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September 01, 2017
L-17-270

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 Emergency Core Cooling System (ECCS) Evaluation Model Change Pursuant to 10 CFR 50.46

On August 7, 2017, AREVA Inc., issued a notification that identified a change in the evaluation model regarding the ECCS – loss of coolant accident (LOCA) analyses for the Davis-Besse Nuclear Power Station (DBNPS). The 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." This change is considered a significant change since the cumulation of changes and errors to the model results in the sum of absolute magnitudes of the respective temperature changes being greater than 50 degrees Fahrenheit (°F). As required by 10 CFR 50.46(a)(3)(ii), FirstEnergy Nuclear Operating Company (FENOC) is notifying the Nuclear Regulatory Commission (NRC) of the change.

The attachment provides a summary of the estimated effect on the DBNPS ECCS analyses. The impact of this change, accounting for the previous reported changes and errors, results in the DBNPS peak cladding temperature (PCT) for large break LOCA and small break LOCA remaining 2119°F and 1780°F, respectively. These PCT values continue to satisfy the 10 CFR 50.46(b)(1) criteria of PCT not to exceed 2200°F.

The attachment also addresses the DBNPS LOCA reanalysis schedule.

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

A002
NRR

Sincerely,

Mark B. Bezilla

Attachment:
Report of Significant Cumulation of Changes to AREVA LOCA Swelling and Rupture Model that Affect the Peak Cladding Temperature Calculation

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

Report of Significant Cumulation of Changes to AREVA LOCA Swelling and Rupture Model that Affect the Peak Cladding Temperature Calculation

Background

On August 7, 2017, FirstEnergy Nuclear Operating Company (FENOC) received AREVA correspondence identifying a change to the M5® fuel clad swelling and rupture model (SRM) affecting large-break loss-of-coolant-accident (LBLOCA) and small-break loss-of-coolant-accident (SBLOCA) analyses for the Davis-Besse Nuclear Power Station (DBNPS) (Reference 2). AREVA determined that the SRM change affects ruptured clad temperatures between 1652°F to 1994°F. Additionally, for LBLOCA, only the beginning-of-life (BOL) peak clad temperatures may potentially be affected. AREVA identified the effect of the change to the SRM using a screening process to determine applicability of the change and then evaluated any potential impacts.

The M5® fuel clad SRM is used in several of the AREVA LOCA methodologies. The SRM was approved by the NRC in the early 2000s as part of the M5® Licensing Topical Report, BAW-10227, Rev. 1 (P)(A). Additional M5® cladding rupture test data has been obtained since the model's approval. Upon review of the data and the SRM used in the LOCA analysis, it was determined that certain aspects of the model would be impacted. The aspects of the SRM that are impacted are the fast ramp rate rupture strain curve and the fast ramp rate assembly blockage factors in the SRM. The model changes do not change the predicted occurrence or conditions at the time of rupture, but would impact the post-rupture cladding characteristics for certain rupture temperatures.

Assessment

LBLOCA:
The DBNPS LBLOCA analysis of record (AOR) results show that the limiting peak clad temperature (PCT) case has a rupture temperature below 1652°F, so the limiting peak clad temperature case is not affected by this change. For the DBNPS, all LBLOCA cases are unruptured temperature limited. A subset of the non-limiting PCT BOL LBLOCA results show that the rupture temperature is above 1652°F, and may be impacted by the SRM change. For these cases, a peak clad temperature penalty of 0°F was applied based on engineering judgement. This engineering judgement considered the impact on the difference in strain, flow blockage, gap size, oxide thickness, metal-water reaction energy deposition and heat transfer. It is concluded that little change is expected in the PCT for these types of changes for a LBLOCA. This conclusion is reasonable at peak clad temperatures around 2000°F, where the metal-water reaction energy generation is one-third to one-half of the energy created by fuel decay heat at its peak. Therefore, it is estimated that the ruptured segment peak clad temperature change is negligible and within the accuracy of the model to predict a change based on small variations in geometry and heat removal. Since the peak unruptured segment is not impacted other than via downstream effects from the ruptured segment that has a

negligible peak clad temperature change, it is also concluded that the unruptured segment change in peak clad temperature is also negligible. Given where the current peak clad temperatures are and the small changes expected from the updated M5® SRM fast ramp rupture strain changes, engineering judgment concluded that the LBLOCA peak clad temperature change is negligible and is estimated to be 0°F. The engineering judgement was confirmed using scoping studies. The LBLOCA evaluation model change results in a cumulative change that is considered significant as defined in 10 CFR 50.46(a)(3)(i), since the cumulation of changes and errors to the model results in the sum of absolute magnitudes of the respective temperature changes being greater than 50°F.

SBLOCA:
The DBNPS SBLOCA AOR results show that the rupture temperature is less than 1652°F for all cases. It is acknowledged that there were existing significant peak clad temperature penalties applied to the limiting SBLOCA peak clad temperature after the completion of the AOR. As reported in FENOC letter dated September 2, 2010 (Reference 4), the model error was due to the SBLOCA axial power shape not bounding the middle to end-of-life cycle conditions. The penalties applied could result in the ruptured temperature being above 1652°F. The change to SRM results in a 0°F change in peak clad temperature based on engineering judgement. The engineering judgement is based on the application of studies that show that if the peak clad temperature is below 1800°F, then a BOL unruptured fuel pin always produces the limiting peak clad temperature, and therefore rupture does not impact the limiting results. Additional assessment has determined that the maximum difference in strain and flow blockage is minimal. Given these minimal changes, the impact on the limiting DBNPS peak clad temperature is negligible. An analysis with the updated rupture strains or re-evaluation of the rupture strain would be needed if SBLOCA peak clad temperature exceeds 1800°F. The SBLOCA evaluation model change results in a cumulative change that is considered significant as defined in 10 CFR 50.46(a)(3)(i), since the cumulation of changes and errors to the model results in the sum of absolute magnitudes of the respective temperature changes being greater than 50°F.

Estimated Effect

The impact of the evaluation model change is summarized in Table 1 for LBLOCA and Table 2 for SBLOCA.

Reanalysis Schedule

The requirements of 10 CFR 50.46(a)(3)(ii) includes providing a proposed schedule for reanalysis or taking other action as may be needed to show compliance with 10 CFR 50.46.

AREVA has completed an evaluation that shows compliance with 10 CFR50.46 as summarized in Reference 1. The LOCA evaluation model (specifically the M5® fuel clad SRM) has been updated to reflect the updated data identified in this report. LOCA reanalysis for DBNPS is not necessary to address the 0°F impact on PCT due to this SRM change. However, LOCA reanalysis activities are ongoing to resolve previously identified model changes and errors. The reanalysis is expected to be completed nine months following NRC issuance of the final safety evaluation report for BAW-10179, "Safety Criteria and Methodology for Acceptable Cycle Reload Analysis," Revision 9, as previously identified in FENOC letter dated May 28, 2015 (Reference 5). This LOCA reanalysis will utilize the updated model that includes the SRM change.

References

1. AREVA Letter FAB17-00361-002, "AREVA CR 2017-3565, 'M5® LOCA Swelling and Rupture Model (SRM) Update' (Rev 2)," Russell K. Cox Project Manager, Fuel Commercial & Customer Center, to Mr. Daniel B. Kelley, FENOC, dated August 22, 2017.

2. FENOC Condition Report CR 2017-08328, initiated 8/10/2017.

3. FENOC Letter L-17-041, "2016 Annual 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, dated August 22, 2017.

4. FENOC Letter L-10-250, "Notification of Significant Change in Small-Break Loss-of-Coolant Accident Emergency Core Cooling Model in Accordance with 10 CFR 50.46(a)(3)," Davis-Besse Nuclear Power Station, Unit No. 1, dated September 2, 2010.

5. FENOC Letter L-15-087, "Response to Request for Additional Information Concerning Report of Errors in Evaluation Model (TAC No. MF5578)," Davis-Besse Nuclear Power Station, Unit No. 1, dated May 28, 2015.

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 (2017 50.46 report for 2016, Reference 3)	2119			----
AREVA Condition Report 2017-3565		0	0	M5® LOCA SRM Update, Estimated
Final Results	2119			----

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 (2017 50.46 report for 2016, Reference 3)	1780			----
AREVA Condition Report 2017-3565		0	0	M5® LOCA SRM Update, Estimated
Final Results	1780			----