



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

July 25, 2013

Mr. Joseph W. Shea  
Vice President, Nuclear Licensing  
Tennessee Valley Authority  
1101 Market Street, LP 3D-C  
Chattanooga, TN 37402-2801

**SUBJECT: WATTS BAR NUCLEAR PLANT – COMPONENT DESIGN BASES  
INSPECTION FOLLOW UP REPORT 05000390/2013010**

Dear Mr. Shea:

On July 8, 2013, the U. S. Nuclear Regulatory Commission (NRC) completed an inspection at your Watts Bar Nuclear Plant, Unit 1. The enclosed inspection report documents the inspection results, which were discussed on July 8, 2013, with Mr. Tim Cleary and other members of your staff.

The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. The inspector reviewed selected procedures, evaluations, and records, and interviewed personnel.

One NRC identified finding of very low safety significance (Green) was identified during this inspection. This finding was determined to involve a violation of NRC requirements. The NRC is treating this violation as a non-cited violation (NCV) consistent with Section 2.3.2 of the Enforcement Policy.

If you contest the violation or significance of the NCV, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington DC 20555-0001; with copies to the Regional Administrator Region II; the Director, Office of Enforcement, United States Nuclear Regulatory Commission, Washington, DC 20555-0001; and the NRC Resident Inspector at the Watts Bar Nuclear Plant.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's Agencywide Document Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

Sincerely,

**RA**

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

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

Enclosure:  
Inspection Report 05000390/2013010,  
w/Attachment: Supplementary Information

cc: (See page 3)

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**RA**

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

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PUBLICLY AVAILABLE      NON-PUBLICLY AVAILABLE      SENSITIVE       NON-SENSITIVE  
 ADAMS:  Yes      ACCESSION NUMBER: \_\_\_\_\_       SUNSI REVIEW COMPLETE       FORM 665 ATTACHED

OFFICE	RII:DRS	NRR:DE	RII:DRS	RII: DRS	RII: DRP
SIGNATURE	RA	RA	RA	RA	RA
NAME	M. Riley	R. Mathew	E. Stamm	R. Nease	S. Shaeffer
DATE	7/12/2013	7/11/2013	7/12/2013	7/23/2013	7/25/2013
E-MAIL COPY	YES NO	YES NO	YES NO	YES NO	YES NO

OFFICIAL RECORD COPY DOCUMENT NAME: S:\DRS\ENG BRANCH 1\BRANCH INSPECTION FILES\2011-2012-2013 CYCLE EB1 INSPECTION FOLDERS FOR ALL SITES\WATTS BAR\WATTSBAR2013010HARMONICSURI CLOSURE FINAL.DOCX

cc:

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Letter to Joseph W. Shea from Rebecca L. Nease dated July 25, 2013.

SUBJECT: WATTS BAR NUCLEAR PLANT – COMPONENT DESIGN BASES  
INSPECTION FOLLOW UP REPORT 05000390/2013010

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RIDSNRRDIRS

PUBLIC

RidsNrrPMWattsBar1 Resource

RidsNrrPMWattsBar2 Resource

**U. S. NUCLEAR REGULATORY COMMISSION**

**REGION II**

Docket No: 050000390

License No: NPF-90

Report No: 05000390/2013010

Licensee: Tennessee Valley Authority (TVA)

Facility: Watts Bar Nuclear Plant, Unit 1

Location: Spring City, TN 37381

Dates: April 3, 2013 – July 8, 2013

Inspector: M. Riley, Reactor Inspector

Approved by: Rebecca Nease, Branch Chief  
Engineering Branch 1  
Division of Reactor Safety

Enclosure

## SUMMARY

IR 05000390/2013-010; 04/03/2013 – 07/08/2013; Watts Bar Nuclear Plant, Unit 1; Component Design Bases Inspection Follow up.

This inspection was conducted by a Nuclear Regulatory Commission (NRC) inspector from Region II over a three-month period. One Green non-cited violation was identified. The significance of inspection findings is indicated by their color (i.e., greater than Green, or Green, White, Yellow, Red) and determined using NRC Inspection Manual Chapter 0609, "Significance Determination Process," dated June 2, 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.

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

Cornerstone: Mitigating Systems

Green: The NRC identified a non-cited violation of 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," for the licensee's failure to implement corrective actions to identify and evaluate the effects of electrical system harmonics on safety-related undervoltage relays. This was a performance deficiency. The licensee entered this issue into their corrective action program as Problem Evaluation Reports 515413 and 703444. The licensee also established a preventative maintenance program to monitor motors powered from the 6.9 kilovolt shutdown boards for harmonic distortion until further monitoring and evaluation of harmonic distortion on the 6.9 kilovolt shutdown board degraded voltage relays can be completed.

The performance deficiency was more than minor because it affected the design control attribute of the Mitigating Systems cornerstone and adversely impacted the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Specifically, at the time of identification, there was reasonable doubt as to whether the degraded voltage scheme would perform as required by the Watts Bar 1 Technical Specifications during design basis conditions. The inspector 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, and the structure, system, or component maintained its operability and functionality. Because the opportunity to identify the impact of harmonics on degraded voltage relay performance occurred in 1993, the inspector determined that no cross-cutting aspect was applicable because the finding was not indicative of current licensee performance. (Section 1R21.1)

### B. Licensee Identified Violations

No findings were identified.

## REPORT DETAILS

### 1. REACTOR SAFETY

Cornerstones: Initiating Events, Mitigating Systems, Barrier Integrity

#### 1R21 Component Design Bases Inspection (71111.21)

##### .1 (Closed) URI 05000390/2012008-04, "Effect of System Harmonics on Degraded Voltage Relay Function."(ML12165A186)

###### a. Inspection Scope

During the 2012 Component Design Bases Inspection, an unresolved item was identified related to the effect of electrical system harmonics on safety-related under voltage relays. In 1993, the licensee identified that harmonic distortions adversely affected the 6.9 kilovolt (kV) bus overvoltage relays by causing them to alarm unnecessarily. However, the licensee did not identify (or otherwise evaluate) the effect that harmonics could have on the ability of degraded voltage relays of similar design to perform their safety function as required by limiting condition for operation 3.3.5 of the plant's technical specifications (TS). The inspector was concerned that harmonics on the 6.9kV system could cause the degraded voltage relays to fail to perform as required by TS.

This item was unresolved pending further inspection to determine if the licensee's performance constituted a violation of NRC regulatory requirements. The inspector determined that additional consultation with the Office of Nuclear Reactor Regulation (NRR) was warranted before reaching a final disposition of the unresolved item.

The inspector conducted an in-office review of the licensee's maintenance and testing procedures to verify that the licensee had established compensatory measures to monitor for harmonic distortion. The inspector conducted a conference call on June 13, 2013, with the licensee to get their answers to questions that arose during the inspection. The inspector also verified that the licensee established long-term corrective action measures to identify and evaluate the effects of harmonics on the degraded voltage relays.

###### b. Findings

Introduction: The NRC identified a Green non-cited violation (NCV) of 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," for the licensee's failure to implement corrective actions to identify and evaluate the effects of electrical system harmonics on safety-related undervoltage relays. This was a performance deficiency.

Description: The Watts Bar 1 degraded voltage protection scheme features three Asea Brown Boveri (ABB) Type 27N relays for each 6.9kV Class 1E shutdown board, arranged in a two out of three tripping scheme. The vendor manual for this relay stated that, (1) the relay employs a peak voltage detector, and (2)



harmonic distortion on the AC waveform can have a noticeable effect on the relay operating point and the measuring instruments used to calibrate the relay. In 1993, the licensee experienced spurious actuations of the ABB type 59H overvoltage relays, and entered the condition in the corrective action program as Problem Evaluation Report (PER) 930397. These overvoltage relays are similar in design to the ABB type 27N degraded voltage relays (DVRs). The licensee performed troubleshooting tests and found that high levels of 6.9kV system harmonics accompanied the spurious actuations. The transient harmonics documented in Problem Evaluation Report (PER) 930397 were attributed to events that included the trip of the nearby Sequoyah generating station and breaker operations at the Watts Bar station. The 'Causal Factor' section of PER 930397 stated that the relays sometimes trip on harmonic distortion although the root mean square voltages are at acceptable levels. The licensee implemented corrective actions to address this condition by replacing the type 59H overvoltage relays with a model equipped with harmonic filters.

The inspector noted that the 'Extent of Condition' section of PER 930397 did not identify or address whether the DVRs could also be affected by the same harmonics implicated in the maloperation of the overvoltage relays. The reset function of the existing DVRs is identical to the tripping function of the ABB type 59H overvoltage relays that actuated due to transient harmonics in 1993. The DVR's design features an 'instantaneous' reset characteristic that could allow reset of the DVR in less than two cycles in the presence of harmonics, and thereby delay the protective function beyond the 10 seconds stipulated in TS limiting condition for operation 3.3.5. The NRC issued Task Interface Agreement (TIA) 2012-14, "Assessment of Watts Bar Nuclear Plant, Unit1, Evaluations that Address the Effect of AC Waveform Harmonic Distortion on DVR Function and the Applicability of 10 CFR 50, Appendix B Requirements," (ADAMS Accession No. ML13092A322) which concluded that harmonic distortion on Class 1E electrical distribution buses could result in the premature reset of the DVRs during a degraded voltage event. The TIA further concluded that reset of the DVRs (and associated timers) during the onset of such an event would: (1) prevent the relays from actuating within the time required by TS, (2) represent a condition adverse to the quality of relay operation, and (3) be subject to treatment in accordance with the requirements of 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants."

The inspector found that the licensee missed three opportunities to identify and evaluate the potential adverse effects of harmonics on the DVRs: (1) the vendor manual alerted the user to the effect of harmonics on relay accuracy; (2) the licensee experienced adverse effects in 1993, on similar relays due to system harmonics during pre-operational testing; and (3) NRC Information Notice 95-05 alerted the industry regarding adverse effects of harmonics on relay accuracy. The licensee entered this issue into their corrective action program as PERs 515413 and 703444, and performed an immediate operability determination on the DVRs. The licensee also established a preventative maintenance program to monitor motors powered from the 6.9kV shutdown boards for harmonic distortion until further monitoring and evaluation of harmonic distortion on the 6.9kV shutdown board DVRs can be completed.

Analysis: The licensee's failure to implement corrective actions to identify and evaluate the effects of electrical system harmonics on safety-related under voltage relays was a performance deficiency. The performance deficiency was more than minor because it affected the design control attribute of the Mitigating Systems cornerstone and adversely impacted the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Specifically, at the time of identification, there was reasonable doubt as to whether the degraded voltage scheme would perform as required by TS during design basis conditions. The inspector used Inspection Manual Chapter 0609, Att. 4, "Initial Characterization of Findings," issued 6/19/12, for Mitigating Systems, and Inspection Manual Chapter 0609, App. A, "The Significance Determination Process (SDP) for Findings at Power," issued 6/19/12, 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, and the structure, system, or component maintained its operability and functionality. Because the opportunity to identify the impact of harmonics on DVR performance occurred in 1993, the inspector determined that no cross-cutting aspect was applicable because the finding was not indicative of current licensee performance.

Enforcement: Appendix B of 10 CFR Part 50, Criterion XVI, "Corrective Action," requires, in part, that measures be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and non-conformances are promptly identified and corrected. Contrary to the above, since 1993 (when transient harmonics were observed to have an adverse effect on overvoltage relays), the licensee failed to implement corrective action program measures to identify and evaluate the adverse effects of electrical system harmonics on safety-related DVR function. Transient harmonics could cause the DVRs to spuriously reset during an actual degraded voltage event and delay the protective function beyond the time (10 seconds) stipulated in TS. The licensee established a preventative maintenance program to monitor motors powered from the 6.9kV shutdown boards for harmonic distortion until further monitoring and evaluation of harmonic distortion on the 6.9kV shutdown board DVRs can be completed. 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 PERs 515413 and 703444. (NCV 05000390/2013010-01, "Failure to Implement Corrective Actions to Identify and Evaluate Effects of Harmonics on Degraded Voltage Relay Function")

#### 4. OTHER ACTIVITIES

##### 4OA6 Meetings, Including Exit

On July 8, 2013, the inspector presented the inspection results to Mr. Tim Cleary, Site Vice President, and other members of the licensee's staff. The inspector verified that no proprietary information was retained by the inspector or documented in this report.

## SUPPLEMENTARY INFORMATION

### KEY POINTS OF CONTACT

#### Licensee personnel

D. Guinn, Site Licensing Manager

T. Morgan, Site Licensing

R. Stroud, Site Licensing

#### NRC personnel

R. Monk, Senior Resident Inspector, Watts Bar Unit 1 Resident Office

K. Miller, Resident Inspector, Watts Bar Unit 1 Resident Office

S. Shaeffer, Chief, Project Branch 6, Division of Reactor Projects, Region II

R. Mathew, Acting Branch Chief, Office of Nuclear Reactor Regulation, Division of Engineering

### ITEMS OPENED, CLOSED, DISCUSSED, AND UPDATED

#### Opened and Closed

05000390/2013010-01	NCV	Failure to Implement Corrective Actions to Identify and Evaluate Effects of Harmonics on Degraded Voltage Relay Function (Section 1R21.1)
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#### Closed

05000390/2012008-04	URI	Effect of System Harmonics on Degraded Voltage Relay Function (Section 1R21.1)
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## **LIST OF DOCUMENTS REVIEWED**

### Corrective Action Program Documents

PER 484561, Baker Online Motor Testing, 1/4/12  
PER 515413, Routine Monitoring Program for Harmonics, 3/2/12  
PER 546072, Implementation of White Paper in Response to 2012 CDBI, 5/3/12  
PER 930397, Corrective Action for Harmonics on Overvoltage Relays, 11/4/93

### Procedures

0-MI-57.108, Insulation Resistance and Continuity Tests for Rotating Machinery, Valves, Cables, Buses, and Transformers, Rev. 0005  
0-MI-57.110, Dynamic Motor Testing, Rev. 0000  
NETP-107, Medium Voltage Motor Testing and Maintenance Program, Rev. 0006  
TI-12.15, 161KV Offsite Power Requirements, Rev. 0024

### Corrective Action Documents Generated as a Result of the Inspection

PER 703444, Evaluate Operability of Degraded Voltage Relays, 3/29/13

### Other Documents

Prompt Determination of Operability for PER 703444, 4/19/13  
TIA 2012-04, Assessment of Watts Bar Nuclear Plant, Unit1, Evaluations that Address The Effect of AC Waveform Harmonic Distortion on Degraded Grid Voltage Relay Function and the Applicability of 10 CFR 50, Appendix B Requirements, 4/2/13  
TVA Position Paper, 2012008-004 Degraded Voltage Relay Issue Response, 9/25/12