MFN 09-456

Enclosure 2

ESBWR Design Comparison To BWROG EPG/SAG Revision 2 For Minimum Inventory Development

Non-Proprietary Version

HITACHI

GE Hitachi Nuclear Energy

Revision 1
Class I
DRF 0000-0093-4723-R1
July 2009

ESBWR

DESIGN COMPARISON TO BWROG EPG/SAG REVISION 2

FOR ESBWR MINIMUM INVENTORY DEVELOPMENT

Copyright 2009 GE-Hitachi Nuclear Energy Americas LLC

All Rights Reserved

PROPRIETARY INFORMATION NOTICE

This is a non-proprietary version of "ESBWR Design Comparison to BWROG EPG," which has the proprietary information removed. Portions of the document that have been removed are indicated by an open and closed bracket as shown here [[ ]].

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please read carefully

The information contained in this document is furnished as reference to the NRC Staff for the purpose of obtaining NRC approval of the ESBWR Certification and implementation. The only undertakings of GE Hitachi Nuclear Energy (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 that 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.

TABLE OF CONTENTS

1. Introduction 1-1
2. General Differences 2-1
3. Cautions 3-1
4. RPV Control - Emergency Procedure Guideline 4-1
5. Primary Containment Control Emergency Procedure Guideline 5-1
6. Reactor Building Control Emergency Procedure Guideline 6-1
7. Radioactivity Release Control Emergency Procedure Guideline 7-1
8. EPG Contingency #1 Alternate Level Control 8-1
9. EPG Contingency #2 Emergency Depressurization 9-1
10. EPG Contingency #3 Steam Cooling 10-1
11. EPG Contingency #4 RPV Flooding 11-1
12. EPG Contingency #5 Level / Power Control 12-1

1. INTRODUCTION

This document compares the EPG strategies and actions of Revision 2 of the BWR Owners' Group Emergency Procedure and Severe Accident Guidelines (EPGs/SAGs) with the ESBWR design as documented in ESBWR Design Control Document Revision 5. This document was solely created as an input for the determination of the ESBWR Minimum Inventory. This review does not propose or imply any changes to the existing EPG/SAG guidelines, since they do not apply to the ESBWR.

Within each section, BWROG EPG steps are replicated, and the differences between the BWROG EPG/SAG and ESBWR design are discussed in a subsequent paragraph located directly below each step.

The detailed plant design required to draft an ESBWR-specific EPG has not been completed. The basic strategies and actions of Revision 2 of the BWR Owners' Group Emergency Procedure and Severe Accident Guidelines (EPGs/SAGs) are used as a basis to determine the minimum inventory- the fixed alarms, displays, and controls necessary for the operators to implement the emergency operating procedures. The SAG strategies are not required for the development of minimum inventory, and are not encompassed by this document.

Using this document, analysts will evaluate each human action within the context of the task sequence containing it (for example: an implementation action analysis considers the goals of the strategy being implemented and any preceding steps). During the analysis, consideration is given to HSIs needed to prompt action, support any decision-making imbedded in the action, perform the action, and monitor plant response to the action.

Where appropriate, analysts combine alarms, displays, and controls at high levels while still meeting HSI needs identified during task analysis. For example, analysts might specify reactor water level indication and/or alarm as a minimum inventory HSI in lieu of individual flow indications for each injection system.

2. GENERAL DIFFERENCES

This section describes general differences between Revision 2 EPGs/SAGs and ESBWR design.

(1) The Gravity Driven Cooling System (GDCS), system and concept are unique to the ESBWR. Although similar in nature to the existing BWR design combination of ADS and low-pressure ECCS, the current BWROG EPG does not provide guidance for GDCS use, nor does it provide contingencies in the event of a system failure to function. For this reason, and the given safety significance of the GDCS, contingency actions will be developed to provide guidance to the operators for system implementation, and contingency actions in the event of system failure.

(2) The GDCS system uses both Safety Relief Valves (SRVs) and Depressurization Valves (DPVs) to both depressurize the reactor, and to ensure sufficient ECCS driving head by equalizing reactor pressure and drywell pressure. The DPVs are squib valve operated, and as such cannot be used to modulate reactor pressure, only to depressurize the reactor. All of the SRVs are considered ADS valves.

(3) The ESBWR uses the diverse and redundant feature of Fine Motion Control Rod Drive run-in as an alternate means of control rod insertion. In the ESBWR, if the alternate control rod insertion strategy of re-scramming the rods is determined to be appropriate for the design, the CRD system requires the accumulators to be recharged prior to attempts to re-scram the reactor, as the design does not incorporate a scram discharge volume. As a result, the ESBWR design does not require guidance for draining the scram discharge volume prior to initiating subsequent scrams.

(4) The ESBWR uses an accumulator to inject SLC into the vessel, and the action to ensure SLC accumulator isolation on low level will be added to ensure no excess nitrogen is injected into the reactor vessel. The step to ensure pump trip on low SLC tank level will not apply, as the ESWBR does not use pumps to inject SLC into the reactor vessel.

(5) The Fuel and Auxiliary Pool Cooling System (FAPCS) provides suppression pool cooling and level control, fuel pool cooling and level control, a low-pressure injection system to the reactor (LPCI mode), and a drywell spray function.

(6) The ESBWR design does not include Reactor Recirculation Pumps or associated jet pumps.

(7) The ESBWR does not use the strategies contained within the BWROG CN/T guidance. CN/T containment temperature control actions apply only to Mark III plants in which the drywell and containment are separate volumes, and the containment, which is larger, contains more and diverse equipment, and is not inerted.

(8) The ESBWR design does not employ a traditional BWR Secondary Containment. The term Reactor Building will be used in the guidance document for the ESBWR, and the purpose and ensuing actions are similar. This does not preclude the use of reactor building ventilation features (Reactor Building Purge Filter Units and Reactor Building HVAC Accident Exhaust Filter Unit) in some mitigation strategies.

(9) The control rod drive (CRD) high pressure makeup function is a feature of the ESBWR design that provides high pressure vessel injection, and is similar in capacity to current design RCIC systems.

(10) There are ESBWR design-specific suppression pool elements that may influence various EPG limits. These include:

- Suppression pool spillover hole
- FAPCS pump suction elevation
- PCCS vent line termination elevation
- Wetwell vent elevation
- Wetwell passive recombiner elevation

Although these factors may change what forms the basis of the limiting domains, it will not impact the minimum inventory for indications or controls, as the affected and controlling parameters remain the same.

(11) ICS is the ESBWR term for IC

Reference Plant Systems for EPG Implementation	
Reactor Level Control	
BWROG EPG Reference Plant(s)	**ESBWR**
Condensate Feedwater CRD RCIC HPCI HPCS LPCS LPCI RHR RHR Service Water crosstie Fire System Interconnections with other units ECCS Keep-Full SLC (test tank) SLC (boron tank)	Condensate Feedwater CRD HPCRD Injection Mode FAPCS LPCI Mode GDCS SLC Fire System Condensate Transfer [inter-connection with other units]
Pressure Control	
BWROG EPG Reference Plant(s)	**ESBWR**
Main Condenser MSL drains IC SRVs HPCI RCIC RWCU RHR (steam condensing mode) [Other steam-driven equipment] Head vent IC tube side vent Shutdown cooling	Main Condenser MSL drains ICS SRVs DPVs RWCU Shutdown Cooling [Other steam-driven equipment] Head Vent
ATWS Mitigation	
BWROG EPG Reference Plant(s)	**ESBWR**
ARI SLC	ARI SLC FMCRD SCRRI/SRI Feedwater Runback

3. CAUTIONS

BWROG EPG/SAG Step: Caution Introduction

This section lists cautions that are applicable at one or more specific points within the guidelines. Where a caution is applicable, a circled number in reverse type in the right margin identifies it.

ESBWR Design Differences

None.

BWROG EPG/SAG Step: Caution 1

❶ [[

]]

ESBWR Design Differences

ESBWR design- specific temperatures and instrument ranges will be used.

BWROG EPG/SAG Step: Caution 2

❷ [[ ]]

ESBWR Design Differences

ESBWR does not use heated reference legs; this caution does not apply.

BWROG EPG/SAG Step: Caution 3

❸ [[ ]]

ESBWR Design Differences

Guidance is identical, however the applicable system for the ESBWR is FAPCS.

BWROG EPG/SAG Step: Caution 4

❹ [[ ]]

ESBWR Design Differences

ESBWR does not use RCIC; this caution does not apply.

BWROG EPG/SAG Step: Caution 5

❺ [[ ]]

ESBWR Design Differences

ESBWR does not use RCIC or HPCI; this caution does not apply.

BWROG EPG/SAG Step: Caution 6

❻ [[ ]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step: Caution 7

❼ [[ ]]

ESBWR Design Differences

None.

4. RPV CONTROL - EMERGENCY PROCEDURE GUIDELINE

BWROG EPG/SAG Step (RC Purpose)

[[

]]

ESBWR Design Differences

ESBWR design- specific values will be used for Cold Shutdown conditions.

BWROG EPG/SAG Step (Entry Conditions)

[[

]]

ESBWR Design Differences

ESBWR design- specific values will be used for set points.

BWROG EPG/SAG Step (RC Override)

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step: RC-1

[[ ]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step (RC- CB&CT)

[[ ]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step: RC/L

[[ ]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step: RC/L-1

[[

[ ]]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step (First override before Step RC/L-2)

[[

]]

ESBWR Design Differences

ESBWR design- specific values will be used for Maximum Subcritical Banked Withdrawal Position.

BWROG EPG/SAG Step (Second override before Step RC/L-2)

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step: RC/L-2

[[❸❹❺

]]

ESBWR Design Differences

ESBWR design- specific values will be used for set points.

BWROG EPG/SAG Step (RC/L-2, continued)

- [[

❸❹❺

]]

ESBWR Design Differences

The list of injection systems will be changed to meet the design- specific attributes of the ESBWR.

BWROG EPG/SAG Step (RC/L-2, continued)

[[

]]

ESBWR Design Differences

ESBWR design- specific values will be used for set points.

BWROG EPG/SAG Step (RC/L-2, continued)

[[

]]

ESBWR Design Differences

The list of injection systems will be changed to meet the design- specific attributes of the ESBWR.

BWROG EPG/SAG Step (RC/L-2, continued)

[[

]]

ESBWR Design Differences

ESBWR design- specific values will be used for set points.

BWROG EPG/SAG Step (RC/L-2, continued)

[[

]]

ESBWR Design Differences

ESBWR design- specific values will be used for set points.

BWROG EPG/SAG Step: RC/P

[[

❷

]]

ESBWR Design Differences

ESBWR design- specific values will be used for Maximum Subcritical Banked Withdrawal Position.

BWROG EPG/SAG Step: RC/P-1

[[

]]

ESBWR Design Differences

ESBWR has 100% bypass capability, so the guidance for RPV pressure at which all turbine bypass valves are fully open is not required.

The intent of this step will be accomplished in RC/P-2. Step RC/P-2 controls reactor pressure below the SRV setpoints.

BWROG EPG/SAG Step (First override before Step RC/P-2)

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step (Second override before Step RC/P-2)

[[

]]

ESBWR Design Differences

ESBWR does not have interlocks related to MSL or Offgas high radiation that isolates the MSIVs, so the guidance to bypass those interlocks is not used.

BWROG EPG/SAG Step: RC/P-2

[[

]]

ESBWR Design Differences

ESBWR design- specific values will be used for set points.

BWROG EPG/SAG Step (RC/P-2 continued)

[[

]]

ESBWR Design Differences

ESBWR design- specific values will be used for set points and elevations.

Provisions made in the BWROG for RCIC and HPCI are not required in the ESBWR design. Additional guidance will be provided for use of the RWCU Shutdown Cooling mode for the ESBWR depressurization.

BWROG EPG/SAG Step: (Override before Step RC/P-3)

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step: RC/P-3

[[

]]

ESBWR Design Differences

ESBWR design- specific values will be used for Maximum Subcritical Banked Withdrawal Position.

BWROG EPG/SAG Step: RC/P-4

[[

]]

ESBWR Design Differences

ESBWR has full-pressure Shutdown Cooling capability, so pressure interlock related guidance is not necessary.

BWROG EPG/SAG Step: RC/Q

[[ ]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step (Override before Step RC/Q-1)

[[

]]

ESBWR Design Differences

The ESBWR uses an accumulator with "squib" type valves to inject boron into the vessel. As a result, it does not have provisions for termination of injection. There is an isolation of the accumulators on low level, however this is intended to prevent N2 introduction into RCS, not the termination of SLC injection.

ESBWR design- specific values will be used for Maximum Subcritical Banked Withdrawal Position.

BWROG EPG/SAG Step RC/Q-1

[[ ]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step RC/Q-2

[[ ]]

ESBWR Design Differences

An ESBWR design feature, Fine Motion Control Rod Drive run-in; provides an independent and diverse method for reactor shutdown, in addition to this method.

BWROG EPG/SAG Step RC/Q-3

[[

]]

ESBWR Design Differences

ESBWR does not use reactor recirculation pumps; the provisions in the BWROG guidance do not apply.

BWROG EPG/SAG Step RC/Q-4

[[

]]

ESBWR Design Differences

ESBWR does not use reactor recirculation pumps; the provisions in the BWROG guidance do not apply.

BWROG EPG/SAG Step RC/Q-5

[[ ]]

ESBWR Design Differences

The instruction regarding ARI initiation is not applicable at this point in the sequence for the ESBWR. This action to control reactor power only applies to those plants where initiating ARI also causes a trip of the reactor recirculation pumps.

ESBWR does not use reactor recirculation pumps; the provisions in the BWROG guidance do not apply.

BWROG EPG/SAG Step (Branch before Step RC/Q-6)

[[ ]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step RC/Q-6

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step (RC/Q-6 continued)

[[

]]

ESBWR Design Differences

ESBWR design-specific means of alternate Boron injection will be used if required.

BWROG EPG/SAG Step (RC/Q-6 continued)

[[

]]

ESBWR Design Differences

The ESBWR uses an accumulator to inject SLC into the vessel, and the action to ensure SLC accumulator isolation on low level will be added to ensure no excess nitrogen is injected into the reactor vessel. The step to ensure pump trip on low SLC tank level will not apply, as the ESWBR does not use pumps to inject SLC into the reactor vessel.

BWROG EPG/SAG Step RC/Q-7

[[ ]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step RC/Q-7.1

[[ ]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step

[[

]]

ESBWR Design Differences

The ESBWR uses the diverse and redundant feature of Fine Motion Control Rod Drive run-in as an alternate means of control rod insertion. In the ESBWR, the CRD system requires the accumulators to be recharged prior to attempts to re-scram the reactor, as the design does not incorporate a scram discharge volume. Conversely, the ESBWR design does not require guidance for draining the scram discharge volume prior to initiating subsequent scrams.

The BWROG guidance to vent the over-piston area, and to increase cooling water differential pressure is not applicable to the ESBWR design.

5. PRIMARY CONTAINMENT CONTROL EMERGENCY PROCEDURE GUIDELINE

BWROG EPG/SAG Step (PC Purpose)

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step (Entry Conditions)

[[

]]

ESBWR Design Differences

Design-specific set points and elevations are used for the ESBWR, and the guidance contained in BWROG CN/T is not required.

BWROG EPG/SAG Step (First PC Override)

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step (Second PC Override)

[[❼

]]

ESBWR Design Differences

Suppression Pool Spray is not a feature of the ESBWR design, and guidance for use of this system is not required.

BWROG EPG/SAG Step (Third PC Override)

[[

❸

]]

ESBWR Design Differences

Suppression Pool Spray is not a feature of the ESBWR design, and guidance for use of this system is not required.

BWROG EPG/SAG Step (Fourth PC Override)

[[

❸

]]

ESBWR Design Differences

Design-specific set points and elevations are used for the ESBWR guidance.

The ESBWR does not use Reactor Recirculation Pumps, and the guidance to secure them is not needed.

BWROG EPG/SAG Step (Fifth PC Override)

[[❸]]

ESBWR Design Differences

Design-specific set points and elevations are used for the ESBWR guidance.

BWROG EPG/SAG Step (Branch before Step SP/T)

[[ ]]

ESBWR Design Differences

ESBWR section CN/T is not used.

BWROG EPG/SAG Step SP/T

[[❸]]

ESBWR Design Differences

Design-specific set points and elevations are used for the ESBWR guidance.

BWROG EPG/SAG Step SP/T-1

[[

]]

ESBWR Design Differences

The ESBWR active LPCI system function, and suppression pool cooling function is provided by FAPCS not RHR.

BWROG EPG/SAG Step SP/T-2

[[

]]

ESBWR Design Differences

The ESBWR guidance will provide actions for reactor shutdown based on the Technical Specification reactor scram setpoint for suppression pool temperature.

BWROG EPG/SAG Step SP/T-3

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step DW/T

[[

❶

]]

ESBWR Design Differences

Design-specific set points and elevations are used for the ESBWR guidance.

BWROG EPG/SAG Step DW/T-1

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step DW/T-2

[[

]]

ESBWR Design Differences

Design-specific set points and elevations are used for the ESBWR guidance.

BWROG EPG/SAG Step DW/T-3

[[

]]

ESBWR Design Differences

Design-specific set points and elevations are used for the ESBWR guidance.

BWROG EPG/SAG Step CN/T

[[

]]

ESBWR Design Differences

The guidance contained in BWROG CN/T is not required.

BWROG EPG/SAG Step CN/T-1

[[

]]

ESBWR Design Differences

The guidance contained in BWROG CN/T is not required.

BWROG EPG/SAG Step CN/T-2

[[

]]

ESBWR Design Differences

The guidance contained in BWROG CN/T is not required.

BWROG EPG/SAG Step CN/T-3

[[

]]

ESBWR Design Differences

The guidance contained in BWROG CN/T is not required.

BWROG EPG/SAG Step PC/P

[[

]]

ESBWR Design Differences

Design-specific set points and elevations are used for the ESBWR guidance.

The ESBWR does not use a Standby Gas Control system, and guidance for this system is not required. The drywell purge flow path can use the option of using the Reactor Building Purge Exhaust Filter Units.

BWROG EPG/SAG Step PC/P-1

[[

]]

ESBWR Design Differences

Suppression Pool Spray is not a feature of the ESBWR design, and guidance for use of this system is not required.

BWROG EPG/SAG Step PC/P-2

[[

]]

ESBWR Design Differences

Initiation of drywell sprays will be based upon design-specific calculations.

BWROG EPG/SAG Step PC/P-3

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step PC/P-4

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step PC/P-5

[[

]]

ESBWR Design Differences

The phrase "*irrespective of whether adequate core cooling is assured*" describes a condition where the decision has to be made between adequate core cooling, and containment integrity via the same penetration/flow-path. The ESBWR design does not rely on a containment vent path that shares the ability to inject into the reactor core, so this guidance is not used.

BWROG EPG/SAG Step SP/L

[[ ]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step SP/L-1

[[

]]

ESBWR Design Differences

Design-specific set points and elevations are used for the ESBWR guidance.

The ESBWR design does not have a SPMS, and provisions related to this system are not required.

BWROG EPG/SAG Step SP/L-2

[[

]]

[[ ]]

ESBWR Design Differences

Design-specific set points and elevations are used for the ESBWR guidance.

BWROG EPG/SAG Step SP/L-2.1

[[

]]

ESBWR Design Differences

The ESBWR system configuration factors that will be considered for the most limiting suppression pool low level are the following: a predetermined elevation above the GDCS equalization line and bottom of the PCC Vent Line. The GDCS equalization line level limit will ensure sufficient inventory for the equalization function of GDCS to perform its safety function. The bottom of the PCC Vent Line level limit will prevent a bypass path from the drywell to the suppression chamber and ensure there is not a bypass of suppression capability in the event of a large-break LOCA. The elevation of both of these limits is above the BWROG EPG guidance limitation of 2 feet above the elevation of the top of the horizontal vents.

BWROG EPG/SAG Step SP/L-2.2

[[

]]

ESBWR Design Differences

The BWROG guidance provides actions for HPCI, this system is not used in the ESBWR design, and the guidance is not required.

BWROG EPG/SAG Step SP/L-3

[[

]]

[[ ]]

ESBWR Design Differences

Design-specific set points and elevations are used for the ESBWR guidance.

ESBWR design does not use the SPMS system, and BWROG guidance related to this system is not required.

BWROG EPG/SAG Step SP/L-3.1

[[

]]

ESBWR Design Differences

Guidance is identical.

BWROG EPG/SAG Step SP/L-3.2

[[

]]

ESBWR Design Differences

Step SP/L-3.2 applies only to plants with suppression chamber-to-drywell vacuum breaker penetrations significantly below the top of the suppression chamber. The ESBWR Suppression Pool design does not have vacuum breaker inlets that are low enough to trap a significant volume of non-condensable gasses, and the limitation contained in the BWROG guidance is not required.

BWROG EPG/SAG Step PC/G

[[ ]]

....

The full compliment of steps contained in section PC/G has not been reproduced here. Although the steps provide guidance for the control and maintenance of the primary containment atmosphere, the extent and level of detail provided by the BWROG EPG/SAG is not required for determination of minimum inventory of controls.

ESBWR Design Differences

The ESBWR containment is required to be inerted with nitrogen.

The ESBWR uses passive recombiners, and does not require steps to govern the use of active system recombiners.

The ESBWR does not use a hydrogen mixing system, and does not require steps to govern their use.

The ESBWR uses design-specific elevations for EPG guidance.

The ESBWR will require H2 and O2 detection and monitoring systems.

6. REACTOR BUILDING CONTROL EMERGENCY PROCEDURE GUIDELINE

BWROG EPG/SAG Step (SC Purpose)

[[

]]

ESBWR Design Differences

The ESBWR design does not employ a traditional BWR Secondary Containment. The term Reactor Building will be used in the guidance document for the ESBWR, and the purpose and ensuing actions are similar. This does not preclude the use of reactor building ventilation features (Reactor Building Purge Filter Units and Reactor Building HVAC Accident Exhaust Filter Unit) in some mitigation strategies.

BWROG EPG/SAG Step (SC Entry Conditions)

[[

]]

ESBWR Design Differences

The passive design of the ESBWR does not use negative pressure as a criterion for building integrity; the BWROG guidance entry condition on low building differential pressure does not apply to the ESBWR design.

BWROG EPG/SAG Step (First SC Override)

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step (Second SC Override)

[[

]]

ESBWR Design Differences

ESBWR design-specific set points are used for the ESBWR guidance.

The ESBWR does not use Standby Gas Treatment system, BWROG guidance for system use is not used. This does not preclude the use of reactor building ventilation (Reactor Building HVAC Accident Exhaust Filter Unit) in some mitigation strategies.

BWROG EPG/SAG Step (Third SC Override)

[[

]]

ESBWR Design Differences

ESBWR design-specific set points are used for the ESBWR guidance.

BWROG EPG/SAG Step (Branch before Step SC/T)

[[ ]]

ESBWR Design Differences

ESBWR will use RB rather than SC for the step descriptors.

BWROG EPG/SAG Step SC/T

[[❶

]]

[[ ]]

ESBWR Design Differences

ESBWR will use RB rather than SC for the step descriptors.

BWROG EPG/SAG Step SC/T-4

[[

]]

ESBWR Design Differences

ESBWR will use RB rather than SC for the step descriptors.

BWROG EPG/SAG Step SC/T-5

[[

]]

ESBWR Design Differences

ESBWR will use RB rather than SC for the step descriptors.

BWROG EPG/SAG Step SC/R

[[

]]

ESBWR Design Differences

ESBWR will use RB rather than SC for the step descriptors.

BWROG EPG/SAG Step SC/R-2

[[

]]

ESBWR Design Differences

ESBWR will use RB rather than SC for the step descriptors.

BWROG EPG/SAG Step SC/R-3

[[

]]

ESBWR Design Differences

ESBWR will use RB rather than SC for the step descriptors.

BWROG EPG/SAG Step SC/L

[[

]]

[[ ]]

ESBWR Design Differences

ESBWR will use RB rather than SC for the step descriptors.

BWROG EPG/SAG Step SC/L-2

[[

]]

ESBWR Design Differences

ESBWR will use RB rather than SC for the step descriptors.

BWROG EPG/SAG Step

[[

]]

ESBWR Design Differences

ESBWR will use RB rather than SC for the step descriptors.

7. RADIOACTIVITY RELEASE CONTROL EMERGENCY PROCEDURE GUIDELINE

BWROG EPG/SAG Step (RR Purpose)

[[

]]

ESBWR Design Differences

The term Reactor Building is used in the guidance document for the ESBWR, and the purpose and ensuing actions are similar. This does not preclude the use of reactor building ventilation (Reactor Building HVAC Accident Exhaust Filter Unit) in some mitigation strategies.

BWROG EPG/SAG Step (RR Entry Conditions)

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step (First override before Step RR-1)

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step (Second override before Step RR-1)

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step RR-1

[[

]]

ESBWR Design Differences

The ESBWR design does not employ a traditional BWR Secondary Containment, the term Reactor Building will be used.

BWROG EPG/SAG Step RR-2

[[

]]

ESBWR Design Differences

The ESBWR design does not employ a traditional BWR Secondary Containment, the term Reactor Building will be used.

8. EPG CONTINGENCY #1 ALTERNATE LEVEL CONTROL

BWROG EPG/SAG Step (First override before Step C1-1)

[[

]]

ESBWR Design Differences

ESBWR design-specific elevations and set points will be used in the ESBWR guidance.

ESBWR design- specific values will be used for Maximum Subcritical Banked Withdrawal Position.

BWROG EPG/SAG Step (Second override before Step C1-1)

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step C1-1

[[ ]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step C1-2

[[ ]]

ESBWR Design Differences

The ESBWR acronym for isolation condenser is ICS.

BWROG EPG/SAG Step C1-3

[[❸ ❹ ❺

]]

ESBWR Design Differences

ESBWR design- specific systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step (C1-3 continued)

[[

]]

ESBWR Design Differences

ESBWR design- specific systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step (C1-3 continued)

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step C1-4

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step (C1-4 continued)

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

The ESBWR design includes a gravity driven cooling system that integrates both a depressurization and injection scheme under a single logic.

BWROG EPG/SAG Step (C1-4 continued)

[[

]]

ESBWR Design Differences

The ESBWR design does not use Reactor Recirculation Jet Pumps, and does not have provisions for a Core Spray system. Guidance for these components and related strategies is not used.

BWROG EPG/SAG Step (C1-4 continued)

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

9. EPG CONTINGENCY #2
EMERGENCY DEPRESSURIZATION

BWROG EPG/SAG Step (First override before Step C2-1)

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step (Second override before Step C2-1)

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step (Third override before Step C2-1)

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

The ESBWR design includes DPVs, (depressurization valves, squib-fired, open to the drywell atmosphere) which allow the reactor to depressurize, and ensure the capability of vent path for this override. The DPVs do not require interlock overrides to actuate, and will provide an enhancement to this guidance.

BWROG EPG/SAG Step C2-1

[[❷

]]

ESBWR Design Differences

ESBWR design- specific values will be used for Maximum Subcritical Banked Withdrawal Position.

BWROG EPG/SAG Step C2-1.1, C2-1.2

[[

]]

ESBWR Design Differences

The ESBWR does not have active injection systems that start on high drywell pressure, and this guidance is not required.

BWROG EPG/SAG Step C2-1.3

[[

]]

ESBWR Design Differences

In the ESBWR design, all SRVs are ADS valves, guidance to use non-ADS SRVs does not apply.

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step (C2-1.3 continued)

[[❸ ❹ ❺

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step (C2-1.3 continued)

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step (C2-1.3 continued)

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step (override before Step C2-2)

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step C2-2

[[

]]

ESBWR Design Differences

The ESBWR has a full pressure range shutdown cooling system that is integral to the RWCU system. The BWROG EPG guidance for the SDC low-pressure permissive, and the guidance to not use required injection systems for SDC does not apply to the ESBWR design.

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

ESBWR design- specific values will be used for Maximum Subcritical Banked Withdrawal Position.

BWROG EPG/SAG Step (Step C2-2 continued)

[[❸ ❹ ❺

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step (Step C2-2 continued)

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

10. EPG CONTINGENCY #3 STEAM COOLING

BWROG EPG/SAG Step (First override before Step C3-1)

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step (Second override before Step C3-1)

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step C3-1

[[ ]]

ESBWR Design Differences

The ESBWR acronym for isolation condenser is ICS.

BWROG EPG/SAG Step C3-2

[[❸ ❹ ❺

]]

ESBWR Design Differences

HPCI and RCIC guidance is not valid for ESBWR.

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step C3-3

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

11. EPG CONTINGENCY #4 RPV FLOODING

BWROG EPG/SAG Step (First override before Step C4-1)

[[

]]

ESBWR Design Differences

ESBWR design- specific values will be used for Maximum Subcritical Banked Withdrawal Position.

BWROG EPG/SAG Step (Second override before Step C4-1)

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step (Third override before Step C4-1)

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step C4-1

[[

]]

ESBWR Design Differences

ESBWR design- specific values will be used for Maximum Subcritical Banked Withdrawal Position.

BWROG EPG/SAG Step (Override before Step C4-1.1)

[[

]]

ESBWR Design Differences

ESBWR design- specific values will be used for Maximum Subcritical Banked Withdrawal Position.

BWROG EPG/SAG Step C4-1.1

[[

]]

ESBWR Design Differences

The ESBWR design does not include RCIC; guidance for this system is not used in the ESBWR.

BWROG EPG/SAG Step C4-1.2

[[

]]

ESBWR Design Differences

In the ESBWR design, all SRVs are ADS valves, guidance to use non-ADS SRVs does not apply.

BWROG EPG/SAG Step (Override before Step C4-1.3)

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step C4-1.3

[[❸ ❹ ❺

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step (Step C4-1.3 continued)

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step (Step C4-1.3 continued)

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step (Step C4-1.3 continued)

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step (Step C4-1.3 continued)

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step (Step C4-1.3 continued)

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step (Step C4-1.3 continued)

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step (Step C4-1.3 continued)

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step C4-2

[[

]]

ESBWR Design Differences

ESBWR design- specific values will be used for Maximum Subcritical Banked Withdrawal Position.

BWROG EPG/SAG Step C4-2.1

[[

]]

ESBWR Design Differences

All ESBWR SRVs that can be operated remotely are considered ADS valves. BWROG EPG Guidance to operate other SRVs will not be used in the ESBWR.

BWROG EPG/SAG Step C4-2.2

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance. The ESBWR design does not require guidance to isolate RCIC, HPCI, and RHR steam condensing isolations.

BWROG EPG/SAG Step (Override before Step C4-2.3)

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step C4-2.3

[[❸ ❹ ❺

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step (Step C4-2.3 Continued)

[[

]]

ESBWR Design Differences

ESBWR design incorporates the use of the High Pressure Makeup function of the Control Rod Drive System. This system provides high pressure RPV makeup without the use of steam driven equipment.

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step (Step C4-2.3 Continued)

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance. Guidance for use of RCIC, HPCI, and RHR steam condensing isolation valves is not applicable for ESBWR design.

12. EPG CONTINGENCY #5 LEVEL / POWER CONTROL

BWROG EPG/SAG Step (Override before Step C5-1)

[[

]]

ESBWR Design Differences

ESBWR design- specific values will be used for Maximum Subcritical Banked Withdrawal Position.

BWROG EPG/SAG Step C5-1

[[ ]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step C5-2

[[

]]

ESBWR Design Differences

The ESBWR design does not provide MSIV isolations on MSL or Offgas high radiation levels; guidance for these conditions is not applicable to the ESBWR design.

The control systems for the ESBWR are not hardwired, and the pre-emptive nature of "commence" is not required.

BWROG EPG/SAG Step C5-3

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

Guidance for use of RCIC is not applicable for ESBWR design.

BWROG EPG/SAG Step C5-4

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance. Guidance for use of RCIC is not applicable for the ESBWR design.

BWROG EPG/SAG Step (First override before Step C5-5)

[[

]]

ESBWR Design Differences

None.

BWROG EPG/SAG Step (Second override before Step C5-5)

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step (Third override before Step C5-5)

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step C5-5

[[

❸ ❹ ❺

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step (Step C5-5 Continued)

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step C5-5.1

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance. Guidance for use of RCIC is not applicable for the ESBWR design.

BWROG EPG/SAG Step C5-5.2

[[❸ ❹ ❺ ❻

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step (Step C5-5.2 Continued)

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step (Step C5-5.2 Continued)

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step C5-5.3

[[

]]

ESBWR Design Differences

ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance.

BWROG EPG/SAG Step C5-6

[[

]]

[[

]]

ESBWR Design Differences

The BWROG EPG override and the following steps contained in C5-6 apply only to plants where boron is injected below the core. In the ESBWR boron is injected directly inside the core shroud, and raising RPV water level could displace the borated water inside the shroud with non-borated water drawn from outside the shroud and below the core. The ESBWR therefore does not restore RPV water level to the normal band until all control rods are inserted to or beyond the Maximum Subcritical Banked Withdrawal Position or it has been determined that the reactor will remain shutdown under all conditions without boron.

MFN 09-456

Enclosure 3

ESBWR Design Comparison To BWROG EPG/SAG Revision 2 For Minimum Inventory Development

Affidavit

GE-Hitachi Nuclear Energy Americas LLC

AFFIDAVIT

I, Larry J. Tucker, state as follows:

(1) I am Manager, ESBWR Engineering, GE-Hitachi Nuclear Energy ("GEH"), and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in enclosure 1 of GEH's letter, MFN 09-456 Mr. Richard E. Kingston to U.S. Nuclear Energy Commission, entitled "Submittal of ESBWR Design Comparison To BWROG EPG/SAG Revision 2 For Minimum Inventory Development" dated July 8, 2009. The proprietary information in enclosure 1, which is entitled "*MFN 09-456 – Submittal of ESBWR Design Comparison To BWROG EPG/SAG Revision 2 For Minimum Inventory Development,*" is delineated by a [[dotted underline inside double square brackets{3}]]. Figures and large equation objects are identified with double square brackets before and after the object. In each case, the superscript notation {3} refers to Paragraph (3) of this affidavit, which provides the basis for the proprietary determination.

(3) In making this application for withholding of proprietary information of which it is the owner or licensee, GEH relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), and 2.390(a)(4) for "trade secrets" (Exemption 4). The material for which exemption from disclosure is here sought also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by GEH's competitors without license from GEH constitutes a competitive economic advantage over other companies;

b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

c. Information which reveals aspects of past, present, or future GEH customer-funded development plans and programs, resulting in potential products to GEH;

d. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a, (4)b, and (4)c above.

(5) To address 10 CFR 2.390(b)(4), the information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GEH, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GEH, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge, or subject to the terms under which it was licensed to GEH. Access to such documents within GEH is limited on a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist, or other equivalent authority for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GEH are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(8) The information identified in paragraph (2) is classified as proprietary because it contains details of GEH's design and licensing methodology. The development of the methods used in these analyses, along with the testing, development and approval of the supporting methodology was achieved at a significant cost to GEH.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GEH's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GEH's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate

evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

The research, development, engineering, analytical and NRC review costs comprise a substantial investment of time and money by GEH.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

GEH's competitive advantage will be lost if its competitors are able to use the results of the GEH experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GEH would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GEH of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing and obtaining these very valuable analytical tools.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information, and belief.

Executed on this 8th day of July 2009.

Larry J. Tucker
GE-Hitachi Nuclear Energy Americas LLC