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Your ref: Docket No. 52-006  
Our ref: DCP/NRC1651

November 18, 2003

**SUBJECT: Transmittal of Revised Responses to AP1000 DSER Open Items**

This letter transmits Westinghouse revised responses to Open Items in the AP1000 Design Safety Evaluation Report (DSER). A list of the revised DSER Open Item responses transmitted with this letter is Attachment 1. The non-proprietary responses are transmitted as Attachment 2.

Please contact me at 412-374-4728 if you have any questions concerning this submittal.

Very truly yours,

A handwritten signature in black ink, appearing to read 'R. P. Vijuk'.

R. P. Vijuk, Manager  
Passive Plant Engineering  
AP600 & AP1000 Projects

/Attachments

1. List of the AP1000 Design Certification Review, Draft Safety Evaluation Report Open Item Responses transmitted with letter DCP/NRC1651
2. Non-Proprietary AP1000 Design Certification Review, Draft Safety Evaluation Report Open Item Responses dated November 18, 2003

D0603

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**Attachment 1**

List of  
Non-Proprietary Responses

<b>Table 1</b> <b>“List of Westinghouse’s Responses to DSER Open Items Transmitted in DCP/NRC1651”</b>	
3.8.4.2-1 Revision 2	

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**Attachment 2**

**AP1000 Design Certification Review  
Draft Safety Evaluation Report Open Item Non-Proprietary Responses**

# AP1000 DESIGN CERTIFICATION REVIEW

## Draft Safety Evaluation Report Open Item Response

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DSER Open Item Number: 3.8.4.2-1 (Revision 2)

Original RAI Number(s): None (April 3, 2003, meeting summary)

### *Summary of Issue:*

During the April 2 through 5, 2003, design audit, the staff reviewed the applicant's approach to the design of boundary elements potentially needed to reinforce boundaries and edges around openings of structural walls. In accordance with Chapter 21.6 of ACI 349-01, if the vertical compressive stress at the opening does not exceed  $0.2 f'_c$ , then a boundary element is not required. The applicant contended that this compressive stress limit is not applicable when seismic member forces are based on elastic analysis, no ductility reduction factor is applied, and a stress limit of  $1.0 f'_c$  is used as the stress threshold for boundary elements. The staff disagreed with the approach proposed by the applicant, and also pointed out that the stress prediction at an opening is highly dependent on the finite element mesh refinement. In addition, the staff review of Westinghouse calculation APP-1200-CCC-102 "Auxiliary Building Wall 7.3 Reinforcement Calculation" indicated that boundary element evaluations were not considered at the intersection of reinforced concrete walls. The staff position is that the need for boundary elements around openings and at intersections of reinforced concrete walls should be evaluated in accordance with Chapter 21.6 of ACI-349-01. The applicant agreed to consider the staff's positions and to develop criteria to implement the provisions of Chapter 21.6 of ACI-349-01. The applicant's action will be reviewed by the staff when submitted. This is Open Item 3.8.4.2-1.

### **Westinghouse Response: (Revision 2)**

The text of ACI 349-01 is incorrect. In the 1997 code, boundary elements for structural walls are specified in 21.6.5. The 2001 code renumbered this section to 21.6.6. Paragraph 21.6.1 in the 1997 code states: "For shear walls with  $h_w/l_w$  of less than 2.0, provisions of 21.6.5 can be waived." This paragraph was inadvertently not revised in the 2001 edition so this waiver was incorrectly applied to "21.6.5 Shear strength" in 349-01 instead of to the renumbered "21.6.6 Boundary elements for structural walls". This correction is being included in the next edition of the ACI 349 code. This correction is also expected to be included in the Errata for ACI 349-01.

ACI 349-97 has been endorsed in Regulatory Guide 1.142. The AP1000 design will follow the wording of ACI 349-97 for this provision since this was the intent of the code committee and will be included in the future code provision. This correction is being noted in the DCD as shown below.

Commentary paragraph R21.6 in ACI 349R-01 explains that the provisions of boundary elements are intended for walls subject to flexure and that shear walls with low aspect ratio do not require them. Wall 7.3 has the maximum total height to overall length of any of the walls in the auxiliary building. It extends from the basemat at elevation 66.5' up to the top of the roof at elevation 160.5'. Shear loads are transferred to the 22' thick basemat below the shield building at elevation 82.5. Its horizontal length is 36 feet from the inside face of the shield building to the

# AP1000 DESIGN CERTIFICATION REVIEW

## Draft Safety Evaluation Report Open Item Response

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exterior face of the exterior wall. The height to length ratio ( $h_w/l_w$ ) of the wall above elevation 82.5' is 2.2; however, its overall response is controlled by the shield building with a total height to diameter ratio of 1.8, and a height of the cylindrical wall to diameter ratio of 1.3. In addition, wall 7.3 acts in 18' high segments between floors with a height to length ratio of 0.5. Thus, all walls are controlled by shear and boundary elements are not required by ACI 349-97 and the corrected ACI 349-01. Note that vertical stresses in local regions of this wall are close to the threshold limit of  $0.2 f'_c$ . These regions were evaluated in the design calculations and would not have required the addition of boundary elements.

### Design Control Document (DCD) Revision:

Revise subsection 3.8.4.5.1 as follows:

#### 3.8.4.5.1 Supplemental Requirements for Concrete Structures

*[Supplemental requirements for ACI-349-01 are given in the position on Regulatory Guide 1.142 in Appendix 1A. The structural design meets the supplemental requirements identified in Regulatory Positions 2 through 8, 10 through 13, and 15.]\**

Paragraph 21.6.1 of ACI 349-01 should reference 21.6.6 instead of 21.6.5. Paragraph 21.6.5 in ACI 349-97 was renumbered to 21.6.6 in ACI 349-01 and the reference in 21.6.1 was not updated. The errata for ACI 349-01 are being updated to include this correction. This makes the paragraph consistent with ACI 349-97, which was endorsed by Regulatory Guide 1.142.

*[Design of fastening to concrete is in accordance with ACI 349-01, Appendix B.]\**

### PRA Revision:

None