March 26, 1997

MEMORANDUM TO: Theodore R. Quay, Director
Standardization Project Directorate
Division of Reactor Program Management

FROM: Goutam Bagchi, Chief
Civil Engineering and Geosciences Branch
Division of Engineering

SUBJECT: REVIEW OF WESTINGHOUSE'S DRAFT REVISION OF SSAR SECTIONS 2.5.4.5 AND 3.8.5.4

Reference: Facsimile from Don Lindgren, Westinghouse to Diane Jackson, NRC, "Draft SSAR Changes to Support the Senior Management Meeting," dated February 27, 1997

The Civil Engineering and Geosciences Branch has completed its review of the draft revision of SSAR Sections 2.5.4.5 and 3.8.5.4 provided through a facsimile (reference) by Westinghouse. Our review comments are attached. If you have any questions, please contact Thomas Cheng at 415-2770.

Attachment: As stated

cc: B. W. Sheron
G. C. Lainas
D. Jackson

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

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Review Comments on the Proposed Revision of
the SSAR Sections 2.5.4.5 and 3.8.5
Submitted By Fax on February 27, 1997

1. Section 2.5.4.5.2.1 (page 2-11, 3rd line from bottom) states that a series of borings should be drilled on a grid pattern that encompasses the nuclear island footprint and 40 feet beyond the boundary of the footprint. The basis for the proposed 40 feet limit is not clear; the limit should be about one-third to one-half of the length/width of the nuclear island (which measures 256 feet in length and about 160 feet in width).

2. Section 2.5.4.5.2.1 (page 2-12, the first paragraph, the tenth line) states that at least one-fourth of the primary boring should penetrate sound rock, or for deep soil sites, to a maximum depth, d_{max}, taken as the depth at which the vertical stress during or after construction for the combined foundation loading is less than 10 percent of in situ the effective overburden stress. Other boring may terminate at a depth of 160 feet below the foundation (equal to the width of the structure).

   This is not acceptable because the depth at which the borings are stopped should depend on the suspected presence or absence of compressible materials or the suspected presence of voids (i.e. sinkhole, etc.) below the nuclear island footprint. In any case, the 160 feet limit should be changed to at least 200 feet (which is approximately equal to the "side" of the equivalent square of the nuclear island footprint).

3. From the review of Page 2-12 and 2-13 (Section 2.5.4.5.2.1) of the submittal, it seems to the staff that, to establish the "uniformity" of a site, there are three criteria that the site must satisfy: (1) the uniformity of the layer thickness (layers must be uniform), (2) the dip angle of the layer (maximum 20 degrees), and (3) uniformity of shear wave velocity within any layer (variation must be less than 10 or 20 percent of the layer average). In addition, there seems to be two other criteria discussed in the third and fourth paragraphs of page 2-12, and in pages 2-14 and 2-15: (4) the depth of a given layer must not deviate by more than 5 percent of the depth of the "best estimate" plane for the layer, and (5) any undulatory bed rock must be at least 40 feet below the bottom of the basemat. Westinghouse should clearly state these five acceptance criteria in the SSAR. The lengthy discussion of the draft revision is very confusing and is likely to lead to a misinterpretation. The procedure for establishing the acceptability of AP600 design for non-uniform sites should also be established. In addition, for the site to be acceptable as a uniform site, the last paragraph of page 2-12 states that the variation of the shear wave velocity in the material below the foundation to a depth of 80 feet below the basemat within the footprint of the plant shall meet the criteria specified on Page 2-13. Westinghouse should justify the basis for the 80 feet limit.

Attachment

4. In Section 2.5.4.5.2.2, Westinghouse indicates that if a site is classified as non-uniform based on the criteria listed on the top of Page 2-13, the investigative effort should be extended in such a way that the site may be demonstrated to be acceptable for AP600 by showing that the in-structure response spectra are enveloped by the design in-structure response spectrum envelopes. However, it should be clearly stated in the SSAR that the demonstration must specifically include a complete re-evaluation of the soil-structure interaction effects for this non-uniform site, because all soil-structure interaction analyses (2D or 3D) performed by Westinghouse were based on uniformly bedded site profiles. The staff, in the previous review meetings, has raised concern regarding how the effect of local hills and valleys of the bed rock (or competent material) need to be include in the evaluation. The staff's concern is that these non-uniform conditions would serve to change the input free-field ground motions coming into the site (e.g., local amplification effects).

5. Section 2.5.4.5.5 (page 2-16) states that for sites with soil characteristics outside the range considered in Appendices 2A.2, and 2B.2, COL applicant may use the site-specific soil conditions and site-specific SSE, and perform site-specific SSI analyses, and demonstrate acceptability (of the site) by comparing the floor response spectra at specified locations. A similar statement permitting the COL applicant to perform a site-specific seismic analysis of the nuclear island is made in Section 2.5.4.5.2.2 (Acceptance criteria for non-uniform sites). The proposed revision is not acceptable to the staff. The SSAR should state that such sites are not covered by the certified design.

6. The statement made in Section 3.8.5.4.3 concerning construction induced stresses is not acceptable. During previous review meetings, the staff has indicated that the basemat stresses induced by construction settlements can be additive to the basemat stresses induced by other design basis loads. It is not necessarily proper to treat these stesses as secondary or self-relieving stresses. The settlement induced stresses can be additive at some locations depending on the construction sequence, the geometry of the structure, and the sense of the induced moments and shears developed in the basemat. In the December 9 through 13, 1996 meeting, Westinghouse was requested to provide information on those issues typically encountered during construction of large structures (stress relief and expansion due to excavation, effective stress increase and settlements from dewatering effects, and long term consolidation effects on the settlement time history). The staff also requested Westinghouse to provide a possible use of a limitation on the anticipated construction for definition of an adequate site. However, the information was not provided. In addition, the analyses performed by Westinghouse are based on two-dimensional analyses and only considered the effect of immediate settlements based on construction-induced stresses. Even then, Westinghouse's calculations indicated that these stresses are sensitive to the particular sequence of construction

assumed. The effects of settlement time history were not evaluated. Furthermore, the conversion of two dimensional to three dimensional (real world) effects used an unusually large factor to reduce the predicted bending moments and shears of the basemat without a proper justification. The adequacy of using this reduction factor needs to be demonstrated by Westinghouse.