

May 27, 2009

MEMORANDUM TO: Eileen M. McKenna, Chief  
AP1000 Projects Branch 2  
Division of New Reactor Licensing  
Office of New Reactors

FROM: William C. Gleaves, Sr. Project Manager  
AP1000 Projects Branch 2 /RA/  
Division of New Reactor Licensing  
Office of New Reactors

SUBJECT: SUMMARY OF REGULATORY AUDIT HELD WITH  
WESTINGHOUSE ELECTRIC COMPANY REGARDING THE  
PROPOSED AP1000 BASEMAT DESIGN, HELD IN  
MONROEVILLE, PENNSYLVANIA, MAY 4-8, 2009

The U.S. Nuclear Regulatory Commission (NRC) held a regulatory audit at the Westinghouse Energy Center office in Monroeville, Pennsylvania, the week of May 4, 2009. The Office of New Reactors (NRO) staff met with Westinghouse Electric Company (Westinghouse) staff and representatives to discuss the proposed AP1000 basemat design submitted as part of their design certification amendment (DCA).

This regulatory audit was for the purposes of continuing the staff review of the proposed DCA by allowing the staff to review and assess the information supporting the proposed DCA, such as calculations and computer codes and its results. Specifically, the participants discussed the technical issues related to the AP1000 proposed seismic design. The foundation for the meeting was Westinghouse's responses to previous NRC requests for additional information and on AP1000 Technical Reports (TRs), submitted by Westinghouse to support the proposed DCA. The review scope included both audit of information supporting the proposed AP1000 basemat design as described in TR-85, "Foundation & Containment Basemat," and other NRC Standard Review Plan, Section 3.8, reviews such as of the proposed AP1000 containment internals structures & materials, critical sections, and TR-09, "Large Penetrations."

With this memorandum summarizing the meeting are enclosures containing a list of meeting attendees and the updated action items resulting from the audit.

The purpose of this meeting summary is to briefly describe the meeting, its participants, and to delineate the results. There were 21 participants at the audit. The meeting started promptly at 12:30 p.m. EST. on May 4, 2009 and ended at 1:00 p.m. EST. on May 8, 2009.

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Discussion

Following the introductions of the attendees at the meeting, the Project Manager reviewed the purpose of the meeting; this NRC technical audit is to review documents and calculations that support Westinghouse's request for amendment to the certified AP1000 reactor.

The week's discussions were prioritized as "A," "B," "C" and "D." This enabled the staff and Westinghouse to focus efforts in the time allowed. However, this was not proven to be necessary as the staff completed its audit of all prioritized items in the time allotted and used the remaining time to review SRP3.8 Structural RAIs as described.

Throughout the week, Westinghouse staff made presentations on the various issues and were normally accompanied by presentation slides. The slides were primarily to facilitate discussions with the staff and are not included in this summary. However, if information contained in those slides are relevant to the action items listed in Enclosure 3, then that information may be included in Westinghouse's response to that RAI. As stated, the results of the technical audit are summarized in Enclosure 3 which gives a status and actions for the meeting participants.

Conclusion

In general, the staff found the meeting to be effective and resulted in significantly advancing NRC review of Westinghouse's proposed amendment to the AP1000 design certification. At the conclusion of the meeting, the NRC staff reviewed the draft list of action items from the meeting and agreed to have another conference call on Monday, May 11, 2009 to settle both the final action items and the due dates for those items.

Following the meeting held at 12:00 p.m. to summarize the progress and review the action items with Westinghouse, the audit was complete.

Docket No. 52-006

Enclosures:  
As stated

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ADAMS ACCESSION NO: ML091390709

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NAME	RButler	BGleaves	EMcKenna
DATE	05/20/2009	05/27/2009	05/27/2009

Regulatory Audit on AP1000 Basemat and SRP 3.8 Issues  
Attendance List  
Westinghouse, Monroeville  
May 4-8, 2009

<b>Name</b>	<b>Organization</b>
Brian Thomas	U.S. NRC
John Ma	U.S. NRC
Billy Gleaves	U.S. NRC
Joe Braverman	U.S. NRC/BNL
Carl Costantino	U.S. NRC/BNL
Ed Cummins	Westinghouse
Lee Tunon-Sanjur	Westinghouse
Rob Sisk	Westinghouse
Don Lindgren	Westinghouse
Bill LaPay	Westinghouse/consultant
Richard Orr	Westinghouse/consultant
Narendra Prasad	Westinghouse
Dali Li	Westinghouse
Venky Pravu	Westinghouse
Scott Altmayer	Westinghouse
Brandon Schoonmaker	Westinghouse
John McConaghy	Duke/NuStart
Don Moore	Southern Nuclear
Ron Knott	Progress Energy
Sam Mazella	Westinghouse/Contractor GAI
Eddie Grant	NuStart

**Action Item List at Conclusion of Meeting  
May 4-8, 2009**

Enclosure 2

## **Draft Summary of Action Items from NRC Technical Audit of Westinghouse AP1000 DCA, May 4-8, 2009**

### **TR85 Structural Basemat**

NOTE: In general, for each structural basemat item, NRC wants a narrative on, and the presentations made, during the May 4, 2009-May 8, 2009 technical audit.

#### **“A” Priority Items**

Action Item 1: Regarding RAI-TR85-SEB1-02, R1, Calculation of Lateral Earth Pressure Loads

Status: Audit complete. Waiting on Westinghouse RAI response and estimated completion date.

- 1) Include in RAI response discussion and presentation; add SASSI curves and column to Table in handout. Also include in response clarification that what was used in wall design was worst case load combinations.
- 2) Consider worst case pressure distribution.
- 3) Describe delta of structural design changes between DCD Revision.15, Revision.16, and Revision 17

Action Item 2: Regarding RAI-TR85-SEB1-05, R1, Soil Springs & Values of Subgrade Modulus

Status: Audit Complete. Westinghouse will send RAI response and estimated completion date.

- 1) Include in RAI response narrative and presentation material including comparison of 520 to 80 kcf and plots of bending moment @ Section C-C for 1.0G in N-S and E-W.

Action Item 3: Regarding RAI-TR85-SEB1-32, R1, Uniformity of Soil Springs

Status: Audit complete. Westinghouse will send RAI response and estimated completion date.

- 1) Westinghouse will deliver in a revised RAI response a narrative on the presentation material given on May 5, 2009 related to the Boussinesq Effect and also include description of model & use of FE on soil boundaries.

Action Item 4: Regarding RAI-TR85-SEB1-35, R1, “Enveloping Loads.” Found in RAI parts (b) high sliding stability, and (d) demonstration of coefficient of friction by COL applicant.

Status: Audit complete Westinghouse will send narrative, presentation, and RAI response as described below.

- 1) Westinghouse will submit a RAI response to SEB1-10, R1, using results from 2D non-linear analysis based on worst case ranges of soil properties.
- 2) Westinghouse will address in its revised RAI response each of the three paragraphs in (d) in a new RAI response: 1<sup>st</sup> para.= coeff of friction must be demonstrated by COL. 2<sup>nd</sup> para.= West. will provide more detailed information about the waterproofing and the appropriate industry standard, 3<sup>rd</sup> para.= regarding “crystalline material” for waterproofing material for foundation, Westinghouse will provide clarification on its use in the revised RAI response.

Action Item 5: Regarding RAI-TR85-SEB1-40, R1, Consideration of Unsaturated Soils  
Status: Audit complete. Westinghouse will submit RAI response and estimated completion date.

- 1) Westinghouse will send revised RAI response capturing narrative and presentation, model used & assumptions on saturation, non-conservative deviations (with all critical nodes) and Poisson's Ratio.

### **“B” Priority Items**

Action Item 6: Regarding RAI-TR85-SEB1-10, R1, Development of Passive Pressure Resistance Curves. (related to RAI-TR85-SEB1-35 because both relate to coefficient of friction of mat)

Status: Audit complete. Westinghouse will submit RAI response and estimated date for completion.

- 1) Westinghouse will submit narrative and presentation and revised RAI response including a 2D analysis with non-linear sliding friction elements.

Action Item 7: Regarding RAI-TR85-SEB1-12, R1, Uplift/sliding of NI Under all Conditions

Status: Audit complete. No further action by NRC/Westinghouse

Action Item 8: Regarding RAI-TR85-SEB1-18, Audit of Detailed Basemat Design Summary Report.

Status: Audit complete. No further action by NRC or Westinghouse

Action Item 9: Regarding RAI-TR85-SEB1-19, Audit of Evaluation of Settlement and Construction Sequences

Status: Audit complete. No further action by NRC or Westinghouse

Action Item 10: Regarding RAI-TR85-SEB1-29, Audit of Detailed Basemat Calcs./Design Report.

Status: Audit Complete. No further actions by NRC or Westinghouse

Action Item 11: Regarding RAI-TR85-SEB1-36, R1, Settlements Exceeding 3 Inches in DCD 2.5-1.

Status: Audit complete. Westinghouse will provide RAI response and estimated date of completion.

- 1) Westinghouse will submit revised RAI response addressing excessive settlement criteria during construction (related to Table 2.5-1 in DCD).
- 2) Westinghouse will revise RAI response including DCD revisions if necessary.

### **Priority “C” Items**

Action Item 12: Regarding RAI-TR85-SEB1-30, Audit Basemat Design Procedure per ACI 349-01

Status: Audit complete. No further actions by NRC or Westinghouse

Action Item 13: Regarding RAI-TR85-SEB1-37, R1, Blow Count for Soil under Basemat and Foundation/wall Backfill

Status: Audit complete. Westinghouse will provide RAI response and estimated completion date.

- 1) Westinghouse will revise RAI response to address blow count, passive site soils and friction factor. Westinghouse will address NRC concerns and propose changes to DCD in the RAI response.

Action Item 14: Regarding RAI-TR85-SEB1-39, Audit Westinghouse “Design Summary Report,” APP-1010-S3R-001

Status: Audit complete. NRC audited selected calculations. No further actions by NRC or Westinghouse

### **Priority “D” Items**

Action Item 15: Regarding RAI-TR85-SEB1-04, R1, DCD Summary of Bearing Pressure Demand and Foundation Stability Evaluations.

Status: Audit Complete. Westinghouse will submit RAI response as stated below and give estimated completion date.

- 1) Westinghouse commits to include a summary of the TR85 information (on bearing pressure and stability) into the DCD via a revised RAI response that includes new DCD pages + including a summary of 2D non-linear evaluation.

Action Item 16: Regarding RAI-TR85-SEB1-15, R1, “Effect of Containment Conditions.”

a) magnitude of soil bearing pressure from containment and accidents, and b) accident thermal loading with pressure.

Status: Audit complete. Westinghouse will submit RAI response and estimated date for completion.

- 1) Westinghouse will provide a revised RAI response with presentation & narrative including addressing “negligible difference” and effects of containment pressure and temperature on basemat.

Action Item 17: Regarding RAI-TR85-SEB1-17, R2, Assumptions for COL Construction Sequence Limitations.

Status: Audit complete. Westinghouse will submit RAI response and estimated completion date.

- 1) Westinghouse will provide new RAI response on DCD 2.5 to clarify limitations to COL applicant.

Action Item 18: Regarding RAI-TR85-SEB1-28

Status: Acceptable DCD changes shown in recent RAI response will be Confirmatory Item.

### **SRP(3.8) Structures**

The items described below, related to AP1000 DCD Section 3.8, were discussed in detail during the audit and summarized during the exit meeting.

#### 1. Review of Westinghouse design reports/calculations for the Nuclear Island structures

The staff reviewed Westinghouse seismic response spectrum calculations which evaluate the seismic loading on the various nuclear island structures. The calculations reviewed are: “Response Spectrum Analysis of AP1000 Auxiliary and Shield Building,” Revision 1 and “Response Spectrum Analysis of AP1000 Containment Internal Structures,” Revision 5. The resulting member forces for the finite elements in this model are then used in a separate calculation to design the various structural members.

The Westinghouse Action Items identified during the review of these calculations and the other reports/calculations associated with TR-85 – Foundation/Basemat are:

- a) The review of the seismic response spectrum calculations for the containment internal structures revealed the use of commas rather than decimal notation to denote some of the numerical results (e.g., 5,147 rather than 5.147). Therefore, Westinghouse

needs to review all of their calculations and identify where this has occurred, correct the calculations, and ensure that decimal notation will always be utilized in the future.

b) The Westinghouse structural design criteria document does not appear to be consistent with the criteria in DCD Section 3.8 regarding the supplementary requirements when using ACI 349-01. Westinghouse needs to revise the criteria document to be consistent with the DCD.

## 2. Review of Westinghouse responses to DCD 3.8 RAIs –

There were a total of 16 RAIs associated with the review of Section 3.8 of AP1000 DCD Rev. 16/17 that were transmitted in the past to Westinghouse. The remaining responses for this set of RAIs were recently received by the NRC. During this audit the staff discussed 8 of the Westinghouse RAI responses. The results of the discussion for these eight RAIs are as follows:

RAI-SRP-3.8.2-SEB1-01 – Westinghouse provided sufficient information. No Action is required by Westinghouse.

RAI-SRP-3.8.2-SEB1-02 – Westinghouse understands the staff's request to compare their design criteria/approach to the guidance contained in several key NRC regulatory guides. Westinghouse will provide a revised RAI response to address this item.

RAI-SRP-3.8.2-SEB1-03 – Westinghouse understands the staff's request to confirm whether several additional load combinations identified in the RAI were considered in the design of the containment. Westinghouse will provide a revised RAI response to address this item.

RAI-SRP-3.8.2-SEB1-04 – Westinghouse understands the staff's request regarding: Item 1 of the RAI which requested more legible figures of the finite element models used for the major containment penetrations and Item 2 of the RAI which requires editorial corrections to the proposed DCD revision. Westinghouse will provide a revised RAI response to address this item.

RAI-SRP-3.8.2-SEB1-05 – Westinghouse RAI response previously transmitted is technically acceptable. Therefore, this RAI is Confirmatory pending revision of the DCD to incorporate the proposed revision to the DCD presented in the RAI response.

RAI-SRP-3.8.2-SEB1-06 – Westinghouse RAI response previously transmitted is acceptable. Therefore, this RAI is resolved.

RAI-SRP-3.8.3-SEB1-01 – For those portions of the AP1000 structural design that were revised between DCD Rev. 15 (certified design) and DCD Rev. 16/17, Westinghouse will determine whether the applicable provisions of the AISC/ANSI N690 Supplement 2 and updated AWS standards have been satisfied. Westinghouse will provide a revised RAI response to address this item.

RAI-SRP-3.8.3-SEB1-02 – Westinghouse RAI response previously transmitted is acceptable. Therefore, this RAI is resolved.

The remaining DCD RAIs that still need to be discussed are: RAI-SRP-3.8.3-SEB1-03, -04, -05, -06, and -07; RAI-SRP-3.8.4-SEB1-03; and RAI-SRP-3.8.6-SEB1-01 and -02. These will be discussed next week with Westinghouse in a telephone conversation.