Discussion of Status of Review of Responses to Requests for Additional Information November 12, 2002

The following comments resulted from the staff's review of Westinghouse's responses to requests for additional information (RAIs) 220.001 through 220.019. Westinghouse provided its responses to these RAIs via letters dated October 4, October 18, and November 1, 2002. The purpose of these comments is to identify areas where supplemental information may be necessary for the staff to complete its review of the AP1000 design certification application. As of November 12, 2002, the staff had not reviewed Westinghouse's responses to 220.007, 220.012, or 220.015.

RAI 220.001

Part A

In response to this RAI, Westinghouse identified the similarities between the AP600 and the AP1000 containment vessel designs as justification for the applicability of the AP600 passive containment cooling system water distribution tests to the AP1000 design. However, the staff would like more information in two (2) areas, both related to the need for increased cooling capacity for the AP1000, compared to the AP600.

First, the need for increased cooling capacity requires a larger cooling water storage tank, which necessitated structural design changes to both the tank and its supporting structure. It is not clear whether the water flow paths are identical. Please describe the technical basis for concluding that the circumferential widths of the wetted and dry bands are not affected by these design changes.

Second, to achieve the increased heat removal capacity required for the AP1000, it is necessary to increase the total heat transfer from the containment vessel to the cooling system water. Please (1) describe the operational changes (e.g., same flow rate, but longer time; faster flow rate for the same time) specified for AP1000 in order to achieve the increased heat removal required for the AP1000; and (2) present its technical basis for concluding that these operational changes do not change either the circumferential water distribution (widths of wetted and dry bands) or the maximum delta T (ΔT) between the wetted and dry bands, when compared to the AP600 test results.

If either the circumferential widths of the wetted and dry bands or the maximum ΔT between the wetted and dry bands are not identical for both the AP1000 and AP600, then provide a detailed technical basis for extrapolation of the AP600 test results to the AP1000 design loads.

Part B

The response indicates that the time histories resulting from the automatic depressurization system (ADS) hydraulic tests done for the AP600 are also applicable to the AP1000 because they occur at the beginning of the transient, and the ADS initial conditions are the same for the two plant designs. The design of the ADS valves that discharge into the in-containment refueling water storage tank (IRWST) are the same for both plants, including the key features controlling blowdown, such as valve opening times, flow areas, flow rates, and fluid conditions. Also, the design of the sparger and the IRWST are the same for both plants.

Recognizing that the ADS hydraulic tests may be applicable to the AP1000 plant, please explain why the increased energy in the AP1000 design does not affect the ADS actuation pressure time histories in any way. Even if the valve opening times, flow areas, flow rates and fluid conditions are the same, isn't there more energy in the AP1000 design that must be dissipated in some manner?

Also, explain why the RAI response indicates that the time histories resulting from the ADS hydraulic tests done for the AP600 are also applicable to the AP1000 because "...they occur at <u>the beginning of the transient</u>, and ..." [a]s described in the DCD [design control document] and response to RAI 220.009, one of the critical pressure time histories for analysis corresponds to loading case ADS stage 2 (ADS2) which occurs after prolonged operation of the passive residual heat removal (PRHR) system. This loading case is identified as controlling the structural design. Therefore, clarify the phrase "occur at the beginning of the transient."

Part C

In response to this RAI, Westinghouse identified the similarities between the AP600 and the AP1000 containment vessel and shield building designs as justification for the applicability to the AP1000 of the pressure coefficients from the AP600 passive containment cooling system wind tunnel tests, even though the AP1000 shield building and containment vessel heights and the containment air baffle length have been increased by approximately 25'. Please provide additional information in the following two (2) areas.

First, Westinghouse does not indicate whether the same design external wind velocity is applicable to both the AP600 and the AP1000 designs. Two factors may result in a higher design external wind velocity for the AP1000: (1) the use of American Society of Civil Engineers (ASCE) 7-98 for the AP1000; and (2) the approximately 25' increase in the elevation of the air intakes for AP1000. Please define the design external wind velocities at the air intakes for both the AP600 and AP1000, and describe how any difference has been considered in extrapolating the AP600 test data to the AP1000 containment vessel and air baffle design loads.

Second, Westinghouse does not describe the technical basis for selecting the pressure coefficients to be applied to the additional 25' of the containment vessel and the air baffle, nor the technical basis for concluding that the additional 25' does not affect the overall vertical distribution and magnitudes of the pressure coefficients. Please describe the extrapolation process, for both downward flow and upward flow, utilized to define the AP1000 design loads from the AP600 wind tunnel tests. Also, provide a tabulation of the spatial distribution of pressure coefficients for both the AP600 design and the AP1000 design.

RAI 220.002

Part A

In the response to this RAI, Westinghouse implies that it has changed the governing American Society of Mechanical Engineers (ASME) Code edition for AP1000, from 1998 including 1999 and 2000 addenda, to 2001 including 2002 addenda. (This is clearly indicated in the Westinghouse response to RAI 220.003, discussed below.)

Westinghouse has limited the containment shell thickness to 1.75" because a greater thickness would require post-weld heat treatment. Westinghouse states that, based on the 2002 addenda, the minimum required containment shell thickness is 1.726", and not 1.7456" as calculated by the staff. In the 2002 addenda, the allowable stress intensity has increased to 26.7 ksi (thousand pounds-per-square inche), compared to 26.4 ksi based on the original governing code edition. This is an after-the-fact revision to the original AP1000 design basis. The original margin available as a corrosion allowance was 0.0044"; the new margin is 0.024".

Westinghouse presents a flawed comparison of the corrosion margins for AP1000 vs. AP600. The AP600 minimum required shell thickness based on the 1992 code edition is 1.597", compared to the design thickness of 1.625" (increased to 1.75" for the bottom cylinder section as a corrosion allowance). Therefore, Westinghouse calculates a nominal margin available as a corrosion allowance of 0.028". However, if the same code rules were to be applied to the AP600 as are applied to AP1000, the margin for corrosion allowance would be significantly greater (on the order of 0.25"). Conversely, if the 1992 code rules were applied to the AP1000 design, the 1.75" design thickness would not meet the code requirements for minimum thickness.

To address the staff's concern about the consideration for corrosion in the embedment transition region, Westinghouse presents tabulated membrane stress results for the design pressure load condition, for the bottom 20' of the containment shell (Table 220.002-1). The maximum membrane stress intensity is 27.3 ksi at elevation 110', which is 10' above the 100' embedment elevation. This is considered to be a local primary membrane stress intensity, with an allowable 1.5 times the general primary membrane stress intensity of 26.7 ksi (2002 addenda). The results also show that the primary membrane stress intensity, away from the discontinuity, is about 26.3 ksi. This assessment is incomplete because all applicable load combinations and the associated applicable code stress intensity limits need to be considered, before a conclusion can be reached. Local shell bending stress will maximize at the embedment location and will increase as a function of $(t_{design}/t_{corroded})^2$. Please present a complete assessment of the effect of corrosion in the embedment transition region.

Part B

In response to this RAI, Westinghouse indicated that corrosion protection is provided by coating the vessel as described in DCD Sections 3.8.2-8 and 6.1, in addition to the margin described in the Part A response. DCD Section 6.1 identifies corrosion protection as a nonsafety function of the containment coatings.

More specifically, the staff reviewed WCAP-15800 for technical issues potentially significant for Section 3.8 of the DCD. Information Notice (IN) 86-99 and IN 86-99, Supplement 1 address "degradation of steel containments". IN 89-79 and IN 89-79, Supplement 1 address "degraded coatings and corrosion of steel containment vessel." Westinghouse refers to DCD Section 3.8.2.7 and DCD Section 3.8.2, respectively for its "Comment" related to these issues. The role of coatings in preventing/mitigating corrosion on the inside and outside surfaces of the steel containment shell is not specifically addressed in DCD Section 3.8.2. The 2nd and 3rd paragraphs of DCD Section 3.8.2.6 describe the containment coatings, but only corrosion of the embedded portion of the containment shell (which is NOT coated) is discussed in these 2 paragraphs. DCD Section 3.8.2.7 states that "[i]n-service inspection of the containment vessel will be performed according to ASME Code Section XI, Subsection IWE, and is the responsibility of the Combined License applicant."

Identifying Westinghouse's position on the role of coatings as a preventer/mitigator of containment corrosion took some digging through the DCD. DCD Tier 2, Appendix 1A, p. 1A-20, addresses Westinghouse's conformance to Reg. Guide 1.54, Rev. 1, March 2000 - "Quality Assurance Requirements for Protective Coatings Applied to Water-Cooled Nuclear Power Plants." Westinghouse identifies an "Exception" and refers to DCD Tier 2, subsections 6.1.2 and 6.1.3 for information. After reading these subsections and the referenced Table 6.1-2, it appears that the coatings on the inside and outside surfaces of the containment shell are designated "safety-related"; however, for the coating function "inhibit corrosion", they are classified "nonsafety." See Table 6.1-2, p. 6.1-13. Therefore, the staff concludes that the containment coatings cannot serve as a substitute for a containment shell corrosion allowance. In order to take credit for the containment coatings, please identify corrosion protection as a safety-related function of the coatings on the exterior and interior surfaces of the containment shell, and also identify that the inspection and maintenance of these coatings, to preserve the corrosion protection function of the coatings, is the responsibility of the Combined License applicant throughout the unit operating life.

RAI 220.003

In response to this RAI, Westinghouse will revise the AP1000 DCD, to change the governing ASME code edition from 1998 (including 1999 and 2000 addenda) to 2001 (including 2002 addenda). The staff has not evaluated the technical bases for the recent code revisions credited by Westinghouse. Please provide the significant technical data that supports the recent code revisions, so that the staff can evaluate the recent code revisions for acceptability.

RAI 220.004

In response to this RAI, Westinghouse confirmed that the AP600 and AP1000 containment buckling criteria based on Code Case N-284 are identical. The latest revision of Code Case N-284-1 is the same as the AP600 buckling criteria, based on Code Case N-284-0 plus the Appendix G supplementary requirements, previously accepted by the staff. No further information is needed from Westinghouse.

RAI 220.005

In response to this RAI, Westinghouse describes the technical basis for the -15° F minimum containment shell temperature, but the basis for and sensitivity to the assumed heat transfer coefficient on the shell external surface needs further explanation. Westinghouse states that doubling the natural circulation heat transfer coefficient is conservative, without adequately explaining the technical basis. Also, from the brief description of the calculation, it appears that the minimum exterior shell temperature would be very sensitive to a modest increase in the heat transfer coefficient. Can the AP600 containment passive air cooling test results be used to develop/verify appropriate heat transfer coefficients for the AP1000?

Also, please address the local containment shell temperature at air baffle attachments. Has heat transfer analysis demonstrated that the local containment shell temperature at the air baffle attachment locations is also greater than -15° F when the environment is -40° F? These locations are more susceptible to cracking because the air baffle attachment welds create local stress concentrations and the welding process may have locally embrittled the containment shell.

Westinghouse states that "[i]t is expected that it (SA738, Grade B) could be procured to meet the impact requirements of NE-2000 if the minimum service temperature requirement were -40° F." Please clarify this statement. What temperature will Westinghouse specify for procurement of SA738, Grade B to meet the requirements of NE-2000?

RAI 220.006

In response to this RAI, Westinghouse indicated that typical anchorage details for structural modules are shown in Figure 3.8.3-8, and stated that "[t]he connection between the steel plate module and the reinforced concrete basemat is a combination of mechanical connections welded to the steel plate and lap splices where the reinforcement overlaps shear studs on the steel plate." However, the revisions Westinghouse made to subsection 3.8.3.1 and DCD subsection 3.8.3.5.3 do not clearly convey the same information as in the RAI response.

The revised wording in the 4th paragraph of subsection 3.8.3.1, "...by a combination of mechanical connections, shear studs, or reinforcement as shown in Figure 3.8.3-8." is not consistent because the word "or" is used here instead of "and".

Also, the revised wording of the last paragraph of subsection 3.8.3.5.3, which states "...a combination of mechanical connections welded to the steel plate or lap splices where the reinforcement overlaps shear studs on the steel plate." is not consistent.

The staff recommends incorporating the RAI response wording into the DCD revisions.

RAI 220.007

Westinghouse submitted its response to this RAI via letter dated November 8, 2002. Consequently the staff did not have the opportunity to review this RAI response before the meeting.

RAI 220.008

Using the information provided in the response to the RAI, the maximum shear stress due to seismic loading would be 137 psi (pounds-per-square inch) times 1.25 or 171 psi. This is based on the AP600 maximum calculated stress scaled up by the ratio of AP1000 seismic shear force to the AP600 seismic shear force (25% increase). The RAI response states that this would not cause significant cracking of the concrete so the monolithic assumption is valid. No specific references for this conclusion have been provided. However, based on some available references, their statement does appear to be acceptable for a shear stress of 171 psi provided that the dead load and live load compressive stresses are large enough to compensate most of the tensile stresses due to seismic vertical forces and overturning moments. This is expected to be the case since the containment internal structures are relatively short in comparison to their overall base dimension. In addition to the above discussion, as stated in the AP600 safety evaluation report (SER), test data performed on concrete-filled steel specimens have been shown to experience less overall stiffness degradation than reinforced concrete sections. The test data also demonstrated that the concrete-filled steel test specimens possess substantial ductility and ultimate capacity. Therefore, Westinghouse's RAI response is considered to be technically acceptable, pending (1) finalization of the seismic analysis of the containment internal structures, and (2) the staff audit to review the application of the analysis/design methodology and the final numerical results.

Westinghouse's RAI response contains the phrase "...partly due to changing the boundary conditions in the seismic analysis and removing the lateral support below grade for the hard rock site." in its discussion of increased shear forces. Please explain these boundary condition changes in greater detail and how they contribute to increased shear forces.

RAI 220.009

Part 1 - Insufficient information was provided to support the conclusion that the increased wall heights and mass of the steam generator and pressurizer will have a minor effect on the structural frequencies. The response does try to explain why the differences in mass and wall heights would not affect the IRWST forces from the hydrodynamic excitations and states that "the increase in mass from the AP600 design is less than ten percent (frequency change less than 5%)." However, it appears that this increase in mass is based on the increase over the total IRWST modules and contributing water, which would not be appropriate for the local out of plane excitation.

Part 2 - The response indicates that two forcing functions are used in the IRWST hydrodynamic analyses. The response states that the response spectra for these two transients are "characteristic of a white noise character." This isn't evident from the figures provided showing the response spectra of the time histories because one figure has significant content with fluctuating amplitude for frequencies between 15 and 55 Hz while the other response spectrum has significant content with fluctuating amplitude in the frequency range 40 to 60 Hz. Based on this information it is not clear how the response provided to Part 1 can conclude from this that "...any shift in structural frequency will not affect the structural response..." Please clarify.

Part 3 - The response indicates that the hydrodynamic analyses show that member forces in the walls of the IRWST are bounded by a case with a uniform pressure of 5 psi applied to the walls. Tables are provided to demonstrate this and a conclusion is made in the response that "[a]s seen from these tables, there is significant margin in the uniform 5 psi pressure case compared to the hydrodynamic results." However, for the south wall of the steam generator cavity for some locations, the margin is in the range of 1.09 to 1.16 which is not considered to be significant. The west wall of the refueling cavity also has a margin of 1.09. These are not considered to be significant margins and therefore, they can not be relied upon to resolve the technical issues raised by this RAI.

RAI 220.010

In response to this RAI, Westinghouse indicated that the responses to RAI 230.006 and 230.007, ,dated October 4, 2002, provide the information requested. In addition, the response to this RAI indicated that Tables 3.7.2-1 to 3.7.2-7 of the DCD provide numerical values for frequency and accelerations. Also, the response explained that the AP1000 and AP600 will maintain a comparable level of safety which is based on the code criteria stress limits that are being used.

Westinghouse response to RAI 230.006 indicated that the equivalent static acceleration and mode superposition time-history analysis methods are primarily used for the evaluation of the nuclear island structures. Response spectrum analyses may be used to perform an analysis of a particular structure or portion of a structure using the procedures described in DCD subsections 3.7.2.6, 3.7.2.7, and 3.7.3. Specific references to the response spectrum analysis method which were not appropriate were removed or revised (subsections 3.7.2-6, 3.7.2.12, Table 3.7.2-16, and Tables 3.7.2-17 to 3.7.2-19).

Westinghouse response to RAI 230.007 indicated that DCD subsection 3.7.2.6 describes how seismic member forces are calculated when the equivalent static acceleration analysis method is used in conjunction with a three-dimensional (3D) finite element model. The RAI response also stated that an analysis for each earthquake component is made by applying equivalent static loads to the structural model at each finite element node with mass equal to the mass times the maximum absolute acceleration value (obtained from the time history analysis of the stick models). We interpret this statement to mean not "with mass equal to the mass times the maximum absolute acceleration ..." but with a force equal to the mass times the maximum absolute acceleration. The RAI response indicated that member forces in the floors, walls, and slabs used for the design of nuclear island structures are developed using either the equivalent static acceleration method or the mode superposition time-history method. A paragraph in subsection 3.8.4.4.1 will be revised to explain that the out-of-plane bending and shear loads for flexible floors and walls are analyzed using the methodology described in subsection 3.7.2.6 and 3.7.3.

With the additional information contained in the RAI responses described above; revisions/additions that will be made to DCD sections 3.7 and 3.8; and the existing information contained in the DCD, it is now clear how the containment internal structures were analyzed to obtain seismic design loads. An equivalent static analysis of a 3D finite element model of the containment internal structures on a fixed base (DCD Fig. 3.7.2-2) was utilized to obtain the seismic forces and moments required to design the containment internal structures. The equivalent static seismic loads applied at each node correspond to the mass times the maximum acceleration from a mode-superposition time-history analysis of a stick model of the nuclear island structures, that includes a stick model representation of the containment internal structures. For other Category I structures a similar methodology was utilized as summarized in DCD Table 3.7.2-14.

The above methodology was utilized to obtain the in-plane forces for design purposes. To calculate out-of-plane forces for flexible floors and walls, response to RAI 230.007 states that the methodology described in DCD subsections 3.7.2.6 (Three Components of Earthquake Motion) and 3.7.3 (Seismic Subsystem Analysis) are used. This explanation will be incorporated into a future revision of DCD subsection 3.8.4.4.1. DCD subsection 3.7.3 does provide a description of seismic analysis methods that could be used to analyze out-of-plane member forces. The methods described include response spectrum analysis, time-history analysis, and equivalent static analysis. Information is provided on modeling, selection of frequencies, calculation of equivalent static forces, consideration of three components of earthquake motion, and combination of modal responses.

For containment internal structures, there is an additional seismic analysis that was performed which is summarized in DCD Table 3.8.3-2 and described in DCD subsections 3.8.3.4.1.3 and 3.8.3.4.2.2. This analysis was performed to obtain the local response of the walls and water of the in-containment refueling water storage tank. A description of the model and response spectrum analysis is provided and is judged to be acceptable.

Numerical values for the significant modal frequencies from the 3D stick models for the shield and auxiliary buildings, steel containment, and containment internal structures are provided in Tables 3.7.2-1 through 3.7.2-4 and modeshape plots are provided in Figures 3.7.2-9 through 3.7.2-11. Numerical values of maximum absolute nodal accelerations for these structures are provided in DCD Tables 3.7.2-5 through 3.7.2-7. The above frequencies and accelerations are from the seismic stick models for the various structures. These would be used for calculating in-plane seismic forces for design. Numerical values for frequencies and accelerations for the out-of-plane calculations are not provided. Therefore, it is recommended that such information be provided for representative cases or this can be reviewed during the design review stage to be performed at a future date.

In response to Part C of RAI 220.010, Westinghouse indicates that the level of safety is comparable since both AP600 and AP1000 meet the respective applicable code criteria stress limits. However, some analysis methods may have changed (e.g., static analysis versus response spectra method for seismic, and potentially others loads), which would have some effect on comparing the level of safety between AP600 and AP1000. Also, code revisions may affect making the conclusion that the AP600 and AP1000 will maintain a comparable level of safety based on meeting the code criteria stress limits. Further information on (a) the differences in analytical methodologies and code provisions between the AP600 and AP1000 designs and (b) submittal of the responses to the other RAI's will be needed in order to properly review and address this subject.

Based on the above discussion, most of the information requested in RAI 220.010 relating to Parts A, B, and C was provided and is considered relevant. However, further information would be needed as follows:

1. Table 3.8.3-2 refers to 3D finite element model (FEM) of containment internal structures (CIS) fixed at 82'-6" using equivalent static analysis for in-plane seismic forces; however, there is also a FEM model of CIS fixed at 103' using response spectrum method for member forces. Presumably the FEM model fixed at 103' corresponds to the localized seismic analysis described in DCD subsections 3.8.3.4.1.3 and 3.8.3.4.2.2. Which FEM and corresponding analysis apply to what portions of the CIS?

2. Numerical values for frequencies and accelerations for the out-of-plane calculations for representative cases should be provided or made available for review.

3. (a) Differences in analytical methodologies and code provisions between the AP600 and AP1000 designs and (b) submittal of the responses to the other RAI's will be needed in order to properly review and evaluate whether the AP1000 has a comparable level of safety as the AP600.

RAI 220.011

In response to Part A of this RAI, Westinghouse provided a description of the CA Structure Module With Single Surface Plate and has revised the second paragraph of DCD subsection 3.8.3.1.3; in response to Part B of this RAI, Westinghouse described the unidentified markings on sheets 1,2,4,6, and 7 of Figure 3.8.3-1, and has revised this figure accordingly to add missing information. No further information is needed for Part B; however, additional information is necessary for Part A because the description of the CA Structure Module With Single Surface Plate provided in the RAI response should be included in the revision to subsection 3.8.3.1.3.

RAI 220.012

As of November 12, 2002, Westinghouse has not provided its response to this RAI. Consequently the staff did not provide any comments.

RAI 220.013

In response to this RAI, Westinghouse (1) stated that the changes between ACI-349-97/R.G.1.142 and ACI-349-01/ Westinghouse Position do not affect the AP1000 design of Category I structures; (2) confirmed and corrected the 2 typographical errors in AP1000 DCD Appendix 1A; and (3) revised the description of Tier 2* material in AP1000 DCD subsection 3.8.4.5.1, to include conformance with RG 1.142 Regulatory Positions 2 through 8, 10 through 13, and 15. Regulatory Positions 1,9, and 14 do not apply to AP1000. No further technically justification is necessary (please see discussion below).

Discussion:
As part of its RAI response, Westinghouse indicated that ACI 349-01, Appendix B for anchoring to concrete "is covered in Draft Regulatory Guide DG-1099." BNL's review of DG-1099 (July 2002) identified the following statement in the 8th paragraph under B.

This Draft Regulatory Guide DG-1099 generally endorses Appendix B (February 2001) to ACI 349- 01, with exceptions in the area of load combinations." The discussion of Regulatory

Position 1.3, on page 4 of DG-1099, states "[t]he staff agrees with the strength reduction factors given in Section B.4.4, but recommends that load factors consistent with SRP Section 3.8.4, 'Other Seismic Category I Structures,' be applied to the load combinations given in Section 9.2 of ACI 349-01." DG-1099 Regulatory Position 1.3 defines the specific exceptions to the load factors used in ACI 349-01, Section 9.2.1 to be:

-1.2T_0 in place of 1.05T_0 in load combs. 9,10, and 11;
-1.5P_a in place of 1.25P_a in load comb. 6;
-1.25P_a in place of 1.15P_a in load comb. 7.

However, RG 1.142 Regulatory Position 6 defines the specific exceptions to the load factors used in ACI 349-97, Section 9.2.1 to be
-1.2T_0 in place of 1.05T_0 in load combs. 9,10, and 11;
-1.4P_a in place of 1.25P_a in load comb. 6.

Westinghouse has indicated that it conforms to Regulatory Position 6 of RG 1.142, but this does not completely satisfy the load factor exceptions identified in DG-1099 for use with ACI 349-01, Appendix B.

RAI 220.014

In response to this RAI, Westinghouse reviewed the changes between the criteria previously accepted by the staff for AP600 (AISC N690-84 plus the supplementary requirements of AP600 DCD subsection 3.8.4.5.2) and the AP1000 criteria (AISC N690-94 plus identical supplementary requirements as defined in AP1000 DCD subsection 3.8.4.5.2) and has concluded that these changes do not affect the AP1000 design. No further information is necessary.

RAI 220.015

Westinghouse has not yet provided its response to this RAI. Consequently, the staff does not provide any comments at this time.

RAI 220.016

The staff is providing no input as of November 12, 2002.

RAI 220.017

In the response to this RAI, Westinghouse confirmed that the final design for the two critical sections of the NI basemat is still in progress and will be available for the structural audit. DCD Table 3.8.5-3 will be updated to reflect the final design.

Westinghouse also stated its intention to delete the Tier 2* designation from Sheets 1, 2 and 5 of Figure 3.8.5-3, instead of adding the Tier 2* designation to sheets 3 and 4 of this figure. This deletion is a reversal of a commitment made for AP600, and is unacceptable pending review of the staff's technical basis for requiring sheets 1, 2 and 5 for AP600 to be designated Tier 2*.

RAI 220.018

In the response to this RAI, Westinghouse submitted (1) quantitative data used as input to the AP1000 and the AP600 floatation, overturning, and sliding calculations, and (2) a comparison of safety factors between AP1000 and AP600. Based on the data submitted, it is not obvious why both AP600 and AP1000 have a safety factor of 1.2 for overturning due to an E-W earthquake. The AP1000 moment appears to be 40% higher than the AP600 moment. This is especially significant because this case has the lowest margin between the required safety factor (1.1) and the calculated safety factor (1.2). Westinghouse needs to describe this specific calculation in sufficient detail to demonstrate the 1.2 safety factor for both the AP1000 and the AP600.

RAI 220.019

In response to this RAI, Westinghouse describes the different basemat shear reinforcement requirements for the AP1000 hard rock site, compared to the AP600 basemat shear reinforcement requirements for the envelope of site conditions analyzed. The AP600 basemat design criteria required minimum shear reinforcement even if the factored shear forces were small. However, the AP600 design shear forces were large enough to require shear reinforcement. Because only a hard rock site is being evaluated for AP1000, and the design shear forces are much lower, the AP1000 basemat design criterion for shear reinforcement follows the provisions of ACI 349-01, paragraph 11.5.5.1. No further technical justification is necessary at this time. However there appears to be a minor discrepancy as follows:

AP1000 DCD Section 3.8.5.5 refers to "factored shear strength" while the RAI response correctly refers to "factored shear force". Westinghouse needs to correct AP1000 DCD Section 3.8.5.5 accordingly. Also, in addition to the description of the criterion, Westinghouse should make direct reference to ACI 349-01, paragraph 11.5.5.1 in DCD Section 3.8.5.5.