Westinghouse Meeting Presentation Slides

Non Proprietary

Enclosure 2

AP1000 Shield Building Roof PCS Water Storage Tank Analysis

June 30, 2011

Agenda

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- Background
  - Shield Building
  - PCS Tank Design
- Design & Licensing Basis
  - DCD Chapter 3.7 & 3.8
- Wrap-Up

Meeting objectives

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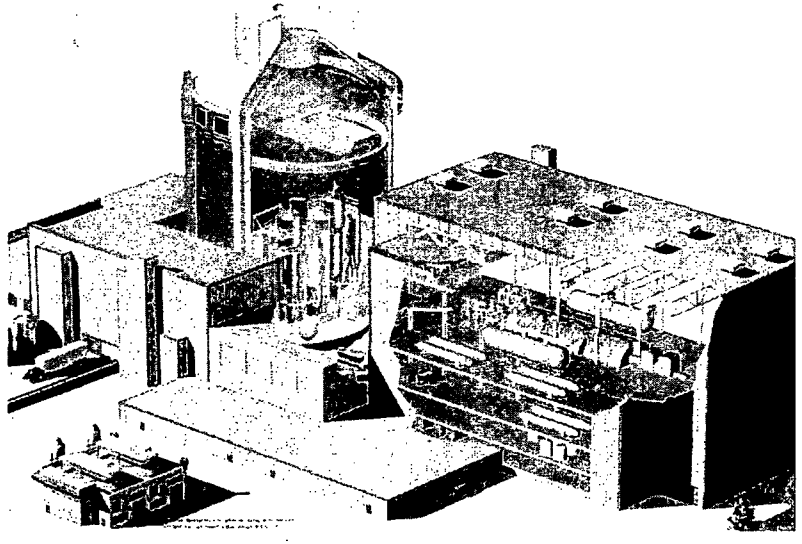
- Describe the design analysis of the PCS tank associated with the Design Certification.
- Describe the design analysis of the PCS tank associated with the Design Certification Amendment.
- Describe the licensing basis changes in the DCD associated with the PCS tank.
- Demonstrate that the revised analyses methods described in DCD Rev 19 does not change the PCS tank design described in DCD Rev 18.

AP1000 Shield Building

- Shields the containment vessel and systems within the containment from external events, such as tornados and tornado-driven objects
- Supports the passive containment cooling water storage tank (PCCWST)
- Provides for natural air circulation cooling of the containment vessel
- Provides radiation shielding from radioactive systems and components inside the containment vessel



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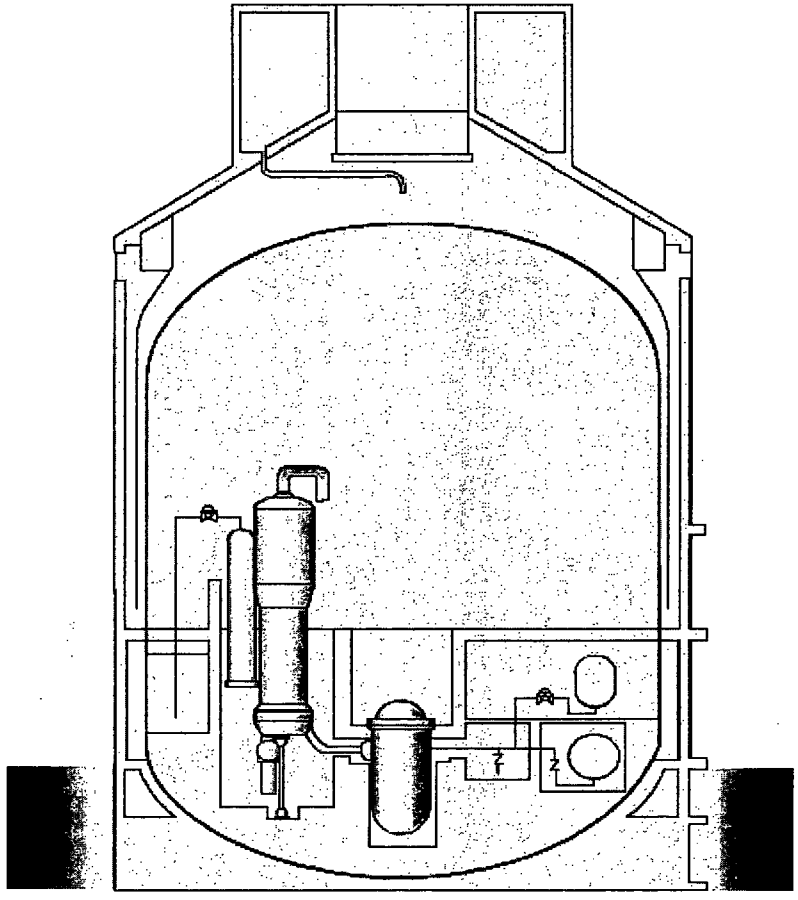
Passive Containment Cooling



Shield Building Evolution

- The initial shield building consisted of a reinforced concrete design, which was certified in December 2005
- In response to world events, the NRC challenged new plant design organizations to meet enhanced aircraft impact design standards
- Westinghouse chose a combination of steel concrete composite (SC) and reinforced concrete (RC) construction techniques to meet this challenge

Shield Building Design Features

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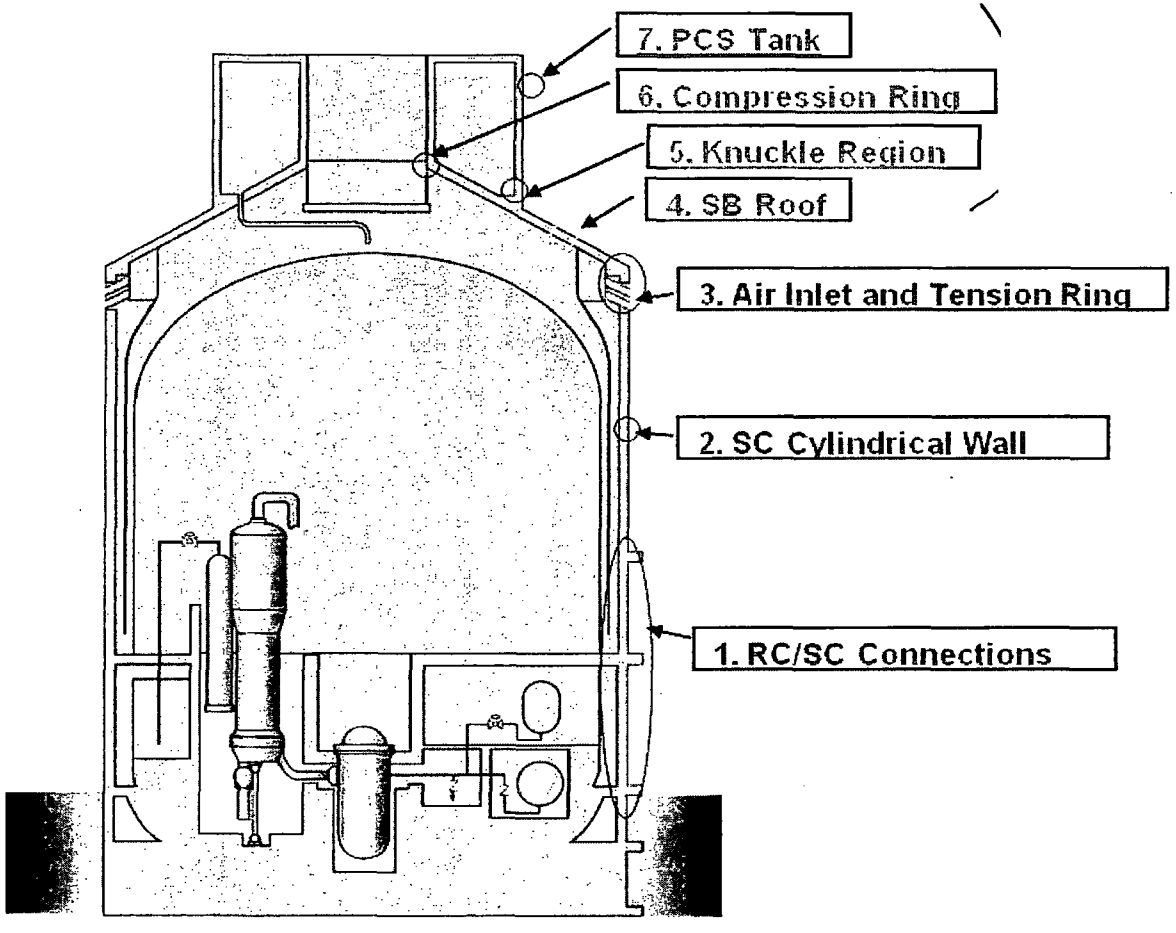
Hardened design to meet Aircraft Crash requirement

- Revised the air inlet/ tension ring design for constructability and strength
- Reinforced cylindrical wall with tie bars between steel plates
- Changed SC plate thickness and material properties to improve strength and ductility
- RC/SC connection redesigned to improve ductility



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Background of PCS Tank Updated Analysis

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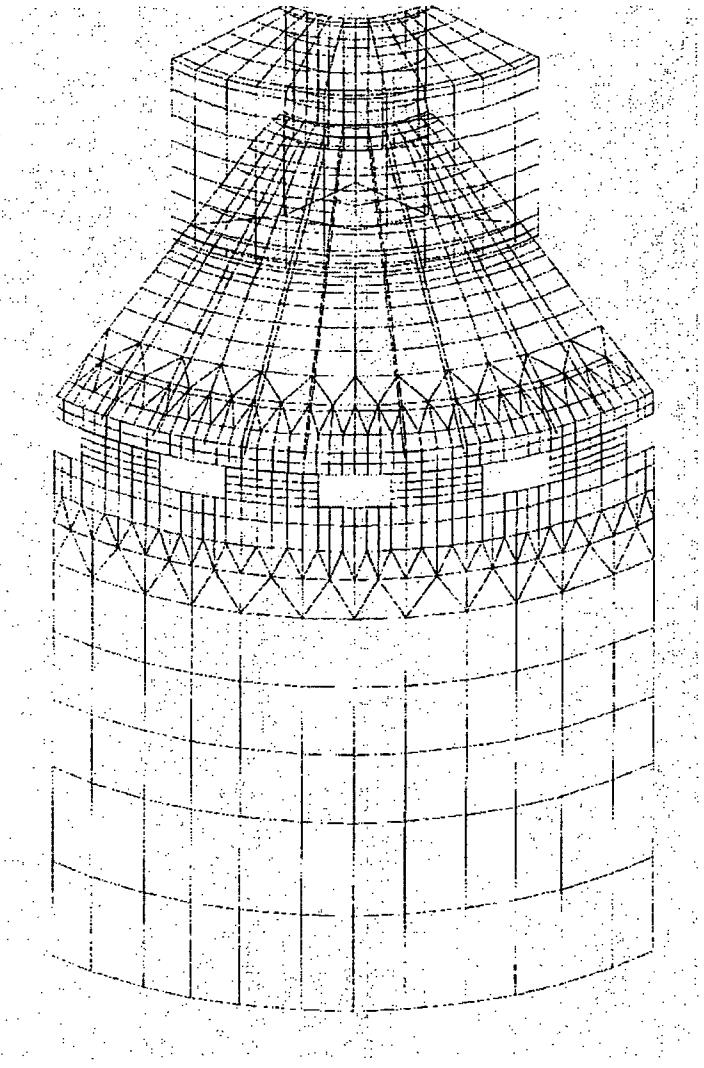
- During the AFSER Confirmatory Review of DCD Rev 18, the NRC requested Westinghouse to provide additional justification to demonstrate that the load combination requirements for inclusion of thermal loads were satisfied
- In addition, Westinghouse updated the licensing basis analysis of record described in DCD 18 to conform with a Shield Building Action Item associated with the NRC shield building review addressing the evaluation of hydrodynamic loads in the PCS tank
- Westinghouse has completed the additional analyses and the results are included in DCD Rev 19

PCS Tank Design DCD Rev 15

Hard Rock Design Certification

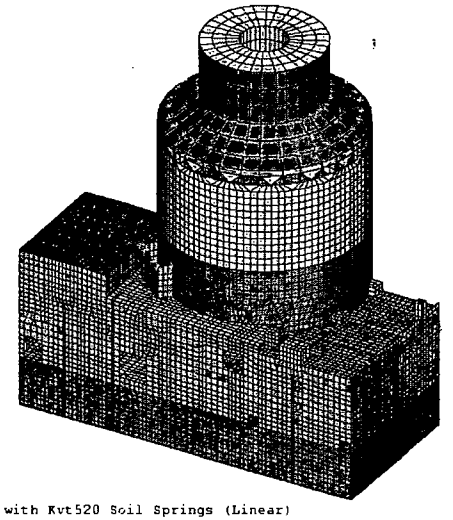
- PCS exterior wall is a critical section with results summarized in the DCD
- ¼ model of the SB roof was used for Hard Rock Design Certification
- Equivalent static analysis applying maximum acceleration from time history analyses
- Hydrodynamic load applied as pressure



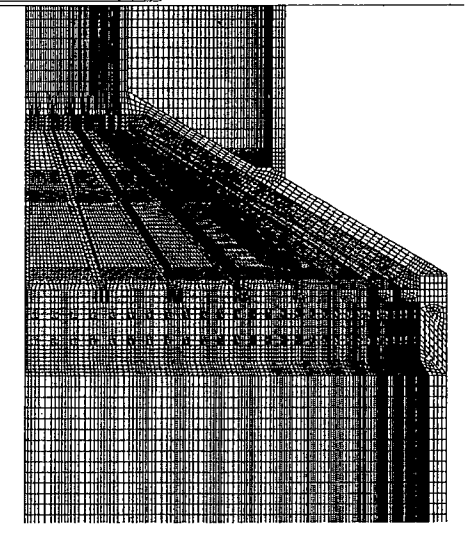
PCS Tank Design DCD Rev 16-18

Extension to Soft Soils

- Seismic member forces for Shield Building are obtained from response spectrum analysis of the NI05 model for all except the air inlet region
- The remaining loads such Dead, hydrostatic , wind and thermal loads are obtained from the detailed ¼ model
- Seismic forces for the air inlets is obtained by performing an equivalent static analysis
- Both models and analyses been reviewed by the NRC



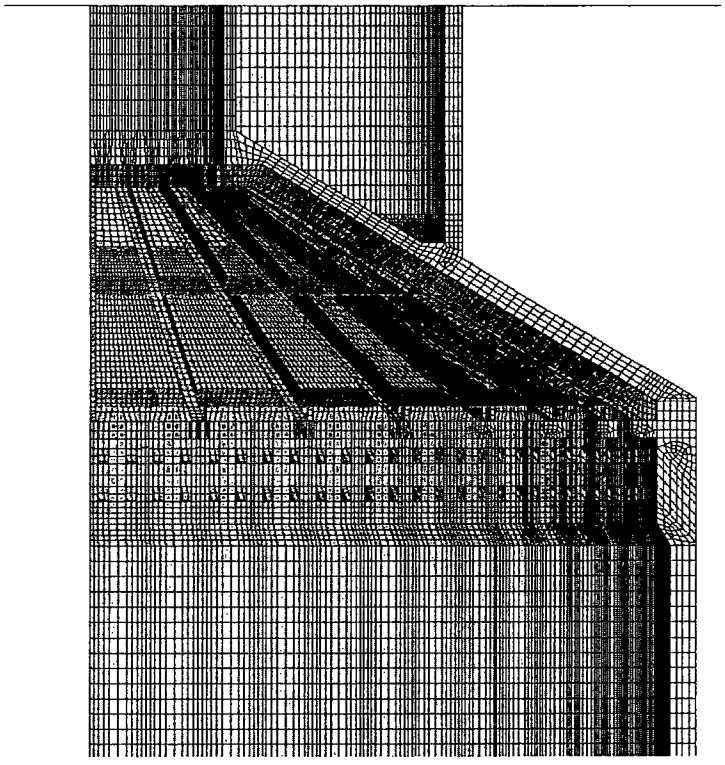
with Kvt520 Soil Springs (Linear)



PCS Tank Design DCD Rev 19

Action Item from NRC Shield Building Review

- Required WEC to apply equivalent static analysis to the PCS tank applying maximum acceleration from time history analyses
- This analysis change was not incorporated in DCD Rev. 18 and was subsequently included in DCD Rev. 19
- PCS exterior wall is a critical section with results summarized in the DCD



PCS Tank Licensing Basis

- PCS tank design is described in DCD Section 3.7, 3.8. Appendices 3G and 3H.
  - Equivalent static analysis is used for evaluation of the design of the PCS tank
  - Additional information on the design of the PCS tank is provided in DCD Rev. 19; this information is consistent with the design supporting Rev. 18
  - The use of equivalent static analysis is described in Subsection 3.7.2.1 and 3G.2
  - The PCS tank design is described in Subsection 3.8.4.1 and 3H.2.2
  - The portions of the PCS tank identified as critical sections are identified in 3H.5.6.

PCS Tank Licensing Basis

- PCS Tank Design Methodology / Licensing Basis Revised
- DCD Rev 16-18:
  - Design methodology uses the NI05 response spectrum analysis
- DCD Rev 19:
  - Design methodology uses the equivalent static methodology similar to what was certified in DCD Rev. 15 and similar to the method used for the air inlet structure and the tension ring.
  - The equivalent static method and quadrant model for the shield building roof are described in Appendix 3G.

The PCS Tank Design has not changed between DCD Rev 18 and 19

PCS Tank Design

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- The reinforcement design of the PCS tank and adjacent shield building roof is defined and shown in tables and figures in Appendix 3H as follows:

Shield Building Roof
DCD Figure 3H.5-11 Sheet 1

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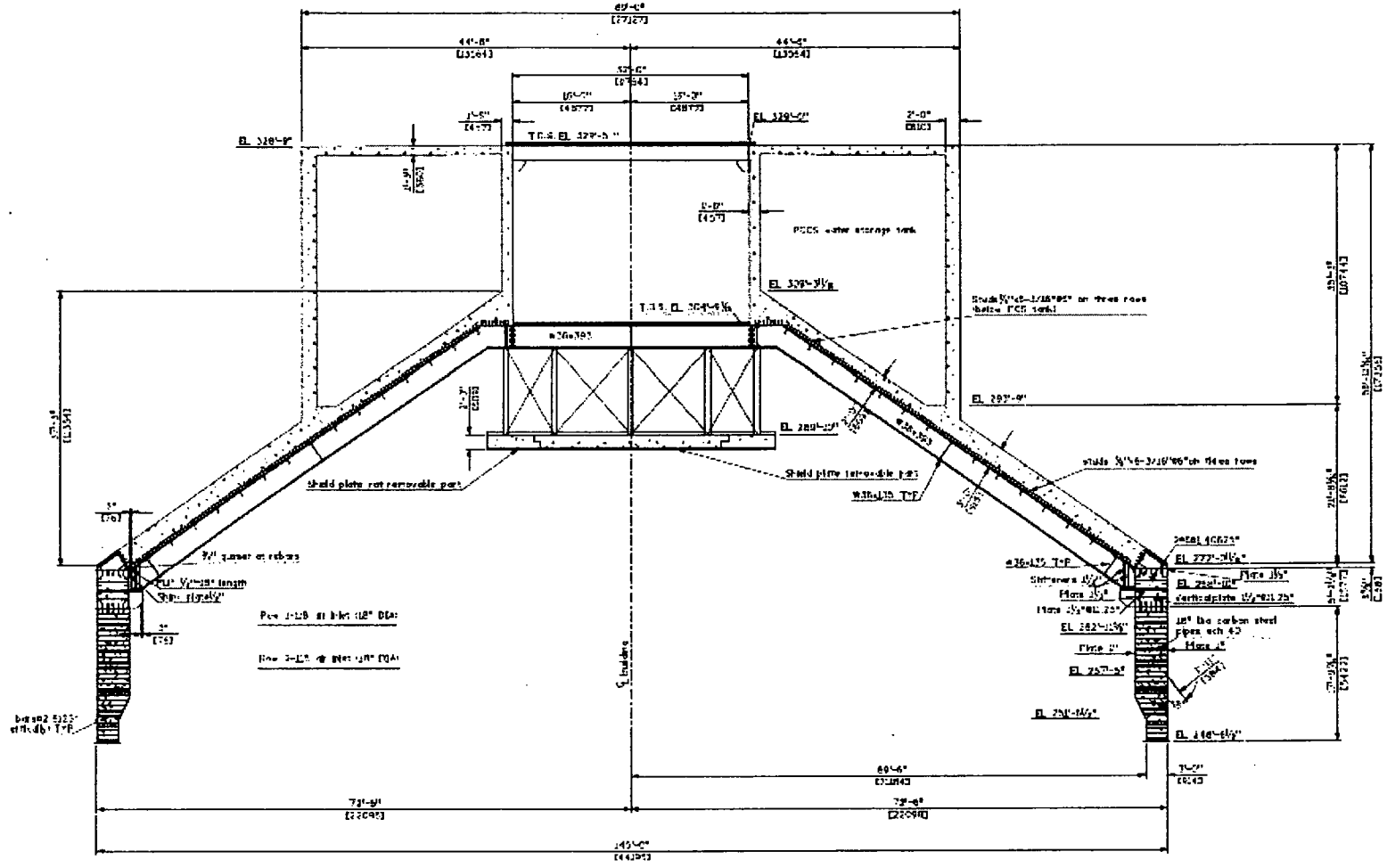

Shield Building Roof
DCD Figure 3H.5-11 Sheet 5

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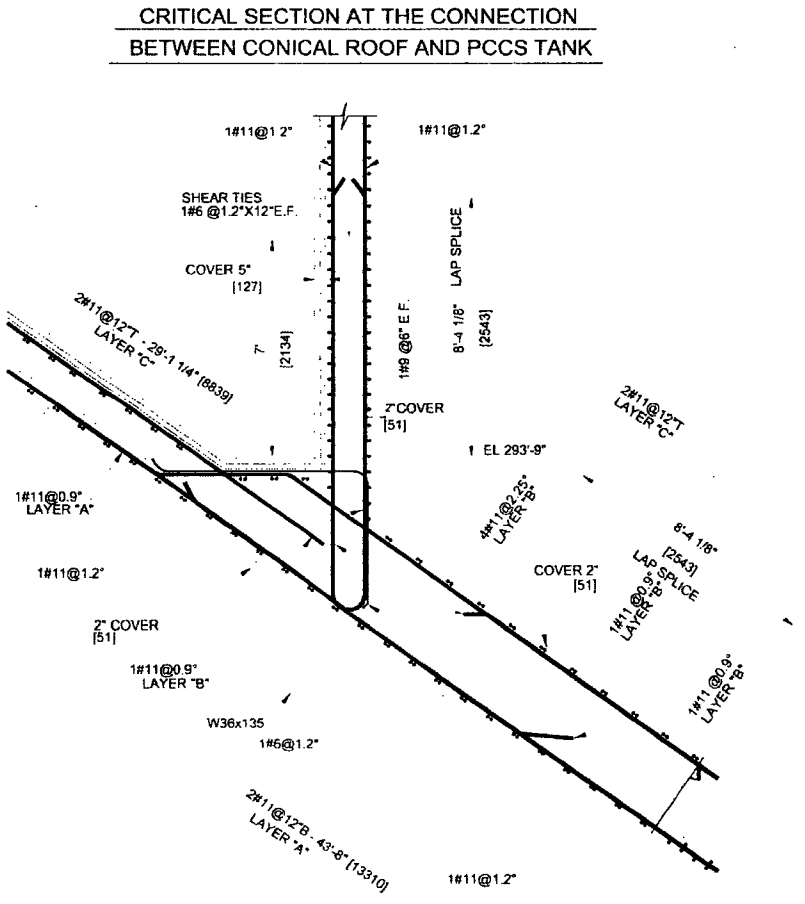
Figure 3H.5-11 Sheet 5 shows the knuckle region and a portion of the exterior wall. It is consistent with the reinforcement design defined in Table 3H.5-9 Sheet 3



Shield Building Roof
DCD Figure 3H.5-11 Sheet 6

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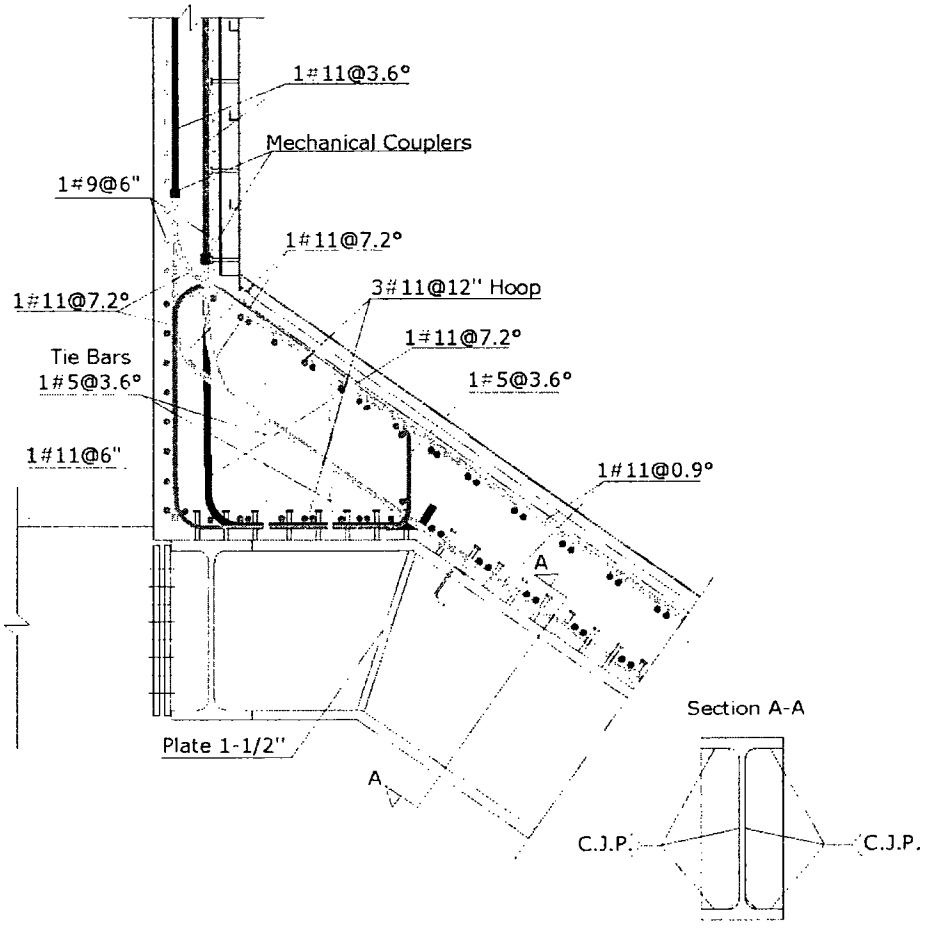
Figure 3H.5-11 Sheet 6 was added to show reinforcement design of compression ring

Compression Ring Configuration



Summary of Results Presented in DCD Rev 19

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- Table 3H.5-9 Sheet 3 provides information on the reinforcement design of the exterior wall of the PCS Tank

Table 3H.5-9 (Sheet 3 of 3)

SHIELD BUILDING ROOF REINFORCEMENT SUMMARY (EXTERIOR WALL OF PASSIVE CONTAINMENT COOLING SYSTEM TANK)

Wall Segment	Location (Figure 3H .5-11 Sheet 5 of 6)	Reinforcement on Each Face, in^2/ft			Ratio Required/ Provided
		Maximum Required	Provided (Minimum)		
Bottom	Vertical	1.37	1#11@1.2°	[*1 .72*	0.80
	Hoop	0.67	1#9@6"	*2*	0.33
	Shear	0.07	1#6@1.2°x 12"	*0.48*	0.15
Mid-height	Vertical	0.64	1#11@1.2°	*1.72*	0.37
	Hoop	1.85	1#9@6"	*2*	0.92
Top	Vertical	0.52	1#11@1.2°	*1.72*	0.30
	Hoop	0.79	1#9@6"	*2]**	0.39

The PCS Tank Design has not changed between DCD Rev 18 and 19

Summary of Results Presented in DCD Rev 19

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- Table 3H.5-15 was added and provides information on the reinforcement design of portions of the PCS Tank and SB roof

Table 3H.5-15

SHIELD BUILDING ROOF REINFORCEMENT RATIO OF CODE REQUIRED VERSUS PROVIDED

Critical Sections	Stress Component	Required in^2/ft	Provided (Minimum) in^2/ft	Reinforcement Ratio
[*Conical Roof Steel Beams*]* (1)	Axial + Bending	-	[*Radial Beams W36 X 393*]*	1.33
	Shear	-		8.33
[*Conical Roof Near Tension Ring*]*	Radial	1.80	[*1.96*]*	1.09
	Hoop	4.31	[*4.68*]*	1.09
[*Knuckle Region*]*	Vertical	1.37	[*1.72*]*	1.25
	Radial	1.52	[*2.23*]*	1.47
	Hoop	1.37	[*3.12*]*	2.28
[*Compression Ring*]*	Vertical	1.04	[*1.48*]*	1.42
	Radial	3.09	[*4.42*]*	1.43
	Hoop	2.14	[*3.12*]*	1.45

Summary of Results Presented in DCD Rev 19

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- The use of equivalent static analysis for the PCS tank is summarized in Section 3.7.
- Appendix 3G includes a more detailed description of the use of equivalent static analysis for the PCS tank.
- A table (3H.5-15) and figure (3H.5-11, Sheet 6) added to Appendix 3H for additional design information on the PCS tank and adjacent shield building roof is consistent with use of equivalent static analysis for the PCS tank.
- The design of the reinforcement for the PCS tank critical sections is not changed in DCD Revision 19.

Summary

- Westinghouse has provided a comprehensive Shield Building Report to document the design, analysis and testing performed in support of the design of the Shield Building
  - Design based on ACI349 and other applicable criteria

- AP1000 Shield Building is a safe robust structure that meets regulatory requirements as demonstrated by testing and analysis and the design and analysis results are presented in DCD Rev 19

- NRC has reviewed the revised calculations that address the additional analyses performed by Westinghouse that support DCD Rev 19

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