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Subject: **Transmital of NEDO-33181 Revision 6, NEDO-33260 Revision 5, and NEDO-33289 Revision 2, Related to ESBWR Design Certification Application – Chapter 17**

The purpose of this letter is to formally submit the following documents referenced by ESBWR DCD Revision 6, Chapter 17, Quality Assurance (Ref. 1).

Enclosure 1 contains GE Hitachi Nuclear Energy, "NP-2010 COL Demonstration Project Quality Assurance Plan," NEDO-33181, Revision 6, August 2009.

Enclosure 2 contains GE Hitachi Nuclear Energy, "Quality Assurance Requirements for Suppliers of Equipment and Services to the GEH ESBWR Project," NEDO-33260, Revision 5, April 2008.

Enclosure 3 contains GE Energy Nuclear, "ESBWR Reliability Assurance Program," NEDO-33289, Revision 2, September 2008.

If you have any questions about the information provided, please contact me.

Sincerely,

Richard E. Kingston

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Vice President, ESBWR Licensing

Reference:

1. MFN 09-572, ESBWR Standard Plant Design Certification Application Design Control Document, Revision 6, Tier 1 and Tier 2, dated August 31, 2009

Enclosures:

1. GE Hitachi Nuclear Energy, “NP-2010 COL Demonstration Project Quality Assurance Plan,” NEDO-33181, Revision 6, August 2009.
2. GE Hitachi Nuclear Energy, “Quality Assurance Requirements for Suppliers of Equipment and Services to the GEH ESBWR Project,” NEDO-33260, Revision 5, April 2008.
3. GE Energy Nuclear, “ESBWR Reliability Assurance Program,” NEDO-33289, Revision 2, September 2008.

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Enclosure 3

MFN 10-007

GE Energy Nuclear, "ESBWR Reliability Assurance Program," NEDO-33289, Revision 2, September 2008.

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3901 Castle Hayne Road, Wilmington, NC 28401

NEDO-33289
Revision 2
DRF 0000-0060-1791
Class II
September 2008

Licensing Topical Report

ESBWR Reliability Assurance Program

Principal Author:

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ELECTRONIC COPY

Electronic approvals filed in

EDRF Section 0000-0060-1791

IMPORTANT NOTICE REGARDING THE CONTENTS OF THIS REPORT

Please Read Carefully

The information contained in this document is furnished for the purpose of obtaining NRC approval of the GE Hitachi Nuclear Energy (GEH) ESBWR Certification and implementation. The only undertakings of GEH with respect to information in this document are contained in contracts between GEH and participating utilities, and nothing contained in this document shall be construed as changing those contracts. The use of this information by anyone other than those participating entities and for any purposes other than those for which it is intended is not authorized; and with respect to any unauthorized use, GEH makes no representation or warranty, and assumes no liability as to the completeness, accuracy, or usefulness of the information contained in this document.

Changes From Revision 1

Change	Description
Updated entire document to latest LTR format	Format only; no technical change. Includes addition of change list, list of tables, list of abbreviations and acronyms, and executive summary.
Corrected typographical errors in references, Section 6.	Editorial corrections to close out CAR 46111.
Corrected acronym use.	Editorial only; spelled out all acronyms at first use.
Changed from 3 to 4 phases in Sections 2 and 4 to account for COL applicant and COL holder, and added appropriate text.	Revised to be consistent with response to RAI 17.4-20.
Removed blank pages.	Format only.
Updated TOC to reflect added sections.	Editorial for consistency.

Contents

List of Tables

None

Abbreviations And Acronyms List

Term	Definition
PRA	Probabilistic Risk Assessment
RAP	Reliability Assurance Program
D-RAP	Design Reliability Assurance Program
SSC	Systems, Structures, and Components
COL	Combined Operating License
ITAAC	Inspections, Tests, Analyses and Acceptance Criteria
GEH	GE Hitachi Nuclear Energy
RTNSS	Regulatory Treatment of Nonsafety Systems

ABSTRACT

This document presents the plans for, and the constituents of, the generic Reliability Assurance Program required by NUREG-0800 as part of the ESBWR Design Certification. ESBWR reliability assurance will provide for a high level of equipment reliability that is consistent with the ESBWR Probabilistic Risk Assessment (PRA) and the ESBWR design such that it is preserved throughout the life of the plant. It will also ensure that as the design evolves through ESBWR design certification into initial fuel load and operation, an ESBWR licensee can assure that the reliability estimated in the design certification PRA is preserved.

1. OVERVIEW

1.1 INTRODUCTION

ESBWR reliability assurance is the continuous process of assuring that a high level of equipment reliability, as estimated by the Probabilistic Risk Assessment (PRA), is consistent with the ESBWR design and is preserved throughout the life of the plant. The Design Reliability Assurance Program (D-RAP) is designed to ensure that as the design evolves through ESBWR design certification into initial fuel load and operation, sufficient information is available for an ESBWR licensee to assure that the reliability estimated in the design certification PRA is preserved.

1.2 OBJECTIVES

The objectives of the RAP are to provide reasonable assurance of the following:

- The plant is designed, constructed, and operated consistent with risk-significant PRA assumptions and insights for systems, structures and components (SSCs);
- Risk-significant SSCs will not degrade to an unacceptable level during plant operations;
- The frequency of transients posing challenges to risk-significant SSCs is minimized;
- Risk-significant SSCs will function reliably when challenged.

1.3 USING THIS DOCUMENT

Significant insights into what constitutes an effective D-RAP may be found in NUREG-0800 Section 17.4 (Reference 1). The procedures and performance requirements for implementing the D-RAP are provided in Section 3 of this plan. It is helpful to think of the overall reliability assurance program in the phases described in Section 2 in order to help discern among the reliability program products and procedures. While not specifically part of the D-RAP, Section 4 summarizes the procedures and performance requirements for which the ESBWR licensees will be responsible.

2. RELIABILITY ASSURANCE PROGRAM PHASES

2.1 PHASE I – DESIGN CERTIFICATION

The D-RAP is the first reliability assurance phase. It is developed by the designer to support ESBWR design certification. During this phase, a preliminary, generic PRA model is developed, along with PRA insights and assumptions.

In this phase, preliminary ESBWR design certification PRA information is incorporated into the plant design. The PRA is a generic model, i.e., plant-specific details are not available. The PRA data is based on generic estimates for initiating event frequencies, failure rates, and human error probabilities. The essential elements of the D-RAP for Phase I include:

- A preliminary summary of risk-significant design PRA insights and assumptions (see Reference 2);
- A preliminary list of risk-significant SSCs and the reliability assumed in the design PRA (see Reference 3);
- Inspections, Tests, Analyses and Acceptance Criteria (ITAAC) prepared in accordance with Reference 1 to be used by the licensee to verify that probability assumptions used for the design certification are consistent with the as-built plant (see Reference 4);
- A description of the ESBWR D-RAP (see Reference 5).

During the design phase, key risk-informed information is provided to the system engineer to ensure that it is incorporated into the final system design. The procedures for identifying and prioritizing SSCs are discussed in Section 3. The ESBWR PRA reliability assumptions are described in the design certification PRA (Reference 2).

2.2 PHASE II – COL APPLICANT D-RAP ACTIVITIES

The Combined Operating License (COL) Applicant ensures that the list of risk-significant SSCs is updated with plant-specific information, such as departures from the standard design.

2.3 PHASE III – COL HOLDER D-RAP ACTIVITIES

In this phase, the COL Holder carries forward and refines the products from Phases I and II. The COL Holder completes the ITAAC, and the list of risk-significant SSCs within the scope of the RAP is refined based on plant-specific PRA results and insights. These results are evaluated using a licensee's expert panel to ensure establishment of dominant failure modes as well as recommended operations, maintenance and monitoring strategies.

The design certification PRA model and reliability products are updated to include plant-specific details. The design certification applicant and plant license holder may have joint responsibility for creating an expert panel to review the risk-significant SSC list. The panel evaluates the updated PRA information, in concert with traditional engineering evaluations, sensitivity studies, PRA insights and assumptions, operational experience, and current regulatory requirements. The evaluation provides an updated comprehensive list of risk-significant SSCs. In addition, the

expert panel may use this evaluation to develop reliability assurance strategies for procurement and construction and pre-operational testing.

The PRA model is also updated to contain plant-specific design details and estimated human error probabilities that are based on the development of plant operating procedures. The plant licensee has the responsibility for updating the list of risk-significant SSCs and developing the Maintenance Rule program.

2.4 PHASE IV – OPERATIONS

Phase IV is plant operation following initial fuel load. During the operations phase, the products from Phase III are used to implement the RAP through the plant's Maintenance Rule Program and other processes required under 10CFR 50, such as Quality Assurance, In-Service-Inspection and Testing, and Corrective Action Program.

The ESBWR licensee incorporates recommended operations, maintenance and monitoring strategies into Phase IV of the RAP, to assure that applicable SSCs can be expected to operate throughout plant life with reliable performance that is consistent with the PRA.

The PRA is now a comprehensive (but inexperienced) model. The Operations PRA model and the key RAP products are updated using the plant-specific procedural controls. The RAP is integrated primarily into the Maintenance Rule Program, but some elements may also be included in the Appendix B Program, the Inservice Inspection Program or other risk-informed applications.

3. ESBWR D-RAP IMPLEMENTATION FOR PHASE I

The D-RAP is implemented in a manner consistent with the elements described in Section 17.4 of NUREG-0800 (Reference 1). The D-RAP is described in detail in Section 17.4 of the Tier 2 Design Control Document (Reference 5). An ITAAC for the D-RAP is included in Section 3.6 of the Tier 1 Design Control Document (Reference 4). A list of risk-significant SCCs is provided in Reference 3. The organizational responsibilities, the application of design controls, and the D-RAP procedures described in the Design Control Documents are consistent with the following sections.

3.1 PURPOSE

The purpose of the ESBWR D-RAP described in this document is to implement the design certification RAP in order to provide reasonable assurance that plant safety, in the form of equipment reliability as estimated by the ESBWR PRA, is available from the design phase so that pertinent information related design equipment reliability, as it affects plant safety, can be maintained through the entire plant life.

3.2 SCOPE

The scope of the ESBWR D-RAP includes risk-significant SSCs, both safety-related and nonsafety related, that provide defense-in-depth or have been shown to result in significant improvement in the PRA evaluations. A list of risk-significant SSCs within the scope of the D-RAP is developed during the design certification phase. This information ultimately helps form the basis for the Maintenance Rule program, which in turn ensures that risk-significant SSCs operate throughout plant life with reliable performance that is consistent with the PRA.

3.3 DESIGN ORGANIZATION

The GE ESBWR Engineering Section is an integrated design and engineering organization that is responsible for formulating and implementing the D-RAP. The Manager, ESBWR Engineering, is responsible for the design and licensing of the ESBWR, and for development of the D-RAP.

The ESBWR Engineering organization is responsible for the ESBWR design analysis and PRA engineering that is necessary to support development of the D-RAP. PRA personnel are directly involved with the design organization and keep the design staff cognizant of risk-significant items, program needs, and project status. PRA personnel participate in the design change control process, which includes providing RAP related inputs in the design process.

3.4 DESIGN CONTROLS

ESBWR design control procedures provide guidance for developing reliability assurance. The overall GE ESBWR engineering design procedural controls are also applied to the D-RAP. These procedures provide guidance on the design process, control of design changes, and storage and retrieval controls.

Design change control procedures define the process for evaluating design changes in engineering controlled documents to ensure that the total effect is considered before a change is approved. The procedure provides authority for a change and identifies the pertinent interfaces and organizations responsible for these interfaces, including PRA review, and provides accurate and traceable records of a change.

The documentation procedure establishes the requirements and responsibilities for the preparation, approval, and issue of documents controlled by the engineering design organizations. The quality assurance records procedure provides requirements for quality assurance record retention. The self-assessment, corrective action and audits procedure specify the responsibilities for performing self-assessments; internal audits of the engineering organization; and prompt identification, documentation, and corrective actions on conditions that are adverse to quality.

3.5 D-RAP PROCEDURES FOR PHASE I

The ESBWR D-RAP procedure or procedures contain, but may not be limited to, the program purpose, scope, limitations, bases, responsibilities, the procedures used to implement the D-RAP, as well as any self-assessment and corrective actions methods and program record keeping requirements for the program.

The reliability assurance procedures developed for the ESBWR D-RAP are consistent with the performance requirements provided in this section. Procedures provide for corrective actions when the requirements are not met.

In addition to the standard engineering design processes and quality controls, specific guidance is necessary to implement an effective D-RAP. The D-RAP procedures describe the processes for identifying and prioritizing risk significance, maintaining design and PRA reliability assumptions consistent for risk-significant SSCs, and monitoring program effectiveness. D-RAP procedures are used to develop the Phase I products such that the risk-significant SSC reliability assumed in the design certification PRA in incorporated into the design of the ESBWR can be carried through fuel load and into operation.

During the design phase, procedures provide instructions for developing and documenting ESBWR design certification PRA risk insights and assumptions. Procedures require that these risk-significant PRA insights and assumptions be compared with the evolving ESBWR design.

Design phase procedures require that a list of risk-significant SSCs be developed. Preliminary lists are developed based on the generic ESBWR PRA information available as the design evolves during the design certification phase. As the design progresses, the list of risk significant SSCs is updated using methods that apply the best information from PRA results with defense-in-depth principles and pertinent operating experience. Procedures provide for an expert panel with collective knowledge and experience in operations and maintenance processes. This expert panel may be used as an option to evaluate this design certification information during the design phase, but is not required.

4. ESBWR RAP IMPLEMENTATION FOR PHASES II, III AND IV

4.1 SCOPE

The COL Applicant and COL Holder are responsible for implementing Phases II, III and IV of the RAP, respectively. Licensees use the Phase I products as inputs to implement these phases.

Licensee procedures describe the processes used to translate risk insights and the list of risk-significant SSCs from Phase I into strategies for reliability assurance. This involves confirming the dominant failure modes of risk-significant SSCs and their effects on safety functions. Specific operations and maintenance strategies to address the dominant failure modes are identified so that equipment performance is consistent with the PRA.

4.2 PHASE II III AND IV PROCEDURES

Licensee procedures contain instruction for engineers to evaluate the design of a component, train or system to identify dominant failure modes and their effects. Inputs may include PRA importance analysis, root cause analysis, failure modes and effects analysis, and review of operating experience.

Equipment performance information, including vendor manuals, ASME Section XI, technical specifications, Regulatory Treatment of Non-Safety Systems (RTNSS), and other regulatory requirements may be reviewed to identify important safety functions. Licensee procedures provide instructions for engineers to analyze this information to identify dominant failure modes, such as single failures, latent failures not detected by routine monitoring, common cause failures, or failures that could cascade into more significant safety functional failures. This information is incorporated into the baseline and routine design reliability assessments.

4.3 LICENSEE RAP PROCEDURE PERFORMANCE REQUIREMENTS

Licensee procedures describe requirements and instructions for the engineers and the expert panel, collectively, to identify operational reliability assurance strategies for all phases of design and construction that are realistic and achievable. Risk insights may be applied in each phase of development, as indicated by the following examples:

- ESBWR Equipment Procurement and Fabrication
  - Incorporate Risk-Significant Insights into Procurement Specifications, when applicable. Risk-significant components, especially those that are unique to the ESBWR design, are procured with the reliability that is assumed in the PRA. If a component's reliability deviates significantly from the assumed PRA value, it must be evaluated to determine if a PRA model change or a design change is warranted.
- ESBWR Reliability Procedures for Construction
  - Monitor Design Changes. Changes that affect functional characteristics of major components might affect the PRA model.

  - Assess physical layout of SSCs with respect to adverse interactions, fire and flood separation.

- ESBWR Procedures for Pre-Operational Testing
  - Validate risk-significant PRA assumptions by tests, if applicable.
- ESBWR Plant Operations Reliability Procedures
  - Maintenance Rule implementation.
  - Operator training and procedures.
    - Preventive and predictive maintenance (including test and maintenance unavailability used in the PRA model)
  - Surveillance testing.
  - Component performance.
  - Initiating event experience.
  - Human factors.

5. MONITORING AND FEEDBACK (ALL PHASES)

Throughout all phases of the ESBWR RAP, procedures are in place to ensure that processes are established to continuously monitor and refine the elements of the reliability program. These processes include, but are not limited to, design reliability assessments and operations and maintenance reliability assessments.

6. REFERENCES

(1) NUREG-0800, U.S. Nuclear Regulatory Commission Standard Review Plan, Sections 17.4, Reliability Assurance Program (RAP), March 2007

(2) NEDO-33201, ESBWR Probabilistic Risk Assessment

(3) NEDO-33411, ESBWR Risk-Significance of Structures, Systems and Components for the Design Phase of the ESBWR

(4) 26A6641AB, ESBWR Design Control Document/Tier 1

(5) 26A6642BW, ESBWR Design Control Document Chapter 17/Tier2