



Entergy Operations, Inc.  
1448 S.R. 333  
Russellville, AR 72802  
Tel 479-858-4704

**Stephenie L. Pyle**  
Manager, Regulatory Assurance  
Arkansas Nuclear One

0CAN061501

June 9, 2015

U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
11555 Rockville Pike  
Rockville, MD 20852

SUBJECT: Annual 10 CFR 50.46 Report for Calendar Year 2014  
Emergency Core Cooling System Evaluation Changes  
Arkansas Nuclear One – Units 1 and 2  
Docket Nos. 50-313 and 50-368  
License Nos. DPR-51 and NPF-6

REFERENCE: 1. Entergy letter to NRC, "Special Report, Licensee Event Report  
50-313/2014-002-00, Special Report – Significant Change in Peak  
Cladding Temperature," dated December 22, 2014 (1CAN121405)  
(ML14357A098)

2. NRC email to Entergy dated February 27, 2015, "Request for Additional  
Information – ANO- 1 Report Regarding Changes in Peak Cladding  
Temperature ECCS Analysis (per 10 CFR 50.46 and 10 CFR 50.73) –  
TAC No. MF5545" (1CNA021504) (ML15061A155)

3. Entergy letter to NRC, "Responses to Request for Additional Information  
Report Regarding Significant Change in Peak Cladding Temperature for  
ECCS LOCA Analysis Pursuant to 10 CFR 50.46 and 10 CFR 50.73,"  
dated March 30, 2015 (1CAN031505) (ML15090A307)

Dear Sir or Madam:

10 CFR 50.46(a)(3)(ii) requires licensees to report annually each change to or error discovered in an acceptable evaluation model or in the application of such model for the emergency core cooling system that affects the peak cladding temperature (PCT). Entergy Operations, Inc. has reviewed the small and large break loss-of-coolant accident (LOCA) PCT evaluations for both Arkansas Nuclear One, Units 1 and 2 (ANO-1 and ANO-2).

A deficiency was identified in the ANO-1 large break LOCA evaluation model. When this deficiency was accounted for, a significant change in the PCT resulted. This change was reported via Reference 1. In the course of its review, the NRC staff has determined that additional information is required to complete its evaluation (Reference 2). Entergy's response to the NRC's request for additional information (RAI) was provided in Reference 3.

No issues were identified for ANO-2 in 2014 that impacted the results reported for the calendar year 2013.

A summary / overview of the information required to be submitted each year is attached to this submittal.

This submittal fulfills the reporting requirements referenced above.

This letter contains no new regulatory commitments.

If you have any questions or require additional information, please contact me.

Sincerely,

**ORIGINAL SIGNED BY STEPHENIE L. PYLE**

SLP/rwc

Attachment: Summary / Overview of Information for Arkansas Nuclear One, Units 1 and 2  
10 CFR 50.46 Annual Report for 2014

cc: Mr. Marc L. Dapas  
Regional Administrator  
U. S. Nuclear Regulatory Commission  
Region IV  
1600 East Lamar Boulevard  
Arlington, TX 76011-4511

NRC Senior Resident Inspector  
Arkansas Nuclear One  
P. O. Box 310  
London, AR 72847

U. S. Nuclear Regulatory Commission  
Attn: Ms. Andrea E. George  
MS O-8B1  
One White Flint North  
11555 Rockville Pike  
Rockville, MD 20852

**Attachment to**

**0CAN061501**

**Summary / Overview of Information for  
Arkansas Nuclear One, Units 1 and 2  
10 CFR 50.46 Annual Report for 2014**

**Summary / Overview of Information for Arkansas Nuclear One, Units 1 and 2 10 CFR 50.46 Annual Report for 2014**

|  | <b>Analysis of Record (AOR)<br/>Peak Clad Temperature<br/>(PCT), (°F)<br/>Evaluation Model (EM) Used<br/>AOR Date</b> | <b>Adjustment as<br/>of End-of-Year<br/>(EOY) 2013,<br/>(°F)</b> | <b>Net PCT at the<br/>EOY 2013, (°F)</b> | <b>New<br/>Adjustments for<br/>Calendar Year<br/>2014, (°F)</b> | <b>Net PCT at the<br/>EOY 2014, (°F)</b> |
|--|---|--|--|---|--|
| <b>ANO-1</b>   |   |  |  |   |  |
| <b>Small-Break<br/>Loss-of-Coolant<br/>Accident<br/>(SBLOCA)</b> | 1459<br>RELAP5 / MOD2-B&W<br>February 2011  | None   | 1459<br>(estimated)                      | None  | 1459<br>(estimated)                      |
| <b>Large-Break<br/>Loss-of-Coolant<br/>Accident<br/>(LBLOCA)</b> | 2008.1<br>RELAP5 / MOD2-B&W<br>July 2005  | None   | 2008.1<br>(estimated)                    | None<br>(Note)  | 2008.1<br>(estimated)                    |
| <b>ANO-2</b>   |   |  |  |   |  |
| <b>SBLOCA</b>  | 2111<br>S2M<br>October 2007   | None   | 2111<br>(analyzed)                       | None  | 2111<br>(analyzed)                       |
| <b>LBLOCA</b>  | 2144<br>1999 EM<br>January 2008   | None   | 2144<br>(analyzed)                       | None  | 2144<br>(analyzed)                       |

## Note

On November 25, 2014, AREVA NP Inc. (AREVA) notified Entergy Operations, Inc. (Entergy) of a deficiency in the Arkansas Nuclear One, Unit 1 (ANO-1) Emergency Core Cooling System (ECCS) evaluation model (EM). When the deficiency is accounted for, the Large Break Loss-of-Coolant Accident (LBLOCA) Peak Clad Temperature (PCT) was estimated to exceed 2200 °F and the absolute value of the deficiency is greater than the requirement of 10 CFR 50.46(a)(3)(ii). Exceeding 2200 °F resulted in ANO-1 making an 8-hour NRC notification on November 25, 2014.

The current LOCA EM for Babcock & Wilcox (B&W) plants uses the fuel performance code TACO3. The identified deficiency is in the thermal conductivity model in this computer code. The deficiency is that the code does not adequately represent the reduction in fuel thermal conductivity with burnup. This issue was discussed in NRC Information Notice (IN) 2009-23 "Nuclear Fuel Thermal Conductivity Degradation".

TACO3 does not model the thermal conductivity degradation (TCD) with burnup explicitly, but has adjustments to the methodology and increases in the LOCA fuel temperature inputs that can compensate for TCD not being modeled. These adjustments were intended to compensate for the non-conservative thermal conductivity model in TACO3.

The continued use of this code was previously evaluated by AREVA in 2009 following the NRC issuance of IN 2009-23. In 2009, it was concluded that sufficient conservatism in both code predictions and LOCA methodology compensated for a lack of TCD models. However this evaluation has been challenged and reversed based on recent LOCA initialization studies.

Based on the new LBLOCA initializations, it is concluded that the LOCA EM that uses TACO3 must be modified by application of additional fuel temperature uncertainty to account for the effects of TCD based on COPENIC2, a code that models TCD adequately, as a function of burnup.

An evaluation was performed by applying the EM change to a Lower-Loop (LL) LBLOCA plant model with an axial power shaped peaked at the 2.506-foot (ft) core elevation with a middle-of-life (MOL) burnup condition. The results of the evaluation show that the original limiting MOL case cladding temperatures at the 2.506 ft core elevation were increased by 481 °F for the ruptured node and 288 °F for the unruptured node. The results of this evaluation can be generically applied to all B&W plants. These ruptured and unruptured node cladding temperature deltas were applied to the ANO-1 full spectrum of MOL cases and led to an increase in limiting PCT of 388 °F. An evaluation of the cladding temperatures at end-of-life (EOL) has confirmed that the MOL results remain limiting. Also it is noted that the cladding temperatures at beginning-of-life (BOL) remain unaffected by TCD. When applying the estimated PCT increases with the revised EM approach, the limiting PCT was estimated to be 2396 °F, which is in excess of 2200 °F. This LBLOCA EM model change results in a significant increase to the calculated PCT.

In order to reduce the PCT to less than 2200 °F, AREVA recommended linear heat rate (LHR) limit reductions on October 21, 2014, and suggested that it was prudent to administratively implement any changes as a compensatory measure. The compensatory measures recommended a 2 kilowatt/foot reduction in the MOL LHRs. Imposition of the compensatory

measures assures that the PCT will be equal to the PCT prior to the EM correction and thus will be less than 2200 °F. Pending the completed analysis, ANO-1 will maintain the compensatory measures.

The local oxidation and whole core hydrogen also remain well within the 10 CFR 50.46 acceptance criteria for the LBLOCA scenarios. With the MOL LHR limit reduction, the core geometry remains amenable to cooling and acceptable long-term cooling is unaffected by these changes.