



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION**  
WASHINGTON, D.C. 20555-0001

May 17, 2013

Vice President, Operations  
Entergy Operations, Inc.  
Grand Gulf Nuclear Station  
P.O. Box 756  
Port Gibson, MS 39150

**SUBJECT: GRAND GULF NUCLEAR STATION, UNIT 1 - AUDIT REPORT FOR THE  
APRIL 3-4, 2013, AUDIT OF THE CRITICALITY SAFETY ANALYSIS FOR  
SPENT FUEL POOL STORAGE LICENSE AMENDMENT REQUEST  
(TAC NO. ME7111)**

Dear Sir or Madam:

By letter dated September 9, 2011, as supplemented by letters dated November 21, 2011, April 18, 2012, October 1, 2012, and October 22, 2012, Entergy requested approval of an amendment to the Grand Gulf Nuclear Station, Unit 1 (GGNS) Operating License (OL) and Technical Specifications (TSs). The proposed amendment would (1) revise the criticality requirements of TS 4.3.1, "Criticality," (2) revise the criticality safety analysis (CSA) for the spent fuel and new fuel storage racks, and (3) delete the spent fuel pool (SFP) loading criteria OL condition in paragraph 2.C.(46) of Facility Operating License No. NPF-29.

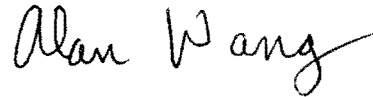
On April 3-4 2013, the U.S. Nuclear Regulatory Commission (NRC) staff and its contractor conducted an audit of the licensee's analysis supporting the license amendment request to change its SFP storage requirements. Specifically, the audit reviewed the licensee's proposed responses to the NRC staff's request for additional information (RAI) from April 1, 2013.

The NRC staff's audit report is provided in the Enclosure. In addition, the NRC staff has determined that Question 7 from the April 1, 2013, RAI needs to be modified. The revised Question 7 is provided in Section 3.0 of the audit report. Entergy has stated it will respond to the April 1, 2013, RAI and the revised Question 7 by June 28, 2013.

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If you have any questions regarding the audit report, please contact me at (301) 415-1445.

Sincerely,

A handwritten signature in black ink that reads "Alan Wang". The signature is written in a cursive style with a long horizontal stroke at the end of the word "Wang".

Alan B. Wang, Project Manager  
Plant Licensing Branch IV  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-416

Enclosure:  
Audit Report

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UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

AUDIT REPORT BY THE OFFICE OF NUCLEAR REACTOR REGULATION

AUDIT OF THE CRITICALITY SAFETY ANALYSIS FOR THE  
SPENT FUEL POOL STORAGE LICENSE AMENDMENT REQUEST

ENTERGY OPERATIONS, INC.

GRAND GULF NUCLEAR STATION, UNIT 1

DOCKET NO. 50-416

By letter dated September 9, 2011, as supplemented by letters dated November 21, 2011, April 18, 2012, October 1, 2012, and October 22, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML112521287, ML113320260, ML12109A281, ML12276A152, and ML12296A417, respectively), Entergy Operations, Inc. (Entergy), the licensee for Grand Gulf Nuclear Station, Unit 1 (GGNS), submitted a license amendment request (LAR) to change to the facility operating license, technical specifications, and licensing basis as necessary to change the spent fuel pool (SFP) storage requirements. Portions of the letter dated October 1, 2012, contain proprietary information and, accordingly, have been withheld from public disclosure. By letter dated April 1, 2013 (ADAMS Accession No. ML13071A154), the U.S. Nuclear Regulatory Commission (NRC) staff issued a request for additional information (RAI).

1.0 PURPOSE

The NRC is reviewing this LAR and has determined that an audit of the safety analyses supporting the LAR is necessary. The audit will facilitate the NRC staff's gathering of information, enable the composition of specific RAIs, and reduce the potential to issue iterative rounds of RAIs. The audit will also prepare the licensee to respond to NRC staff's RAIs.

2.0 REGULATORY AUDIT BASES

The regulations in 10 CFR 50.68(b)(4) state that

If no credit for soluble boron is taken, the k-effective of the spent fuel storage racks loaded with fuel of the maximum fuel assembly reactivity must not exceed 0.95, at a 95 percent probability, 95 percent confidence level, if flooded with unborated water. If credit is taken for soluble boron, the k-effective of the spent fuel storage racks loaded with fuel of the maximum fuel assembly reactivity must not exceed 0.95, at a 95 percent probability, 95 percent confidence level, if flooded with borated water, and the k-effective must remain below 1.0

Enclosure

(subcritical), at a 95 percent probability, 95 percent confidence level, if flooded with unborated water.

## 2.1 Audit Date and Location

April 3-4, 2013.

The audit is presently planned at Global Nuclear Fuels (GNF)/GE-Hitachi (GEH) facilities in Wilmington, North Carolina.

## 2.2 Audit Attendees

NRC: Kent A. L. Wood, Reactor Systems Branch

NRC Contractors: Donald E. Mueller, Oak Ridge National Laboratory

Entergy: Fred Smith, Brian Holman, and Scott Stonchfield

GEH: Chris Geiser, Kristin Bennett, Bill Berg, and John Zino

GNF: John Hannah

## 2.3 Regulatory Audit Scope

The GGNS SFP does not contain soluble boron so it must meet the no soluble boron credit criterion. The GGNS SFP is being categorized into two regions: one that continues to take credit for the installed Boraflex and one that does not to meet the regulatory requirements for subcriticality. The analysis for the Boraflex credit models the degraded material through a complex set of algorithms which use degradation estimates. The audit focused on the derivation and use of those algorithms.

The audit also covered the basic orientation of the probability distributions that were derived for the degraded Boraflex, the algorithms that use those distributions, and the analysis methodology that implements the algorithms in aggregate.

In addition, the NRC staff audited the licensee's data and analyses that support a response to the request for additional information regarding the Boraflex crediting analysis.

## 2.4 Audit Summary

The first day was used to review and discuss the April 1, 2013, set of RAIs. This face-to-face contact was used to resolve and clarify the April 1, 2013, RAIs. Perhaps the most significant issue discussed was the need to address correlations in the sampling distributions used to model Boraflex gap sizes and locations in Monte Carlo-style calculations. Due to the fact that the radiation doses to the four panels around any one assembly are at least partially correlated (i.e., the assembly in the cell provides similar radiation source terms for radiation to all four adjacent panels), one would expect the damage to be at least partially correlated. It is expected that the gaps in Boraflex panels around a storage cell would have somewhat correlated locations and sizes. Kent Wood, NRC, highlighted this by comparing gap locations in panels

around one randomly selected storage location. The licensee acknowledged the need to model correlations in Boraflex panel damage. During the meeting, it was apparent how this issue will be resolved by the licensee. Fred Smith, Entergy, agreed to review and address the issue at a later date.

The second day entailed an exchange of thoughts and questions from the first day. Kent Wood noted that the maximum  $k_{eff}$  value determined from the Monte Carlo simulations of the damaged Boraflex needs to be handled in a more conservative manner. The licensee had used an average value and included a 95/95 uncertainty that was convoluted with other uncertainties. He suggested that more appropriate approaches would be to use the 95/95 maximum  $k_{eff}$  value directly or to use a bias term representing the delta- $k_{eff}$  between the average value and the 95/95 maximum  $k_{eff}$  value.

### 3.0 CONCLUSION

This audit provided the licensee and its contractor (GNF/GEH) a better understanding of the remaining issues needed for the NRC staff to complete the review of the subject LAR.

During the meeting, it was agreed that RAI #7 from the April 1, 2013, letter would be revised to state:

7. Crediting degraded Boraflex to perform its safety function is problematic as it may react differently to normal and abnormal events than when it is in a pristine condition (i.e., it may settle during normal or seismic events, it may be susceptible to accelerated degradation during loss of cooling events). Describe the expected range of conditions considered in this analysis and how Boraflex is expected to respond under those conditions. Provide the rationale for the Boraflex response. Describe how the analysis either bounds the expected Boraflex response or the licensee's controls to ensure the current analysis remains bounding.

Principal Contributor: K. Wood

Date: May 17, 2013

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If you have any questions regarding the Audit Report, please contact me at (301) 415-1445 or [Alan.Wang@nrc.gov](mailto:Alan.Wang@nrc.gov).

Sincerely,

*/ra/*

Alan B. Wang, Project Manager  
Plant Licensing Branch IV  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-416

Enclosure:  
Audit Report

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**ADAMS Accession Nos. ML13121A333**

OFFICE	NRR/DORL/LPL4/PM	NRR/DORL/LPL4/LA	NRR/DSS/SXRB/BC	NRR/DORL/LPL4/BC	NRR/DORL/LPL4/PM
NAME	ABWang	JBurkhardt	CJackson	MMarkley	ABWang
DATE	5/6/13	5/6/13	5/15/13	5/17/13	5/17/13

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