GE Hitachi Nuclear Energy

Richard E. Kingston
Vice President, ESBWR Licensing

PO Box 780 M/C A-65
Wilmington, NC 28402-0780
USA

T 910 819 6192
F 910 362 6192
rick.kingston@ge.com

HITACHI

MFN 10-253 Revision 1

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Document Control Desk
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Subject: **Transmittal of ESBWR DCD Markups to Tier 1 and Chapters 2, 3, and 19 Related to GEH Internal Corrective Actions and Discussions with the NRC**

The purpose of this letter is to resubmit markups to the ESBWR DCD which are the result of further GEH internal review and discussion with the NRC. These markups will be incorporated into DCD, Revision 8.

Note that Revision 0 of this letter was identified as security-related because of changes associated with Section 19D. Revisions to those changes have been transmitted via MFN 10-313 (Reference 1).

Associated changes are summarized below with a description of the revision to the change in parenthesis. Markups are contained in Enclosure 1.

Affected Section	Description of Change
Tier 1, Table 5.1-1	Modified note 8 regarding wind speed **(relocated call out to note 8 and clarified note 7)**
Tier 1, Table 2.4.2-2	**(added – correction of "Safety-Related Display" designation for "GDCS lower drywell temperature switch high" from Yes to No)**
Ch. 2, Table 2.0-1	Added note 13 regarding wind speed **(relocated call out to note 13 and clarified note 3)**
Ch. 3, Table 3.2-1	Revised Classification for U80 Electrical Building Structure and U84 Service Water Building Structure **(no additional changes)**

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Affected Section	Description of Change
Ch. 19, Section 19.2.3.1.1	Updated to reflect revised PRA analysis RAI 6.2-202 **(no additional changes)**
Ch. 19, Table 19A-2	Clarification of Mode **(no additional changes)**
Ch. 19, Section 19A.4.1	Clarification of Mode **(no additional changes)**
Ch. 19, Section 19A.4.4	Clarification of Mode **(no additional changes)**
Ch. 19, Section 19A.6.1.3.1	Clarification of FAPCS makeup line **(no additional changes)**
Ch. 19, Section 19A.8.3	Clarification regarding wind speed **(added additional text as clarification related to wind speed and added notes to further clarify Table 19A.3 and Table 19A.4)**
Ch. 19, Section 19D.5	Updated to reflect Aircraft Impact Assessment audit and discussions **(additional changes submitted via MFN 10-313)**
Ch. 19, Table 19D-1	Updated to reflect Aircraft Impact Assessment discussions **(additional changes submitted via MFN 10-313)**

Reference:

1. MFN 10-313, Letter from Richard E. Kingston to U.S. Nuclear Regulatory Commission, Transmittal of Final ESBWR DCD Markups to Section 19D, October 8, 2010

Enclosure:

1. Transmittal of ESBWR DCD Markups to Tier 1 and Chapters 2, 3, and 19 Related to GEH Internal Corrective Actions and Discussions with the NRC – DCD Markups

cc:	AE Cubbage	USNRC (with enclosures)
	J G Head	GEH/Wilmington (with enclosures)
	DH Hinds	GEH/Wilmington (with enclosures)
	LF Dougherty	GEH/Wilmington (with enclosures)
	eDRF Section	0000-0123-4920, 0000-0108-5391 Rev 3, 0000-0123-2752, 0000-0123-4925 0000-0124-3453

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

MFN 10-253 Revision 1

Transmittal of ESBWR DCD Markups to Tier 1 and Chapters 2, 3, and 19 Related to GEH Internal Corrective Actions and Discussions with the NRC

DCD Markups

Table 5.1-1

Envelope of ESBWR Standard Plant Site Parameters [1]

Maximum Ground Water Level:	0.61 m (2 ft) below plant grade
Extreme Wind: [8]	**Seismic Category I, II and Radwaste Building Structures** - 100-year Wind Speed (3-sec gust): 67.1 m/s (150 mph) - Exposure Category: D **Other Seismic Category NS Standard Plant Structures** - 50-year Wind Speed (3-sec gust): 58.1 m/s (130 mph)
Maximum Flood (or Tsunami) Level:	0.3 m (1 ft) below plant grade
Tornado:	- Maximum Tornado Wind Speed: 147.5 m/s (330 mph) - Maximum Rotational Speed: 116.2 m/s (260 mph) - Translational Speed: 31.3 m/s (70 mph) - Radius: 45.7 m (150 ft) - Pressure Drop: 16.6 kPa (2.4 psi) - Rate of Pressure Drop: 11.7 kPa/s (1.7 psi/s) - Missile Spectrum[7]: Spectrum I of SRP 3.5.1.4, Rev 2 applied to full building height.
Precipitation (for Roof Design):	- Maximum Rainfall Rate: 49.3 cm/hr (19.4 in/hr) - Maximum Short Term Rate: 15.7 cm (6.2 in) in 5 minutes - Maximum Ground Snow Load for normal winter precipitation event: 2394 Pa (50 lbf/ft^2) - Maximum Ground Snow Load for extreme winter precipitation event: 7757 Pa (162 lbf/ft^2)
Ambient Design Temperature:	**2% Annual Exceedance Values** - Maximum: 35.6°C (96°F) dry bulb 26.1°C (79°F) wet bulb (mean coincident) 27.2°C (81°F) wet bulb (non-coincident) - Minimum: -23.3°C (-10°F) **1% Annual Exceedance Values** - Maximum: 37.8°C (100°F) dry bulb 26.1°C (79°F) wet bulb (mean coincident) 27.8°C (82°F) wet bulb (non-coincident) - Minimum: -23.3°C (-10°F) **0% Exceedance Values** - Maximum: 47.2°C (117°F) dry bulb 26.7°C (80°F) wet bulb (mean coincident) 31.1°C (88°F) wet bulb (non-coincident) - Minimum: -40°C (-40°F)

soil properties at minus one sigma from the mean. The ratio of the largest to the smallest shear wave velocity over the mat foundation width of the supporting foundation material does not exceed 1.7.

(4) Safe Shutdown Earthquake (SSE) design ground response spectra of 5% damping, also termed Certified Seismic Design Response Spectra (CSDRS), are defined as free-field outcrop spectra at the foundation level (bottom of the base slab) of the Reactor/Fuel and Control Building structures. For the Firewater Service Complex, which is essentially a surface founded structure, the CSDRS is 1.35 times the values shown in Figures 5.1-1 and 5.1-2 and is defined as free-field outcrop spectra at the foundation level (bottom of the base slab) of the Firewater Service Complex structure.

(5) Settlement values are long-term (post-construction) values except for differential settlement within the foundation mat. The design of the foundation mat accommodates immediate and long-term (post construction) differential settlements after the installation of the basemat.

(6) For sites not meeting the soil property requirements, a site-specific analysis is required to demonstrate the adequacy of the standard plant design.

(7) Tornado missiles do not apply to Seismic Category NS and Seismic Category II buildings. For the Radwaste Building, the tornado missiles defined in Regulatory Guide 1.143, Table 2, Class RW-IIa apply. The hurricane missile spectrum for Seismic Category NS and Seismic Category II structures that house RTNSS equipment is consistent with the tornado missile spectrum identified in this table.

(8) Values were selected to comply with expected requirements of southeastern coastal locations, which include the consideration of hurricanes as described in ASCE 7-02. Wind speeds are considered to be at 10 m (33 ft) above ground per ASCE 7-02. Seismic Category NS buildings that house RTNSS equipment are designed to withstand hurricane Category 5 wind velocity at 87.2 m/s (195 mph), 3-second gust, and missiles generated by that wind velocity.

Table 2.4.2-2

GDCS Electrical Equipment

Equipment Name (Description)	Equipment Identifier See Figure 2.4.2-1	Control Q-DCIS/ DPS	Seismic Category I	Safety-Related	Safety-Related Display	Remotely Operated	Containment Isolation Valve Actuator
Deluge System squib valve initiator DC power supply battery and charger Train 1	–	–	No	No	No	–	–
Deluge System PLC DC power supply battery and charger Channel A Train 2	–	–	No	No	No	–	–
Deluge System PLC DC power supply battery and charger Channel B Train 2	–	–	No	No	No	–	–
Deluge System squib valve initiator DC power supply battery and charger Train 2	–	–	No	No	No	–	–
GDCS lower drywell temperature switch high Switch A Train 1	–	–	Yes	Yes	~~Yes~~No	–	–
GDCS lower drywell temperature switch high Switch B Train 1	–	–	Yes	Yes	~~Yes~~No	–	–
GDCS BiMAC thermocouples Channel A Train 1	–	–	No	No	No	–	–
GDCS BiMAC thermocouples Channel B Train 1	–	–	No	No	No	–	–

Table 2.4.2-2

GDCS Electrical Equipment

Equipment Name (Description)	Equipment Identifier See Figure 2.4.2-1	Control Q-DCIS/ DPS	Seismic Category I	Safety-Related	Safety-Related Display	Remotely Operated	Containment Isolation Valve Actuator
GDCS lower drywell temperature switch high Switch A Train 2	–	–	Yes	Yes	~~Yes~~No	–	–
GDCS lower drywell temperature switch high Switch B Train 2	–	–	Yes	Yes	~~Yes~~No	–	–
~~GDCS BiMAC~~ thermocouples Channel A Train 2	–	–	No	No	No	–	–
GDCS BiMAC thermocouples Channel B Train 2	–	–	No	No	No	–	–

Table 2.0-1

Envelope of ESBWR Standard Plant Site Parameters [1]

[Maximum Ground Water Level:	*0.61 m (2 ft) below plant grade*	
Extreme Wind: *[13]*	***Seismic Category I, II and Radwaste Building Structures***	
	~~*- 100-year Wind Speed*~~	
	(3-sec gust): ~~*[13]*~~	*67.1 m/s (150 mph)*
	- Exposure Category:	*D*
	Other Seismic Category NS Standard Plant Structures	
	- 50-year Wind Speed	
	(3-sec gust):	*58.1 m/s (130 mph)*
Maximum Flood (or Tsunami) Level: *[2]*	*0.3 m (1 ft) below plant grade*	
Tornado:	*- Maximum Tornado Wind Speed: [3]*	*147.5 m/s (330 mph)*
	- Maximum Rotational Speed:	*116.2 m/s (260 mph)*
	- Translational Speed:	*31.3 m/s (70 mph)*
	- Radius:	*45.7 m (150 ft)*
	- Pressure Drop:	*16.6 kPa (2.4 psi)*
	- Rate of Pressure Drop:	*11.7 kPa/s (1.7 psi/s)*
	- Missile Spectrum: [3]	*Spectrum I of SRP 3.5.1.4, Rev 2 applied to full building height.*
Precipitation (for Roof Design):	*- Maximum Rainfall Rate: [4]*	*49.3 cm/hr (19.4 in/hr)*
	- Maximum Short Term Rate:	*15.7 cm (6.2 in) in 5 minutes*
	- Maximum Ground Snow Load [5] for normal winter precipitation event:	*2394 Pa (50 lbf/ft^2)*
	- Maximum Ground Snow Load[5] for extreme winter precipitation event:	*7757 Pa (162 lb/ft^2)*

Notes for Table 2.0-1:

(1) The site parameters defined in this table are applicable to Seismic Category I, II, and Radwaste Building structures, unless noted otherwise.

(2) Probable maximum flood level, as defined in Table 1.2-6 of Volume III of Reference 2.0-4.

(3) Maximum speed selected is based on Attachment 1 of Reference 2.0-5, which summarizes the NRC Interim Position on Regulatory Guide 1.76. Concrete structures designed to resist Spectrum I missiles of SRP 3.5.1.4, Rev. 2, also resist missiles postulated in Regulatory Guide 1.76, Revision 1. Tornado missiles do not apply to Seismic Category NS and Seismic Category II buildings. For the Radwaste building, the tornado missiles defined in Regulatory Guide 1.143, Table 2, Class RW-IIa apply. The hurricane missile spectrum for Seismic Category NS and Seismic Category II structures that house RTNSS equipment is consistent with the tornado missile spectrum identified in this table. See Tables 19A-3 and 19A-4 for additional details.

(4) Based on probable maximum precipitation (PMP) for one hour over 2.6 km^2 (one square mile) with a ratio of 5 minutes to one hour PMP of 0.32 as found in Reference 2.0-3. See also Table 3G.1-2.

(5) See Reference 2.0-9 for the definition of normal winter precipitation and extreme winter precipitation events. The maximum ground snow load for extreme winter precipitation event includes the contribution from the normal winter precipitation event. See also Table 3G.1-2.

(6) Zero percent exceedance values are based on conservative estimates of historical high and low values for potential sites. Consistent with Reference 2.0-4, they represent historical limits excluding peaks of less than two hours. One and two percent annual exceedance values were selected in order to bound the values presented in Reference 2.0-4 and available Early Site Permit applications.

(7) At the foundation level of Seismic Category I structures. The static bearing pressure is the average pressure. The dynamic bearing pressure is the toe pressure. The maximum static bearing demand is multiplied by a factor of safety appropriate for the design load combination and is compared with the site-specific allowable static bearing pressure, which is obtained by dividing the ultimate soil bearing capacity by a factor of safety appropriate for the design load combination. The maximum dynamic bearing demand is multiplied by a factor of safety appropriate for the design load combination and is compared with the site-specific allowable dynamic bearing pressure, which is obtained by dividing the ultimate soil bearing capacity by a factor of safety appropriate for the design load combination. When a site-specific shear wave velocity is between soft soil and medium soil the larger of the soft or medium maximum dynamic bearing demand will be used. When a site-specific shear wave velocity is between medium soil and hard soil the larger of the medium or hard maximum dynamic bearing demand will be used. Alternatively, for soils with a site-specific shear wave velocity a linearly interpolated dynamic bearing demand between soft and medium soil or between medium and hard soil can be used. The shear wave velocities of soft, medium and hard soils are 300 m/sec (1000

ft/sec), 800 m/sec (2600 ft/sec) and greater than or equal to 1700 m/sec (5600 ft/sec), respectively.

(8) *This is the minimum shear wave velocity of the supporting foundation material and material surrounding the embedded walls associated with seismic strains for lower bound soil properties at minus one sigma from the mean. The ratio of the largest to the smallest shear wave velocity over the mat foundation width of the supporting foundation material does not exceed 1.7.*

(9) *Safe Shutdown Earthquake (SSE) design ground response spectra of 5% damping, also termed Certified Seismic Design Response Spectra (CSDRS), are defined as free-field outcrop spectra at the foundation level (bottom of the base slab) of the Reactor/Fuel and Control Building structures. For the Firewater Service Complex, which is essentially a surface founded structure, the CSDRS is 1.35 times the values shown in Figures 2.0-1 and 2.0-2 and is defined as free-field outcrop spectra at the foundation level (bottom of the base slab) of the Firewater Service Complex structure.*

(10) *Values reported here are actually design criteria rather than site design parameters. They are included here because they do not appear elsewhere in the DCD.*

(11) *If a selected site has a X/Q value that exceeds the ESBWR reference site value, the COL Applicant will address how the radiological consequences associated with the controlling design basis accident continue to meet the dose reference values provided in 10 CFR 52.79(a)(1)(vi) and control room operator dose limits provided in General Design Criterion 19 using site-specific X/Q values.*

(12) *~~If a selected site has X/Q values that exceed the ESBWR reference site values, the release concentrations in Table 12.2-17 would be adjusted proportionate to the change in X/Q values using the stack release information in Table 12.2-16. In addition, for a site selected that exceeds the bounding X/Q or D/Q values, the COL Applicant will address how the resulting annual average doses (Table 12.2-18b) continue to meet the dose reference values provided in 10 CFR 50 Appendix I using site-specific X/Q and D/Q values~~Subsection 12.2.2.1 provides a discussion regarding the X/Q and D/Q values in this table. Per Subsection 12.2.2.2, a COL applicant is responsible for ensuring that offsite dose (using site-specific generated X/Q and D/Q values) due to radioactive airborne effluents complies with the regulatory dose limits in Sections II.B and II.C of 10 CFR 50, Appendix I.*

(13) *~~Value was~~ Values were selected to comply with expected requirements of southeastern coastal locations~~.~~, which include the consideration of hurricanes as described in ASCE 7-02. Wind speeds are considered to be at 10 m (33 ft) above ground per ASCE 7-02. Seismic Category NS buildings that house RTNSS equipment are designed to withstand hurricane Category 5 wind velocity at 87.2 m/s (195 mph), 3-second gust, and missiles generated by that wind velocity. See Tables 19A-3 and 19A-4 for additional details.*

(14) *Localized liquefaction potential under other than Seismic Category I structures is addressed per SRP 2.5.4 in Table 2.0-2.*

(15) *Settlement values are long-term (post-construction) values except for differential settlement within the foundation mat. The design of the foundation mat accommodates immediate and long-term (post-construction) differential settlements after the installation of the basemat.*

Table 3.2-1

Classification Summary

Principal Components[1]	Safety Class.[2]	Location[3]	Quality Group[4]	Safety-Related Classification[5]	Seismic Category[6]	Notes
U72 Turbine Building Structure	N	TB	—	S	II	(5) c
U73 Control Building Structure						
1. Main building	3	CB	—	Q	I	
2. Stair towers and elevator shaft	N	CB	—	S	II	(5) c
U74 Radwaste Building Structure	N	RW	—	S	NS	(5) d
U75 Service Building Structure	N	SB	—	S	II	(5) c
U77 Control Building HVAC						
1. Ducts, valves, and dampers (including supports) supporting safety-related areas	3	CB	—	Q	I	
2. Other ducts, valves and dampers (including supports)	N	CB	—	N	NS	
3. Electrical modules and cable with safety-related function	3	CB	—	Q	I	
4. Control Room air handling units and the air conditioning for their coils	N	CB	—	S	II	(5) c, (5) h
5. Other Nonsafety-Related equipment	N	CB	—	N	NS	
6. Emergency Filter Unit	3	CB	—	Q	I	
7. Safety-Related DCIS (Q-DCIS) room coolers	N	CB	—	S	II	(5) c, (5) h
U78 Cold Machine Shop	N	OO	—	N	NS	
U80 Electrical Building Structure	N	EB	—	~~N~~S	NS	(5) i – Structure houses RTNSS C equipment
U81 Seismic Monitoring System	N	ALL	—	N	NS	

Table 3.2-1

Classification Summary

Principal Components[1]	Safety Class.[2]	Location[3]	Quality Group[4]	Safety-Related Classification[5]	Seismic Category[6]	Notes
U84 Service Water Building Structure	N	SF	—	~~N~~S	NS	(5) i – Structure houses RTNSS C equipment
~~**U85 Service Water Building HVAC**~~	~~N~~	~~SF~~	~~—~~	~~N~~	~~NS~~	
U91 Administration Building Structure	N	OL	—	N	NS	
U93 Training Center	N	OL	—	N	NS	
U95 Hot Machine Shop	N	OO	—	N	NS	
U97 Fuel Building Structure						
1. Main building	3	FB	—	Q	I	
2. HVAC penthouse, stair towers and elevator shaft	N	FB	—	S	II	(5) c
3. Spent fuel pool liner and pool gates	3	FB	—	Q	I	
4. Fuel Building pressure relief devices	3	FB	—	Q	I	
U98 Fuel Building HVAC						
1. Building isolation dampers	3	FB	—	Q	I	
2. Ducting penetrating fuel building boundary	3	FB	—	Q	I	
3. Controls associated with the isolation dampers	3	FB	—	Q	I	
4. Other system components	N	FB	—	S	II	(5) c, (5) i – for RTNSS equipment
W INTAKE STRUCTURE AND SERVICING EQUIPMENT						
W12 Intake and Discharge Structures	N	OO	—	N	NS	
W24 Cooling Tower	N	OO	—	N	NS	
W32 Screen Cleaning Facility	N	OO	—	N	NS	
W33 Screens, Racks, and Rakes	N	OO	—	N	NS	

- Loss of Service Water System,
- Inadvertent Opening of a Relief Valve,
- ATWS from Generic Transient,
- ATWS from Transient with Loss of Feedwater System,
- ATWS from Transient with Loss of Preferred Power,
- ATWS from Transient with Loss of Service Water System,
- ATWS from Inadvertent Opening of a Relief Valve,
- ATWS from Transient with LOCA,
- Large Steam LOCA,
- Large LOCA on Feedwater Line A,
- Large LOCA on Feedwater Line B,
- Medium Liquid LOCA,
- Small and Medium Steam LOCA,
- Small Liquid LOCA,
- Reactor Vessel Rupture,
- Break Outside of Containment on Main Steam Lines,
- Break Outside of Containment on Feedwater Line A,
- Break Outside of Containment on Feedwater Line B,
- Break Outside of Containment on RWCU/SDC Line, and
- Break Outside of Containment on Isolation Condenser Line.

Systems Analysis of Internal Events

As part of the systems analysis, fault trees are developed for all the safety-related systems and several nonsafety-related systems whose operation could mitigate the effects of an accident. The fault tree analysis provides modeling of the major components in the plant. Failures on demand and during the mission of the component are both modeled. Common cause failure is treated for components used in redundant applications. The human actions that are modeled include both pre-initiator failures and post-initiator failures. Test and maintenance unavailability is also included explicitly in the systems analysis. Table 19.1-1 provides a list of the systems and functions that are included in the PRA model.

19.2.3.1.1 Significant Core Damage Sequences of Internal Events

There are important commonalities in the dominant accident sequences that play a key role in contributing to core damage. In addition to requiring a scram, each initiating event in the dominant sequences causes a loss of a key mitigating function. For example, Feedwater injection is unavailable in a Loss of Feedwater initiating event, and an inadvertent opening of a relief valve event indirectly results in the loss of the ICS. The dominant sequences typically do not contain multiple independent component failures. Instead, they consist of common cause failures that disable entire mitigating functions. And, it is important to note that multiple mitigating functions must fail in the dominant sequences, so a single common cause event is insufficient to directly result in core damage. The ATWS sequences are dominated by an assumed failure of the control rods to insert into the core due to mechanical binding. Core damage in ATWS accident sequences results from the inability to maintain a lowered RPV water level prior to achieving subcriticality. While the DPVs are challenged in a majority of the accident sequences, they are successful in most cases.

Important operator actions involve recognizing the need for depressurization or providing low pressure injection in particular scenarios and recognizing the need to make up to the IC/PCCS pools. Information on important operator actions is incorporated into the human factors engineering program, as discussed in Subsection 19.2.2.1.

The dominant sequences are described below, on a functional level. This distillation of the PRA accident sequences is intended to represent the important insights that represent the behavior of the ESBWR design in response to postulated accidents.

- General Transient with ATWS
  - Scram fails
  - SLCS fails
- Inadvertent Opening of a Relief Valve
  - Scram is successful
  - High Pressure Injection fails
  - Depressurization is successful
  - Low Pressure Injection fails
- Inadvertent Opening of a Relief Valve
  - Scram is successful
  - High Pressure Injection fails
  - Depressurization fails
- Medium Liquid LOCA
  - Scram is successful
  - Vacuum Breakers Pressure Suppression is successful
  - Depressurization is successful
  - Low Pressure Injection fails
- General Transient with ATWS
  - Scram fails
  - One or more SRVs sticks open

  - Failure to maintain RPV water level
- Medium Liquid LOCA
  - Scram is successful
  - Vacuum Breakers Pressure Suppression is successful
  - Depressurization is successful
  - Low Pressure Injection fails
- Medium Liquid LOCA
  - Scram is successful
  - Vacuum Breakers Pressure Suppression is successful
  - Depressurization fails
- Small Steam LOCA
  - Scram is successful
  - Vacuum Breakers Pressure Suppression is successful
  - Depressurization is successful
  - Low Pressure Injection fails
  - CRD Injection fails
- Small Liquid LOCA
  - Scram is successful
  - Isolation Condensers are successful
  - Depressurization is successful
  - Vacuum Breakers Pressure Suppression is successful
  - Low Pressure Injection fails
  - CRD Injection fails
- ~~Loss of Preferred Power~~Small Steam LOCA
  - Scram is successful
  - ~~Isolation Condensers fail~~Feedwater isolates on High Drywell Pressure
  - ~~SRV Open and Reclosure is successful~~
  - Automatic and Manual Depressurization fail~~s~~
  - CRD Injection fails

identify RTNSS candidates includes focused PRA sensitivity studies, an assessment of the effects of nonsafety-related systems on initiating event frequencies, and an assessment of uncertainties in these analyses, or that may be introduced by first of a kind passive components.

19A.4.1 Focused PRA Sensitivity Study

Focused PRA sensitivity studies are used to evaluate whether safety-related systems alone are adequate to meet the NRC safety goals of CDF less than 1.0 E-4 per year and LRF less than 1.0 E-6 per year. The Focused PRA studies, which encompass at-power and shutdown modes for internal and external events, retain the same initiating event frequencies as the baseline PRA models, and set the logic status of nonsafety-related systems to failed, while safety-related systems remain unchanged in the models. The Focused PRA models are evaluated using only the safety-related systems and RTNSS systems determined from Criterion A, those functions from Criterion B that are evaluated in the PRA models. Additional nonsafety-related systems are included only if they are required to meet the CDF or LRF goals.

The Focused PRA sensitivity studies include a baseline Focused PRA, (i.e., safety-related SSCs only) to determine if the safety goal guidelines are met without adding nonsafety-related SSCs. In addition, a RTNSS-based Focused PRA is created to determine which nonsafety-related systems are necessary to meet the safety goal guidelines. Success paths of the RTNSS functions from Criteria A and B are added to the baseline Focused PRA models because they receive regulatory oversight and their functions are modeled in the PRA. If the RTNSS-based Focused PRA results do not satisfy the NRC safety goal guidelines, then active functions are added to the RTNSS-based model until the goals are satisfied.

Once the NRC goals are met, there may be several combinations of SSCs that can satisfy them. In order to identify an optimal combination of SSCs, risk achievement worth importance values are calculated for each SSC in the RTNSS-based Focused PRA. The value of each SSC is determined by excluding one RTNSS function at a time. If the NRC goal cannot be met with an SSC out of service, then the SSC is considered to be highly significant.

The ESBWR baseline Focused PRA results determined that some models do not meet the CDF or LRF goals. The dominating failure mode in the baseline Focused PRAs is a common cause software failure that disables the controls to the safety-related functions. With the addition of DPS functions of GDCS injection mode and equalize mode actuation, ADS actuation, isolation of RWCU/SDC isolation valves, and opening of the IC/PCCS pool cross-connect valves, the safety goals are met.

Because these functions are required to meet the safety and containment performance goals, they are designated as High Regulatory Oversight, as discussed in Subsection 19A.8.1. The DPS functions that are not highly significant are still addressed in the Availability Controls Manual.

Assessment of Nonsafety Related Systems on Seismic Events

The focused PRA uses the internal and external events PRA models to quantify the effects of RTNSS SSCs on the safety goal guidelines. The effects of seismic events are evaluated deterministically, in accordance with the seismic margins analysis. The ESBWR plant and equipment are designed with a HCLPF of at least 1.67 times the peak ground acceleration of the safe shutdown earthquake (SSE). Only passive safety-related systems are credited in the seismic event tree. In addition, FPS is classified as nonsafety-related but is designed so that the diesel

19A.4.4 Summary of RTNSS Candidates from Criterion C

The focused PRA sensitivity study requires certain portions of DPS being designated as RTNSS. The portions that provide capability for a manual backup of safety-related automatic actuation of safety functions provides the level of p~~rotection necessary to meet both the CDF and LRF~~ goals. These RTNSS DPS functions are: GDCS injection mode and equalize mode actuation, ADS actuation, isolation of RWCU/SDC isolation valves, and opening of the IC/PCCS pool cross-connect valves. They are risk signific~~ant and receive high regulatory oversight, as descri~~bed in Subsection 19A.8.1.

The assessment of uncertainties concludes that the defense-in-depth role of FAPCS in providing a backup source of low pressure injection and suppression pool cooling is within the scope for RTNSS. Supporting systems for FAPCS include: RCCWS, standby diesel generators, PIP buses, Electrical Building HVAC, Fuel Building HVAC, Nuclear Island Chilled Water, and PSWS. In addition, the assessment of shutdown initiating events identifies that the lower drywell hatches should have regulatory oversight.

19A.5 CRITERION D: CONTAINMENT PERFORMANCE ASSESSMENT

The containment performance goal in SECY-93-087, Issue I.J is addressed in Subsection 19.3.3 and Appendices 19B and 19C.

The containment bypass issue from SECY-93-087, Issue II.G, during severe accidents is concerned with potential sources of steam bypassing the suppression pool and failure of heat exchanger tubes in passive containment cooling systems. These concerns are addressed in the Design Control Document. Subsection 19.3.2.4 addresses the steam bypass of the suppression pool. Subsection 6.2.2.3 addresses the design of the Passive Containment Cooling Heat Exchanger tubes. These Criterion D safety concerns are addressed in the ESBWR design, and no RTNSS candidates are identified.

The BiMAC device provides an engineered method to assure heat transfer between a core debris bed and cooling water in the lower drywell during severe accident scenarios. Waiting to flood the lower drywell until after the introduction of core material minimizes the potential for energetic fuel-coolant interaction. Covering core debris with water provides scrubbing of fission products released from the debris and cools the corium, thus limiting off-site dose and potential core-concrete interaction. The BiMAC device provides additional assurance of debris bed cooling by providing engineered pathways for water flow through the debris bed. BiMAC failure could occur if no water is supplied. The BiMAC device is not safety-related. It is added to the ESBWR to reduce the uncertainties involved with severe accident phenomenology. As such, the BiMAC device, the nonsafety-related GDCS deluge squib valves, and the associated actuation logic are in the scope for RTNSS.

Igniters (glow plugs) in the lower drums of the PCCS condensers recombine the hydrogen and oxygen at low concentrations, thereby keeping the resultant internal pressure of the PCCS condensers within acceptable limits to ensure there is no plastic deformation during a detonation under severe accident conditions. During the initial stages of a severe accident, there is essentially no water in the vicinity of the core, so radiolysis is greatly reduced. However, large quantities of hydrogen are released into the drywell due to metal-water reactions. The high abundance of hydrogen relative to oxygen effectively reduces the potential for detonation in the

ADS is required, in event of loss of feed water, such that the ADS can take place from a lower water level.

Each IC is located in a subcompartment of the Isolation Condenser/Passive Containment Cooling System (IC/PCCS) pool, and all pool subcompartments communicate at their lower ends to enable full utilization of the collective water inventory, independent of the operational status of any given IC train. A valve is provided at the bottom of each IC/PCCS pool subcompartment that can be closed so the subcompartment can be emptied of water to allow IC maintenance. Pool water can heat up to about 101°C (214°F); steam that is formed, being non-radioactive and having a slight positive pressure relative to station ambient, vents from the steam space above each IC segment where it is released to the atmosphere through large-diameter discharge vents. A moisture separator is installed at the entrance to the discharge vent lines to preclude excessive moisture carryover. IC/PCCS pool makeup clean water supply for replenishing level during normal plant operation is provided from FAPCS. A separate~~nonsafety related independent~~ FAPCS makeup line ~~is provided to~~ provides emergency makeup water into the IC/PCCS pool from the fire protection system and from piping connections located in the reactor yard.

A purge line is provided to assure that, during normal plant operation (ICS standby conditions), excess hydrogen from radiolytic decomposition or air entering into the reactor coolant from the feedwater does not accumulate in the isolation condenser steam supply line, thus assuring that the isolation condenser tubes are not blanketed with non-condensables when the system is first started.

Upper header and lower header vent lines with valves are provided to mitigate the buildup of hydrogen during LOCA and non-LOCA events. Both valves can be operated manually. The lower header vent valve is fail-open and is automatically opened ~~six hours~~with a time delay after ICS is initiated.

On the condensate return piping just upstream of the reactor entry point is a loop seal and two valves in parallel: (1) a condensate return valve (fail as-is), and, (2) a condensate return bypass valve (fail open). These two valves are closed during normal station power operations. Because the steam supply line valves are normally open, condensate forms in the in-line isolation condenser reservoir and develops a level up to the steam distributor, above the upper headers. To start an isolation condenser into operation, the condensate return valve or condensate return bypass valve is opened, whereupon the standing condensate drains into the reactor and the steam-water interface in the isolation condenser tube bundle moves downward below the lower headers to a point in the main condensate return line. The fail-open condensate return bypass valve along with the fail-open vent valves open~~s~~ if the DC power is lost.

The ICS is automatically isolated to mitigate buildup of noncondensable gases during LOCA events. The signal that isolates ICS is a confirmed opening of any two DPVs.

19A.6.1.3.2 System Interfaces

System interfaces include: Main Steam, Containment, Suppression Pool, FAPCS, DC Power, and Process Radiation Monitoring

LRO - If a RTNSS system is not significant, as described above, then the proposed level of regulatory oversight is Low Regulatory Oversight (LRO), which is addressed in regulatory availability specifications, which are described in the Availability Controls Manual in this appendix.

Support – These systems are LRO and they provide support (generally component and room cooling) for RTNSS systems that provide active mitigation functions. Treatment of support systems relative to the systems they support is described in the Availability Controls Manual in this appendix.

19A.8.2 Reliability Assurance

All RTNSS systems shall be in the scope of the Design Reliability Assurance Program, as directed by Section 17.4, which will be incorporated into the Maintenance Rule program.

Quality assurance controls for RTNSS SSCs are addressed in Subsection 17.1.22, which states that nonsafety-related structures, systems and components (SSCs) that perform safety significant functions have quality assurance requirements applied commensurate with the importance of the items function. The identification of nonsafety-related structures, systems and components and their quality classification is shown in Table 3.2-1.

19A.8.3 Augmented Design Standards

Systems that meet RTNSS Criterion B (that is, for actions required beyond 72 hours and seismic events) require augmented design standards to assure reliable performance in the event of hazards, such as seismic events, high winds, flooding, and environmental conditions experienced during an accident.

RTNSS B components are required to function following a seismic event and they are designed to Seismic Category II, at a minimum. (Some RTNSS B structures are Seismic Category I due to safety-related equipment within). Because these systems are designated to perform their function post 72 hours, the equipment does not need to be able to perform their functions during the seismic event, but must be available following the event. The structures housing RTNSS B components are identified in Table 19A-3. In addition, any non-RTNSS system that can adversely interact with RTNSS B systems are designed to the same seismic requirements as the affected RTNSS system.

RTNSS Criterion B equipment are qualified to IEEE-344-1987 to demonstrate seismic performance and structural integrity.

In addition to seismic standards, Seismic Category II structures that house RTNSS Criterion B equipment are designed ~~Criterion B systems must meet design standards~~ to withstand ~~winds and~~ missiles generated from Category 5 hurricanes at 195 mph (313.8 km/hr), 3-sec gust. As with seismic, the systems do not need to perform their functions during the high wind event, but must be available following the event. Table 19A-4 discusses the capability of structures housing RTNSS B components with respect to flooding, winds and wind-generated missiles.

The plant design for protection of SSCs from the effects of flooding considers the relevant requirements of General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," and 10 CFR Part 100, Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," Section IV.C as related to protecting safety-related SSCs from the effects of floods, tsunamis and seiches. The design meets the guidelines of Regulatory Guide 1.59 with regard to the methods utilized for establishing the probable maximum flood (PMF), probable maximum precipitation (PMP), seiche and other pertinent hydrologic considerations, and the guidelines of Regulatory Guide 1.102 regarding the means utilized for protection of safety-related SSCs from the effects of the PMF and PMP. To ensure that RTNSS systems are protected from flood-related effects associated with fluid piping and component failures, they are located above the maximum internal flooding level analyzed by Section 3.4

To provide assurance that RTNSS components are capable of performing in any anticipated environmental conditions, they are designed with the following requirements:

(1) RTNSS components inside containment are designed, procured, and maintained in accordance with the environmental requirements of the environmental qualification (EQ) program, as described in DCD Tier 2, Sections 3.9, 3.10, and 3.11.

(2) RTNSS components outside the containment are required to be designed and procured with the requirement that they remain functional in any anticipated environmental conditions.

Systems that meet RTNSS Criteria A, C, D, or E do not require augmented design standards described above, but must incorporate the defense-in-depth principles of redundancy and physical separation to ensure adequate reliability and availability.

RTNSS C systems do not require augmented seismic design criteria. However, some RTNSS C systems are housed in Seismic Category I or II structures, and some are housed in non-seismic structures that are designed using the International Building Code – 2003 by International Code Council, Inc. (IBC-2003) to maintain structural integrity under SSE conditions. Non-seismic structures that house RTNSS Criterion C systems are seismically designed using dynamic analysis method with the SSE ground input motion equal to two-thirds of the Certified Seismic Design Spectra taken from Figures 2.0-1 and 2.0-2 adjusted as required to their bases. An Occupancy Importance Factor of 1.5, Response Modification Factor of 2 and Seismic Design Category D/Seismic Use Group III apply to these structures. RTNSS C systems and components are designed to the seismic requirements of IBC-2003 consistent with the above SSE ground motion.

Seismic Category NS structures that house RTNSS Criterion C equipment are designed ~~RTNSS C systems and structures must meet design standards~~ to withstand wind and missiles generated from Category 5 hurricanes at 195 mph (313.8 km/hr), 3-sec gust. Seismic Category II structures that house RTNSS Criterion C equipment are designed to withstand missiles generated from Category 5 hurricanes at 195 mph (313.8 km/hr), 3-sec gust. Table 19A-4 discusses the capability of structures housing RTNSS C components with respect to flooding, winds and wind-generated missiles. RTNSS Criterion C equipment are qualified to IEEE-344-1987 to only demonstrate structural integrity. RTNSS C components are not required to remain functional following a seismic event. The seismic margins analysis results indicate that RTNSS C components are not required to function in order to avoid core damage following a seismic event. In addition, any non-RTNSS system that can adversely interact with RTNSS C systems are designed to the same seismic requirements as the affected RTNSS system.

The hurricane missile spectrum for Seismic Category NS and Seismic Category II structures that house RTNSS equipment is consistent with the tornado missile spectrum identified in

Table 2.0-1. The design criteria associated with hurricane missile protection follows Section 3.5 for missiles generated by natural phenomenon. The tornado wind speed is substituted with hurricane wind speed to design the concrete or steel barriers for missile impact.

19A.8.4 Regulatory Treatment

The proposed regulatory treatment of RTNSS systems is presented below, and is summarized in Tables 19A-2, 19A-3 and 19A-4.

19A.8.4.1 Nonsafety-Related ATWS Actuation Logic

ATWS actuation logic provides backup reactor shutdown methods that are diverse from the safety-related reactor protection system. Alternate Rod Insertion, Feedwater Runback, and ADS Inhibit use DPS to perform their actuation functions. These functions are RTNSS Criterion A relative to the ATWS Rule, 10 CFR 50.62. They do not have a high risk significance due to the redundancy and diversity of the reactor protection system. The proposed level of regulatory oversight for these functions is in the Availability Controls Manual.

19A.8.4.2 FPS Pool Cooling Makeup

The diesel-driven and motor-driven FPS pumps, and associated tanks, piping and valves, are RTNSS Criterion B. The pumps and the FPS piping and valves are classified as nonsafety-related but are designed so that the necessary portions of the system remain available following a seismic event to keep equipment required for safe shutdown free from fire damage during a safe shutdown earthquake. In conjunction with the pumps, FPS makeup includes the water supply, the suction pipe from the water supply to the pump, one of the supply pipes from the FPE to the Reactor Building and Fuel Building, and the connections to the FAPCS. Loss of this function does not challenge the CDF or LRF goals. Therefore, the proposed level of regulatory oversight for this function is in the Availability Controls Manual.

19A.8.4.3 Diverse Protection System

DPS provides diverse actuation functions that enhance the plant's ability to mitigate dominant accident sequences involving the common cause failure of actuation logic or controls. The following functions of DPS are significant with respect to the focused PRA sensitivity study to meet the NRC safety goal guidelines: ADS actuation, GDCS actuation, RWCU/SDC valve isolation, and IC/PCCS Pool Connection valves actuation. The risk significance is high for the special case of the focused PRA, such that the proposed level of regulatory oversight for the portions of DPS that provide these functions are contained in Technical Specifications.

DPS provides backup shutdown methods for ATWS mitigation, as described in Subsection 19A.8.4.1.

In addition, DPS provides the following backup functions that are modeled in the PRA:

- Scram
- MSIV Closure
- SRV Actuation
- FMCRD Actuation

Table 19A-2
RTNSS Functions

RTNSS Function	Description	Availability Controls
DPS – ARI Actuation	A - ATWS Rule	ACLCO 3.3.1
DPS – FWRB Actuation	A - ATWS Rule	ACLCO 3.3.3
DPS – ADS Inhibit	A - ATWS Rule	ACLCO 3.3.4
FPS Diesel Driven Pump	B - Long Term Core Cooling: RPV At-Power and Spent Fuel Pool; Long Term Containment Integrity	ACLCO 3.7.1
FPS Motor Driven Pump	B - Long Term Core Cooling: RPV At-Power and Spent Fuel Pool; Long Term Containment Integrity	ACLCO 3.7.1
FPS to FAPCS Connection Piping	B - Long Term Core Cooling: RPV At-Power and Spent Fuel Pool; Long Term Containment Integrity	ACLCO 3.7.1
PARs	B - Long Term Containment Integrity	ACLCO 3.6.2
PCCS Vent Fans	B - Long Term Containment Integrity	ACLCO 3.6.3
Emergency Lighting	B - Post-Accident Monitoring	Maintenance Rule
DPS – GDCS Injection Mode and Equalize Mode Actuation	C - Focused PRA (CDF, LRF) High Regulatory Oversight	TS LCO 3.3.8.1
DPS – ADS Actuation	C - Focused PRA (CDF, LRF) High Regulatory Oversight	TS LCO 3.3.8.1
DPS – Open IC/PCCS Pool Cross-Connect Valves	C - Focused PRA (CDF, LRF) High Regulatory Oversight	TS LCO 3.3.8.1
DPS – Isolation RWCU/SDC Valves	C - Focused PRA (CDF, LRF) High Regulatory Oversight	TS LCO 3.3.8.1
DPS – Scram	C - Focused PRA (CDF, LRF)	ACLCO 3.3.4
DPS – MSIV Closure	C - Focused PRA (CDF, LRF)	ACLCO 3.3.4
DPS – SRV Actuation	C - Focused PRA (CDF, LRF)	ACLCO 3.3.4
DPS- FMCRD Actuation	C - Focused PRA (CDF, LRF)	ACLCO 3.3.4
DPS – ICS Actuation (Condensate Return Valve and Vent Valve)	C - Focused PRA (CDF, LRF)	ACLCO 3.3.4
DPS – SLC Actuation LOCA	C - Focused PRA (CDF, LRF)	ACLCO 3.3.4
FAPCS (LPCI, SPC Modes)	C - Focused PRA (Uncertainty)	ACLCO 3.7.2 ACLCO 3.7.3

Table 19A-3
Structures Housing RTNSS Functions

System	RTNSS Criterion	Location	Building Category
FPS Diesel Driven Pump	B	Fire Pump Enclosure	Seismic Cat. I
FPS Motor Driven Pump	B	Fire Pump Enclosure	Seismic Cat. I
FPS to FAPCS Connection	B	Reactor Building	Seismic Cat. I
PARs	B	Containment	Seismic Cat. I
PCCS Vent Fans	B	Containment	Seismic Cat. I
CRHAVS Air Handling Units	B	Control Building	Seismic Cat. I
Emergency Lighting	B	Control Building	Seismic Cat. I
FPS Water Tank	B	Fire Pump Enclosure	Seismic Cat. I
FPS Diesel Fuel Oil Tank	B	Fire Pump Enclosure	Seismic Cat. I
Ancillary Diesel Generators	B	Ancillary DG Building	Seismic Cat. II
Ancillary AC Power Buses	B	Ancillary DG Building	Seismic Cat. II
Ancillary DG Fuel Oil Tank	B	Ancillary DG Building	Seismic Cat. II
Ancillary DG Fuel Oil Transfer Pump	B	Ancillary DG Building	Seismic Cat. II
Ancillary Diesel Building HVAC	B	Ancillary DG Building	Seismic Cat. II
CRHAVS Air Handling Unit auxiliary heaters and coolers	B	Control Building	Seismic Cat. I

Notes:

(1) RTNSS components that support the RTNSS functions for the systems shown in Table 19A-3 are_designed/installed with similar protection from missiles and flooding described in Table 19A-4.

(2) Seismic Category I and II structures that house RTNSS equipment are not required to be designed to withstand hurricane Category 5 wind velocity at 87.2 m/s (195 mph), 3- second gust but are required to be designed to withstand 100-year wind velocity at 67.1 m/s (150 mph) identified in Table 2.0-1.

(3) The hurricane missile spectrum for Seismic Category II structures that house RTNSS equipment is consistent with the tornado missile spectrum identified in Table 2.0-1. The design criteria associated with hurricane missile protection follows Section 3.5 for missiles generated by natural phenomenon. The tornado wind speed is substituted with hurricane wind speed to design the concrete or steel barriers for missile impact.

Table 19A-4 Capability of RTNSS Related Structures(1)(2)				
System Location	**A. (Internal Flooding)**	**B. (External Flooding)**	**C. (Internal Missiles)**	**D. (Extreme Wind and Missiles)**
Reactor Bldg. (RB) Control Bldg. (CB) Fuel Bldg. (FB) Fire Pump Enclosure Bldg. (FPE)	The design/installation of RTNSS equipment includes protection from the effects of internal flooding.	Seismic Category I structures are designed to withstand the flood level and groundwater level specified in Table 2.0-1 and described in Subsection 3.4.1.2. All exterior access openings are above flood level and exterior penetrations below design flood and groundwater levels are appropriately sealed as described in Subsection 3.4.1.1. On-site storage tanks are designed and constructed to minimize the risk of catastrophic failure and are located to allow drainage without damage to site facilities in the event of a tank rupture per Subsection 3.4.1.2.	There are no credible sources of internal missiles per Section 3.5.	Seismic Category I structures designed for tornado and extreme wind phenomena are described in Section 3.3 and Subsection 3.5.1.4.
Ancillary DG Building		The Ancillary DG Building is designed to withstand external flooding with the same acceptance criteria as a Seismic Category I Structure.		The Ancillary DG Building is designed for tornado ~~and Category 5 hurricane~~ wind loads. RTNSS systems in the Ancillary Diesel Building are protected from Category 5 hurricane ~~wind and~~ missiles.

Table 19A-4
Capability of RTNSS Related Structures[1][2]

System Location	A. (Internal Flooding)	B. (External Flooding)	C. (Internal Missiles)	D. (Extreme Wind and Missiles)
Electrical Bldg. (EB) Service Water Bldg. (SF) Turbine Bldg. (TB)	The design/installation of RTNSS equipment includes protection from the effects of internal flooding.	All exterior access openings are above flood level and exterior penetrations below design flood and groundwater levels are appropriately sealed; basemat and walls are designed for hydrostatic loading, therefore protected from external flooding.	N/A	The EB and SF are RTNSS Structures designed for Category 5 hurricane winds. RTNSS systems in the EB and SF are protected from Category 5 hurricane wind and missiles. The TB structure is designed for tornado ~~and Category 5 hurricane~~ wind loads. The design/installation of the RTNSS systems in the TB includes protection to comply with the requirement of Subsection 19A.8.3 to withstand ~~winds and~~ missiles generated from Category 5 hurricanes.
PSW System located Outdoors Onsite	N/A	The design/installation of the RTNSS system includes protection from the effects of flooding.	N/A	The design/installation of the RTNSS system complies with the requirement of Subsection 19A.8.3 to withstand winds and missiles generated from Category 5 hurricanes.

Notes:

(1) ~~Category 5 hurricane wind speed is 195 mph, 3 sec. Gust~~Seismic Category NS structures and PSW System located outdoors onsite that house RTNSS equipment are designed to withstand hurricane Category 5 wind velocity at 87.2 m/s (195 mph), 3-second gust. Seismic Category I and II structures that house RTNSS equipment are not required to be designed to withstand hurricane Category 5 wind velocity at 87.2 m/s (195 mph), 3-second gust but are required to be designed to withstand 100-year wind velocity at 67.1 m/s (150 mph) identified in Table 2.0-1.

(2) The hurricane missile spectrum ~~is~~ for Seismic Category NS, PSW System located outdoors onsite and Seismic Category II structures that house RTNSS equipment is consistent with the tornado missile spectrum identified in Table 2.0-1. The design criteria associated with hurricane missile protection follows Section 3.5 for missiles generated by natural phenomenon. The tornado wind speed is substituted with hurricane wind speed to design the concrete or steel barriers for missile impact.