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**Date:** 06/22/2007 8:16:29 AM
**Subject:** Chapter 12 New Supplemental RAIs

Frostie:

Attached are followup questions regarding ESBWR DCD Section 12. These supplemental questions, along with the outstanding information that already exists for Chapter 12, will constitute the contents of the forthcoming open item letter for this chapter.

Please also note the following:

RAI 12.2-9 has grown rather involved and lengthy, so if any of the questions related to this RAI are redundant to ones you have already received please let me know.

RAI 12.3-9 and 12.4-6 are still being discussed to some extent in terms of how best to disposition them. If you feel that the supplemental questions related to these two RAIs are not necessary or need to be phrased differently we can definitely put together a call to finish that discussion.

Please let me know if you have any other questions or would like to schedule a conference call to discuss these comments.

Thanks and have a great weekend!
Marlayna Vaaler

Marlayna Vaaler
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**Supplemental Requests for Additional Information for the Review of ESBWR Tier 2, Rev. 3 DCD Chapters 12**

The staff has determined that supplementary information is required to complete its review of the ESBWR design control document (DCD) Tier 2, Chapter 12. Please provide supplementary RAI responses for the following RAIs.

Reference: GE Response Letter MFN-06-212, Supplement 2, dated May 22, 2007, which addressed NRC RAI Letter No. 71, dated October 4, 2006.

**RAI 12.2-9 (Supplement 3):**

Please address the following issues relative to the subject RAI:

a. As a followup to RAI No. 12.2-9, the staff requested the applicant to address inconsistencies in analyzing the radiological consequences of the postulated failure of the charcoal delay bed (offgas system) using the technical guidance of Branch Technical Position ESTB 11.5, as described in SRP Section 11.3.II. The method described in ESTB 11.5 requires the use of the BWR-GALE Code (NUREG-0016).

   However, a review of the applicant's response to NRC RAI 12.2-9(b) states that BWR-GALE Code was not used in the analysis and the applicant used its own computer code in developing an estimate of effluent releases associated with the failure. Using the source term described in DCD Rev. 3, Table 11.3-6, the staff confirmed the results of the estimated dose presented in DCD Table 11.3-7.

   However, the discussion is incomplete on the basis of the radioactive source term presented in Section 11.3.7 and Table 11.3-6 of the DCD. Specifically, the DCD states that "There is no motive force to remove any significant inventory from the eight follow-on charcoal tanks while in bypass and, therefore, no activity from these tanks is included in the final release calculations." Accordingly, the applicant is requested to provide the technical justifications for the origin of the radioactive source term listed in DCD Rev. 3, Table 11.3-6, and describe the mechanism driving those levels of radioactivity out of the OGS and in the environment.

b. A COL applicant referencing the ESBWR certified design should identify the types of adsorbent media it plans to use for the eight main charcoal beds and two guard charcoal beds, and for the charcoal filters used in building ventilation exhaust systems, depending upon plant-specific design features of the GWMS/OGS and building HVAC systems. The selection of adsorbent media should be consistent with the method used in demonstrating compliance with the requirements of 10 CFR 20.1301 and 20.1302, and Appendix I to 10 CFR Part 50, as described in DCD Rev. 3, Sections 12.2.2.1 and 12.2.2.2. However, DCD Rev. 3, Section 11.3.8 does not commit the COL applicant to the description and performance of adsorbent media necessary in demonstrating compliance with the requirements of 10 CFR 20.1301 and 20.1302, and Appendix I to 10 CFR Part 50. Please create a COL Applicant Item to address this issue and include it in the DCD or justify why a COL Action Item is not necessary.

c. A COL applicant referencing the ESBWR certified design should describe the quality assurance (QA) program for design, fabrication, procurement, construction of structures, and installation of permanent or mobile GWMS and OGS systems and components in the plant in accordance with its overall QA program. However, DCD Rev. 3, Section 11.3.8 does not commit the COL applicant to conform with the QA guidance specified in Regulatory Guides 1.21, 1.33, and 4.15. Please create a COL Applicant Item to address this issue and include it in the DCD or justify why a COL Action Item is not necessary.

d. In Revision 3 of the DCD Tier 2, Section 11.3.1, the applicant states that the design of OGS follows the guidance of IE Bulletin 80-10 “Contamination of Non-radioactive Systems and Resulting Potential for Unmonitored, Uncontrolled Release to Environment” and does not include interconnections between plant systems that could become radioactive through improper interfaces with radioactive systems. However, DCD Rev. 3, Section 11.3.8 does not commit the COL applicant to confirm that the OGS, as installed, fulfills this commitment. Please create a COL Applicant Item to address this issue and include it in the DCD or justify why a COL Action Item is not necessary.

e. In Revision 3 of the DCD Tier 2, Section 11.3.1, the applicant states that the design of OGS is in compliance with the requirements of 10 CFR 20.1406 as it relates to the design and operational procedures to minimize contamination, facilitate eventual decommissioning, and minimize the generation of radioactive waste. While DCD Rev. 3, Section 12.6 addresses some requirements associated with Part 20.1406, the discussions of DCD Section 12.6 are broadly generic and do not focus specific design issues for the OGS and DCD Rev. 3, Section 11.3.8 does not commit the COL applicant to confirm that the OGS, as installed, fulfills this commitment. Please create a COL Applicant Item to address this issue and include it in the DCD or justify why a COL Action Item is not necessary.

f. Under the requirements of Sections II.B, II.C, and II.D of Appendix I to Part 50, a COL applicant is responsible for addressing the requirements of 10 CFR 50 Appendix I dose objectives in controlling doses to a hypothetical maximally exposed member of the public and populations living near the proposed nuclear power plant. The requirements define dose objectives for liquid effluents, require a cost-benefit analysis in justifying installed processing and treatment systems, as permanently installed equipment and mobile systems. However, DCD Rev. 3, Section 11.3.8 does not commit the COL applicant to address these requirements. Please create a COL Applicant Item to address this issue and include it in the DCD or justify why a COL Action Item is not necessary.

Reference: GE Response Letter MFN-06-212, Supplement 2, dated May 22, 2007, which addressed NRC RAI Letter No. 71, dated October 4, 2006.

**RAI 12.2-9 (Supplement 4):**

Regarding methods used to derive estimates of total airborne radioactivity releases, as presented in DCD Tier 2, Rev. 3, Table 12.2-16:

In GE’s May 22, 2007, response (MFN 06-212, Supplement 2) ) to RAI 12.2-9 S01, the applicant provides new information used in deriving the estimates of total airborne radioactivity releases. The estimates are listed in DCD Tier 2, Rev. 3, Table 12.2-16. The new information presents models, equations, and values for specific parameters, either given in the new information or extracted from NUREG-0016.

Generally, the staff independently confirmed the approach and most results presented in MFN 06-212, except in a few instances where specific results could not be duplicated or clarifications

are being requested on the basis of specific assumptions or values used in calculations. The following presents items for which further clarifications are sought in order to resolve these outstanding issues.

1. The adjustment factors for gaseous effluent source terms presented in equation (1) are based on a rated power levels of 4590 MW, while the basis of all radioactive source terms presented in DCD Table 11.1-3 is defined at 4500 MW. Similarly, the derivation of all liquid effluent source terms is based on 4500 MW (DCD Table 12.2-19a). Provide the justification for using a power rating of 102% for the estimation of gaseous effluent source terms.

2. The derivation of C-14 activity released is based on 34,200 kg as the mass of water subject to neutron irradiation and production of C-14 (p.3 of 5). This value is smaller than the one (39,000 kg) applied in NUREG-0016 for a generic plant rated at 3400 MW. Provide the justification for using a value of 34,200 kg for a plant rated at 4500 MW and designed with a larger reactor vessel.

3. For equation (2), provide the justification for the value of 0.4 as the water flash fraction. The text supporting the use of this equation is silent on the basis of this value.

4. For equation (3), provide the information with which to derive the $A_i/A_t$ ratio for noble gases listed in DCD Table 12.2-16. Indicate whether the ratios are based on steam concentration (uCi/g) or steam release rates (uCi/sec at 30 min.). Note that DCD Table 12.2-16 presents source term estimates for Kr-90 and Xe-139, but DCD Tables 11.1-2a and 11.1-2b do not list these two nuclides. Accordingly, update DCD Tables 11.1-2a and 11.1.2b so as to include Kr-90 and Xe-139.

5. In support of equation (3), the derivation of noble gas activity released is based on a steam mass flow rate of $9.65 \times 10^{+6}$ kg/hr, while the basis of all radioactive source terms presented in DCD Table 11.1-3 is defined at a steam flow rate of $8.76 \times 10^{+6}$ kg/hr. Provide the justification for using a different steam flow rate in this equation.

6. For equations (4) and (5), provide the justification for the value of 0.9 as the condensation removal factor. The text supporting the use of this equation is silent on the basis of this value.

7. In deriving the release rate of Ar-41, provide a justification in using the NUREG-0016 value of 40 uCi/sec as a design basis and then adjusting it downward by a factor of five as a normal operational release rate. In light of the qualifier noted in NUREG-0016, an average release rate of 20 uCi/sec (see Table 2-37) seems more appropriate in characterizing normal operations than the value of 11 uCi/sec used in this calculation. Using the information presented in MFN 06-212, the staff's estimate of the Ar-41 source term is twice than that derived by the applicant, using a hold up time of 1.1 day in charcoal decay tanks.

8. In deriving the release rate of Xe-133 and Xe-135, provide a justification for not adjusting the release rates by the ratios of the power levels (4500 vs 3400 MW) and capacity factors (0.92 vs 0.80) of 1.35 and 1.15, respectively. Using the information presented in MFN 06-212, the staff estimates are correspondingly higher for Xe-133 and Xe-135 source terms after making such adjustments.

9. In confirming radioactivity release rates from the Drywell via equation (5), the staff could not duplicate the results for particulates nuclides, but confirmed those for all radioiodines and tritium. For particulates, the staff's estimates are consistently higher by a factor of 1,000 for the 24 nuclides that were checked.

10. In confirming radioactivity release rates from the Drywell via equation (5), the staff could not duplicate the results for 13 of the 15 noble gases, excluding Kr-90 and Xe-139. The staff's estimates are both higher and lower than that provided by the applicant by factors ranging from 0.1 to nearly 270. See related issues noted in item 4 on the need for further clarification on derivation of $A_i/A_t$ ratio for all listed noble gases.

11. A review of the information presented in MFN 06-212, Suppl. 2, indicates that the enclosure present key and important information supporting the basis, models, and assumptions used in deriving airborne effluent source terms. Regarding the development of the airborne effluent source terms, DCD Section 12.2.2.1 briefly states that "The methodology of NUREG-0016 was used in determining the annual airborne release values in Table 12.2-16." The staff's observation is that the models, assumptions, and parameters presented in MFN 06-212 cannot be inferred from NUREG-0016 alone. Accordingly, it is suggested that the enclosure to MFN 06-212, once revised to address the above noted issues, be appended to DCD Chapter 12.2 and that the text in DCD Section 12.2.2.1 refers the reader to this appendix for specific details and information on the derivation of the airborne source terms. This approach would make the presentation of the supporting information about airborne effluents consistent with the corresponding details provided in the development of the source terms for liquid effluents.

Reference: GE Response Letter MFN-07-220, dated April 20, 2007, which addressed NRC RAI Letter No. 60, dated September 18, 2006.

**RAI 12.3-8 (Supplement 1):**

In GE's April 20, 2007 response to RAI 12.3-8, GE included Table 12.2-5, Radioactive Sources in the Control Rod Drive System. The estimated gamma dose rate for the Rotating Ball Spindle "before cleaning" of "0.0E+00 mSv/hr" appears to be in error. It would appear that the "before cleaning" dose rate value for this component would be larger than the "after cleaning" dose rate value listed at "3.0E-01 mSv/hr". Please correct this apparent discrepancy.

Reference: GE Response Letter MFN-06-389, dated October 18, 2006, which addressed NRC RAI Letter No. 60, dated September 18, 2006.

**RAI 12.3-9 (Supplement 1):**

RAI 12.3-9 asked the applicant to provide a description of any sources (such as calibration sources) needed to construct and operate an ESBWR plant or provide justification why this should be left to the COL applicant. To the extent that radiation protection features for these sources are provided for in the design (shielding, separate source rooms, etc.), they need to be addressed in the DCD. To the extent that these design features are to be provided in a COL, please identify them as COL Action Items.

Reference: GE Response Letter MFN-06-512, Supplement 1, and MFN-06-528, Supplement 1, dated June 7, 2007, which addressed NRC RAI Letter No. 60, dated September 18, 2006.

**RAI 12.4-4 (Supplement 2):**

In GE's June 7, 2007, response to RAI 12.4-4 S01, GE revised the estimated radiation zone designations for several rooms depicted in Figure 12.3-19. The revised radiation zone

designations for three of these rooms are still inconsistent with the zone designations listed in GE's initial response to RAI 12.4-4.

In GE's initial response to RAI 12.4-4, the following rooms are listed as having anticipated dose rates of >100 rads/hr (zone I) during normal operations: 6106, 6107, and 6161. In GE's response to RAI 12.4-4S01, these rooms are designated as having the following dose rates: Rm 6106 (< 10 R/hr, zone G), 6107 and 6161(<100 rads/hr, Zone H). Please clarify these apparent zone designation inconsistencies.

Reference: GE Response Letter MFN-06-512, Supplement 1, and MFN-06-528, Supplement 1, dated June 7, 2007, which addressed NRC RAI Letter No. 60, dated September 18, 2006.

**RAI 12.4-6 (Supplement 2):**

In GE's response to Supplement 1 of RAI 12.4-6, GE stated that, "if required, special shielding features using other materials such as lead blankets, lead curtains, etc., will be defined later by the COL holder." To the extent that these design features are to be provided in a COL, they should be identified as COL Action Items in the DCD.

Reference: GE Response Letter MFN-06-512 dated December 22, 2006, which addressed NRC RAI Letter No. 60, dated September 18, 2006.

**RAI 12.4-17 (Supplement 1):**

In addition to other information requested in RAI 12.4-17, RAI 12.4-17 noted that Figure 12.3-20 is missing radiation zone designations for several rooms in the -2350 mm elevation of the Radwaste Building. Although GE provided the missing radiation zone designations in their response to this RAI, the staff noted that the radiation zone designations provided in the RAI response (zones E/F) appear to differ from radiation zones shown on Figure 12.3-20 (zones E/C) for Room 6283. Please clarify these apparent zone designation inconsistencies.

Reference: GE Response Letter MFN-06-499 dated December 22, 2006, which addressed NRC RAI Letter No. 60, dated September 18, 2006.

**RAI 12.4-19 (Supplement 1):**

In its February 21, 2007, memo, the staff issued Supplement 1 to RAI 12.2-19 concerning the core burn-up values used for the fuel with respect to GE's shielding analysis. This supplemental RAI also applies to RAI 12.4-19. Upon further review of GE's response to RAI 12.4-19, the staff finds that it needs the following additional information regarding the IFTT:

a. In your response to RAI 12.4-19, verify that all of the dose rate measurements are correct in light of the fact that some of the dose rates are given in units of mrem/h and some in mSv/h.

b. In Figure 9.1-2 there appears to be two areas where the embedded IFTT comes very close to potentially accessible areas. One of these areas is in room 2400 (rail car bay)

near the rail supports of the main crane in the Fuel Building (roughly at level +13570). The other is in room 2400 near the lower part of the fuel handling machine opposite the trapezoidal room at elevation +4650. Describe what features (both physical and administrative) are in place to restrict personnel access to these two areas during fuel transfer operations. Provide the thickness of the concrete at the narrowest point between the IFTT and each of these two areas and provide the corresponding maximum dose rate at these points from a spent fuel assembly in the adjacent portion of the IFTT.

c. On elevation 13570 mm (Figure 12.3-6) there appears to be hallway between quadrants of general area 1600 in the Reactor Building which passes by the IFTT which is embedded in the concrete wall to the south of this hallway. The note on Figure 12.3-6 states that this hallway is listed as Radiation zone I (<500 rem/hr) during spent fuel transfer.

+ Provide the minimum concrete thickness between the IFTT and this hallway.
+ Provide the maximum dose rate at this point from a spent fuel assembly in the adjacent portion of the IFTT.
+ Describe what features (both physical and administrative) are in place to restrict personnel access to this hallway when fuel is being transferred in the IFTT.
+ Indicate where this hallway is located on Figure 9.1-2.

d. In your response to RAI 12.4-19, you mention access stairs to the crane in the Fuel Building. Describe where these stairs are located (list appropriate figure(s) showing location of the access stairs) with respect to the IFTT .

e. Figure 9.1-2 indicates that there is an access plug (elevation +4650 mm) to access the portion of the IFTT which runs through the trapezoidal room. State what plant layout figure shows this access plug entrance to the trapezoidal room (it does not seem to be shown on Figure 12.3-4) and describe the access route to reach this access plug.

Reference: GE Response Letter MFN-07-143 dated March 12, 2007, which addressed RAI resolutions incorporated in ESBWR DCD, Revision 3.

**RAI 12.4-23 (Supplement 1):**

RAI 12.4-23 asked GE to list the ESBWR ventilation systems designed to operate during accident conditions and to indicate their location on plant layout drawings. GE was also asked to describe the maximum radiation source term in the filter or adsorption media, and give associated radiation dose rates in adjacent areas. Finally, they were to describe design features to ensure that the radiation exposures resulting from maintenance (filter change out) of these systems is ALARA.

The information contained in the modifications made to Revision 3 of the DCD (Section 12.3.3.3 and Table 12.3-10) to address RAI 12.4-23 do not adequately respond to the staff's concerns.

Please address the following issues:

a. On the plant layout drawings, indicate the location of the Reactor Building HVAC Filter Units.

b. Include a table in the DCD similar to Table 12.3-10 which shows the dose rates in the RB HVAC Filter Units and adjacent rooms under accident conditions.

c. In Section 12.3.3.3 of the DCD, GE states that the shielding wall thickness between the RB HVAC filter cubicles is sized so that the dose contribution in any cubicle from the

filter in the adjacent one does not exceed 250 mSv/hr. Describe what maintenance (such as filter change-out), if any, would be required on the RB HVAC filter units under accident conditions.

If these units would have to be accessed following an accident to aid in the mitigation of or recovery from an accident, show that an operator would be able to perform the necessary operations on these units without exceeding the dose criteria of 50 mSv (5 rem) whole body, or its equivalent to any part of the body, for the duration of the accident (per 10 CFR Part 50 and GDC 19, Control Room).

d. Modify Figure 12.3-47 to show the post-accident radiation zones in the vicinity of the Control Building Emergency Filter Units on level 9060 of the Control Building.

Reference: GE Response Letter MFN-06-437 dated November 6, 2006, which addressed NRC RAI Letter No. 60, dated September 18, 2006.

**RAI 12.4-28 (Supplement 1):**

The original RAI noted that the second bullet under DCD Tier 2 Section 12.3.4 indicates that two redundant high range monitors are provided in the drywell and two in the wetwell "as required by RG 1.97." GE was asked to verify that these monitors meet the criteria of NUREG-0737 II.F.1 as required by 10 CFR 50.34(f)(xvii)(D) and to indicate the location of these monitors on the plant layout drawings.

The staff is in need of additional information for RAI 12.4-28 concerning which revision to Regulatory Guide 1.97 is being used; noting that Revision 3 to RG 1.97 contains monitor ranges. Please provide this information.