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MFN 05-014

Project 717

February 22, 2005

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20852-2738

Subject: GE Responses to NRC Request for Additional Information Related to NEDE-33083P, Supplement 1, "TRACG Application for ESBWR Stability Analysis"

In the referenced letter, the NRC indicated that additional information was necessary to continue its review of the subject topical report. This request for additional information (RAI) covered the areas of additional calculations, additional data from existing calculations and additional ESBWR design information. GE's responses to RAIs 4 through 8 are provided in the Enclosure 2 CD containing proprietary information. GE's response to RAIs 1 through 3 involves additional calculations and will be provided in approximately two weeks.

Enclosure 2 contains GE proprietary information as defined by 10 CFR 2.390. Non proprietary information also is included in order to form a complete package. The proprietary information is contained in the following files:

MFN 05-014 2D&3D Power Dist.xls
MFN 05-014 Harmonic Shape.xls
MFN 05-014 Channel Data.xls
MFN 05-014 Data for DR figures.xls

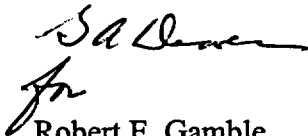
GE customarily maintains this information in confidence and withholds it from public disclosure. A non proprietary version of Enclosure 2 is provided in Enclosure 1.

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

If you have any questions about the information provided here, please contact Bharat Shiralkar at 408-925-6889 (Bharat.Shiralkar@ge.com) or myself.

Sincerely,



Robert E. Gamble
Manager, ESBWR

Reference:

MFN 05-008, Letter from U.S. Nuclear Regulatory Commission to Robert E. Gamble, *Request for Additional Information Letter No. 1 Related to NEDE-33083P, Supplement 1, "TRACG Application for ESBWR Stability Analysis,"* February 3, 2005

Enclosures:

1. MFN 05-014 – NEDE-33083P, Supplement 1, "TRACG Application for ESBWR Stability Analysis" GE Responses to RAIs 4 through 8 – Non Proprietary
2. MFN 05-014 – NEDE-33083P, Supplement 1, "TRACG Application for ESBWR Stability Analysis" GE Responses to RAIs 4 through 8 (MFN 05-014 Enclosure 2.pdf (non proprietary), MFN 05-014 2D&3D Power Dist.xls, MFN 05-014 Harmonic Shape.xls, MFN 05-014 Channel Data.xls, MFN 05-014 Data for DR figures.xls) – GE Proprietary Information
3. Affidavit, George B. Stramback, dated February 22, 2005

cc:	WD Beckner	USNRC (w/o enclosures)
	AE Cabbage	USNRC (with enclosures)
	MB Fields	USNRC (with enclosures)
	GB Stramback	GE (with enclosures)
	BS Shiralkar	GE (with enclosures)

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Enclosure 1

ENCLOSURE 1

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**NEDE-33083P, Supplement 1, "TRACG Application for
ESBWR Stability Analysis"
GE Responses to RAIs 4 through 8**

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Enclosure 1

**Responses to Requests for Additional Information
NEDE-33083P, Supplement 1 "TRACG Application for ESBWR Stability Calculation"**

Requests for Additional Data from Existing Calculations

4. 3D Power Distribution

Please provide the 2D (channel powers) and 3D power distributions for BOC, middle of cycle (MOC), and end of cycle (EOC) in electronic format.

GE Response:

The 2D and 3D power distributions for BOC, MOC and EOC are contained in file MFN 05-014 2D&3D Power Dist.xls on the enclosed CD.

5. Subcritical Mode Power Distribution

Please provide the 2D and 3D power distributions for the calculation shown in Figure 8.1-5 of the first subcritical mode at BOC conditions in electronic format. Also, please provide a short description of the calculation tools used for this calculation.

GE Response:

The 2D and 3D power distributions for the first harmonic mode (Figure 8.1-5) are contained in the file: MFN 05-014 Harmonic Shape.xls on the enclosed CD.

A description of calculational tool for the calculation of the harmonic flux shapes is provided below:

Calculation of Harmonic Modes of the Neutron Flux Distribution

The HARMONICS module in PANAC11 has been developed to support the analysis of BWR stability. The module has the ability to generate harmonic modes of the neutron flux distribution. The method used is based on the well-known Gram-Schmidt orthogonalization process. Let A represent the diffusion operator and let ϕ_i be the i -th eigenfunction of the diffusion operator corresponding to the eigenvalue λ_i . Then,

$$A\phi_i = \lambda_i\phi_i \quad \text{Eq. (1)}$$

The eigenfunctions of this operator form a complete orthonormal set. Therefore,

$$\langle \phi_i, \phi_j \rangle = \delta_{ij} \quad \text{Eq. (2)}$$

For this solution, the inner product is defined as the summation over all nodes in the core. This is not strictly correct, since it does not account for the spatial variation of the flux within each node, but it does a very good approximation. Any function, ψ , may be expanded in terms of ϕ_i as

$$\psi = \sum_{i=0}^N a_i \phi_i, \quad \text{Eq. (3)}$$

$$= \sum_{i=0}^N \langle \phi_i, \psi \rangle \phi_i \quad \text{Eq. (4)}$$

Suppose that the eigenfunctions are ordered such that:

$$\lambda_0 > \lambda_1 \geq \lambda_2 \geq \dots \geq \lambda_i \geq \dots \quad \text{Eq. (5)}$$

ϕ_0 then represents the fundamental mode, which may be determined by the "power" iteration method. The power iteration method may also be used to find the first harmonic, provided that the initial iterate contains a component of the first harmonic and provided that at the end of each iteration, all traces of the fundamental mode are removed. The first requirement is met by choosing a random distribution as the initial guess:

$$\psi^0 = \bar{\phi}_0 (R-1/2) \quad \text{Eq. (6)}$$

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where $\bar{\phi}_0$ is the average of the fundamental mode over the entire core and R is a random distribution of numbers between zero and one. The second requirement is met by subtracting the fundamental mode flux from the n -th iteration as follows:

$$\tilde{\psi}^n = \psi^n - \frac{\langle \phi_0, \psi^n \rangle}{\langle \phi_0, \phi_0 \rangle} \phi_0 \quad \text{Eq. (7)}$$

The division by $\langle \phi_0, \phi_0 \rangle$ assures proper normalization during the process. This iterative procedure converges albeit slowly. Studies have shown that the L_2 norm of the residuals given by

$$\left[\frac{1}{N} \langle \varphi_i^n - \varphi_i^{n-1}, \varphi_i^n - \varphi_i^{n-1} \rangle \right]^{1/2} \quad \text{Eq. (8)}$$

is more effective as the convergence criterion than the usual convergence parameter:

$$\text{Max}_i(\varphi_i^n / \varphi_i^{n-1}) - \text{Min}_i(\varphi_i^n / \varphi_i^{n-1}) \quad \text{Eq. (9)}$$

Calculation of the higher harmonics proceeds in a similar way, except that all previous harmonics must be subtracted after each iteration. For the m -th harmonic:

$$\tilde{\psi}^n = \psi^n - \sum_{i=0}^{m-1} \frac{\langle \phi_i, \psi^n \rangle}{\langle \phi_i, \phi_i \rangle} \phi_i \quad \text{Eq. 10)}$$

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6. Pressure Drops

Please provide the pressure drop and void fraction as function of elevation for BOC conditions. Provide it at least for a hot channel and an average channel along with their power and flow conditions.

GE Response:

The pressure drop and void fraction profiles for hot and average power channels are contained in the file : MFN 05-014 Channel Data.xls on the enclosed CD

7. TRACG Time Traces

Please provide the time trace data for Figures 8.1-8 through 11, and 8.1-19 through 20 in electronic format.

GE Response:

The time trace data for the requested figures are contained in the file: MFN 05-014 Data for DR figures.xls on the enclosed CD

Request for ESBWR Design Information:

8. ESBWR Design Parameters

Please provide the following ESBWR design parameters:

(Table is not repeated here)

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GE Response:

The requested information is provided in the table below.

Parameter	Units	Value
Number of fuel rods per bundle		92
Channel height (in heated length)	cm	304.8
Heat transfer area per unit axial length	cm	296.59 (lower part), 251.46 (above PLR)
Channel flow area	cm ²	91.59 (lower part); 103.34 (above PLR)
Hydraulic diameter	cm	1.00 (lower part), 1.29 (above PLR)
Density of the fuel	g/cm ³	10.40
Fuel pellet diameter	cm	0.8763
Cladding heat capacity	cal/cm ³ . °C	0.502 @ 277 °C
Cladding thermal conductivity	cal/cm. s. °C	0.0379 @ 277 °C
Cladding thickness	cm	0.066
Gap heat transfer coefficient	cal/cm ² .s. °C	0.10 to 0.24
Gap width	cm	0.00889

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Enclosure 3

ENCLOSURE 3

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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 05-014, Robert E. Gamble to NRC, *GE Responses to NRC Request for Additional Information Related to NEDE-33083P, Supplement 1, "TRACG Application for ESBWR Stability Analysis,"* dated February 22, 2005. The proprietary information is contained in the "xls" files in Enclosure 2 (CD), *NEDE-33083P, Supplement 1, "TRACG Application for ESBWR Stability Analysis" GE Responses to RAIs 4 through 8 (MFN 05-014 Enclosure 2.pdf (non proprietary), MFN 05-014 2D&3D Power Dist.xls, MFN 05-014 Harmonic Shape.xls, MFN 05-014 Channel Data.xls, MFN 05-014 Data for DR figures.xls)*. The CD is identified by the marking "GE Proprietary Information" on the label. However, due to the nature of the data files contained on the CD, it is not possible to mark each file with the designation, "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 analytical models, methods and processes, including computer codes, which GE has developed, and applied to perform stability evaluations using the TRACG code for the BWR. GE has developed this TRACG code for over fifteen years, at a total cost in excess of three 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.

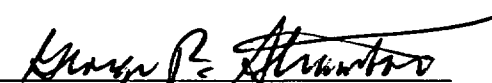
The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

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 22nd day of February 2005


George B. Stramback
General Electric Company

ENCLOSURE 2

MFN 05-014

NEDE-33083P, Supplement 1, “TRACG Application for ESBWR Stability Analysis”

GE Responses to RAIs 4 through 8

(MFN 05-014 Enclosure 2.pdf (non proprietary), MFN 05-014 2D&3D Power Dist.xls,
MFN 05-014 Harmonic Shape.xls, MFN 05-014 Channel Data.xls,
MFN 05-014 Data for DR figures.xls)

GE Company Proprietary

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. Each page in this enclosure that contains proprietary information carries the notation “GE Proprietary Information.” Paragraph (3) of the affidavit provided in Enclosure 3, documents the basis for the proprietary determination.