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MFN 06-299
Supplement 8

Docket No. 52-010

August 4, 2008

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Subject: Revision 2 to Response to Portion of NRC Request for Additional Information Letter No. 148 Related to ESBWR Design Certification Application -- Design and Selection of Pipe Whip Restraints -- RAI Number 3.6-7 S02

The purpose of this letter is to submit the revised GE Hitachi Nuclear Energy (GEH) partial response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) received from the NRC, via Reference 1 (RAI 3.6-7 S02).

Enclosure 1 contains revision 2 to GEH's response to NRC RAI 3.6-7 S02 that was received from the NRC on February 19, 2008, via MFN 08-158 (NRC Letter 148) (Reference 3). Previously GEH received RAI 3.6-7 S01, on May 20, 2007, via an e-mail from the NRC (Amy Cubbage) (Reference 5), to which GEH responded, on December 14, 2007, via MFN 06-299, Supplement 1 (Reference 4). Original RAI 3.6-7 was received by GEH, on August 3, 2006, via MFN 06-271 (NRC Letter 45) (Reference 7), to which GEH responded, on August 28, 2006, via MFN 06-299 (Reference 6).

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If you have any questions or require additional information, please contact me.

Sincerely,

Richard E. Kingston

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Vice President, ESBWR Licensing

References:

1. MFN 06-299 Supplement 7 from Richard Kingston to the U.S. Nuclear Regulatory Commission, *Revised Response to Portion of NRC Request for Additional Information E-mail from Amy Cubbage (NRC) Related to ESBWR Design Certification Application – Evaluation of Postulated Pipe Breaks – RAIs 3.6-7 S02,* dated July 2, 2008

2. MFN 06-299 Supplement 6 from Jim Kinsey to the U.S. Nuclear Regulatory Commission, *Response to Portion of NRC Request for Additional Information E-mail from Amy Cubbage (NRC) Related to ESBWR Design Certification Application – Evaluation of Postulated Pipe Breaks – RAIs 3.6-7 S02*, dated April 21, 2008

3. MFN 08-158 from Leslie Perkins, Project Manager, ESBWR/ABWR Projects Branch 2, Division of New Reactor Licensing, Office of New Reactors, to Robert E. Brown, *Request for Additional Information Letter No. 148 Related to ESBWR Design Certification Application, [concerning quality control procedures for computer programs]*, dated February 19, 2008

4. MFN 06-299 Supplement 1 from Jim Kinsey to the U.S. Nuclear Regulatory Commission, *Response to Portion of NRC Request for Additional Information E-mail from Amy Cubbage (NRC) Related to ESBWR Design Certification Application – Evaluation of Postulated Pipe Breaks – RAIs 3.6-7 S01 and 3.6-8 S01*, dated December 14, 2007

5. E-mail from Amy Cubbage, U.S. Nuclear Regulatory Commission to GEH, (RAIs 3.6-7 S01 and 3.6-8 S01), comment that responses to RAIs 3.6-7 and 3.6-8 are incomplete, dated May 20, 2007

6. MFN 06-299 from Jim Kinsey to the U.S. Nuclear Regulatory Commission, *Response to Portion of NRC Request for Additional Information Letter No. 45 Related to ESBWR Design Certification Application – Protection against Dynamic Effects Associated with the Postulated Rupture of Piping - RAI Numbers 3.6-1 through 3.6-10*, dated August 28, 2006

7. MFN 06-271 from Lawrence Rossbach, Project Manager, ESBWR/ABWR Projects Branch, Division of New Reactor Licensing, Office of Nuclear Reactor Regulation, to David H. Hinds, *Request for Additional Information Letter No. 45 Related to ESBWR Design Certification Application* [RAI concerning the evaluation of postulated pipe breaks as described in Section 3.6 of the ESBWR Design Control Document], dated August 3, 2006

Enclosure:

1. Revised Response to Portion of NRC Request for Additional Information Letter No. 148 Related to ESBWR Design Certification Application -- Design and Selection of Pipe Whip Restraints -- RAI Number 3.6-7 S02

cc:	AE Cubbage	USNRC (with enclosures)
	RE Brown	GEH/Wilmington (with enclosures)
	DH Hinds	GEH/Wilmington (with enclosures)
	eDRF	0000-0081-9611 Rev. 3 (RAI 3.6-7 S02)

Enclosure 1

MFN 06-299 Supplement 8

Response to Portion of NRC Request for Additional Information Letter No. 148 Related to ESBWR Design Certification Application Design and Selection of Pipe Whip Restraints RAI Number 3.6-7 S02, Revision 2

For historical purposes, the original text of RAI 3.6-7 S02 and the GE responses are included. The attachments (if any) are not included from the original response to avoid confusion.

NRC RAI 3.6-7

In DCD Section 3.6.2.2 and Appendix 3J, GE provides details regarding assumptions in the piping dynamic analysis. The staff notes that SRP Section 3.6.2, item III.2.a, provided dynamic analysis criteria and discusses material capacity limitations for a crushable material type of whip restraint, while SRP Section 3.6.2, item III.2.b discusses various methods of analyses. Also, ANSI/ANS-58.2-1988, Paragraph 6.3 presents several different types of dynamic analysis methods. Provide answers to the following:
(a) In SRP Section 3.6.2, item III.2.a, it is stated that for piping pressurized during normal operation at power, the initial condition should be the greater of the contained energy at hot standby or at 102% power. Clarify if this is applicable to all approaches used for the ESBWR. If not, then provide technical justification for the alternate initial conditions assumed in the analyses.
(b) Acceptable dynamic models suggested in the SRP include lumped parameter analysis models, energy balance analysis models, and static analysis models. Also, alternate analytical approaches are discussed in ANS standard Paragraphs 6.3.1 through 6.3.5. DCD Appendix 3J presents only two specific approaches: dynamic time-history analysis with simplified models and dynamic time-history analysis with detailed piping models. Clarify if any other analytical (nonlinear) methods and modeling techniques (discussed in SRP and ANS standard) will be used for ESBWR plants.
(c) Discuss acceptable procedures and computer programs to be used to calculate the pipe whip dynamic responses for all those methods not discussed in DCD Appendix 3J.
(d) Provide examples illustrating nonlinear and simplified methods of analysis that will be used in the ESBWR design, demonstrating compliance with SRP Section 3.6.2 stress limit requirements. Also, describe the computer programs for selecting the size and different types of whip restraints (i.e., crushable or rigid, if any)
(e) Discuss the validation of the computer programs which the NRC staff has not yet approved.

GE Response

The ESBWR Plant design does not utilize "crushable" material type of whip restraint as allowed by SRP Section 3.6.2.

(a) The criterion of energy at hot standby or 102 % power is applicable to ESBWR. DCD Subsection 3.6.2.3.1 will be updated as noted in the attached markup.

(b) Enclosure 4 provides sample calculations prepared for a typical ABWR Plant for

the pipe break nonlinear method and modeling technique for main steam pipe break at terminal end RPV nozzles, which is a representative method to be used for ESBWR Plant.

(c) GEs computer program Pipe Dynamic Analysis (PDA) is used. ANSYS computer program can also be used.

(d) Response to this question is included in attached Enclosure 3.

(e) The analytical approach for (1) a complete system dynamic analysis as defined in Paragraph 6.3.1 of ANS 58.2 using ANSYS computer program, and (2) a simplified dynamic analysis as defined in Paragraph 6.3.2 of ANS 58.2 using the PDA computer program.

NRC RAI 3.6-7 S01

In the same letter [letter dated August 28, 2006] GE responded to RAI 3.6-7(a) through (e). The staff, in this RAI, requested

(a) GE to clarify certain details of the analytical methods and modeling techniques in DCD Appendix 3J and the use of computer programs to calculate the pipe whip dynamic responses. The following responses are incomplete.

(b) Acceptable dynamic models suggested in the Standard Review Plan (SRP) include lumped parameter analysis models, energy balance analysis models, and static analysis models. Also, alternate analytical approaches are given in ANS standard Paragraphs 6.3.1 through 6.3.5. DCD Appendix 3J presents only two specific approaches: dynamic time-history analysis with simplified models and dynamic time-history analysis with detailed piping models. The RAI was if any other analytical (nonlinear) methods and modeling techniques (discussed in the SRP and ANS standard) will be used for ESBWR plants. GE's response refers to enclosure 4 which should be enclosure 3. Enclosure 3 provides a sample calculation prepared for a typical ABWR plant for pipe break nonlinear method and modeling technique for main steam pipe break at terminal end reactor pressure vessel (RPV) nozzles, which claims to be the representative method to be used. But the question was if any other methods discussed in SRP and the ANS Standard will be used for ESBWR. GE should address whether any other analytical (nonlinear) methods and modeling techniques (discussed in the SRP and ANS standard) will be used for ESBWR plants.

(c) GE identified computer program PDA and ANSYS to be used to calculate the pipe whip dynamic responses. This part of the RAI was related to the question raised in (b) above. Without identifying the methods to be used, this response is not complete. Hence, GE should identify the methods to be used and then the computer programs to be used for each of these methods.

(e) The original question was related to the quality control of the computer programs and the computed results. GE's response was the analytical approach used for the two types of analyses presented in DCD appendix 3J, without addressing the quality control of computer codes. GE should address the quality control of computer programs and the computer results as requested.

GEH Response

(b) To perform the dynamic time-history analysis for pipe rupture evaluations, GEH will use either (1) Dynamic Time-History Analysis with Simplified Model Method, or, (2) Dynamic Time-History Analysis Using Detailed Piping Model Method as described in the DCD Tier 2, Appendix 3J subsection 3J.4. ESBWR is committed to using these two methods only.

(c) Computer programs such as, "Pipe Dynamic Analysis" (PDA) and ANSYS finite element program may be used for a simplified piping model or for a detailed piping model to perform the pipe rupture evaluations. The use of these computer programs are identified in the DCD Tier 2, Appendix 3J, subsections 3J.4.2.3 and 3J.4.3.2.

(e) The quality control of these programs is controlled by the GEH internal procedures [Engineering Operating Procedure (EOP)/GEH Policies and Procedure (P&P)]. Design/analyses production computer programs such as PDA and ANSYS have been used for this application for prior BWR plants. In GEH, these programs are identified as "Level 2" status that is, the programs are procedurally required to be maintained in a computer library under the control of a responsible individual. The Level 2 documentation includes Users Manual, Software Requirements Description, Software Design Description, Software Test Plan, Software Test Report, and Independent Design Verification. Any revision to the program requires a review by a design review team prior to implementation.

DCD Impact

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

NRC RAI 3.6-7 S02

NRC Summary:

Provide quality control procedures for computer programs.

NRC Full Text:

In response to RAI 3.6-7 S01, Item (e), GEH indicated that both PDA and ANSYS computer programs are controlled by the GEH internal procedures. However, GEH is using another computer code or file "REDEP" to define the pipe whip restraint (PWR) force and deflection relationship based on its design parameters. In accordance with DCD Subsection 3J.3.1, REDEP is a file containing a large database and is used to supply the force/deflection data for the design of GEH U-Bar whip restraint. GEH must control the quality of REDEP by internal procedures, similar to that of PDA and ANSYS.

Therefore, the staff requests GEH to revise DCD, Tier 2 to indicate that all of the above programs will have proper quality control procedures in place.

GEH Response

The "REDEP" file mentioned in Appendix 3J subsection 3J.3.1 DCD Tier 2, revision 4, is only used as a data file and not a computer program similar to PDA or ANSYS. Therefore, the program control procedures applicable to computer program codes such as PDA and ANSYS are not applicable to "REDEP" file. The "REDEP" file as described in section 3J.3.1 contains a set of tables for selecting force/deflection data for the design of pipe whip restraint components. The data obtained is then used as input to the PDA program. A structural analysis is then performed on the preliminary pipe whip restraint design to confirm the adequacy of the final configuration. The "REDEP" file data is maintained in accordance with GEH quality requirements that are pertinent to a data file.

DCD Impact

DCD Tier 2, Appendix 3J subsection 3J.3.1 will be is revised as noted in the attached markup.

Revision 1 to GEH Response

The "REDEP" file mentioned in DCD Tier 2, Appendix 3J, subsection 3J.3.1 is only a data file and not a computer program similar to PDA or ANSYS. Therefore, the program control procedures applicable to computer program codes such as PDA and ANSYS are not applicable to "REDEP" file. The "REDEP" file as described in section 3J.3.1 contains a set of tables for selecting force/deflection data for the preliminary design of pipe whip restraint components. The resulting preliminary design is then used as a preliminary input to the PDA program. A structural analysis is then performed on this preliminary pipe whip restraint design to confirm the adequacy of the final configuration. The final selection of a pipe whip restraint is only based on satisfactory structural analysis using analysis tools that comply with the GEH program control procedures.

Therefore, since it is only used for preliminary selection of a pipe whip restraint design that is subsequently confirmed or modified using other programs maintained in accordance with GEH quality requirements, it is not necessary to revise DCD Tier 2 to indicate that "REDEP" file data is maintained in accordance with GEH quality requirements. Also, since the scope of Chapter 17 includes defining the QA processes required in the design process, there is no need to provide QA process discussions in other chapters.

DCD Impact

DCD Tier 2, Appendix 3J, subsection 3J.3.1 was revised in revision 5.

Revision 2 to GEH Response

The "REDEP" file mentioned in DCD Tier 2, Appendix 3J, subsection 3J.3.1 is only a data file and not a computer program similar to PDA or ANSYS. Therefore, the program control procedures applicable to computer program codes such as PDA and ANSYS are not applicable to "REDEP" file. "REDEP" file, however, is maintained as a part of the GEH design record file system (eDRF/eMatrix) both in its own entry and as a part of the eDRF section for the specific calculations for which it is used. Chapter 17 of the DCD includes the definitions of the QA processes required in the design process.

The final selection of a pipe whip restraint is only based on satisfactory structural analysis using analysis tools (PDA or ANSYS) that comply with the GEH program control procedures. The final pipe rupture design calculation contains the input design data, analysis assumptions and justifications, pipe break modeling input/output, which are prepared, verified, and approved in accordance with GEH quality requirements for safety-related calculations. The REDEP file, which contains verified engineering data, is maintained in the Design Record File (i.e.:

eDRF/eMatrix) in the GEH PDMS (Product Data Management System), and complies with all applicable QA requirements.

The steps for selecting, preparing, analyzing, and confirming the design of pipe whip restraint components with regard to REDEP file use are listed below:

1. The "REDEP" file as described in section 3J.3.1 contains a set of tables for selecting force/deflection data for the preliminary design of pipe whip restraint components.
2. A preliminary design is established using data selected from the REDEP file.
3. A structural analysis is then performed on the pipe whip restraint design to confirm the adequacy of the final configuration.
4. The final analysis is reviewed and verified by a qualified engineer who is skilled in such type of analyses and is performed in accordance with approved quality assurance procedures.
5. The Design Record File (DRF) section includes design input, analysis, and output as well as any supporting information. The REDEP file becomes a part of the DRF section either directly or by reference.
6. The completed calculation and contents of the DRF are reviewed and approved by the Responsible Manager before it is authorized to be released for use.

In conclusion, the REDEP file is used for the initial preliminary selection of pipe whip restraint components and properties. REDEP is maintained in the GEH design record file (eDRF/eMatrix) in accordance with all appropriate QA requirements for the ESBWR project. Pipe whip restraint designs are confirmed using methods and programs that are consistent with GEH quality requirements and the final design calculations are verified by persons skilled in such analyses and then approved by the Responsible Manager before they are released for use. The final design calculation contains all relevant input and output information as well as necessary supporting information that was used in the preparation of the calculation.

DCD Impact

DCD Tier 2, Appendix 3J, subsection 3J.3.1 was revised in revision 5.