framatome

52-020

November 19, 2019
NRC:19:030

U.S. Nuclear Regulatory Commission
Document Control Desk
11555 Rockville Pike
Rockville, MD 20852

10 CFR 50.46 Annual Report for the U.S. EPR Design Certification

Ref. 1: Letter, Sandra M. Sloan (AREVA NP Inc.) to Document Control Desk (NRC), "Application for Standard Design Certification of the U.S. EPR (Project No. 733)," NRC:07:070, December 11, 2007.

Ref. 2: Letter, Getachew Tesfaye (NRC) to Sandra M. Sloan (AREVA NP Inc.), "AREVA NP Inc. – Acceptance of the Application for Standard Design Certification of the U.S. EPR," February 25, 2008.

Ref. 3: Letter, Gary Peters (Framatome Inc.) to Document Control Desk (NRC), "10 CFR 50.46 Annual Report for the U.S. EPR Design Certification," NRC:18:042, November 30, 2018.

Framatome Inc. (Framatome) submitted the application for a Standard Design Certification of the U.S. EPR design in Reference 1. The NRC accepted the application for review in Reference 2. In accordance with 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Reactors," Framatome is submitting this annual report of the emergency core cooling system (ECCS) evaluation model changes and errors for the U.S. EPR Standard Design (Docket 52-020). The previous annual report was submitted in Reference 3.

This report addresses two evaluation models: one for the large break loss of coolant accident (LBLOCA), and one for the small break loss of coolant accident (SBLOCA). The summary of the changes and error corrections made between October 1, 2018 and September 30, 2019 for the LBLOCA evaluation model is provided in Attachment A. The summary of the changes and error corrections made between October 1, 2018 and September 30, 2019 for the SBLOCA evaluation model is provided in Attachment B.

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If you have any questions related to this information, please contact Gayle Elliott, Deputy Director, Licensing & Regulatory Affairs, by telephone at (434) 832-3347, or by e-mail at Gayle.Elliott@framatome.com.

Sincerely,

Gary Peters

Gary Peters, Director
Licensing & Regulatory Affairs
Framatome Inc.

cc: Docket 52-020

Attachment A:
Large Break Loss of Coolant Accident (LBLOCA) Evaluation Model

A report of changes and errors in the LBLOCA evaluation model for the period of October 1, 2018 to September 30, 2019 is presented below. The estimated effect on peak cladding temperature is summarized in Table A1.

1. An issue was identified with the implementation of the Cathcart-Pawel correlation for metal-water reaction (MWR). The correlation is used for the calculation of metal-water reaction in the U.S. EPR Realistic Large Break LOCA (RLBLOCA) methodology. Cathcart-Pawel provided a set of equations for the rate constants associated with the oxidation process[1]. In the RLBLOCA methodology, the correlation for the rate of oxide thickness was used instead of the correlation for the rate of total oxygen consumed. The expected correlation based on the follow-on calculations in S-RELAP5 and the 10 CFR 50.46(b)(2) criterion is the total oxygen consumed correlation.

   As compared to a total oxygen-based implementation, the use of the oxide-based implementation led to a more conservative prediction of the transient oxidation and heat released during the reaction. The additional heat from the reaction could have resulted in higher calculated values of the peak clad temperature (PCT). For LBLOCA though, the degree of differences between the two correlation implementations has a negligible impact on PCT. The ΔPCT for the U.S. EPR RLBLOCA analysis is 0°F. Previously reported change and error estimates are not impacted. The local oxidation and whole core hydrogen also remain well within the 10 CFR 50.46 acceptance criteria with the correction. The U.S. EPR SBLOCA methodology uses the Baker-Just correlation and is not impacted by this error.

The LBLOCA evaluation model for the U.S. EPR design is described in the topical report ANP-10278PA. The primary computer code in the LBLOCA evaluation model is S-RELAP5.

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[1] J.V. Cathcart, R.E. Pawel, R.A. McKee, R.E. Druschel, G.J. Yurek, J.J. Campbell, and S.H. Jury, ORNL/NUREG-17, Zirconium Metal-Water Oxidation Kinetics IV. Reaction Rate Studies, Published August 1977.

Table A1: LBLOCA Margin Summary Sheet – Annual Report

Plant Name: U.S. EPR Standard Design Certification

Evaluation Model: RLBLOCA (ANP-10278PA)

Initial Peak Cladding Temperature (PCT) = 1780°F

			Net PCT Effect	Absolute PCT Effect
A.	Prior 10 CFR 50.46 Changes or Error Corrections – previous Years	ΔPCT =	+0°F	+0°F
B.	Current 10 CFR 50.46 Changes – This Report Error in the S-RELAP5 Cathcart-Pawel MWR	ΔPCT =	+0°F	+0°F
	Sum of 10 CFR 50.46 Changes for this Reporting Period	ΔPCT =	+0°F	+0°F
	Estimate of PCT (unchanged)	= 1780°F		

The sum of the PCT from the most recent analysis using an acceptable evaluation model and the estimates of PCT impact for changes and errors identified since this analysis is less than 2200°F.

Attachment B
Small Break Loss of Coolant Accident (SBLOCA) Evaluation Model

There were no changes or errors reported in the SBLOCA evaluation model for the period of October 1, 2018 to September 30, 2019. The estimated effect on peak cladding temperature is summarized in Table B1.

The SBLOCA evaluation model for the U.S. EPR design is described in the topical report ANP-10263PA and in the topical report EMF-2328PA. The primary computer code in the SBLOCA evaluation model is S-RELAP5.

Table B1: SBLOCA Margin Summary Sheet – Annual Report

Plant Name: U.S. EPR Standard Design Certification

Evaluation Model: SBLOCA (ANP-10263PA and EMF-2328PA)

Initial Peak Cladding Temperature (PCT) = 1638°F

			Net PCT Effect	Absolute PCT Effect
A.	Prior 10 CFR 50.46 Changes or Error Corrections – previous Years	ΔPCT =	+2°F	+266°F
B.	Current 10 CFR 50.46 Changes – This Report (no changes or errors)	ΔPCT =	+0°F	+0°F
	Estimate of PCT (unchanged)	=	1640°F	

The sum of the PCT from the most recent analysis using an acceptable evaluation model and the estimates of PCT impact for changes and errors identified since this analysis is less than 2200°F.