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Revision 0

AREVA MCPR Safety Limit Methodology Responses to RAIs

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AREVA NP Inc.

AREVA

AREVA MCPR Safety Limit Methodology

Responses to RAIs

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Nature of Changes

Item	Page	Description and Justification
1.	All	This is a new document.

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Nomenclature

Parameter	Description
ACE	Critical Power Correlation
AOO	Anticipated Operational Occurrence
ΔCPR	Change in Critical Power Ratio
LPF	Local Peaking Factor
NRC	Nuclear Regulatory Commission
OLMCPR	Operating Limit Minimum Critical Power Ratio
SLMCPR	Safety Limit Minimum Critical Power Ratio
SPCB	Critical Power Correlation

1.0 Introduction

In October 2009, AREVA NP Inc. (AREVA) submitted the AREVA MCPR safety limit methodology topical report (Reference 1). This document provides responses to the request for additional information (Reference 2) regarding the AREVA MCPR safety limit methodology for boiling water reactors.

2.0 Round 1 RAI Question 1

The second paragraph on Page 1-4 of topical report (TR) ANP-10307P, provides a snapshot of the current Safety Limit Minimum Critical Power Ratio (SLMCPR) methodology and the proposed MICROBURN-B2 methodology. The paragraph also, briefly, discusses the conservatism in both methods. It appears to the NRC staff that, from the contents of the last sentence of the same paragraph, that the current methodology is more conservative than the proposed methodology.

a) Please provide a qualitative and a quantitative technical basis in support of the use of the proposed method, other than the fact that the proposed method utilizes state of the art computer codes and methods.

b) Provide a flow chart representing the current SLMCPR methodology vs. the proposed SLMCPR methodology.

Response

a) The 2nd paragraph on page 1-4 is referring to the addition of a more detailed calculation approach for assessing channel bow with SAFLIM3D.

Qualitative basis for channel bow methodology

[

]

- [

]

The proposed methodology introduces a more detailed calculation of the impact of channel bow on the LPF to eliminate several of the simplifying assumptions used in the current model.

- [

]

- [

]

Quantitative basis for channel bow methodology

[

]

[

]

b) A flow diagram is shown in Figure 2-1.

Figure 2-1 Comparative Flow Diagram

3.0 Round 1 RAI Question 2

The first paragraph on Page 2-4, alludes to applying the channel bow model in a conservative manner. It then, briefly discusses the meaning of "conservative manner". However, it is not discussed as to how and when [ ] is determined and when/why one particular conservative manner is selected or the other. Please provide additional information regarding this process.

Response

Non-typical situations identified on page 2-4 include 1) abnormal channel bow, 2) transition cores, and 3) new channel designs. [

]

[

]

4.0 Round 1 RAI Question 3

The third paragraph on Page 2-4, discusses addressing abnormal channel bow issues. Is this issue ongoing? Is the issue currently being addressed by the NRC staff?

Response

[

]

5.0 Round 1 RAI Question 4

On Page 2-5, Section 2.2.3.1, it is stated that [ ]. Please provide bases for selecting [ ].

Response

Section 2.2.3.1 provides a discussion regarding how the [ ] are used for [ ]. Using [ ], the number of depletion calculations required to achieve a 95/95 (95% probability with 95% confidence) is [ ]. The basis for this number is presented on page 2-6 and thereby allows for the determination of the high estimate and the low estimate from the statistically varied runs. The number is derived from [ ].

6.0 Round 1 RAI Question 5

It appears that the uncertainty associated with [ ] expressions presented on Page 2-7, were taken out of the MICROBURN-B2 methodology, and are thus approved formulation. Is that correct?

Response

The approach for calculating the uncertainties was taken from the approved Realistic Thermal-Mechanical Fuel Rod Methodology for Boiling Water Reactors topical report (Reference 3), not the MICROBURN-B2 methodology. The uncertainty expressions pertaining to [

]

7.0 Round 1 RAI Question 6

On Page 2-9, second paragraph, an [ ] is briefly discussed. Is this an uncertainty in the [ ] ? Please explain.

Response

Yes. The discussion regarding [ ] presented in the second paragraph is an introduction to Section 2.3.3 where the process is fully presented.

8.0 Round 1 RAI Question 7

Is the [ ] discussed on Page 2-10, a new process?

Response

Yes, the [ ] presented is a new process. [

]

9.0 Round 1 RAI Question 8

On Page 2-13, it is stated that the updated methodology incorporates an uncertainty due to bow. Is this part of the MICRBURN-B2 approved methodology?

Response

No, [

]

10.0 Round 1 RAI Question 9

Figure 2-1, page 2-15, depicts the major codes in the calculational process of the SAFLIM3D.

a) *Is [ ] an in-house interface code?*

b) *In the same figure, the flow chart indicates that [ ] executes MICRBURN-B2 calculations using [ ] cases. What is the basis for the [ ] cases?*

Response

a) Yes, [ ] was developed to [

]

b) The [ ] cases are identified on page 2-5, Section 2.2.3.1. [ ] provides the basis for establishing the nominal conditions. The [ ] is used as [

] provide the basis for determining the [

] The [ ] sum to [ ].

11.0 Round 1 RAI Question 10

On Page 3-10, Figure 3-1, the flow chart indicates that a Safety Limit MCPR to be supported is selected. How is the initial MCPR limit selected? Is it based on core design?

Response

An iterative process is used. The employed operating limit MCPR (OLMCPR) in the [ ] calculations is assumed based on prior cycle analyses or scoping calculations. The OLMCPR is a combination of the SLMCPR and the ΔCPR from limiting anticipated operational occurrences. If the OLMCPR employed is not sufficient to provide the customer required design margin, the limit may need to be modified (or the core design modified) to result in the desired margin. The selection of the number of fresh assemblies, the placement of assemblies, the control rod patterns throughout the cycle depletion, etc. all enter into the design process and have an influence on the MCPR throughout the cycle.

Once the cycle design has been completed, the SLMCPR and the AOO analyses are performed. The OLMCPR from these analyses is compared to the assumed OLMCPR used in the cycle design analysis. If this OLMCPR is larger than assumed in the cycle design, the cycle design is evaluated using the more restrictive limit. If the required margins are not maintained, the cycle design is revised using the larger limit. The SLMCPR and AOO analyses are then repeated to confirm the limits in the cycle design. Therefore, selection of the initial OLMCPR is iterative.

12.0 References

1. ANP-10307P, Revision 0, "AREVA MCPR Safety Limit Methodology for Boiling Water Reactors," AREVA NP, October 2009.

2. "Request for Additional Information: AREVA NP Inc. (AREVA) Topical Report (TR) ANP-10307P, Revision 0, "AREVA MCPR [Minimum Critical Power Ratio] Safety Limit Methodology for Boiling Water Reactors" (TAC NO. ME2914)" NRC Letter to Ronnie Gardner, August 12, 2010.

3. BAW-10247PA Revision 0, "Realistic Thermal Mechanical Fuel Rod Methodology for Boiling Water Reactors," AREVA NP, February 2008.

4. ANP-10249PA, Revision 1, "ACE/ATRIUM-10 Critical Power Correlation," AREVA NP, September 2009 (See page 50-59 of ANP-10249Q1P, Revision 0).

5. ANP-10298PA, Revision 0, "ACE/ATRIUM 10XM Critical Power Correlation," AREVA NP, March 2010.

6. EMF-2209(P)(A), Revision 3, "SPCB Critical Power Correlation," AREVA NP, September 2009.

7. EMF-2158(P)(A), Revision 0, "Siemens Power Corporation Methodology for Boiling Water Reactors: Evaluation and Validation of CASMO-4/MICROBURN-B2," Siemens Power Corporation, October 1999.

8. [

]