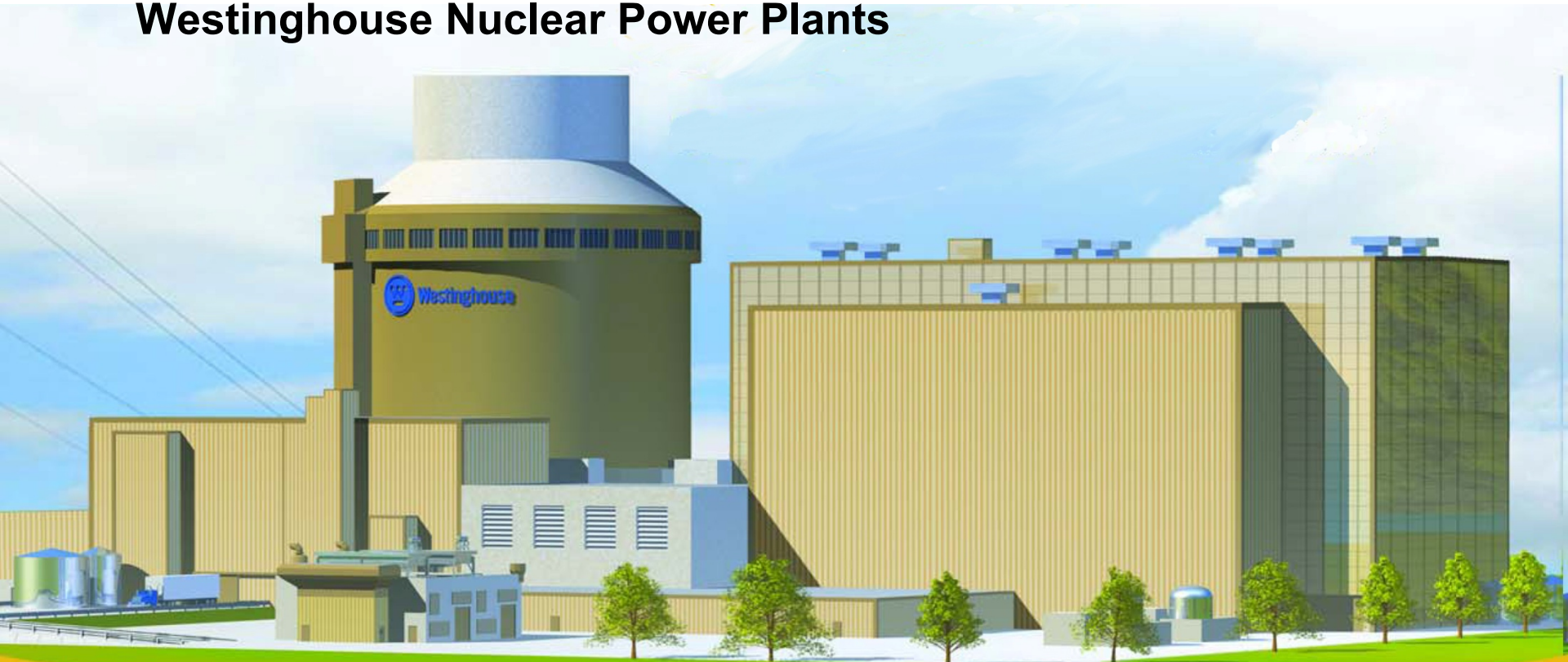


AP1000 Shield Building Structural Review Update

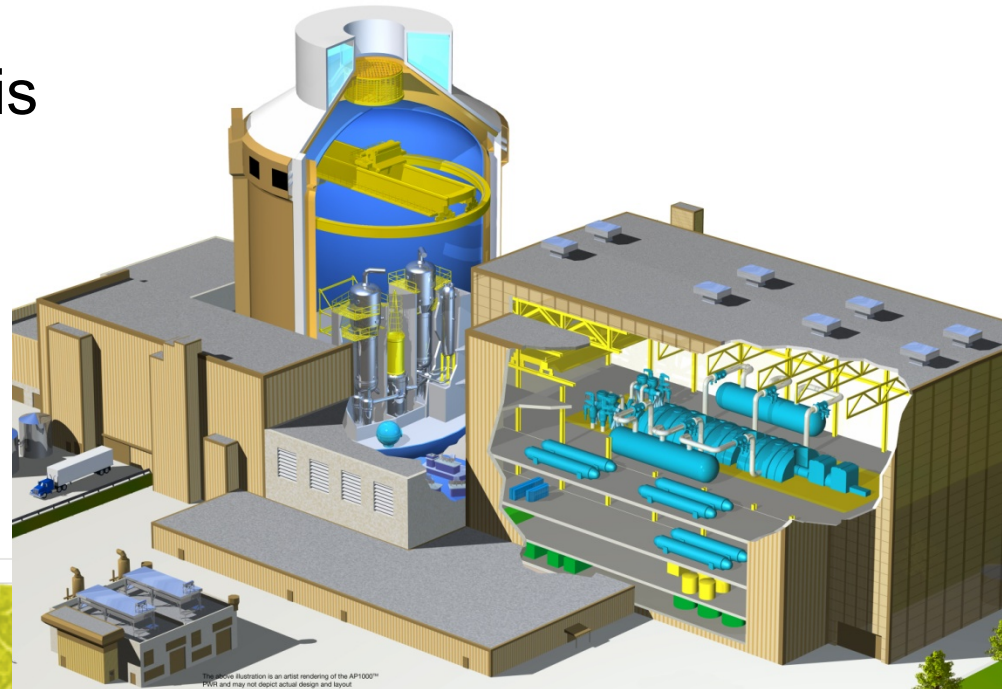
NRC PUBLIC SESSION
January 28, 2010

Bruce Bevilacqua
Vice President, Engineering
Westinghouse Nuclear Power Plants



Resolution Plan for Shield Building

- Technical Overview
 - Summary of NRC letter
 - Westinghouse Integrated Approach
 - Design Changes
 - Testing and Analysis
- NRC Meetings
- Schedule of Future Licensing Submittals



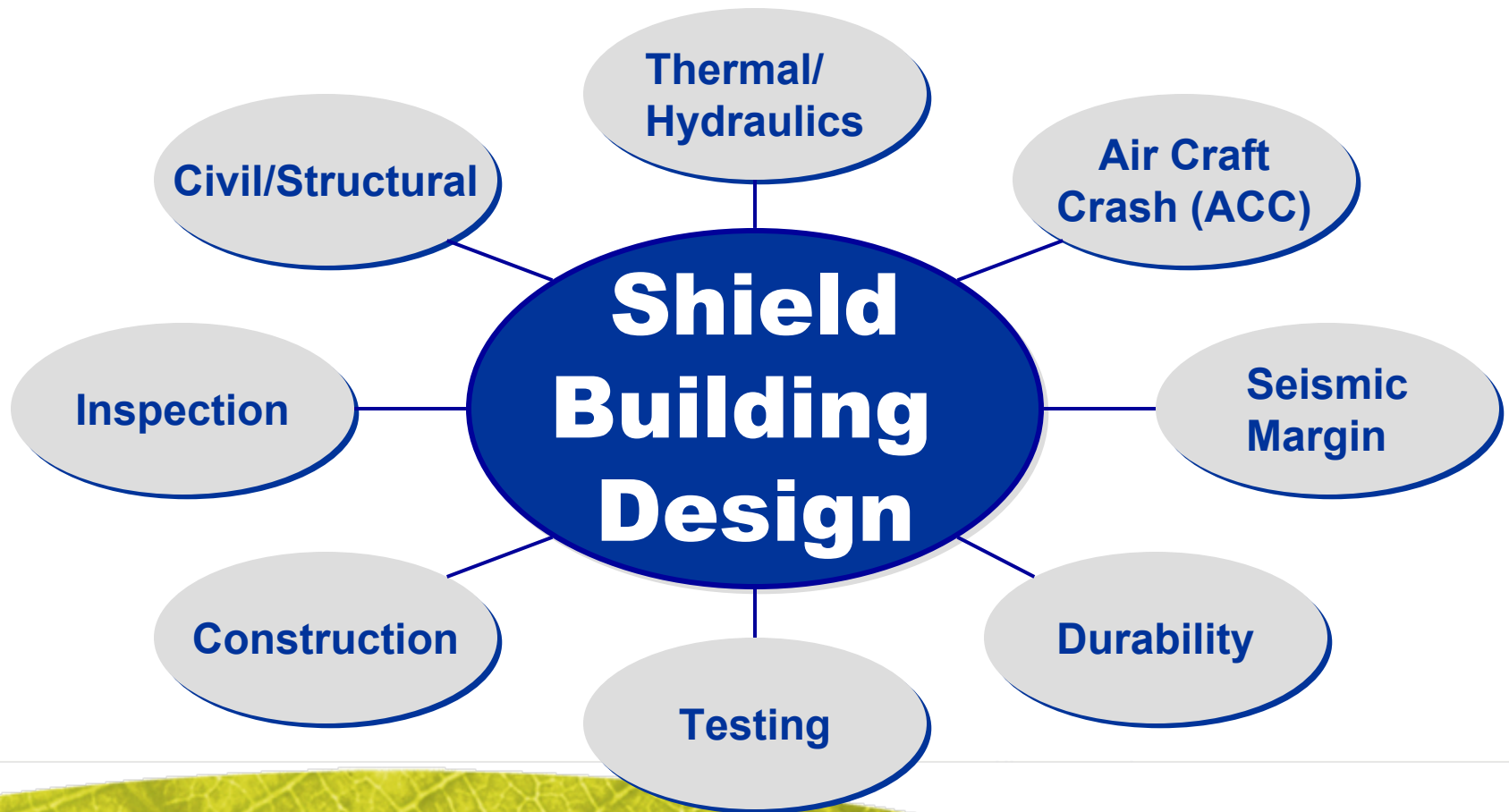
Technical Overview

- The AP1000 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

Summary of NRC Letter

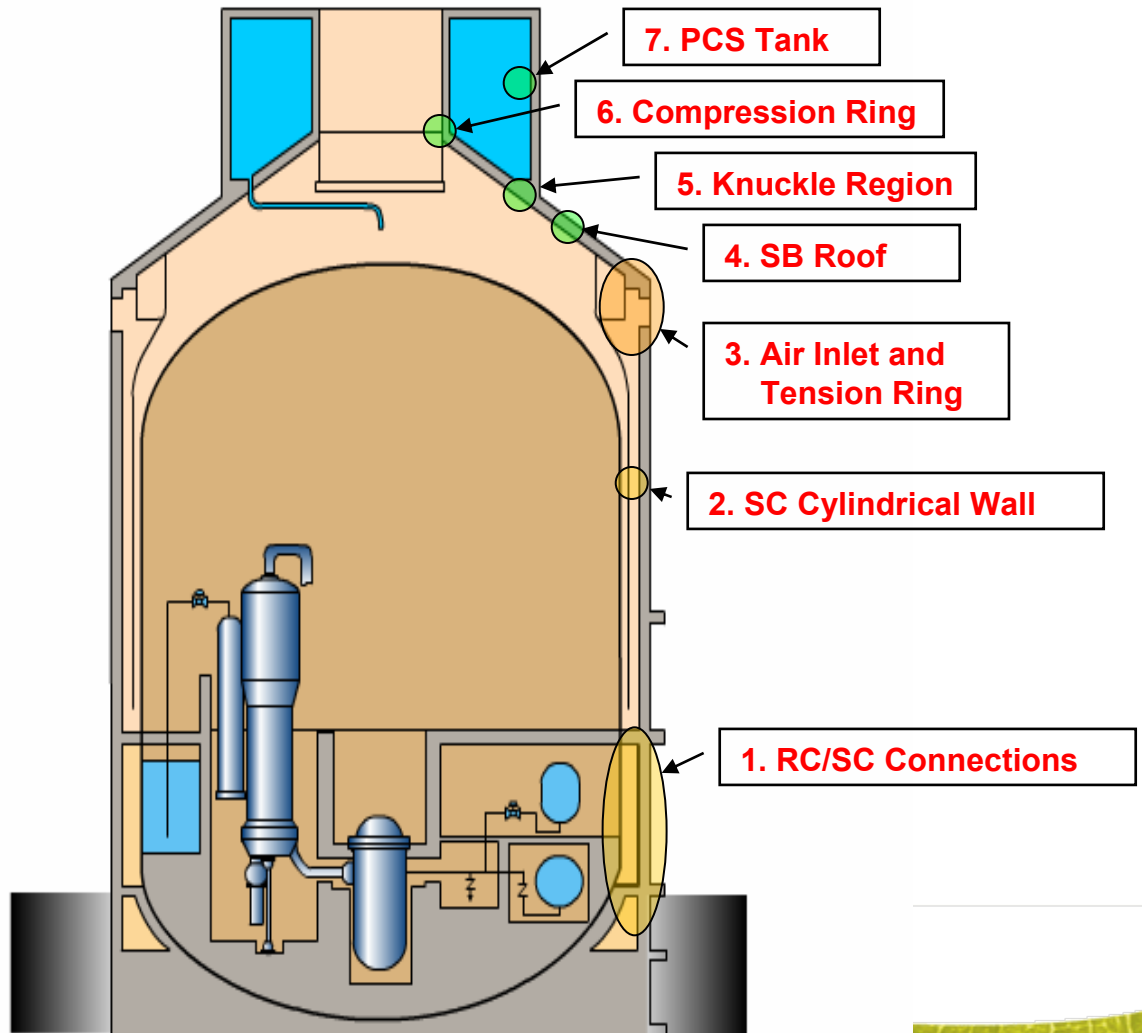
- On October 15, 2009 the NRC issued Westinghouse a letter on the Shield Building Design
 - Design of the SC structure must demonstrate the ability to function as a unit during Design Basis Event (DBE)
 - The design of the SC/RC connection must function following a DBE
 - Design of the tension girder (air-inlets) must be supported by a confirmation test or a validated benchmarked analysis method

Integrated Design Process



Shield Building Design Changes

- Added Shear Reinforcing Tie Bars that tie the entire SC structure together so that the Shield Building acts as a single unit
- Increased SC plate thickness and changed to a more ductile material to improve its strength, ductility and resistance to buckling
- Simplified air-inlet design to increase its structural integrity and to improve the SC-RC connection to the RC roof design



Shield Building Design Process Matrix

	Tension	In-of-Plane Shear	Out-of-Plane Shear	Out-of-Plane Moment
PCS Tank	C	C	C	C
Compression Ring	C	C	C	C
Knuckle Region	C	C	C	C
Roof	C	C	C	C
Air-Inlet and Tension Ring	BM NLA	BM NLA	BM NLA	BM NLA
Cylindrical Wall	T	T	T	T
SC/RC Connection	T	BM NLA	BM NLA	BM NLA

Legend:

C = Industry Code Basis

BM NLA = Benchmark Non-Linear Analysis

T = Confirmatory Testing

Shield Building Analysis Activities

Level 1:
Development of Building
Load Magnitudes

Linear Elastic

Level 1 Confirmatory
Analysis Performed to assess
the effects of cracking on
Floor Response Spectra
using non-linear analyses

Level 2:
Determination of Building
Force Distribution

Linear Elastic

Level 2 Confirmatory
Analysis Performed to assess
the effects of cracking on the
force distribution throughout
the building

Level 3:
Assessment of Building
Design Margins

Evaluation against ACI 349 Criteria

Level 3 Confirmatory
Analysis Performed using
detailed finite element
analyses models that have
been benchmarked to tests

Confirmatory Tasks to demonstrate “Margin” and “Effects of Cracking”

Test Matrix

Test	Number of Specimens	Goal of Test	Test Status
Anchorage	1	Strength and Ductility of RC to SC Connection	Completed Successfully
Behavioral / Mini Anchorage	3	Show the overall behavior of the SC structures & benchmarking process	Completed Successfully
Behavioral / Pushout	2	Show the overall behavior of the SC structures & benchmarking process	Completed Successfully
	2		Confirmatory Test
Out of Plane w/out Tension	2	Out of plane shear strength is calculated conservatively using $2(f'c)^{0.5}bT$	Completed Successfully
	2		Confirmatory Test
Out of Plane w/ Tension	1	Out of plane shear strength is calculated conservatively using $2(f'c)^{0.5}bT$	Completed Successfully
	1		Confirmatory Test
Weld	2	Weld connection is stronger than bar or plate	Completed Successfully
In Plane Shear	2	Interaction equation used in the AP1000 design is conservative	Confirmatory Test
Test w/ Old Design	Anchorage	These tests were done using previous versions of the Shield Building design. Since the design changed, these specimens were used primarily to calibrate data acquisition equipment and as additional data	Completed Successfully
	Anchorage		Completed Successfully
	Anchorage		Completed Successfully
	OOP		Completed Successfully
	OOP+T		Completed Successfully

Summary of NRC Meetings

- November 18th Public Meeting
 - Outlined Integrated Design Approach
 - Described design changes to be included in the Shield Building
 - Identified overall licensing response including preliminary test and analysis plan
- November 18th Closed Meeting
 - Good information exchange with the staff
 - Reviewed in detail SB design changes

Summary of NRC Meetings

- December 21st /22nd Closed Meeting
 - Outlined Analysis Plan
 - Described Test Setups and Test Matrix
 - Described SC behavioral model

Summary of Test & Analysis Meeting

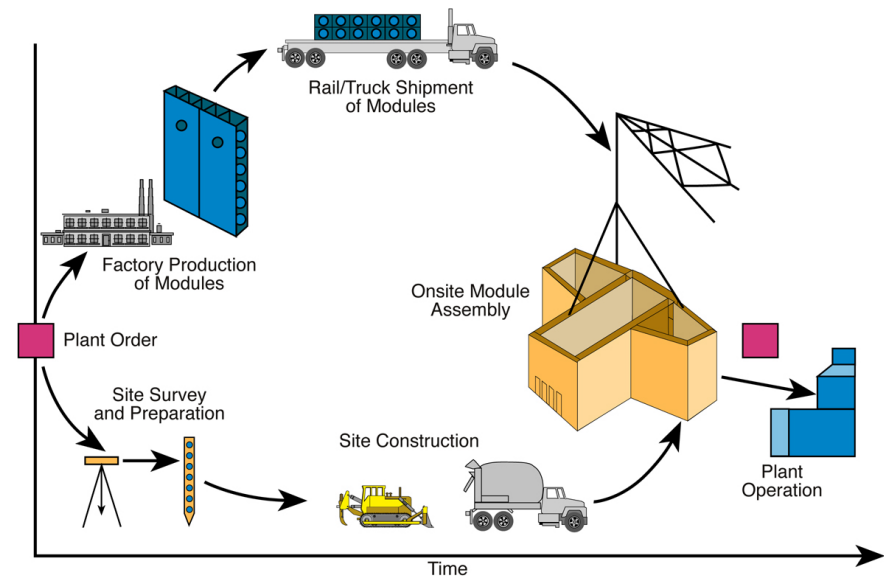
- Key NRC Comments on Overall Approach :
 - Analysis Plan approach of the Level 1, Level 2 and Level 3 analyses is comprehensive. Westinghouse approach appears to be a reasonable design methodology
 - Proposed approach of testing to benchmark codes appears reasonable
 - For In-plane shear loading on SC modules, it was shown that it is more appropriate to perform tests of In-plane shear w/o tension and this will be the basis for the Westinghouse in-plane shear confirmatory tests

Schedule for Westinghouse Submittals

- Submit Revised SB Design Report February 2010
- Submit Revised Technical Reports March 2010
 - Seismic (TR03)
 - Hard Rock High Frequency (TR115)
- Target NRC SB Technical Audit March 2010
- Submit SB Confirmatory Test Results Report April 2010

AP1000 Modular Construction

- The Westinghouse AP600 and AP1000 Certified Designs utilize modular construction
 - Modules improve quality and constructability
- The tests and analyses completed to date as part of the Shield Building review continue to demonstrate the adequacy of structural modules



Summary

- Westinghouse is addressing NRC review comments about the SB design in an integrated and complete fashion
- SB design changes to enhance the safety of the structure are underway and will be described in the revised AP1000 Shield Building design deliverables scheduled for submittal to the NRC in early 2010
- Westinghouse will demonstrate that the AP1000 shield building design is safe and robust with ample safety margin to meet NRC General Design Criteria regulatory requirements through analysis, benchmarking and testing

More information about the AP1000 and a copy of this presentation can be found at:

http://ap1000.westinghousenuclear.com/ap1000_nui_reg.html

