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MFN 04-106

Project 717

September 27, 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: **GENE Presentation Regarding TRACG Application for ESBWR Stability and ATWS, September 29, 2004**

Enclosed is General Electric's presentation material for the September 29, 2004 meeting regarding its proposed proprietary Licensing Topical Reports on TRACG application for ESBWR Stability and TRACG application for ESBWR ATWS. The proprietary and non proprietary versions of the presentation materials are contained in Enclosures 1 and 2, respectively.

GE considers Enclosure 1 to be proprietary in accordance with 10 CFR 2.390. The proprietary pages are indicated by the words "GE Proprietary Information" in the top right corner.

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.

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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 04-106 – *TRACG Application for ESBWR Stability & ATWS – Closed Session, September 29, 2004* – GE Proprietary Information
2. MFN 04-106 – *TRACG Application for ESBWR Stability & ATWS – Open Session, September 29, 2004* – non Proprietary Information
3. Affidavit, George B. Stramback, dated September 27, 2004

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

MFN 04-106
Enclosure2

ENCLOSURE 2

MFN 04-106

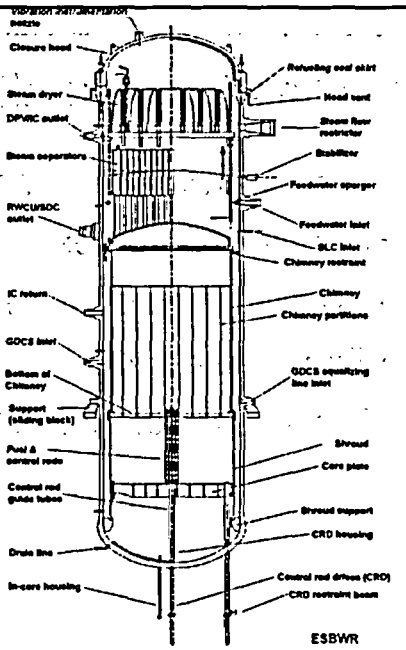
TRACG Application for ESBWR Stability & ATWS – Open Session, September 29, 2004

TRACG Application for ESBWR Stability & ATWS – Open Session

Discussion with NRC Staff

Bharat Shiralkar
Wayne Marquino

September 29, 2004



imagination at work

Outline

Stability

- Purpose and Scope
- Licensing Requirements and Scope of Application
  - Proposed design bases
- TRACG Application Methodology
  - Compliance with CSAU
- Phenomena Identification and Ranking
- Model Applicability
  - Additional model qualification
- Model biases and uncertainties

Outline (continued)

- Plant parameters and initial conditions
- Sensitivity studies
- Combination of uncertainties
- Example results
- Discussion of plant startup

Purpose and Scope

TRACG will be used for licensing analysis of ESBWR stability

- Stability margins during normal operation and anticipated transients

TRACG is also used to analyze plant startup trajectories, to assure a smooth ascension in pressure and power with a minimum of flow oscillation. Large MCPR margins are demonstrated for the startup scenario.

GE requests that the NRC approve TRACG for analyzing and demonstrating compliance with licensing limits for stability analysis for the ESBWR

Licensing Requirements

General Design Criterion 10 (Reactor Design) requires that:

"..specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences."

Criterion 12 (Suppression of Reactor Power Oscillations) requires that:

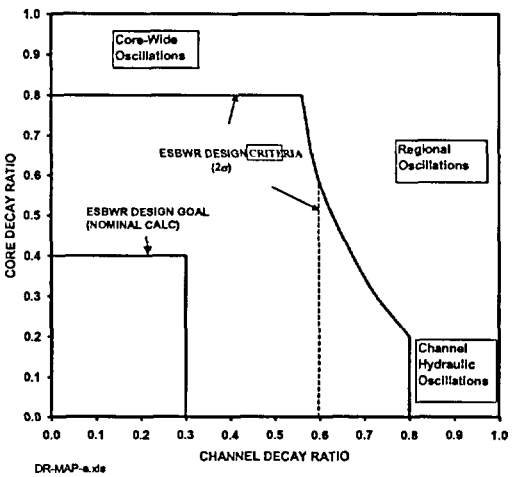
"power oscillations which can result in conditions exceeding specified acceptable fuel design limits are not possible or can be reliably and readily detected and suppressed."

ESBWR Stability Licensing Basis

A high degree of confidence is established that oscillations will not occur by imposing conservative design criteria on the channel, core wide (and regional) decay ratios under all conditions of normal operation and anticipated transients.

As a backup, the ESBWR will implement the DSS-CD solution as a defense-in-depth system.

ESBWR Stability Design Criteria



TRACG Application Methodology

Calculate figures of merit (core and channel decay ratios) over range of operating conditions

Statistically account for the uncertainties and biases in the models and plant parameters using a Monte Carlo method

- Normal Distribution One-Sided Upper Tolerance Limit (ND-OSUTL) if the output distribution is normal, or the Order Statistics method if it is not
- Demonstrate that decay ratios meet design criteria with sufficient margin (2 sigma) for uncertainties

Application Methodology (continued)

Uncertainties and biases considered include

- Model uncertainties
- Experimental uncertainties and any uncertainties related to test scale-up
- Plant uncertainties
- Process measurement errors
- Manufacturing tolerances

Conformance with CSAU Process

CSAU Step	Description	Addressed
1	Scenario Specification	Normal operation, AOOs, plant startup
2	Nuclear Power Plant Selection	ESBWR 450 MWth
3	Phenomena Identification and Ranking	Table 3-1
4	Frozen Code Version Selection	TRACG04A
5	Code Documentation	References [1,2,6,7,9]
6	Determination of Code Applicability	Table 4-1
7	Establishment of Assessment Matrix	Table 4-2
8	Nuclear Power Plant Nodalization Definition	Section 8
9	Definition of Code and Experimental Accuracy	Reference [1,2,24]
10	Determination of Effect of Scale	Section 5
11	Determination of the Effect of Reactor Input Parameters and State	Section 6
12	Performance of Nuclear Power Plant Sensitivity Calculations	Section 8
13	Determination of Combined Bias and Uncertainty	Section 8
14	Determination of Total Uncertainty	Section 8

Sections & Table nos. refer to LTR

PIRT – Differences from Operating BWRs

GOVERNING PHENOMENA	Channel Thermal Hydraulic Stability	Core wide Stability	Regional Stability	Highest Ranking	Critical Safety Parameter	COMMENTS
						1. Decay Ratio - controls stability margin/growth rate of perturbations
LOWER PLENUM RADIAL RESISTANCE	M	M	M	M		Affects natural circulation flow
AXIAL AND RADIAL RESISTANCE	M	M	M	M		Affects bypass and chimney flow distribution
MARGIN TO DRYOUT/BT (steady-state and transient effects)	N/A	N/A	N/A	N/A		Criteria based on margin to stability.
VOID DISTRIBUTION	H	H	H	H	1	Affects natural circulation flow
FLOW OSCILLATION DURING STARTUP	NA	NA	NA	NA		See seperate PIRT for plant startup.
INTERACTIONS BETWEEN CHIMNEY CELLS	H	H	H	H	1	Need to consider stability of 16 bundles together with a chimney cell
INITIAL MCPR	N/A	N/A	N/A	N/A		Criteria based on stability margin
SLMCPR	N/A	N/A	N/A	N/A		Criteria based on stability margin

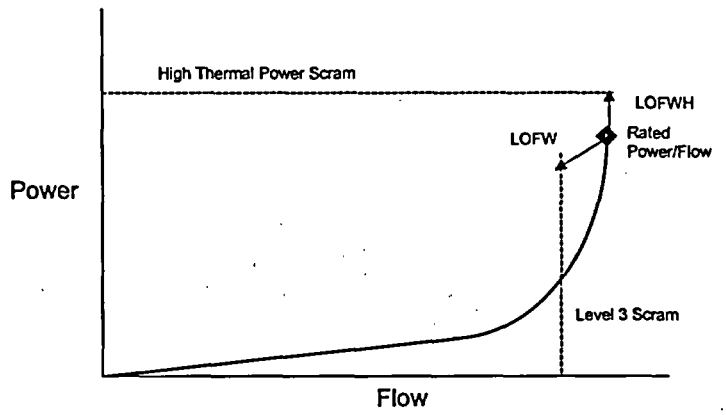
Applicability of TRACG for ESBWR Stability Analysis

TRACG models adequate – Model LTR, TRACG DSS-CD LTR

TRACG qualified vs extensive data base

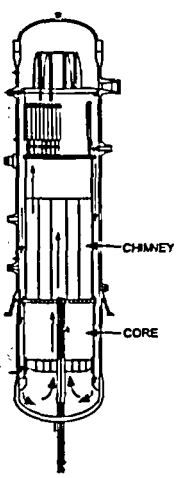
- Separate effects, component, integral tests, BWR transient and stability data
- Additional qualification performed vs. low decay ratio plant tests

Limiting Conditions for Stability

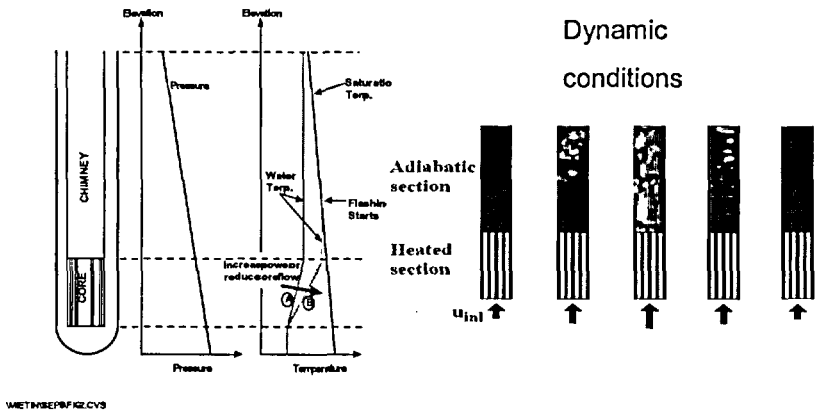


Startup - Background

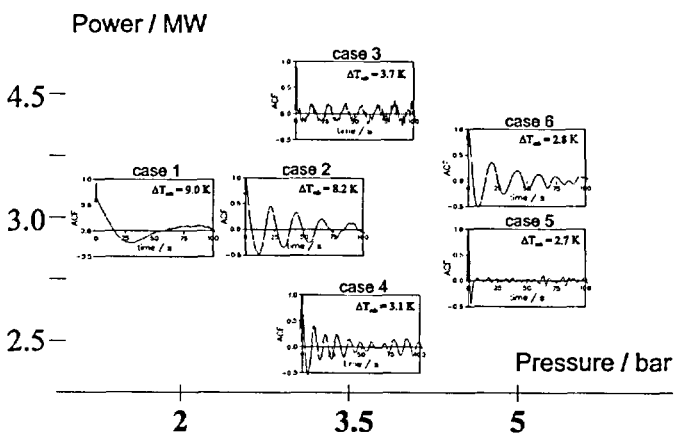
- **ESBWR natural circulation startup**
  - –Generally follow established procedure from Dodewaard plant
  - –Heat up reactor coolant to ~ 80 - 90 C with Shutdown Cooling System auxiliary heater and decay heat
  - –Deaerate reactor coolant by drawing vacuum on main condenser with steam drain line open
  - –Withdraw control rods to criticality
  - –Increase power at controlled heatup rate
  - –As pressure increases, open turbine bypass valve to control pressure



Pressure and Temperature at Startup Pressures



Indications of periodic behaviour at Dodewaard start-up conditions



Plant Startup Summary

Significant oscillations have not been observed at Dodewaard reactor during normal startup

During startup, core flow is single phase

- Voids initiate at top of chimney
- No oscillations in neutron flux
- No power oscillations

Startup flow oscillations pose no threat to any thermal limits- will demonstrate for typical startup paths

Conclusion

Application Methodology for stability analysis consistent with CSAU approach for realistic analysis

- Accounts for model and plant parameter uncertainties

Results will demonstrate ESBWR meets design criteria

TRACG ATWS Outline
Presentation of Application Framework

- Background
- Licensing Requirements and Acceptance Criteria
- CSAU Application Methodology
- Scenario Description
- Phenomena Identification and Ranking

Background

GE ATWS analysis of BWRs currently performed with:

- ODYN or TRACG for peak pressure
- ODYN for steam flow to pool
- TASC code for PCT
- Energy balance model for Suppression pool heat-up

NRC recently approved TRACG application to ESBWR LOCA

- ESBWR AOO follows approved TRACG forced circ. application methodology
- ESBWR ATWS follows TRACG AOO & LOCA w/ extensions

GE to submit LTR for ESBWR ATWS with TRACG for RPV pressure, PCT, and Pool Temperature

- References or follows analysis models, nodalization, procedures, tests and qualification, which have been previously been submitted or approved by the NRC
- Justify TRACG adequate w.r.t. phenomenon or models that have not been reviewed in the NRC's review of prior TRACG applications

Scope of Review

GE will request NRC approval of TRACG for use in analysis of ESBWR ATWS transients

Licensing Requirements and Scope of Application

- **10CFR50 Appendix A**
  Anticipated Transient Without Scram (ATWS)
  Anticipated Operational Occurrence (AOO) followed by failure of the reactor trip portion of the protection system

10CFR50.62: Features required to mitigate ATWS

1) An ARI system that utilizes sensors and logic which are diverse and independent of the RPS,
2) An automatic standby liquid control system (SLCS) with a minimum capacity equivalent to 86 gpm of 13 weight percent sodium pentaborate solution,
3) Automatic recirculation pump trip (RPT)

- HW requirements, rather than acceptance criteria,
- BWR performance with the required hardware shown to meet specific criteria in NED-24222
- ESBWR HW features provide equivalent mitigation

NED 24222 Acceptance Criteria

RPV Integrity

- Primary System pressure is limited to ASME Emergency Limit (1500 psi)

Fuel Integrity

- 2200 deg. F PCT
- 17% local oxidation (same as 10CFR50.46)

Containment Integrity

- Pressure & Temperature limited to design limits

Long-Term Shutdown Cooling

- Reactor brought to a safe shutdown condition, cooled down and maintained in cold shutdown

Implementation Requirements

-Review and approval by the NRC of the process for analyzing ATWS events

Review Requirements For Updates

-Similar to TRACG AOO

Nuclear Power Plant Selection

-ESBWR

ATWS Scenarios Include AOO Initiating Events

- Pressurization events
- Depressurization events
- Core flow transients (NA for ESBWR)
- Cold water events
- Level transient events
- Accidents are not combined w/ failure to scram e.g. load rejection w/ bypass failure

ATWS Methodology Summary

TRACG is well suited to ESBWR ATWS analysis

The models and qualification for most phenomena have been previously reviewed and approved

Submittal will document applicability of boron mixing, transport and reactivity models

Application range of the other models will be justified. Application Method described in LTR.

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 04-106, Robert E. Gamble to NRC, *GENE Presentation Regarding TRACG Application for ESBWR Stability and ATWS, September 29, 2004,* dated September 27, 2004. The proprietary information is in Enclosure 1, *TRACG Application for ESBWR Stability & ATWS – Closed Session, September 29, 2004.* The proprietary pages are identified by the marking "GE Proprietary Information" in the top right corner of the page. 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 detection and suppression capability of the confirmation density algorithm for the BWR. GE has developed this TRACG code 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 detection and suppression capability of the confirmation density algorithm for the BWR was achieved at a significant cost, in excess of one quarter million dollars, 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 27th day of September 2004

George B. Stramback
General Electric Company