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Project 717

December 20, 2002

U.S. Nuclear Regulatory Commission  
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Attention: Chief, Information Management Branch  
Program Management  
Policy Development and Analysis Staff

Reference: Letter S. Hucik, GE to S. Collins, NRC, Pre-application Review of ESBWR,  
dated April 18, 2002

Subject: **ESBWR Test and Analysis Program Description, NEDC-33079 and  
Supplement 1 - Document Transmittal for Pre-Application Review of  
ESBWR**

The CD accompanying this letter contains the GE non-proprietary report NEDC-33079, "ESBWR Test and Analysis Program Description", (TAPD) and Supplement 1 to NEDC-33079, "Discussion of PIRT Parameters". It is item number 2 in Enclosure 1. Supplement 1 also contains responses to NRC Requests for Additional Information (RAIs) related to the SBWR TAPD, dated July 11, 1996. This report is submitted in support of the pre-application review of the ESBWR (Reference).

GE is seeking NRC concurrence on the adequacy of the testing program for the ESBWR. The ESBWR TAPD, the test reports and the scaling report (Items 2, 7, 8, 9 and 10, Enclosure 1) provide the background information and bases for the NRC to address the issue of the adequacy of the testing program for the ESBWR. The ESBWR TAPD (Item 2, Enclosure 1) provides a road map for the technology program that includes PIRTs and defines the necessary test and analysis program. The SBWR and ESBWR Test Reports (Items 7, 8 and 9, Enclosure 1) provide the results of the test programs. The ESBWR Scaling Report (Item 10, Enclosure 1) provides the scaling bases for the tests. The NRC is requested to issue a single assessment on the adequacy of the ESBWR testing basis, based on the above referenced five items.

GE is also seeking approval for the use of the TRACG code for the one-time application for Design Certification of the ESBWR. The ESBWR Test and Analysis Program Description (TAPD), NEDC-33079, (Item 2, Enclosure 1) defines the necessary qualification program for the ESBWR and will be used in conjunction with items in Enclosure 1, as background for the TRACG application. GE is seeking a single NRC SER for the application of TRACG to the ESBWR SSAR to be used for Design Certification.

If you have any questions about the information provided here, please contact Atam Rao at (408) 925-1885, or myself.

Sincerely,



J. Deacon

Enclosures

(1) List of Reports in Support of ESBWR Pre-application Review

cc: A. Cabbage USNRC (with enclosures and CD)  
J. Lyons USNRC (w/o enclosures)  
G.B. Stramback - GE (with enclosures and CD)

## Enclosure 1

### List of Reports in Support of ESBWR Pre-application Review

1. ESBWR Design Description, NEDC-33084  
Reference document that defines the ESBWR reference design – **not for review**.
2. ESBWR Test and Analysis Program Description (TAPD), NEDC 33079  
A road map for the technology program that includes PIRT, adequacy of test program and TRACG qualification plan. A similar document was **reviewed for SBWR** and the **testing plan was found acceptable**.
3. TRACG Model Description. NEDE-32176P, Rev.2  
This report has been **reviewed and approved** for operating plants.
4. TRACG Qualification, NEDE-32177P, Rev.2. Comparisons for BWR Application of TRACG  
This report has been **reviewed and approved** for operating plants
5. TRACG Qualification for SBWR, NEDC-32725P, Rev.1, Vol.1 and 2  
This report contains TRACG comparisons to test data covering extensive passive system testing that was described and found acceptable for SBWR.
6. TRACG Qualification for ESBWR, NEDC-33080, Rev 0  
This report covers ESBWR specific testing and extends the passive system qualification of TRACG.
7. SBWR Testing Summary Report, NEDC-32606P, Rev 0  
This report covers a summary of all BWR passive system testing and interrelations between tests, that are discussed in detail in item 8 below.
8. Test Reports for Passive Safety Systems  
This covers all previously submitted reports on the passive systems testing for SBWR.
9. ESBWR Test Report, NEDC-33081, Rev 0  
This report covers integral PCCS systems tests done for the ESBWR configuration. **New testing** done at PSI.
10. ESBWR Scaling Report, NEDC-33082P  
Addresses the scaling basis for passive safety systems test programs Based on previously **NRC reviewed SBWR** scaling report

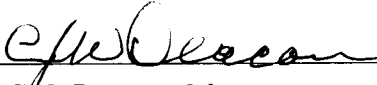
11. TRACG Application for Anticipated Operational Occurrences Transient Analyses, NEDE-32906P  
This TRACG application methodology for BWR AOO transients was **reviewed and approved** by the NRC for operating plants.
12. TRACG Application for ESBWR, NEDC-33083P  
This covers the TRACG application approach for AOO transient, LOCA and containment analysis. Transient analysis based on approved operating plant application; others based on bounding approach.

NEDC-33079  
Supplement 1  
Class I  
DRF 0000-0006-8825-0  
August, 2002

# ESBWR Test and Analysis Program Description

## Supplement 1 - Discussion of PIRT Parameters

B. S. Shiralkar  
J. G. M. Andersen  
W. Marquino  
J. R. Fitch

Approved:   
C. J. Deacon, Manager  
Advanced Reactor Projects

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CONTENTS OF THIS REPORT  
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*This work was performed partially as part of a contract between various utilities and GE for “ESBWR Development”.*

## Table of Contents

S1.0	Introduction	S1-1
S1.1	Purpose	S1-1
S1.2	Definition of PIRT Phenomena Listed in TAPD	S1-1
S1.3	Discussion of PIRT Phenomena and Rankings	S1-1
S1.3.1	Loss-of Coolant Accidents (Reactor Vessel and Core)	S1-1
S1.3.2	Loss-of Coolant Accidents (Containment)	S1-8
S1.3.3	Transients	S1-15
S1.3.4	Anticipated Transients Without Scram (Pressurization Transients)	S1-23
S1.3.5	Stability	S1-24
S1.4	Conclusion	S1-29
S1.6	References	S1-29
	Attachment A	A-1
	Attachment B	B-1

## List of Tables

Table S1-1	Definition of PIRT Phenomena Listed in TAPD	<b>S1-Error! Bookmark not defined.</b>
Table S1-2 a.	Rationale for Important Parameters for ESBWR LOCA (Blowdown Period)	S1-44
Table S1-2 b.	Rationale for Important Parameters for ESBWR LOCA (GDCCS period)	S1-45
Table S1-3	Rationale for Important Parameters for Short Term Containment Pressure Response (Blowdown Period)	S1-46
Table S1-4	Rationale for Important Parameters for Long Term Containment Response (GDCCS & PCCS Periods)	S1-47
Table S1-5	Rationale for Important Parameters for Pressurization Transients	S1-48
Table S1-6	Rationale for Important Parameters for Depressurization Transients	S1-49
Table S1-7	Rationale for Important Parameters for Plant Startup Transient	S1-50
Table S1-8	Rationale for Important Parameters for Loss of Feedwater Heater Transient	S1-51



## Abbreviations and Acronyms

ABWR	Advanced Boiling Water Reactor
AC	Alternating Current
ADS	Automatic Depressurization System
APRM	Average Power Range Monitor
ARI	Alternate Rod Insertion
ASME	American Society of Mechanical Engineers
ATLAS	GE's 8.6 MW Heat Transfer Loop
ATWS	Anticipated Transients Without Scram
Bldn	Blowdown
BO	Boiloff
BWR	Boiling Water Reactor
CACS	Containment Atmospheric Control System
CCFL	Counter Current Flow Limiting
CISE	Centro Informazioni Studi Esperienze
COL	Combined Operating License
CPR	Critical Power Ratio
CRD	Control Rod Drive
CTP	Core Thermal Power
CRIEPI	Central Research Institute of Electric Power Industry
CSAU	Code Scaling, Applicability and Uncertainty
CSHT	Core Spray Heat Transfer
DBA	Design Basis Accident
DC	Downcomer
DPV	Depressurization Valve
DW, D/W	Drywell
EBWR	Experimental Boiling Water Reactor
ECCS	Emergency Core Cooling System
EOPs	Emergency Operating Procedures
ESF	Engineered Safety Feature
FAPCS	Fuel and Auxiliary Pool Cooling System
FIST	BWR Full Integral Simulation Test
FIX	Swedish Test Loop Used for Testing External Pump Circulation
FMCRD	Fine Motion Control Rod Drive
FRIGG	Research Heat Transfer Loop Operated for Danish Atomic Energy Commission
FW	Feedwater
FWCS	Feedwater Control System
GDCS	Gravity-Driven Cooling System

## Abbreviations and Acronyms (Continued)

GE	General Electric Company
GEXL	General Electric Critical Quality Boiling Length Correlation
GIRAFFE	Gravity-Driven Integral Full-Height Test for Passive Heat Removal
GIST	GDCS Integral System Test
HCU	Hydraulic Control Unit
HVAC	Heating, Ventilating and Air Conditioning
IC	Isolation Condenser
ICS	Isolation Condenser System
INEL	Idaho National Engineering Laboratory
LASL	Los Alamos Scientific Laboratory
LB	Large Break
LOCA	Loss-Of-Coolant Accident
LOOP	Loss Of Offsite Power
LPCI	Low Pressure Coolant Injection
MCPR	Minimum Critical Power Ratio
MIT	Massachusetts Institute of Technology
MPL	Master Parts List
MSIV	Main Steamline Isolation Valve
MSL	Main Steamline
MW	Megawatt
NBS	Nuclear Boiler System
NRC	Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratory
P&ID	Process and Information Diagram
PANDA	Passive Nachwarmeabfuhr-und DruECKabbau-Testanlage (Passive Decay Heat Removal and Depressurization Test Facility)
PANTHERS	Performance Analysis and Testing of Heat Removal Systems
PAR	Passive Autocatalytic Recombiners
PCCS	Passive Containment Cooling System
PCT	Peak Cladding Temperature
PIRT	Phenomena Identification and Ranking Tables
PSTF	Pressure Suppression Test Facility
RC&IS	Rod Control and Information System
RPV	Reactor Pressure Vessel
RWCU	Reactor Water Cleanup
SB	Small Break

## Abbreviations and Acronyms (Continued)

SBWR	Simplified Boiling Water Reactor
S/C	Suppression Chamber (wetwell)
SDC	Shutdown Cooling
SIET	Societa Informazioni Esperienze Termoidrauliche
SLCS	Standby Liquid Control System
SPERT	Special Power-Excursion Reactor Tests
SRV	Safety/Relief Valve
SSAR	Standard Safety Analysis Report
SSLC	Safety System Logic Control
SSTF	Steam Sector Test Facility
TAPD	Test and Analysis Program Description
TCV	Turbine Control Valve
THTF	Thermal-Hydraulic Test Facility
TLTA	Two-Loop Test Apparatus
TPS	Turbine Protection System
TRAC	Transient Reactor Analysis Code
TRACG	Transient Reactor Analysis Code, GE version
TT	Turbine Trip
UCB	University of California, Berkeley
VB	Vacuum Breaker
WW	Wetwell

## **S1.0 Introduction**

### **S1.1 Purpose**

Supplement 1 provides a discussion of the Phenomena Identification and Ranking Tables (PIRT) parameters described in Section 2 of the ESBWR Test and Analysis Program Description (TAPD) [1].

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### **S1.2 Definition of PIRT Phenomena Listed in TAPD**

This section provides definitions of phenomena considered in TAPD.

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### **S1.3 Discussion of PIRT Phenomena and Rankings**

This section provides a discussion of PIRT Phenomena and Rankings.

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#### **S1.3.1 Loss-of Coolant Accidents (Reactor Vessel and Core)**

This section provides a discussion of the detailed phenomena considered for LOCA (Reactor Vessel and Core).

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**S1.3.2 Loss-of Coolant Accidents (Containment)**

This section provides a discussion of the detailed phenomena considered for LOCA (Containment).

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Table S1-4 serves the same purpose as Table S1-3, except for the long term containment response.

### **S1.3.3 Transients**

This section provides a detailed discussion of the phenomena considered for transients.

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**S1.3.4 Anticipated Transients Without Scram (Pressurization Transients)**

This section presents a discussion of the detailed phenomena considered in ATWS (Pressurization Transients).

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**S1.3.5 Stability**

This section provides a discussion of the detailed phenomena related stability as provided in TAPD Sections 2.2.4 and 2.3.4.

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#### **S1.4 Conclusion**

Based on the results of the ranking evaluation in the PIRT (Top-Down approach, TAPD Section 2) and the results of the identification of the ESBWR-unique features (Bottom Up approach, TAPD Section 3) a composite list was developed. Items ranked high were carried through for further analysis in TAPD Section 4. In addition those ranked medium in importance were also examined, but in less detail. The matrix of tests to address the identified phenomena are shown in Section 5 of the TAPD, where the needs for any further required qualification of TRACG are also examined.

#### **S1.6 References**

- [1] *ESBWR Test and Analysis Program Description*, NEDC-33079P, August 2002
- [2] *SBWR Test and Analysis Program Description*, NEDC-32391P, Revision C, August 1995.
- [3] Letter from Theodore R. Quay (NRC) to James E. Quinn (GE), *Staff Evaluation of General Electric's (GE's) Test and Analysis Program Description*, NEDC-32391, Revision C, July 11, 1996.
- [4] *TRACG Qualification*, J.G.M. Andersen, Y.K. Cheung, C.L. Heck, L.A. Klebanov, J.C. Shaug, B.S. Shiralkar, NEDE-32176P, Revision 2, Licensing Topical Report, January 2000.



**Table S1-1 Definition of PIRT Phenomena Listed in TAPD**

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**Table S1-1 Definition of PIRT Phenomena Listed in TAPD (Continued)**

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**Table S1-1 Definition of PIRT Phenomena Listed in TAPD (Continued)**

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**Table S1-1 Definition of PIRT Phenomena Listed in TAPD (Continued)**

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**Table S1-2 a. Rationale for Important Parameters for ESBWR LOCA (Blowdown Period)**

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**Table S1-2 b. Rationale for Important Parameters for ESBWR LOCA (GDCS period)**

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**Table S1-3 Rationale for Important Parameters for Short Term  
Containment Pressure Response (Blowdown Period)**

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**Table S1-4 Rationale for Important Parameters for  
Long Term Containment Response (GDCS & PCCS Periods)**

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**Table S1-5 Rationale for Important Parameters for Pressurization Transients**

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**Table S1-6 Rationale for Important Parameters for Depressurization Transients**

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**Table S1-7 Rationale for Important Parameters for Plant Startup Transient**

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**Table S1-8 Rationale for Important Parameters for Loss of Feedwater Heater Transient**

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**RESPONSES TO NRC RAIS ON SBWR TAPD, DATED July 11, 1996**

**APPENDIX A**

**Pages A1 through A7**

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**APPENDIX B**  
**SIGNIFICANT QUESTIONS**

**Pages B1 through B25**

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