ENCLOSURE 4

APP-GW-GLR-603

"AP1000 Shield Building Design Details for Select Wall and RC/SC Connections"

(Non-Proprietary)

March 2011

AP1000 License Report

AP1000 Shield Building Design Details for Select Wall and RC/SC Connections

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1 INTRODUCTION

This report documents proprietary design detail information, including Tier 2* information, for the AP1000 Shield Building cylinder and connections to the auxiliary building and basemat as described in design basis documents. See Section 3.5 of the introduction to the AP1000 Design Control Document (APP-GW-GLR-700) for a discussion of Tier 2* information. This information is consistent with the information previously provided in the Shield Building Report (Reference 1). The NRC staff, in its review of information in reports and responses to Requests for Additional Information (RAIs) provided by Westinghouse to support the AP1000 Design Certification amendment, identified information that should be incorporated into the Design Control Document (DCD). Some of this information provided to explain, define, and support the Shield Building design has been determined to be information proprietary to the Westinghouse Electric Company LLC. In conformance with the requirements of 10 CFR Section 2.390 Sensitive Unclassified Non-Safeguards Information, including proprietary information submitted to the NRC, may be withheld from public disclosure.

The AP1000 uses the innovative application of steel-concrete composite construction in the design of the shield building. Design information and criteria to demonstrate the strength of the shield building and the response to seismic and other loads is based on [ ]^{a,c}. This design information is not publicly available and is proprietary. The NRC staff has determine that some of this detailed design information, in particular key design information for the design and construction of the shield building, is of sufficient importance that it should be incorporated into the DCD. This report considers the design details that are contained within selected portions of the shield building that are incorporated into DCD Section 3H by reference to this document.

The list of components with the material properties used in the enhanced shield building is identified in the following table.

Table1
LIST OF COMPONENTS AND MATERIAL PROPERTIES USED IN THE SHIELD BUILDING

Component	Material
Stiffener Plate	ASTM A572 Gr50[1]
Liner Plate	
Gussets	
Support Plate	
End Plate	
[ ]^{a,c} Tie Bar in RC/SC Connection	ASTM A706[1]
[ ]^{a,c} Tie Bar	ASTM A496[1]
[ ]^{a,c} Stud	ASTM A108[1]
[ ]^{a,c}	ASTM A615 Gr60[1]
[ ]^{a,c}	
[ ]^{a,c}	

[1]Steel with equal or better material properties may be used in place of the listed material.

2 REFERENCES

1. APP-1200-S3R-003; Design Report for the Enhanced Shield Building, Revision 3, September 2010 (Westinghouse Proprietary)

3 REGULATORY IMPACT

This document documents and summarizes key structural design details of the AP1000 shield building. The technical information contained within this report is derived from the information contained in Reference 1 for selected shield building components. The information included in Reference 1 was subject to extensive review by the NRC as part of their review of the Shield Building design. The Shield Building report (Reference 1) was docketed during the review.

The information included in the text, table, and figures of this report (APP-GW-GLR-603) is incorporated by reference as part of the DCD in Appendix 3H.5.7 and is considered to have the same level of importance as information as the reference itself. The generation and revision of this report is subject to the same process and review as DCD information.

The information included in this report was identified by the NRC as important to their conclusions documented in the Safety Evaluation Report supplement for the AP1000 Design Certification amendment. The information required to be included in this report was discussed with the NRC during meetings and phone call in January, February and March 2011.

4 TECHNICAL BACKGROUND

This report identifies selected proprietary design detail information for the AP1000 Shield Building cylinder and connections to the auxiliary building and basemat as described in design basis documents. It is intended to be consistent with the information which was provided in the Shield Building Report (Reference 1) and Appendix 3H5.7 of the DCD.

This report provides the requisite design details that are contained within selected portions of the auxiliary and shield building critical sections that are part of DCD Appendix 3H.

Steel Concrete Composite (SC) Shield Building RC/SC Connection Zone Details (3H.5.7.2)

Figure 1 shows the representative details for the vertical RC/SC connection zone which are based on Figure 4.1-2 of the enhanced SB design report (Reference 1). The liner plate, support plate, and gusset plates are American Society of Testing Materials (ASTM) A572 Grade 50 or equivalent steel. The steel liner plate is thickened in this region to 1.0 inch thick. The connection design methodology is similar for each of the RC/SC connections, vertical connections at elevation 100', 146'-10" and the hoop bar connection at Azimuths 340 degrees and 177 degrees. A view of the hoop bar [ ]^{a,c} is shown in Figure 3. An end plate on the [ ]^{a,c} is used to allow for welding of the hoop bars that are within the height of the [ ]^{a,c} The end plate and [ ]^{a,c} to

the plate are shown in Figure 2. [

]^{a,c}

The [ ]^{a,c} that are welded to the steel liner plates are ASTM A706 or equivalent steel. The [ ]^{a,c} tie bars are made of ASTM A496 or equivalent steel.

DCD Table 3H.5-14 (Sheet 3 of 3) shows the plate thickness provided and plate thickness required for mechanical load cases. This location, on the west side at grade, is one of the most stressed locations in the shield building under SSE loading due to overturning of the cylinder. The shear reinforcement required is also calculated. [ ]^{a,c} The out of plane shear capacity is calculated using beam action equations in ACI-349 Section 11, including the reduction in concrete shear strength when the section is under significant tension.

The welds that anchor the liner plates to the RC/SC connection are complete joint penetration (CJP) welds, as defined by AWS A3.0M/A3.0:2010. The welds that anchor the liner plate to liner plate welds are also CJP welds.

Steel Concrete Composite (SC) Shield Building Wall Panel (3H.5.7.1)

Figure 5 shows the representative details for a standard (Type 2 module) shield building wall panel which are based on Figure 3.1-2 of the enhanced SB design report (Reference 1). [

]^{a,c} fabricated of ASTM A572 or steel with equal or better material properties steel liner plates on each face. The [ ]^{a,c} are made of ASTM A496 or steel with equal or better material properties. The studs are [ ]^{a,c} made of ASTM A108 material or steel with equal or better material properties.

Type 1 module are fabricated in the same manner except [ ]^{a,c} Type 1 modules are used in regions with higher out of plane shear.

The studs and tie bars are provided to ensure composite action. [

]^{a,c}

DCD Table 3H.5-14 (Sheet 2 of 3) provides details about the loading and plate required and provided for an element with maximum out of plane demand for a Type 2 module outside of [ ]^{a,c} This element is located at elevation 175 ft near wall 7.3 above the auxiliary building roof line. The shear reinforcement required is also calculated. [ ]^{a,c} The out of plane shear capacity is calculated using beam action equations in ACI-349 Section 11, including the reduction in concrete shear strength when the section is under significant tension.

DCD Table 3H.5-14 (Sheet 1 of 3) provides details about the loading and plate required and provided for an element with maximum out of plane demand for a Type 1 module inside of [ ]^{a,c} This element is located at elevation 180 ft near fuel handling building roof line. The shear reinforcement required is also calculated. [ ]^{a,c} The out of plane shear capacity

is calculated using beam action equations in ACI-349 Section 11, including the reduction in concrete shear strength when the section is under significant tension.

The tie bars are welded to the steel face plates using a weld detail that will develop 125% of the specified yield of the bar. The liner plates are connected to adjacent panels with a complete joint penetration weld.

Figure 6 shows the representative details for the rolled-out circumferential RC/SC connection zone which are based on Figure 4.1-1 of the enhanced SB design report (Reference 1). The SC Shield Building walls are anchored to the RC basemat and walls by [

]^{a,c}

Other areas of the shield building

Table 2 presents the Reinforcement Ratio of Code Required vs. provided for other areas of the shield building roof. This information is being provided to complete the required vs. provided tables for the Enhanced Shield Building.

[ ] a,c

a,c

Figure 1: RC/SC Connection Zone Showing Nominal Connection to SC Panel and Reinforcing Bars

[ ]a,c

Figure 2: Plan View of RC/SC Connection of [ ]a,c from Elevation 100 Feet to Elevation 103 Foot, 6 Inches

[ ]a,c

Figure 3: Plan View of RC/SC Connection of [ ]a,c above Elevation 103 Feet, 6 Inches

[ ]a,c

Figure 4: Typical Interface Between Vertical Bar [ ]^{a,c} and Hoop Bar [ ]^{a,c} at grade

a,c

Figure 5: Nominal SC Panel Details

a,c

Figure 6: Rollout View Detailing Nominal Spacing of Tie Bars (Viewed from SB Interior)