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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 07-197

Docket No. 52-010

April 12, 2007

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

Subject: **Response to Portion of NRC Request for Additional Information Letter No. 69 Related to ESBWR Design Certification Application Safety Analysis – RAI Number 15.4-4**

Enclosure 4 contains proprietary information as defined in 10CFR2.390. The affidavit contained in Enclosure 3 identifies the information contained in Enclosure 4 has been handled and classified as proprietary to GE. GE hereby requests that the proprietary information in Enclosure 4 be withheld from public disclosure in accordance with the provisions of 10 CFR 2.390 and 9.17. Enclosure 4 is a proprietary compact disc (CD) containing GE Proprietary Information RWCU Break RADTRAD V3.0.3 Input and Output Deck Files for the Reactor Water Cleanup Unit break dose consequences analyses. A non-proprietary version of these files is not available since the information is entirely proprietary.

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

Sincerely,

James C. Kinsey

James C. Kinsey
Project Manager, ESBWR Licensing

D068

Reference:

1. MFN 06-381, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 69 Related to ESBWR Design Certification Application*, October 11, 2006

Enclosures:

1. MFN 07-197– Response to Portion of NRC Request for Additional Information Letter No. 69 – Safety Analysis – RAI Number 15.4-4 – GE Proprietary Information
2. MFN 07-197 – Response to Portion of NRC Request for Additional Information Letter No. 69 – Safety Analysis – RAI Number 15.4-4 – DCD Markups
3. Affidavit – James C. Kinsey – dated April 12, 2007
4. MFN 07-197 – Response to Portion of NRC Request for Additional Information Letter No. 69 – Safety Analysis – Compact Disc (CD) – RWCU Break RADTRAD v3.0.3 Input and Output Deck Files – GE Proprietary
    a. ESBWR_RWCU_Rev1.rft
    b. ESBWR_RWCU_Rev1_TSEq.nif
    c. ESBWR_RWCU_Rev1_TSEq.o0
    d. ESBWR_RWCU_Rev1_TSEq.psf
    e. ESBWR_RWCU_Rev1_TSMax.nif
    f. ESBWR_RWCU_Rev1_TSMax.o0
    g. ESBWR_RWCU_Rev1_TSMax.psf

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GB Stramback GE/San Jose (with enclosures)
RE Brown GE/Wilmington (with enclosures)
eDRF 0064-8437

MFN 07-197

ENCLOSURE 2

DCD Markups

15.4.9 RWCU/SDC System Line Failure Outside Containment

15.4.9.1 Identification of Causes

To evaluate liquid process line pipe breaks outside containment, the failure of a cleanup water line is assumed to evaluate the response of the plant design to this postulated event. The postulated break of the cleanup water line, representing the most significant liquid reactor coolant line outside containment, provides the envelope evaluation for this type of break. The break is assumed to be instantaneous, circumferential and downstream of the outermost isolation valve.

15.4.9.2 Sequence of Events and Systems Operation

15.4.9.2.1 Sequence of Events

The sequence of events is presented in Table 15.4-20.

15.4.9.2.2 Identification of Operator Actions

Because automatic actuation and operation of the ECCS is a system design basis, no operator actions are required or credited in the radiological consequence analysis. However, the operator should perform the following (shown for informational purposes only):

- determine that a line break has occurred,
- ensure that if vessel water level is below level 3 that reactor has scrammed,
- confirm RWCU/SDC System containment isolation valves closed,
- monitor vessel water level and ensure actuation of ECCS as needed, and
- implement site radiation incident procedures.

These actions occur over an elapsed time of 3–4 hours.

15.4.9.2.3 Systems Operation

It is assumed that the normally operating plant instrument and controls are functioning. Credit is taken for the actuation of the ECCS. The Reactor Protection System, SRVs, ECCS, and safety related functions of the Control Rod Drive system are assumed to function properly to ensure a safe shutdown.

The ESF systems, including the ADS and GDCS, are assumed to operate normally.

15.4.9.3 Core and System Performance

The fuel is covered throughout the transient and there are no pressure or temperature transients sufficient to cause fuel damage.

15.4.9.4 Barrier Performance

Accidents that result in the release of radioactive materials outside the containment are the result of postulated breaches in piping connected to the RCPB or the steam power-conversion system boundary. A break spectrum analysis for the complete range of reactor conditions indicates that the limiting fault event for breaks outside the containment is a complete severance of one of the main steamlines as presented in Subsection 15.4.5. The cleanup water system piping break is less severe than the main steamline break.

15.4.9.5 Radiological Consequences

15.4.9.5.1 General

The NRC provides no specific regulatory guidelines for the evaluation of this accident; therefore, the analysis presented is based upon conservative assumptions considered acceptable to the NRC.

Specific values of parameters used in the evaluation are presented in Table 15.4-21.

15.4.9.5.2 Fission Product Release

There is no fuel damage as a consequence of this accident. The only activity available for release from the break is that which is present in the reactor coolant and RWCU/SDC System downstream components prior to the break.

~~At the initiation of this accident it is assumed that the total non-filtered inventory in both the regenerative and non-regenerative heat exchangers is released through the break. Inventory in the demineralizer is prevented from being released by back-flow check valves from exiting that component. A break on the downstream side of the demineralizer would be bounded due to the demineralizer action compared to a break on the upstream side of the demineralizer.~~

Isolation of the line is conservatively analyzed based upon actuation of the flow differential pressure instrumentation. A total of 46 seconds is allowed for differential flow detection ~~This instrumentation has a built in 45 second~~and time delay prior to initiating containment isolation valve closure~~.so that for the initial 45 seconds of the accident full flow exists through the line.~~ After the initial ~~45~~ 46 seconds ~~flow~~, ~~motor operated~~containment isolation valves close over a period of ~~30~~ 20 seconds. The initial break flow rate is limited to 2218 kg/sec assuming two-phase critical flow for limiting diameter piping inside containment. The initial break flow rate is assumed to remain constant for the initial 50-seconds following the pipe break. The flow rate is assumed to linearly decrease to zero over the subsequent 16-second period. The total break release period for sources inside containment is 66 seconds. ~~During this period of 75 seconds, flow of reactor water is assumed at the maximum equilibrium reactor water concentration, with flashing to steam at reactor temperature and pressure. In addition, iodine spiking is assumed. Noble gas activity in the reactor coolant is negligible and is therefore ignored in this analysis.~~

In addition to the flow of reactor coolant out of the break, the total non-filtered inventory contained in the RWCU/SDC System regenerative and non-regenerative heat exchanger is released. Check valves prevent back flow of inventory from the upstream demineralizer. A break on the downstream side of the demineralizer is bounded by the assumed break location due

to reduced flow, steam flashing, and radionuclide source concentrations downstream of the heat exchangers and demineralizer.

Reactor coolant radionuclide source terms are calculated consistent with Regulatory Guide 1.183 iodine spiking assumptions provided for analyzing consequences of a Main Steam Line Break for a BWR. Noble gas activity in the reactor coolant is negligible and is therefore ignored in this analysis.

A summary of RWCU/SDC System line break accident radiological consequence assumptions are provided in Table 15.4-21.

15.4.9.5.3 Fission Product Transport to the Environment

It is conservatively assumed that the release to the environment is instantaneous, with no iodine plateout. Fission product releases to the environment are presented in Table 15.4-22.

15.4.9.5.4 Assumptions to be Confirmed by the COL Applicant

The assumptions in the radiological analysis that require confirmation by the COL Applicant are documented in Section 15.4.11. ~~The following are assumptions in the radiological analysis that require confirmation by the COL applicant:~~

~~- The initial flow rate for the RWCU/SDC system line break accident is no greater than 8.76E+04 kg/hr.~~

~~- The water masses in the RHX and NRHX are no greater than 3405 kg and 1317 kg, respectively. Applying the assumed flashing fractions (0.279 for RHX and 0.074 for NRHX) to the masses released from the heat exchangers yields a total of 1051 kg coolant flashed to steam.~~

~~- The mass of coolant released from the RHX and NRHX that is flashed to steam is no greater than 1051 kg (flashing fractions of 0.279 for RHX and 0.074 for NRHX are used to determine the total mass of coolant flashed to steam).~~

15.4.9.5.5 Results

The calculated exposures for the analysis are presented in Table 15.4-23 and are less than the regulatory guideline exposures.

15.4.10 Spent Fuel Cask Drop Accident

15.4.11 COL Information

COL Applicants must confirm atmospheric dispersion factors for the following release locations:

- All release points must have an EAB X/Q value of less than or equal to that presented in Table 2.0-1 for all events.
- All release must have a LPZ X/Q values of less than or equal to those presented in Table 2.0-1 for all events.
- Fuel Handling Accident:

- Releases from the Reactor Building or the Fuel Building must have control room air intake X/Q values less than or equal to those presented in Table 2.0-1.

- Loss of Coolant Accident:LOCA analysis assumptions (Subsections 15.4.4.6.1 and 15.4.4.6.2)
  - Releases from the Reactor Building, PCCS Ventilation Stack, and main Condenser must have control room louver X/Q values less than or equal to those presented in Table 2.0-1.
- Main steamline break analysis assumptions (Subsections 15.4.5.5.1 and 15.4.4.5.3) Main Steam Line Break Accident:
  - Releases from the Turbine Building must have control room air intake X/Q values less than or equal to those presented in Table 2.0-1.
- Instrument Line Break Accident:
  - Releases from the Reactor Building must have control room air intake X/Q values less than or equal to those presented in Table 2.0-1.
- Feedwater line break analysis assumptions (Subsection 15.4.7.5.4)
- RWCU/SDC Line Break Accident:
  - Releases from the Reactor Building must have control room normal air intake X/Q values less than or equal to those presented in Table 2.0-1.~~line break analysis assumptions (Subsection 15.4.9.5.4)~~

15.4.12 References

15.4-1 General Electric Co., "Radiological Accident Evaluation - The CONAC04A Code," NEDO-32708, August 1997.

15.4-2 Electric Power Research Institute, "Advanced Light Water Reactor Utility Requirements Document," Volume III.

15.4-3 General Electric Company, "Anticipated Chemical Behavior of Iodine under LOCA Conditions," NEDO-25370, January 1981.

15.4-4 GE Nuclear Energy, "BWROG Report for Increasing MSIV Leakage Rate Limits and Elimination of Leakage Control Systems," NEDC-31858P (GE proprietary), Revision 2, September 1993.

15.4-5 General Electric Company, "Alternatives to Current Procedures Used to Estimate Concentrations in Building Wakes," 21st DOE/NRC Nuclear Air Cleaning Conference, pgs 714-729.

15.4-6 General Electric Company, "Maximum Two-Phase Vessel Blowdown from Pipes," ASME Paper Number 65-WA/HT-1, March 15, 1965.

15.4-7 NUREG/CR-6604, "RADTRAD: A Simplified Model for Radionuclide Transport and Removal and Dose Estimation," USNRC, April 1998.

15.4-8 VTT Energy, "Investigation on Aerosol Deposition in a Heat Exchanger Tube," Jouni Hoklanen, Ari Auvinen, Tommi Renvall, Wolfgang Ludwig, Joma Jokriniemi, VTT Research Report ENE53/46/2000, August 2001.

15.4-9 NUREG/CR-6189, "A Simplified Model of Aerosol Removal by Natural Processes in Reactor Containments," USNRC, July 1996.

15.4-10 ABWR Design Control Document, Section 19E.

15.4-11 NUREG/CR-0009, "Technological Bases for Models of Spray Washout of Airborne Contaminants in Containment Vessels," USNRC, October 1978.

Table 15.4-20

RWCU/SDC System Line Failure Outside Containment Sequence of Events

Sequence of Events	~~Elapsed~~ Time (sec)
Clean up water line break occurs	0
Check valves on clean up water line to feedwater line isolate. Differential pressure instrumentation initiates delay sequence	0+
Differential pressure instrumentation actuates isolation valves	~~4~~56 ~~min~~
Isolation valves complete closure and isolation	~~7~~566 ~~min~~
Normal reactor shutdown and cooldown procedure	1-2 hour
* Core remains covered throughout the transient and no core heatup occurs.	

Table 15.4-21

RWCU/SDS Line Break Accident Parameters

I. Data and assumptions used to estimate source terms	
A. ~~Power level, Mwt~~Fuel Damage	~~4590~~none
B. ~~Number of bundles in core~~Reactor Coolant Activity: Pre-incident Spike Equilibrium Iodine Activity	~~1132~~ 4.0 μCi/g DE I-131 0.2 μCi/g DE I-131
C. ~~Duration of accident, hr~~Water Mass Released, kg (lbm) RPV Coolant Blow-down RWCU/SDC System RHX RWCU/SDC System NRHX	~~< 2~~ 128,650 (283,620) 975 (2150) 3651 (8050)
II. Data and assumptions used to estimate activity released	
A. Water-to-Steam Flashing Fractions RPV Coolant Blow-down RWCU/SDC System RHX RWCU/SDC System NRHX~~Iodine water concentration~~	~~0.2 μCi/g DE I-131~~ 0.38 0.28 0.074
B. Iodine Plateout Fraction, %~~Iodine Spiking~~	0
C. Reactor Building Flow rate, %/hour~~Iodine plateout fraction, %~~	Instantaneous~~0~~
III Dispersion and Dose Data	
A. Meteorology EAB LPZ Control Room Reactor Building Release	 ~~1~~2.00E-03 s/m^3 Table 2.0-1 Table 2.0-1
B. Method of Dose Calculation	RG 1.183~~Ref 15.4-1~~
C. Dose conversion Assumptions	RG 1.183~~ and Ref. 15.4-1~~
D. Activity Inventory/~~releases~~Releases	Table 15.4-22
E. Dose ~~evaluations~~Evaluations	Table 15.4-23

Table 15.4-22

RWCU/SDS Line Break Accident Isotopic Release to Environment

Isotope	Coincident Spike (MBq)	~~Aetivity~~ Pre-incident Spike (MBq)
I-131	1.46E+05	2.92E+06~~1.03E+06~~
I-132	1.38E+06	2.77E+07~~2.09E+06~~
I-133	1.01E+06	2.02E+07~~2.75E+06~~
I-134	2.54E+06	5.09E+07~~3.61E+06~~
I-135	1.42E+06	2.84E+07~~2.84E+06~~
Cs-134	1.68E+03	3.37E+04
Cs-136	1.12E+03	2.24E+04
Cs-137	4.49E+03	8.97E+04
Co-58	8.40E+02	8.40E+02
Co-60	1.63E+03	1.63E+03
Sr-89	6.36E+03	1.27E+05
Sr-90	4.49E+02	8.97E+03
Y-90	4.49E+02	8.97E+03
Sr-91	2.39E+05	4.79E+06
Sr-92	5.61E+05	1.12E+07
Y-91	2.47E+03	4.94E+04
Y-92	3.48E+05	6.95E+06
Y-93	2.39E+05	4.79E+06
Zr-95	4.86E+02	9.72E+03
Nb-95	4.86E+02	9.72E+03
Mo-99	1.23E+05	2.47E+06
Tc-99m	1.23E+05	2.47E+06
Ru-103	1.23E+03	2.47E+04
Ru-106	1.87E+02	3.74E+03
Te-129m	2.47E+03	4.94E+04
Te-131m	5.98E+03	1.20E+05
Te-132	5.98E+02	1.20E+04
Ba-140	2.47E+04	4.94E+05
La-140	2.47E+04	4.94E+05
Ce141	1.87E+03	3.74E+04
Ce-144	1.87E+02	3.74E+03
Np-239	4.86E+05	9.72E+06

Table 15.4-23

RWCU/SDS Line Break Accident Results

Exposure Location and Time Period/Duration	**Maximum Calculated TEDE** (rem)	**Acceptance Criterion TEDE** (rem)
Exclusion Area Boundary (EAB) for the Entire Period of the Radioactive Cloud Passage ~~0.6~~ ~~2.5~~		
Coincident Iodine Spike Case	0.49	2.5
Pre-incident Iodine Spike Case	9.8	25
Outer Boundary of Low Population Zone (LPZ) for the Entire Period of the Radioactive Cloud Passage ~~0.6~~ ~~2.5~~		
Coincident Iodine Spike Case	0.047	2.5
Pre-incident Iodine Spike Case	0.93	25
Control Room Dose for the Duration of the Accident		
Coincident Iodine Spike Case	0.24	5
Pre-incident Iodine Spike Case	4.7	5

ENCLOSURE 3

MFN 07-197

AFFIDAVIT

General Electric Company

AFFIDAVIT

I, James C. Kinsey, state as follows:

(1) I am Project Manager, ESBWR Licensing, General Electric Company ("GE") 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 4 (CD) of GE's letter MFN 07-197, Mr. James C. Kinsey to U.S. Nuclear Regulatory Commission, *MFN 07-197 – Response to Portion of NRC Request for Additional Information Letter No. 69 – Safety Analysis – RAI Number 15.4-4* dated April 12, 2007. The proprietary information is in Enclosure 4 CD label, which is entitled "*MFN 07-197 – Response to Portion of NRC Request for Additional Information Letter No. 69 – Safety Analysis – RAI Number15.4-4 – GE Proprietary Information – RWCU Break RADTRAD v3.0.3 Input and Output Deck Files*" is delineated by a [[dotted underline inside double square brackets.{3}]]:

a. *ESBWR_RWCU_Rev1.rft*
b. *ESBWR_RWCU_Rev1_TSEq.nif*
c. *ESBWR_RWCU_Rev1_TSEq.o0*
d. *ESBWR_RWCU_Rev1_TSEq.psf*
e. *ESBWR_RWCU_Rev1_TSMax.nif*
f. *ESBWR_RWCU_Rev1_TSMax.o0*
g. *ESBWR_RWCU_Rev1_TSMax.psf*

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 or licensee, 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 describes the models and methodologies GE will use in evaluating the dose consequences of design basis accidents (DBAs) for the ESBWR. GE and its partners performed significant additional research and evaluation to develop a basis

for these revised methodologies to be used in evaluating the ESBWR over a period of several years at a cost of over one million dollars.

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 12th day of April 2007.

James C. Kinsey

James C. Kinsey
General Electric Company

ENCLOSURE 4

MFN 07-197

RWCU Break RADTRAD v3.0.3
Input and Output Deck Files

Contains GE Proprietary Information

PROPRIETARY INFORMATION NOTICE

This enclosure contains proprietary information of the General Electric Company (GE) and is furnished in confidence solely for the purpose(s) stated in the transmittal letter. No other use, direct or indirect, of the document or the information it contains is authorized. Furnishing this enclosure does not convey any license, express or implied, to use any patented invention or, except as specified above, any proprietary information of GE disclosed herein or any right to publish or make copies of the enclosure without prior written permission of GE. The proprietary information is in dark red font enclosed within double brackets. [[dotted underline inside double square brackets.{3}]] Each CD contains the designation "GE Proprietary Information." The superscript notation {3} refers to Paragraph (3) of the enclosed affidavit, which provides the basis for the proprietary determination.

[[

a. ESBWR_RWCU_Rev1.rft
b. ESBWR_RWCU_Rev1_TSEq.nif
c. ESBWR_RWCU_Rev1_TSEq.o0
d. ESBWR_RWCU_Rev1_TSEq.psf
e. ESBWR_RWCU_Rev1_TSMax.nif
f. ESBWR_RWCU_Rev1_TSMax.o0
g. ESBWR_RWCU_Rev1_TSMax.psf {3}]]