August 13, 2010

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

FROM: Perry Buckberg, Senior Project Manager ***/RA/***
AP1000 Projects Branch 2
Division of New Reactor Licensing
Office of New Reactors

SUBJECT: AUDIT PLAN FOR REVIEW OF THE AP1000 SEISMIC MARGINS ISSUES – AUGUST 9 - 10, 2010

Enclosed is the audit plan related to Docket No. 52-006 covering selected areas of the AP1000 Design Control Document (DCD), Section 19.55, "Seismic Margins Analysis." Westinghouse submitted to the U.S. Nuclear Regulatory Commission (NRC) DCD Revision 17 for its AP1000 application in September 2008. After conducting a comprehensive review of the DCD, the staff concluded that additional information was needed from the applicant to support the staff's safety evaluation. The purpose of this audit is to review additional Westinghouse documents that contain information not currently in the DCD that are related to the generic AP1000 seismic margins analysis.

Enclosure:
As stated

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(301) 415-1052
Malcolm.Patterson@nrc.gov

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|---|---|---|---|
| NAME | RButler | PBuckberg | EMcKenna |
| DATE | 8/12/10 | 8/12/10 | 8/13/10 |

**OFFICIAL RECORD COPY**

**AP1000 Design Control Document**
**Chapter 19, Section 19.55,**
**"Seismic Margin Analysis"**
**Audit Plan**

### *Background*

Westinghouse Electric Company, LLC (Westinghouse) proposed a revision to the certified design to document the generic seismic margins analysis (SMA) for AP1000. Westinghouse also established an information item for combined operating license (COL) applicants to address the applicability of the generic SMA to the proposed plant site. The staff has reviewed this proposed revision and determined that an audit of the supporting analysis is appropriate.

### *Regulatory Audit Bases*

The proposed revision was reviewed by the staff in accordance with the requirements of 10 CFR 52.47(a)(27), which requires a "description of the design-specific probabilistic risk assessment (PRA) and its results." Part of the assessment addresses risk from seismic events.

In SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor Design," the staff recommended that the plant designer should perform a PRA-based seismic margins analysis (SMA). Its purpose is to identify the seismic vulnerabilities of the design. Using logic models derived from the internal events PRA, the designer determines all important seismic accident sequences. Separately, the fragility of each component in those sequences is determined and expressed as the acceleration for which a high confidence in low probability of failure (HCLPF) can be established for that component. From this, the designer determines the minimum HCLPF value for the plant. The accident sequences that dominate the plant level HCLPF indicate which structures, systems and components (SSC's) limit the seismic capability of the plant and provide a conservative estimate of the earthquake ground motion which the plant is expected to be able to withstand without core damage.

In a staff requirements memorandum (SRM) dated June 21, 1993, the Commission agreed that the plant designer should assess the available margin to seismic failures, and specified that the plant level HCLPF should be at least 1.67 times the ground motion acceleration of the design basis safe-shutdown earthquake (SSE).

The applicant has reported the results of its SMA and proposed a revision to the design control document. Westinghouse includes a provision for COL applicants to update the seismic margins analysis and demonstrate adequate seismic margin on a site-specific basis. COL holders must confirm that the margin still exists in the plant as constructed.

The staff is conducting this audit to examine the basis for the reported results and confirm that the SMA has been performed and documented in a manner that is generally consistent with the recently published interim staff guidance, DC/COL-ISG-020, "Implementation of a Probabilistic Risk Assessment-Based Seismic Margin Analysis for New Reactors."

***Regulatory Audit Scope or Methodology***

Details regarding the determination of structure, system, and component (SSC) HCLPF values will be reviewed by staff and used to support the evaluation of Westinghouse methods for

- considering high-frequency ground motion effects in equipment qualification of sensitive components
- establishing the basis for the shield building HCLPF given the Design Control Document (DCD) Revision 17 design changes
- determining the effects of AP1000 nuclear island soil-structure interaction (SSI) on SSC HCLPF values

**Audit Task 1**

Review the procedure by which the test response spectra (TRS) are to be established for equipment to be qualified by testing. Review a sample of supporting documents relating to

- in-structure response spectra and any associated TRS applicable to the seismic equipment lists in Tables 19.55-1 and 19.55-2
- design specifications that require use of robust switching and relay components (those that must perform system design functions without interruption despite seismic ground motion)
- procurement specifications
    - for equipment to be qualified by test
    - for equipment to be qualified by analysis
    - for equipment to be qualified by a combination of testing and analysis

In addition, the staff will review any criteria for the vendors to conduct equipment HCLPF capacity analysis.

**Audit Task 2**

Review HCLPF values developed for the shield building and perform a detailed review of Westinghouse use of the conservative deterministic failure margin approach, as appropriate.

**Audit Task 3**

Identify which SSC HCLPF values were revised to account for SSI effects from high frequency design response spectra. For the new values, review the technical basis (e.g., assumptions for capacity and response factors), including uncertainties.

**Audit Task 4**

Review the assessment of design changes for the potential to affect the SMA.

***Information and Other Material Necessary for the Regulatory Audit***

The staff will require access to the procedures, models, calculations, and reports used or developed by Westinghouse to perform the activities identified in the audit scope. It would be helpful to the staff to have a brief overview of how Westinghouse performed these activities before delving into documentation or models.

If any of the methods are more readily explained or understood by demonstrating a computer-based process, please ensure that an individual who is familiar with the relevant application is available to do so.

One or more members of the staff audit team also intend to review the DCD revision to Section 19.55 and its associated tables, and Section 19.59.10.5 for specific topics that include the following:

1. treatment of incoherent ground motion in seismic fragility analysis (SFA) of structures and equipment
2. identification of specific strength design factors for SFA
3. comparison of capacity as determined by different methods for a particular ssc (e.g., conservative deterministic failure margin versus pra-based fragility)
4. application of robust bistable devices
5. treatment of margin for sliding and uplift in SFA
6. clarification of the treatment of component and control system failures in the seismic event trees
7. design changes considered for potential impact upon DCD Chapters 17 and 19.

***Team Assignments***

| | |
|---|---|
| * Lynn Mrowca | Chief, PRA and Severe Accidents Branch |
| * Perry Buckberg | Project Manager, AP1000 DCA Chapter 19 |
| Malcolm Patterson | Team Leader, SMA scope |
| Bret Tegeler | SMA methodology |
| Goutam Bagchi | Qualification by testing |
| Keith Tetter | SMA methodology** |
| Abhinav Gupta | HCLPF calculations |

* May participate by telephone or not at all
** Mr. Tetter will be in a training status

***Logistics***

The audit will be conducted at the Westinghouse offices in Cranberry Township, Pennsylvania, beginning on August 9, 2010 An escort is requested to meet the audit team in the lobby of the building at 12:45 p.m. The entrance briefing is scheduled for 1:00 p.m. An exit briefing is tentatively scheduled for 3:30 p.m. on August 10, 2009; however, this may change according to the requirements of the audit and the availability of principals.

All material subject to the site visit (hard copy or electronic) will be left at the site. If any documentation is required to support the staff's regulatory findings, the staff will identify it in a request for additional information.

***Special Requests***

Please make a space available for the team members to meet privately and discuss the progress of the audit. Audit team members will bring computers for note taking and preparation

of a report on the audit. For this reason, access to the PRA report and supporting documents in electronic form would make the audit more effective and efficient.

In addition to workspace with power for the team's computers, please provide access to a local or network printer and a secure (firewalled), hardwired Ethernet connection to the Internet by which the team can remotely access computer resources at the NRC (Additional computer monitors would also be helpful). Finally, please arrange a teleconference line to permit the project manager, PRA branch chief, and others at NRC headquarters to participate as needed.

***Deliverables***

A summary report of the audit will be prepared and issued in accordance with NRO-REG-108.

***References***


1. NRO-REG-108, "Regulatory Audits," April 2, 2009

2. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," March 2007

3. DC/COL-ISG-020, "Implementation of a Probabilistic Risk Assessment-Based Seismic Margin Analysis for New Reactors," March 15, 2010

4. Draft Supplement 2 to NUREG-1793, "Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design," ML09071070012 (predecisional)