Tennessee Valley Authority, Post Office 2000, Spring City, Tennessee 37381-2000

Mike Skaggs
Site Vice President, Watts Bar Nuclear Plant

10 CFR 50.73

JAN 1 3 2006

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D. C. 20555

Gentlemen:

| | | |
|---|---|---|
| In the Matter of | ) | Docket No. 50-390 |
| Tennessee Valley Authority | ) | |

WATTS BAR NUCLEAR PLANT (WBN) - UNIT 1 - FACILITY OPERATING LICENSE NPF-90 - LICENSEE EVENT REPORT (LER) 50-390/2005-002

This submittal provides LER 390/2005-002. This LER documents the results of an inspection of spent fuel that was performed on November 14, 2005. During the inspection an opening was found to exist in the cladding of a fuel pin in fuel assembly G45. The degradation of the fuel assembly cladding (a principal safety barrier) was initially reported under 10 CFR 50.72(b)(3)(ii)(A) on November 14, 2005 as Event Notification 42140. The enclosed report contains preliminary information regarding this event is provided in accordance with 10 CFR 50.73(a)(2)(ii)(A). Additional inspections of the affected assembly are planned and the results of the inspections will be provided in a supplement to this LER.

There are no regulatory commitments associated with this letter. Should there be questions regarding this submittal, please contact Paul L. Pace at (423) 365-1824.

Sincerely,

for M. D. Skaggs

Enclosure:
LER 390/2005-002

cc: See page 2

IE22

cc (Enclosure):

NRC Resident Inspector
Watts Bar Nuclear Plant
1260 Nuclear Plant Road
Spring City, Tennessee 37381

Douglas V. Pickett, Senior Project Manager
U.S. Nuclear Regulatory Commission
MS 08G9a
One White Flint North
11555 Rockville Pike
Rockville, Maryland 20852-2738

U.S. Nuclear Regulatory Commission
Region II
Sam Nunn Atlanta Federal Center
61 Forsyth St., SW, Suite 23T85
Atlanta, Georgia 30303

Institute of Nuclear Power Operations
700 Galleria Parkway, NW
Atlanta, Georgia 30339-5957

NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 06/30/2007

Estimated burden per response to comply with this mandatory collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by Internet e-mail to Infocollects@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

# LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

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**4. TITLE**

G45 Fuel Assembly Clad Damage (Preliminary Report)

| 5. EVENT DATE | | | 6. LER NUMBER | | | 7. REPORT DATE | | | 8. OTHER FACILITIES INVOLVED | |
|---|---|---|---|---|---|---|---|---|---|---|
| MONTH | DAY | YEAR | YEAR | SEQUENTIAL NUMBER | REV NO. | MONTH | DAY | YEAR | FACILITY NAME | DOCKET NUMBER |
| | | | | | | | | | | 05000 |
| 11 | 14 | 2005 | 2005 | - 002 - | 00 | 01 | 13 | 2006 | FACILITY NAME | DOCKET NUMBER |
| | | | | | | | | | | 05000 |

**9. OPERATING MODE**

Mode 1

**10. POWER LEVEL**

100%

**11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)***

| | | | |
|---|---|---|---|
| ☐ 20.2201(b) | ☐ 20.2203(a)(3)(i) | ☐ 50.73(a)(2)(i)(C) | ☐ 50.73(a)(2)(vii) |
| ☐ 20.2201(d) | ☐ 20.2203(a)(3)(ii) | ☑ 50.73(a)(2)(ii)(A) | ☐ 50.73(a)(2)(viii)(A) |
| ☐ 20.2203(a)(1) | ☐ 20.2203(a)(4) | ☐ 50.73(a)(2)(ii)(B) | ☐ 50.73(a)(2)(viii)(B) |
| ☐ 20.2203(a)(2)(i) | ☐ 50.36(c)(1)(i)(A) | ☐ 50.73(a)(2)(iii) | ☐ 50.73(a)(2)(ix)(A) |
| ☐ 20.2203(a)(2)(ii) | ☐ 50.36(c)(1)(ii)(A) | ☐ 50.73(a)(2)(iv)(A) | ☐ 50.73(a)(2)(x) |
| ☐ 20.2203(a)(2)(iii) | ☐ 50.36(c)(2) | ☐ 50.73(a)(2)(v)(A) | ☐ 73.71(a)(4) |
| ☐ 20.2203(a)(2)(iv) | ☐ 50.46(a)(3)(ii) | ☐ 50.73(a)(2)(v)(B) | ☐ 73.71(a)(5) |
| ☐ 20.2203(a)(2)(v) | ☐ 50.73(a)(2)(i)(A) | ☐ 50.73(a)(2)(v)(C) | ☐ OTHER |
| ☐ 20.2203(a)(2)(vi) | ☐ 50.73(a)(2)(i)(B) | ☐ 50.73(a)(2)(v)(D) | Specify in Abstract below or in NRC Form 366A |

**12. LICENSEE CONTACT FOR THIS LER**

| FACILITY NAME | TELEPHONE NUMBER *(Include Area Code)* |
|---|---|
| Jerry Bushnell, WBN Licensing Engineer | (423) 365-8048 |

**13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT**

| CAUSE | SYSTEM | COMPONENT | MANU-FACTURER | REPORTABLE TO EPIX | CAUSE | SYSTEM | COMPONENT | MANU-FACTURER | REPORTABLE TO EPIX |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

**14. SUPPLEMENTAL REPORT EXPECTED**

☑ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ☐ NO

**15. EXPECTED SUBMISSION DATE**

| MONTH | DAY | YEAR |
|---|---|---|
| 07 | 14 | 2006 |


*ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)*

On November 14, 2005, WBN Unit 1 was at 100 percent power and inspection results were being reviewed to establish the cause of a cladding leak in fuel assembly G45. The existence of a cladding leak was initially established during Cycle 6 operation through sampling of the Reactor Coolant System (RCS) that identified elevated levels of Iodine 131 (I-131) and Xenon 133 (Xe-133). This condition was documented in TVA's corrective action program and one element of the planned actions was the examination of the spent fuel during the Cycle 6 refueling outage. In-mast sipping was performed during the outage and established that fuel assemblies E59, G45 and H03 were leaking. The inspections identified a one-inch gap in the fuel cladding on fuel rod P-9 of fuel assembly G45. The visible damage to the rod was located approximately six inches above grid number 7. Due to this damage, it was concluded that some fuel pellet material (up to three fuel pellets) has been dislocated from rod P-9. Fragments of the pellets appeared to be lodged on the top of grid number 7. The corrective actions include measures to; 1) limit the radiological consequences of the fuel degradation, 2) define appropriate contingencies for operation during Cycle 7 with leaking fuel, 3) schedule additional inspections to confirm the primary cause of the cladding degradation.

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**17. NARRATIVE** *(If more space is required, use additional copies of NRC Form 366A)*

I. PLANT CONDITIONS:

Watts Bar Nuclear Plant (WBN) Unit 1 was in Mode 1 and operating at 100 percent power.

II. DESCRIPTION OF EVENT

A. Event

On November 14, 2005, WBN Unit 1 was at 100 percent power and inspection results were being reviewed to establish the cause of a cladding leak in fuel assembly G45. The existence of a cladding leak was initially established during Cycle 6 operation through sampling of the Reactor Coolant System (RCS) that identified elevated levels of Iodine 131 (I-131) and Xenon 133 (Xe-133). This condition was documented in TVA's corrective action program as Problem Evaluation Report (PER) 9174. A limit for the concentration of I-131 is defined in Limiting Condition for Operation (LCO) 3.4.16, "Reactor Coolant System (RCS) Specific Activity." In order to ensure this limit was closely monitored during Cycle 6, the RCS was sampled three times a week and reviewed by site management. The I-131 concentration for the samples taken throughout Cycle 6 remained well below the LCO limit. One element of the planned actions was the examination of the spent fuel during the Cycle 6 refueling outage. In-mast sipping was performed during the outage and established that fuel assemblies E59, G45 and H03 were leaking.

The inspection of the assemblies identified a one inch gap in the fuel cladding on fuel rod P-9 of fuel assembly G45. The damage to the rod was located approximately six inches above grid number 7. Due to this damage, it was concluded that some fuel pellet material (up to three fuel pellets) has been dislocated from rod P-9. Fragments of the pellets appeared to be lodged on the top of grid number 7. The damage to fuel assembly G45 was documented as PER 92432.

The degradation of the fuel assembly cladding (a principal safety barrier) was initially reported under 10 CFR 50.72(b)(3)(ii)(A) on November 14, 2005 as Event Notification 42140. This report is provided in accordance with 10 CFR 50.73(a)(2)(ii)(A).

B. Inoperable Structures, Components, or Systems that Contributed to the Event

There were no structures, components or systems inoperable at the start of the event that contributed to the event.

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17. NARRATIVE *(if more space is required, use additional copies of NRC Form 366A)*

II. DESCRIPTION OF EVENT (continued)

C. Dates and Approximate Times of Major Occurrences

| Date | Occurrences |
|---|---|
| October 20, 2003 | WBN Unit 1 returned to power operation (Mode 1) to begin operating Cycle 6. |
| October 27, 2003 | An analysis of reactor coolant identified elevated levels of I-131 and Xe-133. This is an indication of a potential leak in the fuel cladding. |
| February 22, 2005 | The Cycle 6 refueling outage begins. |
| March 1, 2005 | Fuel sipping is performed to identify leaking fuel assemblies. |
| March 31, 2005 | The Cycle 6 refueling outage is completed. |
| November 12-14, 2005 | Inspections of the spent fuel identified a gap in the cladding on fuel assembly G45. |
| November 14, 2005 | The degradation of the fuel assembly cladding (a principal safety barrier) was confirmed to exceed expected values and was reported under 10 CFR 50.72(b)(3)(ii)(A). |

D. Other Systems or Secondary Functions Affected

No other systems or secondary functions were affected by this event.

E. Method of Discovery

A half-face visual examination was conducted on fuel assembly G45 in the spent fuel pool. During this visual inspection, damage was observed on fuel rod P-9.

F. Operator Actions

At the time a fuel leak was initially identified in October 2003, Operations personnel notified appropriate site management of the problem and ensured the problem was documented in TVA's corrective action program. When the cladding defect in rod G45 was identified in November 2005, the Operations staff ensured the required notifications were made to NRC in accordance with 10 CFR 50.72.

G. Safety System Responses

There were no automatic or manual safety system responses and none were necessary.

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III. CAUSE OF EVENT

TVA's preliminary assessment indicates that the cladding degradation to the fuel rod was caused by secondary hydriding. Secondary hydriding occurs when water enters a fuel rod that is operating at a certain power level. The water at the defect site (primary breach location) is disassociated into hydrogen and oxygen by radiolysis. The oxygen rapidly oxidizes the zirconium metal in the vicinity of the defect site and the hydrogen migrates to cooler regions of the fuel, usually some distance away from the primary defect. The hydrogen is then absorbed into the zirconium cladding and forms hydrates which expand and degrade the cladding in that region. If the rod power is high enough, and the leaking rod operates long enough, cladding degradation can occur. The primary leaking site in fuel rod P-9 of assembly G45 has not been determined and TVA is working with the fuel vendor to schedule additional inspections to conclusively establish that secondary hydriding was the cladding degradation mechanism.

IV. ASSESSMENT OF SAFETY CONSEQUENCES

Although the G45 assembly is in the spent fuel pool and not part of the Cycle 7 core, TVA took steps to consider the possible impact of the cladding degradation on Cycle 7 operation. Based on a sample of the RCS, the fuel core in use at Watts Bar during Cycle 7 appears to have two leaking fuel assemblies. The current values of I-131 and Xe-133 activity are within the values defined in Technical Instruction (TI) 7.004, "Fuel Integrity Assessment Program." The limit for the concentration of I-131 is defined in LCO 3.4.16, "Reactor Coolant System (RCS) Specific Activity." The controls provided in TI-7.004 require monitoring, notification and evaluation of the RCS activity at levels much lower than Technical Specification limit.

As of January 11, 2006, Watts Bar's Dose Equivalent Iodine (DEI) value is 1.43E-02 micro curies per gram ($\mu$Ci/gm). The DEI value was 1.14E-02$\mu$Ci/gm at the end of Cycle 6. These numbers are comparable and are a small fraction of the Technical Specification limit of .265$\mu$Ci/gm. Should the DEI concentration increase by factor of 10 from the present DEI value during Cycle 7, the projected DEI will be slightly above 50 percent of the Technical Specification limit. Near the end of Cycle 6 the 100/EBAR (total RCS activity) was 401$\mu$Ci/gm and coolant gross specific activity at shutdown was 2.5$\mu$Ci/gm. Presently, 100/EBAR is 397$\mu$Ci/gm and coolant gross specific activity is 4.3$\mu$Ci/gm. In addition, Chemistry Manual (CM) 3.01, "Chemistry Specifications" requires that the Operations staff be notified whenever the I-131 or Xe-133 concentrations change by more than 25 percent above the previous value. Based on the preceding, the RCS activity levels are currently a small fraction of the Technical Specification limits and the existing procedural controls will ensure adequate sampling and oversight of the RCS activity levels.

G45 is a 17 x 17 Vantage+/Performance+ fuel assembly. Some assemblies of this type are in the baffle region of the current reactor core. This is a low power region but can be prone to grid to rod fretting. Fuel assembly G45 was in a high power region of the core when the cladding degradation occurred. According to the fuel vendor, the 17 x 17 Vantage +/Performance+ fuel assemblies in the low power region are significantly less likely to undergo damage similar to that found on G-45. Further, fuel assemblies that leak on the core periphery very rarely experience secondary hydriding and, if it occurs, it would be less likely to lead to an open area on a rod.

Based on the preceding, TVA has concluded that WBN may safely continue to operate to the end of Cycle 7 (Fall 2006). The current sampling and monitoring practices ensure that the proper level of oversight is maintained so that appropriate actions may be taken if conditions in the RCS change.

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**17. NARRATIVE** *(If more space is required, use additional copies of NRC Form 366A)*

V. CORRECTIVE ACTIONS

A. Immediate Corrective Actions

1. A night order was issued to ensure that Radiological Controls department surveys for hot particles and hot spots when system breaches are made to the Reactor Coolant, Chemical and Volume Control, the Refueling Water Storage Tank, the Residual Heat Removal, Safety Injection, the Spent Fuel Pool Cooling Systems and to the Reactor side and Auxiliary Building side of the fuel transfer canal system.

2. A night order was issued to ensure during the upcoming Cycle 7 outage, that ALARA preplanning reports include the surveys described in Item 2 above.

B. Contingencies for Cycle 7 Operation:

1. A limitation on power escalation was established to decrease the possibility of a cladding degradation.

2. A forced outage plan was developed to ensure the proper contingencies are defined to address an event caused by significant fuel degradation.

C. Corrective Actions to Prevent Recurrence (TVA does not consider these items to constitute regulatory commitments. TVA's corrective action program tracks completion of these actions.):

TVA is working with the fuel vendor to schedule additional inspections to conclusively establish that secondary hydriding was the cladding degradation mechanism, to establish the best method to remove the pellet fragments and loose cladding from Fuel Assembly G45, and how best to store and/or handle the fragments. Pending completion of the final cause analysis, the following actions have been established:

1. Training Lesson Plan Dynamic Learning Center (DLC) 300 has been updated to ensure that contractors and plant workers are made aware of the higher potential for hot particle contamination as a result of the failure of the cladding in fuel assembly G45 and the fact that the current fuel cycle is indicating at least two open fuel leakers in the reactor vessel.

2. Administrative action has been taken to prevent the movement of fuel assemblies until it is required for the inspection activities discussed above.

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**17. NARRATIVE** *(If more space is required, use additional copies of NRC Form 366A)*

VI. ADDITIONAL INFORMATION

A. Failed Components

The cladding failed as described in Section III, "Cause of the Event."

B. Previous LERs on Similar Events

There have been no previous LERs initiated for Watts Bar that addressed fuel degradation issues.

C. Additional Information:

None.

D. Safety System Functional Failure

This fuel cladding degradation event is not considered a safety system functional failure in accordance with Nuclear Energy Institute (NEI) 99-02, Revision 3.

E. Loss of Normal Heat Removal Consideration

This event is not considered a scram with loss of normal heat removal.

VII. COMMITMENTS

None