated this 7<sup>th</sup> day of April 2006



## LIST OF ATTENDEES

### Nuclear Regulatory Commission:

W. Travers, Region II (RII)  
J. Shea, Deputy Director, Division of Reactor Projects (DRP), RII  
C. Christensen, Deputy Director, Division of Reactor Safety (DRS), RII  
S. Cahill, Branch Chief, DRP, RII  
J. Bartley, Senior Resident Inspector, DRP, RII  
R. Bernhard, Senior Risk Analyst, DRS, RII  
L. Trocine, Senior Enforcement Specialist, Office of Enforcement  
C. Evans, Regional Attorney and Enforcement Officer, RII  
S. Sparks, Senior Enforcement Specialist, RII  
M. Reinhart, Office of Reactor Regulation (telecon)  
M. Pohida, Office of Reactor Regulation (telecon)  
F. Bonnett, Office of Reactor Regulation (telecon)

### Tennessee Valley Authority:

M. Skaggs, Site Vice President  
D. White, Operations Manager  
F. Koontz, Engineering Specialist  
P. Pace, Licensing and Industrial Affairs Manager  
J. Smith, Sequoyah Licensing Manager  
T. Langley, Browns Ferry Licensing Manager  
J. Mayo, Watts Bar Shift Manager  
C. Borrelli, TVA PSA Engineer  
S. Roa, Director of Risk Management Solutions, ABS Consulting