



GE Energy

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Subject: **Response to Portion of NRC Request for Additional Information
Letter No. 84 – Radiation Protection Monitoring – RAI Numbers
11.5-27 through 11.5-30, 11.5-32, and 11.5-36**

Enclosure 1 contains GE's response to the subject NRC RAIs transmitted via the
Reference 1 letter.

If you have any questions or require additional information regarding the information
provided here, please contact me.

Sincerely,

James C. Kinsey for

James C. Kinsey
Project Manager, ESBWR Licensing

Reference:

1. MFN 06-517, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 84 Related to the ESBWR Design Certification Application*, December 7, 2006

Enclosures:

1. MFN 07-167– Response to Portion of NRC Request for Additional Information Letter No. 84 – Radiation Protection – RAI Numbers 11.5-27 through 11.5-30, 11.5-32 and 11.5-36

cc: AE Cubbage USNRC (with enclosures)
GB Stramback GE/San Jose (with enclosures)
BE Brown GE/Wilmington (with enclosures)
eDRF 0065-4987

Enclosure 1

MFN 07-167

**GE Responses to NRC Request for Additional Information
Letter No. 84 for ESBWR Design Certification Application**

Process Radiation Monitoring System

RAI Numbers 11.5-27 through 30, 11.5-32, & 11.5-36

NRC RAI 11.5-27:

Address the applicable revision of the Regulatory Guides in Section 11.5.8.

The references in Section 11.5.8 include the revisions for the ANSI Standards and NUREG-0737, but does not address the applicable revision for the Regulatory Guides (RG). Please update the DCD to include the applicable revision number for the RG.

GE Response:

Revision numbers for all applicable Regulatory Guides are maintained in the DCD Tier 2 Table 1.9-21, Regulatory Guides Applicability to ESBWR. Revision 3 of this table lists RG 1.21 Rev. 1, RG 1.45 Rev. 0, RG 1.97 Rev. 4, and RG 4.15 Rev. 1 as applicable for the Regulatory Guides referenced in Subsection 11.5.2 and 11.5.8.

DCD Impact:

No changes are required to the DCD for this RAI response.

NRC RAI 11.5-28:

Update references regarding applicability of revision 4 of RG 1.97 and IEEE Std. 497-2002.

Revision 4 of the RG 1.97 was issued in June 2006. Per RAI 7.5-5 response, General Electric (GE) has agreed to update the DCD to reflect revision 4 of the RG 1.97 and IEEE Std. 497-2002. The reference documents in Section 11.5.8 and the System Design Basis and Criteria in Section 11.5.2 should be updated to reflect the same.

GE Response:

See response to RAI 11.5-27. Subsections 11.5.8 and 11.5.2 reference RG 1.97 but do not include the applicable revision number, since revision numbers for all applicable Regulatory Guides are maintained in the DCD Tier 2 Table 1.9-21, Regulatory Guides Applicability to ESBWR. Revision 3 of Table 1.9-21 identifies Revision 4 applicability to RG 1.97.

DCD Impact:

No changes are required to the DCD for this RAI response.

RAI 11.5-29:

Address the issue of common cause failure.

Paragraph 6.2 of IEEE Std. 497-2002 addresses common cause failures concerning use of common software. It states, "Design of instrumentation using microprocessor based sensors, data acquisition, or display equipment for Type A, Type B, and Type C variables, shall address concerns over the possibility that the use of computer software could result in a common cause failure. Common cause failures for the instrumentation channels shall be addressed at the variable level." Update DCD Section 11.5.4 to address common cause failure concern as stated in Paragraph 6.2 of IEEE Std. 497-2002.

GE Response:

Subsection 7.5.1.3.1.4 of DCD Tier 2 Revision 3 states that the ESBWR design process meets the intent of RG 1.97 and applicable requirements of IEEE Std. 497.

Paragraph 6.2 of IEEE Std. 497-2002 accepts the use of identical software in redundant instrumentation channels if analysis demonstrates that defense-in-depth exists against consequences of a software common mode failure. Licensing Topical Report NEDO-33251, *ESBWR I&C Defense-In-Depth and Diversity Report*, was submitted via MFN 06-240 dated July 24, 2006.

The report follows the guidelines of NUREG-0493, "Defense-in-Depth of the RESAR-414 Integrated Protection System", and NUREG/CR-6303, "Method for Performing Diversity and Defense-in-Depth Analyses of Reactor Protection Systems". In ESBWR design, diversity in the Engineered Safety Features (ESF) echelon of defense-in-depth is provided by:

- (a) Safety-Related Distributed Control and Information System (Q-DCIS), which interfaces with Safety-Related sub-systems of the Process Radiation Monitoring System (PRMS) for generating signals for ESF actuation.
- (b) Diverse Protection System (DPS), which is part of the Nonsafety-Related Distributed Control and Information System (N-DCIS) to provide diverse backup for ESF actuation.

Therefore, software common-mode failures associated with a Safety-Related PRMS sub-system would not prevent the DPS from initiating protective actions when required.

The concern for common cause failure, as stated in Paragraph 6.2 of IEEE Std. 497-2002, is also addressed by diverse methods of measurement of radiation parameters in the use of grab sample analyses for comparison with online PRMS outputs. Subsection 11.5.4.3 of DCD Tier 2 Revision 3 states that grab samples are analyzed to identify and quantify specific radionuclide effluents. The results from the sample analysis are used to establish relationships between gross gamma monitor readings of process radiation monitors and release rates of radionuclides in continuous effluent releases. DCD Tier 2, Revision 3, Tables 11.5-4 through 11.5-8 summarize

the information concerning frequency, analysis, sensitivity, and purpose of extracted samples that are analyzed in the health physics laboratory.

DCD Impact:

No changes are required to the DCD for this RAI response.

RAI 11.5-30:

On Section 11.5.2.1 the tenth bullet from top in this paragraph states, "Register full-scale output if radiation detection exceeds full scale;". Per IEEE Std. 497-2002 type C variables are those variables that provide primary information to the control room operators to indicate the potential for breach or the actual breach of the three fission product barriers (extended range). Further RG 1.97 clarifies under item C.3 that the ranges for type C variables shall have expanded ranges and a source term that consider a damaged core. In light of the above, please clarify if any variable will exceed the range. If so, justify.

GE Response:

The 10th bullet in Subsection 11.5.2.1 and 7th bullet in Subsection 11.5.2.2 of DCD Revision 2 regarding PRMS outputs exceeding full scale, have been deleted in Revision 3.

Also in DCD Tier 2, Revision 3, the design criteria in the 11th bullet of Subsection 11.5.2.1 and 6th bullet of Subsection 11.5.2.2 require the use of instrumentation compatible with the anticipated radiation levels and ranges expected under normal, abnormal and accident conditions (Regulatory Guide 1.97), with extended ranges taking into consideration the source term arising out of a damaged core.

DCD Impact:

No changes are required to the DCD for this RAI response.

RAI 11.5-32:

Clarify inconsistencies between descriptions of subsections under sections 11.5.3.1 and 11.5.3.2.

Subsystem descriptions under sections 11.5.3.1 and 11.5.3.2 are not consistent. The description contents vary among the subsections. Some subsections do not describe logic or do not include the alarms description (e.g., 11.5.3.1.5 and 11.5.3.1.6), other sections do not describe the number of channels (e.g., 11.5.3.2.5 and 11.5.3.2.16). DCD descriptions should be consistent and systematic. As a minimum each subsection should either address directly or by reference to the tables (e.g., Table 11.5-1 and Table 11.5-2) the following items: a) system overview description, b) number of paths and monitoring channels per path, c) initiation logic (not required if only one channel exists), d) channel testing, e) ranges, and f) alarms. Clarify inconsistencies between descriptions of subsections under sections 11.5.3.1 and 11.5.3.2.

GE Response:

Subsections 11.5.3.1 and 11.5.3.2 have been revised in DCD Tier 2 Revision 3 to be consistent with respect to system overview description, number of channels, initiation logic, channel testing, ranges, and alarms, and referencing Tables 11.5-1 and 11.5-2, where applicable.

DCD Impact:

No changes are required to the DCD for this RAI response.

RAI 11.5-36:

Update section 11.5.4 to address accuracy, response time, and reliability of the instruments used for PRMS.

DCD section 11.5.4 should address accuracy, response time, and reliability of the instruments used for PRMS and provide overlapping sensor/instrument ranges if the desired accuracy cannot be achieved with a single sensor/instrument.

GE Response:

Accuracy, response time, and reliability parameters are addressed in hardware/software design specifications during the detailed design phase of the project, in accordance with applicable codes and specifications referenced in Subsection 11.5.2, System Design Bases & Criteria.

The 11th bullet in Subsection 11.5.2.1, and 6th bullet in Subsection 11.5.2.2, have been revised in DCD Tier 2 Revision 3 to clarify that overlapping sensor/instrument ranges are to be provided if the desired accuracy cannot be achieved with a single sensor/instrument.

DCD Impact:

No changes are required to the DCD for this RAI response.