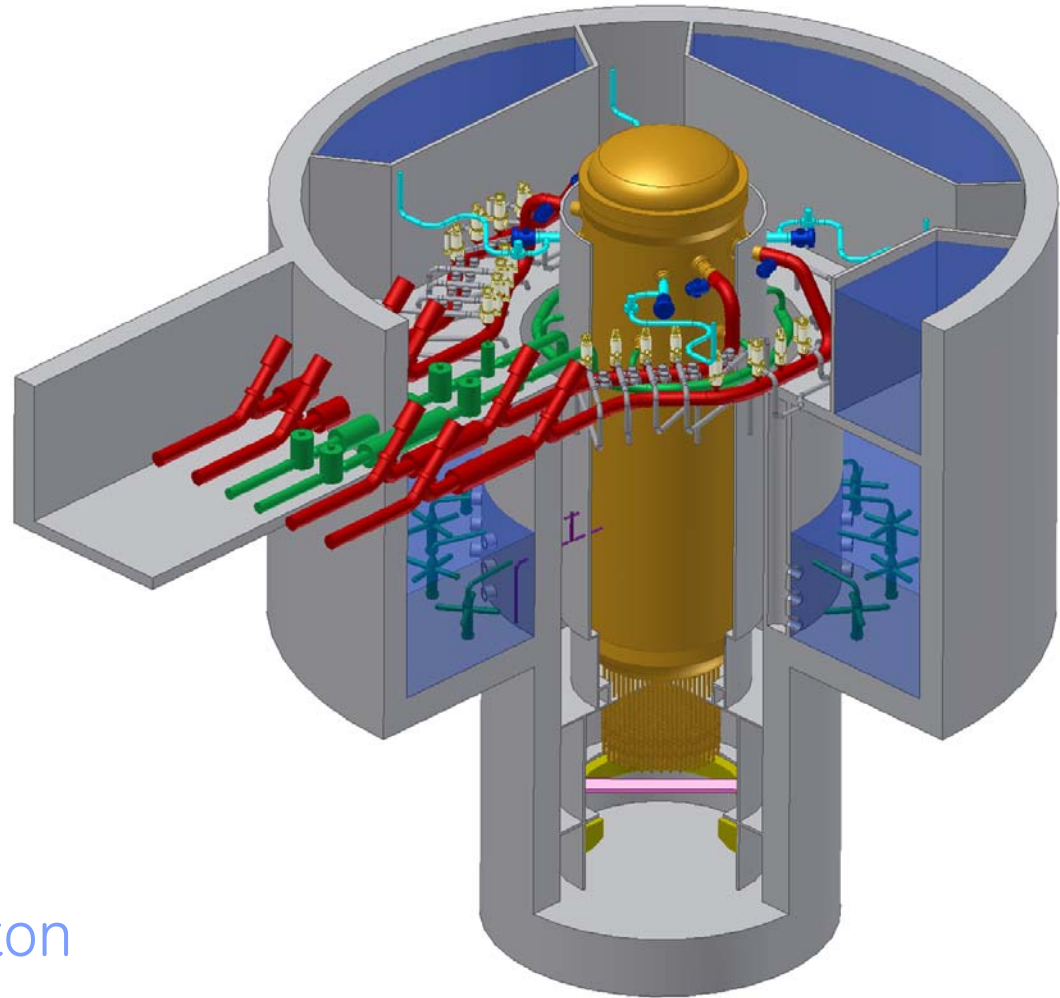


ESBWR Structural Design Overview



Presented by Hugh Upton
September 27, 2005

ESBWR Structural Design Overview

- Wind and Tornado Loadings (DCD Tier 2 Sec. 3.3)
- Water Level (Flood) Design (DCD Tier 2 Sec. 3.4)
- Missile Protection (DCD Tier 2 Sec. 3.5)
- Seismic Design (DCD Tier 2 Sec. 3.7)
- Seismic Category I Structures (DCD Tier 2 Sec. 3.8)

Wind and Tornado Loadings (DCD Sec. 3.3)

- Design Wind Parameters
 - Wind speed 140 mph, importance factor 1.15 for safety-related
 - Wind speed 110 mph, importance factor 1.00 for nonsafety-related
 - Design performed in accordance with current industry standard ASCE 7-02
- Tornado Parameters
 - Wind speed 330 mph
 - SRP 3.5.1.4 Spectrum I missiles

Water Level (Flood) Design (DCD Sec. 3.4)

- External Flood
 - Probable maximum flood (PMF): 1 ft below grade
 - All exterior access openings are above flood level
 - Exterior penetrations below design flood level are appropriately sealed

- Internal Flood
 - Leakage cracks postulated at any point of moderate energy piping larger than 1 inch diameter
 - Time to identify a flood source, followed by either remote or local operator action to isolate the break conservatively taken to occur within 30 minutes
 - Fire fighting events considered on the basis that limited combustibles inventories limit the event to 60 minutes considering two 125 gpm fire hoses are in service
 - Leakage collected by floor drainage and discharge to sumps on basemat

Missile Protection (DCD Sec. 3.5)

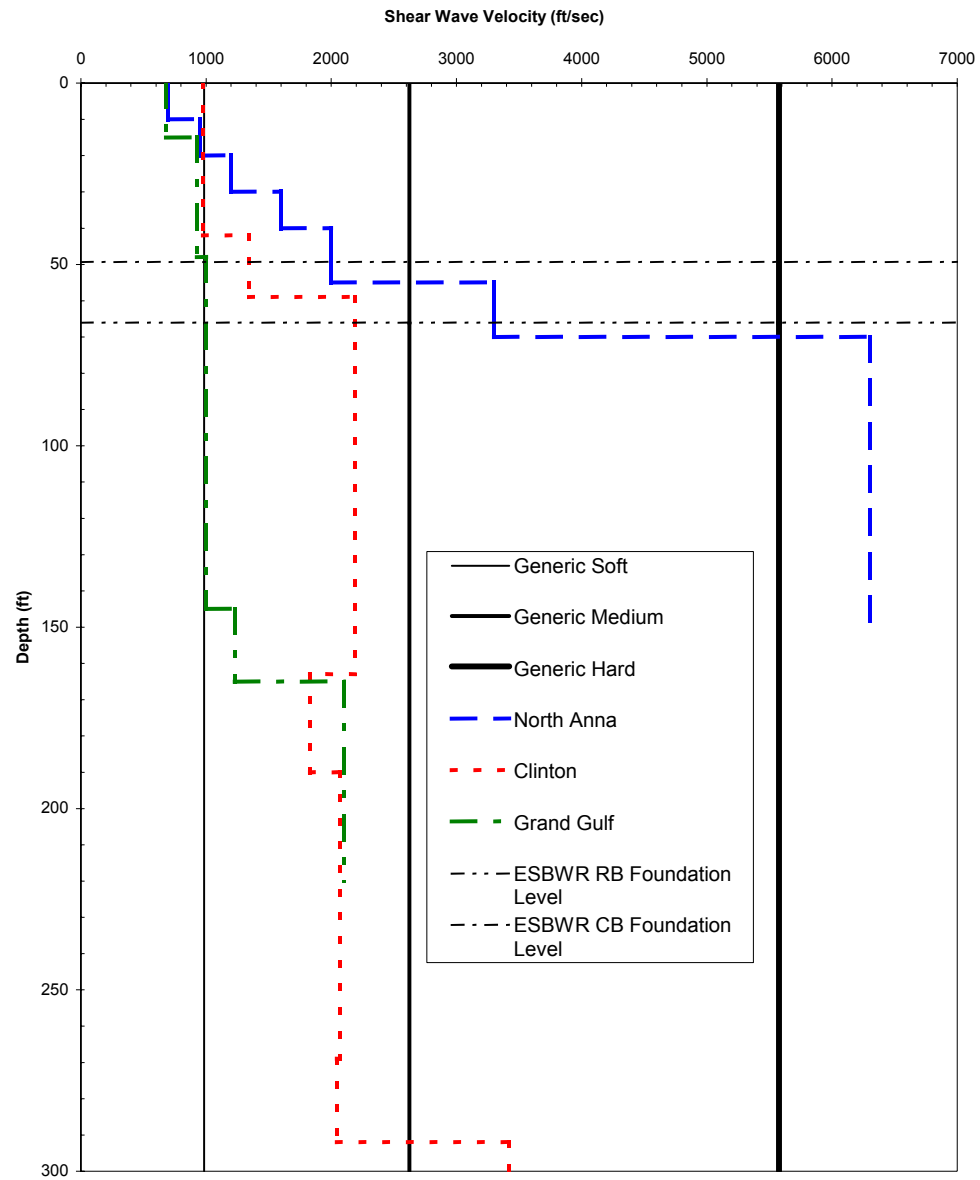
- Internal missiles considered involve rotating & pressurized component sources
- Site arrangement is perpendicular and Cat. I structures are located outside the low trajectory path of turbine missiles
- External missiles
 - Tornado missiles are SRP 3.5.1.4 Spectrum I
 - Aircraft missiles not considered since probability of occurrence is assumed to be less than $10E-7$ per year. COL to confirm
 - COL to address other site-unique external missiles

- Barrier are concrete or steel
 - For concrete, the modified National Defense Research Committee (NDRC) formula is used in conjunction with ACI-349 Appendix C
 - For steel barriers, the Stanford equation is used
 - Damage prediction is based on energy absorption and penetration investigations

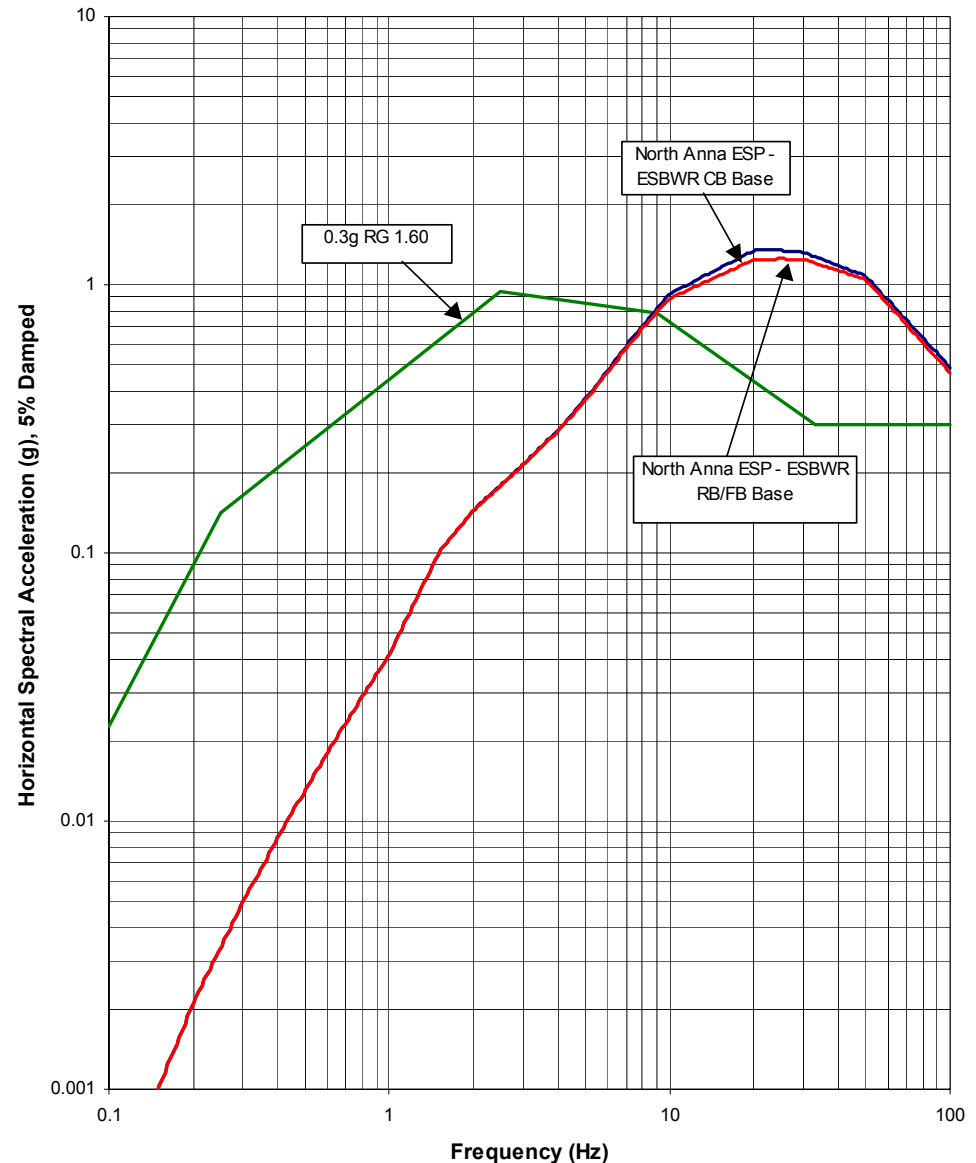
Seismic Design (DCD Sec. 3.7)

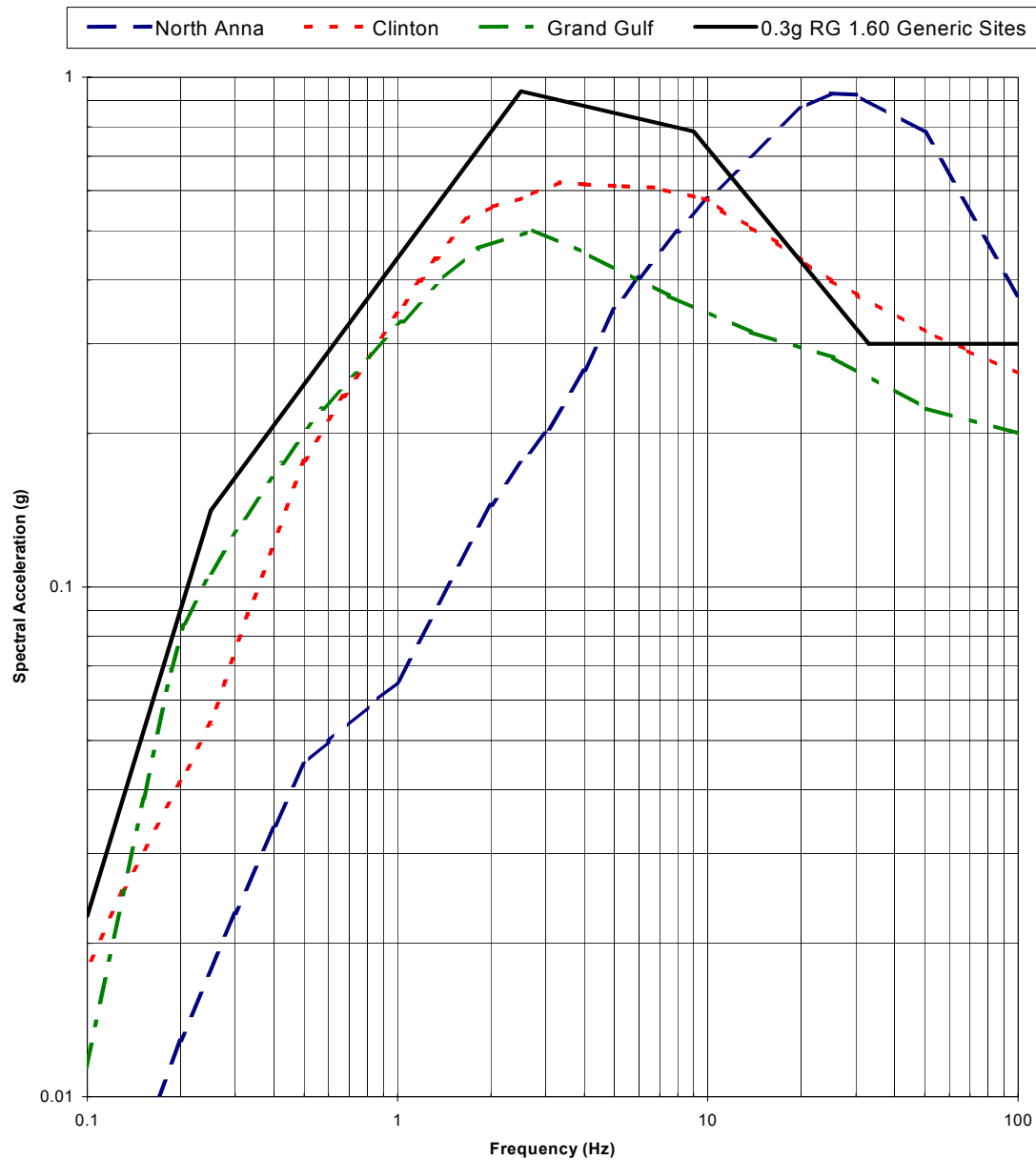
- Seismic Classification
 - Seismic Category I (C-I) for safety-related SSCs
 - Seismic Category II (C-II) for nonsafety-related SSCs whose structural failure or interaction could degrade the functioning of a C-I item
 - Non-Seismic (NS) for others
- C-I Buildings
 - Reactor Building (RB) including containment
 - Fuel Building (FB)
 - Control Building (CB)
 - Emergency Breathing Air System (EBAS) Building

- Site Conditions for Site-Envelope Design
 - Generic sites from soft soil to hard rock
 - Soft $V_s = 300$ m/sec
 - Medium $V_s = 800$ m/sec
 - Hard $V_s = 1700$ m/sec
 - Fixed base
 - North Anna ESP site-specific
 - Grand Gulf and Clinton ESP sites are within envelope



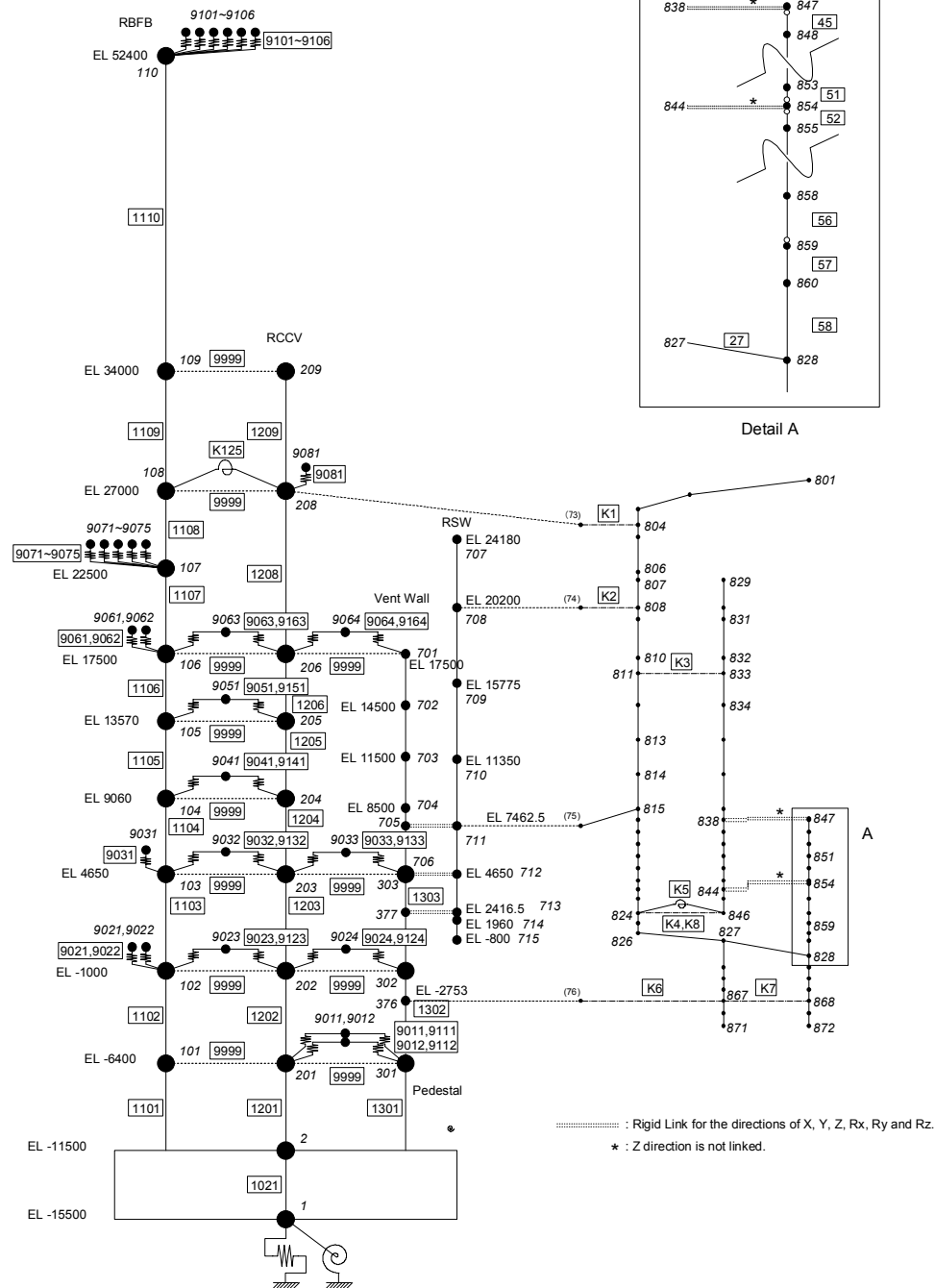
- SSE Ground Spectra
 - 0.3g RG 1.60 for generic sites
 - North Anna ESP site-specific
 - Foundation level in the free field
- OBE=1/3 SSE, no explicit OBE design required
- Grand Gulf and Clinton ESP sites are within envelope

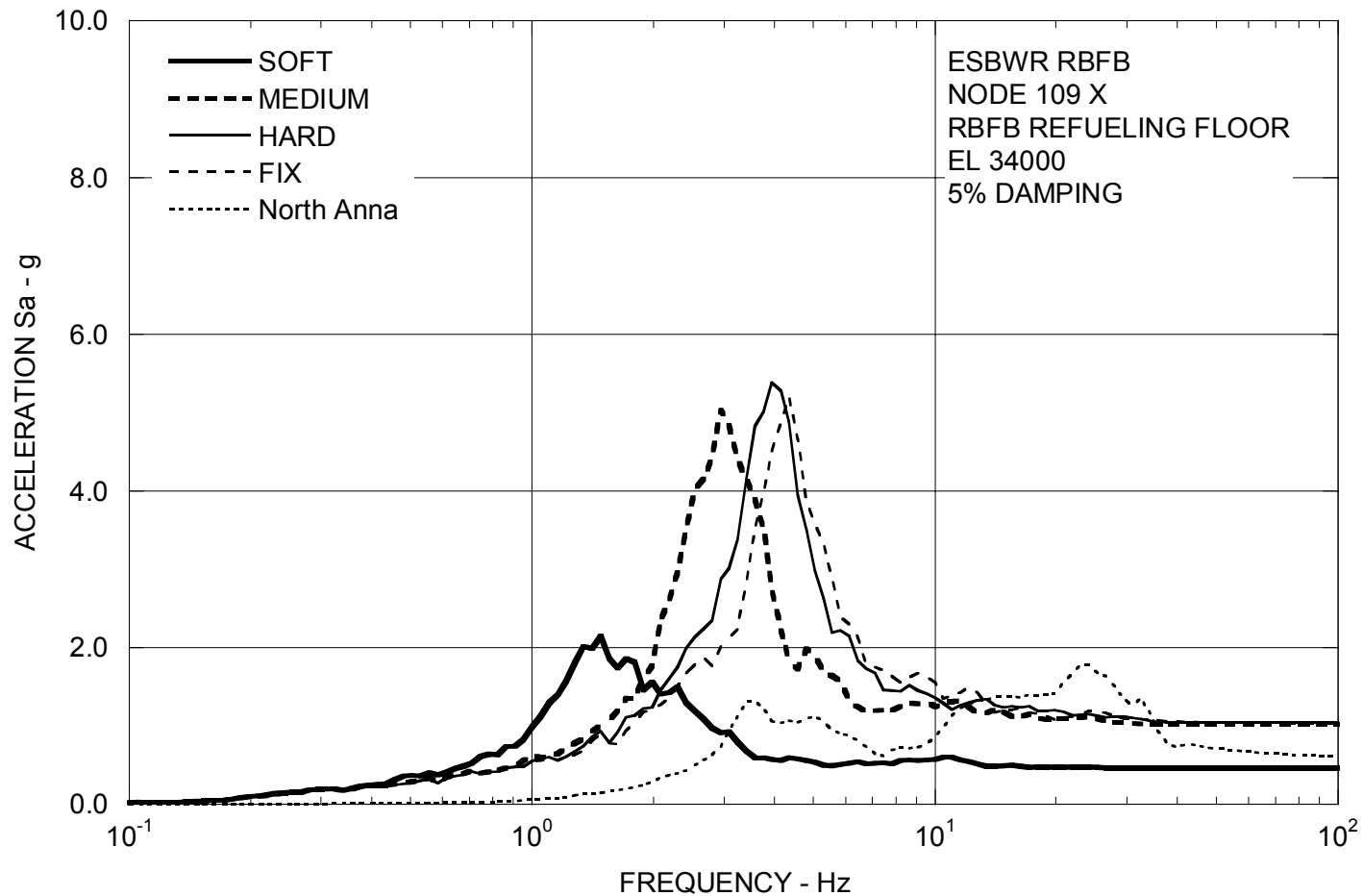




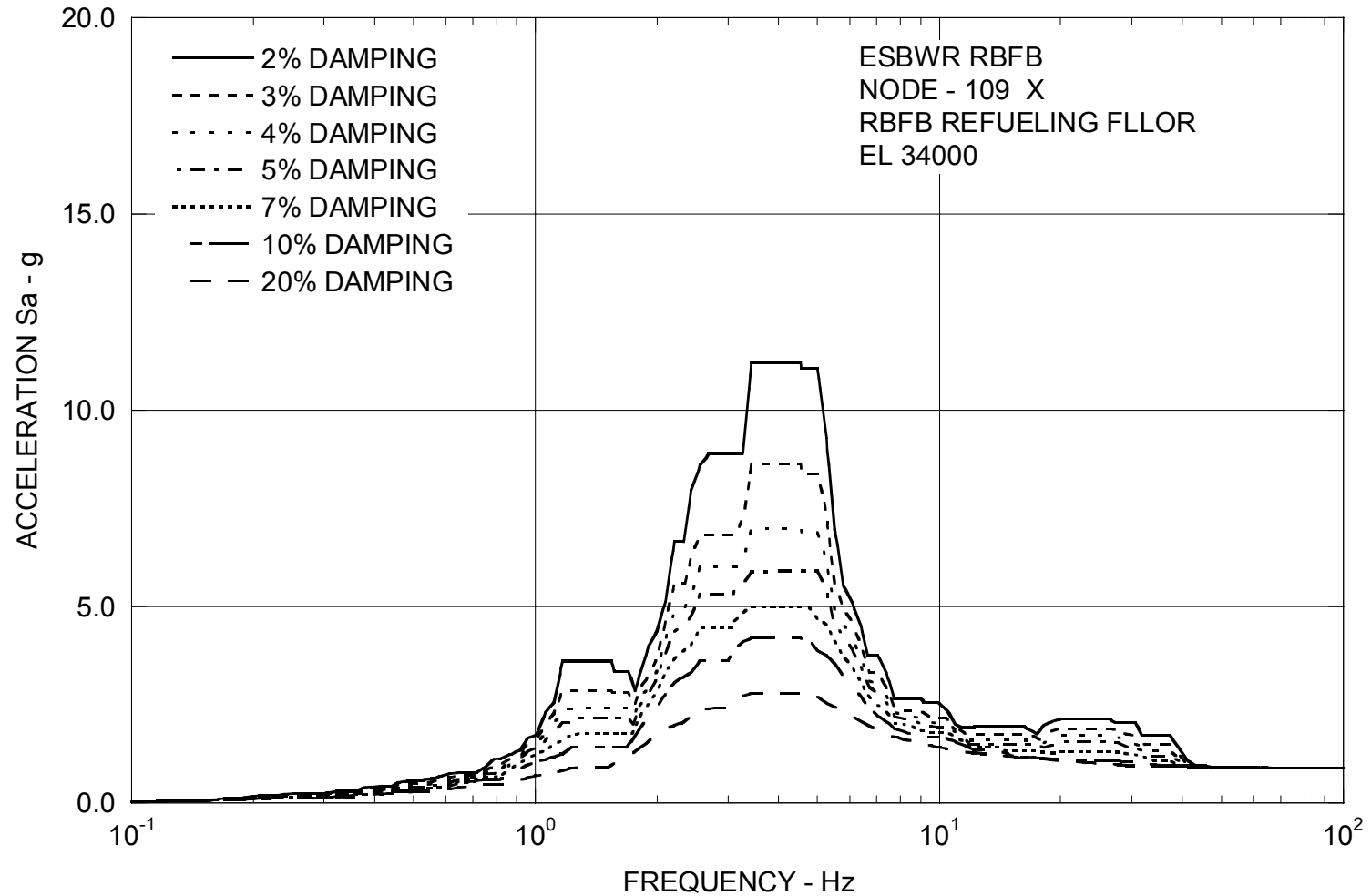
- SSI analysis performed
 - 4 generic sites with 0.3g RG 1.60 spectrum
 - North Anna site-specific
 - Results enveloped for design use
 - Building design performed
 - Subsystem seismic design in accordance with methods described in DCD Subsection 3.7.3

SSI analysis Model for RB/FB





Typical Calculated Floor Response Spectra for Effect of Site Conditions

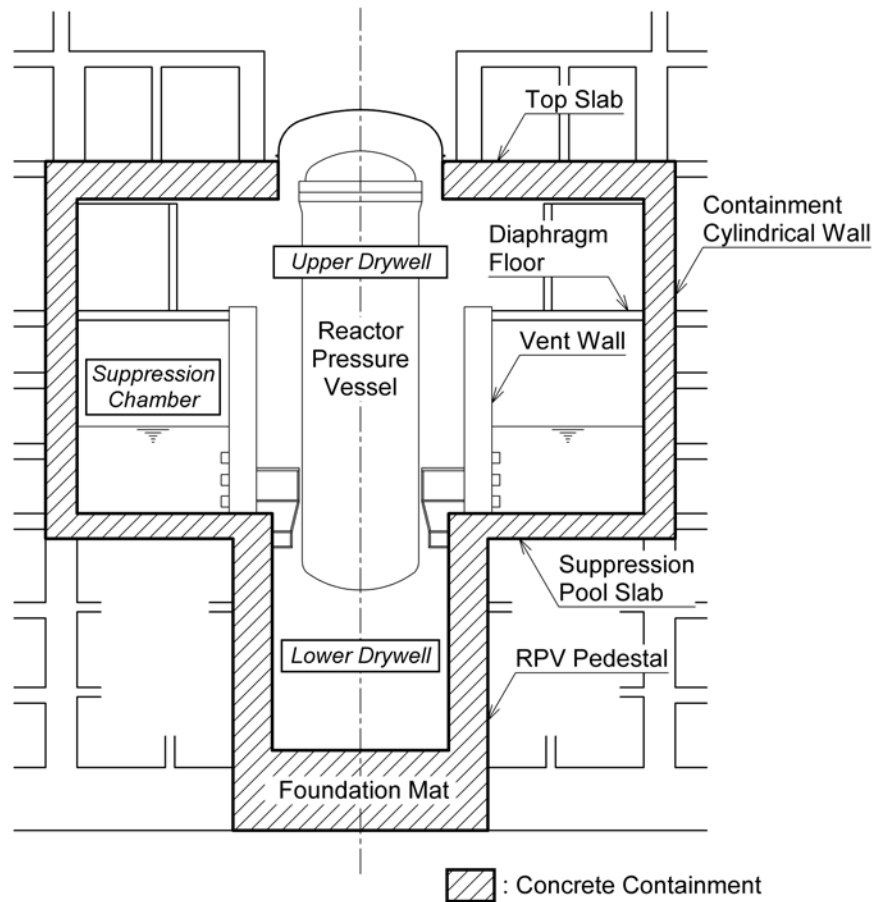


Site-Envelope Floor Spectra

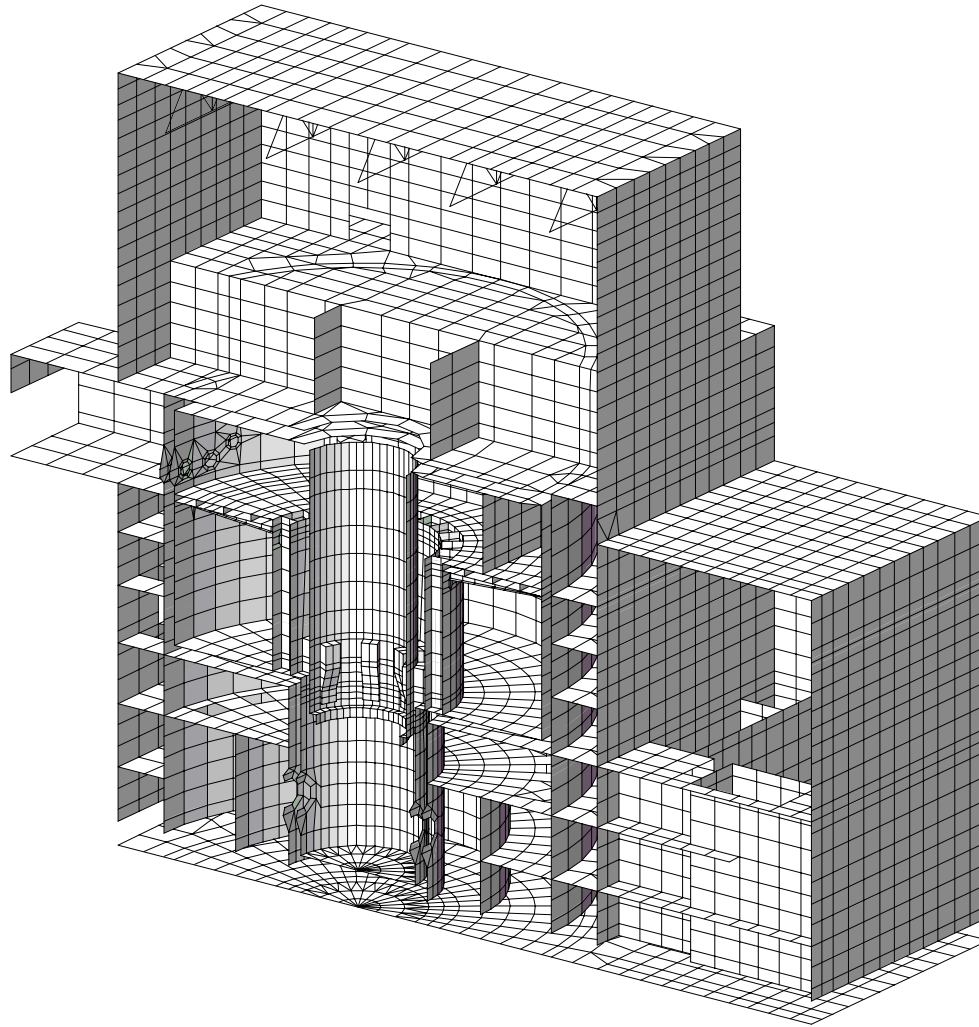
Seismic Category I Structures (DCD Sec. 3.8)

Major Structures	Type of Construction
Containment	Reinforced Concrete
Containment Internals Diaphragm Floor, Vent Wall Reactor Shield Wall RPV Support Brackets GDCS Pools	Steel with concrete fill Steel Steel Steel
Reactor Building	Reinforced Concrete
Fuel Building	Reinforced Concrete
Control Building	Reinforced Concrete

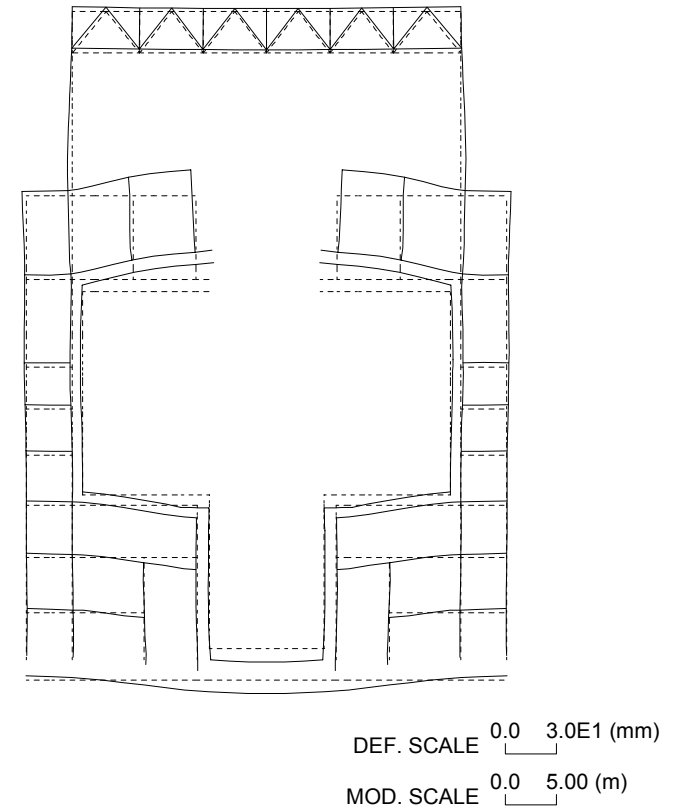
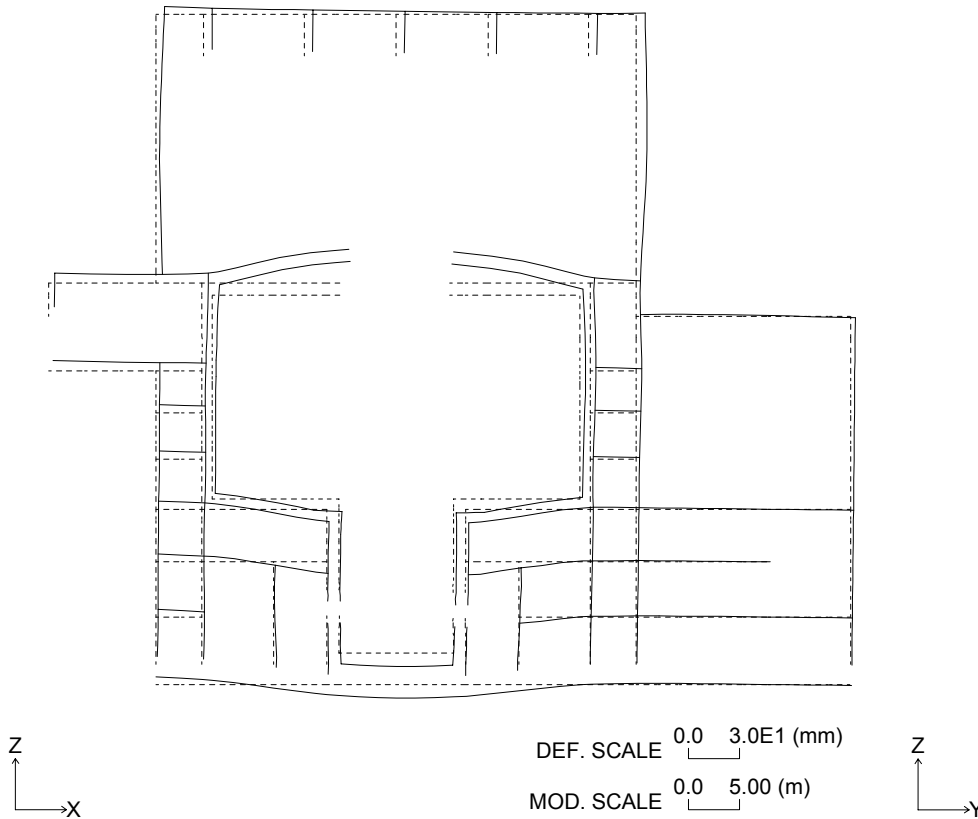
- Containment fully integrated with RB
- FB also fully integrated with RB



Configuration of Concrete Containment



Cutaway of FEM for Integrated Containment/RB/FB



Deformation under Drywell Unit Pressure (1 MPa)

- Major Design Codes
 - ASME-2004
 - ACI 349-01
 - AISC N690-1994s2 (2004)
- Design adequacy confirmed meeting all regulations and code requirements



