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1CAN031505

March 30, 2015

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

SUBJECT: 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
Arkansas Nuclear One, Unit 1
Docket No. 50-313
License No. DPR-51

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)

Dear Sir or Madam:

By Reference 1, Entergy Operations, Inc. (Entergy), submitted a report describing a significant error identified in the emergency core cooling system (ECCS) loss of coolant accident (LOCA) evaluation model, and an estimate of the effect of the error on the predicted peak cladding temperature (PCT) for Arkansas Nuclear One, Unit 1 (ANO-1). This report was submitted pursuant to Title 10 of the Code of Federal Regulations (10 CFR) Section 50.46(a)(3) and 10 CFR 50.73.

Correction for this error caused a significant increase in the PCT predicted for ANO-1. When applying the estimated PCT increases, the limiting PCT was estimated to exceed the 2200 °F limit.

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) is included in Attachment 1 to this letter.

Two new commitments have been identified in this letter. These commitments are summarized in Attachment 2.

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

Sincerely,

ORIGINAL SIGNED BY STEPHENIE L. PYLE

SLP/rwc

Attachments:

1. 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
2. List of Regulatory Commitment

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
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11555 Rockville Pike
Rockville, MD 20852

Attachment 1 to

1CAN031505

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**

ATTACHMENT 1

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

BACKGROUND

By letter dated December 22, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14357A098), Entergy Operations, Inc. (Entergy, the licensee), submitted a report describing a significant error identified in the emergency core cooling system (ECCS) loss of coolant accident (LOCA) evaluation model, and an estimate of the effect of the error on the predicted peak cladding temperature (PCT) for Arkansas Nuclear One, Unit 1 (ANO-1). This report was submitted pursuant to Title 10 of the Code of Federal Regulations (10 CFR) Section 50.46(a)(3) and 10 CFR 50.73.

The reported error concerned the BWNT LOCA ECCS evaluation model (EM), which is documented in Volume I of the NRC-approved licensing topical report (LTR) BAW-10192P-A, "BWNT Loss-of-Coolant Accident Evaluation Model for Once-Through Steam Generator Plants, Volume I - Larger Break." The error relates to the ability of upstream fuel performance analysis codes to provide accurate predictions of the fuel pin initial temperature. The TACO3 code documented in NRC-approved LTR BAW-10162P-A, "TACO3 - Fuel Pin Thermal Analysis Computer Code," and the GDTACO code documented in NRC-approved LTR BAW-10184P-A, "GDTACO - Urania Gadolinia Fuel Pin Thermal Analysis Code," use uranium thermal conductivity models that do not account for the degradation of the thermal conductivity that occurs as a function of the fuel burnup.

Correction for this error caused a significant increase in the PCT predicted for ANO-1. Most notably, for postulated LOCAs that initiate at middle of life (MOL) or end of life (EOL) core conditions, thermal conductivity degradation (TCD) causes the predicted PCT to increase significantly. Because fuel at the beginning of life (BOL) does not experience appreciable TCD, the effects of the error at BOL conditions are much less significant. Similarly, EOL fuel operates at a non-limiting local heating rate (LHR), and remains generally non-limiting even when corrected for TCD. Therefore, TCD effects are most significant at MOL conditions.

During the course of its review of the licensee's report dated December 22, 2014, the U.S. Nuclear Regulatory Commission (NRC) staff has determined that additional information is required to complete its evaluation. In particular, 10 CFR 50.46(a)(3)(ii) states, for significant errors, that licensees "shall provide this report within 30 days and include with the report a proposed schedule for providing a reanalysis or taking other action as may be needed to show compliance with § 50.46 requirements." In light of the significant model changes required to correct for this error, it is not clear to the NRC staff how the licensee's indication, in the report, that a reanalysis would be provided on an NRC agreed-upon schedule will show compliance with 10 CFR 50.46 requirements.

REQUESTS FOR ADDITIONAL INFORMATION

SNPB RAI-1

The report dated December 22, 2014, indicates that Entergy will correct for the TCD deficiency in a future LOCA analysis on an NRC agreed-upon schedule.

The NRC has determined that the TACO3/GDTACO fuel temperature uncertainty values are explicitly reflected in the NRC-approved fuel performance methodology documented in BAW-10162P-A and BAW-10184P-A. In addition, the BWNT LOCA ECCS EM requires the use of NRC-approved fuel thermal mechanical models. It is not clear how a potential revision to the fuel temperature modeling provided by these thermal mechanical codes would remain compliant with the NRC-approved methodology.

Regarding calculated emergency core cooling performance evaluation (i.e., LOCA analysis), 10 CFR 50.46 states, in part, "ECCS cooling performance must be calculated in accordance with an acceptable evaluation model.. ." The change in fuel performance modeling discussed above has not been submitted to the NRC staff for generic review and approval; therefore, it is not possible for the NRC staff to conclude that the evaluation model, once updated to incorporate the effects of TCD, would remain acceptable.

In light of the fact that TCD-corrected versions of the TACO3 and GDTACD fuel performance models have not been previously reviewed and approved by the NRC, explain how Entergy will ensure that the corrected ECCS evaluation is performed in accordance with an acceptable evaluation model, pursuant to 10 CFR 50.46(a)(1)(i).

Entergy's Response

A supplement to BAW-10192P-A, "BWNT Loss-of-Coolant Accident Evaluation Model for Once-Through Steam Generator Plants, Volume I - Larger Break", Revision 0 describing the modification to the Babcock and Wilcox (B&W) plant large break (LB) LOCA (LBLOCA) EM to address TCD will be submitted by AREVA to the NRC for review and approval. AREVA is currently projecting this supplement will be submitted by the end of the third quarter of this year (2015). In addition, a modification will be made to BAW-10179P-A, "Safety Criteria and Methodology for Acceptable Cycle Reload Analysis", Revision 8, to reference the supplement to BAW-10192P-A Revision 0, concurrently with the supplement to BAW-10179-A. The topical report BAW-10179P-A is the single reference in the ANO-1 Technical Specifications (TSs) for the LBLOCA EM. BAW-10179P-A provides an overview of the LBLOCA EM and references all of the NRC approved topical reports that form the LBLOCA EM.

The LBLOCA EM modifications being made to address TCD use bounding fuel temperature input from the TACO3, GDTACO, and COPERNIC2 codes. Each of these codes and LBLOCA initialization methods have been reviewed and approved for developing input to 10 CFR 50.46 analyses. It should be noted that ANO-1 does not use gadolinia fuel. The previously approved EM (primarily topical report BAW-10192P-A, Revision 0) uses TACO3 and GDTACO for all fuel pin burnups, but the uncertainties applied to these codes were determined to be inadequate relative to TCD effects. The revised EM will adequately account for TCD by using the limiting

fuel temperatures from TACO3 and COPERNIC2 for uranium dioxide (UO₂) fuel, and GDTACO and COPERNIC2 for gadolinia fuel. Since the approved COPERNIC2 code includes the effects of TCD, the lack of adequate TCD compensation in the TACO series of codes will be adequately addressed.

The current compensatory measure of reducing the middle of life linear heat rate limit by 2 kilowatt/foot has been incorporated into the appropriate ANO-1 processes. This measure will be maintained until the reanalysis described above is complete.

Use of this compensatory measure both compensates for the inadequate uncertainties relative to TCD effects and ensures that operation remains conservative with respect to, i.e. in compliance with, the NRC reviewed and approved evaluation model, pursuant to 10 CFR 50.46(a)(1)(i).

SNPB RAI-2

The report dated December 22, 2014, indicates that the TCD-related model changes will be incorporated into a version the BWNT LOCA ECCS EM. This model revision will significantly change the predicted ECCS performance for ANO-1.

Regarding the evaluation of ECCS performance, 10 CFR 50.46(a)(1)(i) states, in part, that ECCS cooling performance “must be calculated for a number of postulated loss-of-coolant accidents of different sizes, locations, and other properties sufficient to provide assurance that the most severe postulated loss of-coolant accidents are calculated.” It is unclear how, or whether, the reanalysis suggested in the December 22, 2014, report would address this requirement.

Explain how the re-analysis will address the requirement identified above, regarding assurance that the most severe hypothetical loss-of-coolant accidents are calculated.

Entergy's Response

The revised LBLOCA analyses will review the current LBLOCA analyses to determine if the conclusion of the previous evaluation of a spectrum of break sizes, locations, and other properties is sufficient to verify the selection of the most severe hypothetical case. If the review determines that additional calculations are required to select the most severe hypothetical case, then the additional calculations will be performed. This is consistent with the regulation and past practice on compliance with the regulation.

The LBLOCA analyses are performed at the limiting break size and location. B&W plant type sensitivity studies have been performed to show the limiting LBLOCA peak cladding temperature (PCT) is produced by a double-ended guillotine break in the cold leg pump discharge pipe. Smaller break sizes or other break locations are less limiting than the break sizes and locations that were analyzed. In addition the parameters that produce limiting consequences for the worse break size and location are also imposed on the analyses. The calculated consequences for the limiting cases will be more severe when the initial steady-state fuel temperatures are increased. Therefore, implementation of revised fuel temperature

uncertainties to account for TCD is not expected to affect the predicted emergency core cooling performance for the spectrum of break sizes, location, and other properties such that the most limiting LBLOCA event is analyzed.

SNPB RAI-3

ANO1 TS 5.6.5, “Core Operating Limits Repot,” states that the “analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC and specifies a list of those approved methods, includng Babcock & Wilcox LTR BAW-10179P-A, “Safety Criteria and Methodology for Acceptable Cycle Reload Analyses.”

As discussed in RAI 1, above, the updated fuel temperature uncertainty value does not appear consistent with the NRC-approved BWNT LOCA ECCS Evaluation Model. The application of COPERNIC-based fuel temperature uncertainties to TACO3 and GDTACO evaluation models is not consistent with NRC-approved fuel performance methodology. Furthermore, it is not clear that the proposed TCD correction is consistent with the discussion contained in Section 9.2.3 of BAW-10179P-A.

Explain how Entergy will ensure that the reanalysis referenced in the December 22, 2014, letter, will adhere to this TS requirement.

Entergy’s Response

As described in the response to SNPB RAI 1 above, a supplement to BAW-10192P-A, Revision 0, describing the modification to the LBLOCA EM will be submitted by AREVA to the NRC for review and approval. In addition, a modification will be made to BAW-10179P-A to reference the supplement to BAW-10192P-A, Revision 0. Topical report BAW-10179P-A is the single reference in the ANO-1 TSs for the LBLOCA EM. BAW-10179P-A provides an overview of the B&W plant LBLOCA EM and references all of the NRC approved topical reports that form the B&W plant LBLOCA EM.

Once BAW-10192P, Revision 0, Supplement 1, and BAW-10179P, Revision 9 are approved by the NRC, the cycle specific Core Operating Limits Report (COLR) will be updated to reference BAW-10179P-A, Revision 9, in accordance with ANO-1 TS 5.6.5.

ANO-1 TS 5.6.5, “Core Operating Limits Report (COLR),” item b states in part:

The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC, specifically those described in the following documents:

Babcock & Wilcox Topical Report BAW-10179-A, “Safety Criteria and Methodology for Acceptable Cycle Reload Analyses” (the approved revision at the time the reload analyses are performed). The approved revision number shall be identified in the COLR. (Emphasis added)

As noted above, use of the compensatory measure to compensate for the inadequate uncertainties relative to TCD effects ensures that operation remains conservative with respect to, i.e., in compliance with, the NRC-approved BWNT LOCA ECCS Evaluation Model.

The ANO-1 TSs will not be required to be revised.

The revision to BAW-10179P-A will provide the complete description and reference for the approved B&W plant LOCA EM. The NRC will be informed when the reanalysis is complete.

The reanalysis will be completed 21 months following NRC issuance of the final Safety Evaluation Report (SER) for BAW-10179, Revision 9.

Attachment 2 to

1CAN031505

List of Regulatory Commitments

List of Regulatory Commitments

This table identifies actions discussed in this letter for which Entergy commits to perform. Any other actions discussed in this submittal are described for the NRC's information and are not commitments.

COMMITMENT	TYPE (Check one)		SCHEDULED COMPLETION DATE (If Required)
	ONE-TIME ACTION	CONTINUING COMPLIANCE	
Maintain the compensatory measure of the reduction in the linear heat rate limit of 2 kilowatt / foot		X	Until the LBLOCA analysis is complete
Reanalysis of LBLOCA event	X		21 months following NRC issuance of the final SER for BAW-10179, Revision 9