Exelon Generation®

200 Exelon Way
Kennett Square, PA 19348

www.exeloncorp.com

10 CFR 50.46

TMI-15-038

April 6, 2015

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Three Mile Island Nuclear Station, Unit 1
Renewed Facility Operating License No. DPR-50
NRC Docket No. 50-289

Subject Response to Request for Additional Information Regarding Report dated December 22, 2014, Submitted Pursuant to 10 CFR 50.46 (TAC NO. MF5564)

References:

1) Letter from James Barstow (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "10 CFR 50.46 Annual Report," dated May 9, 2014 (ML14129A206)

2) Notification Letter FAB 14-00624 from Russell K. Cox (AREVA) to Robert Jaffa (Exelon Generation Company, LLC), "Evaluation of TMI-1 for Condition Report 2014-6492 for Potential Reporting Under 10 CFR 50.46," dated November 25, 2014

3) Notification Letter FAB 14-00658 from Russell K. Cox (AREVA) to Robert Jaffa (Exelon Generation Company, LLC), "Revised Evaluation of TMI-1 for Condition Report 2014-6492 for Potential Reporting Under 10 CFR 50.46," dated December 9, 2014

4) Letter from James Barstow (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "10 CFR 50.46 30-Day Report," dated December 22, 2014

5) Letter from John G. Lamb (Senior Project Manager, U.S. Nuclear Regulatory Commission) to Bryan C. Hanson (Exelon Generation Company, LLC), "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)," dated March 8, 2015

In the Reference 1 letter, Exelon Generation Company, LLC (EGC) submitted the most recent annual 50.46 Report for Three Mile Island Nuclear Station, Unit 1 (TMI), which provided the cumulative Peak Cladding Temperature (PCT) errors. This report provided the results of the most recent Large Break Loss-of-Coolant Accident (LBLOCA) analysis. The PCT reported for the LBLOCA was 1890.0°F.

In the Reference 2 and 3 letters, AREVA notified EGC of a deficiency in the AREVA ECCS-LOCA analysis. The deficiency was related to the modeling of thermal conductivity degradation (TCD) in the codes TACO3 and GDTACO, which are currently part of the approved LOCA evaluation model for B&W plants.

In the Reference 4 letter, EGC submitted the 30-Day Report pursuant to 10 CFR 50.46(a)(3)(iii) because the absolute magnitude of the temperature change was greater than 50°F. The cumulative PCT impact of the TCD error and the change to the LOCA LHR limits was 18°F and the absolute value cumulative impact for the TCD error and the design input change was 768°F. Exelon committed to perform a full LBLOCA re-analysis for TMI Unit 1 by March 31, 2017, to account for the effects of fuel pellet thermal conductivity degradation by use of a fuel temperature uncertainty adjustment factor based on COPERNIC2.

As described in the Reference 5 letter, the U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the report and has determined that additional information is needed to complete its technical review to evaluate whether the report satisfies the reporting requirements of 10 CFR 50.46(a)(3). Attachment 1 to this letter contains our response.

The following commitment is made by this letter (Attachment 2):

> The full LBLOCA re-analysis will be completed within 21 months following NRC issuance of the final Safety Evaluation Report (SER) for BAW-10179 Revision 9, which incorporates by reference the supplement to BAW-10192P-A Revision 0.

The above commitment supersedes the commitment made in Reference 4.

If you have any questions, please contact Frank Mascitelli at 610-765-5512.

Respectfully,

James Barstow
Director - Licensing and Regulatory Affairs
Exelon Generation Company, LLC

Attachments: 1) Response to Request for Additional Information
2) Summary of Regulatory Committments

cc: USNRC Region I, Regional Administrator
USNRC Senior Resident Inspector, TMI
USNRC Project Manager, TMI
R. R. Janati, Pennsylvania Bureau of Radiation Protection

ATTACHMENT 1

Three Mile Island Nuclear Station, Unit 1
Renewed Facility Operating License No. DPR-50
NRC Docket No. 50-289

Response to Request for Additional Information

Regarding Report dated December 22, 2014,
Submitted Pursuant to 10 CFR 50.46 (TAC NO. MF5564)

Response to Request for Additional Information
Regarding Report Dated December 22, 2014,
Submitted Pursuant to 10 CFR 50.46

In the Reference 1 letter, Exelon Generation Company, LLC (EGC) submitted a 30-Day Report pursuant to CFR 50.46(a)(3)(iii) because the absolute magnitude of the temperature change was greater than 50°F. The cumulative Peak Cladding Temperature (PCT) impact of the TCD error and the change to the LOCA LHR limits was 18°F and the absolute value cumulative impact for the TCD error and the design input change was 768°F. Exelon committed to perform a full LBLOCA re-analysis for TMI Unit 1 by March 31, 2017, to account for the effects of fuel pellet thermal conductivity degradation by use of a fuel temperature uncertainty adjustment factor based on COPERNIC2. The NRC reviewed the 30-Day Report and identified the need for additional information in order to complete their evaluation of the 30-Day Report. A request for additional information (RAI) was transmitted to Exelon on March 8, 2015 (Reference 2). The questions are restated below along with EGC's response.

Safety Systems Nuclear Performance & Code Review Branch (SNPB) RAI - Question 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 COPERNIC[1] based TCD uncertainty increase to the TAC03 and GDTACO inputs at MOL and EOL." The letter also documents a regulatory commitment to perform this reanalysis.

The NRC has determined that the TAC03/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).

---

[1] COPERNIC is another NRC-approved, AREVA-proprietary fuel performance code. Refer to BAW-10231 P-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.

SNPB RAI - Question 1 Response

A supplement to BAW-10192P-A Revision 0 describing the modification to the Babcock and Wilcox (B&W) plant large break loss of coolant accident (LBLOCA) evaluation model (EM) to address thermal conductivity degradation (TCD) will be submitted by AREVA to the NRC for review and approval. In addition, a modification will be made to BAW-10179P-A (Revision 9) to reference the supplement to BAW-10192PA Revision 0. The topical report BAW-10179P-A is the single reference in the TMI Technical Specifications, TS 6.9.5, "Core Operating Limits Report," for the B&W plant 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.

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. 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 UO_2 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.

SNPB RAI - Question 2

The letter dated December 22, 2014, states, in part, that "the 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 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 - Question 2 Response

The revised LBLOCA analyses will include a review of 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 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 and gives assurance that the most severe hypothetical LOCAs are calculated and analyzed.

SNPB RAI - Question 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[2014], 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.

SNPB RAI - Question 3 Response

As described in the response to RAI 1, a supplement to BAW-10192P-A Revision 0 describing the modification to the B&W plant 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 (Revision 9) to reference the supplement to BAW-10192P-A Revision 0. The topical report BAW-10179P-A is the single reference in the TMI Technical Specifications, TS 6.9.5, "Core Operating Limits Report," for the B&W plant 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 TMI Core Operating Limits Report will be updated to reference BAW-10179P-A Revision 9. This will provide the complete description and reference for the approved B&W plant LOCA EM. The NRC will be informed when the full LBLOCA reanalysis is complete.

---

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

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

References:

1. Letter from James Barstow (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "10 CFR 50.46 30-Day Report," dated December 22, 2014

2. Letter from John G. Lamb (Senior Project Manager, U.S. Nuclear Regulatory Commission) to Bryan C. Hanson (Exelon Generation Company, LLC), "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)," dated March 8, 2015

ATTACHMENT 2

Three Mile Island Nuclear Station, Unit 1
Renewed Facility Operating License No. DPR-50
NRC Docket No. 50-289

Summary of Regulatory Commitments

Regarding Report Dated December 22, 2014,
Submitted Pursuant to 10 CFR 50.46

ATTACHMENT 2

SUMMARY OF REGULATORY COMMITMENTS

The following table identifies commitments made in this document. (Any other actions discussed in the submittal represent intended or planned actions. They are described to the NRC for the NRC's information and are not regulatory commitments.)

COMMITMENT	COMMITTED DATE OR "OUTAGE"	COMMITMENT TYPE	
		ONE-TIME	PROGRAMMATIC (Yes/No)
The full LBLOCA re-analysis will be completed within 21 months following NRC issuance of the final Safety Evaluation Report (SER) for BAW-10179 Revision 9, which incorporates by reference the supplement to BAW-10192P-A Revision 0.	Within 21 months following NRC issuance of the final SER for BAW-10179 Revision 9.	**Yes**	**No**