GEFR-00881
Class II
October 1990

TECHNOLOGY PROGRAMS IN SUPPORT OF

ADVANCED LIGHT WATER REACTOR PLANTS

ABWR DESIGN VERIFICATION PROGRAM

ANNUAL PROGRESS REPORT
for period October 1, 1989
through September 30, 1990

Prepared for:
UNITED STATES DEPARTMENT OF ENERGY
ASSISTANT SECRETARY FOR NUCLEAR ENERGY
UNDER CONTRACT DE-AC03-86SF16563

GE Nuclear Energy

90-350-03

GEFR--00881

DE91 006976

TITLE: ABWR DESIGN VERIFICATION PROGRAM
ANNUAL PROGRESS REPORT
FOR PERIOD OCTOBER 1, 1989 THROUGH SEPTEMBER 30, 1990

AUTHOR: J. N. Fox

Approved: _____
J. F. Quirk, Program Manager,
ABWR Design Verification Program

Prepared for the
United States Department of Energy
Under Contract No. DE-AC03-86SF16563

GE Nuclear Energy

Advanced Boiling Water Reactor Program
San Jose, California 95125-1088

LEGAL NOTICE

This report was prepared by General Electric Company (GE) as an account of work sponsored by the U.S. Department of Energy (DOE). Neither DOE, nor GE or its suppliers, nor any person acting on behalf of any of them:

A. Makes any warranty or representations, express or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or

B. Assumes any liabilities with respect to the use of, or for damages resulting from the use of, any information, apparatus, method, or process disclosed in this report.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

ABSTRACT

The ABWR Design Verification Program is aimed at restoring confidence in the U.S. licensing process by demonstrating its workability by obtaining USNRC preapproval of GE's ABWR Standard Plant. The purpose of this work is to achieve full NRC approval of the ABWR through the award of an NRC Staff final design approval (FDA) and design certification. The approach is to (1) establish a licensing basis with the NRC Staff for the ABWR, (2) prepare and submit, for NRC Staff review, an SSAR to obtain an FDA, and (3) participate in a rulemaking process to obtain certification of the ABWR design.

This program was initiated August 27, 1986. This report, the fourth annual progress report, summarizes progress on this program from October 1, 1989 through September 30, 1990.

CONTENTS

TABLES

ACRONYMS

ABWR	Advanced Boiling Water Reactor
ACRS	Advisory Committee on Reactor Safety
ALWR	Advanced Light Water Reactor
CFR	Code of Federal Regulations
DOE	Department of Energy
DSER	Draft Safety Evaluation Report
EPRI	Electric Power Research Institute
FDA	Final Design Approval
GFY	Government Fiscal Year
ITAAC	Inspections, Tests, Analyses and Acceptance Criteria
NRC	Nuclear Regulatory Commission
PDSER	Draft Preliminary Safety Evaluation Report
PRA	Probabilistic Risk Assessment
QA	Quality Assurance
RAI	Request for Additional Information
SSAR	Standard Safety Analysis Report

1. EXECUTIVE SUMMARY

The overall objective of the ABWR Design Verification Program is to achieve full NRC approval of GE's ABWR design through the award of a final design approval (FDA) and certification. The approach is to (1) establish a licensing basis with the NRC Staff for the ABWR licensing review prior to initiation of the review, (2) prepare and submit, for NRC Staff review, a standard safety analysis report (SSAR) to obtain an FDA, and (3) participate in a rulemaking proceeding to obtain certification of the ABWR design.

Work on the first two tasks (Licensing Basis and Preparation and Submittal of SSAR) was initiated when the contract was executed on August 27, 1986. The Licensing Basis task was completed in GFY87 with the issuance of the ABWR Licensing Review Bases document by the NRC on August 7, 1987. Work on the Design Certification task was initiated late in GFY90.

The GFY90 major accomplishments for the Preparation and Submittal of SSAR task are summarized below:

SSAR Amendments

Amendment 9 — 11/17/89

- Compartment Pressurization Results
- Description of Containment Penetrations and Isolation Valves
- Description of the Motor-Generator Set
- Evaluation of Postulated Radioactive Release due to a Liquid Radwaste Failure
- Technical Specifications

Amendment 10 — 3/28/89

- Expansion of Radiation Protection Design
- TMI Action Plan Item II.B.2
- Containment Overpressure Protection System
- Combustion Turbine System
- Drywell Flood System
- AC Independent Water System

Amendment 11 — 5/2/90

- Standby Gas Treatment System Update
- Hydrogen Recombiner System
- Turbine Island and Radwaste Facility Portion of Initial Test Program
- Hydrogen Water Chemistry System
- Reactor and Turbine Service Water Systems
- Design Related Issues Pertaining to Emergency Preparedness
- Update of Applicable USIs and GSIs
- Chapter 7 Scope Expansion

Amendment 12	6/4/90
- IE Bulletins, Generic Letters and IE Information Notices	
Amendment 13	7/3/90
- Preservice and Inservice Inspection Program - Control Rod Details and Emergency Procedure Guidelines	
Amendment 14	10/2/90
- Inservice Testing of Safety-Related Pumps and Valves - Balance of Fire Hazard Analysis	

GE Response to NRC Review

Chapter 19 NRC Questions	01/09/90 06/01/90
Chapter 10 NRC Questions	02/28/90
Chapters 7 & 10 NRC Questions	04/16/89
Chapters 11 & 12 NRC Questions	06/01/90 06/07/90
Chapters 3, 9 & 13 Questions	09/28/90

2. LICENSING BASIS

2.1 STATEMENT OF OBJECTIVES

The objective of the Licensing Basis task is to define the process and to reach agreement on administrative matters, and to address technical issues where requirements have not been resolved. No further discussions of regulatory basis during the detailed review of the ABWR design will be expected, only a determination that GE had met the agreed-to-regulatory basis.

2.2 SUMMARY OF PROGRESS ACHIEVED

The licensing basis for the ABWR was established with the August 1987 issuance of the "Licensing Review Bases," as an attachment to Reference 1. This document sets forth the licensing bases for the NRC Staff review and certification of the ABWR standard plant and fulfilled Program Milestone No. 120.

2.3 PRINCIPAL ACCOMPLISHMENTS AND FINDINGS

The Licensing Review Bases document concept was first introduced to the NRC Staff in a meeting August 28, 1986. The NRC Staff was receptive to such a document. The first draft of the actual document was issued in early December, 1986. Subsequent drafts were issued with comments incorporated in an effort to arrive at a position on each issue which was acceptable to both parties. Both the ACRS and the Commission were introduced to the concept of the agreement.

Following 10 months of development and intense interaction between the NRC Staff and GE, the document was issued August 7, 1987, as an attachment to the NRC letter identified above. The objective of the licensing basis was thus accomplished.

The Licensing Review Bases document has proved to be very effective thus far in the NRC review.

3. PREPARATION AND SUBMITTAL OF SSAR

3.1 STATEMENT OF OBJECTIVES

This task is focused on the preparation, submittal, and review of an SSAR (a GESSAR II type document; Reference 2) for the ABWR, and NRC approval of the ABWR design as evidenced by an NRC Staff-approved FDA. Submittals will include not only the typical requirements set forth in the NRC Standard Review Plan (Reference 3), but also the requirements for severe accidents including a probabilistic risk assessment (PRA). Given that the regulatory basis for the ABWR has been established in Licensing Basis task, it is expected that the NRC review will be completed with the award of an FDA in the time frame shown in Table 3-1.

The submittals will cover the entire Nuclear Island, Turbine Island and Radwaste Facility.

The objective of this task is to prepare and submit an SSAR to the NRC which is based on the approved licensing criteria, support the NRC in their review of the SSAR, and provide support to the NRC towards issuance of a FDA.

3.2 SUMMARY OF PROGRESS ACHIEVED

All of the 20 SSAR chapters identified in Table 3-2 have been submitted. The dates of these submittals is provided in Table 3-3.

Regulatory review of the ABWR design has consisted of Commission briefings, ACRS meetings, NRC management meetings, and requests for additional information (RAIs) from the NRC staff during their review. These regulatory briefings and meetings are summarized in Table 3-4. The schedule of responses to the RAIs is shown in Table 3-5.

3.3 PRINCIPAL ACCOMPLISHMENTS AND FINDINGS

In addition to completing and submitting Amendments 9 through 14 (see Section 1) and responding to RAIs 9 through 13 (see Table 3-5), the following are principal accomplishments:

DSER on Chapters 4, 5, 6 and 17

GE prepared and transmitted responses (Reference 4) to the open items identified at the October 31, 1989 ACRS Subcommittee meeting to review the Staff's Draft Safety Evaluation Report (DSER) covering Chapters 4, 5, 6 and 17.

PDSER on Chapters 3, 6 and 9

On November 28-30, 1989 a 3-person team from the NRC along with two consultants from the Idaho National Engineering Laboratory, met in San Jose to review the seismic design of the ABWR. The main purpose was to afford the individual reviewers a better understanding of some of the detailed analyses used to support the material in the SSAR. Most of the issues were resolved at the meeting. However, there were also a few issues that required the submittal of additional information. This information was transmitted to the NRC on May 16, 1990 (Reference 5).

Tracking Resolution of Major Issue

On May 16-17, 1990 meetings were held between GE and the NRC Staff in San Jose, California. The purpose of these meetings was to make sure that the remaining major issues in the ABWR design were receiving appropriate attention by the Staff and by GE. The discussion topics included: drywell head failure; containment overpressure protection; source term; shutdown risk; fire and seismic risk and lower drywell flooder. The meetings were very fruitful in that several potentially tough issues were resolved and solution paths identified. GE provided formal responses to these issues on August 9, 1990 (Reference 6) and October 17, 1990 (Reference 7).

Comparison of ALWR Requirements and GE ABWR SSAR Design

On June 12, 1990 GE provided the NRC with the comparison of the ALWR Requirements Document and the GE ABWR SSAR design (Reference 8). A detailed comparison to the several thousand ALWR requirements Document shows that the ABWR complies with all but nine requirements. The results of this comparison were reviewed with the EPRI ALWR program staff. In a follow-up June 15, 1990 letter (Reference 9), EPRI acknowledged that the comparison demonstrated a high degree of consensus within the industry and the requirements and design for future BWRs. The letter went on further to say that the differences which exist between the ALWR Requirements Document and the ABWR SSAR design are understandable given the fact that these programs were undergoing parallel review by the NRC.

In January a number of NRC Staff documents and corresponding Commission memoranda were released to the public which included revised schedules for standard plant reviews currently in process. At that time the schedule for issuance of the FDA for the ABWR was several months beyond the Work Plan date. However, later releases indicated the potential for much later dates and no definitive schedule commitment. At the end of GFY90 there were still no definitive schedules for conclusion of the NRC's technical/safety review of the ABWR SSAR or the issuance of the FDA and subsequent Certification. The main obstacle at this time is the resolution of the level of detail issue [pursuant to 10CFR52.57 (a) (2)] between industry and NRC. The Commission, although under significant political pressure to move ahead, has indicated that they feel they must "get it right" and only after such resolution has been reached will they be able to confidently establish new schedules for conducting and concluding the various ALWR reviews. GE and the NRC staff, in the interim are aggressively working toward issuance of an ABWR FDA expeditiously.

GE is also pursuing other avenues with regard to maintenance of desired schedules, including preliminary discussions with the NRC regarding a possible decoupling of specific certification process activities (i.e. ITAAC and NEPA) with the traditional staff safety review. In this way it might be possible to obtain the FDA for the ABWR, which is a prerequisite for certification and thus a significant milestone, on a more timely basis. There seem to be numerous advantages to pushing for an FDA unencumbered by certification issues which are new to the process and as of yet undefined. The NRC seems receptive to such an approach, and has indicated an interest in further discussions along these lines.

TABLE 3-1

ABWR DESIGN VERIFICATION PROGRAM
MILESTONE LOG

Element Code	Description	Planned Completion Date	Actual Completion Date	Comment
110	Program Management and Support Completed	09/30/91		Level of effort
120	Licensing Review Bases Document Issued	06/30/87	08/07/87	NRC Staff delayed issuance
130a	Chapters 4-6 and 15 Submitted	09/30/87	09/29/88	
130b	Chapters 1-3 and 17 Submitted	03/31/88	03/29/88	
130c	Chapters 7-9 and 11 (1)-14 Submitted	06/30/88	06/29/88	
130d	Chapter 10 (Turbine Island) Submitted	03/31/88	12/30/88	
130e	Chapters 16, 18, 19, and FMEAs Submitted	Note(2)	Note(3)	
130f	Chapter 11 (Radwaste Facility) Submitted	03/31/89	03/31/89	
130g	Maintenance and Reliability Submittal	05/31/90	Note(5)	
130h	Inspections, Tests, Analyses and Acceptance Criteria (ITAAC) Initial Submittal	07/31/90	Note (6)	
130	Final SER and FDA Issued	09/30/90(4)		
140	NRC Certification Issued	09/30/91(4)		

(1) Nuclear Island portion of Chapter 11.
(2) Chapter 19 internal events, 1/30/89. Balance of Nuclear Island submittals 3/31/89.
(3) Chapter 19 internal events submitted 1/30/89. Balance of Nuclear Island submittals 3/31/89 with the exception of Chapter 16 which was submitted 6/23/89.
(4) Work Plan dates; dates contingent on the NRC.
(5) Submitted 10/2/90 following decision to submit it independent of ITAAC.
(6) Pending acceptance of NUMARC ITAAC approach.

f:JNF90:j
October 1990

TABLE 3-2

ABWR SSAR CHAPTERS

Chapter No.	Title
1	Introduction and General Description of Plant
2	Site Characteristics
3	Design of Structures, Components, Equipment and Systems
4	Reactor
5	Reactor Coolant System and Connected Systems
6	Engineered Safety Features
7	Instrumentation and Control Systems
8	Electric Power
9	Auxiliary Systems
10	Steam and Power Conversion Systems
11	Radioactive Waste Management
12	Radiation Protection
13	Conduct of Operations
14	Initial Test Program
15	Accident Analyses
16	Technical Specifications
17	Quality Assurance
18	Human Factors Engineering
19	Response to Severe Accident Polic Statement
20	Question and Response Guide

TABLE 3-3

ABWR SSAR CHAPTER SUBMITTALS

Chapters	Description	Submittal Date	Milestone No.
4-5 and 15	Reactor and Safety Systems	9/29/87	130a
1-3	Plant Arrangement and Criteria	3/29/88	130b
17	Quality Assurance	6/29/88	130b
7-9 & 11-14	I&C and Auxiliary Systems	6/29/88	130c
20	Questions and Response Guide	6/29/88	-
10	Turbine Island	12/30/88	130d
19	PRA Internal Events	1/31/89	130e
18 and FMEAs	Human Factors and Reliability	3/31/89	130e
19	PRA External Events	7/28/89	130e
11	Radwaste Facility	3/31/89	130f

TABLE 3-4

REGULATORY BRIEFINGS AND MEETINGS

Commission Briefings

September 19, 1986

April 30, 1987

January 26, 1988

January 24, 1989

November 1, 1989

ACRS Full Committee Meetings

January 8, 1987

March 6, 1987

January 7, 1988

August 11, 1989

November 17, 1989

March 5, 1990

ACRS Subcommittee Meetings

January 7, 1987

June 1, 1988

November 15-16, 1988

May 10-11, 1989

October 31, 1989

NRC Management Meetings

October 16, 1986

October 21-22, 1987

March 13-14, 1989

TABLE 3-5

RESPONSE TO NRC REQUESTS

FOR ADDITIONAL INFORMATION (RAI)

RAI NO.	DATE	SUBJECT	PRIMARY RESPONSE DATE
1	2/22/88	Chapters 4, 5, 6 & 15	4/29/88
2	7/7/88	Chapters 4, 5, 6 & 15	9/14/88
3	9/12/88	Chapters 1, 2 & 3	11/14/88
4	9/20/88	Chapters 4, 5, 6 & 15	12/9/88
5	9/26/88	Chapters 1, 2 & 3	12/9/88
6	10/26/88	Chapters 4, 5, 6 & 15	12/9/88
7	2/7/89	Chapters 9, 11, 12, & 13	3/7/89
8	5/16/89	Chapters 7, 8 & 17	7/13/89
9	11/28/89	Appendix 19D	1/9/90
10	1/26/90	Chapter 10	2/28/90
11	3/14/90	Chapters 7 & 10	4/16/90
12	5/1/90	Chapter 19	6/1/90
13	5/4/90	Chapter 11 Chapter 12	6/7/90 6/1/90
14	7/27/90	Chapter 18	9/28/90*
15	8/15/90	Chapters 3, 9 & 13	9/28/90
16	8/19/90	Chapter 9	10/31/90*

*Requested response date

4. DESIGN CERTIFICATION

4.1 STATEMENT OF OBJECTIVES

The objective of this task is to achieve certification of the ABWR design for referencing in new licensing applications. Upon granting of the FDA by the NRC, and prior to initiating certification steps, a reassessment of continuing through certification will be made taking into account industry, regulatory, and other applicable conditions which prevail at that time. Once the decision is made to continue, the NRC would be expected to proceed to certification through rulemaking. The Commission may also adopt new administrative provisions to the Regulations that institute needed improvements to the licensing process -- improvements aimed at establishing a licensing framework matched to the needs of nuclear power plant standardization. This would begin with new Part 52 to 10CFR which allows the ABWR to be referenced in combined license applications (i.e., CP/OL) with adequate protection from subsequent challenge in individual hearings.

4.2 SUMMARY OF PROGRESS ACHIEVED

The Design Certification task was initiated late in GFY90. The planned initial work was to perform detailed planning and initiate coordination for the rulemaking hearings. However, because of the close relationship between the FDA and design certification through Part 52, it was decided to cover all the broad Part 52 issues under the task in addition to the specifics of the rulemaking hearings.

4.3 PRINCIPAL ACCOMPLISHMENTS AND FINDINGS

Design Certification activities focused on industry initiatives via NUMARC, mostly regarding resolution of the format and content of the design certification rule (i.e., Tier 1/Tier 2), the format and content of ITAAC and the "level of detail" issue. Specific Commission guidance on this and other related certification issues (e.g., NEPA) is expected in Early GFY91. Principal accomplishments in these areas are:

Level of Detail

By way of SECY-90-241, the NRC staff has informed the Commission of what they believe to be the range of options in regard to the level of detail issue, and have specifically asked the Commission for guidance in this area. The staff is, or will be preparing a subsequent paper that offers specific recommendations in this regard and should be expected to forward such to the Commission early in GFY91. Informed sources report that the staff will probably suggest something very close to the industry position, and thus, in such case, the impact on the ABWR submittal would not be significant. However, it is unclear whether the Commission is ready to embrace such a recommendation at this time. The Commission is expected to provide their guidance in this area sometime later this fall.

Format & Content of Rulemaking/ITAAC

A key aspect of the forthcoming policy guidance will be whether or not the Commission agrees that the "two-tier" approach to the certification rulemaking process being offered by industry is an acceptable one. Such a two-tiered certification rule is essential to the industry approach to ITAAC, as documented in the NUMARC draft ITAAC Report. It is likely that ITAAC will be the next certification policy issue for which Commission guidance will be sought. However, industry is pushing for early buy-in on at least the two-tier aspect the approach so that GE, and others to follow, can finalize the submit ITAAC that are at least reasonably close to what the NRC is expecting. Of course, the final agreed upon ITAAC are expected to be the result of NRC staff and certification applicant negotiations. Currently, GE is expecting to submit proposed ITAAC sometime during the first quarter of GFY91.

5. REFERENCES

1. Thomas E. Murley (NRC) to Ricardo Argitas (GE) dated August 7, 1987.

2. General Electric Company GESSAR II BWR/6 Nuclear Island Design (22A7007), March 1980.

3. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Plants," U.S. Nuclear Regulatory Commission.

4. J. F. Quirk (GE) to Carlyle Michelson (ACRS), "November 17, 1989 ACRS Meeting on Module 1 of ABWR Draft Safety Evaluation Report," March 29, 1990.

5. R. C. Mitchell (GE) to Charles L. Miller (NRC), "Responses to ABWR Seismic Design Audit Open Issues and Information Requests," May 16, 1990.

6. P. W. Marriott (GE) to Charles L. Miller (NRC), "Response to NRC/GE May 16-17, 1990 Meeting Discussion Topics", August 9, 1990.

7. P. W. Marriott (GE) to Charles L. Miller (NRC), "Response to NRC/GE May 16-17, 1990 Meeting Discussion Topics," October 17, 1990.

8. D. R. Wilkins (GE) to Dr. Thomas E. Murley (NRC), "Comparison of ALWR Requirements Document and ABWR SSAR Design," June 12, 1990.

9. John J. Taylor (EPRI) to Dr. Thomas E. Murley (NRC), "GE ABWR Certification," June 15, 1990.

END

DATE FILMED

02 / 14 / 91