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10 CFR 50.46

OCAN042003

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

Subject: Annual 10 CFR 50.46 Report for Calendar Year 2019
Emergency Core Cooling System Evaluation Changes

Arkansas Nuclear One, Units 1 and 2
NRC Docket Nos. 50-313, 50-368, and 72-13
Renewed Facility Operating License Nos. DPR-51 and NPF-6

References: Entergy Operations, Inc. (Entergy) letter to the U. S. Nuclear Regulatory Commission (NRC), *Annual 10 CFR 50.46 Report for Calendar Year 2018 Emergency Core Cooling System Evaluation Changes*, (OCAN061901) (ML19155A057), dated June 4, 2019.

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 (ECCS) that affects the peak cladding temperature (PCT). Entergy Operations, Inc. (Entergy), has reviewed the small and large break loss-of-coolant accident (LOCA) PCT evaluations for Arkansas Nuclear One, Units 1 and 2 (ANO-1 and ANO-2).

There were two Evaluation Model (EM) error corrections, changes, or application errors incurred in 2019 for the ANO-1 analyses. No issues were identified for ANO-2 in 2019 that impacted the results reported for the calendar year 2018 referenced above.

A summary / overview of the information required to be submitted each year is provided in Attachment 1 to this submittal. A detailed discussion of the two EM error corrections, changes, or application errors is provided in Attachment 2.

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.

Respectfully,

ORIGINAL SIGNED BY RILEY D. KEELE, JR.

RDK/rwc

Attachments:

1. Summary / Overview of Information for Arkansas Nuclear One, Units 1 and 2
10 CFR 50.46 Annual Report for 2019
2. Discussion of Evaluation Model (EM) Error Corrections, Changes, or Application Errors

cc: NRC Region IV Regional Administrator
NRC Senior Resident Inspector – Arkansas Nuclear One
NRC Project Manager – Arkansas Nuclear One

Attachment 1

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**Summary / Overview of Information for
Arkansas Nuclear One, Units 1 and 2
10 CFR 50.46 Annual Report for 2019**

Summary / Overview of Information for Arkansas Nuclear One, Units 1 and 2 10 CFR 50.46 Annual Report for 2019

	Analysis of Record (AOR) Peak Clad Temperature (PCT), (°F) Evaluation Model (EM) Used AOR Date	Adjustment as of End-of-Year (EOY) 2018, (°F)	Net PCT at the EOY 2018, (°F)	New Adjustments for Calendar Year 2019, (°F)	Net PCT at the EOY 2019, (°F)
ANO-1					
Small-Break Loss-of-Coolant Accident (SBLOCA)	1459 RELAP5 / MOD2-B&W February 2011	None	1459 (estimated)	None	1459 (estimated)
Large-Break Loss-of-Coolant Accident (LBLOCA)	1991 RELAP5 / MOD2-B&W July 2005 (Note 1)	None	1991 (analyzed)	None	1991 (analyzed)
ANO-2					
SBLOCA	2111 S2M October 2007	None	2111 (analyzed)	None	2111 (analyzed)
LBLOCA	2144 1999 EM January 2008	None	2144 (analyzed)	None	2144 (analyzed)

Notes:

1. Framatome has completed a new ANO-1 LBLOCA analysis in accordance with NRC-approved methodology to address thermal conductivity degradation (1,2). The analysis was completed in September 2018(3) and formally transmitted to ANO in January 2019 (4) and was incorporated into the ANO-1 design and licensing basis in February 2019. The results of this analysis depict a 17° F reduction in PCT, leaving 1991° F (analyzed) (5). Due to the timing, these results are not captured in the previous ANO annual 10 CFR 50.46 report.

References:

1. Framatome Topical Report BAW-10192PA-00, *BWNT LOCA – BWNT Loss-of-Coolant Accident Evaluation Model for Once-Through Steam Generator Plants*.
2. Framatome Topical Report BAW-10192PA-00_Supplement_1PA-000, *BWNT LOCA – BWNT Loss-of-Coolant Accident Evaluation Model for Once-Through Steam Generator Plants*.
3. Framatome Document FS1-0039424, Revision 1.0, *ANO-1 LBLOCA Summary Report*, September 2018.
4. Framatome Letter FS1-0041794, Revision 1.0, *Transmittal of Framatome Fuel Thermal Conductivity Degradation LBLOCA Analyses for Potential PCT Reporting under 10 CFR 50.46*, dated January 16, 2019.
5. Framatome Letter FS1-0043205-1.0, *Transmittal of Input for ANO-1 50.46 Report for 2018*, dated March 26, 2019.

Attachment 2

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**Discussion of Evaluation Model (EM) Error Corrections,
Changes, or Application Errors**

Discussion of Evaluation Model (EM) Error Corrections, Changes, or Application Errors

The EM model documentation error correction for M5 cladding properties

Background:

Two documentation errors from circa 2000 topical reports related to M5 cladding were discovered in 2019. One error was related to the clad outside emissivity used in the Loss of Coolant Accident (LOCA) analyses and the other error did not report updated cladding thermal expansion models from 2001 in the M5 cladding topical report BAW-10227PA (Reference). The 10 CFR 50.46 report identified the incorrect descriptions in the M5 topical versus what was modeled in the demonstration cases and, also the models used for current Arkansas Nuclear One, Unit 1 (ANO-1) plant Large Break LOCA (LBLOCA) and Small Break LOCA (SBLOCA) analyses. Since the models used for current LBLOCA and SBLOCA licensing basis are consistent with the updated description provided from this 10 CFR 50.46 report, there are no changes to the current Peak Clad Temperatures (PCTs) reported via 10 CFR 50.46 for ANO-1 plant LOCA analyses.

- **Emissivity Inputs**

The M5 topical report (Reference) describes a single constant emissivity value that was to be used for both inside and outside of the cladding for radiation heat transfer. The LBLOCA demonstration cases contained in the M5 topical report, however, used a different approach for the outside emissivity. This inconsistency is the source of M5 emissivity documentation error. The current ANO licensing basis analyses use the approach used in the topical report LBLOCA demonstration cases. An evaluation was performed, and it concluded that the emissivity inputs used in the EM demonstration analysis and all current LBLOCA and SBLOCA are appropriate. Therefore, this issue is considered as an EM documentation error.

The impact of the documentation error in the M5 topical report was assessed and it concluded that impact of the use of emissivity inputs in the current 2019 licensing basis analyses is either negligible or more conservative than the input error stated in the M5 topical report. Thus, no change is needed to the current PCT related to this documentation error.

- **Thermal Expansion Input**

In 2001, the thermal expansion inputs used in LOCA analyses were revised and were used in the current ANO-1 licensing LOCA analyses. The change in the thermal expansion should have been evaluated and reported in the 2001 time period. Therefore, this is considered a documentation error omission. Similar to the emissivity inputs, the thermal expansion model used in the current licensing basis is part of the currently acceptable EM input. Therefore, there is no change to the 2019 PCTs from the documentation error.

Results:

All LBLOCA and SBLOCA current licensing basis analyses have been performed with the modified thermal expansion model and the emissivity models used in the M5 topical report LBLOCA demonstration cases. These inputs are verified to be correct inputs that should be used for the LOCA licensing analyses evaluation. Since these are documentation errors and do not affect the analyses (other than the description of the analyses) for the current ANO licensing bases, the impact on PCT for these errors will be 0 °F for both SBLOCA and LBLOCA licensing basis analyses.

The EM model error correction for the SBLOCA LOCA holes and slots between the core and core baffle region

Background:

The EM incorrectly documented the modeling approach used for the junctions modeling the baffle plate holes and slots between the core and core baffle region in SBLOCA applications. The EM documentation described the modeling approach as different than the LBLOCA methods but all SBLOCA 177 fuel assembly (FA) analyses have applied the modeling approach consistent with the LBLOCA modeling. The SBLOCA PCT results are not sensitive to how these minor crossflow junctions are modeled because there is little phase separation that occurs in the holes between the baffle and the core. However, the modeling guidance should be clear and consistent. For consistency of modeling the break range transition (e.g. where larger SBLOCAs meet the smallest LBLOCAs) and for obtaining results with fewer oscillations, homogeneous modeling is selected as the modeling choice.

Results:

This issue does not impact LBLOCA results; therefore, no change is required with respect to the LBLOCA analysis. Since the SBLOCA analyses used the appropriate junction modeling option, the 177 FA Analysis of Record PCT, local oxidation, and whole core hydrogen results are unchanged. Nonetheless, a 0 °F PCT change for the EM junction modeling change is reported for SBLOCA results to address the incorrect EM documentation.

Reference

Framatome Proprietary Topical Report, BAW-10227PA-01 (45-10227PA-01), *Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel*.