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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 3 Related to ESBWR Design Certification Application ESBWR Probabilistic Risk Assessment RAI Number 19.0.0-5 S01.**

The purpose of this letter is to supplement the GE-Hitachi Nuclear Energy Americas LLC (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by NRC letter dated December 8, 2005 and responded to on December 8, 2007. This letter provides further discussion as requested by an NRC email. The GEH response to RAI Number 19.0.0-5 is addressed in the Enclosure.

Should you have any questions about the information provided here, please contact me.

Sincerely,

Kathy Sedney for

James C. Kinsey
Project Manager, ESBWR Licensing

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NRO

References:

1. MFN 05-156, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 3 for the ESBWR Design Certification Application,* December 8, 2005.

2. MFN 05-169, Response to NRC Request for Additional Information Letter No. 3 Related to ESBWR Design Certification Application – Chapter 19 –PRA & Severe Accident. December 29, 2005.

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 3 Related to ESBWR Design Certification Application ESBWR probabilistic Risk Assessment RAI Number 19.0.0-5 S01.

   Attachment 1 of Enclosure 1. *SEVERE ACCIDENT MANAGEMENT in SUPPORT of the ESBWR DESIGN CERTIFICATION DOCUMENT Section 3. Containment and BiMAC Performance Against Basemat Melt Penetration (BMP), page III-35.*

cc:	AE Cubbage	USNRC (with enclosure)
	GB Stramback	GEH/San Jose (with enclosure)
	RE Brown	GEH/Wilmington (with enclosure)
	eDRF Section:	0000-0072-6752

Enclosure 1 of MFN 05-169 Supplement 1

Response to Portion of NRC Request for Additional Information Letter No. 3 Related to ESBWR Design Certification Application ESBWR Probabilistic Risk Assessment RAI Number 19.0.0-5 S01

NRC RAI 19.0.0-5 S01

Received by e-mail from Tom Kevern.

The response to RAI 19.0.0-5 refers to Revised Section 21.5.2, for a description of how the LDW sumps are protected. The description focuses on how the BiMAC cavity could accommodate the entire core inventory without the LDW liner being threatened. It does not address liner or penetration attack due to direct impingement or high temperatures during the ~40 seconds that the debris would be held up by the cover plate and the refractory material below it. Please provide an analysis to show that the liner and penetrations (including the LDW equipment hatch and personnel airlock) would not fail during this period.

RAI 19.0.0-5, Protection of the LDW sumps by the BiMAC Cooling Jacket (Original question)

The protection of the LDW sumps by the BiMAC cooling jacket is only briefly mentioned (e.g., PRA p. 21.5-9, DCD p. 19.3-20). Also, a corium splash shield is identified in PRA Figure 4.18-1, but is not mentioned or discussed anywhere in the DCD or PRA. Provide a more detailed discussion and evaluation of these features.

GE Response (Original Response)

Revised Section 21.5.2, which was provided as enclosure 2 of MFN 05-165, dated December 19, 2005, provides a more detailed description of the protection of the LDW sumps by the BiMAC device.

The corium splash shield is not part of the ESBWR design. A revised Figure 4.18-1, with the corium splash shield removed, will be provided in revision 1 to the PRA. The schedule for the issuance of Revision 1 of the PRA is provided in GE Letter, MFN 05-140, dated November 22, 2005.

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The relevant portions of Rev. Section 21.5.2 are:

"For this purpose the top plate is stainless steel, 2 mm in thickness so as to be essentially instantaneously penetrable by a high-velocity melt jet."
"Between the plate and the grating we have a layer of refractory material, like a mat of zirconium oxide, so as to protect the steel material from thermal loads **from below** [emphasis added] during the ~ 40 s needed to the end of steam blowdown, yet not able to provide any structural resistance to melt penetration as needed for the trapping function noted above. **For low pressure sequences, this whole cover structure has no bearing on the outcome.**" [emphasis added]

Thus there was never an intent to design so as to "hold up" the melt for 40 seconds. On the contrary, the original idea was (for high velocity jets only, as in DCH scenarios) that the melt be trapped under the plate to minimize large scale dispersal into the UDW.

Subsequent considerations during the ROAAM Review (RR) period, as explained in the RR version of Section 21, submitted to the NRC on May 25, 2007 (MFN MFN 05-165S01 /06-313 S02), led to relaxing this "melt-retentive" property of this plate, while enhancing its structural integrity against mechanical impacts. Moreover, the RR review led to further relaxation of coolability limits, and this was translated to greater flexibility in initiating flooding as well as in the rate of emptying the GDCS pools, RR Section 3.5 *Add Summary and Conclusions for BMP (Addendum of July 31, 2006)*, page III-35. which is included in MFN 06-313 Supplement 8, August 2007. A copy of page III-35 is attached to this response for ease of reference by the NRC Staff.

Thus there is no significant potential for direct or thermal exposure of the liner, or the sump boundaries which are protected by the BiMAC in a like fashion. Moreover the equipment hatch and personnel airlock are at locations that preclude significant thermal exposures from core debris on the BiMAC.

DCD/NEDO-33201 Impact

No DCD changes will be made in response to this RAI.

No changes to NEDO-33201 will be made in response to this RAI.

Attachment 1 to Enclosure 1 of
MFN 05-169, Supplement 1

SEVERE ACCIDENT MANAGEMENT in SUPPORT of the ESBWR DESIGN CERTIFICATION DOCUMENT

Section 3. Containment and BiMAC Performance Against Basemat Melt Penetration (BMP), page III-35

3.5Add Summary and Conclusions for BMP (Addendum of July 31, 2006)

In addition to the thermal load considerations detailed in this chapter, and the upcoming BiMAC experiments, the detailed design of BiMAC will involve considerations of external protection against mechanical loads, such as may be generated by falling, or ejected objects/debris following RPV failure. This addendum is to note that this design effort will be facilitated by relaxing the melt-retentive property originally envisioned for the BiMAC cover plate, and now found to be unnecessary.

In particular, rather than requiring that this cover plate be readily penetrable by impinging molten core material, we now prefer that it be materially substantial, thermally robust, and it be well supported from below in a manner that offers a naturally protective function.

In considering potential mechanical loads for the detailed design, we recognize that:

a) Because in the ESBWR design the control rod drives (CRDs) are "hooked" to the lower core support plate, they cannot fall even if the welds that seal the lower head penetrations were to melt out (actually this hooking is to protect against rod ejection in case of such a failure under normal operation). Thus the only mechanism for failure is detachment of one or more instrument tubes. While not supported externally in a manner that would prevent their total detachment, these tubes have restraints that would impede their motion following such detachment, and these would have to be taken into account in defining the design criteria for the BiMAC cover plate. In addition this would have to include the protective function of the intervening CRD-maintenance platform.
b) Because the CRD motors along with related supports form a massive and compact region at the lower ends of the CRDs, any jet(s) emanating from instrument tube penetration failures on the lower head would be disrupted and dispersed. This dissipation/defocusing of mechanical as well as thermal energy loads beneficially impacts the design requirements for protection of the BiMAC, including its ceramic sacrificial layer.
c) This enhanced protection is consistent and of benefit in the reliability design of the BiMAC flooding deluge system, as it relaxes the timing requirements for activation, following the instant of initial RPV failure and melt release. Of further benefit in this regard is the appreciation that the initial release would be metallic and of rather limited quantity.

3.5Add Further comments on mechanical loads (Addendum of May 7, 2007)

This is written in response to Dr. Henry's suggestion for a more detailed consideration of the physics involved (along a ROAAM framework) in mechanically loading the BiMAC due to detachment of lower head penetrating structures. While initially this was our intent too, further considerations of the coolability limits of BiMAC, such as those provided by Drs. H. Fauske and M. Fisher during the review process, suggest margins to failure that may allow a much lower angle of inclination of the BiMAC pipes. This, in addition to other considerations on thermal aspects, suggest that the final detailed design could be made to incorporate such large amounts of sacrificial material as to make the issue of mechanical impacts mute. Thus we would rather wait for the BiMAC coolability results before we finalize design in a manner consistent, and to the extent possible optimal in every respect including mechanical loads of the type raised in this review.