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Your ref: Docket No. 52-006
Our ref: DCP_NRC_002933

June 30, 2010

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

Westinghouse is submitting responses to NRC requests for additional information (RAI) on Technical Report No. 85. This RAI response is submitted in support of the AP1000 Design Certification Amendment Application (Docket No. 52-006). The information included in this response is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification and the AP1000 Design Certification Amendment Application.

Enclosure 1 provides the response for the following RAI(s):

RAI-TR85-SEB1-35 R3

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.

Very truly yours,

for/ John DeBlasio

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

/Enclosure

1. Response to Request for Additional Information on Technical Report No. 85

D063
NRO

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ENCLOSURE 1

Response to Request for Additional Information on Technical Report No. 85

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR85-SEB1-35
Revision: 3

Question:

Section 2.9 indicates that the sliding resistance is based on the friction force developed between the basemat and the foundation using a coefficient of friction of 0.70. This is based on soil having a friction angle of 35 degrees. The Combined License will provide the site specific angle of internal friction for the soil below the foundation. Based on this information, address the following items:

a. Since DCD Section 3.8.5.5.3 indicates that the sliding factor of safety is based on the shearing or sliding resistance at the base of the basemat and the soil passive resistance, the reliance on both of these resisting forces need to be based on a consistent set of assumptions. Since the passive resistance of soil requires sufficient displacement to mobilize the full passive resisting forces at the foundation walls and side of the basemat, provide the technical basis for using a coefficient of friction of 0.70 for the sliding resistance beneath the basemat which is considered to be applicable to the static (not sliding or dynamic) friction resistance of soil.

b. What are the numerical contributions of the sliding frictional resistance and the soil passive pressure resistance for the NS and EW directions?

c. Has Westinghouse confirmed that using a minimum angle of internal friction of 35 degrees is achievable for most soil sites?

d. DCD Tier 1, Section 3.3, states that "Exterior walls and the basemat of the NI have a water barrier up to site grade level." Describe this water barrier and how does this affect the assumed coefficient of friction between the basemat and the soil? Is it high enough to ensure that soil friction would govern?

Additional Request (Revision 1):

Based on the review of the RAI response provided in Westinghouse letter dated 10/19/07, the following items need to be addressed:

a. The RAI response did not address the requested information in the RAI. In calculating the factor of safety for the basemat against sliding during earthquakes, Westinghouse combines the friction force at the bottom of the basemat and the maximum soil passive pressure resistance on the foundation walls and basemat vertical edge in order to obtain the total resistant force. Westinghouse is request to explain the basis for using the static coefficient of friction of 0.70 (which implies essentially no sliding of the basemat will occur) at the same time as the maximum soil passive resistance (which would require sufficient horizontal displacement of the foundation to mobilize the maximum passive resisting forces at the foundation walls and the side of the basemat). In other words, if the maximum soil passive pressure is relied upon to resist sliding, then the full static coefficient of friction cannot be utilized.

b. From the values given for the sliding resistance for the soil passive pressure, it appears that the soil passive resistance is an important contribution to the total sliding resistance of the foundation. Therefore, Westinghouse is requested to (1) describe how the maximum soil passive pressure resistance is calculated and the passive pressure distribution in the vertical direction and (2) describe whether saturated and/or unsaturated soil conditions were considered in your analysis and indicate which case governs.

c. The RAI response indicates that “soils can achieve a friction angle of 35 degrees which is addressed and answered in Question a of TR-85 RAI-35.” However, the response to Question a of TR-85 RAI-35 did not demonstrate that a friction angle of 35 degrees can be achieved for a range of common soil profiles expected at various sites. The RAI response also indicates that “the basis being provided in Table RAI-TR85-1, which shows an internal friction angle of 35 degrees being included in the medium soil type (sand).” However the staff cannot identify what Table RAI-TR85-1 this statement is referring to. If the actual reference was intended to be Table RAI-TR85-37-1, then classifying soil as “medium soil type (sand)” by itself does not assure that a soil friction angle of 35 degrees can be achieved. Finally, the RAI response indicates that “Dense soil types and hard rock sites will also meet the minimum soil friction angle of 35 degrees, often proven to have a much higher friction angle.” While this may be the case, the staff believes that demonstrating the required soil friction angle should be based on actual testing of the soil, and therefore, the staff is requesting that Westinghouse identify what type of testing will be required to be implemented by the COL applicants to demonstrate that the coefficient of friction for the soil material beneath the foundation at the site meets the required coefficient of friction used in the design. The response to the above items, should clearly demonstrate that the soil friction angle (and thereby the corresponding coefficient of friction) used in design can be achieved for a reasonable range of soil conditions expected to exist at plant sites.

d. The RAI response describes the types of waterproofing membranes that should be placed immediately beneath the upper mud mat, and on top of the lower mud mat or leveling concrete, which has been finished in accordance with ACI 301, Section 5.3.4.2.d. The staff requests that Westinghouse provide technical information which demonstrates that, for the types of waterproofing material proposed in the RAI response, the membranes can (1) achieve a coefficient of friction used in design (at this time specified as 0.70), (2) have the strength, with margin, to withstand the shear and compression loads from the NI, and (3) do not degrade over the design life of the plant under similar loading and environmental conditions in the mud mat concrete. In addition, since this waterproofing membrane is not soil, explain why the RAI response refers to a requirement for this material in terms of a minimum friction angle rather than a coefficient of friction. Describe the location in DCD Tier 1 and DCD Tier 2 for the requirements for the waterproofing membrane where the coefficient of friction and strength are specified.

Additional Request (Revision 2):

To address item b of the RAI response, Westinghouse selected Case number 15, which corresponds to dense sand, for the purpose of calculating the passive pressure. For design purposes of the foundation walls, this case can be considered appropriate. However, for calculating the appropriate value of passive resistance for use in the sliding stability evaluation, the use of the somewhat high value of passive resistance is considered to be unconservative. This becomes important since the response to RAI TR85-SEB1-37 implies that the soil friction angle of the backfill material could be as low as 32 degrees, based on a blow count as low as 10 blows per foot for the soil. Therefore, Westinghouse is requested to explain why, for sliding stability evaluation, a high value was used for the passive resistance of the backfill rather than a lower bound value such as Case 21. In addition, explain what specific passive pressure load(s) were used in the design of the foundation walls and how they compare to the Case number 15 value.

To address item d of the RAI response, Westinghouse indicated that they have reduced the requirement for the coefficient of friction of the waterproofing membrane to 0.55, which is the revised value utilized in the sliding evaluation. This requirement will be specified in DCD Section 3.4.1.1.1.1. However, the proposed mark-up of Section 3.4.1.1.1.1 in DCD Tier 2 does not identify this as a requirement to be satisfied by the COL applicant. Instead it indicates that "The specific static coefficient of friction between horizontal membrane and concrete is 0.55"." Westinghouse is requested to identify where in Section 2 of the DCD, a clear statement is made that this is a requirement to be demonstrated by the COL applicant by testing.

For waterproofing the foundations of the NI, several options are described in DCD Tier 2, Section 3.4.1.1.1.1. The options rely on either a textured waterproofing membrane or the use of crystalline material as an additive or sprayed-on membrane to the concrete. For the option which utilizes the textured waterproofing membrane discussed in DCD Section 3.4.1.1.1.1, more detailed information should be provided such as the type of waterproofing material, minimum thickness, and whether the provisions of an industry standard such as ACI 515.1R-79 (revised 1985) will be used.

For the option of the crystalline material for waterproofing the foundation, this appears to be a new approach to be used in the foundations of nuclear power plants with are deeply embedded, have large bearing pressures and shear forces, and high ground water levels. Therefore, Westinghouse should provide technical information that clearly demonstrates that the use of the crystalline material as an additive or sprayed-on membrane to the concrete is effective under similar loading conditions and groundwater pressure levels of the AP1000 design. Provide information that demonstrates the largest crack size in concrete (under this head of water) that the crystalline material is effective. Explain what provisions have been included in the design of the foundation to ensure that the expected cracks will not exceed these limit(s). Also, explain why sprayed-on crystalline material is presented as an option when it is clear that utilizing crystalline material as an additive within the concrete mix, and then supplemented by surface patching with crystalline wherever cracks may develop (subsequent to curing of the mudmat), would be much more effective.

Additional Request (Revision 3):

The staff reviewed the response provided in Westinghouse letter dated July 21, 2009 and found that insufficient information was provided. Westinghouse is requested to address the following items:

1) The proposed wording in the markup to DCD subsection 3.4.1.1.1.1 (Waterproofing) is not clear. Clarify why the waterproofing system is limited to the "exterior walls" (and not the basemat/mudmat too) and the meaning of the statement "with all unbonded concrete surfaces." Westinghouse is requested to clarify that the COL applicant will demonstrate that the coefficient of friction equal to or greater than 0.55 is achieved for the use of the horizontal waterproofing membrane.

2) Since Westinghouse did not provide the information described in the 3rd paragraph of the previous RAI, related to textured waterproofing membrane. The staff requested more detailed information such as the type of waterproofing material, minimum thickness, and to identify the provisions of an industry standard such as ACI 515.1R-79 (revised 1985) for the waterproofing membrane. Westinghouse is requested to submit this information.

3) Although DCD Figure 3.4-3 and text corresponding to sprayed-on crystalline material were removed, DCD Figure 3.4-4 still refers to "sprayed-on waterproofing membrane." Therefore, the same information requested in the 4th paragraph of the previous follow-up RAI should be provided for this sprayed-on membrane. This information should clearly identify the type of material to be used, technical information that clearly demonstrates that the use of the crystalline material as an additive or sprayed-on membrane to the concrete is effective under similar loading conditions and groundwater pressure levels of the AP1000 design. Provide information that demonstrates the largest crack size in concrete (under this head of water) that the crystalline material is effective. Explain what provisions have been included in the design of the foundation to ensure that the expected cracks will not exceed these limit(s).

Westinghouse Response:

a. Using the formula tan(δ) = φ (tan(35°) = 0.70), Terzaghi, Karl, and Ralph B. Peck, Soil Mechanics in Engineering Practice, the technical basis for using a coefficient of friction of

0.70 for the sliding resistance beneath the basemat is justified. Furthermore the coefficient of wall friction, the value of angle δ between concrete and soil, usually is taken as equal to the angle of internal friction φ of the soil medium, with the coefficient of friction being 0.70 for sound rock sites.

b. The sliding frictional resistance is 142,373 kips, with numerical contributions from the plant deadweight = 281,223 kips, buoyant force = 76,003 kips and vertical wind load = 1,830 kips. The soil passive pressure resistances for the NS and EW directions are 43,456 kips and 69,098 kips respectively.

c. The soils can achieve a friction angle of 35 degrees which is addressed and answered in Question A of TR-85 RAI35. The basis being provided in Table RAI-TR85-1, which shows an internal friction angle of 35 degrees being included in the medium soil type (sand). Dense soil types and hard rock sites will also meet the minimum soil friction angle of 35 degrees, often proven to have a much higher friction angle.

d. A Waterproofing Membrane should be placed immediately beneath the upper Mud Mat, and on top of the lower Mud Mat or leveling concrete, which has been finished in accordance with ACI 301, Section 5.3.4.2.d. This bottom (horizontally planar) geosynthetic membrane should be textured on both sides to maintain minimum sliding coefficient requirements. For plasticized polyvinyl chloride (PVC) membranes, a geocomposite should be formed by applying a geotextile to both sides of the PVC geomembrane, such as CARPI USA's "SIBELON 2CNT" liner. For high-density polyethylene (HDPE) membranes, the geosynthetic should be spiked or studded on both sides, such as AGRU-America's "Super Gripnet Liner." As the membrane transitions to the walls of the Nuclear Island (vertically planar), a smooth geosynthetic liner may be used since sliding is not a design concern along these vertical planes.

   A Waterproofing Membrane is to be selected such that for horizontal surfaces, the minimum friction angle achieved at any interface is at least 35 degrees, yielding a friction coefficient of at least 0.7, to be consistent with AP1000 DCD requirements. In order to provide the durability required for construction and implementation, as well as the flexibility for a manageable installation, it has been recommended from multiple vendors that the Waterproofing Membrane have a thickness of 80 mils, both for HDPE or PVC.

Westinghouse Response (Revision 1):

a. As noted in response to RAI-TR85-SEB1-10, Revision 1, the full passive pressure is not being used, only a portion. The static coefficient of friction has been lowered to 0.55. The maximum deflection of the nuclear island needed to develop the needed passive pressures are less than 0.15 inch for hard rock, less than or equal to 0.5 inch for upper bound soft to medium (UBSM) and soft to medium (SM) soil conditions. The other soil conditions have smaller deflection requirements than the UBSM and SM cases. Therefore, the maximum soil passive pressure is not relied upon to resist sliding.

b. (1) The method used to calculate the passive pressure is given below for the Nuclear Island walls below grade. There is no passive soil pressure resistance component in the vertical direction. Resistance in the vertical direction is supplied by the soil subgrade bearing capacity.

The coefficient of passive pressure (K_P) is determined from the following relationship:

$K_P = \text{Tan}^2(45^\circ + \phi / 2)$ (Rankine Method with no wall friction and horizontal ground surface)
Where, ϕ = angle of internal friction of the granular backfill.

The passive earth pressure is calculated by the following formula:

$P_P = K_P \gamma h$

Where,
h = depth below grade (100' 0")
Above water table: $\gamma = \gamma_s$ = Saturated unit weight of granular back fill above water table.
Below water table: $\gamma = \gamma_s - \gamma_w$

Recognizing that the ground water table is at 98 feet plant elevation, the formula for the passive pressure at the base, 60' 6" can be written as follows:

$P_P = [\text{Tan}^2(45^\circ + \phi / 2)] \times [(100 - 98) \times \gamma_s + (98 - 60.5) (\gamma_s - \gamma_w)]$

(2) The passive earth pressures are defined for 21 soil cases in Table RAI-TR85-SEB1-35-1 for soil types of rock, sand and gravel, and sand. As seen from this table, the highest loads are obtained for the rock cases. However, it is unrealistic to consider the properties for in-place rock to be similar to those of for the backfill material. A more representative soil is between dense and medium sand (case 15), which is the same as used for the AP600 plant.

The general geotechnical model for the site contains a static ground water level 2 feet below the horizontal ground surface. The horizontal ground surface is assumed at elevation 100 feet and the static ground water level is at elevation 98 feet. A saturated unit weight density of the soil above and below the ground water level has been assigned a value of 150 pounds per cubic foot (pcf) for the Case 15 granular (dense sand) soil model.

Table RAI-TR85-SEB1-035-1 – Passive Pressure, El. 60' 6"

Type of Soil		Case	γ_{sub} #/ft^3	γ_{sat} #/ft^3	ϕ deg	P_P psf
Rock	Hard Rock	1	115	175	46	28563
	Rock	2	100	160	46	24933
	Soft Rock	3	100	160	52	34328
	Soft Rock	4	100	160	43	21527
	Soft Rock	5	85	145	52	29331
	Soft Rock	6	85	145	43	18393
Sand & Gravel		7	80	140	36	12634
		8	80	140	32	10675
Sands	Very Dense	9	100	160	46	24933
		10	100	160	41	19597
		11	70	130	46	17674
		12	70	130	41	13891
	Dense	13	88	150	41	17334
		14	88	150	36	13867
		15	87.6	150	35	13229
		16	65	110	36	10236
		17	65	110	36	10236
	Medium	18	68	130	36	10824
		19	68	130	32	9145
		20	60	95	36	9398
		21	60	95	32	7941

c. In Chapter 2 of the AP1000 Design Control Document, Revision 17, Table 2-1site characteristics for which the AP1000 is designed are provided. It is stated:

> "The site is acceptable if the site characteristics fall within the AP1000 plant site design parameters in Table 2-1. Should specific site parameters or characteristics be outside the envelope of assumptions established by Table 2-1, the Combined License applicant referencing the AP1000 will demonstrate that the design satisfies the requirements imposed by the specific site parameters and conforms to the design commitments and acceptance criteria described in the AP1000 Design Control Document."

In Table 2-1 the Minimum Soil Angle of Internal Friction is defined to be Greater than or equal to 35 degrees below footprint of nuclear island at its excavation depth. It should not be Westinghouse's responsibility to identify what type of testing will be required to be implemented by the COL applicants to demonstrate that the coefficient of friction for the soil material beneath the foundation at the site meets the required coefficient of friction used in the design. This is the responsibility of the COL applicants. Therefore, the

Combined License applicant must demonstrate that they have a friction angle of 35 degrees using the testing procedures defined by them.

d. Reference to the angle of friction should not have been given in the initial response, only the coefficient of friction for the membrane. In Section 3.4.1.1.1.1, Revision 17 Tier 2, the requirement related to coefficient of friction and the horizontal membrane is given:

"… the membrane between the mudmats must transfer horizontal shear forces due to seismic (SSE) loading. This function is seismic Category I. The specific static coefficient of friction between horizontal membrane and concrete is ≥0.7."

The requirement for the coefficient of friction will be changed to 0.55. Tests will be performed that demonstrate that this coefficient of friction is achieved.

For strength and durability requirements of the membrane it has been recommended from multiple vendors that the Waterproofing Membrane have a thickness of 80 mils, both for HDPE or PVC. However, it is noted that if the membrane looses strength or degrades over its life, this will not result in a lower coefficient of friction than 0.55 since the surface will be concrete on concrete. In accordance with Reference 2, Section 11.7.4.3, the coefficient of friction shall be taken as a) 1.0 for normal weight concrete placed against hardened surface intentionally roughened as in Section 11.7.9 or b) 0.6 for normal weight concrete placed against hardened surface not intentionally roughed. Case b) could result if the waterproofing membrane looses strength of degrades over time. However, the alkaline (concrete) environment in which the HDPE membrane will be placed is not detrimental to this material.

Westinghouse Response: (Revision 2)

b. A lower bound soil case similar to Case 21 was considered. This evaluation is described in RAI-TR85-SEB1-10, Revision 2. Full passive pressure is used in the design of the Nuclear Island walls below grade. The value of the passive pressure is defined using the Case 15 soil properties. This is discussed in RAI-TR85-SEB1-02, Revision 2.

d. Proposed changes to the DCD in this revision are offered with the intent of defining the performance requirements for waterproofing and eliminating the current restrictions on the systems acceptable for use. Changes incorporate COL applicant's requirement to provide waterproofing membrane capabilities and material properties.

Westinghouse Response: (Revision 3)

1. A waterproof membrane or waterproofing system for the seismic Category I structures below grade is to be installed as an architectural aid to limit the infiltration of subsurface water. A COL applicant is to utilize a waterproofing system for the foundation mat (mudmat) and below grade exterior walls exposed to flood and groundwater that is

demonstrated to have a friction coefficient ≥0.55 with all horizontal concrete surfaces in contact with the waterproofing system.

2. A waterproofing membrane should be placed immediately beneath the upper mudmat, and on top of the lower mudmat or leveling concrete, which has been finished in accordance with ACI 301, Section 5.3.4.2.d. This bottom (horizontally planar) geosynthetic membrane should maintain minimum sliding coefficient requirements. For plasticized polyvinyl chloride (PVC) membranes, a geocomposite should be formed by applying a geotextile to both sides of the PVC geomembrane, such as CARPI USA's "SIBELON 2CNT" liner. Alternative approaches include use of a pre-formed, HDPE, self-adhering sheet system meeting the minimum sliding coefficient requirements on the unbonded face. As the membrane transitions to the walls of the Nuclear Island (vertically planar), a smooth geosynthetic liner may be used since sliding is not a design concern along these vertical planes.

   It shall be demonstrated that the waterproofing membrane used has a friction coefficient of at least 0.55 for all horizontal surfaces on which sliding may occur. In order to provide the durability required for construction and implementation, as well as the flexibility for a manageable installation, it has been recommended from multiple vendors that the waterproofing membrane have a thickness of 40 mils, both for HDPE or PVC.

   Industry standards used to specify performance requirements for waterproofing systems include:

ASTM D 412	(Membrane Tensile Strength)
ASTM D 903	Peel or Stripping Strength of Adhesive Bonds
ASTM D 1876	Peel Resistance of Adhesives
ASTM D 1970	(Low Temperature Flexibility)
ASTM D 1894	Standard Test Method for Static and Kinetic Coefficients of Friction of Plastic Film and Sheeting
ASTM D 4541	Pull-Off Strength of Coatings Using Portable Adhesion Testers (Elcometer)
ASTM D 4787	Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrate
ASTM D 5385	Hydrostatic Pressure Resistance of Waterproofing Membranes

3. Provided is information for the sprayed-on liquid-applied waterproofing membrane as the sprayed-on crystalline material is no longer applicable. The sprayed-on crystalline material is removed as an option from the DCD. The sprayed-on liquid-applied waterproofing membrane may be used either for soil sites, in conjunction with an MSE wall, or for rock sites, where an open excavation may be used. DCD 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 design of the concrete structures is governed by ACI 349 which provides guidance for the distribution of reinforcement. The basis for this guidance is the use of an assumed crack width, on the order of, 0.016 inches for the design loads controlling the selection of the reinforcement. For the below grade structures these loads include both the static and seismic components of the hydrostatic pressure and the lateral and vertical soil bearing pressures, among other loads. The specification for the waterproofing system requires that it meet the provisions of ASTM D5385, which includes a demonstration of the capacity of the membrane to span a 1/8 inch wide crack when subjected to a pressure of 100 psi, equivalent to a hydrostatic head of 230 feet, approximately 5 times the embedment depth of the Auxiliary/Shield Building.

The waterproof function of the membrane is not safety-related; however, the membrane between the mudmats must provide adequate shear strength to transfer horizontal shear forces due to seismic (SSE) loading. This function is seismic Category I. The liquid-applied waterproof membrane will have physical properties, including surface and texture, to achieve the required static coefficient of friction. Primer~~,~~ or geotextile may be added as required.

Reference:

1. Terzaghi, Karl, and Ralph B. Peck, Soil Mechanics in Engineering Practice, John Wiley & Sons, Inc., New York, 1948.
2. Building Code Requirements for Structural Concrete (ACI 318-05), American Concrete Institute, 2005

Design Control Document (DCD) Revision: (Revision 1, 2, 3)

Add item 2.5-17 to Table 1.8-2 as shown at the end of this response.

Modify the final paragraph of Tier 2, Section 2.5.4.1.3, “Mudmat,” to read as follows: (Revision 2)

(3 paragraphs unchanged)

The waterproofing system ~~alternatives are~~is described in subsection ~~3.4.1.1.1.1~~2.5.4.6.12.

Include New Tier 2 Section 2.5.4.6.12 to read as follows: (Revision 2)

2.5.4.6.12 Waterproofing System – The Combined License applicant will provide a waterproofing system used for the foundation mat (mudmat) and below grade exterior walls exposed to flood and groundwater under seismic Category I structures. The waterproofing membrane should be placed immediately beneath the upper mudmat, and on top of the lower mudmat. The performance requirements to be met by the COL applicant for the waterproofing system are described in subsection 3.4.1.1.1.1.

Modify Tier 2, Section 3.4.1.1.1.1, "Waterproofing," to read as follows: (Revision 2~~,~~ and 3)

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 this water barrier.~~ COL applicant will utilize a waterproofing system for foundation mat (mudmat) and the below grade exterior walls exposed to flood and groundwater that will ~~maintain~~ demonstrate a friction coefficient ≥0.55 with all horizontal ~~unbonded~~ concrete surfaces. This friction coefficient is maintained for the life expectancy of the plant and will not introduce a horizontal slip plane increasing the potential for movement during an earthquake. (See Section 3.8.5.5.3) ~~consisting of waterstops and a waterproofing system. Several~~ Typical waterproofing ~~alternate~~ approaches are described as follows:

- HDPE Double-Sided Textured ~~Waterpoof~~Waterproof Membrane

  Figures 3.4-1 and 3.4-2 show the typical application of this waterproofing approach for a mechanically stabilized earth (MSE) wall and for a step-back configuration.

- HDPE Single-Sided Self Adhering Sheet Waterproofing Membrane

  The HDPE single sided adhesive sheet membrane is interchangeable with the HDPE double sided textured membrane for use in the mud mat, and may be used in certain circumstances to waterproof the walls.

- Self-adhesive, Rubberized Asphalt/polyethylene Waterproofing Membrane

  The self-adhesive rubberized membrane is for application to waterproof the walls only.

- ~~Cementitious Crystalline Waterproofing Additive~~

~~This waterproofing system 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 2.5.4.1. 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.~~

- Sprayed-on Waterproofing Membrane

  This method may be used either for soil sites, in conjunction with an MSE wall, or for rock sites, where an open excavation may be used. The membrane consists of 100 percent solids materials based on polymer-modified asphalt or polyurea. This system may include a polyester reinforcement fabric having properties necessary to meet the performance requirements for the system. Figure 3.4-4 shows the typical installation using MSE walls with the sprayed-on, liquid applied 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 provide adequate shear strength to transfer horizontal shear forces due to seismic (SSE) loading. This function is seismic Category I. ~~The specific static coefficient of friction between horizontal membrane and concrete is ≥0.7.~~ The waterproof membrane will have physical properties, including surface and texture, to achieve the required ~~static~~ coefficient of friction. Primer~~,~~ or geotextile~~, or aggregate scatter~~ may be added as required.

DCD Figures Removed: (Revision 2)

DCD Figure 3.4-3 is removed from the DCD.

Figure 3.4-3

~~Nuclear Island Soil Nail Alternate~~Not Used

Revise 3.4 DCD Figure titles ~~modified~~ to include the phase, "Typical Details of…":as shown below.

Figure 3.4-1

Typical Details of Nuclear Island Waterproofing Below Grade

Figure 3.4-2

Typical Details of Nuclear Island Waterproofing Below Grade with Step Back

Figure 3.4-4

Typical Details of Membrane Corner Detail at Basemat and Exterior Wall

(Revision 2 – remove previous modification of Section 3.4.1.1.1.1, Tier 2)

~~Modify Section 3.4.1.1.1.1, Tier 2 to read as follows:~~

~~"… the membrane between the the mudmats must transfer horizontal shear forces due to seismic (SSE) loading. This function is seismic Category I. The specific static coefficient of friction between horizontal membrane and concrete is ≥0.70.55."~~

PRA Revision:
None

Technical Report (TR) Revision:
None

Revision to DCD Table 1.8-2 follows.

Add item 2.5-17 to Table 1.8-2 as shown below.

Table 1.8-2 (Sheet 2 of 13)

SUMMARY OF AP1000 STANDARD PLANT COMBINED LICENSE INFORMATION ITEMS

Item No.	Subject	Subsection	Addressed by Westinghouse Document	Action Required by COL Applicant	Action Required by COL Holder
2.5-16	Settlement of Nuclear Island	2.5.4.6.11	N/A	Yes	–
2.5-17	Waterproofing System	2.5.4.6.12	N/A	Yes	–