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

January 20, 1988

Docket No. 50-508

MEMORANDUM FOR: The record

FROM: Guy S. Vissing, Project Manager
Standardization and Non-Power Reactor
Project Directorate
Division of Reactor Projects III, IV, V
and Special Projects
Office of Nuclear Reactor Regulation

SUBJECT: SUMMARY OF MEETING OF THE STAFF WITH WASHINGTON PUBLIC POWER SUPPLY SYSTEM CONCERNING THE WNP-3 SOIL-STRUCTURE INTERACTION/DECONVOLUTION ANALYSIS

INTRODUCTION

A meeting of the staff with representatives of Washington Public Power Supply System (WPPSS or the Supply System) was held at the offices of the NRC in Bethesda, Maryland, on December 15, 1987. The purpose of the meeting was to resolve some outstanding questions concerning the soil-structure interaction/deconvolution analysis used in the WNP-3 seismic evaluation as described in the WNP-3 FSAR. Enclosure 1 provides the list of those who attended the meeting. Enclosure 2 provides the viewgraphs which were presented during the meeting.

BACKGROUND

Brookhaven National Laboratory (BNL) are the technical review contractors on this issue. BNL provided a report by letter dated October 15, 1987, which indicated that there was not a sufficient basis to conclude the review and prepare a TER. While the applicant has satisfactorily responded to several questions raised in a request for additional information of April 1, 1987, there are still some concerns regarding the applicant's deconvolution analysis. Therefore, BNL proposed a meeting with WPPSS in order to the resolve the concerns raised in the BNL report. The BNL report was sent to WPPSS on November 10, 1987.

DISCUSSION

WPPSS discussed the deconvolution analysis and related issues as indicated in the viewgraphs. A summary of the main issues discussed at the meeting to resolve the questions concerning the SSI/Deconvolution Analysis performed by WPPSS for the WNP-3 plant follows:

The applicant's staff presented some data to answer the questions raised by BNL on the applicants response of July 31, 1987, to our request for additional information of April 1, 1987. Specifically the applicant's staff discussed the procedure used to obtain the side wall interaction springs and damping parameters used in the half-space analysis. The staff indicated that the applicant's methods of determining these impedance parameters were not

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appropriate. For example, fixing the bottom nodes of the finite element model for determining the sidewall spring stiffness did not produce the proper stiffness values. The staff also suggested that assuming the foundation to be rigid and obtaining the impedance functions using the procedures described in the currently available literature might produce reasonable results.

Next the applicant's staff tried to show that the response determined by its half-space analyses of Category-I structures, piping, etc. were bounded by the original (finite element) seismic design results. The staff indicated that the applicant's conclusions appeared to be based on comparison of responses at the ZPA level and that the responses at lower frequences were not included in their presentation.

After a detailed discussion of the various aspects of the applicant's analysis procedures presented, the staff requested the applicant to provide additional information/justification on the following items:

1. Justify that the ZPA alone represents an acceptable upper bound for the structural parameters of interest for Category I structures.

2. Justify that the frequency-independent impedances are adequate for the frequency ranges of interest at the WNP-3 site for the embedded foundation conditions.

3. Compare sidewall impedances used in the half-space analysis with those obtained from analytical solutions for these parameters available in the literature.

4. Provide detailed calculations to show that stresses developed in the steel containment vessel as predicted by the half-space analysis are within acceptable limits.

The staff informed the applicant that, only after providing satisfactory responses to the above items, a comparison should be made of the spectra from the half-space analysis with the design basis spectra (obtained from finite element analysis using deconvolution). If the design basis spectra envelope the half-space analysis results, then the method for obtaining the design basis reported in the FSAR will be considered acceptable. If not, the applicant should consider the specific site effects in determining the ground motion input to be used in the SSI analysis. After that, the staff will perform an audit of the applicant's deconvolution calculations. However, it should be understood that the level of ground motion is subject to modification depending on the results of the Seismology Program review.

In response to the applicant's request concerning the level of detailed analysis that would be expected in justifying the accuracy of its analysis procedure, the staff indicated that the containment analysis should be as complete as possible in order for the staff to resolve this issue.

In summary, the applicant was asked to review and reevaluate the basic input parameters used in the deconvolution/SSI analysis and then compare the half-space analysis results with the design basis spectra reported in the FSAR.

Guy S. Vissing, Project Manager
Standardization and Non-Power
Reactor Project Directorate
Division of Reactor Projects III,
IV, V and Special Projects
Office of Nuclear Reactor Regulation

Enclosures:
As stated

ENCLOSURE 1

ATTENDANCE LIST
FOR
MEETING WITH WPPSS
CONCERNING
SOIL STRUCTURE INTERACTION/DECONVOLUTION
ANALYSIS
FOR WNP-3

NAME	ORGANIZATION
Guy S. Vissing	NRC/NRR/PDSNP
Ramon Pichumani	NRC/NRR/DEST/ESGB
Carl Custuntino	NRC/BNL
Doug Coleman	Supply System Licensing
Dave Bosi	Supply System Engineering
Mike Hsieh	EBASCO Civil
Robin Wang	EBASCO Service Inc.
Kao Ding Chiu	EBASCO Civil
Choul Ho Yum	NRC/NRR/DEST/ESGB (IAZA)
Goutam Bagchi	NRC/NRR/DEST/ESGB
Steve Prussman	EBASCO-Licensing
A. T. Philippalopoulos	BNL/NRC
R. Rothman	NRC/ESGB

Enclosure 2

WNP-3: DECONVOLUTION ISSUE

O	HISTORY/OVERVIEW	D COLEMAN
O	ADDRESS CONCERN REGARDING DIFFERENCES IN SPECTRAL ACCELERATIONS BETWEEN ELASTIC HALF SPACE AND FINITE ELEMENT ANALYSES.	M HSIEH
O	ADDRESS CONCERNS REGARDING FOUNDATION SPRINGS USED IN THE ELASTIC HALF SPACE ANALYSIS.	D BOSI
O	DISCUSS BASIC PREMISE FOR STRUCTURAL AUDIT FINDING #1.	D BOSI

WNP-3: DECONVOLUTION ISSUE

HISTORY

- O NRC FIRST RAISED THE QUESTION IN REQUEST FOR ADDITIONAL INFORMATION ITEM 220.13 MAY 3, 1983.
- O NRC AUDIT FINDING #1 RESULTED FROM THE NRC STRUCTURAL AUDIT CONDUCTED IN NEW YORK SEPTEMBER 1983.
- O NUREG-0800, STANDARD REVIEW PLAN, SECTION 3.7.2, REV 1 WAS ISSUED JULY 1981.
- O 10CFR50.34(G) REQUIRES THAT "APPLICATIONS FOR LIGHT WATER COOLED NUCLEAR POWER PLANT OPERATING LICENSES DOCKETED AFTER MAY 17, 1982 (INCLUDES WNP-3) SHALL INCLUDE AN EVALUATION OF THE FACILITY AGAINST THE STANDARD REVIEW PLAN (SRP) IN EFFECT ON MAY 17, 1982 OR THE SRP REVISION IN EFFECT SIX MONTHS PRIOR TO THE DOCKET DATE OF THE APPLICATION, WHICHEVER IS LATER". THEREFORE, WNP-3 MUST PROVIDE AN EVALUATION AGAINST THE SRP IN EFFECT ON MAY 17, 1982.
- O SUPPLY SYSTEM/EBASCO PERFORM AN ELASTIC HALF SPACE ANALYSIS TO DEMONSTRATE THE VALIDITY OF THE ORIGINAL FINITE ELEMENT ANALYSIS (DESIGN BASIS). THE RESULTS WERE DOCUMENTED IN A SUBMITTAL TO NRC JUNE 27, 1984.
- O THE RESULTS WERE DISCUSSED IN A MEETING WITH THE NRC STAFF JULY 10, 1984.
- O THE SUPPLY SYSTEM SUBMITTED FURTHER ANALYSIS ON JULY 14, 1986 PROVIDING FURTHER VALIDATION OF THE ACCEPTABILITY OF THE ELASTIC HALF SPACE MODEL.

- ADDITIONAL NRC QUESTIONS WERE TRANSMITTED APRIL 7, 1987.
- SUPPLY SYSTEM PROVIDED RESPONSES TO THE LAST SET OF QUESTIONS ON JULY 31, 1987.

3A. THE RESULTS OF THE HALF-SPACE ANALYSIS CORRELATE WELL WITH THOSE ESTABLISHED FOR THE WNP-3 DESIGN BASES UTILIZING A FINITE ELEMENT APPROACH CONSIDERING THAT THE CONTROL MOTION WAS APPLIED AT TWO DIFFERENT LEVELS; AT THE FOUNDATION LEVEL IN THE HALF-SPACE ANALYSIS AND AT THE PLANT GRADE IN THE FINITE ELEMENT ANALYSIS. THE DIFFERENCES IN RESPONSES BETWEEN THE TWO ARE BELIEVED ATTRIBUTABLE TO THE DIFFERENCE IN THE INPUT DEFINITION STATED ABOVE.

THE PRELIMINARY ENGINEERING EVALUATION OF THE HALF-SPACE RESULTS WAS CONDUCTED IN 1984 FOR A NUMBER OF SAMPLE CRITICAL SAFE SHUTDOWN SYSTEMS WITH EMPHASIS ON THE AREAS OF GREATER DEVIATION FROM THE DESIGN BASIS RESULTS. THE RESULTS OF THE EVALUATION ARE SUMMARIZED IN ATTACHMENT 1.

2E. FOR ANY LUMPED MASS-SPRING SYSTEM, THE ASSOCIATED LUMPED DAMPING PARAMETER WILL INCLUDE THE EFFECTS OF RADIATION (GEOMETRICAL) AND MATERIAL (INTERNAL) DAMPING. THE RADIATION DAMPING IN TRANSLATORY MODES (COMPRESSION AND SLIDING) IS KNOWN TO BE MUCH GREATER THAN THE MATERIAL DAMPING TO AN EXTENT THAT THE LATTER MAY BE DISREGARDED IN THE ANALYSIS.

IN THE HALF SPACE ANALYSIS PERFORMED IN RESPONSE TO AUDIT FINDING NO. 1, THE RADIATION DAMPING ASSOCIATED WITH THE SIDE SPRINGS WAS DISREGARDED BECAUSE IT WAS DIFFICULT TO QUANTIFY WITH PROPER JUSTIFICATION.

USE OF ONLY THE MATERIAL DAMPING FOR THE SIDE SPRINGS IN THE LUMPED MASS-SPRING SYSTEM IS CONSERVATIVE SINCE SMALLER DAMPING GENERALLY RESULTS IN HIGHER RESPONSES WITH LITTLE EFFECT ON FREQUENCIES.

MATERIAL DAMPING OF FOUNDATION MATERIALS DETERMINED FROM TESTS IS GENERALLY EXPRESSED IN TERMS OF CORRESPONDING SHEAR STRAIN LEVEL. THE DOMINANT STRUCTURAL RESPONSE IS ASSOCIATED WITH THE SHEAR WAVE MOTION FOR WHICH THE APPLIED MATERIAL DAMPING IS APPROPRIATE.

IT HAS BEEN SHOWN (1),(2) THAT RADIATION DAMPING INCREASES WITH INCREASED EMBEDMENT DEPTH. THE HALF-SPACE ANALYSIS IS CONSERVATIVE IN THIS REGARD SINCE THE HIGHER RADIATION DAMPING EFFECTS WERE NOT CONSIDERED.

not acceptable
Need quantitative analysis

2F. SEVERAL WIDELY ACCEPTED METHODS EXIST FOR COMPLETING SEISMIC DESIGN ANALYSES. IN BROAD TERMS THESE INCLUDE HALF-SPACE AND FINITE ELEMENT METHODOLOGIES. EXPERIMENTS HAVE SHOWN[1] THAT THE HALF SPACE METHOD YIELDS RESULTS JUST AS GOOD AS THE FINITE ELEMENT APPROACH IN CERTAIN CONDITIONS SUCH AS WHEN THE EMBEDMENT IS LESS THAN HALF OF THE BUIDLING HEIGHT. ALSO KAUSEL ET AL [2] OBSERVED THAT "THE FREQUENCY VARIATION OF THESE (HALF SPACE) FUNCTIONS IS NOT VERY DIFFERENT FOR EMBEDDED FOUNDATIONS. THE MAIN EFFECT OF EMBEDMENT SEEMS TO BE AN OVERALL INCREASE IN THE STIFFNESS VALUES OVER THE ENTIRE FREQUENCY RANGE. THIS WOULD ALLOW USE OF THE FINITE ELEMENT TECHNIQUES JUST FOR THE STATIC CASE (TO FIND THE SIDE SPRINGS)". FURTHER Y O BERDUGO AND M NOVAK[3] IMPLIED THAT CONSTANT PARAMETERS (WEIGHTED AVERAGE FREQUENCY INDEPENDENT) YIELDS RESPONSES QUITE CLOSE TO THOSE FROM THE VARIABLE PARAMETERS (FREQUENT DEPENDENT). IN OUR LAST RESPONSE, WE STATED THAT OUR HALF SPACE PLUS STATIC SIDE SPRING MODEL GIVES SATISFACTORY RESULTS IN COMPARISON WITH THE FINITE ELEMENT MODEL. WE BELIEVE THAT FURTHER STUDY IN FREQUENCY DOMAIN IS NOT NECESSARY. THE SIDE WALLS OF WNP-3 ARE NOT RIGID. AS E KAUSEL ET AL STATED "THAT THE ROTATIONAL COMPONENT IS SENSITIVIE TO THE LATERAL SOIL CONDITIONS AND PARTICULARLY TO THE FLEXIBILITY OF THE LATERAL WALLS. FOR FLEXIBILE SIDE WALLS THE ACTUAL ROTATION IS SIGNIFICANTLY SMALLER...." TO DERIVE FREQUENCY SPRINGS FOR FLEXIBLE SIDE WALLS IS VERY CUMBERSOME. THE EFFORT IS MUCH GREATER THAN THE ONE-STEP FINITE ELEMENT APPROACH. WITH 300' WIDE BY 64' DEEP EMBEDDED SIDE WALLS, IT IS VERY HARD TO JUSTIFY THAT THE WALLS CAN BE TREATED AS RIGID.

2G. SIMILAR TO 2F.

Question No.

220.13 (SRP 3.7.1, II, and 2.7.2, II, 4 FSAR 3.7.1.2) The applicant has allowed a considerable reduction in the estimated accelerations at the basemat compared to the full free-field design response spectrum (over 35% at 10 HZ for horizontal SSE). In the FSAR the applicant is comparing his response spectrum at the basemat with a 60% design response spectrum.

This is essentially a rock site. Shear wave velocities of 3000 to 4300 fps were recorded in the supporting medium. Therefore, it is considered that, regardless of the method used to establish response spectra, reductions in seismic response at the basemat level would not be expected. This was specifically confirmed by the applicant in paragraph 2.5.4.7 of the FSAR, the last sentence of which states, "Therefore, there will be no amplification in the sandstone, and the baserock acceleration at the site is equal to the acceleration at the plant foundation." The applicant must provide conclusive justification to show that the approach used is technically correct and also will be properly conservative for this rock site. The seismic analysis methods described in NUREG-0800, Rev. 1, Section 3.7.1 and 3.7.2 will be used by the staff as guidance in our evaluation of an acceptable design basis.

Response

On September 26, 1983, members of the NRC Structural Engineering Branch conducted a design audit at the offices of the WNP-3 Architect/Engineer, Ebasco Services Inc., in New York City.

The results of this audit were transmitted to the Supply System via letter from G. W. Knighton to D. W. Mazur, dated November 2, 1983. The Supply System considers this Question and Audit Finding Number 1 to be essentially the same concern. Accordingly, we consider it appropriate to address the response to this question in the context of our response to Structural Audit Finding Number 1.

Audit Finding #1

In order to proceed with the audit it was decided to discuss with Ebasco the deconvolution analysis for the plant. This issue was previously raised in review of the FSAR. Ebasco has applied the deconvolution methodology to a finite element model of the rock site. Since the rock is essentially elastic in the range of interest, a reduction in motion at the base mat from that postulated at the surface, would not be expected. In the analysis, credit was taken for such a reduction and the staff has desagreed since such results would not be expected for a rock site.

Accordingly, the staff will require that the recommendations of NUREG-0800, Section 3.7.2 be followed. Specifically, either an elastic half-space analysis should be performed to confirm the finite element analysis, or the site should be considered as a rock site, and a fixed-base analysis should be performed. In any case the full value of the SSE/OBE should be input at the base mat without reduction.

Applicants Preliminary Response to Finding #1

The above concern was addressed in a letter dated May 3, 1983, T. Novak to R. L. Ferguson (Questions 220.13 and 220.16). The Supply System intends to provide a response to the cited questions by February of 1984.

SGEB Staff Discussion

The applicant did not furnish computations of his deconvolution sensitivity analysis for the staff to examine in the audit (see also audit finding #8). However, it is considered that the staff direction provided to the applicant during the audit, as described above, represents an acceptable method to verify the adequacy of the structures to withstand seismic (in combination with other) loads.

Any confirmatory analysis by the applicant should include the production of response spectra which can be compared to the applicable response spectra and previous results for the staff evaluation.

Seismic Design for Nuclear Power Plants

Robert J. Hansen, *editor*

The M.I.T. Press
Cambridge, Massachusetts, and London, England

"It is important to recognize that even with a hard rock site there will be differences in motions at the surface and at depth. Figure 28 gives data from a site in Japan of an underground power plant where rock extended to the surface. It was found on a statistical basis that the peak acceleration at ground surface was about twice the peak acceleration at a depth of 300 meters. Thus it is not just having a deposit of soil that may cause motions to increase from depth up to the surface; the same trend occurs in rock."

(LIBRARY OF CONGRESS: 79-110237, SEE PG. 24)

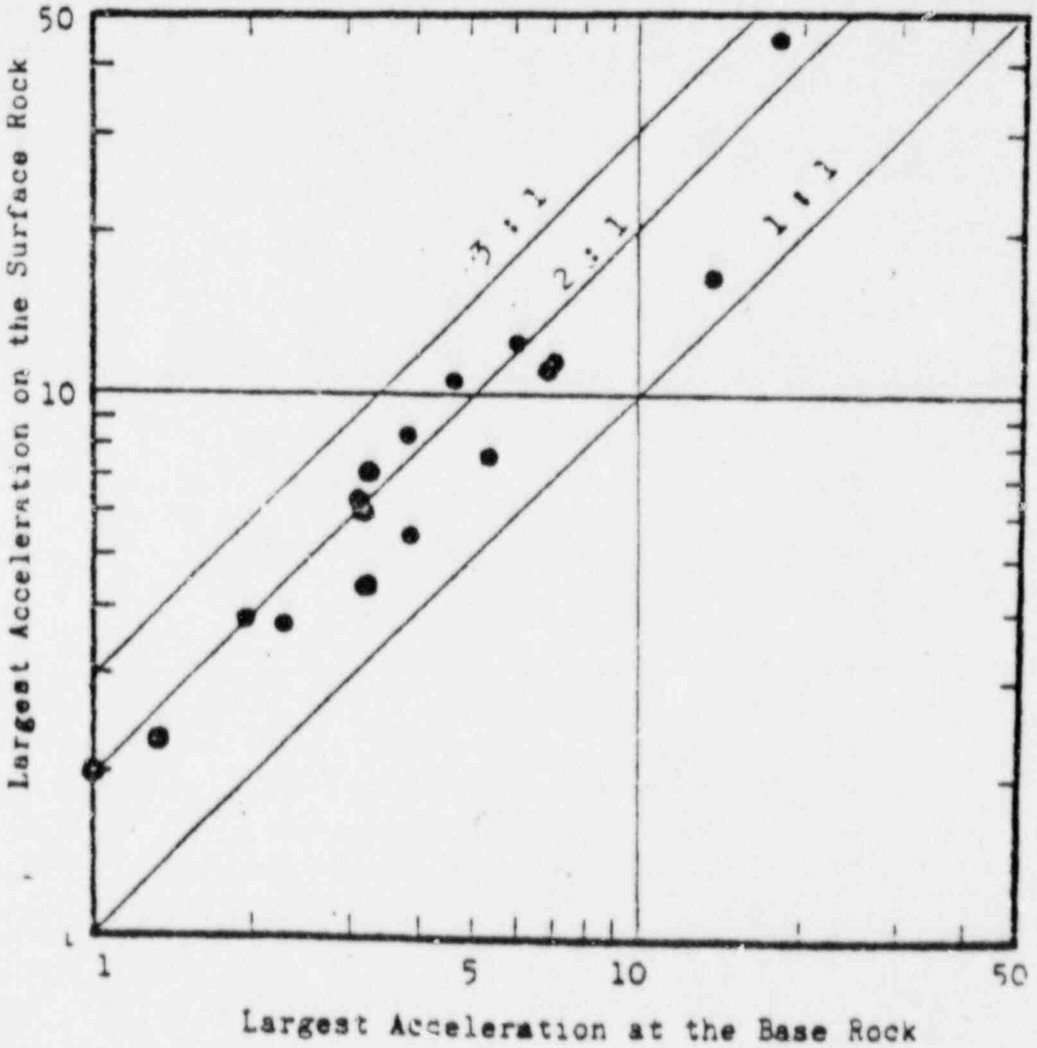


FIGURE 28 PEAK ACCELERATIONS ON ROCK AND AT 300 METER DEPTH
(from Tamura et al., 1969)

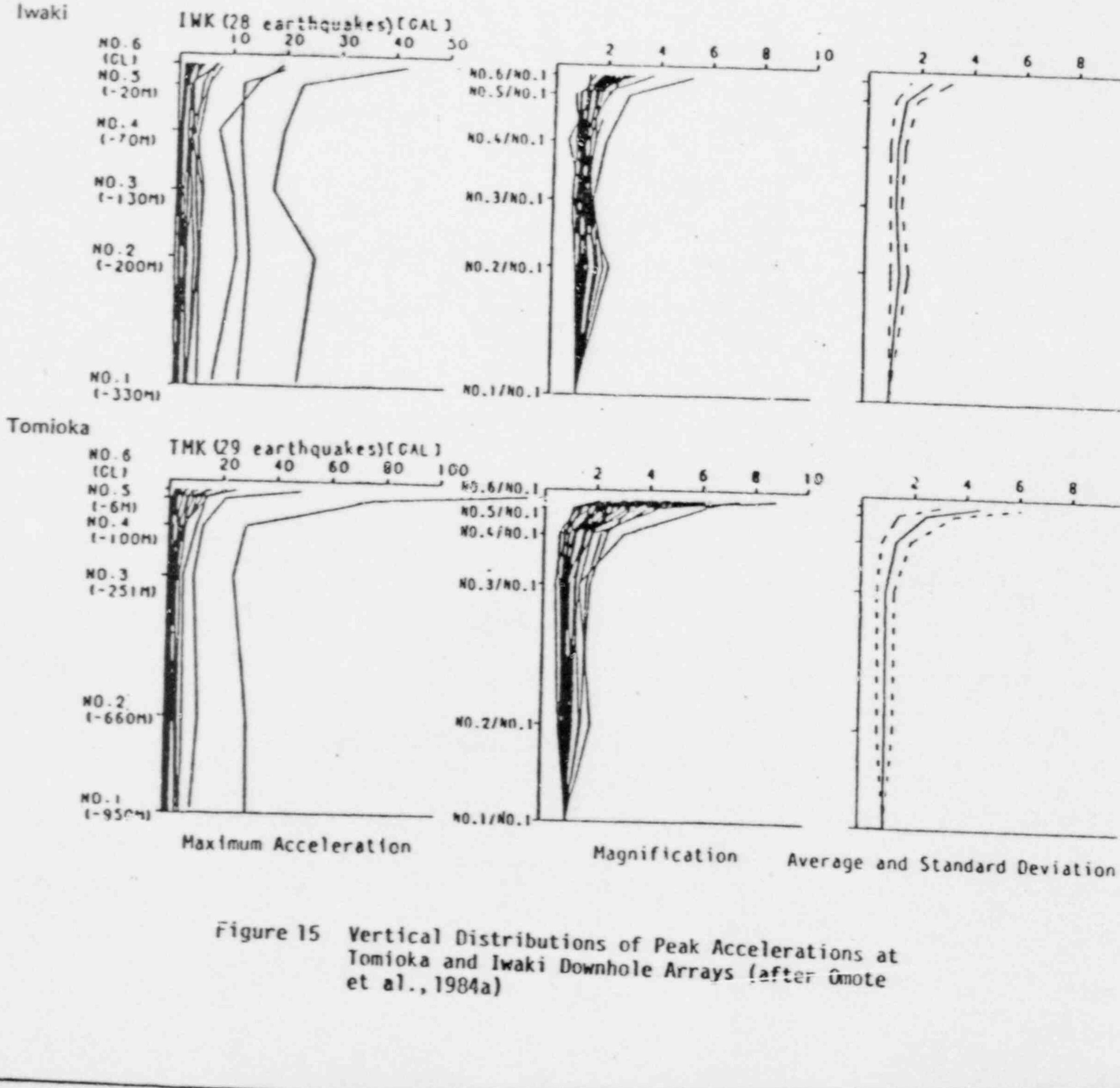


Figure 15 Vertical Distributions of Peak Accelerations at Tomioka and Iwaki Downhole Arrays (after Ohmote et al., 1984a)

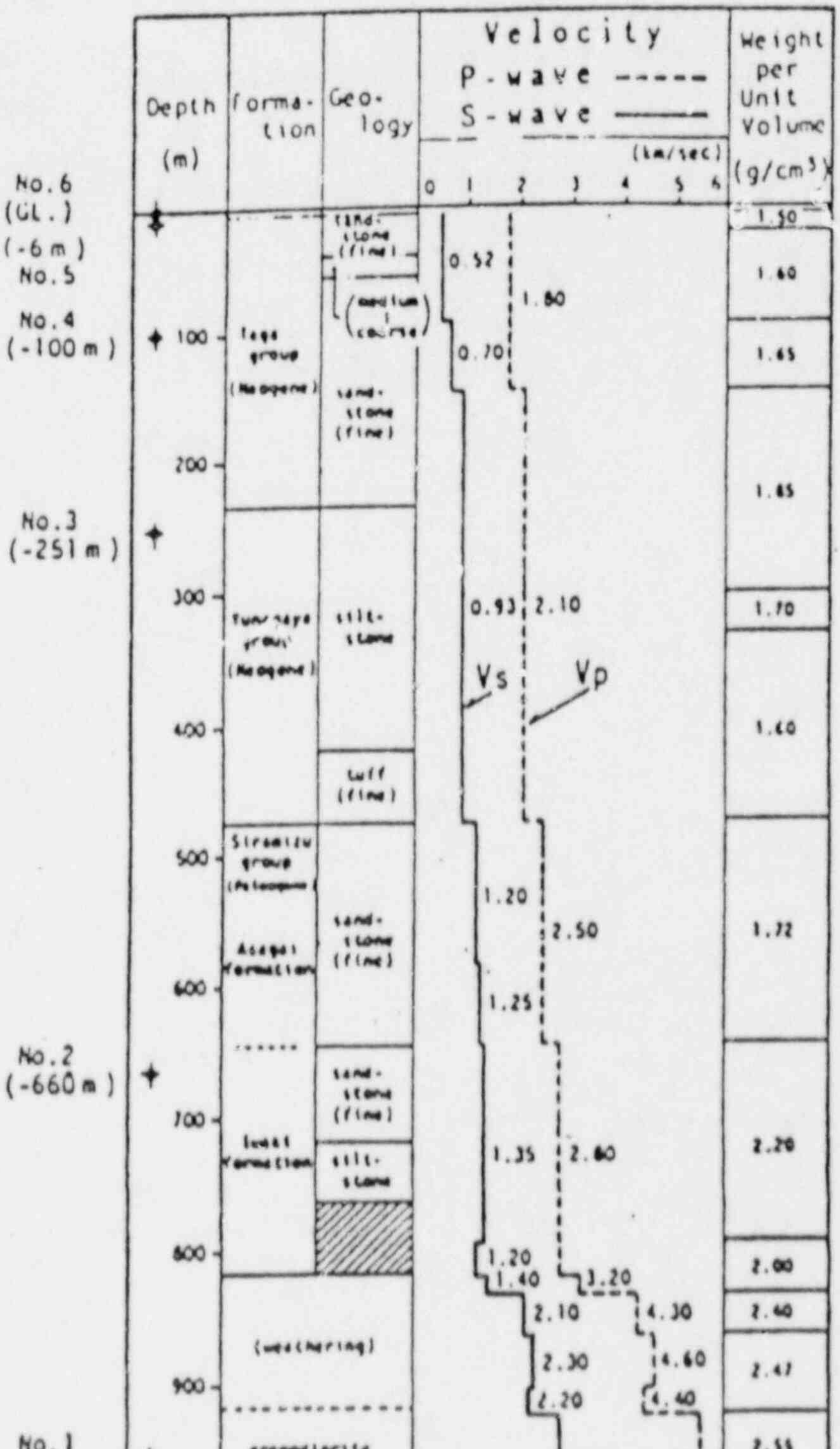


Figure 13 Rock Profile and Shear Wave Velocity Profile at Tomioka Downhole Array (after Omote et al., 1984a)

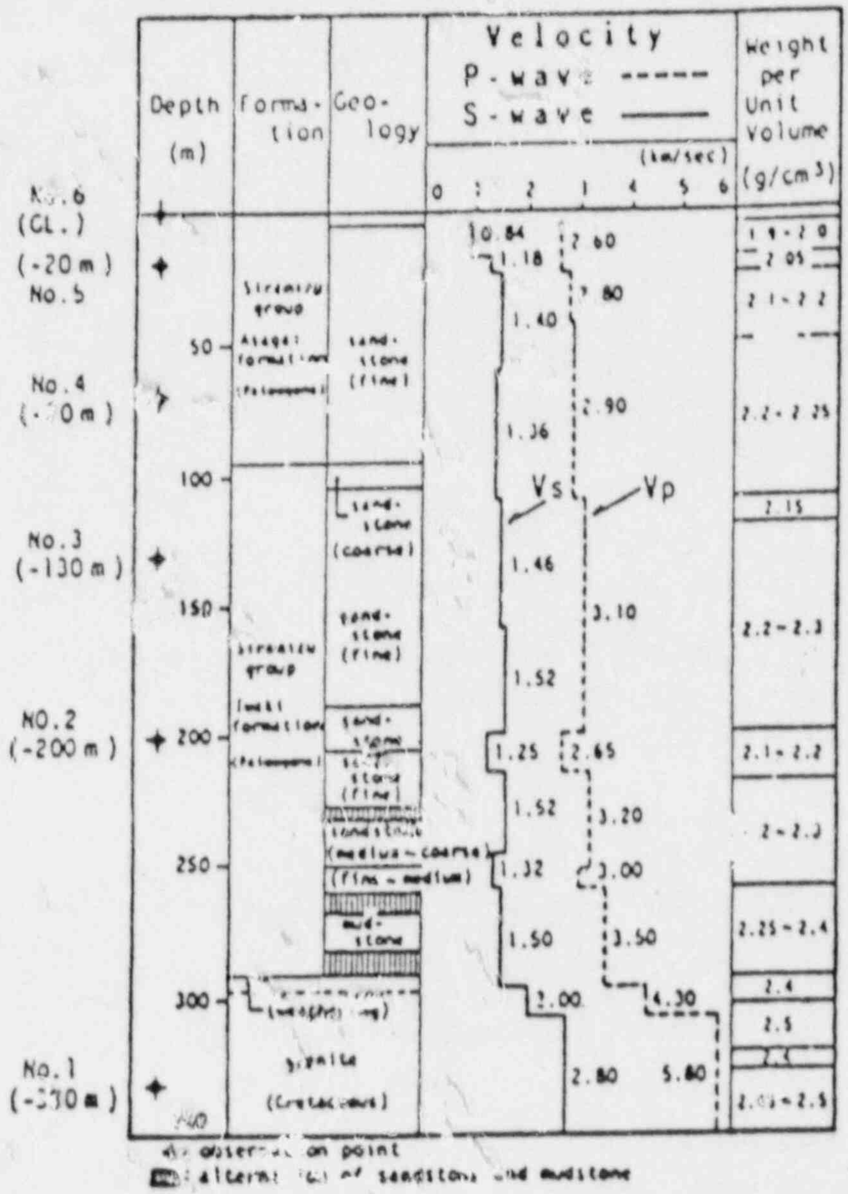


Figure 14 Rock Profile and Shear Wave Velocity Profile at Iwaki Downhole Array (after Omote et al., 1984a)

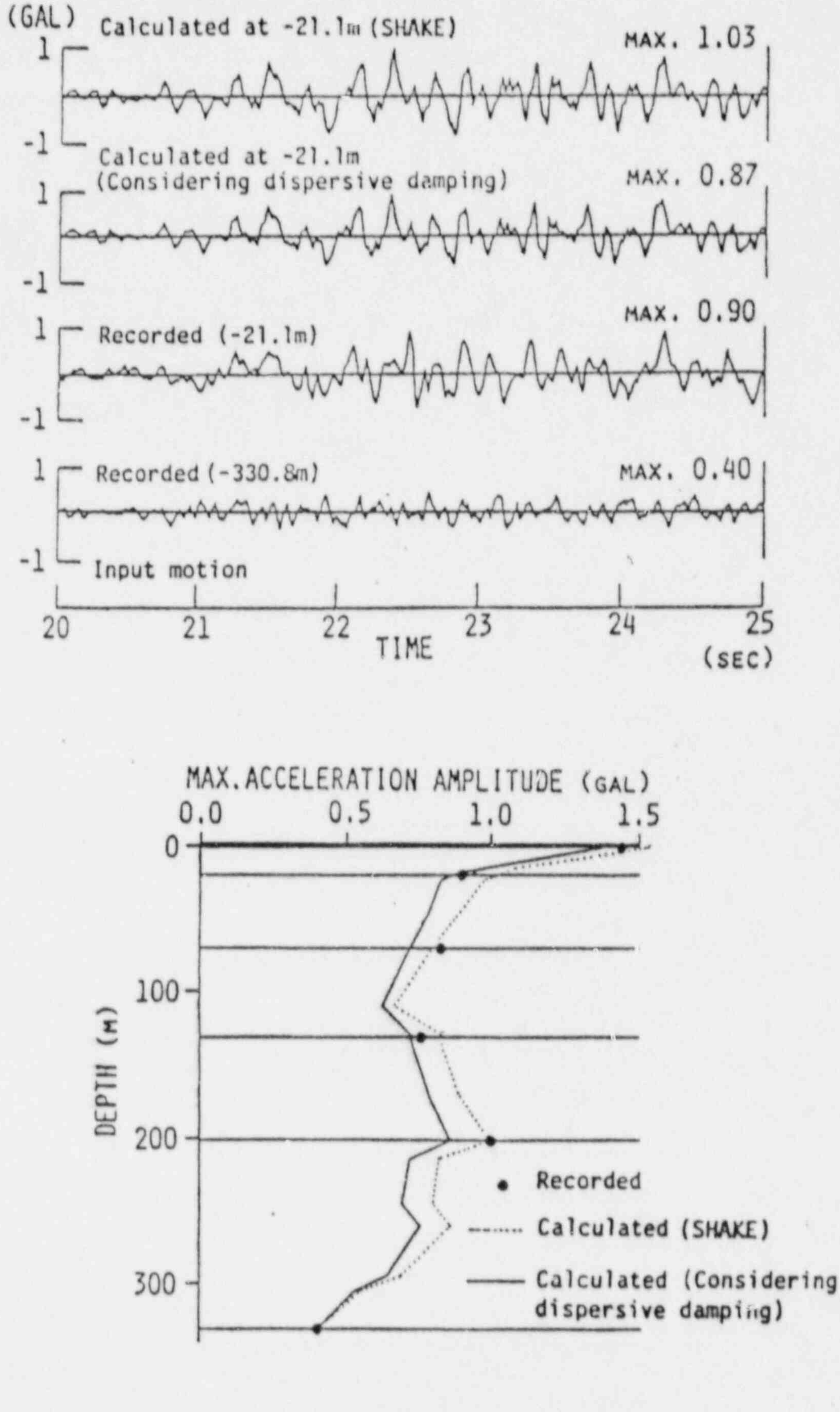
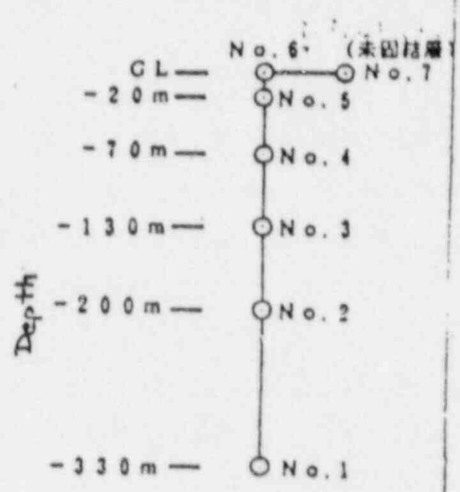
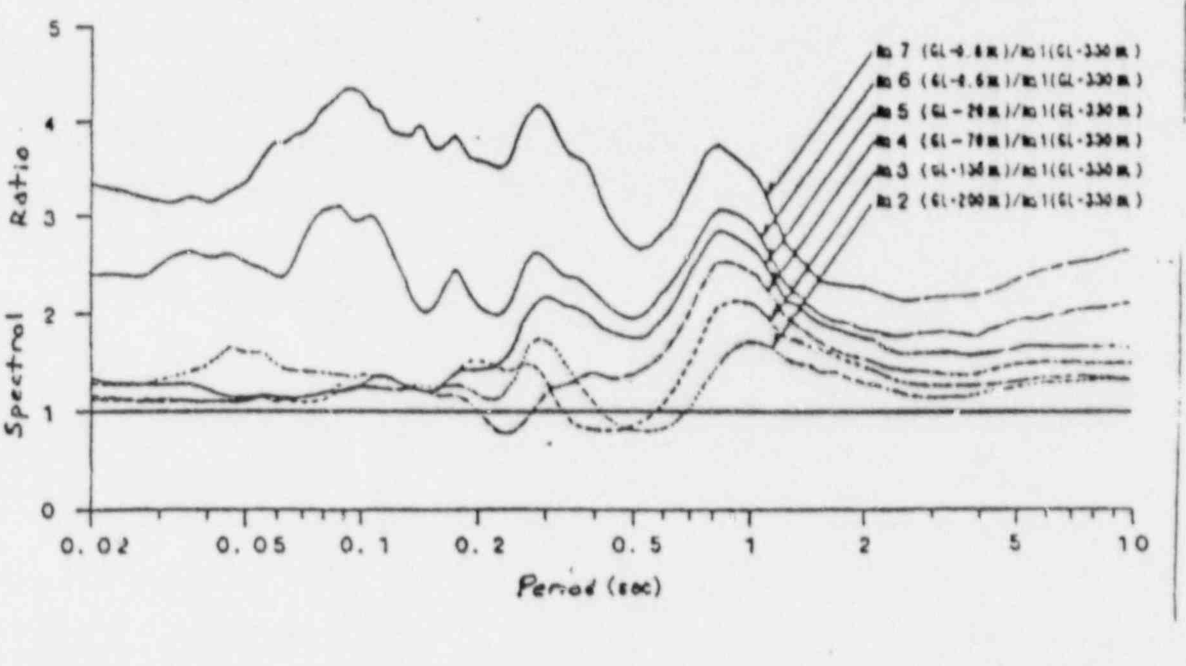


Figure 17 Comparison of Recorded and Calculated Motions (NS Components), Iwaki Downhole Array (September 13, 1981 Earthquake) (Omote et al., 1984b)

③



測点配置状況
Location of downhole Instrument



Average Ratio of Spectral Acceleration

Iwaki Downhole Array (Ohsaki, et al., [illegible])

CONCLUSION

WNP-3 DESIGN BASIS METHODOLOGY FOR ESTABLISHING THE FACILITY RESPONSE SPECTRA (I.E. FINITE ELEMENT ANALYSIS) MEETS THE REQUIREMENTS OF GENERAL DESIGN CRITERION 2. THE WNP-3 DESIGN ANALYSIS PROCEDURES PROVIDES AN ACCEPTABLE BASIS FOR THE SEISMIC DESIGN.

AN ELASTIC HALF SPACE ANALYSIS WAS PERFORMED WHICH INPUT THE FULL VALUE OF THE SSE AT THE BASEMAT. THE RESULTS OF THE ELASTIC HALF SPACE ANALYSIS CORRELATE VERY WELL WITH THE BUILDING RESPONSE SPECTRA GENERATED BY THE DESIGN BASIS FINITE ELEMENT METHOD. THERE ARE NO GROSS DISPARATIES BETWEEN THE TWO SETS OF RESULTS. BOTH TECHNIQUES INCORPORATE SIGNIFICANT CONSERVATISMS IN MODEL INPUTS AND EXECUTION TECHNIQUES. COMPOUNDING THESE SEISMIC ANALYSIS CONSERVATISMS ARE SUBSYSTEM ANALYSES WHICH CONFORM TO RESTRICTIVE DESIGN CODES AND STANDARDS. THE FINITE ELEMENT METHODOLOGY NECESSITATED THE USE OF DECONVOLUTION ANALYSIS.

DECONVOLUTION ANALYSIS IS AN ACCEPTABLE TECHNIQUE EVEN FOR ROCK SITES SUCH AS WNP-3. IN-SITU SEISMIC DATA DEMONSTRATES ACTUAL ATTENUATION IN SEISMIC RESPONSE WITH DEPTH CONSISTENT WITH THAT PREDICTED BY THE SHAKE MODEL RESULTS. IT WOULD BE INAPPROPRIATE TO APPLY THE PRESENTLY DEFINED SURFACE FREE FIELD SAFE SHUTDOWN EARTHQUAKE AT THE FOUNDATION (BASEMAT) WITHOUT REDUCTION.

REFERENCES

1) T MASAO, M HIRASAWA, S YAMANMOTO AND Y KOORI, "EARTHQUAKE RESPONSE OF NUCLEAR REACTOR BUILDING DEEPELY EMBEDDED IN SOIL", 4TH SMIRT, 1977.

2) E KAUSEL, R V WHITMAN, J P MORRAY AND F ELSABEE, "THE SPRING METHOD FOR EMBEDDED FOUNDATIONS", NUCLEAR ENGINEEERING AND DESIGN 48 (1978).

3. Y O BEREDUGO AND M NOVAK, "COUPLED HORIZONTAL AND ROCKING VIBRATION OF EMBEDDED FOOTINGS", CANADIAN GEOTECHNICAL JOURNAL 9, 1972.

4. NUREG/CR-3805, "ENGINEERING CHARACTERIZATION OF GROUND MOTION", VOLS 3 AND 4.

5. C Y CHANG ETAL,. "USE OF OBSERVATIONAL DATA IN EVALUATING THEORETICAL MODELS OF GROUND RESPONSE" EPRI WORKSHOP ON EARTHQUAKE GROUND MOTIONS IN THE EASTERN U.S., MARCH 31 TO APRIL 2, 1987.

6. R J HANSEN, "SEISMIC DESIGN FOR NUCLEAR POWER PLANTS" MIT PRESS CAMBRIDGE, MASS., LIBRARY OF CONGRESS NO. 79-110237.

ATTACHMENT 1

BASIS FOR ENGINEERING EVALUATIONS OF ELASTIC HALF SPACE RESULTS

- Assess areas of maximum deviation from design basis spectral results

- Sample critical Safe Shutdown Systems

  - Major Structures
  - Piping and Supports
  - Active Valves
  - Rotating Equipment
  - HVAC
  - Electrical Power Supply
  - Instrumentation and Racks

- Assess impact of absolute maximum spectral accelerations

CATEGORY I STRUCTURES

- 0 BY INSPECTION MAXIMUM ACCELERATION LOADS ON MAJOR CONCRETE STRUCTURES ARE BASICALLY BOUNDED BY THE ORIGINAL DESIGN BASIS

- 0 INCREASED MAXIMUM ACCELERATION OF THE STEEL CONTAINMENT VESSEL IS ACCEPTABLE BASED ON REVIEW OF THE CHICAGO BRIDGE & IRON CO. STRESS REPORT (IE, DESIGN BASIS STRESSES ARE WELL BELOW ASME ALLOWABLES)

PIPING EVALUATIONS

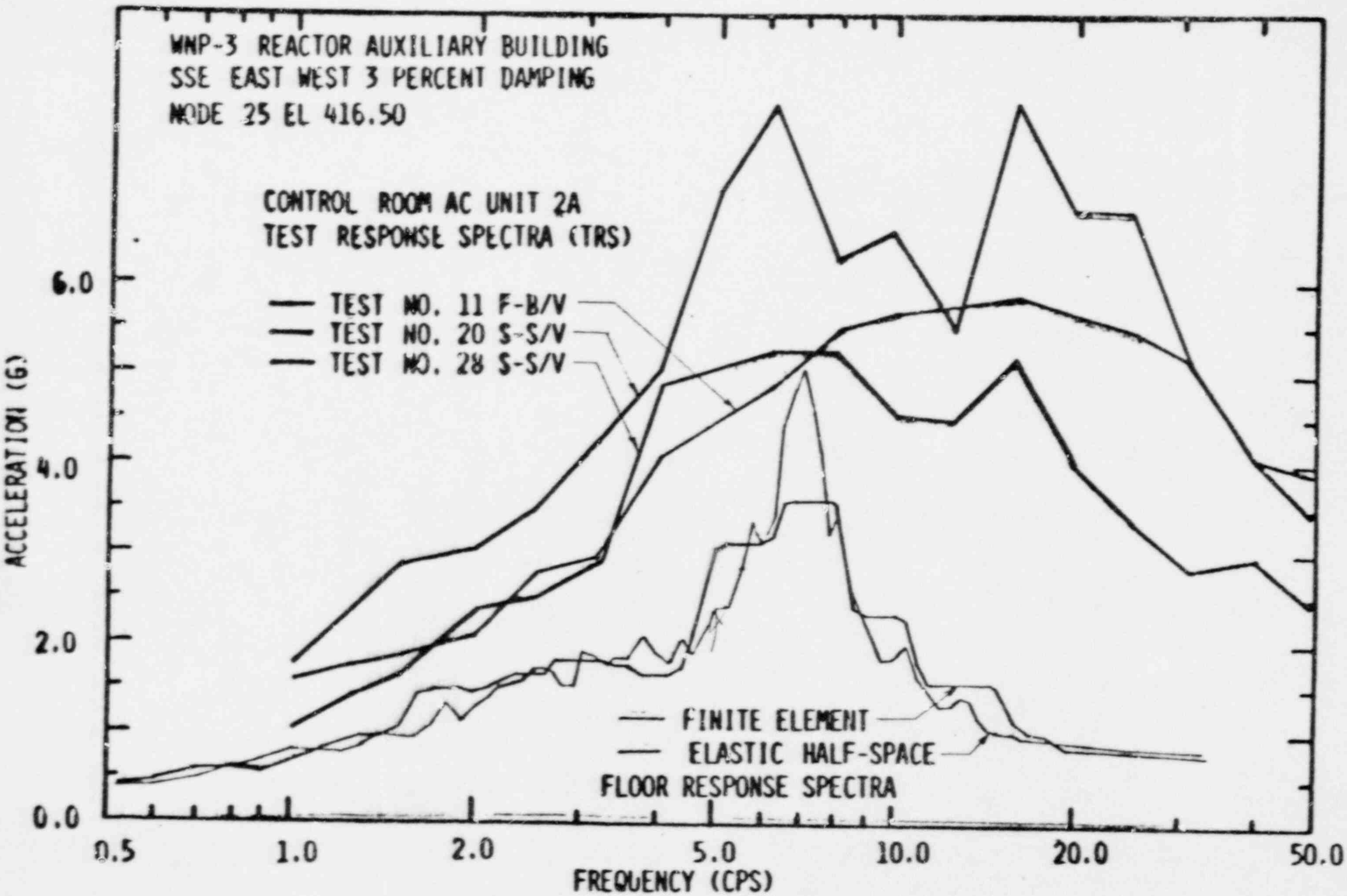
- 0 Containment Spray Header
- 0 Auxiliary Feed Water System
- 0 High Pressure Safety Injection System

- Results:
  - 0 ALL PIPING STRESSES REMAIN WITHIN ASME CODE ALLOWABLES
  - 0 SUPPORT LOAD ALLOWABLES NOT EXCEEDED

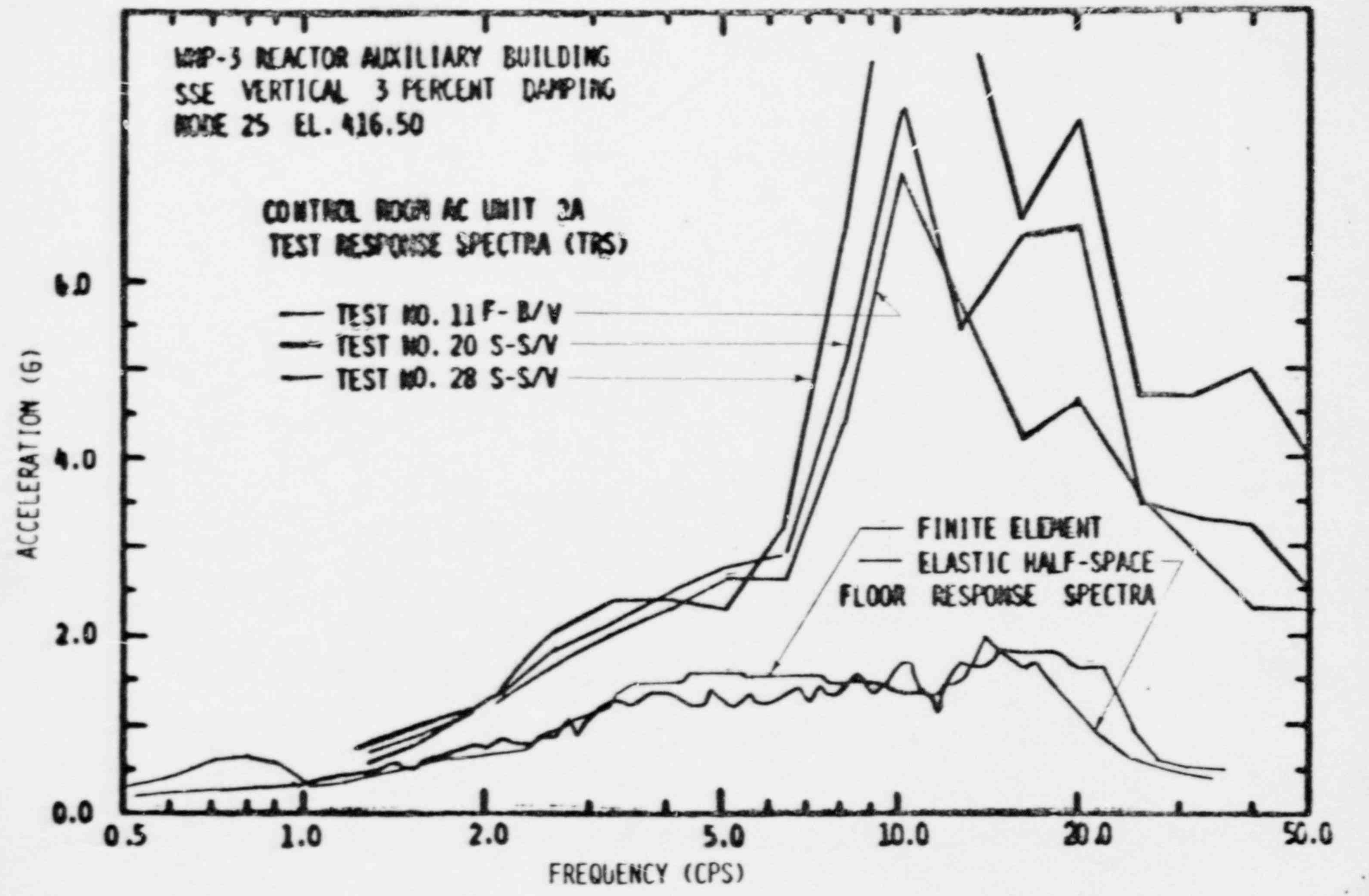
EQUIPMENT EVALUATIONS

- 0 PRESSURIZER RELIEF VALVES
- 0 HVAC EQUIPMENT/AC AND CU UNITS
- 0 HPSI PUMP AND MOTOR

* RESULTS: IN ALL CASES, VENDOR INTERFACE REQUIREMENTS WERE MET (G-LOADING, FREQUENCY, NOZZLE LOADS)



WNP-3 REACTOR AUXILIARY BUILDING
SSE EAST WEST 3 PERCENT DAMPING
NODE 25 EL 416.50
CONTROL ROOM AC UNIT 2A
TEST RESPONSE SPECTRA (TRS)
TEST NO. 11 F-B/V
TEST NO. 20 S-S/V
TEST NO. 28 S-S/V
FINITE ELEMENT
ELASTIC HALF-SPACE
FLOOR RESPONSE SPECTRA
ACCELERATION (G)
0.0
2.0
4.0
6.0
0.5
1.0
2.0
5.0
10.0
20.0
50.0
FREQUENCY (CPS)



WNP-3 REACTOR AUXILIARY BUILDING
SSE VERTICAL 3 PERCENT DAMPING
NODE 25 EL. 416.50
CONTROL ROOM AC UNIT 3A
TEST RESPONSE SPECTRA (TRS)
TEST NO. 11 F-B/V
TEST NO. 20 S-S/V
TEST NO. 28 S-S/V
FINITE ELEMENT
ELASTIC HALF-SPACE
FLOOR RESPONSE SPECTRA
ACCELERATION (G)
0.0
2.0
4.0
6.0
FREQUENCY (CPS)
0.5
1.0
2.0
5.0
10.0
20.0
50.0

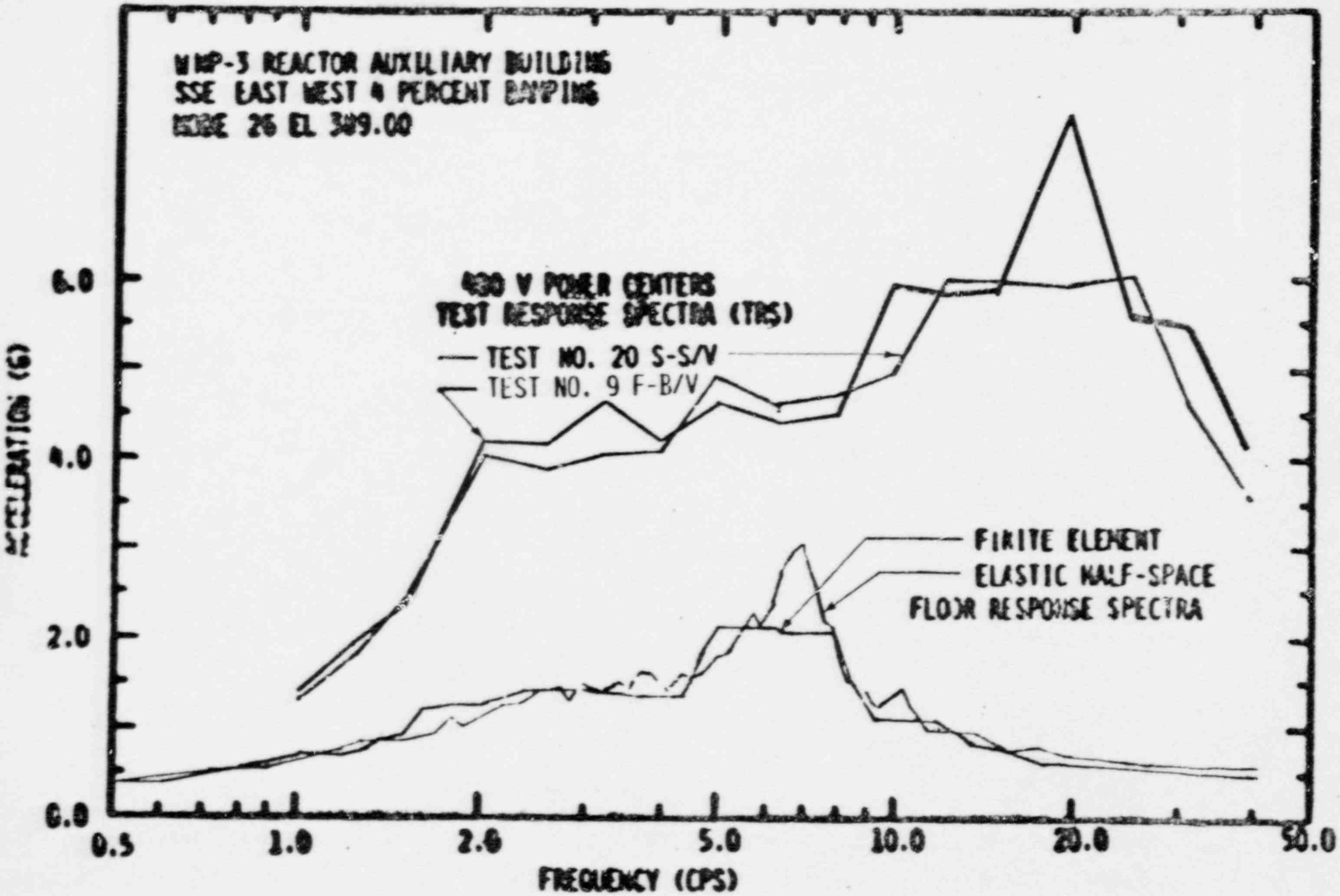
ELECTRICAL/I & C

0 ALL CLASS 1E 480V POWER CENTERS

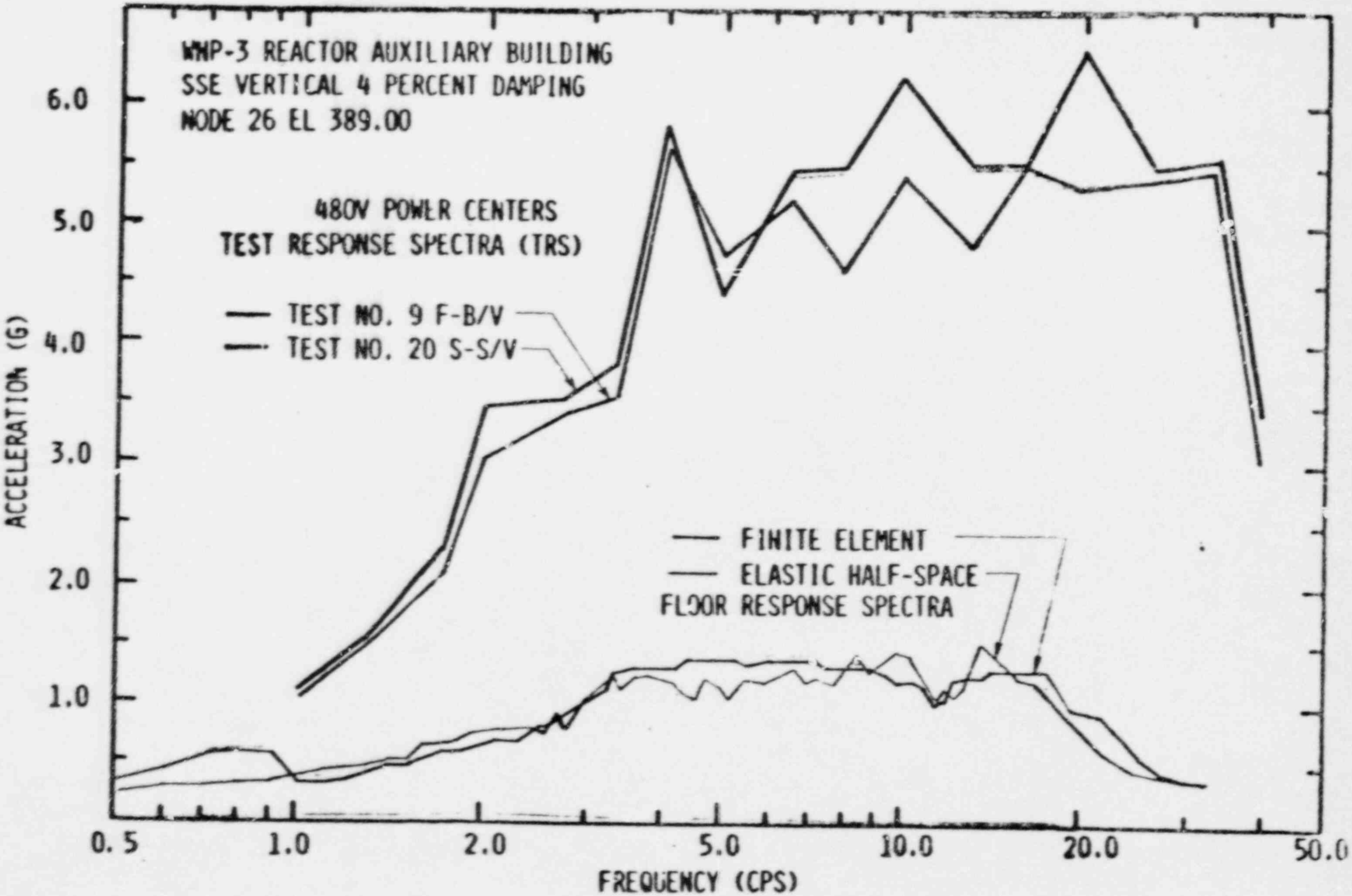
0 INSTRUMENT RACKS AND PANEL MOUNTED HARDWARE

* RESULTS - TEST RESPONSE SPECTRA COMPLETELY ENVELOPES NEW SPECTRA

  - RACKS ARE RIGIDLY DESIGNED



WNP-3 REACTOR AUXILIARY BUILDING
SSE EAST WEST 4 PERCENT DAMPING
NODE 26 EL 309.00
480 V POWER CENTERS
TEST RESPONSE SPECTRA (TRS)
TEST NO. 20 S-S/V
TEST NO. 9 F-B/V
FINITE ELEMENT
ELASTIC HALF-SPACE
FLOOR RESPONSE SPECTRA
ACCELERATION (G)
6.0
4.0
2.0
0.0
0.5
1.0
2.0
5.0
10.0
20.0
50.0
FREQUENCY (CPS)



WNP-3 REACTOR AUXILIARY BUILDING
SSE VERTICAL 4 PERCENT DAMPING
NODE 26 EL 389.00
480V POWER CENTERS
TEST RESPONSE SPECTRA (TRS)
TEST NO. 9 F-B/V
TEST NO. 20 S-S/V
FINITE ELEMENT
ELASTIC HALF-SPACE
FLOOR RESPONSE SPECTRA
ACCELERATION (G)
6.0
5.0
4.0
3.0
2.0
1.0
0.5
1.0
2.0
5.0
10.0
20.0
50.0
FREQUENCY (CPS)

In summary, the applicant was asked to review and reevaluate the basic input parameters used in the deconvolution/SSI analysis and then compare the half-space analysis results with the design basis spectra reported in the FSAR.

original signed by
Guy S. Vissing, Project Manager
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Reactor Project Directorate
Division of Reactor Projects III,
IV, V and Special Projects
Office of Nuclear Reactor Regulation

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As stated

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