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November 1, 1982

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Ms. E. G. Adensam, Chief
Licensing Branch No. 4

Re: Catawba Nuclear Station
Docket Nos. 50-413 and 50-414

Dear Mr. Denton:

W. O. Parker, Jr.'s letter of April 8, 1982 transmitted responses to Action Items which resulted from a December 15-18, 1981 meeting with the NRC's Structural Engineering Branch. Attached is a revised response to Action Item 10.

Very truly yours,

Hal B. Tucker

Hal B. Tucker

ROS/php
Attachment

cc: Mr. James P. O'Reilly, Regional Administrator
U. S. Nuclear Regulatory Commission
Region II
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Mr. P. K. Van Doorn
NRC Resident Inspector
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cc: Mr. Jesse L. Riley
Carolina Environmental Study Group
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Mr. Henry A. Presler, Chairman
Charlotte-Mecklenburg Environmental Coalition
943 Henley Place
Charlotte, North Carolina 28207

10. Provide justification demonstrating negligible amplification assumed in vertical seismic analysis (interior structure, auxiliary building, and steel containment).

Revised Response (Steel Containment only)

During preparation of the design report for the steel containment vessel, a detailed review of all design calculations has been made. In the course of this review, it was found that the spectra submitted in the initial response to this action item had been generated using relative acceleration time histories from the lumped mass stick model. A time history of total accelerations is the appropriate input for generation of these spectra.

The use of spectra generated using relative accelerations results in the conclusion that the vertical ground response spectrum envelopes the vertical spectrum at each point. This, in fact, may not be true when total accelerations are considered. Because of this, the spectra previously submitted are somewhat misleading and should be deleted from Duke's response to this action item.

A reanalysis of the vertical response of the steel containment was made. The containment vessel stick model was analyzed for vertical excitation using an input vertical base acceleration time history identical to the horizontal base acceleration time history used in the horizontal seismic analysis. All containment frequencies up to 33 hz were considered in the analysis. Using total acceleration time histories from this analysis, vertical response spectra were generated at the base and at mass points of interest.

A review of the results of the analysis described above was conducted to quantify the amplification in the vertical direction. Figure 10.1 depicts the methodology used in this review. In this figure, Spectrum "A" represents the required vertical ground response spectrum, defined in the FSAR as two-thirds of the horizontal ground response spectrum. Spectrum "1" represents the vertical ground response spectrum resulting from the input vertical base acceleration time history. It should be noted that this spectrum envelopes the horizontal ground response spectrum shown in the FSAR. Spectrum "n" represents the vertical response spectrum obtained at mass point "n". At a given period $\underline{t}_i$, one point on each spectrum is defined.

For a given frequency or period, the magnification factor $\underline{H}$ was defined to be the ratio of the response acceleration to the excitation acceleration.

$$H = a_n / a_1$$

The digital response spectrum data was reviewed for all frequencies between 0 hz and 33.3 hz and for all applicable damping ratios. In the general frequency range of 5 hz to 20 hz, the magnification factor $\underline{H}$ was found to be greater than 1.05, indicating a 5% or greater amplification of the acceleration input at the base. At some points, the value of $\underline{H}$ reached a maximum of 1.51, indicating an amplification of the input acceleration by 51%.

Since this amplification was felt to be potentially significant, the spectrum data was further reviewed to quantify the magnitude of the acceleration increase. For an input vertical base excitation equal to the required vertical ground response (Spectrum "A"), the magnitude of the increase in acceleration is given by

$$\Delta a = (a_n - a_1)a_A/a_1 = (H-1)a_A$$

A pointwise review of spectrum data showed the maximum amplification of acceleration to be approximately 0.06 g. When this increase is compared to the constant gravitational acceleration of 1.0 g experienced by all attachments to the containment vessel, it is felt that the assumption of negligible amplification in the vertical direction is indeed justified.

It should be pointed out that the analysis in question pertains only to attachments to the steel containment, not the vessel itself. In the analysis of the containment, all vertical and horizintal modes below 30 hz were considered by modeling the entire vessel and applying shock spectra at the base in both directions.

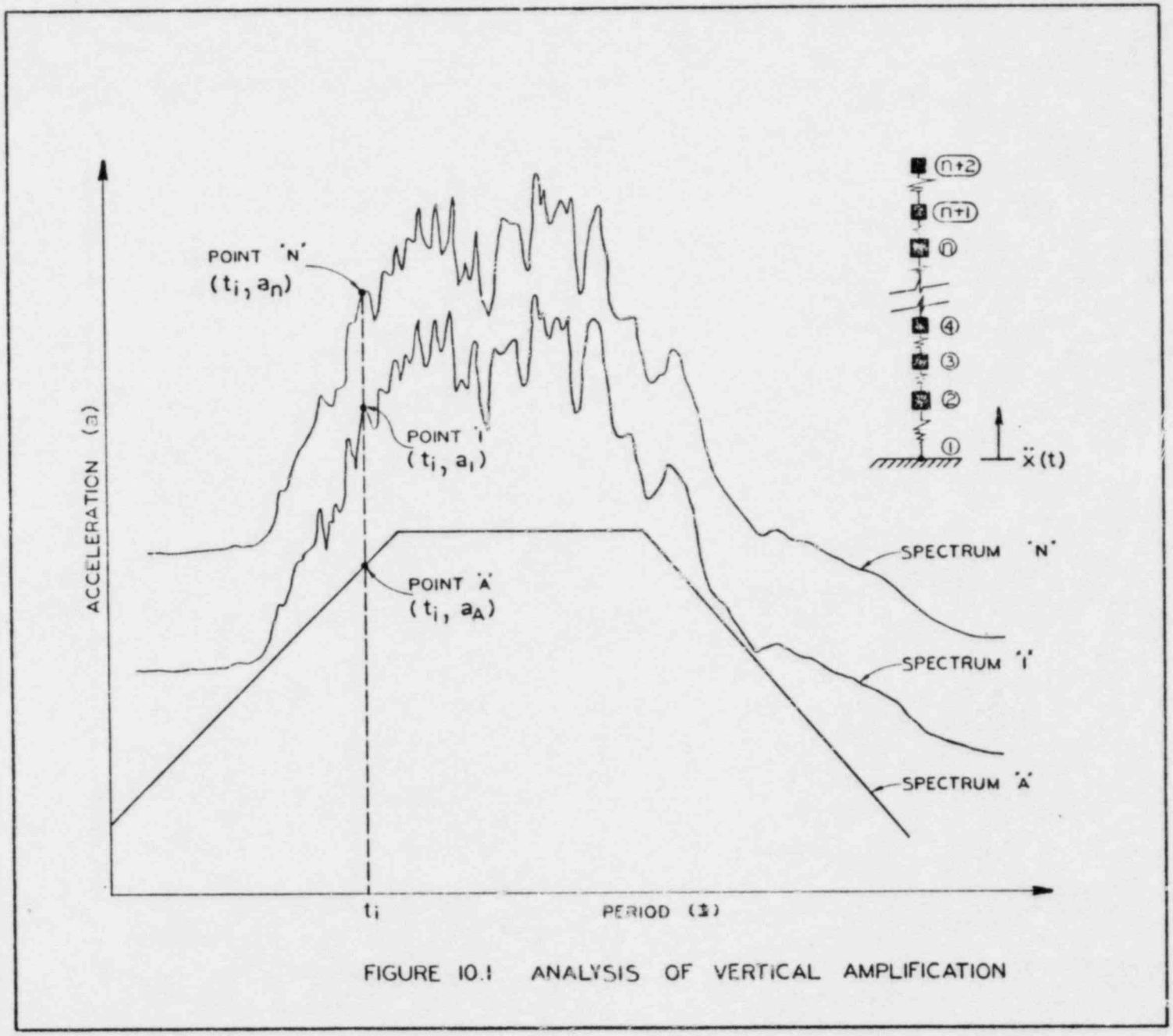

FIGURE 10.1 ANALYSIS OF VERTICAL AMPLIFICATION