October 11, 2006

Mr. David H. Hinds, Manager, ESBWR
General Electric Company
P.O. Box 780, M/C L60
Wilmington, NC 28402-0780

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 78 RELATED TO ESBWR DESIGN CERTIFICATION APPLICATION

Dear Mr. Hinds:

By letter dated August 24, 2005, General Electric Company (GE) submitted an application for final design approval and standard design certification of the economic simplified boiling water reactor (ESBWR) standard plant design pursuant to 10 CFR Part 52. The Nuclear Regulatory Commission (NRC) staff is performing a detailed review of this application to enable the staff to reach a conclusion on the safety of the proposed design.

The NRC staff has identified that additional information is needed to continue portions of the review. The staff's request for additional information (RAI) is contained in the enclosures to this letter. Enclosure 1 includes Proprietary Information which is indicated in brackets and underlines. We have prepared a Non-Proprietary version of the RAI (Enclosure 2) that does not contain Proprietary information.

The RAI questions are related to the proprietary topical report NEDE-33179P "Gamma Thermometer System for LPRM Calibration and Power Shape Monitoring," which is referenced in the ESBWR design control document (DCD): RAIs 7.2-5 through 7.2-21 and 7.2-51 through 7.2-64.

To support the review schedule, you are requested to respond to this RAI by November 22, 2006.

If you have any questions or comments concerning this matter, you may contact me at Amy Cubbage at (301) 415-2875 or aec@nrc.gov.

Sincerely,

/RA/

Amy E. Cubbage, Senior Project Manager
ESBWR/ABWR Projects Branch
Division of New Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 52-010

Enclosures: 1. Request for Additional Information (Proprietary)
2. Request for Additional Information (Non-Proprietary)

cc: See next page (w/o enclosure 1)

October 11, 2006

Mr. David H. Hinds, Manager, ESBWR
General Electric Company
P.O. Box 780, M/C L60
Wilmington, NC 28402-0780

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 78 RELATED TO ESBWR DESIGN CERTIFICATION APPLICATION

Dear Mr. Hinds:

By letter dated August 24, 2005, General Electric Company (GE) submitted an application for final design approval and standard design certification of the economic simplified boiling water reactor (ESBWR) standard plant design pursuant to 10 CFR Part 52. The Nuclear Regulatory Commission (NRC) staff is performing a detailed review of this application to enable the staff to reach a conclusion on the safety of the proposed design.

The NRC staff has identified that additional information is needed to continue portions of the review. The staff's request for additional information (RAI) is contained in the enclosures to this letter. Enclosure 1 includes Proprietary Information which is indicated in brackets and underlines. We have prepared a Non-Proprietary version of the RAI (Enclosure 2) that does not contain Proprietary information.

The RAI questions are related to the proprietary topical report NEDE-33179P "Gamma Thermometer System for LPRM Calibration and Power Shape Monitoring," which is referenced in the ESBWR design control document (DCD): RAIs 7.2-5 through 7.2-21 and 7.2-51 through 7.2-64.

To support the review schedule, you are requested to respond to this RAI by November 22, 2006.

If you have any questions or comments concerning this matter, you may contact me at Amy Cubbage at (301) 415-2875 or aec@nrc.gov.

Sincerely,

/RA/

Amy E. Cubbage, Senior Project Manager
ESBWR/ABWR Projects Branch
Division of New Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 52-010

Enclosures: 1. Request for Additional Information (Proprietary)
2. Request for Additional Information (Non-Proprietary)

cc: See next page (w/o enclosure 1)
ACCESSION NO. ML062830265

OFFICE	NESB/PM	NESB/BC(A)
NAME	ACubbage	JColaccino
DATE	10/10/2006	10/11/2006

OFFICIAL RECORD COPY

Distribution for DCD RAI Letter No. 78 dated October 11, 2006

Hard Copy (w/o enclosure 1)
PUBLIC
NESB R/F
JColaccino
ACubbage

E-Mail (w/o enclosure 1)
MGavrilas
ACRS
OGC
SGreen
ACubbage
JGaslevic
LRossbach
LQuinones
MBarillas
TKevern
DAllen
AAttard
PYarsky
BRice
RLandry
HLi

Draft Requests for Additional Information (RAIs)
NEDE-33179P "Gamma Thermometer System for LPRM Calibration and Power Shape Monitoring"

RAI number	Reviewer	Question Summary	Full Text
7.2-5	Yarsky P Rice B	Provide additional descriptive detail of the gamma thermometer design.	Provide additional information for Figure 1-1 of NEDE 33179P, specifically: A. The materials for the jacket tube, core tube, cable pack, heater wire, the thermocouple metals, and the thermocouple medium. B. The radial dimensions for the jacket tube, fill gas, core tube, cable pack, and heater wire C. The axial length of the fill gas D. The position of the hot and cold junctions relative to the fill gas, jacket tube, and heater wire E. The expected range of pressure of the fill gas during normal operation
7.2-6	Yarsky P Rice B	Describe the heater wire and thermocouple medium interface.	Is the heater wire in the gamma thermometer (GT) design electrically insulated from the thermocouple and core tube? Describe the distribution of [[ ] in the cable pack. Provide a qualitative justification for the GT calibration technique in terms of the relative [[ ]].

RAI number	Reviewer	Question Summary	Full Text
7.2-7	Yarsky P Rice B	Describe the electrical heating during GT calibration	What is the relative magnitude of the [[ ]]? Is the heater wire resistance sensitive to irradiation? If so, does the calibration account for changes in resistance?
7.2-8	Yarsky P Rice B	Describe the effect of heater wire current on the GT signal.	Is the thermocouple medium within the cable pack a metal? Does the interface between the heater wire and medium produce a voltage as a result of dissimilar metals? Does the heater wire current during calibration, or possible interface voltages, impact the thermocouple signal?
7.2-9	Yarsky P Rice B	Provide the [[ ]] model.	What code is used to determine the [[ ]]? Describe how the code is used to determine the [[ ]]. Describe the process for correlating these [[ ]]. Does the gamma thermometer respond to gamma radiation emitting from bundles other than [[ ]]? If so, is this factored into the determination of the [[ ]]?
7.2-10	Yarsky P Rice B	Describe [[ ]].	According to NEDE-33179P, Following the [[ ]]? Are these [[ ]] reflected in the application to ESBWR?

RAI number	Reviewer	Question Summary	Full Text
7.2-11	Yarsky P Rice B	Describe [[ ]].	[[ ]]. Provide additional details regarding the calibration procedure in Section 4.4 of NEDE-33179P, particularly [[ ]]. Describe how the [[ ]] is determined. Do the [[ ]] stated in the procedure reflect the envelope of [[ ]]? What [[ ]] is expected for ESBWR? In regards to [[ ]]? Are these criteria based on the [[ ]]?
7.2-12	Yarsky P Rice B	Provide additional information regarding [[ ]] in the fill gas.	What is the primary source of [[ ]]? Qualitatively describe how the [[ ]] reaches an equilibrium or saturated concentration. Do other [[ ]]? If so, do these other [[ ]] have a significant impact on the [[ ]]?
7.2-13	Yarsky P Rice B	Describe the relationship between [[ ]].	Figure 7-3 in NEDE-33179P shows increased [[ ]]. Explain the relationship between [[ ]].

RAI number	Reviewer	Question Summary	Full Text
7.2-14	Yarsky P Rice B	Describe how GTs are used for axial power shape monitoring.	Describe how automatic fixed in-core probes (AFIPs) allow for axial power shape monitoring. Describe any procedural or calculational controls that ensure accurate axial power distribution monitoring. Is it possible to misrepresent the axial power shape within 3D MONICORE for operating power shapes with multiple local axial peaks (for example, double-hump power shapes) based on the proposed adaption techniques?
7.2-15	Yarsky P Rice B	Describe the relationship between [[ ]].	Describe, mathematically, the relationship between the [[ ]]. Describe, mathematically, the relationship between the [[ ]].
7.2-16	Yarsky P Rice B	Describe [[ ]].	In Table 9-6 of NEDE-33179P, additional uncertainties are included for [[ ]]. Describe the procedure used to determine these additional uncertainties. Justify any assumptions made in the calculation of these additional uncertainties.
7.2-17	Yarsky P Rice B	Explain the [[ ]] and [[ ]].	In Table 9-12 of NEDE-33179P, the [[ ]], however, in the preceding paragraph it is stated that the [[ ]]. Explain this [[ ]]. How are power distribution uncertainties accounted for in the determination of the [[ ]]? It is stated that the [[ ]] is based on engineering judgment. Provide a more detailed explanation to justify this criterion.

RAI number	Reviewer	Question Summary	Full Text
7.2-18	Yarsky P Rice B	Explain [[ ]]	Section 5.1 and 5.2 of NEDE-33179P describe [[ ]]. Section 5.1 states that the [[ ]]; section 5.2 states that [[ ]] (as in the ESBWR design, as shown in DCD Tier 2, Revision 1, Section 7.2). Describe how [[ ]] is performed in the ESBWR design.
7.2-19	Yarsky P Rice B	Provide more information regarding the [[ ]].	Section 4.1 of NEDE-33179P states that the [[ ]] is determined during [[ ]] and Section 4.2 states that the [[ ]]. Provide a qualitative discussion of the validity of the [[ ]] given that the [[ ]].
7.2-20	Yarsky P Rice B	Explain the uncertainties in Tables 9-14 and 9-15.	[[ ]] uncertainties are provided in Table 9-14 and 9-15 of NEDE-33179P. Provide more discussion on how these uncertainties are determined. Specifically: A. Explain why [[ ]] percent uncertainty is applied in NEDC-33237P instead of the [[ ]] percent uncertainty shown in Table 9-14. B. Explain the uncertainties for GT sensor arrangements in terms of the uncertainty in [[ ]] and update uncertainty. C. How are [[ ]] (Table 9-14)? [[ ]]; particularly address the difference between LPRM-only adaption versus LPRM with TIP adaption (Table 9-14)? D. Explain the [[ ]] percent uncertainty quoted in Table 9-15 for both [[ ]]. Specifically explain how GT sensor signals were compared to gamma scan data in

RAI number	Reviewer	Question Summary	Full Text
7.2-20 (cont.)			the axial spans between GT sensor locations. Explain the procedure for calculating the axial power distribution and [[ ]] based on the GT sensors, or alternatively, describe how the gamma scan results were compared to the GT sensor indications. E. What is the GT to neutron TIP [[ ]]? Provide greater discussion as to how this value was determined. F. Explain the rationale behind the GT sensor failed uncertainty. G. Do these uncertainties change assuming LPRM adaption versus GT adaption? H. How are the uncertainties in Table 9-13 related to the [[ ]]?
7.2-65	Rice B Yarsky P	Discuss the [[ ]].	Provide the basis for the [[ ]] and the [[ ]]. Specifically address any anticipated operational occurrences (AOOs) or accident conditions which could lead to [[ ]] that exceed the range. For any conditions in which these values are exceeded, discuss the instrument response. What is the limit for the highest [[ ]] where a GT would fail to produce a signal indicative of the local power?

RAI number	Reviewer	Question Summary	Full Text
7.2-51	Yarsky P Rice B Attard A	Explain the Gamma Thermometer [[ ]]	Explain the [[ ]]. With only [[ ]], discuss the [[ ]]. Explain the treatment of uncertainty arising from this [[ ]]. Discuss the advantages of either [[ ]]. Is [[ ]] necessary when the number of [[ ]]? Include this information in NEDE-33179P (the LTR).
7.2-52	Yarsky P Rice B Attard A	Describe the influence of fuel spacers	Describe the influence of fuel spacers on gamma thermometer signals. Explain how the presence, or absence, of spacers near GT locations is accounted for. If no such compensation exists in the modeling, discuss any influences the spacers have on gamma flux indication, and subsequent uncertainties [[ ]]. Include this information in the LTR.
7.2-53	Yarsky P Rice B Attard A	Explain the [[ ]]	The [[ ]] are combined such that [[ ]] in the model, and subsequently to perform [[ ]]. Describe how these [[ ]] are determined. Are they a function of [[ ]]? Explain the terms in the calculated signal that are related to the [[ ]]. Why are these terms based on the [[ ]]? How are these [[ ]] determined given that the nature of this calculation is [[ ]]? How are the uncertainties in the calculation of the [[ ]] captured in the uncertainty analysis? Include this information in the LTR.

RAI number	Reviewer	Question Summary	Full Text
7.2-54	Yarsky P Rice B Attard A	Discuss the gamma thermometers and [[ ]]	How does the use of GT indications reduce [[ ]] in Table 9-15 for the [[ ]] determination? Include this information in the LTR.
7.2-55	Yarsky P Rice B Attard A	Does [[ ]] include controls for changes to [[ ]]?	Are there any controls, statistical or otherwise, within PANACEA for allowable changes to the [[ ]] based on [[ ]]?
7.2-56	Yarsky P Rice B Attard A	Does the [[ ]] change over exposure?	Discuss the preferred [[ ]] for the control rod patterns of beginning of cycle (BOC0, middle of cycle (MOC), and end of cycle (EOC) based on their influence on [[ ]]. Are there any controls in place, administrative or calculational, to ensure the preferred technique is used given the [[ ]]?
7.2-57	Yarsky P Rice B Attard A	Describe the impact of gamma streaming.	Discuss the influence of gamma streaming through fuel bundles (i.e. between fuel rods through the inter-pin water or steam) on gamma indication from [[ ]]. Include this information in the LTR.

RAI number	Reviewer	Question Summary	Full Text
7.2-58	Yarsky P Rice B Attard A	Describe GT [[ ]].	Describe the procedure for calculating the [[ ]]. Provide the data used to make this determination. Justify the applicability of this value given that it is based on [[ ]]. Provide additional information regarding the cycle specific adaption employed during any [[ ]], and describe the influence of [[ ]]. If available provide comparisons of [[ ]] to justify that this uncertainty is not dependent on the [[ ]]. Provide additional descriptive detail explaining the unexpected results shown in Table 9-13. Specifically explain the nature of the [[ ]], as well as the calculations that were performed (in [[ ]] as well as using statistical analysis) to determine the observed difference. Explain why the [[ ]] is lower than any values shown in Table 9-13. Include this information in the LTR.
7.2-59	Yarsky P Rice B Attard A	Provide the reference for [[ ]].	Provide the reference for the [[ ]] shown in Table 4-1 of NEDE-33179P. If these values were measured or calculated provide details of these measurements or calculations. Include this information in the LTR.
7.2-60	Yarsky P Rice B Attard A	Explain [[ ]].	Figures 8-1 through 8-4 show [[ ]], in Figures 8-3 and 8-4, the areas beneath the curves do not appear the same, explain why the [[ ]] appears consistently larger than the [[ ]].
7.2-61	Yarsky P Rice B Attard A	What is the GT lifetime?	How often must GT instruments be replaced? How is this replacement frequency determined?

RAI number	Reviewer	Question Summary	Full Text
7.2-62	Yarsky P Rice B Attard A	Justify [[ ]].	Section 7.2.5.1 refers to [[ ]]. Provide these [[ ]] and the methods used to determine them. Justify why these [[ ]]. If different [[ ]] will be applied for the ESBWR, provide these as well, and justify why those [[ ]] are suitable.
7.2-63	Yarsky P Rice B Attard A	Explain the GT [[ ]].	Justify all assumptions made to determine the [[ ]]. Provide additional justification in light of the [[ ]]. List the physical phenomena that affect [[ ]] and compare the relevant operating conditions at [[ ]], and the expected conditions for the ESBWR.
7.2-64	Yarsky P Rice B Attard A	Describe [[ ]].	In the comparisons of [ ]], provide additional descriptive details of how the [[ ]] were calculated. Provide details of which [[ ]] were employed, including any [[ ]]. Describe the [[ ]] used in 3D MONICORE for these calculations. Which version of [[ ]] is being used to perform these calculations? How are GT signals processed within this version of [[ ]]?

ESBWR Mailing List

cc:

Mr. David H. Hinds, Manager
ESBWR
P.O. Box 780, M/C L60
Wilmington, NC 28402-0780

Mr. George B. Stramback
Manager, Regulatory Services
GE Nuclear Energy
1989 Little Orchard Street, M/C 747
San Jose, CA 95125

Mr. David Lochbaum, Nuclear Safety Engineer
Union of Concerned Scientists
1707 H Street, NW., Suite 600
Washington, DC 20006-3919

Mr. Paul Gunter
Nuclear Information & Resource Service
1424 16th Street, NW, Suite 404
Washington, DC 20036

Mr. James Riccio
Greenpeace
702 H Street, Suite 300
Washington, DC 20001

Mr. Adrian Heymer
Nuclear Energy Institute
Suite 400
1776 I Street, NW
Washington, DC 20006-3708

Mr. Paul Leventhal
Nuclear Control Institute
1000 Connecticut Avenue, NW
Suite 410
Washington, DC 20036

Mr. Ron Simard
6170 Masters Club Drive
Suwanne, GA 30024

Mr. Brendan Hoffman
Research Associate on Nuclear Energy and Environmental Program
215 Pennsylvania Avenue, SE
Washington, DC 20003

Mr, Jay M. Gutierrez
Morgan, Lewis & Bockius, LLP
1111 Pennsylvania Avenue, NW
Washington, DC 20004

Mr. Glenn H. Archinoff
AECL Technologies
481 North Frederick Avenue
Suite 405
Gaithersburg, MD 20877

Mr. Gary Wright, Director
Division of Nuclear Facility Safety
Illinois Emergency Management Agency
1035 Outer Park Drive
Springfield, IL 62704

Mr. Charles Brinkman
Westinghouse Electric Co.
Washington Operations
12300 Twinbrook Pkwy., Suite 330
Rockville, MD 20852

Mr. Ronald P. Vijuk
Manager of Passive Plant Engineering
AP1000 Project
Westinghouse Electric Company
P. O. Box 355
Pittsburgh, PA 15230-0355

Mr. Ed Wallace, General Manager
Projects
PBMR Pty LTD
PO Box 9396
Centurion 0046
Republic of South Africa

Mr. Russell Bell
Nuclear Energy Institute
Suite 400
1776 I Street, NW
Washington, DC 20006-3708

Ms. Sandra Sloan
Areva NP, Inc.
3315 Old Forest Road
P.O. Box 10935
Lynchburg, VA 24506-0935

Mr. Robert E. Sweeney
IBEX ESI
4641 Montgomery Avenue
Suite 350
Bethesda, MD 20814

Mr. Eugene S. Grecheck
Vice President, Nuclear Support Services
Dominion Energy, Inc.
5000 Dominion Blvd.
Glen Allen, VA 23060

Mr. George A. Zinke
Manager, Project Management
Nuclear Business Development
Entergy Nuclear, M-ECH-683
1340 Echelon Parkway
Jackson, MS 39213

E-Mail:
tom.miller@hq.doe.gov or
tom.miller@ nuclear.energy.gov
sfrantz@morganlewis.com
ksutton@morganlewis.com
jgutierrez@morganlewis.com
mwetterhahn@winston.com
whorin@winston.com
gcesare@enercon.com
jerald.holm@framatome-anp.com
erg-xl@cox.net
joseph_hegner@dom.com
mark.beaumont@wsms.com
steven.hucik@ge.com
patriciaL.campbell@ge.com
bob.brown@ge.com
david.hinds@ge.com
chris.maslak@ge.com
James1.Beard@ge.com
kathy.sedney@ge.com
mgiles@entergy.com
tansel.selekler@nuclear.energy.gov or
tansel.selekler@hq.doe.gov
Frostie.white@ge.com
David.piepmeyer@ge.com
george.stramback@gene.ge.com