



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

March 8, 2015

Mr. Bryan C. Hanson
President and Chief Nuclear Officer
Exelon Nuclear
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: THREE MILE ISLAND, UNIT 1 – REQUEST FOR ADDITIONAL
INFORMATION REGARDING REPORT DATED DECEMBER 22, 2014,
SUBMITTED PURSUANT TO 10 CFR 50.46 (TAC NO. MF5564)

Dear Mr. Hanson:

By letter dated December 22, 2014 (Agencywide Document Access and Management System (ADAMS) Accession No. ML14356A342), Exelon Generation Company, LLC (Exelon or the licensee), submitted a report describing a significant error identified in the emergency core cooling system (ECCS) evaluation model (EM), and an estimate of the effect of the error on the predicted peak cladding temperature (PCT) for Three Mile Island Nuclear Station (TMI), Unit 1. This report was submitted pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 46 (10 CFR 50.46), paragraph (a)(3).

The reported error concerned the Babcock and Wilcox Nuclear Technologies (BWNT) loss-of-coolant accident (LOCA) ECCS 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 TMI, Unit 1. Most notably, thermal conductivity degradation (TCD) causes the predicted PCT for LOCAs that initiate at middle of life (MOL) or end of life (EOL) core conditions 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, and remains generally non-limiting even when corrected for TCD. Therefore, TCD effects are most significant at MOL conditions.

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The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the report, and has determined that a request for additional information (RAI) is needed to complete its technical review to evaluate whether the report satisfies the reporting requirements of 10 CFR 50.46(a)(3). In particular, 10 CFR 50.46(a)(3)(ii) states, in part, that "[i]f the change or error is significant, the applicant or licensee 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 fulfilling the re-analysis commitment provided in the report will show compliance with §50.46 requirements.

The NRC staff's RAI is contained in the enclosure. A draft of these questions was previously sent to Mr. Dave Helker of your staff on January 13, 2015, with an opportunity to have a teleconference to ensure that the licensee understood the questions and their regulatory basis, as well as to verify that the information was not previously docketed.

A conference call was held on January 27, 2015, and a public meeting was held on February 25, 2015, and Mr. Frank Mascitelli of your staff agreed that Exelon would respond to the RAI within 30 days of the date of the letter.

If you have any questions regarding this letter, please feel free to contact me at (301) 415-3100.

Sincerely,



John G. Lamb, Senior Project Manager
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-289

Enclosure:
Request for Additional Information

cc w/encl: Distribution via Listserv

REQUEST FOR ADDITIONAL INFORMATION
BY THE OFFICE OF NUCLEAR REACTOR REGULATION
REGARDING THE REPORT SUBMITTED PURSUANT TO
10 CFR 50.46 REQUIREMENTS
THREE MILE ISLAND NUCLEAR STATION, UNIT 1
EXELON GENERATION COMPANY, LLC
DOCKET NO. 50-289

1.0 BACKGROUND

By letter dated December 22, 2014 (Agencywide Document Access and Management System (ADAMS) Accession No. ML14356A342), Exelon Generation Company, LLC (Exelon or the licensee), submitted a report describing a significant error identified in the emergency core cooling system (ECCS) evaluation model (EM), and an estimate of the effect of the error on the predicted peak cladding temperature (PCT) for Three Mile Island Nuclear Station (TMI), Unit 1. This report was submitted pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 46 (10 CFR 50.46), paragraph (a)(3).

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Correction for this error caused a significant increase in the PCT predicted for TMI, Unit 1. Most notably, thermal conductivity degradation (TCD) causes the predicted PCT for LOCAs that initiate at middle of life (MOL) or end of life (EOL) core conditions 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, and remains generally non-limiting even when corrected for TCD. Therefore, TCD effects are most significant at MOL conditions.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the report, and has determined that a request for additional information (RAI) is needed to complete its technical review to evaluate whether the report satisfies the reporting requirements of 10 CFR 50.46(a)(3). In particular, 10 CFR 50.46(a)(3)(ii) states, in part, that "[i]f the change or error is significant, the applicant or licensee 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 fulfilling the re-analysis commitment provided in the report will show compliance with §50.46 requirements.

2.0 REQUEST FOR ADDITIONAL INFORMATION

SNPB RAI-1) The letter dated December 22, 2014, stated that “AREVA’s recommendation to Exelon with respect to a LB [large break] LOCA reanalysis for TMI is to perform a full LBLOCA reanalysis with the revised EM that uses a COPERNIC2¹ based TCD uncertainty increase to the TACO3 and GDTACO inputs at MOL and EOL.” The letter also documents a regulatory commitment to perform this reanalysis.

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.² In addition, the BWNT LOCA ECCS EM requires the use of NRC-approved fuel thermal-mechanical models.³ Although the COPERNIC code has been approved by the NRC, as documented in BAW-10231P-A, the NRC staff does not consider the application of COPERNIC-based uncertainty values to TACO-based fuel performance methods, for application within the BWNT-LOCA ECCS EM, to be in accordance with NRC-approved methodology.

Regarding calculated ECCS 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 temperature uncertainty 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 EM, once updated to incorporate this new uncertainty, would remain acceptable.

In light of the fact that the proposed TACO and GDTACO fuel temperature uncertainty values have not been previously reviewed and approved by the NRC, explain how Exelon will ensure that the corrected ECCS evaluation is performed in accordance with an acceptable EM, pursuant to 10 CFR 50.46(a)(1)(i).

SNPB RAI-2) The letter dated December 22, 2014, states, in part, that “[t]he reanalysis will address the significant EM error corrections to cover the ECCS bypass error correction and column weldment modeling changes.” Based on previous reports submitted to the NRC pursuant to 10 CFR 50.46 requirements, the NRC staff understands that these model changes, in concert with the changes required to correct for TCD, will significantly change the predicted ECCS performance for TMI 1.

Regarding the evaluation of ECCS performance, the regulations in 10 CFR 50.46(a)(1)(i) state, 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 whether the

¹ COPERNIC is another NRC-approved, AREVA-proprietary fuel performance code. Refer to BAW-10231P-A, “COPERNIC Fuel Rod Design Computer Code.”

² Refer, for example, to Appendix I of BAW-10162P-A.

³ Refer, for example, to Section 4.3.2.3 of BAW-10192P-A.

implementation of the changes described above will affect the predicted ECCS performance for the spectrum of break sizes, locations, and other properties, such that the existing, most limiting LOCA event analyzed remains the most severe hypothetical LOCA.

Since the letter dated December 22, 2014, indicates that a "full LBLOCA reanalysis for TMI Unit 1" will be performed, explain how this analysis will address the requirement identified above, regarding assurance that the most severe hypothetical LOCAs are calculated.

SNPB RAI-3) TMI, Unit 1 Technical Specification (TS) 6.9.5.2 requires, in part, that the "analytical methods used to determine the core operating limits addressed by the individual Technical Specifications shall be those previously reviewed and approved by the NRC for use at TMI-1," specifically:

- (1) BAW-10179P-A, "Safety [Criteria]⁴ and Methodology for Acceptable Cycle Reload Analyses . . ."

Explain how Exelon will ensure that the reanalysis performed in fulfillment of the commitment provided in the letter dated December 22, 2012, will remain consistent with the latest approved revision to BAW-10179P-A.

Specifically, as discussed in RAI 1, above, the updated fuel temperature uncertainty value does not appear consistent with the NRC-approved BWNT-LOCA ECCS EM, which is referenced in BAW-10179P-A. In addition, the revised fuel temperature modeling does not appear consistent with the discussion contained in Section 9.2.3 of BAW-10179P-A.

⁴ Note that the word, "criteria," appears to be omitted from the TS core operating limit report reference.

B. Hanson

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If you have any questions regarding this letter, please feel free to contact me at (301) 415-3100.

Sincerely,

/RA/

John G. Lamb, Senior Project Manager
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-289

Enclosure:
Request for Additional Information

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