July 27, 2007

Mr. Robert E. Brown
Senior Vice President, Regulatory Affairs
GE-Hitachi Nuclear Energy Americas LLC
3901 Castle Hayne Road MC A-45
Wilmington, NC 28401

SUBJECT: ECONOMIC SIMPLIFIED BOILING WATER REACTOR (ESBWR) CHAPTER 12 OPEN ITEMS

Dear Mr. Brown:

As you are aware, the U. S. Nuclear Regulatory Commission staff is preparing the safety evaluation report (SER) for the ESBWR design certification application submitted by GE-Hitachi Nuclear Energy Americas LLC (GHNEA) on August 24, 2005. The staff has identified 29 open items for SER Chapter 12, "Radiation Protection," which are enclosed for your information. The staff is prepared to review your responses to the open items and have conference calls and meetings with your staff, as appropriate, to resolve these open items to support issuance of the SER.

Please provide a response date for any late or unscheduled open items discussed in the enclosure.

This open item letter is based on the staff's review of the ESBWR Design Control Document (DCD) Revision 3, Request for Additional Information (RAI) responses and other submittals received to date. The staff will continue its review as additional RAI responses and other deliverables are submitted, including future DCD Revisions. The staff will inform cognizant GHNEA staff of any resulting changes to the status of Chapter 12. If you have any questions, please contact Amy Cubbage at (301) 415-2875 or aec@nrc.gov or Dennis Galvin at (301) 492-3195 or djg3@nrc.gov.

Sincerely,

/RA/

Mohammed Shuaibi, Chief
ESBWR/ABWR Projects Branch 1
Division of New Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 52-010

Enclosure: As stated

cc: See next page

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GE-Hitachi Nuclear Energy Americas LLC (GHNEA) ESBWR

Preliminary Open Items

Chapter 12

Radiation Protection

RAI 12.2-9, Supplement No. 2, 7/27/2007, ML072080414

Reference: GE Response Letter MFN-06-212, Supplement 2, dated May 22, 2007, which addressed NRC RAI Letter No. 71, dated October 10, 2006.

Please address the following issues relative to the subject RAI:

a. The ESBWR design control document (DCD) should describe the performance requirements of adsorbent media for the eight main charcoal beds and two guard charcoal beds, and for the charcoal filters used in building ventilation exhaust systems. The performance 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. Please update DCD Tier 2 Table 11.3-1 "Offgas System Design Parameters," to specify the delay time for Krypton and Argon in addition to Xenon which is already included, and Table 12.2-15 "Airborne Sources Calculation," to specify the charcoal filtration efficiency for radioactive iodine.

b. In Revision 3 of 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" but does not consider interconnections between plant systems that could become radioactive through improper interfaces with radioactive systems. DCD Rev. 3, Section 11.3.8 does not commit the COL applicant to confirm that the OGS, as installed, fulfills this commitment. Please update the DCD to either (i) make reference to IE Bulletin 80-10 in DCD Sections 11.3.2.2 and 10.4.1.2.3 as they relate to drains designed to capture the contaminated water phase from OGS condensers/coolers, or (ii) create a COL applicant item to address this issue as part of the integration of the final design of the OGS, taking into account specific design features.

c. 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.

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.

d. 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 percent for the estimation of gaseous effluent source terms.

e. 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.

f. 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. Provide the information justifying this value.

g. 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.

h. 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.

i. 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. Provide the information justifying this value.

j. 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.

k. 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. Provide information with which to resolve this discrepancy.

l. 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. Provide information with which to resolve this discrepancy.

m. 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 (g) on the need for further clarification on derivation of A_i / A_t ratio for all listed noble gases. Provide information with which to resolve this discrepancy.

n. A review of the information presented in MFN 06-212, Sup. 2, indicates that the enclosure presents 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.

Status: *GHNEA has not committed to a response date. This RAI and its subsequent supplements will be addressed in an upcoming audit.*

RAI 12.2-15, Supplement No. 1, 5/16/2007, ML071370052

Reference: GE Response Letter MFN-06-305, dated September 1, 2006, which addressed NRC RAI Letter No. 54, dated August 23, 2006.

In RAIs 11.2.2-8, 12.2-10 (and its followup), and 12.2-15, the staff had requested the applicant to provide discussions and assumptions describing offsite dose receptor locations, rationale for the exposure pathways listed in DCD Tier 2, Rev. 1, Table 12.2-20b, and a listing of all model parameters used in calculating doses using the methodology of the BWR-GALE Code

(NUREG-0016) and NUREG/CR-4013. Based on the information presented in DCD Tier 2, Rev. 1, Tables 12.2-19a, 12.2-20a, 11.2-3, 11.2-4, 11.1-3, and 9.3-2, the staff could not duplicate, using the BWR-GALE Code, the average annual liquid effluent concentrations and releases listed in Table 12.2-19b. The following observations were noted:

a. Using the updated information, the staff's evaluation confirmed the estimates of annual radioactivity releases for all but 13 of the 46 radionuclies listed in Table 12.2-19b. The applicant's results were found to be higher than the staff's analysis for Np-239, Sr-90, Te-132, and CS-137, with factors ranging from about 1.1 to 4.0. For nine radionuclides, the applicant's results were found to be lower than the staff's analysis for Br-83, Ru-103, 1-131, 1-132, 1-133, 1-134, 1-135, Cs-136, and H-3 with factors ranging from about 0.2 to 0.09.

Accordingly, provide supplemental information with which to resolve these differences and update the DCD.

Status: *GHNEA has committed to respond by 11/22/2007.*

RAI 12.2-19, Supplement No. 1, 3/6/2007, ML070670050

Reference: GE Response Letter MFN-06-528, dated December 22, 2006, which addressed NRC RAI Letter No. 60, dated September 18, 2006.

The shielding analysis provided in RAI 12.2-19 is based on 35 GWd/MTU exposure of a GE-14 fuel bundle. However, Figure 4A-18e lists several bundles in the core with burn-ups greater than 35 GWd/MTU (e.g. the bundle at 5,17 has a maximum average exposure of 50.38). In addition, Topical Report NEDC-33242P (currently under review in concert with the ESBWR design review) indicates a peak bundle average exposure of 67 GWd/MTU. Clarify how the RAI response provides a bounding analysis of the operational event in question.

Status: GHNEA responded on 6/27/07, MFN 06-528, Supplement 2.
GHNEA's response is under staff review.

RAI 12.2-21, 5/29/2007, ML071450138

In Revision 3 of DCD Tier 2, Section 12.2.4.2, the COL action item is incomplete in demonstrating compliance with NRC regulations for airborne effluents. In addition to demonstrating compliance with the dose objectives of Sections II.B and II.C of Appendix I to 10 CFR Part 50, the COL applicant needs to also demonstrate compliance with Section II.D of Appendix I to Part 50; airborne effluent concentration limits of Appendix B (Table 2, Column 1) to 10 CFR Part 20; and dose limits of Parts 20.1301 and 20.1302 to members of the public. Accordingly, update this COL action in the DCD for the purpose of fully reflecting all applicable NRC regulations.

Status: *GHNEA has committed to respond by 8/24/2007.*

RAI 12.2-22, 5/29/2007, ML071450138

In Revision 3 of DCD Tier 2, Section 12.2.4.3, the COL action item is incomplete in demonstrating compliance with NRC regulations for liquid effluents. In addition to demonstrating compliance with the dose objectives of Section II.A of Appendix I to 10 CFR Part 50, the COL applicant needs to also demonstrate compliance with Section II.D of Appendix I to Part 50; liquid effluent concentration limits of Appendix B (Table 2, Column 2) to 10 CFR Part 20; and dose limits of Parts 20.1301 and 20.1302 to members of the public. Accordingly, update this COL action in the DCD for the purpose of fully reflecting all applicable NRC regulations.

Status: *GHNEA has committed to respond by 8/24/2007.*

RAI 12.3-8, Supplement No. 1, 6/22/2007, ML071730083

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

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.

Status: *GHNEA has not committed to a response date.*

RAI 12.3-9, Supplement No. 1, 12/29/2006, ML070320793, resent 6/22/2007, ML071730083

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 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.

Status: *GHNEA has not committed to a response date.*

RAI 12.4-4, Supplement No. 2, 6/22/2007, ML071730083

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.

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 12.4-4 S01, 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.

Status: *GHNEA has not committed to a response date.*

RAI 12.4-6, Supplement No. 2, 6/22/2007, ML071730083

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.

In the applicant's June 7, 2007, response to RAI 12.4-6 S01, 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.

Status: *GHNEA has not committed to a response date.*

RAI 12.4-11, 9/18/2006, ML062550025

DCD Tier 2, Figures 1.1-1 and 12.3-4 indicate "wash down bays" in the fuel building equipment entry facility. Identify what equipment is intended to be washed down in this facility. If contaminated or potentially contaminated equipment is to be washed down in this facility, discuss the design features employed to minimize the spread of contamination (including the provision for collecting and disposal of wash down fluids).

Status: GHNEA responded on 4/5/07, MFN 07-099.
GHNEA's response is under staff review.

RAI 12.4-16, 9/18/2006, ML062550025

DCD Tier 2, Figure 12.3-12 indicates that the radwaste piping gallery between the Turbine Building and the Radwaste Building also contains electrical equipment. Describe this electrical equipment, including the anticipated frequency of maintenance associated with it. Is shielding provided between the piping carrying radioactive fluids and this electrical equipment? If not, provide a justification why the current design is ALARA.

Status: GHNEA responded on 4/5/07, MFN 07-099.
GHNEA's response is under staff review.

RAI 12.4-17, Supplement No. 1, 6/22/2007, ML071730083

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

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.

Status: *GHNEA has not committed to a response date.*

RAI 12.4-19, Supplement No. 1, 6/22/2007, ML071730083

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

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 a 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.

Status: *GHNEA has not committed to a response date.*

RAI 12.4-23, Supplement No. 1, 6/22/2007, ML071730083

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 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.

Status: *GHNEA has not committed to a response date.*

RAI 12.4-24, 9/18/2006, ML062550025

Indicate the location of the filtration units for the reactor building, the radwaste building, and the fuel building, on plant layout drawings. Describe the maximum radiation source term in the filter or adsorption media, for each and give associated radiation dose rates in adjacent areas. Describe design features to ensure that the radiation exposures resulting from maintenance (filter change out) of these systems is ALARA.

Status: GHNEA responded on 5/25/07, MFN 07-048.
GHNEA's response is under staff review.

RAI 12.4-25, 9/18/2006, ML062550025

DCD Tier 2, Sections 12.3.4.1 and 12.3.4.2 describe the ESBWR area radiation monitoring (ARM) system. Tables 12.3-2 through 12.3-6 list the monitors with their locations provided on Figures 12.3-23 through 12.3-42. However, the information is unclear. Clearly indicate which Regulatory Guide (RG) 1.97 category and accident monitoring type variable, each ARM is provided to meet and show that the range of each monitor is consistent with RG 1.97. For those ARMs not provided for accident monitoring, clearly demonstrate that they meet the guidance in ANSI/ANS 6.8.1, or provide a justification for an alternative.

Status: *GHNEA has committed to respond by 12/7/2007.*

RAI 12.4-28, Supplement No. 1, 6/22/2007, ML071730083

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

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 RG 1.97 is being used; noting that Revision 3 to RG 1.97 contains monitor ranges. Please provide this information.

Status: *GHNEA has not committed to a response date.*

RAI 12.4-29, Supplement No. 1, 12/29/2006, ML070320793

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

The original RAI response indicates monitoring and sampling points in "selected" locations. Please identify the locations or identify the intended criteria for selecting the locations.

Status: *GHNEA responded on 3/12/2007, MFN-07-143.*
GHNEA's response is under staff review.

RAI 12.4-31, 9/18/2006, ML062550025

The post-accident radiation zones on DCD Tier 2, Figures 12.3-43 through 12.3-51 are incomplete. Layout drawings are only provided for the "Nuclear Island" and then only the dose rates in the vital areas and "access pathways" are provided. Although the legends on these drawings go up to Zone I (>100 Rem/hr), with the exception of one area on Figure 12.3-51, no area greater than Zone F (1 Rem/hr) is indicated on any of the figures.

Provide a complete set of post-accident radiation zone drawings. Identify on these drawings the location of: (1) those systems and components that contain post-accident materials outside of the primary containment listed under Item III.D.3.3 of DCD Tier 2, Table 1A-1; (2) each specific area (not just the general room) requiring access to mitigate the consequences of an accident listed under Item II.B.2 of DCD Tier 2, Table 1A-1 (including technical support center and health physics facilities); and (3) the personnel access routes to, and egress routes from, these areas (not just a listing of the general rooms and stairs).

Provide a detailed description of personnel actions to be taken in each area, the significant radiation sources associated with each, and an analysis of the radiation "mission" dose received (including dose from access and egress).

Status: *GHNEA has committed to respond by 12/21/2007.*

RAI 12.4-32 and 12.4-33, Supplement No. 1, 12/29/2006, ML070320793

Reference: GE Response Letter MFN-06-477 dated November 22, 2006, which addressed NRC RAI Letter No. 60, dated September 18, 2006.

The last sentence of subsection 12.3.6 is not clear. The post-accident radiation zone maps should be based on the highest expected radiation dose rates under design basis accident conditions, as stated earlier in the subsection. The issues of whether the control room meets GDC 19, and that access to vital areas of the plant during accidents meet NUREG 0737 II.B.2 (50.34(f) (2)(vii)), or that the zone maps support the conclusions, is the subject of RAIs 12.4-31, 33 and 12.3-10. The response to 12.4-32 is incomplete as it refers the answer to RAI answers that have not been submitted.

Status: *GHNEA has committed to respond by 12/21/2007.*

RAI 12.5-1, 9/18/2006, ML062550025

Provide a complete tabulated dose assessment with a scope and detail consistent with the guidance in RG 8.19. Data should be presented in the format provided in RG 8.19 or an acceptable alternative. The analysis should clearly indicate the basis (i.e., based on recent BWR experience or calculated based on similar tasks in other industries) for the staff-hour and dose rate estimates assumed, and show how each was adjusted to account for ESBWR specific design features. Estimates on work activities similar to the advanced boiling water reactor

(ABWR) design (i.e., control rod drive removal and maintenance) should be based on experience from operating ABWRs.

Status: *GHNEA has committed to respond by 1/3/2008.*

RAI 12.5-6, 9/18/2006, ML062550025

DCD Tier 2, Revision 1, Section 12.4.5 indicates that the radwaste building work activities considered in the dose assessment include movement of casks and liner, activated filter handling, resin moving and the removal of mobile radwaste processing skids. However, DCD Tier 2, Rev. 1, Table 12.4-1 indicates that the average dose rate of 2.5 mrem/hr was assumed for these radwaste activities. Justify this low dose rate for what are typically high dose jobs.

Status: *GHNEA has committed to respond by 1/3/2008.*

RAI 12.5-8, 9/18/2006, ML062550025

DCD Tier 2, Table 12.4-1 gives an estimated total annual time of 33,131 person-hours to complete the radiologically significant work to operate and maintain an ESBWR. Exposure data reported to the NRC, and summarized in Volume 26 to NUREG-0713, "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and other Facilities," indicates that 35 US BWRs reported dose records for a total of 59,991 workers (33,948 that received an annual dose of greater than 100 mrem) for 2004. An average BWR in 2004 had about 970 workers performing radiologically significant work.

Assuming that similar numbers of workers will be required to operate and maintain an ESBWR, and that all the work included in Table 12.4-1 was completed by workers that would have an annual dose greater than 100 mrem, that translates into a work rate of only about 34 (33,131 person-hours per year divided by 970 workers) hours of radiological work per year per ESBWR radiation worker. Justify what appears to be a very low estimate of person hours needed to maintain an operating ESBWR.

Status: *GHNEA has committed to respond by 1/3/2008.*

RAI 12.6-1, 9/18/2006, ML062550025

DCD Tier 2, Section 12.5.2 discusses ESBWR facilities in the service building. Provide layout drawings (to the same scale as the other figures in DCD Tier 2, Section 12.3) of the service building, indicating the described facilities (including, but not limited to, the HP offices, control points, contamination control/monitoring stations, changing rooms (men's and women's), decontamination stations/showers, etc). Indicate the designed plant access and egress control through these facilities.

Status: *GHNEA has committed to respond by 10/19/2007.*

RAI 12.6-2, 9/18/2006, ML062550025

DCD Tier 2, Section 12.5.2 states that shielded rooms are provided for radioactivity analysis and instrument calibration. Describe the radiation sources that these facilities are designed to contain, the shielding provided and any other protective considerations in the design. Does the ESBWR design provide a low background facility for personnel bioassay? If so, include a description with the above.

Status: *GHNEA has committed to respond by 10/19/2007.*

RAI 12.7-1, 9/18/2006, ML062550025

Section 5.2 of NUREG/CR-3587 lists several decommissioning facilitation techniques that are applicable during the design and construction phase of a commercial nuclear power light water reactor. Describe to what extent each of these features were incorporated in the ESBWR design, or describe why the recommendation is not practical. Provide illustrative examples.

Status: GHNEA responded on 5/4/07, MFN 07-222.
GHNEA's response is under staff review. However, resolution of this RAI is dependent on public issuance of guidance on meeting the requirements of 10 CFR 20.1406, and what that guidance ultimately contains.

RAI 12.7-2, 9/18/2006, ML062550025

The discussions of the systems (liquid, solid, and gaseous, as well as waste management) provided in DCD Tier 2, Section 12.6.2 seem to be addressing minimization of effluents and solid waste from normal plant operation. Explain how the bulleted items (such as the segregation of wet and dry active waste for off-site shipment and burial) facilitate decommissioning operations. Describe how the ESBWR design minimizes the generation of radioactive waste during decommissioning operations.

Status: GHNEA responded on 3/12/07, MFN 07-143.
GHNEA's response is under staff review. However, resolution of this RAI is dependent on public issuance of guidance on meeting the requirements of 10 CFR 20.1406, and what that guidance ultimately contains.

RAI 12.7-3, Supplement No. 1, 12/29/2006, ML070320793

Reference: GE Response Letter MFN-06-371 dated October 18, 2006, which addressed NRC RAI Letter No. 60, dated September 18, 2006.

The original RAI response indicates that the radwaste tunnel is designed to the same standard as the radwaste building, and that the radwaste building is designed to mitigate spills. What design features of these structures prevent leakage from piping and components housed in them from reaching the ground water or environment for the life of the plant? Are these continuous pour, reinforced concrete structures, with no seams or joints? Are there expansion joints at the interfaces between the tunnels and the buildings. If so, how is leakage prevented through them for the life of the plant? Are expansion joints accessible for inspection and maintenance? Do the radwaste tunnels have design features to detect leakage (large acute, or

small long term) from the systems into these tunnels? Is there any contaminated piping in the ESBWR design that will be buried in the ground, not routed through one of the radwaste tunnels? Does the Spent Fuel Pool (SFP) have a double liner with a tell-tale leak detection system? The additional information provided does need to be included in the DCD.

Status: GHNEA responded on 5/30/07, MFN 06-371, Supplement 1.
GHNEA's response is under staff review. However, resolution of this RAI is dependent on public issuance of guidance on meeting the requirements of 10 CFR 20.1406, and what that guidance ultimately contains.

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