GE Energy

Proprietary Information Notice
This letter forwards proprietary information in accordance with 10CFR2.390. The balance of this letter may be considered non-proprietary upon the removal of Enclosure 2.

David H. Hinds
Manager, ESBWR

PO Box 780 M/C L60
Wilmington, NC 28402-0780
USA

T 910 675 6363
F 910 362 6363
david.hinds@ge.com

MFN 06-232

Docket No. 52-010

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U.S. Nuclear Regulatory Commission
Document Control Desk
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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 31 Related to ESBWR Design Certification Application – TRACG Application for ESBWR ATWS – RAI Numbers 21.5-1, 21.6-5, 21.6-6, 21.6-9, 21.6-33. 21.6-39, 21.6-40, and 21.6-47**

Enclosures 1 and 2 contain GE's response to the subject NRC RAIs transmitted via the Reference 1 letter.

Enclosure 2 contains proprietary information as defined in 10CFR2.390. The affidavit contained in Enclosure 4 identifies that the information contained in Enclosure 2 has been handled and classified as proprietary to GE. GE hereby requests that the proprietary information in Enclosure 2 be withheld from public disclosure in accordance with the provisions of 10 CFR 2.390 and 9.17. A non proprietary version is contained in Enclosure 3.

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

Sincerely,

Kathy Sedney for

David H. Hinds
Manager, ESBWR

D068

Reference:

1. MFN 06-203, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 31 Related to ESBWR Design Certification Application*, June 23, 2006

Enclosures:

1. MFN 06-232 – Response to NRC Request for Additional Information Letter No. 31 Related to ESBWR Design Certification Application – PIRT Ranking of ESBWR Suppression Pool Equalization Line – RAI Number 21.5-1
2. MFN 06-232 – Response to NRC Request for Additional Information Letter No. 31 Related to ESBWR Design Certification Application – TRACG Application for ESBWR ATWS – RAI Numbers 21.6-5, 21.6-6, 21.6-9, 21.6-33. 21.6-39, 21.6-40, and 21.6-47 – GE Proprietary Information
3. MFN 06-232 – Response to NRC Request for Additional Information Letter No. 31 Related to ESBWR Design Certification Application – TRACG Application for ESBWR ATWS – RAI Numbers 21.6-5, 21.6-6, 21.6-9, 21.6-33. 21.6-39, 21.6-40, and 21.6-47 – Non Proprietary Version
4. Affidavit – George B. Stramback – dated July 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)
eDRFs 0000-0053-6501 and 0000-0056-0508

ENCLOSURE 1

MFN 06-232

Response to NRC Request for Additional Information

Letter No. 31 Related to ESBWR Design Certification Application

PIRT Ranking of ESBWR Suppression Pool Equalization Line

RAI Number 21.5-1

NRC RAI 21.5-1

The NRC SER approving NEDE-33083P, TRACG Application for ESBWR, Confirmatory Item 1 stated that an appropriate long term cooling PIRT must be provided at the design certification stage. ESBWR DCD, Tier 2,Tables 6.3-7 through 10 indicate that the reactor pressure vessel (RPV) level will remain above Level 0.5 for the feedwater line break (FWLB),main steam line break (MSLB), gravity driven cooling system line break(GDLB), bottom drain line break (BDLB) and, therefore, the suppression pool equalizing line valves are not expected to open. GE submittal MFN 05-096, states that a long term PIRT will be provided. GE submittal MFN 05-105 provides a long term PIRT which lists the equalizing line (EQ) importance as "N/A". GE submittal MFN 05-109 indicates in Table 2, "Containment/LOCA long term PIRT," that the equalizing line (EQ1) friction is ranked "High". Clarify the importance of the equalizing line for long term cooling in the DCD and describe appropriate testing (i.e., qualification testing and inspection test analyses and acceptance criteria (ITAAC)).

GE Response

As stated in the DCD Tables 6.3-7 through 10, the equalization line valves are not expected to open for a Loss of Coolant Accident (LOCA) resulting from a break in any of the lines in the current ESBWR design. Figures 1, 2, 3 and 4 (from MFN 05-105) show the downcomer level response for the first 12 hours following a bottom drain line break, feedwater line break, GDCS line break and main steam line break respectively. The figures show that the downcomer water level stabilizes at an elevation well above the elevation of the L0.5 trip (1 m above top of active fuel and approximately 8.5 m above the bottom of the RPV). The lowest level in the long term occurs for the GDCS line break, which still has more than 1 meter margin to L0.5. This is the consequence of two changes in the current design relative to the design analyzed in NEDE-33083P: a larger GDCS pool volume and smaller lower drywell volume.

The long term LOCA PIRT shown in MFN 05-105 for the RPV correctly states the importance of the equalization line (EQ) as N/A.

Table 2,"Containment/LOCA long term PIRT," in MFN 05-109 shows an incorrect 'High' ranking for equalization line friction (EQ1). This table was extracted from a previous report, which did not reflect the changes in the ESBWR design mentioned above. The ranking for EQ1 should be 'N/A' because the equalization line valves will not be activated for any design basis events.

The Equalization Line and valves are part of the GDCS system. The inspection test analysis and acceptance criteria (ITAAC) for the GDCS system can be found in Table 2.4.2-1 of the ESBWR DCD Tier 1.

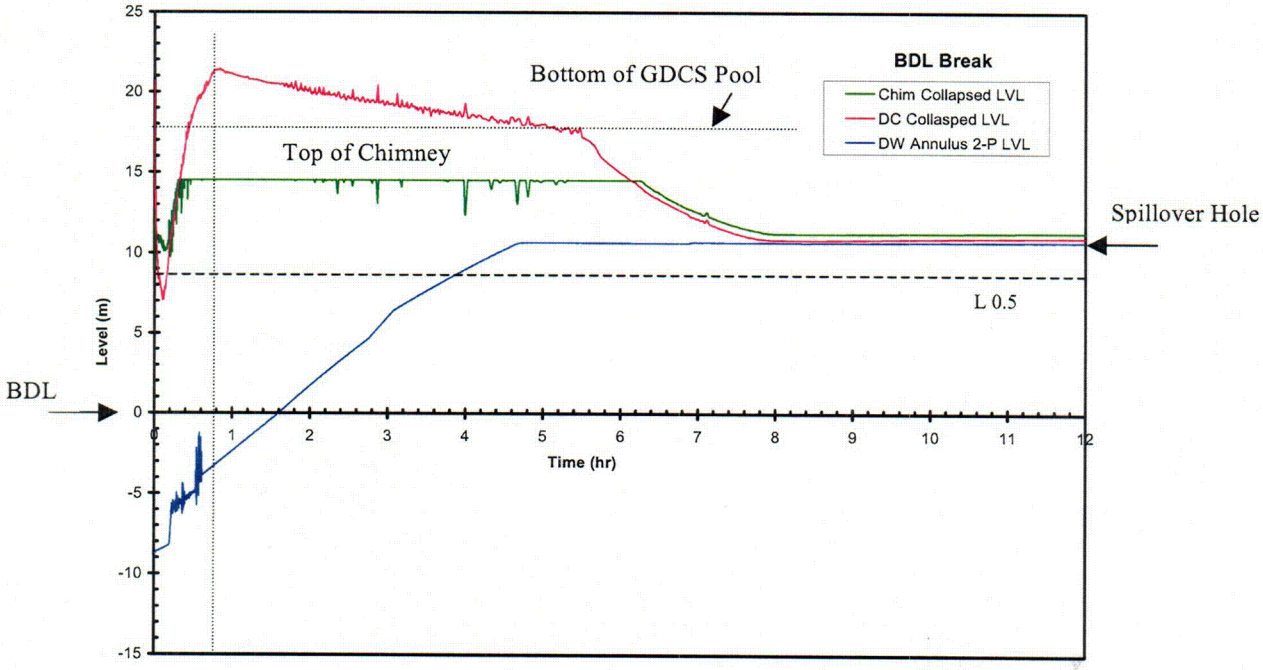

Figure 1: RPV and Drywell Water Levels for BDL Break (12 hours)

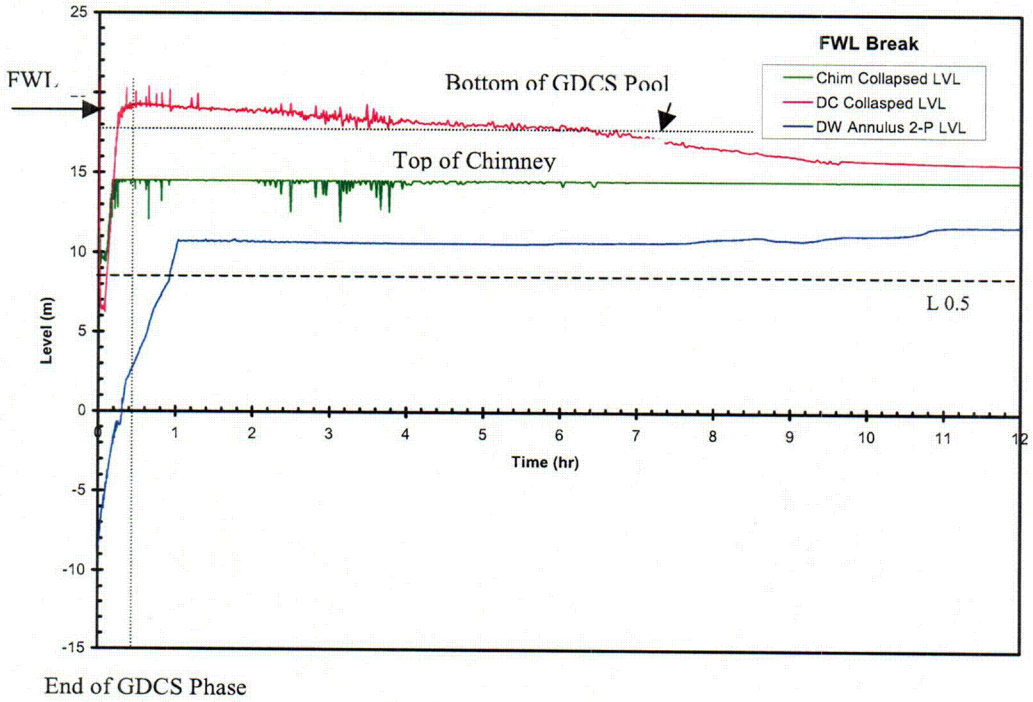

Figure 2: RPV and Drywell Water Levels for FWL Break (12 hours)

C-01

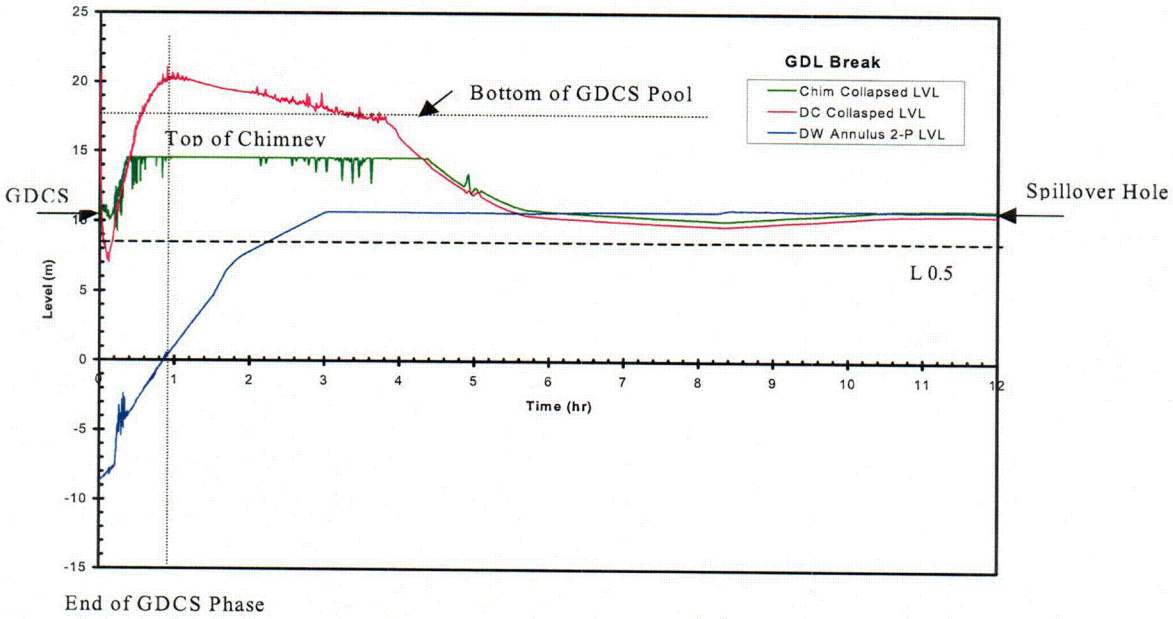

Figure 3: RPV and Drywell Water Levels for GDCS Line Break (12 hours)

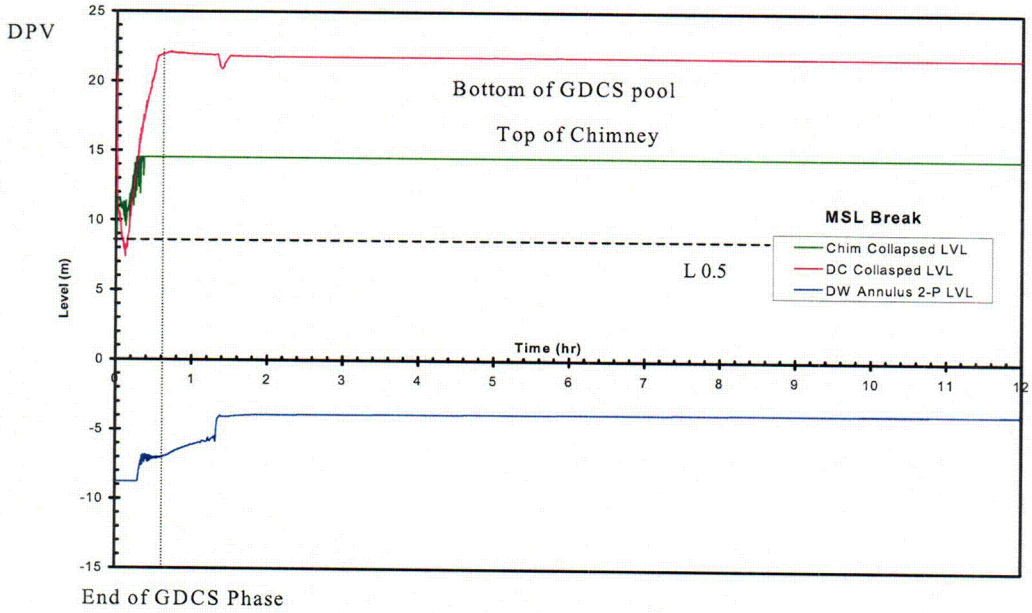

Figure 4: RPV and Drywell Water Levels for MSLB (12 hours)

C-02

ENCLOSURE 3

MFN 06-232

Response to NRC Request for Additional Information

Letter No. 31 Related to ESBWR Design Certification Application

TRACG Application for ESBWR ATWS

RAI Numbers 21.6-5, 21.6-6, 21.6-9, 21.6-33. 21.6-39,

21.6-40, and 21.6-47

Non Proprietary Version

NRC RAI 21.6-5

On Page 5-2, you compare the specific gravity of the injected boron solution to water at 18°C. Is this what you assumed as the temperature of injected solution? If not, what temperature did you assume? Justify this temperature. How does this compare to Technical Specification values for the sodium pentaborate solution tank?

GE Response

The temperature of the injected solution was assumed to be 18°C in all ATWS cases. The room temperature containing the accumulator will be at least 21°C. The sensitivity to SLCS injection temperature is studied using a bounding temperature of 60°C. This temperature represents the maximum design temperature of the squib type valves injecting the boron. Because the peak cladding temperature and the maximum dome pressure occur before the SLCS injection, solution temperature has no effect on those parameters. As shown in Table 21.6.5-1, the increased SLCS injection temperature has no effect on the maximum suppression pool temperature. The ATWS analysis is insensitive to the injection temperature, and thus, the injection temperature will not be affected by Technical Specification Figure 3.1.7-1.

No change to the LTR will be necessary as a result of this RAI.

	Maximum Pool Temperature (K)
Base Case (18°C)	[[ ]]
SLCS Injection Temperature=60°C	[[ ]]

Table 21.6-5-1 Performance of Maximum SLCS Injection Temperature

NRC RAI 21.6-6

You state on Page 5-2 that you assume that the density of the injected solution is approximately 40% higher than the bypass water, what is the sensitivity to the density of the injected solution? Define the allowed range of density differences before the assumptions carried out in the TRACG calculations are no longer valid in relation to Boron mixing and transport. Compare this to the allowed technical specification values for sodium pentaborate solution concentration and temperature.

GE Response

The movement of the SLCS solution through the bypass is calculated in TRACG. Sensitivities to temperature and concentration have been performed. The sensitivity to temperature of the injected solution is small, as shown in the response to RAI 21.6-5. The sensitivity to the concentration is also very small, as demonstrated in the response to RAI 21.6-47. There is no assumption in TRACG that limits the density difference between the SLCS solution and the moderator except for the temperature of the solution. The temperature has been shown to have no effect on the calculation, as shown in the response to RAI 21.6-5. The Technical Specification values for the sodium pentaborate solution concentration and temperature will be defined by the COL applicant and are not defined in the Technical Specification, though the solution will not be impacted by the temperature, as shown in response to RAI 21.6-5.

No change to the LTR will be necessary as a result of this RAI.

NRC RAI 21.6-9

On Page 5-2, you state that "some of the solution could sink into the guide tubes and be lost from the viewpoint of achieving shutdown of the nuclear fission reaction of the core." How is the fraction of solution that leaks into the guide tubes determined? If solution is removed from the active region via this process, how is it accounted for? What is the lost fraction dependent on (i.e. control rod drive (CRD) purge flow rate)? Provide sensitivity analyses that confirm that the lost fraction down the guide tubes is, in fact, very small.

GE Response

Because the velocity calculated at the top of the guide tubes is mostly downwards, no corrections are needed to the TRACG calculations for stratification effects. Boron will be transported into the guide tubes with the bulk liquid with the concentration present in the donor cell at the bottom of the bypass. This boron will accumulate in the guide tubes and eventually leak into the lower plenum, and be carried back up into the core. The base case accounts for the purge flow in the TRACG calculation. To study the effect of the purge flow, a case without the CRD purge flow was run. Both cases resulted in small negative velocities at the top of the guide tubes. The performance of the purge flow case is compared to the base case in Table 21.6-9-1. The mass of boron in the guide tubes is compared for the two cases in Figure 21.6-9-1. The sensitivity to the velocity change is small.

No change to the LTR will be necessary as a result of this RAI.

	Maximum Pool Temperature (K)
Base Case	[[ ]]
Without CRD Purge Flow	[[ ]]

Table 21.6-9-1 Performance of Analysis with no Purge flow

[[

Figure 21.6-9-1 Total Mass of Boron in Guide Tubes

]]

NRC RAI 21.6-33

On Page 5-8, you assume the entrained by-pass liquid will have the same temperature as that in Level 7 in the TRACG model (which is above the SLCS injection point). Provide a plot showing the temperatures in Levels 4, 5, 6 and 7 just prior to the SLCS injection to demonstrate that the axial variation in temperature is not significant. Provide further justification that this value would remain constant until shutdown by boron as the calculated velocity that prevents settling into the lower plenum is based upon a very small temperature difference (2.3°C). Discuss how certain effects such as a reduction in direct moderator heating following the decrease in reactor power from boron mixing, or direct moderator heating of the poison solution impact this result.

GE Response

Figure 21.6-33-1 shows the temperature distribution in Levels 4, 5, 6 and 7 in Ring 3. As can be seen from the figure, the temperatures in Levels 5 and 7 are nearly identical. The Level 5 temperature is [[ ]] and the Level 7 temperature is [[ ]] a negligible difference.

Because the velocities in the CRD tubes and just above the CRD tubes are negative, the settling into the lower plenum is calculated entirely by TRACG. It is demonstrated in response to question 21.6-5 that the analysis is very insensitive to temperature of the poison solution. Reduction in moderator heating would mean a smaller temperature deficit between the poison solution and the moderator, which further prevents settling. No change to the LTR will be necessary as a result of this RAI.

	Temperature (K)
Level 4	[[
Level 5	
Level 6	
Level 7	]]

Figure 21.6-33-1 Temperatures in the bypass prior to SLCS Injection (187 seconds)

NRC RAI 21.6-39

The staff understands that the SLCS injection point (into the bypass) was selected based upon the projected natural circulation patterns during an isolation ATWS. Discuss the mitigation capability of this injection location during non-isolation ATWS events.

GE Response

To address the question of the capability of SLCS injection to power down the reactor during non-ATWS events, the evaluation of boron injected to a normal operating state of the reactor was evaluated. The pool temperature between the injection at normal operation and the base case (an MSIV closure) are compared in Table 21.6-39-1.

The SLCS was injected to a normal water level situation to prove the ability of the boron solution to traverse down the bypass and into the channels at higher water levels. The case shows that the boron is capable of shutting down the core at normal water level in [[ ]] seconds.

The pressure in the normal water level case was assumed to be constant, when in an ATWS event the pressure will drop as the power drops, which will allow additional boron injection.

No change to the LTR will be necessary as a result of this RAI.

	Max Pool Temperature (K)
SLCS Inject to Normal Operation	[[
Base Case	]]

Table 21.6-39-1 Performance of SLCS Capability to Shutdown SLCS Injection to Normal Operation

NRC RAI 21.6-40

Provide a nodalization diagram of the TRACG SLCS modeling. What component is used to model the SLCS? Specifically show how and where (which cells, axially and azimuthally) the SLCS nozzles are connected to the vessel. With the six theta sector TRACG VESSEL model, the user must decide which theta sectors to locate the boron injection. Describe the procedures for selecting these cells. How sensitive is the calculation to the selection of cells where the SLCS injects?

GE Response

A [[ ]] component is used to model the SLCS injection. The SCLS [[ ]] components are connected to the large sector cells in [[ ]] See figures 21.6-40-1 and 2 for diagrams of the location of the SLCS injection [[ ]] components. The calculation is relatively insensitive to the cells selected, as will be demonstrated in response to question 21.6-8.

No change to the LTR will be necessary as a result of this RAI.

[[

]]

Figure 21.6-40-1 Cell Locations of the SLCS FILL Locations

[[

]]

Figure 21.6-40-2 Axial Location of the SLCS FILL Locations

NRC RAI 21.6-47

One of the sensitivity calculations was a 10% reduction in the velocity of the SLCS flow velocity at the nozzle. This has insignificant impact on the shutdown of the ESBWR for an ATWS event. A better way to simulate the loss of boron by settling into the lower plenum and guide tubes would be to reduce the boron concentration by 10%. What is the impact of reducing the boron concentration in the SLCS flow by 10%?

GE Response

The reduction of SLCS concentration by 10% was evaluated with respect to shutdown time and impact on pool temperature. Table 21.6-47-1 compares the performance of the reduced concentration case and the base case. None of the parameters are significantly sensitive to a reduction in boron concentration of 10%.

A case evaluated with natural boron-10, as opposed to 94% enriched boron was evaluated in NEDE-33083P Supplement 2, Section 8.2.2.1. The natural boron case showed no sensitivity to any critical parameter except shutdown time. The natural boron case increased the peak temperature in the suppression pool only [[ ]] takes [[ ]] minutes longer for reactor shutdown from the time of initial SLCS injection for a total of [[ ]] minutes.

No change to the LTR will be necessary as a result of this RAI.

	Maximum Pool Temperature (K)
Base Case (MSIV closure)	[[
Reduction in Boron Concentration	]]

Table 21.6-47-1 Performance of 10% Reduction in Boron Concentration to the MSIV Closure Event

ENCLOSURE 4

MFN 06-232

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 2 of GE letter MFN 06-232, David H. Hinds to NRC, *Response to Portion of NRC Request for Additional Information Letter No. 31 Related to ESBWR Design Certification Application – TRACG Application for ESBWR ATWS – RAI Numbers 21.5-1, 21.6-5, 21.6-6, 21.6-9, 21.6-33. 21.6-39, 21.6-40, and 21.6-47*, dated July 24, 2006. The proprietary information in Enclosure 2, *Response to NRC Request for Additional Information Letter No. 31 Related to ESBWR Design Certification Application – TRACG Application for ESBWR ATWS – RAI Numbers 21.6-5, 21.6-6, 21.6-9, 21.6-33. 21.6-39, 21.6-40, and 21.6-47,* is delineated by a double underline inside double square brackets. Figures and large equation objects are identified with double square brackets before and after the object. In each case, the superscript notation[{3}] refers to Paragraph (3) of this affidavit, which 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, and applied to perform ATWS evaluations for the ESBWR. 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, as they relate to ATWS evaluations for the BWR was achieved at a significant cost, in excess of one quarter million dollars, to GE.

The development of the testing and 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 24th day of July 2006.

George B. Stramback
General Electric Company