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Your ref: Project Number 740
Our ref: DCP/NRC1955

July 5, 2007

Subject: AP1000 COL Response to Requests for Additional Information (TR 57)

In support of Combined License application pre-application activities, Westinghouse is submitting responses to the NRC requests for additional information (RAIs) on AP1000 Standard Combined License Technical Report 57, APP-GW-GLR-045, Nuclear Island: Evaluation of Critical Sections. These RAI responses are submitted as part of the NuStart Bellefonte COL Project (NRC Project Number 740). The information included in the responses is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification.

Responses are provided for TR57-1 through TR57-12, transmitted in letter NRC/DCP1391 from Michael J. Miernicki to Andrea Sterdis, received May 31, 2007. This completes the RAI responses for TR57.

Pursuant to 10 CFR 50.30(b), the responses to the requests for additional information on Technical Report 57, numbered RAI-TR57-001 through RAI-TR57-012 are submitted as Enclosure 1 under the attached Oath of Affirmation.

Questions or requests for additional information related to the content and preparation of these responses should be directed to Westinghouse. Please send copies of such questions or requests to the prospective applicants for combined licenses referencing the AP1000 Design Certification. A representative for each applicant is included on the cc: list of this letter.

Very truly yours,

D. J. Hutchings for

A. Sterdis, Manager
Licensing and Customer Interface
Regulatory Affairs and Standardization

D063
D079
NRO

00196psa.doc

/Attachment

1. "Oath of Affirmation," dated July 5, 2007

/Enclosure

1. Responses to Requests for Additional Information on Technical Report No. 57

cc:	D. Jaffe	-	U.S. NRC	1E	1A
	E. McKenna	-	U.S. NRC	1E	1A
	G. Curtis	-	TVA	1E	1A
	P. Grendys	-	Westinghouse	1E	1A
	P. Hastings	-	Duke Power	1E	1A
	C. Ionescu	-	Progress Energy	1E	1A
	D. Lindgren	-	Westinghouse	1E	1A
	A. Monroe	-	SCANA	1E	1A
	M. Moran	-	Florida Power & Light	1E	1A
	C. Pierce	-	Southern Company	1E	1A
	E. Schmiech	-	Westinghouse	1E	1A
	G. Zinke	-	NuStart/Entergy	1E	1A
	R. Orr	-	Westinghouse	1E	1A

ATTACHMENT 1

"Oath of Affirmation"

ATTACHMENT 1

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of:	)
NuStart Bellefonte COL Project	)
NRC Project Number 740	)

APPLICATION FOR REVIEW OF
"AP1000 GENERAL COMBINED LICENSE INFORMATION"
FOR COL APPLICATION PRE-APPLICATION REVIEW

D. S. Lipman, being duly sworn, states that he is Senior Vice President, Nuclear Power Plants, for Westinghouse Electric Company; that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission this document; that all statements made and matters set forth therein are true and correct to the best of his knowledge, information and belief.

D. S. Lipman
Senior Vice President
Nuclear Power Plants

Subscribed and sworn to
before me this 5 day
of July 2007.

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Katherine W. McGinnett, Notary Public
Monroeville Boro, Allegheny County
My Commission Expires Jan. 4, 2009
Member, Pennsylvania Association of Notaries

Notary Public

ENCLOSURE 1

Responses to Requests for Additional Information on Technical Report No. 57

RAI-TR57-001 through RAI-TR57-012 Revision 0

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR57-001
Revision: 0

Question:

Section 2.1 (page 6) states "However, Containment Interior Structure critical sections only includes; south west wall of the refueling cavity, south wall of west steam generator cavity, north east wall of the In-containment Refueling Water Storage Tank (IRWST), IRWST circular steel wall, and column supporting operating floor." The staff is unclear about how your "critical section" is defined and selected, and, therefore, requests that you provide the definition for critical sections and criteria for selecting them.

Westinghouse Response:

"Critical sections" are defined as a set of locations in the safety related structures where detailed design was performed and audited by the NRC staff to demonstrate implementation of the design process. The 'critical sections' are described in DCD sections 3.8.3.5.8, 3.8.4.5.4 and in Appendix 3H.

The structural design of all buildings of the nuclear island was not completed at the time of Design Certification for the AP600 or the AP1000 at a hard rock site. The design was completed for selected "critical sections" to demonstrate implementation of the design process. The design calculations for these critical sections were audited during the design certification review. The critical sections were selected by Westinghouse and approved by the NRC in the Design Certification of both AP600 and AP1000 to include examples of each type of construction at locations where the design demand was expected to be fairly large. The south west wall of the refueling cavity, south wall of west steam generator cavity, and north east wall of the In-containment Refueling Water Storage Tank (IRWST) are examples of the concrete filled structural wall modules which experience both seismic loading and loads as boundaries of the IRWST. The steel wall was selected as the only steel wall. The column was selected as an example of a column inside containment.

The 'critical sections' were selected during AP600 Design Certification; and have been reviewed by the NRC staff for AP1000 Design Certification. The list of the 'critical sections' remains unchanged.

Reference:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR57-002
Revision: 0

Question:

Section 2.1.1 (page 6) states "For large loads, the moment of inertia is that of the cracked section transformed to concrete." The staff does not understand the meaning of the above statement and requests that you clarify it.

Westinghouse Response:

DCD subsection 3.8.3.4 and Table 3.8.3-1 describe the stiffness properties of the structural modules. The cracked section transformed to concrete is shown as Case 3 and assumes that the concrete in tension has no stiffness. For the flexural stiffness this is the conventional stiffness value used in working stress design of reinforced concrete sections.

Reference:

None

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR57-003
Revision: 0

Question:

Section 2.1.1 (page 7) states "Concrete-filled structural wall modules are designed as reinforced concrete structures in accordance with requirement of [American Concrete Institute] ACI-349." The staff does not believe that ACI-349 addresses or provides design methods or requirements for the type of a structure with steel plates at the exterior faces and concrete filled in between, and, therefore, requests clarification on the above statement by citing the relevant ACI-349 code sections. If you agree with the staff that ACI-349 is not applicable to this type of structure, state your design methodology and the basis which supports the development of the methodology. If the methodology was derived from, or verified by, physical test data, submit the test and test data.

Westinghouse Response:

The design methodology for the concrete-filled structural wall modules is described in DCD subsection 3.8.3.5.3. The methodology follows ACI 349 with supplemental requirements described in the DCD. This methodology was extensively reviewed during the AP600 Design Certification as described in the AP600 FSER and reconfirmed in the AP1000 FSER. The purpose of Technical Report 57 is to update the design results for the revised seismic loads for soil sites. There is no change in the approved design methodology.

Reference:

None

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

Revise first sentence of last paragraph of Section 2.1.1 as follows:

Concrete-filled structural wall modules are designed as reinforced concrete structures in accordance with requirements of ACI-349 **with supplemental requirements as described in DCD Subsection 3.8.3**.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR57-004
Revision: 0

Question:

Section 2.1.2 (page 7) states "The other walls have stainless steel on one face and carbon steel on the other." The staff requests that you briefly describe the design methodology for these walls subjected to in-plane and out-of-plane bending moments and shear forces, and torsion generated in the wall due to the non-symmetrical resistance force provided by the stainless steel on one face and the carbon steel on the other face.

Westinghouse Response:

The design methodology for the walls is described in DCD subsection 3.8.3.5.3. This methodology was reviewed during the AP600 Design Certification and the AP1000 Design Certification for hard rock. No changes have been made to this methodology. The modulus of elasticity of carbon steel and the Duplex stainless steel are similar so the resistance provided by the carbon steel and stainless steel plates up to yield is similar. The required area of steel required on each surface is calculated using the yield strength of the material on that surface.

Reference:

None

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR57-005
Revision: 0

Question:

On the IRWST design, Section 2.1.2 (page 7) states "The wall is evaluated as vertical and horizontal beams." The staff did not see the description of IRWST design, and, therefore, requests that you describe how the IRWST was designed and justify the use of a one dimensional beam design for a three-dimensional IRWST.

Westinghouse Response:

The design of the IRWST steel wall is described in DCD subsection 3.8.3.5.8.2. The wall is modeled in the ANSYS analyses using plate and beam elements. The member forces in these shell and beam elements are combined for evaluation of the wall in accordance with AISC N690.

Reference:

None

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR57-006
Revision: 0

Question:

Section 2.2 (page 8) states "Adjoining buildings, such as the radwaste building, turbine building, and annex building are structurally separated from the nuclear island structures by a 2-inch gap at and below the grade. A 4-inch minimum gap is provided above grade." The staff requests that you clarify the apparent inconsistency between your statements of the 2-inch gap at the grade and the minimum 4-inch gap above the grade because one inch above the grade is considered as above grade.

Westinghouse Response:

There is no inconsistency. Grade is defined as building elevation 100'. The minimum gap is 2 inches below elevation 100' and 4 inches above elevation 100'. One inch above grade the minimum gap is 4 inches.

Reference:

None

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR57-007
Revision: 0

Question:

Section 2.2.2.1 (page 16) states "Interior shear walls, however, are discontinuous in both vertical and horizontal directions." The staff's understanding of walls are always standing in the vertical direction and does not understand your statement on shear walls in the horizontal directions. Therefore, the staff requests that you clarify the above statement.

Westinghouse Response:

The interior shear walls have openings ranging from single door openings to a complete bay between floor elevations. The wall on column line 7.3 is a critical section and is shown in DCD Figure 3H.5-4. This wall has a large opening above grade. The term "discontinuous in both vertical and horizontal directions" was intended to describe the effect of these large openings.

Reference:

None

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR57-008
Revision: 0

Question:

On the composite floor slab design, Section 2.2.2.2 (page 18) states "Shear connectors are also designed." The staff is unclear which code or standard the shear connectors are designed against, and, therefore, requests that you provide the code or standard.

Westinghouse Response:

Shear connectors are designed to American Institute of Steel Construction (AISC), Specification for the Design, Fabrication and Erection of Steel Safety Related Structures for Nuclear Facilities, AISC-N690-1994.

Reference:

None

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR57-009
Revision: 0

Question:

Under Section 2.2.2.2 (page 18), composite structures, it is stated "The global in-plane and out-of-plane forces are obtained from the equivalent static analysis of the 3D finite element model of the auxiliary and shield buildings." The staff understands the term "static analysis of the 3D finite element model", but does not understand what the "equivalent static analysis of the 3D finite element model" is, and, therefore, requests that you describe the analysis method.

Westinghouse Response:

The 3D finite element model used in the design analyses of the auxiliary and shield buildings is described in DCD Rev 15 subsection 3.7.2, item # 6. The equivalent static accelerations used in the seismic analysis described in DCD Rev 15 were the maximum absolute accelerations obtained from the time history analyses of the nuclear island stick model.

Reference 1 describes the use of shell models in updated nuclear island seismic analyses for both hard rock and soil sites. The equivalent static seismic loads used in the updated analyses of the building are described in section 6 of Reference 1.

The descriptions of the seismic analyses were reformatted in DCD Rev 16. The 3D finite element model used in the design analyses of the auxiliary and shield building is described in DCD Rev 16, Appendix 3G, subsection 3G.2.3.

Reference:

1. APP-GW-S2R-010, Revision 0, Extension of Nuclear Island Seismic Analyses to Soil Sites, June, 2006.

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR57-010
Revision: 0

Question:

Section 2.2.2.5 (page 20) states "The structural wall modules are anchored to the concrete base by reinforcing steel dowels or other types of connections embedded in the reinforced concrete below." The staff did not see an anchorage design criteria or a sample detail drawing about the anchorage of the wall modules to the concrete floor or foundation below. Based on your description, the staff assumes that the exterior ½" thick steel walls are not anchored to the concrete, but the vertical reinforcing steel dowels, as defined in ACI codes, act as an anchorage for the wall modules to the concrete floor slab or foundation below. Since the steel walls, not the vertical reinforcing steel bars, provide the primary tensile force to form a resistant bending moment in a shear wall, the tensile force from steel walls is first transferred through horizontal metal studs to concrete that bonded to the studs and then from the concrete through bond to the vertical steel reinforcing dowels into the concrete floor slab or foundation below. The staff questions the effectiveness of such a complicated force transfer mechanism, and, therefore, requests that you provide a criteria for the design of the anchorage and a sample detail drawing for the anchorage.

Westinghouse Response:

Anchorage of the structural module walls to the concrete base is described in DCD subsection 3.8.3.1.3. Typical details are shown in Sheet 2 of Figure 3.8.3-8. There are no changes in this design from that previously certified by the NRC for AP600 and for the hard rock design of AP1000.

Reference:

None

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR57-011
Revision: 0

Question:

Section 2.2.4.1 (page 23) states "The analyses used the detailed model of the nuclear island (NI05)." The report does not describe what NI05 stands for, whether it is a computer code or a mathematical model or something else, and, therefore, the staff requests that you clarify what it is.

Westinghouse Response:

NI05 is the designation for the 3D finite element model used in the design analyses of the auxiliary and shield building. It is described in DCD Rev 15 subsection 3.7.2, item # 6. The descriptions of the seismic analyses were reformatted in DCD Rev 16. The NI05 model is described in DCD Rev 16, Appendix 3G, subsection 3G.2.3.

Reference:

None

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR57-012
Revision: 0

Question:

The staff performed a comparison for a few sample detail drawings between Technical Report 57 and corresponding drawings in the Design Control Document (DCD) and found that the area of steel reinforcing bars in Technical Report 57 is substantially less than that in the DCD. For example, there are only two layers of #11 @ 6" (6.24 square inch per linear foot) near the inside face of the wall in Fig. 2.2-9 (page 49) vs. four layers of #11 @ 4" (18.72 square inch per linear foot) in DCD. In another example, the horizontal steel reinforcing bars are #6 @12" (0.44 square inch per linear foot) at both top and bottom of the slab in Fig. 2.2-11 (page 52) vs. #11 @ 12" (1.56 square inch per linear foot) at both top and bottom of the slab in the DCD. Since the design in Technical Report 57 envelopes all soil sites including the rock site and the design in DCD, and only includes the rock site, the area of steel in Technical Report 57 drawings should always be greater than or equal to that in DCD. Therefore, the staff requests that you resolve this apparent discrepancy.

Westinghouse Response:

The reinforcement design presented in the Technical Report was a result of seismic analyses for both hard rock and soil sites and an extensive constructibility review. This review also included detailed engineering review of the results of the finite element analyses. In some cases the reinforcement shown in the DCD for hard rock sites was excessive for the demand and the quantity was reduced to improve constructibility.

The substantial apparent reduction in Figure 2.2-9 is due to a change in the reinforcement configuration. In the new design #14 hoop reinforcement is provided around the main steam penetration in addition to the horizontal and vertical bars. In the previous design all reinforcement was provided as vertical and horizontal bars.

The example in Figure 2.2-11 is a composite concrete slab on steel beams. The previous reinforcement was sized very conservatively based on the width of the flange of the steel beam. This was corrected to use the effective width of the concrete slab, thus reducing the required reinforcement.

The design calculations for each of the critical sections show the reinforcement provided satisfies the demand for both hard rock and soil sites. These design calculations are available for audit.

Reference:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None