**HITACHI**

**GE Hitachi Nuclear Energy**

Richard E. Kingston
Vice President, ESBWR Licensing

3901 Castle Hayne Road
PO Box 780 M/C A-65
Wilmington, NC 28402-0780
USA

T 910 819 6192
F 910 362 6192
Rick.Kingston@ge.com

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Subject: **Submittal Related to ESBWR Design Certification Application - Appendix 1D, Summary of Tier 2* Information**

Enclosure 1 contains page changes to DCD Tier 2, Chapter 1. These changes add Appendix 1D, Summary of Tier 2* Information in compliance with Standard Review Plan (SRP) 14.3, Appendix A, Section III.2 which states, "A table should be provided in the DCD listing the areas of the DCD that contain Tier 2* information".

Additional DCD changes were identified as a result of compiling the new Appendix. These changes, also part of Enclosure 1, include:

Chapter 1 - Table 1.6-1 was updated to designate instrument setpoint methodology, NEDE-33304P / NEDO-33304, as Tier 2*. The table was also updated to list the non-proprietary versions of NEDO-33243 and NEDO-33244.

Chapter 4 - References 4.2-5, 4.2-8, 4.2-9 and 4.4-12 were updated to list the non-proprietary versions of NEDO-33242, NEDO-33244, NEDO-33243 and NEDO-33237.

Chapter 7 - References 7.1-9, 7.2-1, 7.3-2, 7.4-2, 7.5-2 and 7.8-4 were updated to designate NEDE-33304P / NEDO-33304 as Tier 2*.

D068
NRO

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

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

Enclosure:

1. Submittal Related to ESBWR Design Certification Application - Appendix 1D, Summary of Tier 2* Information– DCD Markup

cc:

| | |
|---|---|
| AE Cubbage | USNRC (with enclosures) |
| JG Head | GEH/Wilmington (with enclosures) |
| DH Hinds | GEH/Wilmington (with enclosures) |
| LF Dougherty | GEH/Wilmington (with enclosures) |
| eDRF Section | 0000-0118-2543 |

# Enclosure 1

# MFN 10-162

# Submittal Related to ESBWR Design Certification Application

# Appendix 1D, Summary of Tier 2* Information

# DCD Markup

# 1. INTRODUCTION AND GENERAL DESCRIPTION OF PLANT

## 1.1 INTRODUCTION

### 1.1.1 Format and Content

This design control document (DCD) describes the ESBWR and is written based on the general contents of the ABWR DCD, with additional material provided to be consistent with the NUREG-0800 Standard Review Plan versions as summarized in Table 1.9-20. In addition, a number of other relevant topics are addressed, e.g., Appendix 1A describes the treatment of TMI-related matters; Appendix 1B discusses plant shielding to provide access to areas and protective safety equipment for post-accident operation in response to NUREG-0737, Item II.B.2; ~~and~~ Appendix 1C discusses industry operating experience; and Appendix 1D provides a summary of DCD locations containing Tier 2* information that requires NRC approval before making any changes.

Chapter 19 provides the response to the severe accident policy statement.

### 1.1.2 General Description

#### *1.1.2.1 ESBWR Standard Plant Scope*

The ESBWR Standard Plant includes buildings dedicated exclusively or primarily to housing systems and equipment related to the nuclear system or controlled access to these systems and equipment. Figure 1.1-1 illustrates a conceptual layout showing the approximate relative locations of these buildings, but an individual Combined License (COL) may be arranged differently.

##### 1.1.2.1.1 Seismic Category I Standard Plant Structures

The following Seismic Category I buildings/structures are within the design certification scope for the ESBWR:

- Reactor Building – houses safety-related structures, systems and components (SSC), except for the main control room, safety-related Distributed Control and Information System equipment rooms in the Control Building and spent fuel storage pool and associated auxiliary equipment in the Fuel Building. The Reactor Building includes the reactor, containment, refueling area and auxiliary equipment.
- Control Building – houses the main control room and safety-related controls outside the reactor building.
- Fuel Building – houses the spent fuel storage pool and its associated auxiliary equipment.
- Firewater Service Complex – consists of two fire water storage tanks and a fire pump enclosure that share a common basemat.

##### 1.1.2.1.2 Seismic Category II and NS Standard Plant Structures

The following Seismic Category II and NS buildings/structures are included in the ESBWR standard plant scope:

**Table 1.6-1**

**Referenced GE / GEH Reports**

| Report No. | Title | Section No. |
|---|---|---|
| NEDC-33238P<br>NEDO-33238 | Global Nuclear Fuel, "GE14 Pressure Drop Characteristics", NEDC-33238P, Class III (Proprietary), and NEDO-33238, Class I (Non-proprietary), December 2005. | 4.4 |
| NEDC-33239P<br>NEDO-33239 | *[Global Nuclear Fuel, "GE14 for ESBWR Nuclear Design Report," NEDC-33239-P, Class III (Proprietary) and NEDO-33239, Class I (Non-proprietary), Revision 4, March 2009.]** | 4.3, 4.4, 4A, 4D, 15.0, 15.2, 15.3, 15.5, Chapter 16 B3.1.1 |
| NEDC-33240P<br>NEDO-33240 | *[Global Nuclear Fuel, "GE14E Fuel Assembly Mechanical Design Report," NEDC-33240P, Class III (Proprietary), and NEDO-33240, Class I (Non-proprietary), Revision 1, January 2009.]** | 4.2 |
| NEDC-33242P<br>NEDO-33242 | *[Global Nuclear Fuel, "GE14 for ESBWR Fuel Rod Thermal-Mechanical Design Report," NEDC-33242P, Class III (Proprietary), and NEDO-33242, Class I (Non-proprietary), Revision 2, June 2009.]** | 4.2 |
| NEDE-33243P<br>NEDO-33243 | *[GE Hitachi Nuclear Energy, "ESBWR Control Rod Nuclear Design," NEDE-33243P, Class III (Proprietary), Revision 2, July 2008, and NEDO-33243, Class I (Non-proprietary), Revision 2, July 2008.]** | 4.2, Chapter 16 B3.1.3 |
| NEDE-33244P<br>NEDO-33244 | *[GE Hitachi Nuclear Energy, "ESBWR Marathon Control Rod Mechanical Design Report," NEDE-33244P, Class III (Proprietary), Revision 1, November 2007, and NEDO-33244, Class I (Non-proprietary), Revision 1, November 2007.]** | 4.2 |
| NEDE-33245P<br>NEDO-33245 | *[GE Hitachi Nuclear Energy, "ESBWR – Software Quality Assurance Program Manual," NEDE-33245P, Class III (Proprietary), Revision 5, February 2010, and NEDO-33245, Class I (Non-proprietary),Revision 5, February 2010.]** | 7.1, 7.2, 7.3, 7.8, 7B, 17.1 |

**Table 1.6-1**

**Referenced GE / GEH Reports**

| Report No. | Title | Section No. |
|---|---|---|
| NEDE-33304P<br>NEDO-33304 | *[GE-Hitachi Nuclear Energy, "GEH ESBWR Setpoint Methodology," NEDE-33304P, Class III (Proprietary), and NEDO-33304, Class I (Non-proprietary), Revision ~~34~~ 34, ~~February~~ May 2010.]** | 7.1, 7.2, 7.3, 7.4, 7.5, 7.8<br>Chapter 16 Sect. 5.5.11 |
| NEDO-33306 | GE Hitachi Nuclear Energy, "ESBWR Severe Accident Mitigation Design Alternatives," NEDO-33306, Class I (Non-proprietary), Revision 1, August 2007. | 19.2 |
| NEDE-33312P<br>NEDO-33312 | GE Hitachi Nuclear Energy, "ESBWR Steam Dryer Acoustic Load Definition," NEDE-33312P, Class III (Proprietary), Revision 1, July 2009, and NEDO-33312, Class I (Non-Proprietary), Revision 1, July 2009. | 3L |
| NEDE-33313P<br>NEDO-33313 | GE Hitachi Nuclear Energy, "ESBWR Steam Dryer Structural Evaluation," NEDE-33313P, Class III (Proprietary), Revision 1, July 2009, and NEDO-33313, Class I (Non-Proprietary), Revision 1, July 2009. | 3.9, 3L |
| NEDC-33326P<br>NEDO-33326 | *[Global Nuclear Fuel, "GE14E for ESBWR Initial Core Nuclear Design Report," NEDC-33326P, Class III (Proprietary), and NEDO-33326, Class I (Non-proprietary), Revision 1, March 2009.]** | 4.3, 4.4, 4A, 4D, 15.0, 15.2, 15.3, 15.5 |
| NEDO-33337 | GE Hitachi Nuclear Energy, "ESBWR Initial Core Transient Analyses," NEDO-33337, Class I (Non-proprietary), Revision 1, April 2009. | 4.4, 4D, 15.0, 15.2, 15.3, 15.5, 15D |
| NEDO-33338 | GE Hitachi Nuclear Energy, "ESBWR Feedwater Temperature Operating Domain Transient and Accident Analysis," NEDO-33338, Class I (Non-proprietary), Revision 1, May 2009. | 1.1, 4.4, 4D, 6.2, 6.3, 15.0, 15.2, 15.3, 15.5, 15D<br>Chapter 16, Sect. 5.6.3 |

# APPENDIX 1D SUMMARY OF TIER 2* INFORMATION

## 1D.1 PLANT-SPECIFIC CHANGES TO CERTAIN DESIGNATED MATERIAL IN TIER 2

Certain information within sections of Tier 2 is designated as Tier 2* with brackets, italicized text, and an asterisk after the closing bracket. Table 1D-1 provides a summary of DCD locations that contain Tier 2* information. A plant-specific change to any of this Tier 2* designated information shall require NRC Staff approval prior to implementing the change. A request for departure from Tier 2* will be treated as a request for license amendment under 10 CFR 50.90 and 50.92.

## 1D.2 EXPIRATION OF TIER 2* INFORMATION

The requirement for prior NRC Staff approval of plant-specific changes will expire for some of the designated information, as indicated in Table 1D-1, when the plant first achieves 100% power.

Tier 2* material related to the following topics has no expiration date and may not be changed without prior NRC approval. A request for a departure will be treated as a request for a license amendment.

- Fuel mechanical and thermal-mechanical design evaluation reports (References 4.2-4 and 4.2-5).
- Control rod mechanical and nuclear design reports (References 4.2-8 and 4.2-9).
- Fuel nuclear design report (referenced in several locations in Chapters 4 and 15).
- Critical power correlation (Reference 4.4-12).
- Fuel licensing acceptance criteria (Appendix 4B).
- Control rod licensing acceptance criteria (Appendix 4C).
- Mechanical and structural design of spent fuel storage racks (Subsection 9.1.2.4 and Reference 9.1-2).

After the plant first achieves full power, Tier 2* material related to the following topics reverts to Tier 2 status and is thereafter subject to the same departure provisions that apply to Tier 2 material.

- ASME Boiler & Pressure Vessel Code, Section III.
- ACI 349 and ANSI/AISC–N690.
- Motor-operated valves.
- Equipment seismic qualification methods.
- Piping design acceptance criteria.
- Instrument Setpoint Methodology

- Safety-Related Distributed Control and Information System (Q-DCIS) performance specifications and architecture.
- Safety System Logic and Control (SSLC) hardware and software qualification.
- Self-test system design testing features and commitments.
- Human factors engineering design and implementation process.

## Table 1D-1

## Summary of Tier 2* Information

| Location | Short Description of Tier 2* Information | Expiration |
|---|---|---|
| **Chapter 1** | | |
| Table 1.6-1 | Selected Licensing Topical Reports (LTRs) consistent with how they are marked at their referenced locations | As marked at their referenced locations later in this table |
| Table 1.9-22 | Applicable Edition/Addenda for ASME Boiler and Pressure Vessel Code, Section III | First Full Power |
| **Chapter 2** | | |
| Table 2.0-1 | Standard Plant Site Parameters | First Full Power |
| Figure 2.0-1 | Horizontal SSE Design Ground Spectra at Foundation Level | First Full Power |
| Figure 2.0-2 | Vertical SSE Design Ground Response Spectra at Foundation Level | First Full Power |
| **Chapter 3** | | |
| S3.6.2.1.1 | Locations of Postulated Pipe Breaks | First Full Power |
| S3.6.2.1.2 | Locations of Postulated Pipe Cracks | First Full Power |
| S3.6.2.5 | Pipe Break Analysis Results and Protection Methods | First Full Power |
| S3.7 | Seismic Design | First Full Power |
| S3.7.1.1.3 | Single Envelope Ground Motion | First Full Power |
| S3.7.1.2 | Percentage of Critical Damping Values | First Full Power |
| S3.7.1.3 | Supporting Media for Category I Structures | First Full Power |
| S3.7.2 | Seismic System Analysis | First Full Power |
| S3.7.2.1.2 b) | Response Spectrum Method, Multi-Supported System with ISMs | First Full Power |
| S3.7.2.1.3 | Static Coefficient Method | First Full Power |
| S3.7.2.2 | Natural Frequencies and Responses | First Full Power |
| S3.7.2.3 | Procedures Used for Analytical Modeling | First Full Power |
| S3.7.2.4 | Soil-Structure Interaction | First Full Power |
| S3.7.2.5 | Development of Floor Response Spectra | First Full Power |
| S3.7.2.6 | Three Components of Earthquake Motion | First Full Power |

## Table 1D-1

## Summary of Tier 2* Information

| Location | Short Description of Tier 2* Information | Expiration |
|---|---|---|
| S3.7.2.7 | Combination of Modal Responses | First Full Power |
| S3.7.2.8.1 | Turbine Building | First Full Power |
| S3.7.2.8.2 | Radwaste Building | First Full Power |
| S3.7.2.8.3 | Service Building | First Full Power |
| S3.7.2.8.4 | Ancillary Diesel Building | First Full Power |
| S3.7.2.9 | Effects of Parameter Variations on Floor Response Spectra | First Full Power |
| S3.7.2.10 | Use of Equivalent Vertical Static Factors | First Full Power |
| S3.7.2.11 | Methods Used to Account for Torsional Effects | First Full Power |
| S3.7.2.13 | Analysis Procedure for Damping | First Full Power |
| S3.7.2.14 | Determination of Seismic Category I Structure Overturning Moments | First Full Power |
| S3.7.3.1 | Seismic Analysis Method | First Full Power |
| S3.7.3.2 | Determination of Number of Earthquake Cycles | First Full Power |
| S3.7.3.3.1 | Piping Systems | First Full Power |
| S3.7.3.3.2 | Equipment | First Full Power |
| S3.7.3.3.3 | Modeling of Special Engineered Pipe Supports | First Full Power |
| S3.7.3.5 | Analysis Procedure for Damping | First Full Power |
| S3.7.3.6 | Three Components of Earthquake Motion | First Full Power |
| S3.7.3.7 | Combination of Modal Responses | First Full Power |
| S3.7.3.8 | Interaction of Other Systems with Seismic Category I Systems | First Full Power |
| S3.7.3.9 | Multiple-Supported Equipment and Components with Distinct Inputs | First Full Power |
| S3.7.3.10 | Use of Equivalent Vertical Static Factors | First Full Power |
| S3.7.3.11 | Torsional Effects of Eccentric Masses | First Full Power |
| S3.7.3.12 | Effect of Differential Building Movements | First Full Power |
| S3.7.3.13 | Seismic Category I Buried Piping, Conduits and Tunnels | First Full Power |

## Table 1D-1

## Summary of Tier 2* Information

| Location | Short Description of Tier 2* Information | Expiration |
|---|---|---|
| S3.7.3.14 | Methods for Seismic Analysis of Seismic Category I Concrete Dams | First Full Power |
| S3.7.3.15 | Methods for Seismic Analysis of Above-Ground Tanks | First Full Power |
| S3.7.3.16 (1) | Design of Small Branch and Small Bore Piping | First Full Power |
| S3.7.5 | Site-Specific Information | First Full Power |
| Table 3.7-2 | 5%-Damped Target Spectra of Single Envelope Design Ground Motion at Foundation Level | First Full Power |
| Table 3.7-3 | Summary of Methods of Seismic Analysis for Primary Building Structures | First Full Power |
| Figure 3.7-38 | Single Envelope Spectrum Match – H1 Component | First Full Power |
| Figure 3.7-39 | Single Envelope Spectrum Match – H2 Component | First Full Power |
| Figure 3.7-40 | Single Envelope Spectrum Match – Vertical Component | First Full Power |
| Figure 3.7-41 | Single Envelope Time Histories – H1 Component | First Full Power |
| Figure 3.7-42 | Single Envelope Time Histories – H2 Component | First Full Power |
| Figure 3.7-43 | Single Envelope Time Histories – Vertical Component | First Full Power |
| S3.8.1.1.1 | Concrete Containment | First Full Power |
| S3.8.1.1.3 | Containment Boundary | First Full Power |
| S3.8.1.2.2 | Construction Codes of Practice | First Full Power |
| S3.8.1.2.3 | General Design Criteria, Regulatory Guides, and Industry Standards | First Full Power |
| S3.8.1.3.6 | Load Combinations for the Containment Structure and Liner Plate | First Full Power |
| S3.8.1.4.1.4 | Corrosion Prevention | First Full Power |
| S3.8.1.5 | Structural Acceptance Criteria | First Full Power |
| S3.8.1.6 | Materials, Quality Control and Special Construction Techniques | First Full Power |
| S3.8.1.6.1 | Concrete | First Full Power |
| S3.8.1.6.2 | Reinforcing Steel | First Full Power |
| S3.8.1.6.3 | Splices of Reinforcing Steel | First Full Power |
| S3.8.1.6.4 | Liner Plate and Appurtenances | First Full Power |

## Table 1D-1

## Summary of Tier 2* Information

| Location | Short Description of Tier 2* Information | Expiration |
|---|---|---|
| S3.8.1.7.1 | Structural Integrity Pressure Test | First Full Power |
| S3.8.1.7.3.12 | Evaluation of Inaccessible Areas | First Full Power |
| S3.8.2.2.1 | Codes, Standards and Regulatory Guides | First Full Power |
| S3.8.2.2.3 | Code Compliance | First Full Power |
| S3.8.2.3 | Loads and Load Combinations | First Full Power |
| S3.8.2.5 | Structural Acceptance Criteria | First Full Power |
| S3.8.2.6 | Materials, Quality Control and Special Construction Techniques | First Full Power |
| S3.8.3.1.1 | Diaphragm Floor | First Full Power |
| S3.8.3.1.3 | Reactor Shield Wall | First Full Power |
| S3.8.3.1.4 | Vent Wall | First Full Power |
| S3.8.3.2 | Applicable Codes, Standards, and Specifications | First Full Power |
| S3.8.3.3.2 | Load Combination | First Full Power |
| S3.8.3.5.1 | Diaphragm Floor | First Full Power |
| S3.8.3.5.2 | Reactor Pressure Vessel Support Brackets | First Full Power |
| S3.8.3.5.3 | Reactor Shield Wall | First Full Power |
| S3.8.3.5.4 | Vent Wall | First Full Power |
| S3.8.3.5.5 | Gravity Driven Cooling System Pool | First Full Power |
| S3.8.3.5.6 | Miscellaneous Platforms | First Full Power |
| S3.8.3.6.1 | Diaphragm Floor | First Full Power |
| S3.8.3.6.2 | Reactor Pressure Vessel Support Brackets | First Full Power |
| S3.8.3.6.3 | Reactor Shield Wall | First Full Power |
| S3.8.3.6.4 | Vent Wall | First Full Power |
| S3.8.3.6.5 | Gravity Driven Cooling System Pool | First Full Power |
| S3.8.3.6.6 | Miscellaneous Platforms | First Full Power |
| S3.8.4 | Other Seismic Category I Structures | First Full Power |
| S3.8.4.1.1 | Reactor Building Structure | First Full Power |
| S3.8.4.1.2 | Control Building | First Full Power |
| S3.8.4.1.3 | Fuel Building | First Full Power |

## Table 1D-1

## Summary of Tier 2* Information

| Location | Short Description of Tier 2* Information | Expiration |
|---|---|---|
| S3.8.4.1.4 | Firewater Service Complex | First Full Power |
| S3.8.4.1.5 | Radwaste Building | First Full Power |
| S3.8.4.2.1 | Reactor Building | First Full Power |
| S3.8.4.2.2 | Control Building | First Full Power |
| S3.8.4.2.3 | Fuel Building | First Full Power |
| S3.8.4.2.4 | Radwaste Building | First Full Power |
| S3.8.4.2.5 | Welding of Pool Liners | First Full Power |
| S3.8.4.3.1.2 | Load Combinations for Concrete Members | First Full Power |
| S3.8.4.3.1.3 | Load Combinations for Steel Members | First Full Power |
| S3.8.4.3.2 | Control Building | First Full Power |
| S3.8.4.3.3 | Fuel Building | First Full Power |
| S3.8.4.3.4 | Radwaste Building | First Full Power |
| S3.8.4.3.5 | Firewater Service Complex | First Full Power |
| S3.8.4.5.1 | Reactor Building | First Full Power |
| S3.8.4.5.2 | Control Building | First Full Power |
| S3.8.4.5.3 | Fuel Building | First Full Power |
| S3.8.4.5.4 | Radwaste Building | First Full Power |
| S3.8.4.5.5 | Firewater Service Complex | First Full Power |
| S3.8.4.6.1 | Concrete | First Full Power |
| S3.8.4.6.2 | Reinforcing Steel | First Full Power |
| S3.8.4.6.3 | Splices of Reinforcing Steel | First Full Power |
| S3.8.4.6.4 | Quality Control | First Full Power |
| S3.8.5.1 | Description of the Foundations | First Full Power |
| S3.8.5.2 | Applicable Codes, Standards and Specifications | First Full Power |
| S3.8.5.3 | Loads and Load Combinations | First Full Power |
| S3.8.5.5 | Structural Acceptance Criteria | First Full Power |
| S3.8.5.6 | Materials, Quality Control, and Special Construction Techniques | First Full Power |
| S3.8.6.1 | Foundation Waterproofing | First Full Power |

## Table 1D-1

## Summary of Tier 2* Information

| Location | Short Description of Tier 2* Information | Expiration |
|---|---|---|
| S3.8.6.2 | Site-Specific Physical Properties and Foundation Settlement | First Full Power |
| Table 3.8-1 | Key Dimensions of Concrete Containment | First Full Power |
| Table 3.8-2 | Load Combinations, Load Factors and Acceptance Criteria for the Reinforced Concrete Containment | First Full Power |
| Table 3.8-3 | Major Allowable Stresses in Concrete and Reinforcing Steel | First Full Power |
| Table 3.8-4 | Load Combination, Load Factors and Acceptance Criteria for Steel Containment Components of the RCCV | First Full Power |
| Table 3.8-5 | Welding Activities and Weld Examination Requirements for Containment Vessel | First Full Power |
| Table 3.8-6 | Codes, Standards, Specifications, and Regulations Used in the Design and Construction of Seismic Category I Internal Structures of the Containment | First Full Power |
| Table 3.8-7 | Load Combination, Load Factors and Acceptance Criteria for Steel Structures Inside the Containment | First Full Power |
| Table 3.8-8 | Key Dimensions of RB, CB, FB, RW and FWSC | First Full Power |
| Table 3.8-9 | Codes, Standards, Specifications, and Regulatory Guides Used in the Design and Construction of Seismic Category I Structures | First Full Power |
| Table 3.8-10 | Temperatures During Operating Conditions (RB) | First Full Power |
| Table 3.8-11 | Temperatures During Operating Conditions (CB) | First Full Power |
| Table 3.8-12 | Temperatures During Operating Conditions (FB) | First Full Power |
| Table 3.8-13 | Key Dimensions of Foundations | First Full Power |
| Table 3.8-14 | Load Combinations and Factor of Safety for Foundation Design | First Full Power |
| Table 3.8-15 | Load Combinations, Load Factors and Acceptance Criteria for the Safety-Related Reinforced Concrete Structures | First Full Power |
| Table 3.8-16 | Load Combinations, Load Factors and Acceptance Criteria for the Safety-Related Steel Structures | First Full Power |
| Table 3.8-18 | Temperatures During Operating Conditions (FWSC) | First Full Power |

## Table 1D-1

## Summary of Tier 2* Information

| Location | Short Description of Tier 2* Information | Expiration |
|---|---|---|
| Figure 3.8-1 | Configuration of Concrete Containment | First Full Power |
| S3.9.2.3 | Dynamic Response of Reactor Internals Under Operational Flow Transients and Steady-State Conditions | First Full Power |
| S3.9.3.1 | Loading Combinations, Design Transients and Stress Limits | First Full Power |
| S3.9.3.1.1 | Plant Conditions – Correlation of Plant Condition with Event Probability | First Full Power |
| S3.9.3.1.2 | Inspections/Testing Following the Reactor Coolant System Exceeding Service Level B Pressure Limit | First Full Power |
| S3.9.3.2 | Reactor Pressure Vessel Assembly | First Full Power |
| S3.9.3.3 | Main Steam System Piping | First Full Power |
| S3.9.3.4 | Other Components:<br>• Main Steamline Isolation, Safety Relief, and Depressurization Valves<br>• ASME Class 1, 2 and 3 Piping | First Full Power |
| S3.9.3.5 | Valve Operability Assurance | First Full Power |
| S3.9.3.6 | Design and Installation of Pressure Relief Devices:<br>• Main Steam Safety Relief Valves<br>• Other Safety Relief and Vacuum Breaker Valves | First Full Power |
| S3.9.3.7 | Component Supports | First Full Power |
| S3.9.3.7.1 | Piping Supports | First Full Power |
| S3.9.3.7.1 Item (3) b. | Inspection, Testing, Repair and/or Replacement of Snubbers | First Full Power |
| S3.9.3.7.1 Item (3) c. iii. | Snubber Design and Testing | First Full Power |
| S3.9.3.7.1 Item (e) | Snubber Preservice and Inservice Examination and Testing | First Full Power |
| S3.9.3.7.2 | Reactor Pressure Vessel Sliding Supports | First Full Power |
| S3.9.3.9.1 | Threaded Fasteners – ASME B&PV Code Class 1, 2 and 3 – Material Selection | First Full Power |

## Table 1D-1

## Summary of Tier 2* Information

| Location | Short Description of Tier 2* Information | Expiration |
|---|---|---|
| S3.9.3.9.2 | Threaded Fasteners – ASME B&PV Code Class 1, 2 and 3 – Special Materials Fabrication Processes and Special Controls | First Full Power |
| S3.9.3.9.3 | Threaded Fasteners – ASME B&PV Code Class 1, 2 and 3 – Preservice and Inservice Inspection Requirements | First Full Power |
| Table 3.9-2 | Load Combinations and Acceptance Criteria for Safety-Related, ASME B&PV Code Class 1, 2 and 3 Components, Component Supports, and Class CS Structures | First Full Power |
| Table 3.9-9 | Load Combinations and Acceptance Criteria for Class 1 Piping Systems | First Full Power |
| Table 3.9-10 | Snubber Loads | First Full Power |
| Table 3.9-11 | Strut Loads | First Full Power |
| Table 3.9-12 | Linear Type (Anchor and Guide) Main Steam Piping Support | First Full Power |
| S3.10.1.1 | Selection of Qualification Method | First Full Power |
| Ref 3.11-6 | LTR NEDE-33516P, ESBWR Qualification Plan Requirements for a 72-Hour Duty Cycle Battery | First Full Power |
| S3A.2 | RB/FB complex, CB and FWSC shape, dimensions and embedment depths | First Full Power |
| Table 3A.2-1 | Standard ESBWR Building Dimensions | First Full Power |
| S3A.3.1 | Generic Site Conditions | First Full Power |
| S3A.3.2 | North Anna ESP Site Conditions | First Full Power |
| Table 3A.3-1 | Generic Site Properties for SSI Analysis | First Full Power |
| Table 3A.3-2 | North Anna Site-specific Properties for SSI Analysis | First Full Power |
| Table 3A.3-3 | Layered Site Cases | First Full Power |
| S3A.4.1 | Input motion for SSI analysis | First Full Power |
| S3A.5, S3A.5.1, S3A.5.2 | Soil-Structure Interaction Analysis Method | First Full Power |
| Table 3A.5-1 | Soil Spring and Damping Coefficient for RB/FB complex | First Full Power |

## Table 1D-1

## Summary of Tier 2* Information

| Location | Short Description of Tier 2* Information | Expiration |
|---|---|---|
| Table 3A.5-2 | Soil Spring and Damping Coefficient for CB | First Full Power |
| Table 3A.5-3 | Soil Spring and Damping Coefficient for FWSC | First Full Power |
| Figure 3A.5-1 | Method for Frequency-Independent Soil Properties | First Full Power |
| S3A.6 | Soil-Structure Interaction Analysis Cases | First Full Power |
| Table 3A.6-1 | Seismic SSI Analysis Cases | First Full Power |
| S3A.7, S3A.7.1, S3A.7.2, S3A.7.3 | Analysis Models | First Full Power |
| Table 3A.7-1 | Eigenvalue Analysis Results for RB/FB model at Soft Site | First Full Power |
| Table 3A.7-2 | Eigenvalue Analysis Results for RB/FB model at Medium Site | First Full Power |
| Table 3A.7-3 | Eigenvalue Analysis Results for RB/FB model at Hard Site | First Full Power |
| Table 3A.7-4 | Eigenvalue Analysis Results for RB/FB model in Fixed-base Case | First Full Power |
| Table 3A.7-5 | Eigenvalue Analysis Results for RB/FB model at Best-estimate North Anna Site | First Full Power |
| Table 3A.7-6 | Eigenvalue Analysis Results for RB/FB model at Upper-bound North Anna Site | First Full Power |
| Table 3A.7-7 | Eigenvalue Analysis Results for RB/FB model at Lower-bound North Anna Site | First Full Power |
| Table 3A.7-8 | Eigenvalue Analysis Results for CB Model at Soft Site | First Full Power |
| Table 3A.7-9 | Eigenvalue Analysis Results for CB Model at Medium Site | First Full Power |
| Table 3A.7-10 | Eigenvalue Analysis Results for CB Model at Hard Site | First Full Power |
| Table 3A.7-11 | Eigenvalue Analysis Results for CB Model in Fixed-base Case | First Full Power |
| Table 3A.7-12 | Eigenvalue Analysis Results for CB Model at Best-estimate North Anna Site | First Full Power |
| Table 3A.7-13 | Eigenvalue Analysis Results for CB Model at Upper-bound North Anna Site | First Full Power |

## Table 1D-1

## Summary of Tier 2* Information

| Location | Short Description of Tier 2* Information | Expiration |
|---|---|---|
| Table 3A.7-14 | Eigenvalue Analysis Results for CB Model at Lower-bound North Anna Site | First Full Power |
| Table 3A.7-15 | Eigenvalue Analysis Results for FWSC Model at Soft Site | First Full Power |
| S3A.9, S3A.9.1, S3A.9.2, S3A.9.3 | Site Envelope Seismic Responses | First Full Power |
| Table 3A.9-1a to 3A.9-1h | Enveloping Seismic Loads | First Full Power |
| Table 3A.9-2a to 3A.9-2e | Enveloping Seismic Loads for LOCA Flooding | First Full Power |
| Table 3A.9-3a to 3A.9-3i | Enveloping Maximum Vertical Acceleration | First Full Power |
| Table 3A.9-4a to 3A.9-4e | Enveloping Maximum Vertical Acceleration for LOCA Flooding | First Full Power |
| Figure 3A.9-1a to 3A.9-3l | Enveloping Floor Response Spectra | First Full Power |
| Appendix 3B | Containment Hydrodynamic Load Definitions | First Full Power |
| Table 3D.1-1 | Computer Program User Details | First Full Power |
| Appendix 3F | Response of Structures to Containment Loads | First Full Power |
| Appendix 3G | Design Details and Evaluation Results of Seismic Category I Structures | First Full Power |
| Ref 3H.4-8 | LTR NEDE-33536P/NEDO-33536, Control Building and Reactor Building Environmental Temperature Analysis for ESBWR | First Full Power |
| Appendix 3I | Designated NEDE-24326-1-P Material Which May Not Change Without Prior NRC Approval | First Full Power |
| **Chapter 4** | | |
| Ref 4.2-4 | LTR NEDE-33240P/NEDO-33240, GE14E Fuel Assembly Mechanical Design Report | None |
| Ref 4.2-5 | LTR NEDC-33242P/NEDO-33242, GE14E for ESBWR Fuel Rod Thermal-Mechanical Design Report | None |

## Table 1D-1

## Summary of Tier 2* Information

| Location | Short Description of Tier 2* Information | Expiration |
|---|---|---|
| Ref 4.2-8 | LTR NEDE-33244P/NEDO-33244, ESBWR Marathon Control Rod Mechanical Design Report | None |
| Ref 4.2-9 | LTR NEDE-33243P/NEDO-33243, ESBWR Marathon Control Rod Nuclear Design Report | None |
| Ref 4.3-8, 4.4-21, 4A-2, 4D-27 | LTR NEDC-33239P/NEDO-33239, GE14 for ESBWR Nuclear Design Report | None |
| Ref 4.3-10, 4.4-20, 4A-1, 4D-23 | LTR NEDC-33326P/NEDO-33326, GE14E for ESBWR Initial Core Nuclear Design Report | First Full Power |
| Ref 4.4-12 | LTR NEDC-33237P/NEDO-33237, GE14 for ESBWR Critical Power Correlation, Uncertainty, and OLMCPR Development | None |
| Ref 4.4-22 | LTR NEDC-33456P/NEDO-33456, Full-Scale Pressure Drop Testing for a Simulated GE14E Fuel Bundle | First Full Power |
| S4B.1 | Fuel Licensing Acceptance Criteria – General | None |
| S4B.3 | Fuel Licensing Acceptance Criteria – Nuclear | None |
| S4B.6 | Fuel Licensing Acceptance Criteria – Critical Power | None |
| Table 4B-1 | Fuel Rod Thermal-Mechanical Design Criteria | None |
| S4C.1 | Control Rod Licensing Acceptance Criteria - General | None |
| Ref 4D-19 | LTR NEDE-33217P/NEDO-33217, ESBWR Man-Machine Interface System and Human Factors Engineering Implementation Plan | First Full Power |
| **Chapter 5** | | |
| S5.2.1.1 | 10 CFR 50.55a compliance for seismic design of piping | First Full Power |
| S5.2.4.2 | Accessibility requirements to support ASME B&PV Code Section XI examinations | First Full Power |
| **Chapter 6** | | |
| S6.6.2 | Accessibility requirements to support ASME B&PV Code Section XI examinations | First Full Power |
| **Chapter 7** | | |
| Ref 7.1-8, 7B.3-3 | LTR NEDE-33295P/NEDO-33295, ESBWR Cyber Security Program Plan | First Full Power |

## Table 1D-1

## Summary of Tier 2* Information

| Location | Short Description of Tier 2* Information | Expiration |
|---|---|---|
| Ref 7.1-9, 7.2-1, 7.3-2, 7.4-2, 7.5-2, 7.8-4 | LTR NEDE-33304P/NEDO-33304P, GEH ESBWR Setpoint Methodology | First Full Power |
| Ref 7.1-10, 7.2-4, 7.3-4, 7.8-3, 7B.3-2 | LTR NEDE-33245P/NEDO-33245, ESBWR – Software Quality Assurance Program Manual | First Full Power |
| Ref 7.1-12, 7.2-3, 7.3-3, 7B.3-1 | LTR NEDE-33226P/NEDO-33226, ESBWR – Software Management Program Manual | First Full Power |
| S7.2.1.3.5, S7.2.2.3.5, S7.3.5.3.5 | BTP HICB-14 discussions about Software Management Program Manual and Software Quality Assurance Program Manual LTRs | First Full Power |
| S7.8.2.1 | Software Quality Assurance Program Manual LTR | First Full Power |
| S7B.1 | Software Development | First Full Power |
| Ref 7B.3-4 | LTR NEDE-33217P/NEDO-33217, ESBWR Man-Machine Interface System and Human Factors Engineering Implementation Plan | First Full Power |
| **Chapter 8** | | |
| | None | N/A |
| **Chapter 9** | | |
| S9.1.2.4 | Mechanical and structural design of spent fuel racks | None |
| Ref 9.1-2 | LTR NEDC-33374P/NEDO-33374, Criticality Analysis for ESBWR Fuel Racks | None |
| **Chapter 10** | | |
| | None | N/A |
| **Chapter 11** | | |
| | None | N/A |
| **Chapter 12** | | |
| | None | N/A |

## Table 1D-1

## Summary of Tier 2* Information

| Location | Short Description of Tier 2* Information | Expiration |
|---|---|---|
| **Chapter 13** | | |
| Ref 13.3-1, 13.5-1 | LTR NEDE-33217P/NEDO-33217, ESBWR Man-Machine Interface System and Human Factors Engineering Implementation Plan | First Full Power |
| **Chapter 14** | | |
| S14.2.8.2.7 | First of a kind testing for reactor stability | Successful completion of testing for First ESBWR |
| S14.2.8.2.35, S14.2.8.2.35.1, S14.2.8.2.35.2, S14.2.8.2.35.3, S14.2.8.2.35.4, S14.2.8.2.35.5 | First of a Kind Tests | Successful completion of testing for First ESBWR |
| S14.3A.2 | Design Acceptance Criteria ITAAC for Piping Design | First Full Power |
| S14.3A.3 | Digital Instrumentation and Control Design Acceptance Criteria ITAAC Closure | First Full Power |
| S14.3A.4 | Human Factors Engineering Design Acceptance Criteria ITAAC Closure | First Full Power |
| **Chapter 15** | | |
| Ref 15.0-6, 15.2-2, 15.3-4, 15.5-6 | LTR NEDC-33239P/NEDO-33239, GE14 for ESBWR Nuclear Design Report | None |
| Ref 15.0-7, 15.2-3, 15.3-5, 15.5-3 | LTR NEDC-33326P/NEDO-33326, GE14E for ESBWR Initial Core Nuclear Design Report | First Full Power |
| **Chapter 16 and 16B** | | |
| | None | N/A |
| **Chapter 17** | | |
| S17.1.3 | Software Quality Assurance Program Manual LTR, Software design verification and validation | First Full Power |
| Ref 17.1-2 | LTR NEDE-33245P/NEDO-33245, ESBWR – Software Quality Assurance Program Manual | First Full Power |

## Table 1D-1

## Summary of Tier 2* Information

| Location | Short Description of Tier 2* Information | Expiration |
|---|---|---|
| **Chapter 18** | | |
| Ref 18.1-1, 18.2-1, 18.3-1, 18.4-1, 18.5-1, 18.6-1, 18.7-1, 18.8-1, 18.9-1, 18.10-1, 18.11-1, 18.12-1, 18.13-1 | LTR NEDE-33217P/NEDO-33217, ESBWR Man-Machine Interface System and Human Factors Engineering Implementation Plan | First Full Power |
| Ref 18.3-2 | LTR NEDO-33262, ESBWR Human Factors Engineering Operating Experience Review Implementation Plan | First Full Power |
| Ref 18.4-2 | LTR NEDO-33219, ESBWR Human Factors Engineering Functional Requirements Analysis Implementation Plan | First Full Power |
| Ref 18.4-3 | LTR NEDE-33220P/NEDO-33220, ESBWR Human Factors Engineering Allocation of Function Implementation Plan | First Full Power |
| Ref 18.5-2 | LTR NEDE-33221P/NEDO-33221, ESBWR Human Factors Engineering Task Analysis Implementation Plan | First Full Power |
| Ref 18.6-2 | LTR NEDO-33266, ESBWR Human Factors Engineering Staffing and Qualifications Implementation Plan | First Full Power |
| Ref 18.7-2 | LTR NEDO-33267, ESBWR Human Factors Engineering Human Reliability Analysis Implementation Plan | First Full Power |
| Ref 18.8-2 | LTR NEDE-33268P/NEDO-33268, ESBWR Human Factors Engineering Human-System Interface Design Implementation Plan | First Full Power |
| Ref 18.9-2 | LTR NEDO-33274, ESBWR Human Factors Engineering Procedures Development Implementation Plan | First Full Power |
| Ref 18.10-2 | LTR NEDO-33275, ESBWR Human Factors Engineering Training Development Implementation Plan | First Full Power |

## Table 1D-1

## Summary of Tier 2* Information

| Location | Short Description of Tier 2* Information | Expiration |
|---|---|---|
| Ref 18.11-2 | LTR NEDE-33276P/NEDO-33276, ESBWR Human Factors Engineering Verification and Validation Implementation Plan | First Full Power |
| Ref 18.12-2 | LTR NEDO-33278, ESBWR Human Factors Engineering Design Implementation Plan | First Full Power |
| Ref 18.13-2 | LTR NEDO-33277, ESBWR Human Factors Engineering Human Performance Monitoring Implementation Plan | First Full Power |
| **Chapter 19** | | |
| | None | N/A |

The ESBWR Marathon control rod is designed to be compatible with the Control Rod Guide Tube (CRGT) cylindrical boundary, to provide a seat with the guide tube base during FMCRD removal, to provide lower guide rollers for smooth transitions, and to have clearance with the orificed fuel support for insertion and withdrawal from the core.

The control rod coupling socket provides a compatible interface with the FMCRD. The coupling engages the FMCRD by rotating one-eighth turn (45°). With the FMCRD, Control Rod Drive Housing (CRDH), and CRGT positively assembled, any orientation of the cruciform control rod between the fuel assemblies is a coupled position, and rotation to an uncoupled position is not possible during reactor operation. The four lobes of the FMCRD coupling spud are in line with the four wings of the control rod in the coupled position.

The control rod is designed to permit coupling and uncoupling of the control rod drive from below the vessel for FMCRD servicing without necessitating the removal of the reactor vessel head. The control rod is also designed to allow uncoupling and coupling from above the vessel using control rod handling tools.

The control rod is positively coupled to the FMCRD and is designed to remain coupled during all scrams and loading conditions, including inoperative buffer scram loads. The control rod withstands the loads induced by the FMCRD without exceeding the structural design criteria as stated in Subsections 4.2.4.1 and 4.2.4.2 above.

The control rod is dimensionally compatible with the fuel assemblies (unirradiated and irradiated). The control rod is guided, rotationally restrained and laterally supported by the adjacent fuel assemblies. The control rod is designed and constructed to establish and maintain the alignment of the control rod drive line (CRDH, CRGT, and fuel assemblies) so that control rod insertion and withdrawal is predictable. The top of the active absorber of a fully withdrawn control rod is below the Bottom of the Active Fuel (BAF). Absorber gap requirements are placed on the control rod in the operating condition to be compatible with the core nuclear design requirements.

### 4.2.5 Testing, Inspection, and Surveillance Plans

GEH has an active program for the surveillance of both production and developmental fuel. The NRC has reviewed the GEH program and approved it in Reference 4.2-6.

### 4.2.6 COL Information

This section contains no requirement for additional information to be provided in support of the combined license. Combined License Applicants referencing the ESBWR certified design will address changes to the reference design of the fuel assembly or control rods from that presented in the DCD.

### 4.2.7 References

4.2-1 Global Nuclear Fuel, " Global Nuclear Fuels Fuel Bundle Designs," NEDE-31152P, Class III (Proprietary), Revision 9, May 2007, NEDO-31152, Class I (Non-proprietary), Revision 9, May 2007.

4.2-2 GE Nuclear Energy, "Fuel Rod-Mechanical Thermal Analysis Methodology (GSTRM)," NEDC-31959P, Class III (Proprietary), April 1991.

4.2-3 Global Nuclear Fuel, "Cladding Creep Collapse," NEDC-33139P-A, Class III (Proprietary), July 2005.

4.2-4 [*Global Nuclear Fuel, "GE14E Fuel Assembly Mechanical Design Report," NEDC-33240P, Class III (Proprietary), Revision 1, January 2009, NEDO-33240, Class I (Non-proprietary), Revision 1, January 2009.*]*

4.2-5 [*Global Nuclear Fuel, "GE14 for ESBWR Fuel Rod Thermal-Mechanical Design Report," NEDC-33242P, Class III (Proprietary), Revision 2, June 2009, and NEDO-33242, Class I (Non-proprietary), Revision 2, June 2009.*]*

4.2-6 USNRC Letter, L. S. Rubenstein (NRC) to R. L. Gridley (GE), "Acceptance of GE Proposed Fuel Surveillance Program," June 27, 1984.

4.2-7 GE Nuclear Energy, "GE Marathon Control Rod Assembly," NEDE-31758P-A, Class III (Proprietary), October 1991.

4.2-8 [*GE Hitachi Nuclear Energy, "ESBWR Marathon Control Rod Mechanical Design Report," NEDE-33244P, Class III (Proprietary), Revision 1, November 2007, and NEDO-33244, Class I (Non-proprietary), Revision 1, November 2007.*]*

4.2-9 [*GE Hitachi Nuclear Energy, "ESBWR Marathon Control Rod Nuclear Design Report," NEDE-33243P, Class III (Proprietary), Revision 2, July 2008, and NEDO-33243, Class I (Non-proprietary), Revision 2, July 2008.*]*

4.2-10 GE Nuclear Energy, "GESTR-LOCA – A Model for Prediction of Fuel Rod Thermal Performance," NEDE-23785-1-P-A (Volume 1), Revision 1, October 1984.

*References that are bracketed and italicized with an asterisk following the brackets are designated as Tier 2*. Prior NRC approval is required to change Tier 2* information.

"Regulatory Relaxation for BWR Loose Parts Monitoring Systems," written by the BWR Owner's Group (Reference 4.4-19).

The ESBWR design and operation minimizes the potential for loose parts in the reactor pressure vessel. The ESBWR design takes into consideration material selection for critical components, and utilizes FIV testing and temporary strainers during startup to prevent loose parts from entering the reactor vessel. Foreign Materials Exclusion (FME) programs and underwater vessel inspections are employed to prevent loose parts from entering the reactor vessel. The ESBWR is capable of performing its safety-related functions without the LPMS.

### 4.4.6 Testing and Verification

The testing and verification techniques to be used to assure that the planned thermal and hydraulic design characteristics of the core have been provided, and remain within required limits throughout core lifetime, are discussed in Chapter 14.

### 4.4.7 COL Information

None.

*4.4.7.1 (Deleted)*

### 4.4.8 References

4.4-1 (Deleted).

4.4-2 General Electric Company, "Core Flow Distribution in a General Electric Boiling Water Reactor as Measured in Quad Cities Unit 1," NEDO-10722A, Class I (Non-proprietary), August 1976.

4.4-3 General Electric Company, "Brunswick Steam Electric Plant Unit 1 Safety Analysis Report for Plant Modifications to Eliminate Significant In-Core Vibrations," NEDO-21215, Class I (Non-proprietary), March 1976.

4.4-4 R.C. Martinelli and D.E. Nelson, "Prediction of Pressure Drops During Forced Convection Boiling of Water," ASME Trans., 70, 695-702, 1948.

4.4-5 C.J. Baroczy, "A Systematic Correlation for Two-Phase Pressure Drop," Heat Transfer Conference (Los Angeles), AIChE, reprint No. 37, 1965.

4.4-6 N. Zuber and J. A. Findlay, "Average Volumetric Concentration in Two-Phase Flow Systems," Transactions of the ASME Journal of Heat Transfer, November 1965.

4.4-7 W. H. Jens and P. A. Lottes, "Analysis of Heat Transfer, Burnout, Pressure Drop and Density Data for High Pressure Water," USAEC Report ANL-4627, 1951.

4.4-8 General Electric Company, "General Electric BWR Thermal Analysis Basis (GETAB): Data Correlation and Design Application," NEDO-10958-A, Class I (Non-proprietary), January 1977.

4.4-9 GE Nuclear Energy, "TRACG Application for ESBWR," NEDE-33083P-A Revision 0, Class III (Proprietary), March 2005.

4.4-10 GE Hitachi Nuclear Energy, "Licensing Topical Report TRACG Model Description," NEDE-32176P, Revision 4, Class III (Proprietary), January 2008, NEDO-32176, Revision 4, Class I (Non-proprietary), January 2008.

4.4-11 GE Nuclear Energy, "Licensing Topical Report TRACG Qualification," NEDE-32177P Revision 3, Class III (Proprietary), August 2007.

4.4-12 [*Global Nuclear Fuel, "GE14 for ESBWR-Critical Power Correlation, Uncertainty, and OLMCPR Development," NEDC-33237P Revision 4, Class III (Proprietary), July 2008, and NEDO-33237, Revision 4, Class I (Non-proprietary), July 2008.*]*

4.4-13 GE Nuclear Energy, "Methodology and Uncertainties for Safety Limit MCPR Evaluations," NEDC–32601P-A, Class III (Proprietary), August 1999.

4.4-14 Global Nuclear Fuel, "GE14 Pressure Drop Characteristics," NEDC-33238P, Class III (Proprietary), December 2005.

4.4-15 GE Nuclear Energy, "TASC-03A, A Computer Program for Transient Analysis of a Single Channel," NEDC-32084P-A, Revision 2, Class III (Proprietary), July 2002.

4.4-16 Letter, J.S. Charnley (GE) to C. O. Thomas (NRC), Amendment 15 to General Electric Licensing Topical Report NEDE-24011-P-A, January 25, 1986.

4.4-17 GE Hitachi Nuclear Energy, "ESBWR Initial Core Transient Analysis," NEDO-33337, Class I (Non-proprietary), Revision 1, April 2009.

4.4-18 GE Hitachi Nuclear Energy, "ESBWR Feedwater Temperature Operating Domain Transient and Accident Analysis," NEDO-33338, Class I (Non-proprietary), Revision 1, May 2009.

4.4-19 GE Nuclear Energy, "Regulatory Relaxation for BWR Loose Parts Monitoring Systems," BWR Owner's Group Licensing Topical Report NEDC-32975P-A, Class III (Proprietary), Revision 0, February 2001.

4.4-20 [*Global Nuclear Fuel, "GE14E for ESBWR Initial Core Nuclear Design Report," NEDC-33326-P, Class III (Proprietary), Revision 1, March 2009, NEDO-33326, Class I (Non-proprietary), Revision 1, March 2009.*]*

4.4-21 [*Global Nuclear Fuel, "GE14 for ESBWR Nuclear Design Report," NEDC-33239-P, Class III (Proprietary), Revision 4, March 2009, NEDO-33239, Class I (Non proprietary), Revision 4, March 2009.*]*

4.4-22 [*Global Nuclear Fuel, "Full-Scale Pressure Drop Testing for a Simulated GE14E Fuel Bundle," NEDC-33456P, Class III (Proprietary), Revision 0, March 2009, NEDO-33456, Class I (Non-proprietary), Revision 0, March 2009*]*

* References that are bracketed and italicized with an asterisk following the brackets are designated as Tier 2*. Prior NRC approval is required to change Tier 2* information.

maintenance provisions of safety-related power supplies. Further discussion of the safety-related power supplies is provided throughout Chapter 8.

A single non-electrical redundant power source (e.g., one of two parallel accumulators, one of two squibs) may be taken to "maintenance bypass" (i.e., isolated) without adversely impacting the safety function of any system.

For those non-electrical power sources having a degree of redundancy of one, taking it to maintenance bypass does not adversely impact the reliability of any safety-related system to perform its safety functions. Additionally, manual bypassing of power sources for each system are discussed in the Safety Evaluation section for each applicable system as part of conformance to 10 CFR 50.55 a(h).

#### 7.1.6.6.1.28 Cyber Security (IEEE Std. 7-4.3.2)

The security measures included in RG 1.152 are evaluated and incorporated in the Q-DCIS design and include plant hardware and software security measures. The software development process plans are developed with the security measures.

The comprehensive ESBWR Cyber Security Program Plan (Reference 7.1-8) includes methods for identifying security risks and outlines appropriate procedures. The plant ensures that hardware, controls, and data networks comprising the control network cannot be disrupted, interrupted, or negatively affected by unauthorized users or external systems. Reference 7.1-8 documents the design commitments, which meet the applicable guidance of RG 1.152, Section C.2, and Positions 2.1 through 2.9.

Inspections, tests, analyses, and acceptance criteria (ITAAC) associated with the cyber security program plan are provided in Tier 1 together with the SDP.

### 7.1.7 COL Information

None.

### 7.1.8 References

7.1-1 (Deleted)

7.1-2 (Deleted)

7.1-3 (Deleted)

7.1-4 GE Hitachi Nuclear Energy, "ESBWR I&C Diversity and Defense-In-Depth Report." NEDO-33251, Class I (Non-proprietary), Revision 2, May 2009.

7.1-5 (Deleted)

7.1-6 (Deleted)

7.1-7 (Deleted)

7.1-8 [*GE Hitachi Nuclear Energy, "ESBWR Cyber Security Program Plan," NEDE-33295P, Class III (Proprietary), Revision 1, July 2009, and NEDO-33295, Class I (Non-Proprietary), Revision 1, July 2009.*]*

7.1-9 [*GE Hitachi Nuclear Energy, "GEH ESBWR Setpoint Methodology," NEDE-33304P, Class III (Proprietary), Revision ~~3~~4, ~~February~~ May 2010, and NEDO-33304, Class II (Non-proprietary), Revision ~~3~~4, ~~February~~ May 2010.*]*

7.1-10 [*GE Hitachi Nuclear Energy, "ESBWR - Software Quality Assurance Program Manual," NEDE-33245P, Class III (Proprietary), Revision 5, February 2010, and NEDO-33245, Class I (Non-Proprietary), Revision 5, February 2010.*]*

7.1-11 (Deleted)

7.1-12 [*GE Hitachi Nuclear Energy, "ESBWR - Software Management Program Manual," NEDE-33226P, Class III (Proprietary), Revision 5, February 2010, and NEDO-33226, Class I (Non-proprietary), Revision 5, February 2010.*]*

7.1-13 (Deleted)

*References that are bracketed and italicized with an asterisk following the brackets are designated as Tier 2*. Prior NRC approval is required to change.

BTP HICB-19, Guidance for Evaluation of Defense-in-Depth and Diversity in Digital Computer-Based Instrumentation and Control Systems:

- Conformance: The SPTM function conforms to BTP HICB-19. The implementation of an additional diverse instrumentation and control system is described in Section 7.8.

BTP HICB-21, Guidance on Digital Computer Real-Time Performance:

- Conformance: The SPTM function conforms to BTP HICB-21.

#### 7.2.3.3.6 TMI Action Plan Requirements

In accordance with the SRP for Section 7.2 and with Table 7.1-1, only I.D.3 applies to the SPTM function. This is addressed in Subsection 7.2.3.3.1 for 10 CFR 50.34(f)(2)(v)[I.D.3]. TMI action plan requirements are generically addressed in Table 1A-1 of Appendix 1A.

### *7.2.3.4 Testing and Inspection Requirements*

Proper functioning of analog temperature sensors is verified by channel cross-comparison during the plant normal operation mode. The bulk pool temperatures are continuously compared between divisions and indicated by the PCF.

Each of four SPTM safety-related divisions is testable during plant normal operation to determine the operational availability of the system. Each safety-related SPTM division has the capability for testing, adjustment, and inspection during a plant outage.

### *7.2.3.5 Instrumentation and Controls Requirements*

The I&C requirements related to SPTM are addressed in Subsections 7.2.3.1 and 7.2.3.2.

## 7.2.4 COL Information

None.

## 7.2.5 References

7.2-1 [*GE Hitachi Nuclear Energy, "GEH ESBWR Setpoint Methodology," NEDE-33304P, Class III (Proprietary), Revision ~~34~~ May 2010, and NEDO-33304, Class II (Non-proprietary), Revision ~~34~~ May 2010.*]*

7.2-2 (Deleted)

7.2-3 [*GE Hitachi Nuclear Energy, "ESBWR - Software Management Program Manual," NEDE-33226P, Class III (Proprietary), Revision 5, February 2010, and NEDO-33226, Class I (Non-proprietary), Revision 5, February 2010.*]*

7.2-4 [*GE Hitachi Nuclear Energy, "ESBWR - Software Quality Assurance Program Manual)," NEDE-33245P, Class III (Proprietary), Revision 5, February 2010, and NEDO-33245, Class I (Non-proprietary), Revision 5, February 2010.*]*

*References that are bracketed and italicized with an asterisk following the brackets are designated as Tier 2*. Prior NRC approval is required to change.

BTP HICB-19, Guidance for Evaluation of Defense-in-Depth and Diversity in Digital Computer-Based Instrumentation and Control Systems:

- Conformance: The VB isolation function design conforms to BTP HICB-19. The discrete logic and solid state controls used in this design are not subject to the vulnerabilities described by BTP HICB-19.

BTP HICB-21, Guidance on Digital Computer Real-Time Performance:

- Conformance: The VB isolation function design conforms to BTP HICB-21.

#### 7.3.6.3.6 Three Mile Island Action Plan Requirements

In accordance with the SRP for 7.3 and with Table 7.1-1, 10 CFR 50.34(f)(2)(v)[I.D.3] applies to the VB isolation function. The VB isolation function complies with the requirements as indicated above. TMI action plan requirements are addressed in Appendix 1A.

### *7.3.6.4 Testing and Inspection Requirements*

The VB isolation function TLUs are self-tested continually at preset intervals and can be tested during plant operation. VB isolation function equipment is tested during reactor operation to support VB Isolation Valve stroke testing as specified in Table 3.9-8 and Subsection 6.2.1.1.5. Refer to Subsection 6.2.1.1.5 for a discussion of mechanical tests performed on the VB isolation functions.

### *7.3.6.5 Instrumentation and Control Requirements*

The performance and effectiveness of the VB isolation function in a postulated accident is verified by observing the following MCR indications (additional discussion on the VB isolation function instrumentation is contained in Subsection 7.3.6.1 and in Subsection 6.2.1.1.5):

- Status indication of VB position;
- Status indication of VB isolation valve position;
- Drywell and wetwell pressure indication;
- Drywell and wetwell temperature indications;
- VB isolation valve bypass status; and
- Status indication of bypass leakage.

The VB isolation function instrumentation located in the drywell is designed to operate in the harsh drywell environment that results from a LOCA. Safety-related instruments, located outside the drywell, are qualified for the environment in which they must perform their safety-related function.

## 7.3.7 COL Information

None.

## 7.3.8 References

7.3-1 (Deleted)

7.3-2 [*GE Hitachi Nuclear Energy, "GEH ESBWR Setpoint Methodology," NEDE-33304P, Class III (Proprietary), Revision ~~34~~ 34, ~~February~~ May 2010, and NEDO-33304, Class II (Non-proprietary), Revision ~~34~~ 34, ~~February~~ May 2010.*]*

7.3-3 [*GE Hitachi Nuclear Energy, "ESBWR - Software Management Program Manual," NEDE-33226P, Class III (Proprietary), Revision5, February 2010, and NEDO-33226, Class I (Non-proprietary), Revision 5, February 2010.*]*

7.3-4 [*GE Hitachi Nuclear Energy, "ESBWR - Software Quality Assurance Program Manual," NEDE-33245P, Class III (Proprietary), Revision 5, February 2010, and NEDO-33245, Class I (Non-proprietary), Revision 5, February 2010.*]*

7.3-5 (Deleted)

*References that are bracketed and italicized with an asterisk following the brackets are designated as Tier 2*. Prior NRC approval is required to change.

- Status indication of HP CRD isolation bypass valve position;
- GDCS pool level indication;
- RPV water level indication; and
- Drywell and RPV pressure indication.

The HP CRD isolation bypass function instrumentation located in the drywell is designed to operate in the harsh drywell environment that results from a LOCA. Instrumentation, located outside the drywell, is qualified for the environment in which they must perform their function.

### 7.4.6 COL Information

None.

### 7.4.7 References

7.4-1 (Deleted)

7.4-2 [*GE Hitachi Nuclear Energy, "GEH ESBWR Setpoint Methodology," NEDE-33304P, Class III (Proprietary), Revision ~~34~~ 34, ~~February~~ May 2010, and NEDO-33304, Class II (Non-proprietary), Revision ~~34~~ 34, ~~February~~ May 2010.*]*

*References that are bracketed and italicized with an asterisk following the brackets are designated as Tier 2*. Prior NRC approval is required to change.

## 7.5.8 References

7.5-1 GE Nuclear Energy, "GE Nuclear Energy Quality Assurance Program Description," NEDO 11209-04A, Class I (Non-proprietary), Revision 8, March 1989.

7.5-2 [*GE Hitachi Nuclear Energy, "GEH ESBWR Setpoint Methodology," NEDE-33304P, Class III (Proprietary), Revision ~~34~~ 4, ~~February~~ May 2010, and NEDO-33304, Class II (Non-proprietary), Revision ~~34~~ 4, ~~February~~ May 2010.*]*

*References that are bracketed and italicized with an asterisk following the brackets are designated as Tier 2*. Prior NRC approval is required to change.

### 7.8.6 COL Information

None.

### 7.8.7 References

7.8-1 GE Hitachi Nuclear Energy, "ESBWR I&C Diversity and Defense-In-Depth Report," NEDO-33251, Class I (Non-proprietary), Revision 2, May 2009.

7.8-2 NUREG/CR-6303, "Method for Performing Diversity and Defense-in-Depth Analyses of Reactor Protection Systems, December 1994

7.8-3 [*GE Hitachi Nuclear Energy, "ESBWR - Software Quality Assurance Program Manual," NEDE-33245P, Class III (Proprietary), Revision 5, February 2010, and NEDO-33245, Class I (Non-proprietary), Revision 5, February 2010.*]*

7.8-4 [*GE Hitachi Nuclear Energy, "GEH ESBWR Setpoint Methodology," NEDE-33304P, Class III (Proprietary), Revision ~~34~~ 4, ~~February~~ May 2010, and NEDO-33304, Class II (Non-proprietary), Revision ~~34~~ 4, ~~February~~ May 2010.*]*

*References that are bracketed and italicized with an asterisk following the brackets are designated as Tier 2*. Prior NRC approval is required to change.