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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 40 Related to ESBWR Design Certification Application, RAI Numbers 19.2-22S01 and 19.2-24S01.**

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 July 5, 2006 (Reference 1) and responded to in Reference 2 on September 18, 2006 respectively. This letter provides further discussion as requested by the NRC Staff via email. The GEH response to RAI Numbers 19.2-22S01 and 19.2-24S01 is addressed in the Enclosure.

Sincerely,

Kathy Sedney for

James C. Kinsey
Project Manager, ESBWR Licensing

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NRO

Reference:

1. MFN 06-222, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 40 Related to ESBWR Design Certification Application,* July 5, 2006.

2. MFN 06-323. *Response to Portion of* NRC *Request for Additional Information Letter No. 40 Related to ESBWR Design Certification Application –ESBWR Probabilistic Risk Assessment – RAI Numbers 19.2-22 and 19.2-24.* September 18, 2006

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 40 Related to ESBWR Design Certification Application ESBWR Probabilistic Risk Assessment RAI Numbers 19.2-22 S01 and 19.2-24 S01.

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 to MFN 06-323, Supplement 1

Response to Portion of NRC Request for Additional Information Letter No. 40 Related to ESBWR Design Certification Application ESBWR Probabilistic Risk Assessment RAI Numbers 19.2-22 S01 and 19.2-24 S01

NRC RAI 19.2-22 S01

Received by e-mail from Tom Kevern.

The response to RAI 19.2-22 provides an incomplete description of the final bounding state of the core debris and heat loads as it would be represented in the BiMAC test program (e.g., mass, composition, temperature distributions). Provide additional details.

NRC RAI 19.2-22 (Original)

Describe the "final bounding state" of the core debris within BiMAC, including crust thickness, and thinning of BiMAC channels (if applicable) as a function of location within the piping array. Discuss the relationship between the final bounding state and the boundary conditions that would be evaluated in the BiMAC test program.

GE Response (Original)

The final bounding state, as explained in detail in Section 21 of NEDO-33201 Rev 1, was taken to involve the full amount of the core debris (decay heat), and thermal loading on BiMAC was obtained from calculations of natural convection inside the BiMAC boundary. Peak average heat flux was found to be less than 100 kw/m^2, and as explained in the answer to the question above this is very conservative upper bound. The locally maximum load at this postulated maximum would be no more than 450 kw/m^2. Simple heat conduction temperature calculations across the pipe of BiMAC channel show that at such heat flux levels, there will be no significant heating of the outside boundary, and of course no melting of the (carbon steel) pipes. The thickness of the crust layer frozen on top of the pipes will depend on the material composition and respective thermal conductivity, and on the melt pool composition and thus temperature. In any case we can expect no less than cm-scale crusts, however as known from the IVR technology, this thickness plays no role on the outcome.

GEH Response, Supplement 1

As explained in describing the BiMAC failure criteria (please see also Addenda in RR version of Section 21), what is required is to envelope both the average and maximum (local) heat fluxes. The appropriate values for these fluxes are given in Section 21 as well as in the original response to this RAI. Also this is a heat-flux controlled system in that the boundaries (crusts etc) adjust to the applied heat fluxes, so the necessary definition of boundary conditions is already given.

Also as discussed in Section 21, the only aspect that is in doubt, and in fact beyond definition, is the actual heat flux distribution, given that in all likelihood a large fraction of the core debris will find itself quenched and frozen, and thus not participating in the energy balance needed for coolability (resulting in much lower fluxes). We expect to demonstrate experimentally in the BiMAC test program that the upper bound of heat flux applied over the whole system is conservative, by parametrically varying flux shapes in the systems effects portion of the program using the ½-scale, ¼-segment model of the device.DCD/NEDO-33201 Impact

DCD/NEDO-33201 Impact

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

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

NRC RAI 19.2-24 S01

The response to RAI 19.2-24 did not describe any provisions to prevent normal reactor coolant system leakage from entering the BiMAC cavity. Describe any such provisions, as well as provisions for preventing core debris from entering the LDW sumps prior to melt-through of the cover plate.

NRC RAI 19.2-24 (Original)

Provide additional details regarding the BiMAC cover plate/lid arrangement, which is said to serve a dual purpose of providing a work surface during plant maintenance and trapping core debris during a high pressure melt ejection event. (The lid is indicated to be a stainless steel top plate over a zirconium oxide mat over a normal floor grating.) Include information regarding the lid materials, properties, thickness, and any seal provisions to prevent normal reactor coolant system (RCS) leakage from entering the BiMAC cavity, if applicable. Discuss the potential for the cover plate/lid to impede debris transport to the BiMAC cavity, particularly if the high velocity debris/gas jet is disrupted/dispersed by the substantial control rod drive (CRD) structures below the RPV, which appear to be neglected in the ESBWR analysis.

GE Response (Original)

Upon further evaluations of the potential DCH threat we are now of the opinion that the "trapping" quality of the plate on top of the BiMAC cavity is not needed (recall that the original concept was to provide some additional relief, even though such could not be, and was not counted on), and that this floor plate could better be used for the physical protection of BiMAC (see Section 21 of NEDO-33201 Rev 1). There is no "impedance" issue, speculated by this question, whatever is the material/structure used to cover the BiMAC. Any non-coolable geometry would penetrate such a structure, and any coolable geometry would be retained by it without further a due. The disruption of a jet from the RPV due to the CRDs and the motors at the lower ends is a good point that we ignored in Rev 1, but it is now discussed in the full ROAAM review version relative to the new purpose and design of this plate (see addenda on Basemat Melt Penetration (BMP) in full ROAAM review Severe Accident Treatment (SAT) report provided as the "Attachment to the GE's response to RAI 19.2-5").

GEH Response, Supplement 1

The BiMAC cavity will drain through many narrow channels into the sumps, as required for leakage detection. As a design assumption (the detailed design is yet to be completed) these channels are sufficiently long to plug by freezing any melt that enters, prior to it reaching the sumps.

Normal reactor coolant system leakage is designed to enter the BiMAC cavity and be directed to the LDW sumps by a channeling system in the BiMAC layer itself. The width and number of the channels will be selected so that the required water flow rate during normal reactor operation is achievable. The cover plate (or personnel plate) above the BiMAC is solely for personnel activities and will not completely cover the area of the LDW floor; it is not designed as a provision to keep leakage flow out of the BiMAC cavity. Additionally, the channels are designed to arrest corium flow such that freezing will occur and prevent corium entry to the LDW sumps.

As discussed in NEDO-33201, Section 21, the BiMAC will function to shield the LDW sumps from the corium ejection. Immediately following RPV failure, the corium will come into contact with the personnel plate. The personnel plate is designed such that virtually no hold-up of the corium occurs; as such, any corium deflection by the personnel plate that could re-direct the ejection toward the sumps is prevented.

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.