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Tornado Response 52-001

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GE Nuclear Energy

ABWR

Date 5/28/92

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Subject SECY-91-153 Outstanding Issues 4, 8 and 9

Message The attached revisions to the SSAR address the subject issues. We have made a preliminary evaluation and have determined the reactor building superstructure and roof will have to be thickened and the roof purlins strengthened. Also the seismic model will have to be modified. These changes will impact several sections of Chapter 3 and several appendices.

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TABLE 2.0-1

ENVELOPE OF ABWR STANDARD PLANT SITE DESIGN PARAMETERS

Maximum Ground Water Level:
2 feet below grade

Maximum Flood (or Tsunami) Level:(3)
1 foot below grade

Precipitation (for Roof Design):
- Maximum rainfall rate: 19.4 in/hr(8)
- Maximum snow load: 50 lb/sq. ft.

Design Temperatures:
- Ambient

<u>1% Exceedance Values</u>
- Maximum: 100°F dry bulb/77°F coincident wet bulb
- Minimum: -10°F

<u>0% Exceedance Values (Historical limit)</u>
- Maximum: 115°F dry bulb/82°F coincident wet bulb
- Minimum: - 40°F
- Emergency Cooling Water Inlet: 95°F
- Condenser Cooling Water Inlet : ≤100°F

Extreme Wind: Basic Wind Speed:
110mph(1)/130mph(2)

Tornado:(4)
- Maximum tornado wind speed: 300 ~~360~~mph
- Translational velocity: 60 ~~67~~mph
- Radius: 150 ~~455~~ ft
- Maximum atm ΔP: 2.0 ~~1.46~~ psid
- Missile Spectra: Per ~~ANSI/ANS-2.3~~ SRP 3.5.1.4 Spectrum I

Soil Properties:
- Minimum Bearing Capacity (demand): 15ksf
- Minimum Shear Wave Velocity: 1000fps(9)
- Liquification Potential:
None at plant site resulting from OBE and SSE(7)

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Seismology:
- OBE Peak Ground Acceleration (PGA): 0.10g(5) (6)
- SSE PGA : 0.30g(5)
- SSE Response Spectra: per Reg.Guide 1.60
- SSE Time History: Envelope SSE Response Spectra

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(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) *Probable maximum flood level (PMF), as defined in ANSI/ANS-2.8, "Determining Design Basis Flooding at Power Reactor Sites."*

(4) 10,000,000 ~~1,000,000~~-*year tornado recurrence interval* ~~*with associated parameters based on ANSI/ANS-2.3.*~~

(5) *Free-field, at plant grade elevation.*

(6) *For conservatism, a value of 0.15g is employed to evaluate structural and component responses in Chapter 3.*

(7) *See item 3 in Section 3A.1 for additional information.*

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(8) *Maximum value for 1 hour 1 sq. mile PMP with ratio of 5 minutes to 1 hour PMP as found in National Weather Source Publication HMR No. 52. Maximum short term rate; 6.2in/5min.*

(9) *This is the minimum shear wave velocity at low storms after the soil property uncertainties have been applied.*

FROM 408-9251687 05-28-92 03:34 PM P02

3.3 WIND AND TORNADO LOADINGS

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

3.3.1 Wind Loadings

3.3.1.1 Design Wind Velocity

Seismic Category I structures are designed to withstand a design wind velocity of 130 mph at an elevation of 33 feet above grade with a recurrence interval of 100 years. See Subsection 3.3.3.1 for interface requirement.

3.3.1.2 Determination of Applied Forces

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

$$q_z = 0.00256\, K_z\, (IV)^2$$

where K_z = the velocity pressure exposure coefficient which depends upon the type of exposure and height (z) above ground per Table 6 of Reference 1.

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

V = design wind velocity of 130 mph, and

q_z = velocity pressure in psf

The velocity pressure (q_z) distribution with height for exposure types C and D of Reference 1 are given in Table 3.3-2.

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 1 by multiplying the velocity pressure by the appropriate pressure coefficients and gust factors. Gust factors are in accordance with Table 8 of Reference 1. Appropriate pressure coefficients are in accordance with Figures 2, 3a, 3b, 4, and Tables 9 and 11 through 16 of Reference 1. Reference 2 is used to obtain the effective wind pressures for cases which Reference 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.

3.3.2 Tornado Loadings

3.3.2.1 Applicable Design Parameters

The design basis tornado is described by the following parameters:

(1) A maximum tornado wind speed of ~~260~~ 300 mph at a radius of ~~463~~ 150 feet from the center of the tornado;

(2) A maximum translational velocity of ~~52~~ 60 mph;

(3) A maximum tangential velocity of ~~208~~ 240 mph, ~~calculated as defined in Section 3.3 of Reference 3,~~ based on the translational velocity of ~~52~~ 60 mph;

(4) A maximum atmospheric pressure drop of ~~1.46~~ 2.00 psi with a rate of the pressure change of ~~0.27~~ 1.2 psi per second, ~~in accordance with Reference 3; and~~

(5) The spectrum of tornado-generated missiles and their pertinent characteristics as given in Subsection 3.5.1.4.

See Subsection 3.3.3.2 for interface requirement.

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 4. 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 4.

The reactor building and control building are not vented structures. The exposed exterior roofs and walls of these structures are designed for the ~~1.46~~ 2.00 psi pressure drop. Tornado dampers

generated from other natural phenomena. The design basis tornado for the ABWR Standard Plant is ~~the ANSI/ANS-2.3 (Reference 8)~~ maximum tornado windspeed corresponding to a probability of 10E-~~6~~7 per year (~~260~~ 300 mph) ~~in accordance with Figure 3.2-2 of Reference 8~~. The other characteristics of this tornado, summarized in ~~Table 2.0-1, are~~ given in ~~Table 3.2-1 of Reference 8~~ subsection 3.3.2.1. The design basis tornado missiles are ~~the standard design missile spectrum of Reference 8, Table 3.4-1.~~ per SRP 3.5.1.4 spectrum 1.

~~Since the ANSI/ANS-2.3 maximum tornado windspeed with probability of 10E-6 per year is now an acceptable tornado siting basis for anywhere in the contiguous United States and the ABWR adopts this as the design basis tornado, it is not necessary to meet the guidelines of Regulatory Guide 1.76, "Design Basis Tornado for Nuclear Power Plants," Positions C.1 and C.2.~~ 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 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.

An evaluation of all non safety-related structures, systems, and components (not housed in a tornado structure) whose failure due to a design basis tornado missile that could adversely impact the safety function of safety-related systems and components will be provided to the NRC by the applicant referencing the ABWR design. See Subsection 3.5.4.2 for interface requirements.

3.5.1.5 Site Proximity Missiles Except Aircraft

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

3.5.1.6 Aircraft Hazards

Aircraft hazards are not a design basis event for the Nuclear Island (i.e. $\leq 10^{-7}$ per year).

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 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.

See Subsection 3.5.4.2 for interface requirement.

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. The following procedures are in accordance with Section 3.5.3 of NUREG-0800 (Standard Review Plan).

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 separately. Composite barriers are not utilized in the ABWR Standard Plant for missile protection.