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Proprietary Notice
This letter forwards proprietary information in accordance with 10CFR2.390. Upon the removal of Enclosure 1, the balance of this letter may be considered non-proprietary.

MFN 06-159

Docket No. 52-010

June 5, 2006

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

Subject: **Partial Response to NRC Request for Additional Information Letter No. 18 Related to ESBWR Design Certification Application – Containment Design – RAI Numbers 6.2-12, 6.2-15, 6.2-18 through 6.2-20, 6.2-22 through 6.2-25, and 6.2-28 through 6.2-30**

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

Enclosure 1 contains GE proprietary information as defined by 10 CFR 2.390. GE customarily maintains this information in confidence and withholds it from public disclosure.

The affidavit contained in Enclosure 3 identifies that the information contained in Enclosure 1 has been handled and classified as proprietary to GE. GE hereby requests that the information of Enclosure 1 be withheld from public disclosure in accordance with the provisions of 10 CFR 2.390 and 9.17. A non proprietary version is provided in Enclosure 2.

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If you have any questions about the information provided here, please let me know.

Sincerely,

/Kathy Sedney for

David H. Hinds
Manager, ESBWR

Enclosures:

1. MFN 06-159 - Partial Response to NRC Request for Additional Information Letter No. 18 Related to ESBWR Design Certification Application – Containment Design – RAI Numbers 6.2-12, 6.2-15, 6.2-18 through 6.2-20, 6.2-22 through 6.2-25, and 6.2-28 through 6.2-30 - GE Proprietary Information
2. MFN 06-159 – Partial Response to NRC Request for Additional Information Letter No. 18 Related to ESBWR Design Certification Application – Containment Design – RAI Numbers 6.2-12, 6.2-15, 6.2-18 through 6.2-20, 6.2-22 through 6.2-25, and 6.2-28 through 6.2-30 - Non Proprietary Version
3. Affidavit – George B. Stramback – dated June 5, 2006

Reference:

1. MFN 06-113, Letter from U. S. Nuclear Regulatory Commission to Mr. David H. Hinds, *Request for Additional Information Letter No. 18 Related to ESBWR Design Certification Application*, April 24, 2006

cc:

WD Beckner	USNRC (w/o enclosures)
AE Cubbage	USNRC (with enclosures)
LA Dudes	USNRC (w/o enclosures)
GB Stramback	GE/San Jose (with enclosures)
eDRF	0000-0054-2973

ENCLOSURE 2

MFN 06-159

Partial Response to NRC Request for Additional Information
Letter No. 18 Related to
ESBWR Design Certification Application

Containment Design
RAI Numbers 6.2-12, 6.2-15, 6.2-18 through 6.2-20, 6.2-22 through 6.2-25, and 6.2-28 through 6.2-30

Non Proprietary Version

NRC RAI 6.2-12

The steam bypass leakage is an "assumed" value used for the DBA. Explain how large the leakage can be without exceeding the containment design limits (See DCD Section 6.2.1.1.5).

GE Response

A sensitivity study has been performed to determine the effect of Bypass leakage size on the peak drywell pressure during the DBA. It has been found that the peak drywell pressure of a feedwater line break accident would approach the design pressure of 45 psig at 72 hours after the pipe break if the leakage size were increased to $A/\sqrt{K} = 100\ cm^2$.

No DCD changes are proposed in response to this RAI.

NRC RAI 6.2-15

Provide the margin applied to the calculated differential pressures for use in the structural design of the subcompartment walls and equipment supports. Provide this information as part of DCD Tier 2, Section 6.2.1.2.1, "Design Bases." This information is necessary to evaluate ESBWR subcomparment loads per SRP 6.2.1.2 and RG 1.70, Section 6.2.1.2.

GE Response

As stated in DCD Section 6.2.1.2.2, Reactor Shield Annulus is the only subcompartment requiring analysis. The reported pressure results for structural analysis of Reactor Shield Annulus include at least 15% margin above the analytically determined pressures.

DCD Tier 2, Section 6.2.1.2.1, "Design Bases." will be appended with the following statement.
"At least 15% margin above the analytically determined pressures is applied for structural analysis."

NRC RAI 6.2-18

Provide a description of the computer program used to calculate the mass and energy release from a postulated pipe break. Discuss the conservatism of the blowdown model with respect to the pressure response of the subcompartment. If the computer code being used has not been previously reviewed by the staff, provide a comparison of the results to those predicted by an accepted code as justification for its use. Provide this information in DCD Tier 2, Section 6.2.1.2.3, "Design Evaluation." This information is necessary to evaluate ESBWR subcomparment loads per SRP 6.2.1.2 and RG 1.70, Section 6.2.1.2.

GE Response

No computer code is used to calculated the mass and energy release. The break flow is determined with Moody's critical flow model. (Reference listed below) An instantaneous guillotine break is postulated for each pipe break. Constant break flow, taking no credit for depressurization and inventory depletion in the RPV and associated pipes, is applied through the duration of analysis. The energy of break flow is also determined based on the initial operating condition.

Moody, F.J., "Maximum Flow Rate of a Single Component, Two-Phase Mixture, " Journal of Heat Transfer, Trans. ASME, Series C, Vol. 87, P 134, February 1965.

It is proposed that DCD Tier 2, Section 6.2.1.2.3, "Design Evaluation" be modified to read:
"FWL or RWCU break within the Reactor Shield Annulus are identified to be the accident with most severe consequences. Steady Mass and Energy releases from the postulated pipe breaks are based on the reactor operating condition prior to the break. The mass release rates are determined with Moody's Frictionless Critical Flow Model, Ref. Moody, F.J., "Maximum Flow Rate of a Single Component, Two-Phase Mixture, " Journal of Heat Transfer, Trans. ASME, Series C, Vol. 87, P 134, February 1965. Analyzed with TRACG, the peak subcompartment pressure responses were found to be below the design pressure for all postulated pipe break accidents."

NRC RAI 6.2-19

Provide a description of the computer program used to calculate the pressure differential pressures

NRC RAI 6.2-20

Provide the assumed initial operating conditions of the plant such as reactor power level and subcompartment pressure, temperature, and humidity. Provide this information in DCD Tier 2, Section 6.2.1.2.3, "Design Evaluation." This information is necessary to evaluate ESBWR subcomparment loads per SRP 6.2.1.2 and RG 1.70, Section 6.2.1.2.

GE Response

It is assumed that the reactor is operating at full power and the containment is filled with dry air at atmospheric pressure and 100°C when the postulated pipe break occurs.

This information will be included in DCD Tier 2, Section 6.2.1.2.3

NRC RAI 6.2-22

Provide a description of the piping system within a subcompartment that is assumed to rupture, the location of the break within the subcompartment, and the break size. Give the inside diameter of the rupture of line and the location and size of any flow restrictions within the line postulated to fail. Provide this information in DCD Tier 2, Section 6.2.1.2.3, "Design Evaluation." This information is necessary to evaluate ESBWR subcompartment loads per SRP 6.2.1.2 and RG 1.70, Section 6.2.1.2.

GE Response

Feedwater and RWCU lines are postulated to break separately inside the Reactor Shield Annulus. An instantaneous guillotine break is assumed for each break type. The mass and energy releases from two ends of the break are lumped. [[

]] The feedwater break flow from RPV is restricted by the spargers inside the RPV.

The MSL and DPV pipe breaks are not analyzed in this analysis. The safe end of these pipes extends beyond the annulus region, such that a break would occur outside the RSW and thus not directly pressurize the annulus region. In addition, the IC return and GDCS line pipe breaks are not calculated because the these pipes are smaller than the RWCU and FW lines and will be bounded by breaks in the larger pipes.

This information will be provided in a proprietary licensing topical report for reference in the DCD.

NRC RAI 6.2-23

Provide the subcompartment nodalization information in accordance with the formats of Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition) Rev. 3 (ADAMS ML011340072, ML011340108, and ML011340116), Section 6.2.1.2. Demonstrate that the selected nodalization maximizes the differential pressures as a basis for establishing the design pressures for the structures and component supports. Provide this information in DCD Tier 2, Section 6.2.1.2.3, "Design Evaluation." This information is necessary to evaluate ESBWR subcompartment loads per SRP 6.2.1.2 and RG 1.70, Section 6.2.1.2.

GE Response

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Sensitivity study of geometric input has been performed as described in the response to RAI 6.2-19. This information will be provided in a proprietary licensing topical report for reference in the DCD.

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Figure 1 – Nodalization Scheme

Table 1 – Axial (z) Nodalization

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Table 2 – Azimuth (θ) Nodalization

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NRC RAI 6.2-24

Provide graphs of the pressure responses of all subnodes within a subcompartment as functions of time to permit evaluations of the effect on structures and component supports. Provide this information in DCD Tier 2, Section 6.2.1.2.3, "Design Evaluation." This information is necessary to evaluate ESBWR subcompartment loads per SRP 6.2.1.2 and RG 1.70, Section 6.2.1.2.

GE Response

The pressure responses of all subnodes (see response to 6.2-23) within the reactor shield annulus as consequence of RWCU and FWL pipe breaks are presented in the attached files. The data cover 0.2 second following the pipe break. Since peak pressures occur at around [[ ]] second, nodal pressures are steady at 0.2 second.

Final RWCU Line Break
Final FW Line Break

Each attachment contains nodal pressure charts for different elevations, with curves for different azimuths in each chart. There is also a tabular presentation of the pressures. The plot and column labels follow the TRAC/GRIT labeling convention (Ref. TRACG04 User Manual, Table 4.1-1). See also the nodalization diagram provided in RAI 6.2-23.

This information will be provided in a proprietary licensing topical report for reference in the DCD.

NRC RAI 6.2-25

Provide the mass and energy release data for the postulated pipe breaks in tabular form, with time in seconds, mass release rate in kg/sec, enthalpy of mass released in kJ/kg, and energy release rate in W/sec. A minimum of 20 data points should be used from time zero to the time of peak pressure. The mass and energy release data should be given for at least the first three seconds. Provide this information in DCD Tier 2, Section 6.2.1.2.3, "Design Evaluation." This information is necessary to evaluate ESBWR subcompartment loads per SRP 6.2.1.2 and RG 1.70, Section 6.2.1.2.

GE Response

Steady mass and energy releases, based on the initial operating condition, are assumed for each analysis. The mass release rate is determined with the Moody critical mass flux model.

Feedwater and RWCU lines are postulated to break separately inside the Reactor Shield Annulus. The RWCU line break, from both ends of a guillotine break, is represented by a break area of [[ ]] at an elevation of [[ ]] above the vessel zero. Since only a half annulus is analyzed, the break area for TRACG analysis is [[ ]] The RWCU line assumed upstream coolant temperature and pressure are [[ ]] respectively, representative of the downcomer hydraulic conditions. The discharge velocity is [[ ]]

The FW line break is represented by a break area of [[ ]] at an elevation of [[ ]] above the vessel zero. Since only a half annulus is analyzed, the break area for TRACG analysis is [[ ]] The assumed FW line upstream coolant temperature and pressure are [[ ]] respectively, representative of the FW line hydraulic conditions. The discharge velocity is [[ ]]

This information will be provided in a proprietary licensing topical report for reference in the DCD.

NRC RAI 6.2-28

If SCAM is used for subcomparment loads analyses, please provide, for reference, a copy of: NEDE-21526, 76NED99 General Electric Co., "Subcompartment Analysis Methods (SCAM)," NEDE-21526, 76NED99, Class II (Proprietary), Revision 0, February 1977. This information is necessary to evaluate ESBWR subcompartment loads per SRP 6.2.1.2 and RG 1.70, Section 6.2.1.2.

GE Response

TRACG04, not SCAM, was used to determine the pressure responses within the Reactor Shield Annulus. A copy of TRACG04 model description has been provided separately.

No DCD changes are proposed in response to this RAI.

NRC RAI 6.2-29

Consideration of asymmetric loads on the reactor pressure vessel, 6.2.1.2.2-Reactor Shield Annulus. It is not clear which method, (1) NEDO-24548, "Technical Description Annulus Pressurization Load Adequacy Evaluation," D.K. Sharma, General Electric Company, January 1979; (2) NEDE-21526, 76NED99, General Electric Co., "Subcompartment Analysis Methods (SCAM)," NEDE-21526, 76NED99, Class II (Proprietary), Revision 0, February 1977; or (3) some alternative method, is used for the shield annulus response to high energy line breaks. Identify and describe the method(s) used for this evaluation.

GE Response

TRACG04 was used to determine the dynamic load on the Reactor Shield Annulus. A copy of TRACG04 model description has been provided separately.

No DCD changes are proposed in response to this RAI.

NRC RAI 6.2-30

Provide the pipe break selection and characteristics (including the method used to develop the mass and energy releases) and the annulus model for the thermal-hydraulic response to the pipe break (compartment descriptions, flows between compartments, compartment pressures and differential pressure between compartments). This information is necessary to evaluate ESBWR reactor shield annulus response to high energy line breaks.

GE Response

Feedwater and RWCU lines are postulated to break separately inside the Reactor Shield Annulus. The MSL and DPV pipe breaks are not analyzed in this analysis. The safe end of these pipes extends beyond the annulus region, such that a break would occur outside the annulus and thus not directly pressurize the annulus region. In addition, the IC return and GDCS line pipe breaks are not calculated because the these pipes are smaller than the RWCU and FW lines and will be bounded by breaks in the larger pipes. (See response to RAI Item 6.2-22)

Instantaneous guillotine break is postulated for either break. Mass release rate is calculated with Moody critical model using the operating condition at full power. Constant break flow is assumed through the duration of analysis, since no credit is taken for the depressurization as consequence of pipe break. . (See response to RAI Item 6.2-25)

TRACG04 was used to determine the subcompartment thermal-hydraulic responses following a pipe break.

Proposed DCD revision as described in the response to RAI 6.2-18.

ENCLOSURE 3

MFN 06-159

Affidavit

General Electric Company

AFFIDAVIT

I, George B. Stramback, state as follows:

(1) I am Manager, Regulatory Services, General Electric Company ("GE") and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in Enclosure 1 of GE letter MFN 06-159, David H. Hinds to NRC, *Partial Response to NRC Request for Additional Information Letter No. 18 Related to ESBWR Design Certification Application – Containment Design – RAI Numbers 6.2-12, 6.2-15, 6.2-18 through 6.2-20, 6.2-22 through 6.2-25, and 6.2-28 through 6.2-30*, dated June 5, 2006. The proprietary information is in Enclosure 1, *Partial Response to NRC Request for Additional Information Letter No. 18 Related to ESBWR Design Certification Application – Containment Design – RAI Numbers 6.2-12, 6.2-15, 6.2-18 through 6.2-20, 6.2-22 through 6.2-25, and 6.2-28 through 6.2-30.* The proprietary information is enclosed within double brackets and pages which contain proprietary information are identified by the marking "GE Proprietary Information." Paragraph (3) of this affidavit provides the basis for the proprietary determination.

(3) In making this application for withholding of proprietary information of which it is the owner, GE relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), and 2.790(a)(4) for "trade secrets" (Exemption 4). The material for which exemption from disclosure is here sought also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by General Electric's competitors without license from General Electric constitutes a competitive economic advantage over other companies;

b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

c. Information which reveals aspects of past, present, or future General Electric customer-funded development plans and programs, resulting in potential products to General Electric;

d. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a., and (4)b, above.

(5) To address 10 CFR 2.390 (b) (4), the information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GE, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GE, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge. Access to such documents within GE is limited on a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his delegate), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GE are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(8) The information identified in paragraph (2), above, is classified as proprietary because it contains the results of TRACG analytical models, methods and processes, including computer codes, which GE has developed. GE has developed this TRACG code for over fifteen years, at a total cost in excess of three million dollars. The reporting, evaluation and interpretations of the results for the BWR was achieved at a significant cost, in excess of one quarter million dollars, to GE.

The development of the evaluation process along with the interpretation and application of the analytical results is derived from the extensive experience database that constitutes a major GE asset.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GE's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GE's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

The research, development, engineering, analytical and NRC review costs comprise a substantial investment of time and money by GE.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

GE's competitive advantage will be lost if its competitors are able to use the results of the GE experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GE would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GE of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing these very valuable analytical tools.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information, and belief.

Executed on this 5th day of June 2006.

George B. Stramback
General Electric Company