FRAMATOME ANP

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FRAMATOME ANP, Inc.

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Document Control Desk
ATTN: Chief, Planning, Program and Management Support Branch
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Final Responses to RAIs on Chapter 13 of BAW-10231P

Ref.: 1. Letter, Stewart Bailey (NRC) to T. A. Coleman (Framatome ANP), "Request for Additional Information – Chapter 13 of Framatome Topical Report BAW-10231P (TAC No. MA9783)," May 14, 2001.

Ref.: 2. Letter, Drew Holland (NRC) to James Mallay (Framatome ANP), "Request for Additional Information – BAW-10231P, Chapter 13, 'COPERNIC MOX Applications,' " April 25, 2002.

Ref.: 3. Letter, James F. Mallay (Framatome ANP) to Document Control Desk (NRC), "Partial Response to RAI," NRC:01:033, July 27, 2001.

Ref.: 4. Letter, James F. Mallay (Framatome ANP) to Document Control Desk (NRC), "Partial Response to RAI on Chapter 13 of BAW-10231P," NRC:02:021, April 26, 2002.

Ref.: 5. Letter, James F. Mallay (Framatome ANP) to Document Control Desk (NRC), "Partial Response to RAI on Chapter 13 of BAW-10231P," NRC:02:038, July 17, 2002.

References 1 and 2 provided requests for additional information (RAIs) on the MOX applications of the COPERNIC topical report. References 3 through 5 contained responses to all but two of the questions in those RAIs.

Attached please find responses to the two remaining questions.

Framatome ANP considers some of the material contained in the attachments to be proprietary. The affidavit submitted with Reference 3 satisfies the requirements of 10 CFR 2.790(b) to support withholding of the information from public disclosure. Attachment 1 is the proprietary version of the RAI responses. Attachment 2 is the non-proprietary version. After the SER is received, Framatome ANP will incorporate all the enclosed material into the approved version of BAW-10231P.

Very truly yours,

Sandra M. Sloan for

James F. Mallay, Director
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Enclosures

cc: D. G. Holland (w/enclosures)
Project 728

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RESPONSE TO OUTSTANDING REQUESTS FOR ADDITIONAL INFORMATION

TOPICAL REPORT BAW-10231P, CHAPTER 13

"COPERNIC MOX APPLICATIONS"

Below are responses to the outstanding 1st- and 2nd-Round questions received on the COPERNIC MOX Addendum.

Round 1, Question 8:

The integral MOX experiments provided, where centerline temperatures are measured, to verify the COPERNIC integral thermal predictions of MOX fuel rods are limited to very low burnup levels, i.e., less than 5 GWd/MTU. Please provide COPERNIC predictions of at least three of the following Halden MOX instrumented assemblies, IFA-597.4/.5/.6, IFA-606, IFA-610, and IFA-648.1, that achieved burnups of approximately 24 GWd/MTM to 57 GWd/MTM, or suggest other Halden MOX instrumented assemblies. Please justify the reasons for eliminating some of the data and/or assemblies for COPERNIC comparisons and the reasons for selecting others (this should be discussed with the NRC reviewer prior to issuing a response to the request for additional information). Also, rod pressures due to fission gas release were measured for two experimental Halden MOX fuel rods in IFA-597.4/.5/.6. COPERNIC predictions of rod pressure are also needed, where appropriate.

Response:

Framatome ANP considers the lower-burnup experiment IFA-597.4/.5/.6 to be atypical of MIMAS fuel performance. The follow-on experiment IFA-597.7 showed very high fission gas release at the beginning of the irradiation, as indicated in Halden Status Report HR1110. This level is unusual and not consistent with other experiments.

Therefore, Framatome ANP selected the experiments IFA-606, IFA-610.2, IFA-610.4, and IFA-648.1, which are more representative of MIMAS fuel, to demonstrate the adequacy of the COPERNIC thermal predictions. Measured versus predicted central temperatures for these four experiments are provided in Figures 1 through 4.

The fission gas release for IFA-606, rodlet 3, which yielded the highest release fraction, was predicted[1] to be 15.9% compared to the measured value of 12.2%.

It is concluded that COPERNIC provides very good agreement with the measured data.

Round 2, Question 5:

The application of COPERNIC for MOX temperature predictions assumes that the uncertainty for MOX is the same as for UO_2 fuel temperature predictions. This assumption is questionable, particularly at higher burnups (>25 GWd/MTU) because there are no centerline temperature data and no thermal diffusivity data for MOX fuel at these burnups. In addition, there may be further reduction in MOX thermal conductivity at higher burnups if the MOX becomes more hypostoichiometric with increasing burnup (see Question 4 above). Please justify why the COPERNIC calculated temperature uncertainty for UO_2 can be applied to MOX at burnups greater than 25 GWd/MTU without data to confirm this assumption.

Response:

As shown in the attached figures, COPERNIC provides very good predictions of high burnup MOX fuel temperatures. Since the temperature uncertainty for these high burnup MOX experiments is

[c, e]

Figure 1

IFA606 Measured and Predicted Peak Temperatures

[d]

Figure 2

IFA610.2 Measured and Predicted Peak Temperatures

[d]

Figure 3

IFA610.4 Measured and Predicted Peak Temperatures

[d]

Figure 4

IFA648.1 Measured and Predicted Peak Teamperatures

[d]

References

1. L.C. Bernard et. al., *An Efficient Model for the Analysis of Fission Gas Release*, Journal of Nuclear Materials 302 (2002), 125-134.