# Enclosure 2

# MFN 14-075 Supplement 1

# GEH Supplemental Response to RAI 02-1

# ABWR DCD DRAFT Revision 6 Markups

## Table 1.9-1 Summary of ABWR Standard Plant COL License Information (Continued)

| Item No. | Subject | Subsection |
|---|---|---|
| 2.16 | Ice Effects | 2.3.2.14 |
| 2.17 | Cooling Water Channels and Reservoirs | 2.3.2.15 |
| 2.18 | Channel Division | 2.3.2.16 |
| 2.19 | Flooding Protection Requirements | 2.3.2.17 |
| 2.20 | Cooling Water Supply | 2.3.2.18 |
| 2.21 | Accidental Release of Liquid Effluents in Ground and Surface Waters | 2.3.2.19 |
| 2.22 | Technical Specifications and Emergency Operation Requirement | 2.3.2.20 |
| 2.23 | Basic Geological and Seismic Information | 2.3.2.21 |
| 2.24 | Vibratory Ground Motion | 2.3.2.22 |
| 2.25 | Surface Faulting | 2.3.2.23 |
| 2.26 | Stability of Subsurface Material and Foundation | 2.3.2.24 |
| 2.27 | Site and Facilities | 2.3.2.25 |
| 2.28 | Field Investigations | 2.3.2.26 |
| 2.29 | Laboratory Investigations | 2.3.2.27 |
| 2.30 | Subsurface Conditions | 2.3.2.28 |
| 2.31 | Evacuation and Backfilling for Foundation Construction | 2.3.2.29 |
| 2.32 | Effect of Groundwater | 2.3.2.30 |
| 2.33 | Liquefaction Potential | 2.3.2.31 |
| 2.34 | Response of Soil and Rock to Dynamic Loading | 2.3.2.32 |
| 2.35 | Minimum Static Bearing Capacity | 2.3.2.33 |
| 2.36 | Earth Pressures | 2.3.2.34 |
| 2.37 | Soil Properties for Seismic Analysis of Buried Pipes | 2.3.2.35 |
| 2.38 | Static and Dynamic Stability of Facilities | 2.3.2.36 |
| 2.39 | Subsurface Instrumentation | 2.3.2.37 |
| 2.40 | Stability of Slopes | 2.3.2.38 |
| 2.41 | Embankments and Dams | 2.3.2.39 |
| 2.42 | CRAC 2 Computer Code Calculations | 2.3.3 |
| 3.1 | Site-Specific Design Basis Wind | 3.3.3.1 |
| 3.2 | Site-Specific Design Basis Tornado | 3.3.3.2 |

Add "and Hurricane"

## Table 1.9-1 Summary of ABWR Standard Plant COL License Information (Continued)

| Item No. | Subject | Subsection |
|---|---|---|
| 3.3 | Effect of Remainder of Plant Structures, Systems and Components Not Designed for Wind Loads | 3.3.3.3 |
| 3.4 | Effects of Remainder of Plant Structures, Systems and Components Not Designed for Tornado Loads | 3.3.3.4 |
| 3.5 | Flood Elevation | 3.4.3.1 |
| 3.6 | Ground Water Elevation | 3.4.3.2 |
| 3.7 | Flood Protection Requirements for Other Structures | 3.4.3.3 |
| 3.8 | Not Used | |
| 3.9 | Protection of Ultimate Heat Sink | 3.5.4.1 |
| 3.10 | Missiles Generated by Other Natural Phenomena | 3.5.4.2 |
| 3.11 | Site Proximity Missiles and Aircraft Hazards | 3.5.4.3 |
| 3.12 | Impact of Failure of Out of ABWR Standard Plant Scope Non-Safety-Related Structures, Systems, and Components Due to Design Basis Tornado | 3.5.4.4 |
| 3.13 | Turbine System Maintenance Program | 3.5.4.5 |
| 3.14 | Maintenance Equipment Missile Prevention Inside Containment | 3.5.4.6 |
| 3.15 | Failure of Structures, Systems, and Components Outside ABWR Standard Plant Scope | 3.5.4.7 |
| 3.16 | Details of Pipe Break Analysis Results and Protection Methods | 3.6.5.1 |
| 3.17 | Leak-Before-Break Analysis Report | 3.6.5.2 |
| 3.18 | Inservice Inspection of Piping in Containment Penetration Areas | 3.6.5.3 |
| 3.19 | Seismic Design Parameters | 3.7.5.1 |
| 3.20 | Pre-Earthquake Planning and Post-Earthquake Actions | 3.7.5.2 |
| 3.21 | Piping Analysis, Modeling of Piping Supports | 3.7.5.3 |
| 3.22 | Assessment of Interaction Due to Seismic Effects | 3.7.5.4 |
| 3.23 | Foundation Waterproofing | 3.8.6.1 |
| 3.24 | Site Specific Physical Properties and Foundation Settlement | 3.8.6.2 |
| 3.25 | Structural Integrity Pressure Results | 3.8.6.3 |
| 3.26 | Identification of Seismic Category I Structures | 3.8.6.4 |
| 3.27 | Reactor Internals Vibration Analysis, Measurement and Inspection Programs | 3.9.7.1 |

Add "and Hurricane"

## Table 5.0 ABWR Site Parameters

**Maximum Ground Water Level:**
61.0 cm below grade

**Maximum Flood (or Tsunami) Level:**
30.5 cm below grade

**Precipitation (for Roof Design):**
- Maximum rainfall rate: 49.3 cm/h[(3)]
- Maximum snow load: 2.394 kPa

**Ambient Design Temperature:**
1% Exceedance Values
- Maximum: 37.8°C dry bulb
  25°C wet bulb (coincident)
  26.7°C wet bulb (non-coincident)
- Minimum: –23.3°C–

0% Exceedance Values (Historical Limit)
- Maximum: 46.1°C dry bulb
  26.7°C wet bulb (coincident)
  27.2°C wet bulb (non-coincident)
- Minimum: –40°C

Exclusion Area Boundary (EAB): An area whose boundary has a Chi/Q less than or equal to $1.37 \times 10^{-3}$ s/m$^3$.

**Extreme Wind:** Basic Wind Speed:
177 km/h[(1)]/197 km/h[(2)]

Change "Extreme Wind" to "Severe Wind"

**Tornado**
- Maximum t 483 km/h
- Maximum p 13.827 kPaD
- Missile spectra: Spectrum I[(4)]

**Hurricane**
- Maximum hurricane wind speed[(8)]: 286.5 km/h
- ~~Maximum pressure drop: 0 kPaD~~
- Missile spectra: Spectrum I[(4)]

Eliminate whole line

**Soil Properties:**
- Minimum static bearing capacity: a
- Minimum shear wave velocity: 305 m/s[(6)]
- Liquefaction potential: None at plant site resulting from site specific SSE ground motion

**Seismology:**
- SSE response spectra: See Figures 5.0a and 5.0b[(7)]

**Meteorological Dispersion (Chi/Q):**
- Maximum 2-hour 95% EAB $1.37 \times 10^{-3}$ s/m$^3$
- Maximum 2-hour 95% LPZ $4.11 \times 10^{-4}$ s/m$^3$
- Maximum annual average (8760 hour) LPZ $1.17 \times 10^{-6}$ s/m$^3$

(1) 50-year recurrence interval; value to be utilized for design of non-safety-related structures only.

(2) 100-year recurrence interval; value to be utilized for design for safety-related structures only.

(3) Maximum value for 1 hour over 2.6 km$^2$ probable maximum precipitation (PMP) with ratio of 5 minutes to 1 hour PMP of 0.32. Maximum short-term rate: 15.7cm/5 min.

(4) Spectrum I missiles consist of a massive high kinetic energy missile which deforms on impact, a rigid missile to test penetration resistance, and a small rigid missile of a size sufficient to just pass through any openings in protective barriers. These missiles consists of an ~~1800~~1810 kg automobile, a ~~125~~130 kg, 20 cm diameter armor piercing artillery shell, and a 2.54 cm diameter solid steel sphere, all impacting at 35% of the maximum horizontal windspeed of the design basis tornado or a 59% of the maximum horizontal wind speed of the design basis hurricane. The first two missiles are assumed to impact at normal incidence, the last to impinge upon barrier openings in the most damaging directions.

(5) At foundation level of the reactor and control buildings.

(6) This is the minimum shear wave velocity at low strains after the soil property uncertainties have been applied.

(7) Free-field, at plant grade elevation.

(8) Maximum hurricane wind speed is the nominal 3-second gust wind speed measured at 10 m above ground over open terrain.

Change "Extreme Wind" to "Severe Wind"

## Table 2.0-1
## Envelope of ABWR Standard Plant Site Design Parameters

| | | |
|---|---|---|
| **Maximum Ground Water Level:** | 61.0 cm below grade | |
| **Extreme Wind:** | Basic Wind Speed: 177 km/h*/ 197 km/h† | |
| **Maximum Flood (or Tsunami) Level:‡** | 30.5 cm below grade | |
| **Tornado:** | – Maximum Tornado Wind Speed: | 483 km/h |
| | – Maximum Rotational Speed: | 386 km/h |
| | – Translational Velocity: | 97 km/h |
| | – Radius: | 45.7m |
| | – Maximum Pressure Drop: | 13.827 kPaD |
| | – Rate of Pressure Drop: | 8.277 kPa/s |
| | – Missile Spectra: | Spectrum I§ |
| **Hurricane:** | – Maximum Hurricane Wind Speed***: | 286.5 km/h |
| | ~~– Maximum Rotational Speed:~~ | ~~261.5 km/h~~ |
| | ~~– Translational Velocity:~~ | ~~25 km/h~~ |
| | ~~– Radius:~~ | ~~1500 m~~ |
| | ~~– Maximum Pressure Drop:~~ | ~~0 kPaD~~ |
| | – Missile Spectra: | Spectrum I |
| **Precipitation (for Roof Design):** | – Maximum Rainfall Rate: | 49.3 cm/h** |
| | – Maximum Snow Load: | 2.394 kPa |
| **Ambient Design Temperature:** | 1% Exceedance Values<br>– Maximum: 37.8°C dry bulb<br>25°C wet bulb (coincident)<br>26.7°C wet bulb (non-coincident)<br>– Minimum: –23.3°C<br>0% Exceedance Values (Historical limit)<br>– Maximum 46.1°C dry bulb<br>26.7°C wet bulb (coincident)<br>27.2°C wet bulb (non-coincident)<br>– Minimum: –40°C | |
| **Soil Properties:** | – Minimum Static Bearing Capacity: | 718.20 kPa†† |
| | – Minimum Shear Wave Velocity: | 305 m/s‡‡ |
| | – Liquification Potential: | None at plant site resulting from site specific SSE ground motion |

Eliminate 4 lines

## 3.3 ~~Wind and Tornado Loadings~~Severe Wind and Extreme Wind (Tornado and Hurricane) Loadings

ABWR Standard Plant structures which are Seismic Category I are designed for ~~tornado and~~ extreme wind phenomena.

Delete "tornado and"

### 3.3.1 ~~Wind Loadings~~Severe Wind Loads

#### 3.3.1.1 Design Wind Velocity

Seismic Category I structures are designed to withstand a design wind velocity of 177 km/h with a recurrence interval of 50 years and 197 km/h with a recurrence interval of 100 years at an elevation of 10m above grade (see Subsection 3.3.3.1 and 3.3.3.3 for COL license information requirements).

#### 3.3.1.2 Determination of Applied Forces

The design wind velocity is converted to velocity pressure ~~in accordance with Reference 3.3-1~~ using the formula:

"given in Reference 3.3.1 which is consistent with that of ASCE/SEI 7-05"

$q_z$ =

where $K_z$ = xposure coefficient which depends upon the type of exposure and height (z) above ground per Table 6 of Reference 3.3-1

I = The importance factor which depends on the type of structure; appropriate values of I are listed in Table 3.3-1

V = Design wind velocity with a recurrence interval of 50 years, in km/h, and

$q_z$ = Velocity pressure in kPa

The design wind pressures and forces for buildings, components and cladding, and other structures at various heights above the ground are obtained, in accordance with Table 4 of Reference 3.3-1 by multiplying the velocity pressure by the appropriate pressure coefficients and gust factors. Gust factors are in accordance with Table 8 of Reference 3.3-1. Appropriate pressure coefficients are in accordance with Figures 2, 3a, 3b, 4, and Tables 9 and 11 through 16 of Reference 3.3-1. Reference 3.3-2 is used to obtain the effective wind pressures for cases which Reference 3.3-1 does not cover. Since the Seismic Category I structures are not slender or flexible, vortex-shedding analysis is not required and the above wind loading is applied as a static load.

Applied forces for the Reactor, Control and Radwaste Buildings are found in Appendices 3H.1, 3H.2 and 3H.3, respectively.

## 3.3.2 ~~Tornado Loadings~~Extreme Wind Loads (Hurricanes and Tornados)

### 3.3.2.1 Applicable De

Eliminate items 2, 3, and 4, and change item 5 to item 2.

Extreme wi hurricane and design basis tornado.

The design basis hurricane is described by the following parameters:

(1) A maximum hurricane wind speed of 286.5 km/h at a radius of 1500 m from the center of the hurricane.

(2) ~~A maximum translational velocity of 25 km/h.~~

~~(3)~~ ~~A maximum tangential velocity of 261.5 km/h, based on the translational velocity of 25 km/h.~~

~~(4)~~ ~~A maximum atmospheric pressure drop of 0 kPa with a rate of the pressure change of 0 kPa/s.~~

~~(5)~~ The spectrum of hurricane generated missile and their pertinent characteristics as given in Table 2.0-1.

The design basis tornado is described by the following parameters:

(1) A maximum tornado wind speed of 483 km/h at a radius of 45.7m from the center of the tornado.

(2) A maximum translational velocity of 97 km/h.

(3) A maximum tangential velocity of 386 km/h, based on the translational velocity of 97 km/h.

(4) A maximum atmospheric pressure drop of 13.8 kPa with a rate of the pressure change of 8.3 kPa/s.

(5) The spectrum of tornado-generated missiles and their pertinent characteristics as given in Table 2.0-1.

See Subsection 3.3.3.2 for COL license information.

### 3.3.2.2 Determination of Forces on Structures

The procedures of transforming the tornado loading into effective loads and the distribution across the structures are in accordance with Reference 3.3-3. The procedure for transforming

the tornado-generated missile impact into an effective or equivalent static load on structures is given in Subsection 3.5.3.1. The loading combinations of the individual tornado loading components and the load factors are in accordance with Reference 3.3-3. Per RG 1.221, in areas where effects of design basis tornado missiles do not bound the effects of site-specific hurricane missiles, the site-specific hurricane loadings should replace tornado loadings. These areas are limited to certain coastal regions along Southwestern Atlantic and Gulf of Mexico.

The reactor building and control building are not vented structures. The exposed exterior roofs and walls of these structures are designed for the 13.8 kPa pressure drop. Tornado dampers are provided on all air intake and exhaust openings. These dampers are designed to withstand a negative13.8 kPa pressure.

#### 3.3.2.3 Effect of Failure of Structures, Systems or Components Not Designed for Tornado Loads

Add "and Hurricane"

All safety-related systems and components are protected within tornado-resistant or hurricane-resistant structures.

See Subsection 3.3.3.4 for COL license information requirements.

### 3.3.3 COL License Information

#### 3.3.3.1 Site-Specific Design Basis Wind

The site-specific design basis wind shall not exceed the design basis wind given in Table 2.0-1 (Subsection 2.2.1).

#### 3.3.3.2 Site-Specific Design Basis Tornado and Hurricane

The site-specific design basis tornado and hurricane shall not exceed the design basis tornado and hurricane given in Table 2.0-1 (Subsection 2.2.1).

#### 3.3.3.3 Effect of Remainder of Plant Structures, Systems and Components Not Designed for Wind Loads

All remainder of plant structures, systems and components not designed for wind loads shall be analyzed using the 1.11 importance factor or shall be checked that their mode of failure will not effect the ability of safety-related structures, systems or components performing their intended safety functions.

Add "and Hurricane"

#### 3.3.3.4 Effect of Remainder of Plant Structures, Systems, and Components Not Designed for Tornado Loads

All remainder of plant structures, systems, and components not designed for tornado loads and hurricane loads shall be analyzed for the site-specific loadings to ensure that their mode of failure will not effect the ability of the Seismic Category I ABWR Standard Plant structures, systems, and components to perform their intended safety functions. (See Subsection 3.3.2.3)

Non-Seismic Category I items and systems inside containment are considered as Follows:

(1) Cable Tray

All cable trays for both Class 1E and non-Class 1E circuits are seismically supported whether or not a hazard potential is evident.

(2) Conduit and Non-Safety Pipe

Non-Class 1E conduit is seismically supported if it is identified as a potential hazard to safety-related equipment. All ABWR Standard Plant non-safety related piping that is identified as a potential hazard is seismically analyzed per Subsection 3.7.3.13.

(3) Equipment for Maintenance

All other equipment, such as hoists, that is required during maintenance will either be removed prior to operation, moved to a location where it is not a potential hazard to safety-related equipment, or seismically restrained to prevent it from becoming a missile. See Subsection 3.5.4.6 for COL license information.

### 3.5.1.3 Turbine Missiles

See Subsection 3.5.1.1.1.3.

### 3.5.1.4 Missiles Generated by Natural Phenomena

~~Tornado-generated missiles have been determined to be the~~The limiting natural phenomena hazard in the design of all structures required for safe shutdown of the nuclear power plant has been determined to be either design basis tornado-generated missiles or site-specific hurricane-generated missiles. ~~Since tornado missiles are used in the design basis, it is not necessary to consider missiles generated from other natural phenomena.~~ The design basis tornado/hurricane for the ABWR Standard Plant is the maximum ~~tornado~~ windspeed corresponding to a probability of l0E-7 per year ~~(483 km/h)~~. The other characteristics of ~~this tornado~~tornados/hurricanes are summarized in Subsection 3.3.2.1. The design basis tornado/hurricane missiles are per SRP 3.5.1.4, Spectrum I.

Add "/hurricane"

Using the design basis tornado and missile spectrum as defined above with the design of the Seismic Category I buildings, compliance with all of the positions of Regulatory Guide 1.117, “Tornado Design Classification,” Positions C.1 and C.2 is assured.

The SGTS charcoal absorber beds are housed in the tornado resistant reactor building and, therefore, are protected from the design basis tornado/hurricane missiles. The offgas system charcoal absorber beds are located deep within the Turbine Building and it is considered very unlikely that these beds could be ruptured as a result of a design basis tornado missile. These features assure compliance with Position C.3 of Regulatory Guide 1.117.

See Subsections 3.5.4.2 and 3.5.4.4 for COL license information requirements.

#### 3.5.1.5 Site Proximity Missiles Except Aircraft

External missiles other than those generated by tornados or hurricanes are not considered as a design basis (i.e. < $10^{-7}$ per year).

#### 3.5.1.6 Aircraft Hazards

Aircraft hazards are not a design basis event for the ABWR Standard Plant (i.e. ≤ $10^{--7}$per year). See Subsection 3.5.4.3 for COL license information requirements.

### 3.5.2 Structures, Systems, and Components to be Protected from Externally Generated Missiles

The sources of external missiles which could affect the safety of the plant are identified in Subsection 3.5.1. Certain items in the plant are required to safely shut down the reactor and maintain it in a safe condition assuming an additional single failure. These items, whether they be structures, systems, or components, must therefore all be protected from externally generated missiles.

These items are the safety-related items listed in Table 3.2-1. Appropriate safety classes and equipment locations are given in this table. All of the safety-related systems listed are located in buildings which are designed as tornado resistant. Since the tornado/hurricane missiles are the design basis missiles, the systems, structures, and components listed are considered to be adequately protected. Provisions are made to protect the charcoal delay tanks against tornado missiles.

Add "/hurricane"

See Subsection 3.5.4.1 and 3.5.4.7 for COL license information requirements.

### 3.5.3 Barrier Design Procedures

The procedures by which structures and barriers are designed to resist the missiles described in Subsection 3.5.1 are presented in this section. Structures and barriers that are designed for design basis tornado missile features described in Tier 1 and Tier 2 are also protected from design basis hurricane missiles. For areas where the effects of design basis tornado missiles do not bound site-specific hurricane missiles, the site-specific hurricane-generated missiles need to meet the criteria specified in RG. 1.221 (see COL information in Section 3.5.4.2). The following procedures are in accordance with Section 3.5.3 of NUREG-0800 (Standard Review Plan). Missile protection design features described in Tier 1 and Tier 2, even if indicated as tornado missile protection, also resist hurricane missiles.

#### 3.5.3.1 Local Damage Prediction

The prediction of local damage in the impact area depends on the basic material of construction of the structure or barrier (i.e., concrete or steel). The corresponding procedures are presented

### 3.5.4.3 Site Proximity Missiles and Aircraft Hazards

Analyses shall be provided that demonstrate that the probability of site proximity missiles (including aircraft) impacting the ABWR Standard Plant and causing consequences greater than 10CFR100 exposure guidelines is $\leq 10^{-7}$ per year (Subsection 3.5.1.6).

### 3.5.4.4 Impact of Failure of Out of ABWR Standard Plant Scope Non-Safety-Related Structures, Systems, and Components Due to a Design Basis ~~Tornado~~Extreme Wind (Tornado and Hurricane)

Add "protected"

An evaluation of all out of ABWR Standard Plant Scope non-safety-related structures, systems, and components (not housed in a tornado/hurricane structure) whose failure due to a design basis tornado/hurricane missile that could adversely impact the safety function of safety-related systems and components will be provided to the NRC by the COL applicant (Subsection 3.5.1.4).

### 3.5.4.5 Turbine System Maintenance Program

A turbine system maintenance program, including probability calculations of turbine missile generation meeting the minimum requirement for the probability of missile generation, shall be provided to the NRC (Subsection 3.5.1.1.1.3).

### 3.5.4.6 Maintenance Equipment Missile Prevention Inside Containment

The COL applicant will provide procedures to ensure that all equipment inside containment, such as hoists, that is required during maintenance will either be removed prior to operation, moved to a location where it is not a potential hazard to safety-related equipment, or seismically restrained to prevent it from becoming a missile [Subsection 3.5.1.2.3 (3)].

### 3.5.4.7 Failure of Structures, Systems, and Components Outside ABWR Standard Plant Scope

Any failure of structures, systems and components outside ABWR Standard Plant scope which may result in external missile generation shall not prevent safety-related structures, systems and components from performing their intended safety function. The COL applicant will provide an evaluation of the adequacy of these designs for external missile protection for NRC review (Subsection 3.5.2).

## 3.5.5 References

3.5-1 K. Karim-Panahi et. al, “Recirculation MG Set Missile Generation Study”, PED-18-0389, March 1989. (Proprietary).

3.5-2 F. J. Moody, “Prediction of Blowdown Thrust and Jet Forces”, ASME Publication 69-HT-31, August 1969.

$Y_m$ = Missile impact equivalent static load on a structure generated by or during the postulated break, like pipe whipping, and including a calculated dynamic factor to account for the dynamic nature of the load.

W = Wind force (Subsection 3.3.1).

Delete "winds and"

$W_t$ = Tornado load (Subsection 3.3.2) (tornado-generated missiles are described in Subsection 3.5.1.4, and barrier design procedures in Subsection 3.5.3). The design basis tornado ~~winds and~~ missile loads bound those of the design basis hurricane.

$P_a$ = Internal negative pressure of 13.73 kPaD due to tornado; accident pressure at main steam tunnel piping embedment.

B = Uplift forces created by the rise of the ground water table.

F = Internal pressures resulting from flooding of compartments.

E' = Safe shutdown earthquake (SSE) loads as defined in Section 3.7.

$T_o$ = Thermal effects — load effects induced by normal thermal gradients existing through the R/B wall and roof. Both summer and winter operating conditions are considered. In all cases, the conditions are considered of long enough duration to result in a straight line temperature gradient. The temperatures are as follows:

(1) Summer operation:

(a) Air temperature inside building — 49°C

(b) Exterior temperature — 46°C

(2) Winter operation:

(a) Air temperature inside building — 21.1°C

(b) Exterior temperature — (-) 40°C

(3) Winter shutdown

(a) Air temperature inside building - 46°C

(b) Exterior temperature — (-) 40°C

For all cases, as-constructed temperature is 15.6°C.

$T_a$ = Thermal effects (including $T_o$) which may occur during a design accident at 74°C maximum 30 minutes after LOCA.

#### 3.8.4.5.2 Control Building

Add "wind"

[*Structural acceptance criteria are defined in ANSI/AISC-N690 and ACI 349 Codes.*]* In no case does the allowable stress exceed 0.9 $F_y$, where $F_y$ is the minimum specified yield stress. The design criteria preclude excessive deformation of the Control Building. The clearances between adjacent buildings are sufficient to prevent impact during a seismic event. The ~~tornado~~extreme (tornado and hurricane) load analysis for this building is the same as the analysis for the Reactor Building.

#### 3.8.4.5.3 Radwaste Building Substructure

[*Structural acceptance criteria are defined in ANSI/AISC-N690 and ACI 349 Codes.*]* In no case does the allowable stress exceed 0.9 $F_y$, where $F_y$ is the minimum specified yield stress. The design criteria preclude excessive deformation of the Reactor Building. The clearances between adjacent buildings are sufficient to prevent impact during a seismic event.

#### 3.8.4.5.4 Seismic Category I Cable Trays and Conduit Supports

Structural acceptance criteria if the analysis option is selected are defined in ANSI/AISC-N690 Code. In no case does the allowable stress exceed 0.9 $F_y$ where $F_y$ is the minimum specified yield stress.

#### 3.8.4.5.5 Seismic Category I HVAC Duct and Supports

The structural acceptance criteria for HVAC ducts if the analysis option is selected will be in accordance with ANSI/ASME AG-1 Code. The HVAC supports will be in accordance with the ANSI/AISC-N690 code.

### 3.8.5 Foundations

This section describes foundations for all Seismic Category I structures of the ABWR Standard Plant.

#### 3.8.5.1 Description of the Foundations

The foundations of the Reactor Building and Control Building are reinforced concrete mat foundations.

These two foundation mats are separated from each other by a separation gap of 2m wide to minimize the structural interaction between the buildings.

The Reactor Building foundation is a rectangular reinforced concrete mat 56.6m by 59.6m and 5.5m thick. The foundation mat is constructed of cast-in-place conventionally reinforced concrete. It supports the Reactor Building, the containment structure, the reactor pedestal, and other internal structures. The top of the foundation mat is 20.2m below grade.

* See Subsection 3.8.3.2.

A set of transfer pumps may be operated with manual control switches from the main control room and locally. However, they are normally operated automatically by level switches on the day tanks. A “low” level switch starts the first transfer pump, a “low-low” level switch starts the standby transfer pump and a “high” level switch stops both pumps.

Capability analyses will be performed in accordance with acceptable industry practice to assure the seven day and eight hour storage and day tank capacities, respectively.

An engine-driven fuel oil pump increases the fuel pressure to the diesel engine fuel manifold. Fuel oil transfer system piping is ASME Code Section III, Class 3, Seismic Category I. A motor driven fuel oil booster pump is also provided for priming purpose, and for added reliability.

### 9.5.4.3 Safety Evaluation

The overall diesel-generator fuel oil storage and transfer system is designed so that failure of any one component may result in the loss of fuel supply to only one diesel-generator. The loss of one diesel-generator does not preclude adequate core cooling under accident conditions.

Day tank fuel oil feed to the fuel pump is by gravity. There are no powered components to fail. A duplex suction strainer prevents foreign matter from entering the pump and causing malfunction. The system is safety-related and all piping and components up to the engine skid connection are designed and constructed in accordance with the ASME Code Section III, Class 3, and Seismic Category I requirements.

Add "/hurricanes"

Add "severe"

The diesel-generator fuel oil storage and transfer system is designed to withstand the adverse loadings imposed by earthquakes, tornadoes and winds. For extreme wind loads, the design basis tornado whose winds and missile loads bound the design basis hurricane are as specified in 3H.1.4.3.1. Earthquake protection is provided by the Seismic Category I construction. Tornado and wind protection is provided by locating system components either underground or within the reactor building. All underground piping is covered with protective coating and wrapping to guard against corrosion. The Seismic Category I portions of diesel-generator fuel oil piping will be routed in tunnels between the storage tanks and the Reactor Building. The system will be provided with a protection against external and internal corrosion. The buried portion of the tanks and piping will be provided with waterproof protective coating and an impressed current-type cathodic protection, to control the external corrosion of underground piping system. The impressed current-type cathodic protection system will be designed to prevent the ignition of combustible vapors or fuel oil present in the fuel oil system, in accordance with Regulatory Guide 1.137, Paragraph C.1.g.

All storage and day tanks are located at a sufficient distance away from the plant control room to preclude any danger to control room personnel or equipment resulting from an oil tank explosion and/or fire. The fuel oil day tank is located in a separate room with 3-hr fire rated concrete walls. The quality of the fuel oil used for diesel engine will be ensured per Appendix

Add "protected"

(4) Doors, in general, are 3-hour rated, complying with NFPA ratings. There are also doors, not labeled, which provide building separation. Typical of these are the doors for the personnel air lock into the reactor containment and the missile/tornado/hurricane doors at the equipment access entrance to the reactor building. The term "doors," where used in the analysis, shall mean doors, frames and hardware.

(5) The fireproofing of structural steel members is accomplished by application of a UL-listed or FM-approved cementicious or ablative material, or by a UL- or FM-approved boxing design. The required fire rating, utilizing gypsum board, determines the fireproofing material thickness.

(6) Surface finishes are specified to have a flame spread, fuel-contributed and smoke-evolved index of 25 or less (Class A), as determined by ASTM-E84 (NFPA 255).

(7) The use of plastic materials, including electrical cable insulation, has been minimized in the ABWR design.

(8) Suspended ceilings are used in some areas of the plant. The ceilings, including the lighting fixtures, are of noncombustible construction.

(9) The electrical cable fire-stops are tested to demonstrate a fire rating equal to the rating of the barrier they penetrate. As a minimum, the penetrations meet the requirements of ANI. The tests are performed or witnessed by a representative of a qualified, independent testing laboratory. The documented test results for the acceptable fire-stops are made a part of the plant design records.

(10) Not Used

(11) Control, power or instrument cables of redundant systems that are used for bringing the reactor to safe, cold shutdown, or of any other divisional system, are separated by 3-hour fire barriers.

(12) Certain areas of the plant have trays in stacked array. Where stacking of trays occurs, power cable, which is the most susceptible to internally generated fires, is routed in the uppermost tray to the greatest extent possible to provide maximum isolation from other trays in the stack.

The fire loadings of electrical cable in trays is based on flame-retardant, cross-linked polyethylene insulation (XLPE-FR) having a calorific value of $32.56x10^3$ J/g.

The cable trays have been estimated at the maximum design fill to contain between 11.91 and 15.63 kg of insulation per running meter of tray.

– 0.61m below grade level

(3) Maximum Flood Level:

– 0.305m below grade level

(4) Maximum Snow Load:

– 2.39 kPa

(5) Design Temperatures:

– 0% exceedence values
Maximum: 46.1°C dry bulb/26.7°C coincident wet bulb.
Minimum: –40°C

– 1% exceedence values
Maximum: 37.8°C dry bulb/25°C coincident wet bulb.
Minimum: –23.3°C

(6) Seismology:

– SSE Peak Ground Acceleration (PGA): 0.30g (for both horizontal and vertical directions). SSE PGA is free field at plant grade elevation.

– SSE Response Spectra: Per Regulatory Guide 1.60

– SSE Time History: Envelope SSE response Spectra in accordance with SRP Section 3.7.1.

(7) ~~Extreme~~ Wind: Change to "Severe"

– Basic wind speed 177 km/h (50 year recurrence interval).

– Importance Factors:
Safety related structures: 1.11
Non-safety related structures: 1.00

– Exposure Category: Exposure D

(8) Tornado:

– Maximum tornado wind speed: 483 km/h

– Maximum Rotational Speed: 386 km/h

– Maximum Translational Speed: 97 km/h