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Your ref: Docket No. 52-006
Our ref: DCP/NRC2113

April 3, 2008

Subject: AP1000 COL Response to Request for Additional Information (TR 85)

Westinghouse is submitting a response to the NRC request for additional information (RAI) on AP1000 Standard Combined License Technical Report (TR) 85, APP-GW-GLR-044, Nuclear Island Basemat and Foundation. This RAI response is submitted in support of the AP1000 Design Certification Amendment Application (Docket No. 52-006). The information included in the response is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification and the AP1000 Design Certification Amendment Application.

A response is provided for RAI-TR85-SEB1-40 as sent in an email from Dave Jaffe to Sam Adams dated August 9, 2007. This response completes all requests received to date for TR 85. Responses to RAI-TR85-SEB1-05, -07, -17, -19, -32, and -36 were submitted under Westinghouse letter DCP/NRC2112 dated March 31, 2008. Responses to RAI-TR85-SEB1-03, -13, -27, and -38 were submitted under Westinghouse letter DCP/NRC1999 dated September 18, 2002. Responses to RAI-TR85-SEB1-01, -09, and -16 were submitted under Westinghouse letter DCP/NRC2002 dated September 21, 2007. Responses to RAI-TR85-SEB1-02 and -21 were submitted under Westinghouse letter DCP/NRC2006 dated September 28, 2007. Responses to RAI-TR85-SEB1-12, -14, -18, -20, -26, -31, and -33 were submitted under Westinghouse letter DCP/NRC2022 dated October 19, 2007. Responses to RAI-TR85-SEB1-10, -11, -15, -24, -25, -28, -29, -30, -34, -35, -37, and -39 were submitted under Westinghouse letter DCP/NRC2025 dated October 19, 2007. Responses for RAI-TR85-SEB1-04 -06, -08, -22, - and -23 and a revised response for RAI-TR85-SEB1-34 were submitted under Westinghouse letter DCP/NRC2050 dated December 5, 2007.

Pursuant to 10 CFR 50.30(b), the response to the request for additional information on SRP Section 5.3.1, is submitted as Enclosure 1 under the attached Oath of Affirmation.

Questions or requests for additional information related to the content and preparation of this response 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.

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D063
NRO

Very truly yours,

Robert Sisk, Manager
Licensing and Customer Interface
Regulatory Affairs and Standardization

/Attachment

1. "Oath of Affirmation," dated April 3, 2008

/Enclosure

1. Response to Request for Additional Information on Technical Report 85

cc:	M. Miernicki	-	U.S. NRC	1E	1A
	E. McKenna	-	U.S. NRC	1E	1A
	P. Ray	-	TVA	1E	1A
	P. Hastings	-	Duke Power	1E	1A
	R. Kitchen	-	Progress Energy	1E	1A
	A. Monroe	-	SCANA	1E	1A
	J. Wilkinson	-	Florida Power & Light	1E	1A
	C. Pierce	-	Southern Company	1E	1A
	E. Schmiech	-	Westinghouse	1E	1A
	G. Zinke	-	NuStart/Entergy	1E	1A
	R. Grumbir	-	NuStart	1E	1A
	E. Schmiech	-	Westinghouse	1E	1A
	B. LaPay	-	Westinghouse	1E	1A

ATTACHMENT 1

"Oath of Affirmation"

ATTACHMENT 1

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of:	)
AP1000 Design Certification Amendment Application	)
NRC Docket Number 52-006	)

APPLICATION FOR REVIEW OF
"AP1000 GENERAL INFORMATION"
FOR DESIGN CERTIFICATION AMENDMENT APPLICATION REVIEW

W. E. Cummins, being duly sworn, states that he is Vice President, Regulatory Affairs & Standardization, 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.

W. E. Cummins
Vice President
Regulatory Affairs & Standardization

Subscribed and sworn to
before me this ~~4th~~ 3rd day
of April 2008.

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Patricia S. Aston, Notary Public
Murrysville Boro, Westmoreland County
My Commission Expires July 11, 2011
Member, Pennsylvania Association of Notaries

Patricia S. Aston
Notary Public

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ENCLOSURE 1

Response to Request for Additional Information on Technical Report 85

RAI Response Number: RAI-TR85-SEB1-40
Revision: 0

Question:

Regarding the dynamic stability of the NI structures, Westinghouse is requested to provide additional information to demonstrate how the sliding criteria assumed during the API000 SSI analyses (sliding friction value of 0.7) are in fact to be attained from the interface between the basemat and mudmat and from the interface between the top portion of the mudmat and the lower portion of the mudmat through the waterproofing membrane.

Westinghouse Response:

Alternate approaches for waterproofing systems are described in subsection 3.4.1.1.1.1. For each of the waterproofing system selected for a site a test to demonstrate that the interface between the top portion of the mudmat and the lower portion of the mudmat has a sliding coefficient of friction of at least 0.7 will be performed. The Combined License applicant will describe the excavation and backfill methods, along with the description of the waterproofing system selected, and reference the test report that documents that the minimum coefficient of friction of 0.7 is achieved. If there are site conditions that could affect the sliding coefficient of friction, separate from the waterproof membrane, a lower coefficient may be justified by performing site specific analyses and demonstrating sliding stability.

DCD subsections 2.5.4.1, 2.5.4.6 and 3.4.1.1 are revised as shown below to clarify the requirements for the waterproofing membrane and the mudmat.

DCD Revision:

2.5.4.1 Excavation

Excavation for the nuclear island structures below grade may use either a sloping excavation or a vertical face as described in subsequent paragraphs. If backfill is to be placed adjacent to the exterior walls of the nuclear island, the Combined License applicant will provide information on the properties of backfill and its compaction requirements as described in subsection 2.5.4.6.3 and will evaluate its properties against those used in the seismic analyses described in subsection 3.7.2.

For the vertical face alternative, excavation in soil for the nuclear island structures below grade will establish a vertical face with lateral support of the adjoining undisturbed soil or rock. This vertical face will be covered by a waterproof membrane as described in subsection 3.4.1.1.1.1 and is used as the outside form for the exterior walls below grade of the nuclear island. ~~One a~~Alternative methods include ~~is to use a~~ soil nailing ~~method~~and mechanically stabilized earth walls.

2.5.4.1.1 Vertical face using soil nails

Soil nailing is a method of retaining earth in-situ. As the nuclear island excavation progresses vertically downward, holes are drilled horizontally into the adjoining undisturbed soil, a metal rod is inserted into the hole, and grout is pumped into each hole to fill the hole and to anchor the "nail" rod.

As each increment of the nuclear island excavation is completed, nominal eight to ten inch diameter holes are drilled horizontally through the vertical face of the excavation into adjacent undisturbed soil. These "nail" holes, spaced horizontally and vertically on five to six feet centers, are drilled slightly downward to the horizontal. A "nail", normally a metal bar/rod, is center located for the full length of the hole. The nominal length of soil nails is 60 percent to 70 percent of the wall height, depending upon soil conditions. The hole is filled with grout to anchor the rod to the soil. A metal face plate is installed on the exposed end of the rod at the excavated wall vertical surface. Welded wire mesh is hung on the wall surface for wall reinforcement and secured to the soil nail face plates for anchorage. A 4,000 psi to 5,000 psi non-expansive pea gravel shotcrete mix is blown onto the wire mesh to form a nominal four to six inch thick soil retaining wall. Installation of the soil retaining wall closely follows the progress of the excavation and is from the top down, with each wire mesh-reinforced, shotcreted wall section being supported by the soil "nails" and the preceding elevations of soil nailed wall placements. ~~The shotcrete contains a crystalline waterproofing material as described in subsection 3.4.1.1.1.~~

Soil nailing as a method of soil retention has been successfully used on excavations up to 55 feet deep on projects in the U.S. Soils have been retained for up to 90 feet in Europe. The state of California CALTRANS uses soil nailing extensively for excavations and soil retention installations. Soil nailing design and installation has a successful history of application which is evidenced by its excellent safety record.

The soil nailing method produces a vertical surface down to the bottom of the excavation and is used as the outside forms for the exterior walls below grade of the nuclear island. Concrete is placed directly against the vertical concrete surface of the excavation.

~~For excavation in rock and for~~ For methods of soil retention other than soil nailing, such as for excavation in rock, four to six inches of shotcrete are blown on to the vertical surface. The concrete for the exterior walls is placed against the shotcrete. ~~The shotcrete contains a crystalline waterproofing material as described in subsection 3.4.1.1.1.~~

2.5.4.1.2 Vertical face using mechanically stabilized earth walls

Mechanically Stabilized Earth Walls (MSE walls) are flexible retaining wall systems that employ strip, grid, or sheet type of tensile reinforcements in the soil mass and a discrete modular pre-cast concrete which is vertical. MSE walls function like and are generally more economical than conventional retaining walls. The tensile strength of the reinforcements and the slip at the interface of the reinforcement and the soil provide great internal stability to MSE walls. These walls may be used where the side soils have to be removed or the grade elevation needs to be raised. The walls and backfill are placed prior to construction of the nuclear island.

2.5.4.1.3 Mudmat

The mudmat provides a working surface prior to initiating the placement of reinforcement for the foundation mat structural concrete.

- Lower Mud Mat – (minimum 6 inches thick) of un-reinforced concrete, with a minimum compressive strength of 2,500 psi, as discussed in subsection 2.5.4.6.3. The Lower Mud Mat will be used as the final dental concrete layer on the underlying foundation media.

- Upper Mud Mat (minimum 6 inches thick) of thick high paste un-reinforced concrete with a minimum compressive strength of 2,500 psi. This Upper Mud Mat will support the chairs that in turn support the reinforcing steel.

The waterproofing system alternatives are described in subsection 3.4.1.1.1.1.

2.5.4.6.3 Excavation and Backfill – Information concerning the extent (horizontal and vertical) of seismic Category I excavations, fills, and slopes, if any will be addressed. The sources, quantities, and static and dynamic engineering properties of borrow materials will be described in the site-specific application. The compaction requirements, results of field compaction tests, and fill material properties (such as moisture content, density, permeability, compressibility, and gradation) will also be provided. Information will be provided concerning the specific soil retention system, for example, the soil nailing system or mechanically stabilized earth walls, including the length and size of the soil nails or tension reinforcement, which is based on actual soil conditions and applied construction surcharge loads. If backfill is to be placed adjacent to the exterior walls of the nuclear island, information will be provided concerning compaction of the backfill and any additional loads on the exterior walls of the nuclear island. ~~Information will also be provided on the waterproofing system along the vertical face and the mudmat. Information will be provided on the mudmat to demonstrate its ability to resist the structural bearing and shear loads described in subsection 2.5.4.2. The maximum bearing pressure is 240 psi. The mudmat may be designed as structural plain concrete in accordance with ACI 318-02 (Reference 1). This requires the specified concrete compressive strength to be no less than 2500 psi. The commentary states this requirement is imposed in the code because "lean concrete mixtures may not produce adequately homogeneous material or well formed surfaces." If the Combined License applicant proposes to use a concrete with strength less than 2500 psi, the applicant must demonstrate that the mix will result in an acceptable homogeneous material.~~

3.4.1.1.1 Protection from External Flooding

The probable maximum flood for the AP1000 has been established at less than plant elevation 100′ as discussed previously in Section 2.4. The probable maximum flood results from site specific events, such as river flooding, upstream dam failure, or other natural causes.

Flooding does not occur from the probable maximum precipitation. The roofs do not have internal roof drains. The annex, radwaste, and diesel/generator buildings have parapets with large weir openings to drain to scuppers/drains to preclude accumulation of water on the roofs. The roofs are sloped such that rainfall is directed towards gutters located along the edges of the roofs. Therefore, ponding of water on the roofs is precluded. Water from roof drains and/or scuppers, as well as runoff from the plant site and adjacent areas, is conveyed to catch basins, underground pipes, or directly to open ditches by sloping the tributary surface area. The site is graded to offer protection to the seismic Category I structures.

The high ground water table interface is at two feet below the grade elevation, as discussed in Section 2.4.

The components that may be potential sources for external flooding are nonsafety-related, nonseismic tanks as shown in DCD Figure 1.2-2:

- Fire water tanks as described in subsection 9.5.1. These two tanks have volumes of approximately 325,000 and 400,000 gallons, and are located at the north end of the turbine building.
- Condensate storage tank as described in subsection 9.2.4. This tank has a volume of approximately 485,000 gallons, and is located at the west side of the turbine building. Water will drain from the tank away from the turbine and auxiliary buildings due to site grading.
- Demineralized water tank as described in subsection 9.2.4. This tank has a volume of approximately 100,000 gallons and is located adjacent to the annex building at elevation 107′-2″. Water will drain from the tank away from the annex building to elevation 100′-0″. Nearby doors lead to areas in the annex building which do not contain safety-related components or systems.
- Boric acid storage tank as described in subsection 9.3.6. This tank has a volume of approximately 70,000 gallons and is located adjacent to the demineralized water storage tank.
- Diesel fuel oil tanks as described in subsection 9.5.4. These two tanks have volumes of approximately 100,000 gallons each. They are located remote from safety-related structures and are provided with dikes to retain leaks and spills.
- Passive containment cooling ancillary water storage tank as described in subsection 6.2.2.3. This tank has a volume of 780,000 gallons and is located at

the west side of the auxiliary building. Water will drain from the tank away from the auxiliary building due to site grading.

In addition, failure of the cooling tower or the service water or circulating water piping under the yard could result in a potential flood source. However, these potential sources are located far from safety-related structures and the consequences of a failure in the yard would be enveloped by the analysis described in DCD subsection 10.4.5.

For the AP1000, the 100'-0" building floor elevations are slightly above the grade elevation. In addition, the slope of the yard grade directs water away from the buildings. Because the probable maximum flood for AP1000 is less than grade elevation, the exterior doors are not required to be watertight for protection from external flooding.

Process piping penetrations through the exterior walls of the nuclear island below grade are embedded in the wall or are welded to a steel sleeve embedded in the wall. There are no access openings or tunnels penetrating the exterior walls of the nuclear island below grade.

The reinforced concrete seismic Category I structures, incorporating the waterproofing and sealing features described above and in subsection 3.4.1.1.1.1, provide hardened protection for safety-related structures, systems, and components as defined in Regulatory Guide 1.59.

3.4.1.1.1.1 Waterproofing

A waterproof membrane or waterproofing system for the Seismic Category I structures below grade will be installed as an architectural aide to limit the infiltration of subsurface water.The seismic Category I structures below grade are protected against flooding by a water barrier consisting of waterstops and a waterproofing system. Several alternate approaches are described as follows:

HDPE Double-Sided Textured Waterproof Membrane

Figures 3.4-1 and 3.4-2 show the application of this waterproofing approach for MSE wall and for a step back configuration.

Cementitious Crystalline Waterproofing Additive

~~The~~ This waterproofing system ~~is provided by~~consists of the introduction of a cementitious crystalline waterproofing additive to the nailed soil retention wall shotcrete or to the shotcrete applied to the rock surface as described in subsection 2.5.1. For the horizontal surface under the basemat, the cementitious crystalline waterproofing additive is added to the mud mat. The waterproofing additive is a unique chemical treatment added to the concrete at the time of batching and consists of portland cement, very fine silica sand, and various active proprietary chemicals. The active chemicals react with the moisture in fresh concrete, and the byproducts of cement hydration cause a catalytic reaction generating a nonsoluble crystalline formation of dendritic fibers throughout the pores and capillary tracts of the concrete. The concrete is thus sealed against penetration of water or liquid as shown on Figure 3.4-3. ~~Figures 3.4-1 and 3.4-2 show the application of the alternate waterproofing approaches for MSE wall and for step back configurations.~~

Sprayed-On Waterproofing Membrane

This method may be used for either soil sites, in conjunction with a mechanically-stabilized earth (MSE) wall, or for rock sites, where an open excavation may be used. Figure 3.4-4 shows the typical installation using MSE walls, with the sprayed-on waterproofing membrane placed on the MSE wall panels and between the two layers of the mudmat. Where the vertical face of excavation is used as a form for the exterior walls, the waterproof membrane is installed on the vertical face of the excavation prior to placement of concrete in the exterior walls.

The waterproof function of the membrane is not safety related; however, the membrane between the mudmats must transfer horizontal shear forces due to seismic (SSE) loading. This function is Seismic Category I. The specified static coefficient of friction between horizontal membrane and concrete is ≥ 0.7. The waterproof membrane shall have physical properties, including surface and texture, to achieve the required static coefficient of friction. Primer, geotextile, or aggregate scatter may be added as required.

~~Process piping penetrations through the exterior walls of the nuclear island below grade are embedded in the wall or are welded to a steel sleeve embedded in the wall. There are no access openings or tunnels penetrating the exterior walls of the nuclear island below grade.~~

~~The reinforced concrete seismic Category I structures, incorporating the waterproofing and sealing features described above, provide hardened protection for safety related structures, systems, and components as defined in Regulatory Guide 1.59.~~

~~Further detail concerning the excavated waterproofing design can be found in subsection 2.5.4.1.~~

PRA Revision: None

Technical Report (TR) Revision: None

Add Figure 3.4-4 following Figure 3.4-3

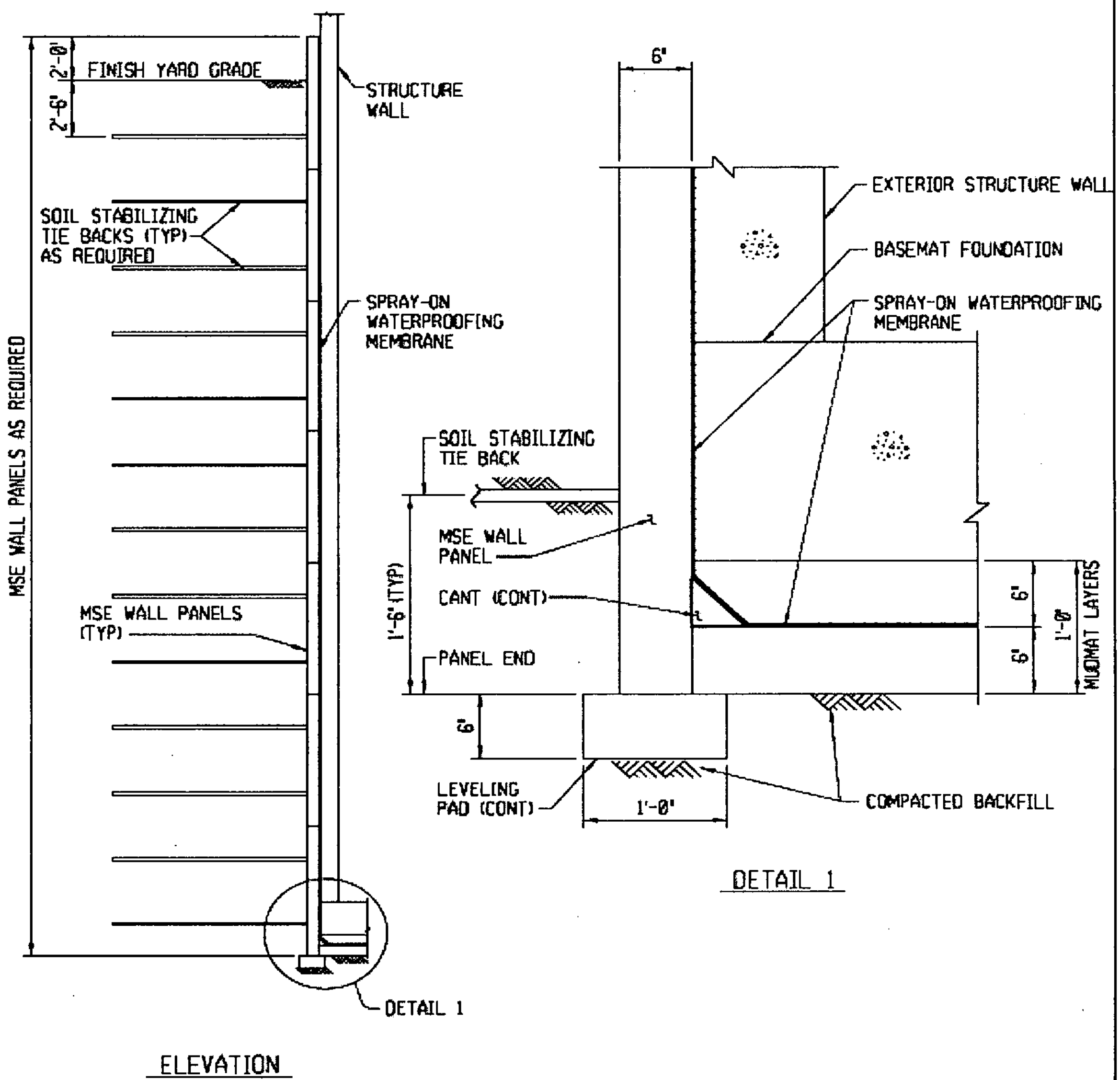

Figure 3.4-4

Membrane corner detail at basemat and exterior wall