RESOLUTION OF COMMENTS BY THE OFFICE OF NUCLEAR REACTOR REGULATION
ON DRAFT SAFETY EVALUATION FOR TOPICAL REPORT EMF-2103, REVISION 3,
"REALISTIC LARGE BREAK LOCA METHODOLOGY

AREVA NP, INC.

Project No. 728

This Attachment provides the U.S. Nuclear Regulatory Commission (NRC) staff's review and disposition of the comments made by AREVA Inc. (AREVA) on the draft safety evaluation (SE) for Topical Report (TR) EMF-2103, Revision 3, "Realistic Large Break LOCA Methodology."

AREVA Comments on the Draft Safety Evaluation for EMF-2103P, Revision 3

For the suggested modifications, the text from the draft SE is shown in *italics*. The text in **bold** identifies additional text inserted while the ~~**strike through bold text**~~ identifies the deletions.

Note on the NRC Resolution of Select Comments:

If the NRC agreed with a suggested change, but determined that different language from that proposed by AREVA was more appropriate, the wording incorporated by the NRC appears in **bold and underlined.**

1) Page 3, Table 2:

Local Cladding Oxidation	*Limiting oxidation results* **accounts for** ~~*consider the effects of*~~ *operational (pre-transient) and interior cladding oxidation for ruptured fuel rods*

The change is suggested to clarify two changes related to local oxidation.

NRC Resolution of comment:

The NRC agrees with the suggested change.

2) Page 3, Section 1.2.2, lines 13 through 16:

This draft SE is limited in scope to the changes listed in Table 2. Notwithstanding the Transition Package changes listed in Table 1, all remaining portions of the EM as described in EMF-2103(P)(A), Revision 0, remain applicable and acceptable to the extent delineated in the NRC staff SE approving the LTR **and subject only to the limitations described in Section 4.0 of the present SE.**

The change is suggested in order to clarify that this SE supersedes the SE on EMF-2103 Rev. 0 and that the limitations introduced in this SE are the only applicable limitations.

NRC Resolution of comment:

The NRC agrees with the suggested change, subject to additional clarification. The following revised language was incorporated into the passage identified above:

This draft SE is limited in scope to the changes listed in Table 2. Notwithstanding the Transition Package changes listed in Table 1, all remaining portions of the EM as described in EMF-2103(P)(A), Revision 0, remain applicable and acceptable to the extent delineated in the NRC staff SE approving the LTR. **_Prior limitations applicable to Revision 0 were either incorporated into the limitations presented in Section 4.0 of the present SE, or addressed by content in the body of Revision 3 of the LTR, or by modeling guidelines in Appendix A of Revision 3 of the TR. Thus, the limitations described in Section 4.0 of the present SE are the only limitations that apply to the current method._**

3) Page 15, Section 3.1.5, line 10:

   *AREVA cites the ~~RELAP5-MOD2 User's Manual~~ **BEACH Topical Report** for the development of the droplet shattering*

   This change is suggested consistent with the errata pages of EMF-2103 Rev.3, Page 7-173, Reference [7-99].

NRC Resolution of comment:

The NRC agrees with the suggested change.

4) Page 17, Section 3.2.1, line 4:

   ~~steam generator tube ruptures~~ non-LOCA events. Since these changes affect modeling in S-RELAP5

NRC Resolution of comment:

The NRC agrees with the suggested change.

5) Page 18, Section 3.3.2, lines 18 through 21:

   [   ]. *While **the swelling and rupture** models are new to RLBLOCA, they are based on previously approved M5™ cladding models, which have been incorporated in both COPERNIC2 and Babcock and Wilcox Nuclear Technologies (BWNT)-LOCA. The present review focuses mainly on adaptations to these models **and the fuel relocation effects as implemented** within RLBLOCA.*

   This change is suggested to clarify that the relocation model is not part of COPERNIC and BWNT-LOCA.

NRC Resolution of comment:

The NRC agrees with the suggested change.

6) Page 20, line 13:

   range is used. AREVA agreed, in response to RAI 27, ***[*** *

   ].

   This change is suggested to clarify that AREVA increased to the NRC proposed range.

NRC Resolution of comment:

The NRC agrees with the suggested change.

7) Page 23, Section 3.3.3, line 2:

*EMF-2103, Revision 3, includes a ~~new~~ **modified** approach to calculate local cladding oxidation for*

This change is suggested because the pre-transient equation utilized in the local cladding oxidation treatment is approved in the Transition Program.

NRC Resolution of comment:

The NRC agrees with the suggested change.

8) Page 26, Section 3.3.3, line 34:

variability if the estimated ~~total [~~
            ], as calculated using the C-P correlation~~, inclusive of pre-transient, steady-state cladding corrosion~~

This change is suggested to because pre-transient is not calculated using C-P. This change is consistent with the NRC text in 2nd ECR related Limitation (Section 4.9) which uses 10% transient.

NRC Resolution of comment:

The NRC agrees with the suggested change.

9) Page 27, Section 3.4.1, line 9:

dispersed flow heat transfer, the assessment focuses on ~~integral~~ separate effects tests involving

This change is suggested because the tests indicated are separate effects tests.

NRC Resolution of comment:

The NRC agrees with the suggested change.

10) Page 33, Section 3.4.3, line 29 through 31:

*The statistical evaluation in EMF-2103P, Revision 3, has been modified to shift from a minimum sample size of 59 cases for univariate coverage using **upper** tolerance intervals ~~for a binomial distribution~~.*

This change is suggested to more accurately reflect the Rev. 0 statistical approach.

NRC Resolution of comment:

The NRC agrees with the revision, subject to the following deletion:

The statistical evaluation in EMF-2103P, Revision 3, has been modified to shift from a minimum sample size of 59 cases for univariate coverage ~~using upper tolerance intervals for a binomial distribution~~.

11) Page 34, Section 3.4.3, lines 23 through 33:

*Other approaches to determining an appropriate sample size for setting joint tolerance limits, with specific regard to reactor safety analysis, have been published. These approaches, however, differ, and there is not universal agreement among the contributors. In particular, Guba et al. (References 43 and 46) devise methods that return significantly higher sample sizes required for a given multivariate tolerance interval than do Nutt and Wallis (References 44 and 45). The NRC staff notes that, at the vendor's minimum sample size ([   ]), ~~the use of~~ the [   ]-derived upper tolerance limits **~~allows the rejection of the same number of cases as a sample size that is roughly 10% larger, when obtained using the limits suggested by Guba et al~~ are estimated by similar ranked order statistics as suggested by other methods published in open literature. ~~This difference narrows as sample sizes, and the number of rejected cases, increases. The trending suggests that both methods perform reasonably consistently~~**.*

This change is suggested because AREVA would like to avoid detailed comparisons between other vendor methods.

NRC Resolution of comment:

The NRC agrees with the suggested change; however, as noted in the SE and referenced sources, the comparison is made among different statistical methods that are published in open literature, and not specifically to other ECCS evaluation models, as suggested by AREVA.

12) Page 35, Section 3.4.3, line 6 through 11:

*According to the **~~binomial sampling~~ order statistics distribution-free tolerance intervals** theory, the use of a larger sample size allows **~~the rejection of one or several code runs while retaining~~** the desired tolerance in the results **to be set by a lower order statistic**. For example, when using a sample size of 59 cases for comparison to a single attribute, the **~~worst~~ top**-ranked result provides a 95-percent probability result with 95-percent confidence. The use of a larger sample size – for example, 124 cases – allows for the **~~rejection of the worst two results with the~~** same tolerance **to be estimated by the third highest order statistic**.*

This change is suggested to better describe the statistical approach used. AREVA does not want to misconstrue that the samples above the selected upper tolerance limit are not considered.

NRC Resolution of comment:

The NRC agrees with the suggested change, subject to the following revision:

The use of a larger sample size – for example, 124 cases – allows for the ~~*rejection of the worst two results with the*~~ *same* __*upper*__ *tolerance* __*limit*__ *to be estimated by the third highest order statistic.*

13) Page 37, Section 3.5.2, line 5 and 6:

In the absence of a known statistical distribution for the sampled parameter, the uniform distribution approach tends to introduce conservatism by increasing the ~~**spread**~~ **frequency of the values sampled** at the limits.

This change is suggested for clarity.

NRC Resolution of comment:

The NRC agrees with the suggested change.

14) Page 39, Section 4.9, line 41 through 6 of Page 40:

In conjunction with Limitation 8 above, Cathcart-Pawel oxidation results will be considered acceptable, provided plant-specific [

], or limiting fuel rods with respect to oxidation remain in the first cycle. If second-cycle fuel is identified in a plant-specific analysis, whose [   ], the NRC staff reviewing the plant-specific analysis may request a ~~*quantitative assessment or similar*~~ *technical justification or* **quantitative assessment** *demonstrating that [*

].

In AREVA's initial review of the six preliminary Limitations, AREVA provided a suggestion and had a discussion with the NRC regarding this Limitation. There seemed to be general agreement with the reason for suggestion. AREVA would like to reiterate the suggestions and reasons:

> - While AREVA realizes that the use of the first cycle is actually easier to disposition, the technical reason for the limitation is based on a concern with the pre-transient application. The limiting rod could change to a 2nd cycle rod with a different pre-transient value.

> - The second modification allows for either a technical justification in line with the previously transmitted but not docketed (e.g. data was peak oxide layer thickness, true "ductility degradation mechanisms", etc.) or a quantitative assessment of other conservatisms in the method. AREVA thinks that this was the intent of the sentences, but an outsider could misinterpret it to be fully quantitative.

NRC Resolution of comment:

The NRC agrees with the suggested change, but notes that AREVA's proposal to transpose "technical justification" and "quantitative assessment" does not change the meaning of the limitation. The adequacy of the chosen disposition, should this portion of the limitation apply to a plant-specific review, will be subject to the determination of the plant-specific reviewer, based on the circumstances associated with the specific, requested licensing action.

15) Throughout the SE:

M5™®

This change is suggested because M5 is a registered trademark.

NRC Resolution of comment:

The NRC agrees with the suggested change.

16) Page 9, Line 6; Page 17, Line 19; Page 28, Line 16; Page 28 Line 17; Page 28, Line 22; Page 38, Line 13 - Modify typographical errors to:

S-RELAP5

This change is suggested for consistency.

NRC Resolution of comment:

The NRC agrees with the suggested change.

Comments

17) Section 4.7, "Pellet Relocation Packing Factor Data Set"

AREVA understands the reason for the Limitation however clarification is needed on the application. The timeline for when the data should be incorporated can vary substantially. AREVA may not be aware of all the on-going testing and it is not clear as to when the NRC may or may not accept new data from a particular test as valid. Furthermore, there is a large risk if this item is not addressed until the licensee submits. AREVA requests that this be more directly tied to an action from the NRC. For example, the Limitation could be tied to a revision of the NRC NUREG, other NRC publication, or formal request for the AREVA model to be updated, prior to the start of the analysis. This would allow for both the NRC reviewer and the AREVA to understand and have a common basis for the initiator.

NRC Resolution of comment:

The NRC agrees that any updates to the database upon which the pellet relocation packing factor model is based should be addressed between AREVA, as the TR sponsor, and the NRC. However, the NRC is concerned about the possibility – albeit unlikely – that new data could indicate that the relocation model is non-conservative or otherwise in error. Considering this possibility, the limitation cannot be so constrained as to either (1) preclude

AREVA or NRC licensees using EMF-2103, Revision 3, from reporting a potential error in the evaluation model, as may be revealed by the identification of new data, or (2) suggest that it is appropriate to wait for the NRC to issue an publication, should new data indicate that a potentially safety-significant error exists.

In consideration of AREVA's comments, and the discussion above, the NRC has added the following sentence to the end of the limitation, in order to underscore that it is most appropriate to resolve this issue outside a plant-specific licensing process, if possible:

Such a request would be tendered by a letter from the NRC to AREVA identifying the newly available data and requesting an update to the model, or an assessment to demonstrate that such an update is not needed.

18) Section 4.11, "**[**   **]**"; Page 34, Section 3.4.3

The limitation and technical evaluation text indicates that the staff review was limited to the sample size requirements for equal individual and simultaneous joint tolerance levels. The additional statistical derivation and levels for unequal criterion levels were supplied with the RAI and modified text as requested during the NRC audit. AREVA requests that the text be revised to clarify that the statistical theory (e.g. number of cases, combinations) for unequal tolerance limits was reviewed and is acceptable and that the limitation justification is only associated with the plant-specific reasons for the application. Similarly, AREVA requests that Section 3.4.3 be modified to reflect that the statistical theory was reviewed by the NRC and is acceptable.

NRC Resolution of comment:

The NRC agrees with AREVA that revision of the SE and limitation would add clarity to this topic. The following text was added in Section 3.4.3 of the SE:

While the above discussion relates one example of the application of the **[**
          ], the general theory is discussed in Section 9.4.2 of EMF-2103, Revision 3. The theory can lead to the **[**

                                        ] ~~Hence,~~
~~plant-specific applications deviating from this approach will require additional~~
~~justification and NRC staff review. Such justification would need to address both the~~
~~acceptability of~~ **[**

                              ]. This is limitation 10, **[**
                    ] as discussed in Chapter 4 of this SE.

The limitation was renamed **[**   **]**

The text of the limitation was replaced with the following:

[

          ]

19) Section 4.12, "Sample Size, Resampling, and Reanalysis"; Page 36, Section 3.4.3

The last paragraph in Section 3.4.3 states that the NRC is in agreement with the detailed approach described in the RAI responses and the modified text associated with those. If any aspect of this approach is not followed, the applicant would have to submit a Deviation to the method. A Limitation is not necessary because adherence to the method is already required. Additionally, the process described in the RAIs 22 and 23 is very detailed and prescriptive. The succinct text in the limitation could lead to misinterpretation. Therefore, AREVA proposes to delete the Limitation to avoid misinterpretations.

AREVA understands that an NRC concern remains with analyses re-executed for the sole purpose of obtaining a more favorable result which meets the regulatory criteria. AREVA believes that the procedures described in the RAI response and additional analyst affirmation in the calculation file are sufficient to ensure that this situation has not occurred. However if the limitation is to remain, it is requested to be revised as follows:

> 4.X RE-ANALYSIS
>
> Any plant submittal to the NRC using EMF-2103P, Revision 3, which is not based on the first statistical calculation intended to be the analysis of record must state that a re-analysis has been performed and must identify the changes that were made to the evaluation model and/or input in order to obtain the results in the submitted analysis.

NRC Resolution of comment:

The NRC agrees with the suggested change. Conforming edits to Section 3.4.3 of the SE were made to reflect the revised wording of the limitation.

20) Section 4.5, "Modeling for Rod-to-Rod Radiation" ; Page 11, Section 3.1.2, line 35 through 46

In review of this Limitation, AREVA recognized an error in how the basis for the power reduction for the radiation enclosure was described and therefore understands the reason that this Limitation was added. Consistent with the text in the Appendix, the 4% reduction is a conservative estimate as opposed to a bound. AREVA proposes to modify the text in the main body of EMF-2103 Rev. 3 to be consistent with the derivation of the 4% as a conservative estimate. This will clarify AREVA's basis and eliminate the need for the Limitation.

The proposed modifications to EMF-2103, Rev. 3 are attached. With this modification, AREVA requests that the Limitation in Section 4.5 be removed.

NRC Resolution of comment:

Based on the errata sheets provided by AREVA, the NRC has revised SE Section 3.1.1, which discusses rod-to-rod radiation, and deleted Limitation 5. Limitations 6-12 have been renumbered accordingly.