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MFN 04-023 Project 717

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

Attention: Chief, Information Management Branch
Program Management
Policy Development and Analysis Staff

Subject: **Response to Requests for Additional Information (RAIs) Related to TRACG Calculations for the GDCS Line Break**

During discussions with the NRC, two questions have arisen related to the TRACG calculation of the GDCS line break. We have designated these questions as RAI A1 and RAI A2. Responses to these RAIs are contained in Enclosures 1 and 2

Enclosure 1 contains the responses with GE proprietary information as defined by 10CFR2.790. GE customarily maintains this information in confidence and withholds it from public disclosure. A non-proprietary version of the responses is provided in Enclosure 2.

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 2.790 and 9.17.

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

Sincerely,

Robert E. Gamble
Manager, ESBWR

Enclosures:

1. MFN 04-023 – RAIs A1 and A2 - TRACG Calculations for the GDCS Line Break - Proprietary Information
2. MFN 04-023 - RAIs A1 and A2 - TRACG Calculations for the GDCS Line Break - Non-proprietary Information
3. Affidavit, George B. Stramback, dated March 3, 2004

cc: A. Cubbage USNRC (with enclosures)
J. Lyons USNRC (w/o enclosure)
G.B. Stramback - GE (with enclosures)

ENCLOSURE 2

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RAIs A1 and A2
TRACG Calculations for GDCS Line Break

MFN 04-023
Enclosure 2

Responses to Additional RAIs on TRACG Calculations for GDCS Line Break

RAI-A1:
Explain the sudden increase in break flow observed in the TRACG calculation of the GDCS line break at about 540 s (see Figure A-1.1).

Response:
The TRACG calculation for the GDCS line break was performed with just one cell representing the broken GDCS line between the reactor pressure vessel (RPV) and the break location. This cell also accounted for the change in cross-sectional area of the pipe from the area of the venturi throat at the RPV nozzle to the full area of the GDCS line (as shown in the inset figure A-1.1). While this representation was adequate for the early transient, it introduced distortions at low pressure. At about 540 s into the transient, the minimum area at the venturi became unchoked, resulting in a shift to Bernoulli flow at the larger exit flow area. This caused a sudden increase in the break flow. This change was exaggerated by the single cell nodalization.

Normal practice for LOCA calculations is to use several cells (typically [[ ]]) for the break pipe. A second calculation was made in which the break pipe was nodalized into [[ ]] cells. The cross-sectional area of these cells was kept constant, equal to the area of the venturi throat. The results are plotted in Figure A-1.2. It can be seen that there is no longer a sudden change in the flow at 540 s. The drop in flow at 600 s, which is common to both calculations, is due to the two-phase level in the downcomer falling to the elevation of the break. The impact of using the [[ ]] break pipe on the minimum collapsed level in the chimney was [[ ]]m, relative to the greater than 2 m margin to core uncovery. Figure A-1.3 shows a comparison of the break flow for the two cases ([[ ]] break pipes). This shows clearly that the sudden increase in break flow in the original calculation is an artifact of the coarse nodalization used.

The calculations for the Safety Analysis Report will be performed with a detailed nodalization of the break region, with at least [[ ]] cells. A break nodalization sensitivity study will also be performed to justify the adequacy of the nodalization used.

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RAI A-2:
In the TRACG calculation of the GDCS line break LOCA (see below), the level in the chimney was oscillating significantly, followed by a sudden jump. Is this physical?
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Response:
The oscillations in the chimney level were present in the time period from 900 to 1400 s. During this time period, GDCS water is refilling the core and chimney through the downcomer and lower plenum. Quenching of voids in the core results in an increased static head inside the shroud. Consequently, the flow from the downcomer is reduced. After a transport delay, the void fraction in the core and chimney increases slightly because of the reduced flow. The reduction in static head in the core and chimney produces an increase in the flow from the downcomer, completing a cycle of manometric oscillation between the core/chimney and downcomer. The TRACE calculation also shows oscillatory behavior in this time period.

The TRACG model of the chimney consists of three rings. The plot shown above is for the central ring with the high power bundles. The transient responses of the collapsed level in the chimney for the three rings and for the downcomer are shown in Figures A-2.1 through A-2.4. There are effectively three parallel paths between the downcomer and the core/chimney regions. The oscillations are most noticeable in the central chimney ring, which has the smallest area and the highest power bundles.

As stated above, the oscillations are physical and not numerical in origin. Figure A-2.5 shows details of a 100 second period between 1000 to 1100 s. The mass flow rates in the Ring 1 chimney region are plotted at different elevations. The time period for these manometric oscillations is of the order of 6-7 s, which is reasonable for these U-tube oscillations. Numerical oscillations would have a time period of the order of two time steps (much less than 1 s). During this time period, the chimney is filling up and the average level in the chimney is below the top. Thus, the mass flux at the exit is zero for the most part with the exception of a few oscillation peaks that result in flow out the top of the chimney.

Later in the transient, the two-phase level in the chimney rises above the top of the partitions and the oscillations in the chimney levels are significantly reduced. As the downcomer level rises still further, the pressure drop imposed on the chimney increases. [[

]]. Rings 2 and 3 are not as significantly affected by flow regime transitions and have a smoother response.

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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 04-023, Robert E. Gamble to NRC, *Response to Requests for Additional Information (RAIs) Related to TRACG Calculations for the GDCS Line Break,* dated March 3, 2004. The proprietary information is in Enclosure 1, *RAIs A1 and A2 – TRACG Calculations for GDCS Line Break.* For text and text contained in tables, GE proprietary information is identified 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 2.790 (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 details for licensing application of TRACG to the ESBWR passive safety system design of the BWR. This TRACG code has been developed by GE 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 the ESBWR, was achieved at a significant cost, 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 3rd day of March 2004

George B. Stramback
General Electric Company