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L-14-403

10 CFR 50.46

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

Davis-Besse Nuclear Power Station, Unit No. 1
Docket No. 50-346, License No. NPF-3
Notification of Significant Errors in or Changes to the Large-Break Loss-of-Coolant
Accident Emergency Core Cooling Model in Accordance with 10 CFR 50.46(a)(3)(ii)

By correspondence dated November 25, 2015, AREVA Inc., notified FirstEnergy Nuclear Operating Company (FENOC) of an error and a change that affect the large-break loss-of-coolant accident (LBLOCA) analysis of record for Davis-Besse Nuclear Power Station, Unit No. 1 (DBNPS). This notification satisfies the criteria of a significant change or error as defined by 10 CFR 50.46(a)(3)(i), "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors."

As required by 10 CFR 50.46(a)(3)(ii), the attached report provides the estimated effect on the limiting emergency core cooling system (ECCS) analysis and a proposed schedule for reanalysis.

Based on AREVA's November 25, 2014 recommendations, FENOC intends to complete a limited reanalysis by April 2016. The results of the reanalysis will be communicated to the Nuclear Regulatory Commission (NRC) in accordance with 10 CFR 50.46(a)(3)(ii).

There are no regulatory commitments contained in this submittal. If there are any questions or if additional information is required, please contact Mr. Thomas A. Lentz, Manager – Fleet Licensing at (330) 315-6810.

Sincerely,


Raymond A. Lieb

Davis-Besse Nuclear Power Station, Unit No. 1

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Attachment:

Report of Significant Changes to AREVA LBLOCA ECCS Evaluation Model that Affect the Peak Cladding Temperature Calculation.

cc: NRC Region III Administrator
Nuclear Reactor Regulation Project Manager
NRC Resident Inspector
Utility Radiological Safety Board

Report of Significant Changes to AREVA LBLOCA ECCS Evaluation Model that Affect
the Peak Cladding Temperature Calculation

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Background

On November 25, 2014, FENOC received AREVA Inc. (AREVA) correspondence FAB14-00625 (Reference 1) identifying an error and a change that affect the LBLOCA analysis of record for DBNPS. AREVA evaluated the effect on initial fuel temperatures due to burnup-dependent fuel pellet thermal conductivity degradation (TCD) using the fuel performance code COPERNIC2, which explicitly accounts for fuel pellet TCD. AREVA determined that the middle-of-life (MOL) and end-of-life (EOL) initial fuel temperature predictions using COPERNIC2 are significantly higher than values calculated for a similar set of conditions using the fuel performance codes TACO3 and GDTACO, which are currently a part of the approved LOCA evaluation model for Babcock & Wilcox (B&W) plants. The TACO3 and GDTACO fuel performance codes do not model TCD. The increase in initial fuel temperatures, when appropriately accounting for TCD, does impact the DBNPS LBLOCA calculations for peak cladding temperature (PCT).

TACO3 and GDTACO do not model TCD with burnup explicitly but have adjustments to the methodology and increases in the LOCA initial fuel temperature inputs that can compensate for TCD not being modeled. These adjustments were intended to compensate for the non-conservative thermal conductivity models in TACO3 and GDTACO. The continued use of these codes was previously evaluated by AREVA in 2009 following the Nuclear Regulatory Commission (NRC) issuance of Information Notice 2009-23, "Nuclear Fuel Thermal Conductivity Degradation." In 2009, AREVA concluded that sufficient conservatism in both code predictions and LOCA methodology compensated for a lack of TCD models based, in part, on comparisons to an early version of the GALILEO code.

However, this evaluation has been challenged and reversed based on recent GALILEO LOCA initialization studies performed by AREVA. Based on these new LBLOCA initializations, AREVA has concluded that the LOCA evaluation model (EM) that uses TACO3 and GDTACO must be modified by application of additional fuel temperature uncertainty to account for the effects of TCD based on COPERNIC2.

Assessment

An evaluation was performed by applying the EM change to a lower loop B&W plant LBLOCA plant model with an axial power shaped peak at the 2.506-foot (ft) core elevation with a middle-of-life (MOL) burnup condition. For the representative plant, the 95/95 volume-average fuel temperature from the limiting PCT case was increased by 230 degrees Fahrenheit (°F). 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, including the DBNPS raised-

loop design. These ruptured and unruptured node cladding temperature deltas were applied to the DBNPS full spectrum of MOL cases and led to an increase in the limiting PCT of 394°F. When applying the estimated PCT increases with the revised EM approach, the limiting PCT was estimated to be 2513°F, which is in excess of 2200°F. This LBLOCA EM model error results in a significant change to the calculated PCT as defined in 10 CFR 50.46(a)(3)(ii). Consequently, FENOC provided an 8-hour notification to the NRC in accordance with 10 CFR 50.72, "Immediate notification requirements for operating nuclear power reactors." (Reference 4)

FENOC implemented actions to reduce the estimated peak cladding temperature to less than 2200°F based on AREVA's recommendation (Reference 2) of linear heat rate (LHR) limit reductions. AREVA recommended a 2 kilowatt (kW)/ft reduction in the LHR limits at MOL and EOL. The imposition of the LHR limit reduction assures that the estimated peak cladding temperature will be less than or equal to the estimated peak cladding temperature prior to the EM correction, thus will be less than 2200°F. The estimated PCT for DBNPS with the uncertainty error correction (input LHR reduction) is reported as 2119°F, which is less than 2200°F. This LBLOCA EM model change is a significant change to the calculated PCT as defined in 10 CFR 50.46(a)(3)(ii).

With the LHR reduction included in the EM, the local oxidation and whole core hydrogen generation also remain similar, and they are within the 10 CFR 50.46 acceptance criteria for the LBLOCA scenarios. The core geometry remains amenable to cooling and acceptable long-term cooling is unaffected by these changes.

Estimated Effect

The impact of the EM correction and compensatory measure is summarized in Table 1 for LBLOCA and in Table 2 for SBLOCA. The small-break loss-of-coolant accident (SBLOCA) analyses are not sensitive to the initial fuel temperatures, thus the estimated impact on the SBLOCA peak cladding temperature is zero.

Reanalysis Schedule

The requirements of 10 CFR 50.46(a)(3)(ii) include providing a proposed schedule for providing a reanalysis or taking other action as may be needed to show compliance with 10 CFR 50.46. A reduction in linear heat rate at MOL and EOL has been imposed at all core elevations. This is documented in the FENOC Corrective Action Program (Reference 5) and DBNPS Standing Order 14-012 (Reference 6). AREVA has performed evaluations to determine the impact of the error and the LHR reduction. (Reference 1)

FENOC is currently performing a LOCA reanalysis, which is scheduled to be completed by July 31, 2015. AREVA recommends FENOC perform a reanalysis with the revised EM that uses a COPERNIC2 based TCD uncertainty increase to the TACO3 and GDTACO inputs at MOL. The recommended reanalysis would consist of formal analysis of the replacement once-through steam generator MOL 9.536-ft elevation case using the revised EM with a 2 kW/ft reduction included. The MOL 9.536-ft case had the

highest cladding temperature at MOL prior to the discovery that TCD modeling was inadequate at MOL and EOL in the previously acceptable evaluation model. This reanalysis will ensure that the case with the highest cladding temperature at MOL is replaced by an analyzed case.

FENOC has evaluated AREVA's recommendation and concludes that this will fulfill the 10 CFR 50.46(a)(3)(ii) required action. Based on the ongoing LOCA reanalysis, FENOC intends to complete the limited reanalysis by April 2016. The results of the analysis will be submitted to the NRC in accordance with 10 CFR 50.46.

References

- 1) AREVA Letter FAB14-00625, "Evaluation of DBE-1 for Condition Report 2014-6492 for Potential Reporting Under 10 CFR 50.46," Russell K. Cox Project Manager, AREVA Fuels BU - Contracts & Services, to Mr. Daniel B. Kelley, FENOC, dated November 25, 2014.
- 2) AREVA Letter FAB14-00551, "Recommendations for Davis-Besse Power Operation with Reduced LOCA LHR Limits," Russell K. Cox Project Manager, AREVA Fuels BU - Contracts & Services, to Mr. Daniel B. Kelley, FENOC, dated October 21, 2014.
- 3) FENOC Letter L-14-148, "10 CFR 50.46 Report of Changes to or Errors in Emergency Core Cooling System Evaluation Models," Davis-Besse Nuclear Power Station, Unit No. 1, Docket No. 50-346, License No. NPF-3, dated May 19, 2014.
- 4) FENOC Reactor Plant Event Notification Worksheet, EN# 50639, Davis-Besse Nuclear Power Station, Unit No. 1, Docket No. 50-346, License No. NPF-3, dated November 25, 2014 at 1632 EST.
- 5) FENOC Condition Report 2014-16024, dated October 21, 2014.
- 6) DBNPS Operations Standing Order No. 14-012, "Limits When Using Ex-Core Detectors for API Determination," dated October 23, 2014.

Table 1: Summary of PCT Impact of LBLOCA Changes and Errors – DBNPS

Analysis	PCT (°F)	Delta PCT (°F)	Absolute Delta PCT (°F)*	Notes
Initial LBLOCA PCT (2014 50.46 report [Reference 3])	2119	----	----	9.536 ft BOL Case
AREVA Condition Report 2014-6492	2513	+394	394	EM Change with updated uncertainty to account for TCD in TACO3/GDTACO 9.536 ft MOL Case
MOL and EOL LHR reduction	2119	-394	----	Compensatory actions of updated imbalance limits based on 2kW/ft plant LHR reduction at MOL and EOL.
Final Results	2119	0	394	----

* Only deltas associated with error corrections are listed.

Table 2: Summary of PCT Impact of SBLOCA Changes and Errors – DBNPS

Analysis	PCT (°F)	Delta PCT (°F)	Absolute Delta PCT (°F)	Notes
Initial SBLOCA PCT (2014 50.46 report [Reference 3])	1780	----	----	----
AREVA Condition Report 2014-6492	1780	0	0	EM Change with updated uncertainty to account for TCD in TACO3/GDTACO 9.536 ft MOL Case
Final Results	1780	0	0	----