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MFN 04-109

Project 717

October 8, 2004

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: **Demonstration Calculations for ESBWR AOOs**

Enclosure 1 to this letter contains nominal calculations for three Anticipated Operational Occurrences (AOOs) for the current ESBWR core design. These calculations for generator load rejection with failure of all bypass valves to open (LRNB); feedwater controller failure at maximum demand (FWCF); and closure of all main steamline isolation valves (MSIVF) replace the corresponding calculations in Section 4.7, "Demonstration Calculations for ESBWR AOOs," of NEDC-33083P, "TRACG Application for ESBWR," (Reference 1). This submittal completes the information needed for the review of the use of TRACG for AOOs. The remainder of the information is contained in NEDC-33083P, and the TRACG Model Description (NEDE-32176P) and TRACG Qualification (NEDE-32177P) reports previously submitted to the NRC (References 2 and 3).

To summarize, GE plans to use the approach approved for operating BWRs for the analysis of ESBWR AOOs. GE will follow the CSAU methodology as for operating BWRs. NEDC-33083P documents the licensing requirements and scope of application, conformance with CSAU, event scenarios and PIRTs for AOOs in Sections 4.1 and 4.2. The applicability of the TRACG models and the assessment matrix are reviewed in Section 4.3. Model uncertainties and biases are discussed in Section 4.4. Application

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uncertainties and biases are covered in Section 4.5. Section 4.6 covers the combination of uncertainties. Nominal calculations for the limiting pressurization events are provided in Enclosure 1 and replace the previous calculations in Section 4.7.

GE is seeking NRC concurrence that the TRACG application methodology approved for operating BWRs can be applied for the ESBWR AOOs with the uncertainties and biases discussed in NEDC-33083P. The nominal ESBWR calculations provide assurance that the AOOs for the ESBWR have responses similar to operating BWRs. GE will perform detailed analysis of the AOOs using the statistical methodology described in NEDC-33083P for the design certification submittal.

Enclosure 1 contains GE proprietary information as defined by 10 CFR 2.390. A non-proprietary version is provided in Enclosure 2. GE customarily maintains this information in confidence and withholds it from public disclosure.

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 2.390 and 9.17.

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

Sincerely,

Robert E. Gamble
Manager, ESBWR

References:

1. MFN 02-090, Letter from C.J. Deacon to U.S. Nuclear Regulatory Commission, *TRACG Application for ESBWR, NEDC-33083P – Document Transmittal for Pre-Application Review of ESBWR*, November 19, 2002
2. MFN 99-040, Letter from James F. Klapproth to U.S. Nuclear Regulatory Commission, *Transmittal of GE Proprietary Licensing Topical Report NEDE-32176P, "TRACG Model Description," Revision 2, dated December 1999,* December 15, 1999
3. MFN 00-002, Letter from James F. Klapproth to U.S. Nuclear Regulatory Commission, *Transmittal of GE Proprietary Licensing Topical Report NEDE-32177P/R2, "TRACG Qualification," Revision 2, dated January 2000,* January 31, 2000

Enclosures:

1. MFN 04-109 – Demonstration Calculations for ESBWR AOOs - GE Proprietary Information
2. MFN 04-109 – Demonstration Calculations for ESBWR AOOs – Non Proprietary
3. Affidavit, George B. Stramback, dated October 8, 2004

cc: AE Cubbage USNRC (with enclosures)
WD Beckner USNRC (w/o enclosures)
GB Stramback - GE (with enclosures)
eDRF 0000-0020-6471

ENCLOSURE 1

MFN 04-109

Demonstration Calculations for ESBWR AOOs

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. The header of each page in this enclosure carries the notation "GE Proprietary Information."

GE proprietary information is identified by a double underline inside double square brackets. [[This sentence is an example.{3}]] 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 the affidavit provided in Enclosure 3, which documents the basis for the proprietary determination. Specific information that is not so marked is not GE proprietary.

ENCLOSURE 2

MFN 04-109

Demonstration Calculations for ESBWR AOOs

4.7 Demonstration Calculations for ESBWR AOOs

The analyses provided in this Section form the bases for application of TRACG to ESBWR AOOs. TRACG performance is demonstrated on one or more limiting licensing basis events for the scenarios specified in Section 4.2.1. This demonstration includes baseline TRACG analysis for a representative core. Statistical calculations for the various limiting AOOs will be performed for the ESBWR Design Control Document utilizing the process described in Section 4.6.

4.7.1 Baseline Analysis

A baseline analysis was performed for three pressurization event scenarios. Pressurization transients are the most limiting ΔCPR transients for the ESBWR. These are sample calculations performed with a preliminary core design for the ESBWR to illustrate the plant response to the transients. The core analyzed had 1132 bundles with a 10 ft active core height and a rated thermal power of 4500 MWth. The plant is loaded with an equilibrium core made up of GE14 10x10 fuel. The core has an N-lattice with the standard ABWR control blade design. The vessel modeling is illustrated in Figure 2.7-1. [[

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The following pressurization events were analyzed with this model:

1. Generator load rejection with failure of all bypass valves to open (LRNB)
2. Feedwater controller failure to maximum flow (168% of rated) (FWCF)
3. Closure of all Main Steamline Isolation Valves (MSIV)

4.7.1.1 Load Rejection No Bypass (LRNB) Baseline Analysis

The LRNB event trips the turbine and initiates a fast closure of the turbine valves. The sudden closure of the valves causes a rapid pressurization of the steam lines and reactor vessel, resulting in a rapid power excursion. The event is heightened by the assumed failure of the pressure relief function provided by the turbine bypass valves. A turbine valve closure scram is initiated at 0.08 sec. The turbine valves close at 0.15 sec. The sequence of events is presented in Table 4.7-1. Power is mitigated with the help of negative reactivity due to the scram and due to void production as the heat flux rises. The maximum pressure in the steam dome is [[
]] into the transient. The long term pressure response would be similar to that presented in Section 4.7.1.3 for the MSIV closure transient. The event is modeled at 100% power and 100% flow with an EOC nominal power shape. The key parameters are presented in Figure 4.7-1 through Figure 4.7-5 for the LRNB event.

While the event is similar to that in operating BWRs, the pressurization is milder. The large steam volume in the steam dome, downcomer and chimney softens the impact of the turbine trip on the pressure. Compared to pressure increases of the order of [[ ]] in operating BWRs [3], the pressure increase in the ESBWR is of the order of [[ ]] (Figure 4.7-1). The neutron flux peak is [[ ]] as seen in Figure 4.7-2. The downcomer level drops because of the void collapse induced by the pressurization and because of the scram. Figure 4.7-3 depicts the calculated level response in the downcomer region. The power in the hot bundle and the corresponding inlet flow are shown in Figure 4.7-4 and Figure 4.7-5. The decrease in CPR for this transient (ΔCPR) is [[ ]] in operating BWRs.

4.7.1.2 Feedwater Controller Failure (Maximum Flow at 168% of Rated)

The FWCF event is characterized by the feedwater flow controller failing to the maximum flow value. This causes an increase in the feedwater flow. The sequence of events for the FWCF transient is shown in Table 4.7-2. The water level rises until the high level trip setpoint (L8) is reached (Figure 4.7-6). When L8 is reached, a high water level turbine trip is initiated, the feedwater pumps are run back, and a reactor scram is initiated. The turbine trip causes a pressurization event that is milder than the LRNB event because turbine bypass valves are not assumed to fail (Figure 4.7-7). This results in a power excursion that is less severe than the LRNB (Figure 4.7-8). Power is mitigated with the help of negative reactivity due to the scram. No safety/relief valves actuate as the steamline pressure is well below the setpoint. As the level drops below L2, MSIVs are closed and ICs are initiated for long-term inventory control. The event is modeled at 100% power and 100% flow with an EOC nominal power shape. The key parameters are presented in Figure 4.7-6 through Figure 4.7-10 for the FWCF event. Figures 4.7-9 and 4.7-10 show the hot bundle power and flow responses. The neutron flux peak is about [[ ]] which is lower than the LRNB event. The ΔCPR for this transient is [[ ]] higher than that for the LRNB event.

4.7.1.3 Main Steamline Isolation Valve (MSIV) Closure

The MSIV closure is characterized by closure of all main steam isolation valves. The closure causes a pressurization event that leads to a power increase. The reactor scram is assumed to occur on isolation valve position. MSIV closure also initiates the operation of the Isolation Condensers (ICs).

The sequence of events for the MSIV closure event is shown in Table 4.7-3. The primary output is peak pressure response. The event is modeled at 100% power and 100% flow with an EOC nominal power shape. Power is mitigated with the help of negative reactivity due to the scram and due to void production as the heat flux rises. Three of the four Isolation Condensers (IC) are assumed available.

The key parameters are presented in Figure 4.7-11 through Figure 4.7-14 for the MSIV event. Figure 4.7-11 shows the pressure response. The pressure rise is limited by the ICs and peaks at 1030 s. The steamline pressure is near the safety/relief valve (SRV) setpoint. The ICs are sized to remove decay heat and maintain the peak pressure for this transient below the SR/V set points. The Isolation Condenser capacity will be reviewed for the higher power to meet the applicable design criteria with adequate margin. Figure 4.7-12 shows the neutron flux and feedwater flow. The increase in the neutron flux is mild in this transient. The downcomer level is shown in Figure 4.7-13. Figure 4.7-14 shows the steam flow being condensed in the ICs. The ΔCPR for this transient is small – [[ ]]

Table 4.7-1. Sequence of Events for LRNB Transient

Time (Sec)	Event
0.0	Turbine-generator load rejection sensing devices trip to initiate turbine control valves fast closure and main turbine bypass valve operation.
0.08	Turbine Valve closure scram initiated.
0.15	Turbine control valves close, bypass valves fail to open on demand.
[[ ]]	[[ ]]

Table 4.7-2. Sequence of Events for FWCF Event

Time (Sec)	Event
0.0	Initiate runout of feedwater pumps.
11.18 – 11.34	Level 8 vessel level set point initiates scram, trip of main turbine, and feedwater flow runback.
20.98	Level 2 vessel set point reached
21.81	ICs initiated for long term inventory control
23.35	MSIV closure initiated from L2 signal.

Table 4.7-3. Sequence of Events for MSIV Closure Transient

Time (Sec)	Event
0.0	Initiation of closure of all main steamline isolation valves.
0.52	Scram initiated based on MSIV valve position. MSIV closure initiates isolation condensers (ICs).
10.0	Feedwater trip initiated
1030.0	Reactor Dome pressure reaches peak value of [[ ]]

Figure 4.7-1. Pressure response for LRNB Transient

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Figure 4.7-2. Neutron Flux Response for LRNB Transient

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Figure 4.7-3. Downcomer Collapsed Level Response for LRNB Transient

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Figure 4.7-4. Bundle Power Response for LRNB Transient

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Figure 4.7-5. Bundle Inlet Flow for LRNB Transient

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Figure 4.7-6. Downcomer Level Response for FWCF Transient

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Figure 4.7-7. Pressure Response for FWCF Transient

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Figure 4.7-8. Neutron Flux response for FWCF Transient

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Figure 4.7-9. Bundle Power Response for FWCF Transient

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Figure 4.7-10. Bundle Inlet Flow Response for FWCF Transient

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Figure 4.7-11. Pressure Response for MSIV Closure Transient

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Figure 4.7-12. Neutron Flux Response for MSIV Closure Transient

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Figure 4.7-13. Downcomer Level for MSIV Closure Transient

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Figure 4.7-14. IC Steam Flow for MSIV Closure Transient

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ENCLOSURE 3

MFN 04-109

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 1 of GE letter MFN 04-109, Robert E. Gamble to NRC, *Demonstration Calculations for ESBWR AOOs,* dated October 8, 2004. The proprietary information is in Enclosure 1, *Demonstration Calculations for ESBWR AOOs*. 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 2.390(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 details specific information regarding application of TRACG to the ESBWR design. 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 8th day of October 2004

George B. Stramback

George B. Stramback
General Electric Company