WM. H. ZIMMER POWER STATION

INSTRUCTIONS FOR UPDATING YOUR DESIGN ASSESSMENT REPORT

Changes to the MARK II DAR are identified by a vertical line in the right margin of the page. To update your copy of the ZPS-1 DAR, remove and destroy the following pages and figures and insert pages and figures as indicated.

REMOVE	INSERT
Page iv	Page iv
After page viii	Page viii (Cont'd)
Page ix	Page ix
Page xii	Page xii
Page xv	Page xv
Pages xvi and xvii	Pages xvi and xvii
Chapter 1.0	
Page 1.0-2	Page 1.0-2
Chapter 5.0	
Page 5.2-13	Page 5.2-13
Pages 5.2-22 through 5.3-24	Pages 5.3-22 and 5.3-23
Figures 5.3-27 through 5.3-34	Sheet for Deleted Figures
Appendix C	
After page C.3-1	Pages C.3-2 and C.3-3; and Figures C.3-1 and C.3-2
Figures C.4-1 through C.4-6	Figures C.4-1 through C.4-8
Appendix I	
After Figure H-9	TAB for Appendix I; Pages I-i and I-ii; I.1-1 and I.1-2, I.2-1 and I.2-2; I.3-1 and I.3-2; Figures I.3-1 through I.3-8; I.4-1; and I.5-1.

8107010293

POOR ORIGINAL

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In this report the individual loads and load combinations that are being utilized in the reassessment are identified and described in the first four sections. Reports defining the individual loads and providing justification for application to the ZPS-1 containment are referenced rather than repeated. This is consistent with the objective of this report.

The methods used in reevaluating the structures, piping systems, and equipment are described in Chapter 7.0. Fatigue analysis of the downcomers and SRV lines is included in Subsection 7.3.2. The plant modification and resultant changes that have been completed are described in Chapter 9.0. The plant margins and conservatisms are summarized in Chapter 10.0. To fulfill the requirements of NUREG-0487, a description of the assessments used to ensure functional capability of piping systems is included in Section E.4 of Appendix E.

The long-term Mark II program is expected to confirm that the plant, as presently designed and constructed, is completely safe and adequate. An assessment using loads derived from results of the 4TCO tests, described in Appendix I, provides additional ensurances. However, additional design modifications and plant changes are being implemented to utilize the full containment capability. This ensures that the maximum possible margins are built into the plant, so that if load definitions should change later, they can be accommodated without plant hardware changes. The ZPS-1 plant startup should, therefore, proceed as scheduled. 16

5.2.3 Assessment of NRC Acceptance Criteria - SRV

The original design methods and the design reassessments described in the above subsections address all the NRC concerns in the Lead Plant Acceptance Criteria (NUREG-0487). An itemized list of the Zimmer Power Station response to the NRC Acceptance Criteria is contained in Section 5.4.

In order to demonstrate the adequacy of the William H. Zimmer Station design-basis frequency range for the all valve discharge case, a comparison was made between it and the frequency range provided in NUREG-0487, Supplement 1 (September 1980). The comparison was accomplished by generating envelopes of the magnitude of the Fourier transforms of the sets of factored design traces produced by the two methods. The Zimmer Station design basis is derived from using a 1.5 amplitude multiplier on the three KWU design traces and sweeping a dominant frequency range of 2.9 to 9.9 hertz. The NRC design basis is derived from using a 1.1 amplitude multiplier on the three KWU design traces and sweeping a dominant frequency range of 3 to 11 hertz. The resulting design envelopes are compared in the attached figure. Note that the Zimmer design-basis is 35% higher than the NRC design basis except in the narrow frequency range of 11 to 13 Hz. In this narrow range, the NRC design basis is, on the average, 8% higher.

In our judgement this small increase over a narrow frequency range is of no design significance. Our opinion is based on the following:

a. The total structural and piping response has contributions from several frequencies. The Zimmer design basis is 35% higher than the NRC design basis except in the 11 to 13 hertz range where it is 8% lower. In our opinion any increase in structural or piping response due to a higher 11 to 13 hertz input will be more than compensated by a lower input (and response) for all other frequencies.

b. The Zimmer design is based on the simultaneous occurence of the SSE, LOCA, and the SRV events. As the combined design response has contribution from all three loads, the increase in the SRV response would be more than compensated for by the conservatism Zimmer has used in other portions of its Empirical Design Basis loads. This is illustrated in Appendix I. 16

5.3.2.5 Condensation Oscillation Loads

The condensation oscillation (CO) load definition originally used in the ZPS-1 design is the Mark II DFFR load definition. However, to account for uncertainties in the load definition and to expedite licensing, a more conservative load definition has been used for reassessment. This method, called the Zimmer Empirical Approach, is described in Chapter 1.0. This approach is more conservative than required by NUREG-0487.

5.3.3 References

1. General Electric Company and Sargent & Lundy, "Mark II Containment Dynamic Forcing Functions Information Report," NEDO-21061, September 1976 (Revision 2).

2. Final Safety Analysis Report, Wm. H. Zimmer Power Station, Chapter 6.0.

3. General Electric Company and Sargent & Lundy Engineers, "Mark II Containment Dynamic Forcing Functions Information Report," NEDE-21061-P, September 1976 (Revision 2). 16

4. "Analytical Model for Liquid Jet Properties for Predicting Forces on Rigid submerged Structures," NEDE-21472, September 1977.

5. S. Abramovich and A. Solan, "The Initial Development of a Submerged Laminar Round Jet," Journal of Fluid Mechanics, Vol. 59, Part 4, pp. 791-801, 1978.

6. "Mark I Containment Program 1/4 Scale Test Report Loads on Submerged Structures Due to LOCA Air Bubbles and Water Jets," NEDE-23817-P, September 1978.

TABLE 5.3-1

ACOUSTIC LOADING ON REACTOR PRESSURE VESSEL SHROUD

TIME (msec)	ACOUSTIC LOAD (kips)
0	0
1.2	0
1.6	250
2.0	320
2.5	650
2.8	250
3.0	100
3.2	0

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FIGURES 5.3-27; 5.3-28;
5.3-29; 5.3-30; 5.3-31; 16
5.3-32; 5.3-33; AND
5.3-34 HAVE BEEN DELETED.
REFER TO FIGURES I.3-1
THROUGH I.3-8.

TABLE C.3-1

PROPERTIES OF BUILDING MODELS*

ELEVATION IN BUILDING (ft)	EQUIVALENT UNIT WEIGHT (lb/ft^3)	EQUIVALENT SHEAR MODULUS NORTH-SOUTH ($kips/ft^2$)	EQUIVALENT SHEAR MODULUS EAST-WEST ($kips/ft^2$)	EQUIVALENT SHEAR MODULUS VERTICAL ($kips/ft^2$)
628 - 593	12.24	2542.0	1229.0	3771.0
593 - 570	13.31	1338.0	1472.0	2810.0
570 - 546	20.93	1814.0	1886.0	3700.0
546 - 525	46.19	9198.0	6442.0	15640.0
525 - 480	24.73	20712.0	16505.0	37217.0
480 - 465	150.00	52856.0	43438.0	84875.0

*Damping used for the building was 5% for the DBE and 2% for the OBE.

1

TABLE C.3-2

GENERALIZED SUBSURFACE PROPERTIES

ELEVATION (feet)	SOIL CLASSIFICATION	RELATIVE DENSITY (%)	UNIT WEIGHT (pcf)	
520 - 500	CL (general fill)	*	125	
500 - 480	SP (recompacted fill)	85**	125	
480 - 470	SP (recompacted fill)	85**	125	
470 - 460	SP (recompacted fill)	85**	125	
460 - 450	SP (recompacted fill)	85**	125	
450 - 445	SP	70	125	
445 - 435	SP	70	132	1
435 - 420	SP-SM	75	125	
420 - 415	SP-SM	80	125	
415 - 400	SP	80	132	

*95% Minimum Modified Proctor Density

**85% Minimum Relative Density

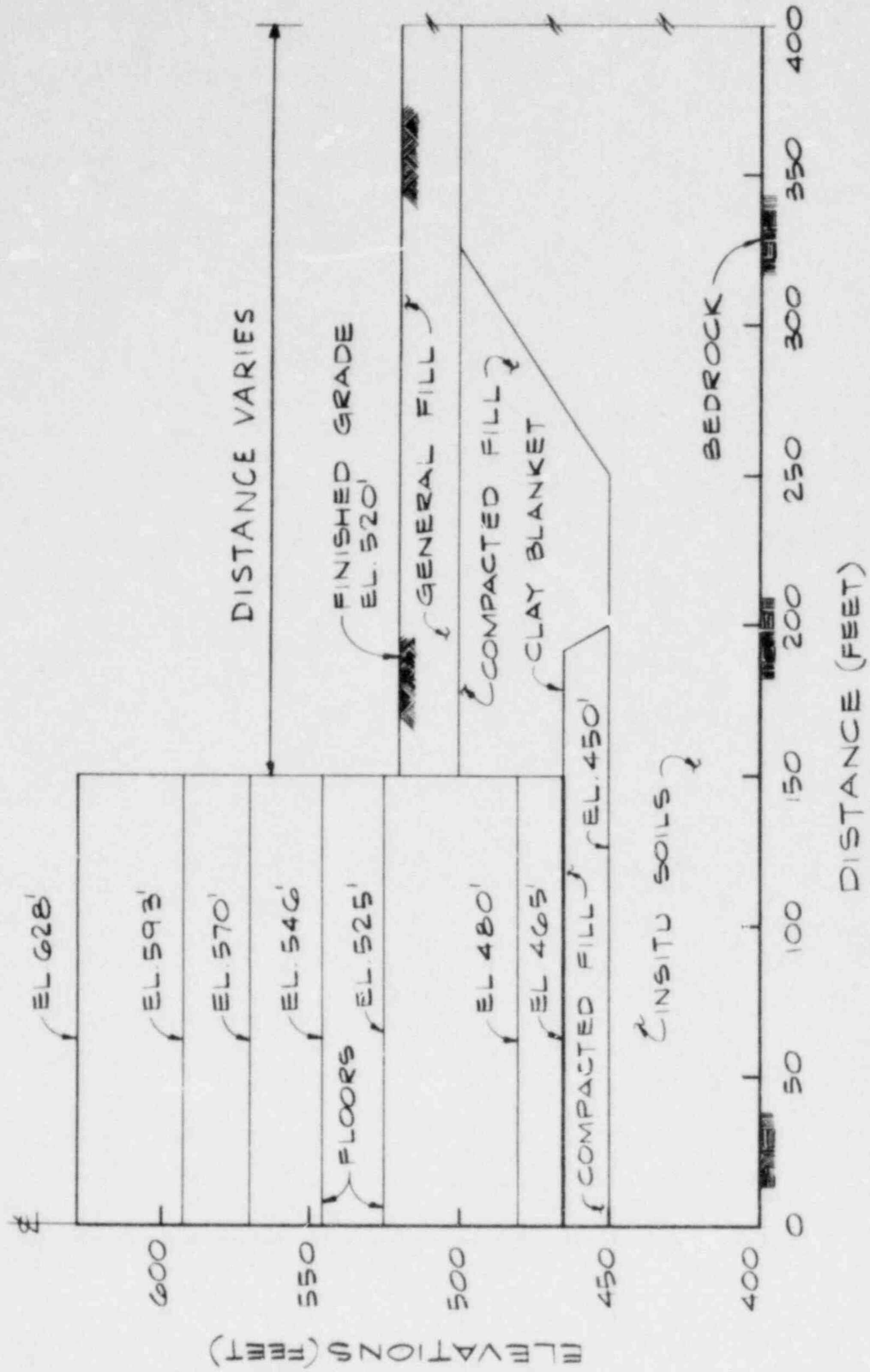

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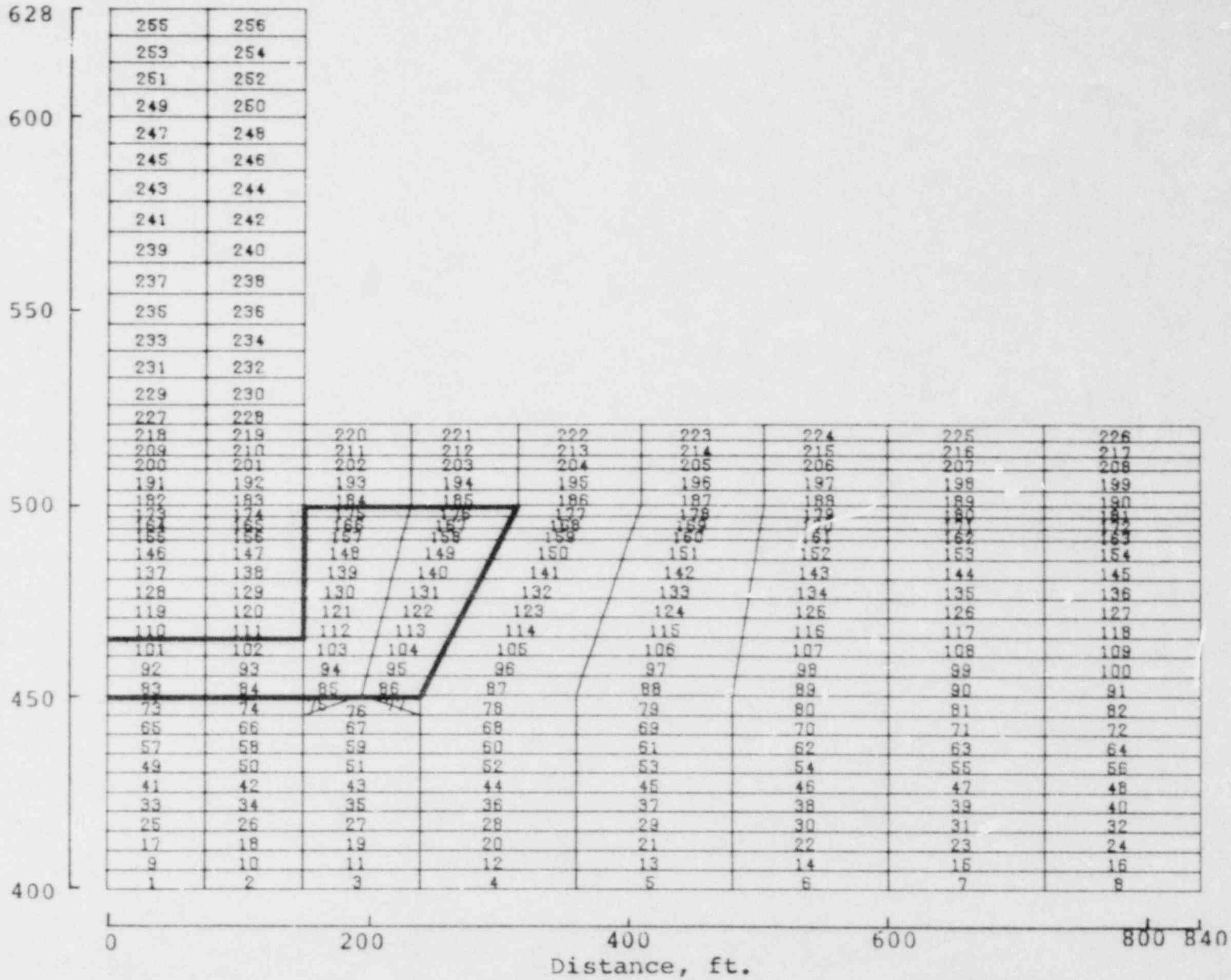
FIGURE C.3-1

REPRESENTATIVE PROFILE



Note: 1. Heavy black line indicates boundary of recompacted fill.

2. Numbers are element numbers in finite element model.

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FIGURE C.3-2

FINITE ELEMENT MODEL

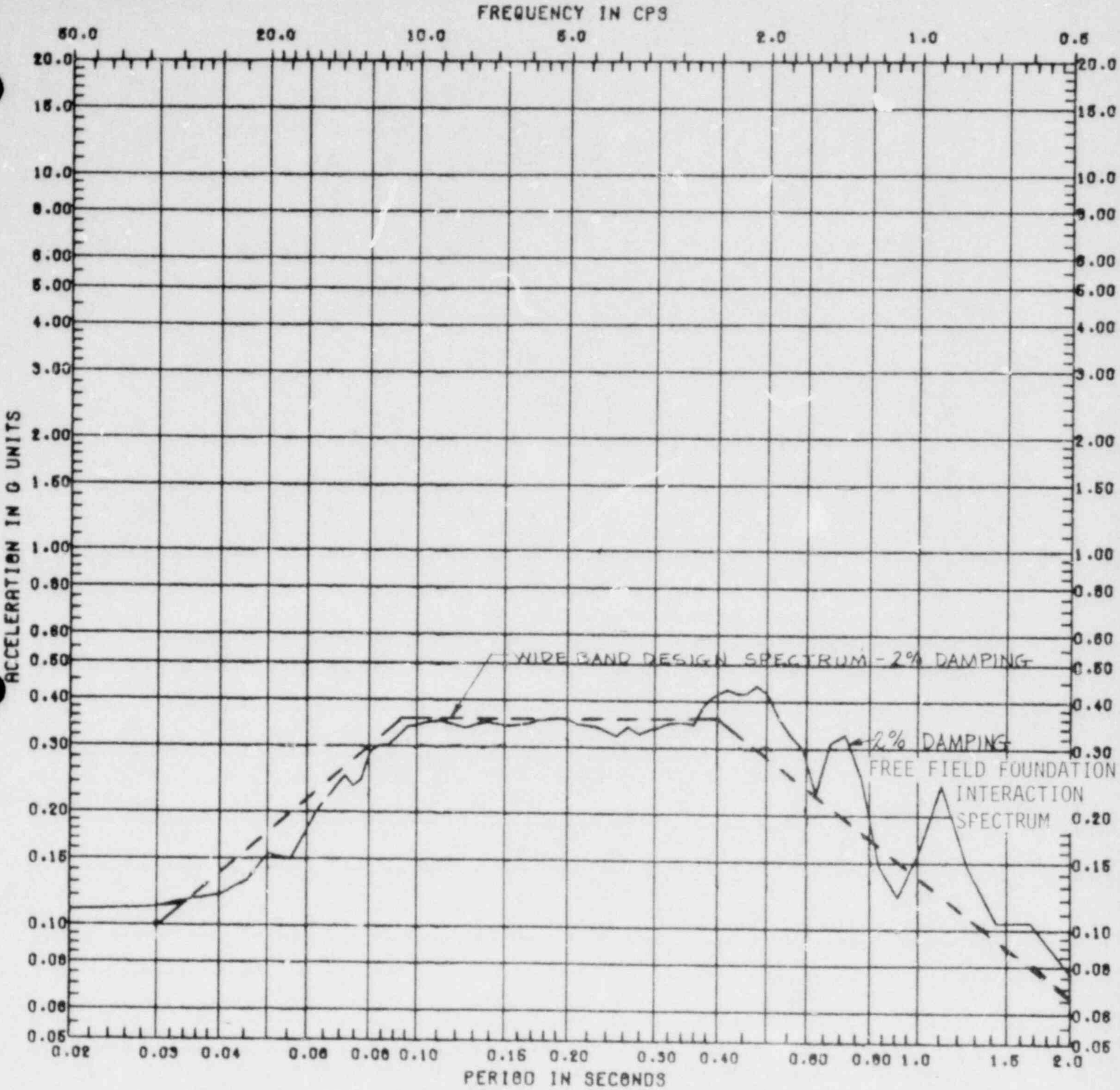

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FIGURE C.4-1

FREE FIELD FOUNDATION RESPONSE
SPECTRA COMPARISON EAST-WEST OBE

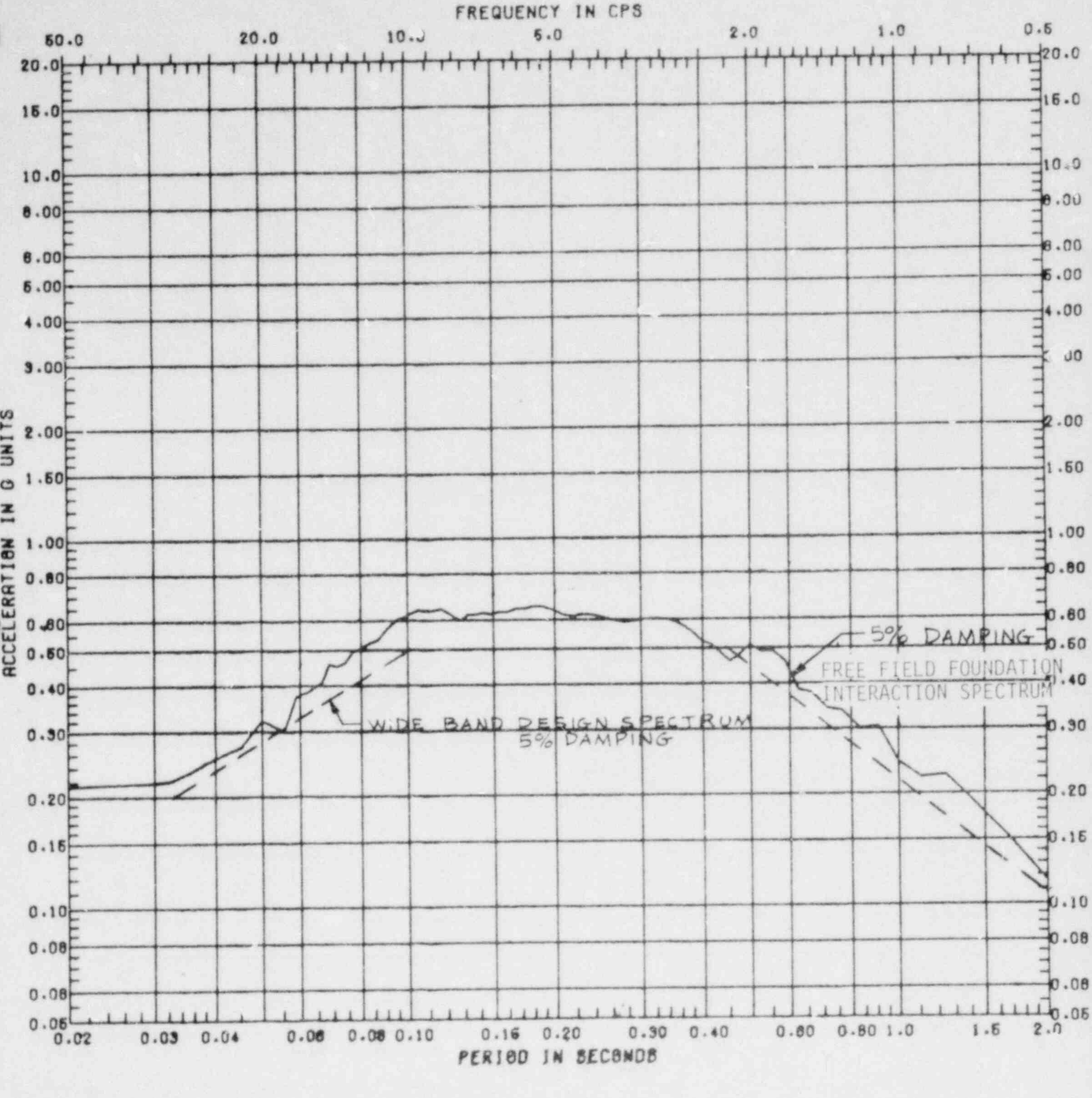

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FIGURE C.4-2

FREE FIELD FOUNDATION RESPONSE
SPECTRA COMPARISON EAST-WEST DBE

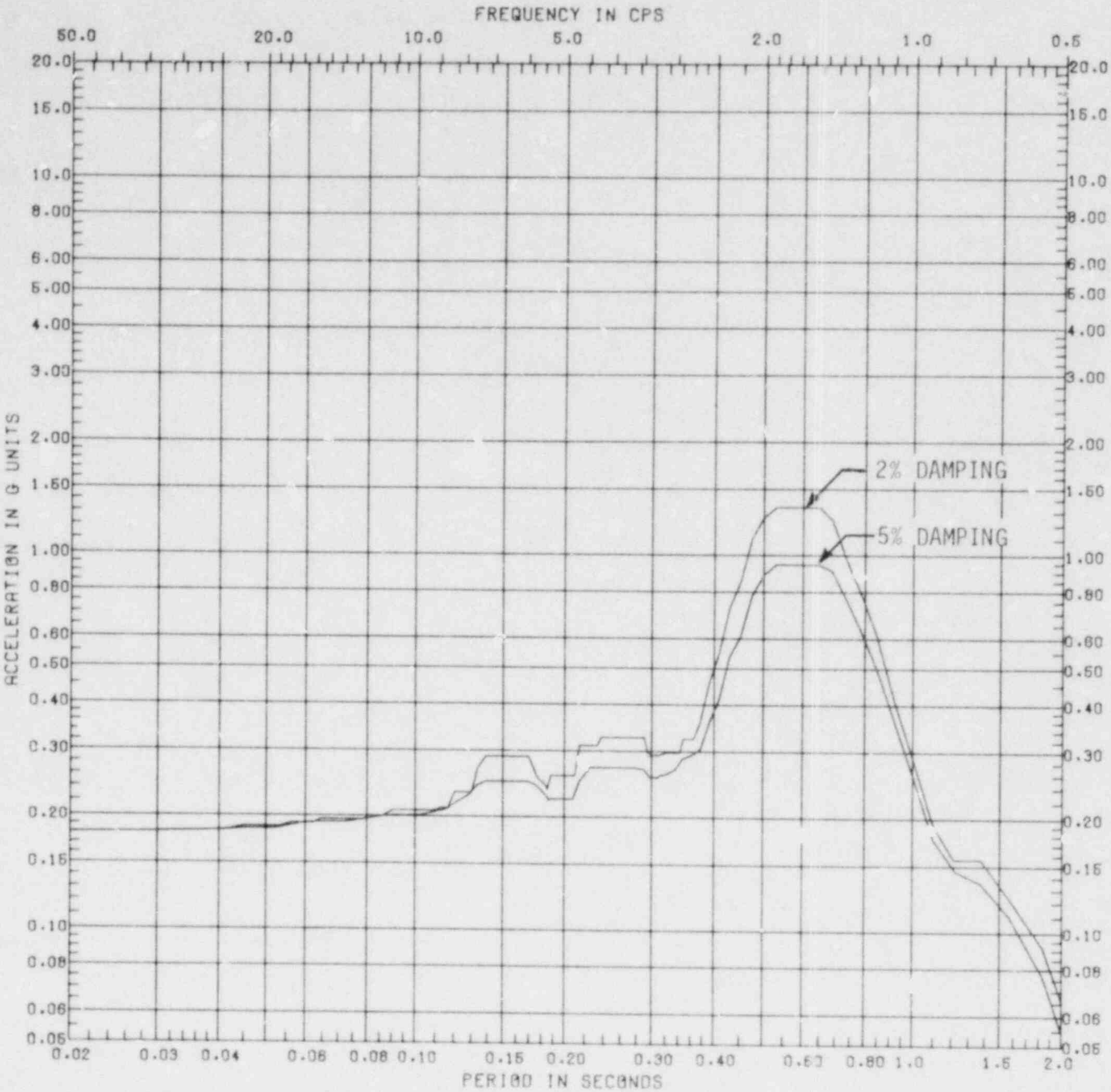

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FIGURE C.4-3 HORIZONTAL OBE N-S INTERACTION SPECTRA AT FOUNDATION (10% WIDENED) ELEVATION 465'

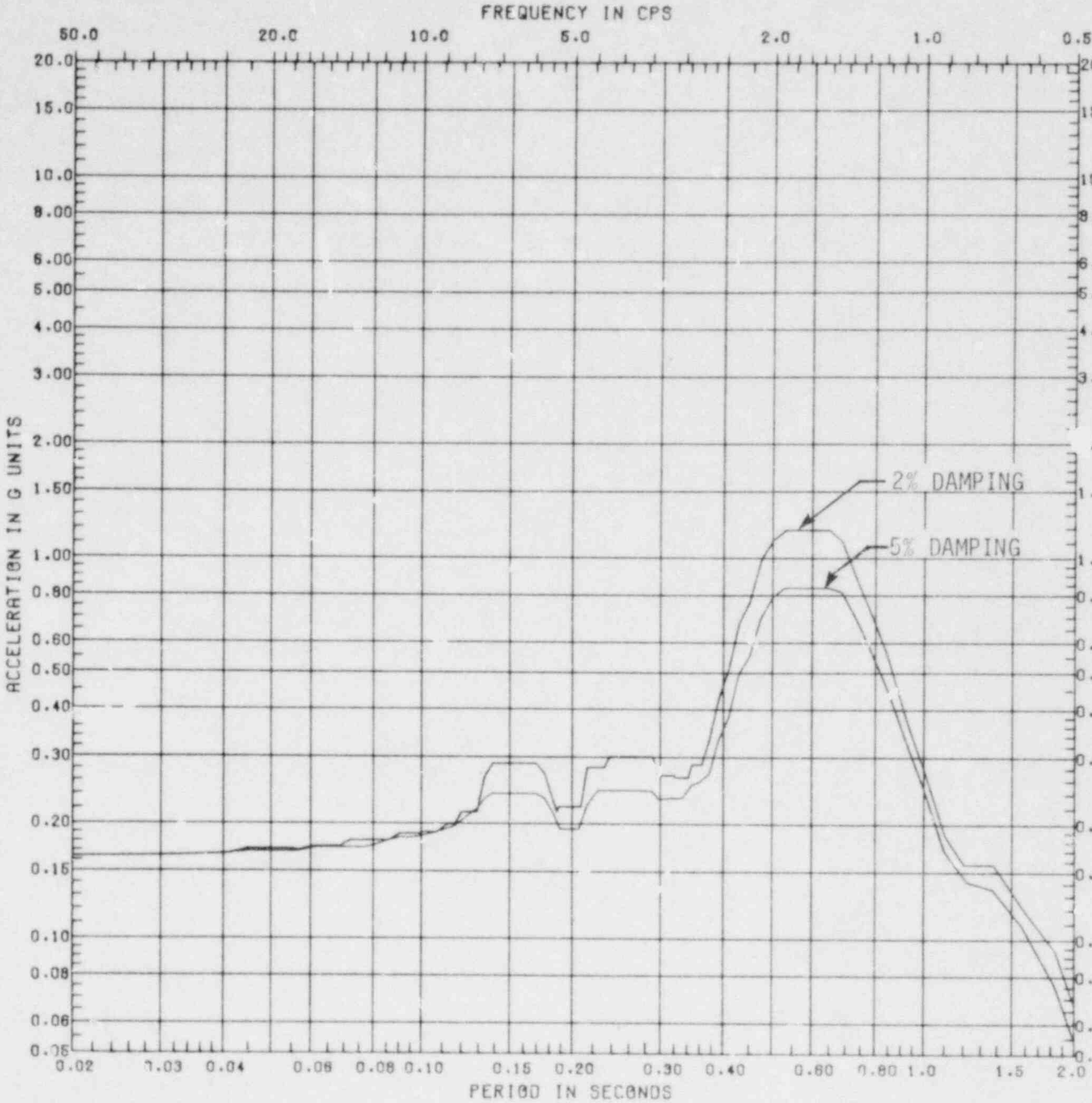

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FIGURE C.4-4

HORIZONTAL OBE E-W FOUNDATION INTERACTION SPECTRA (10% WIDENED) ELEVATION 465'

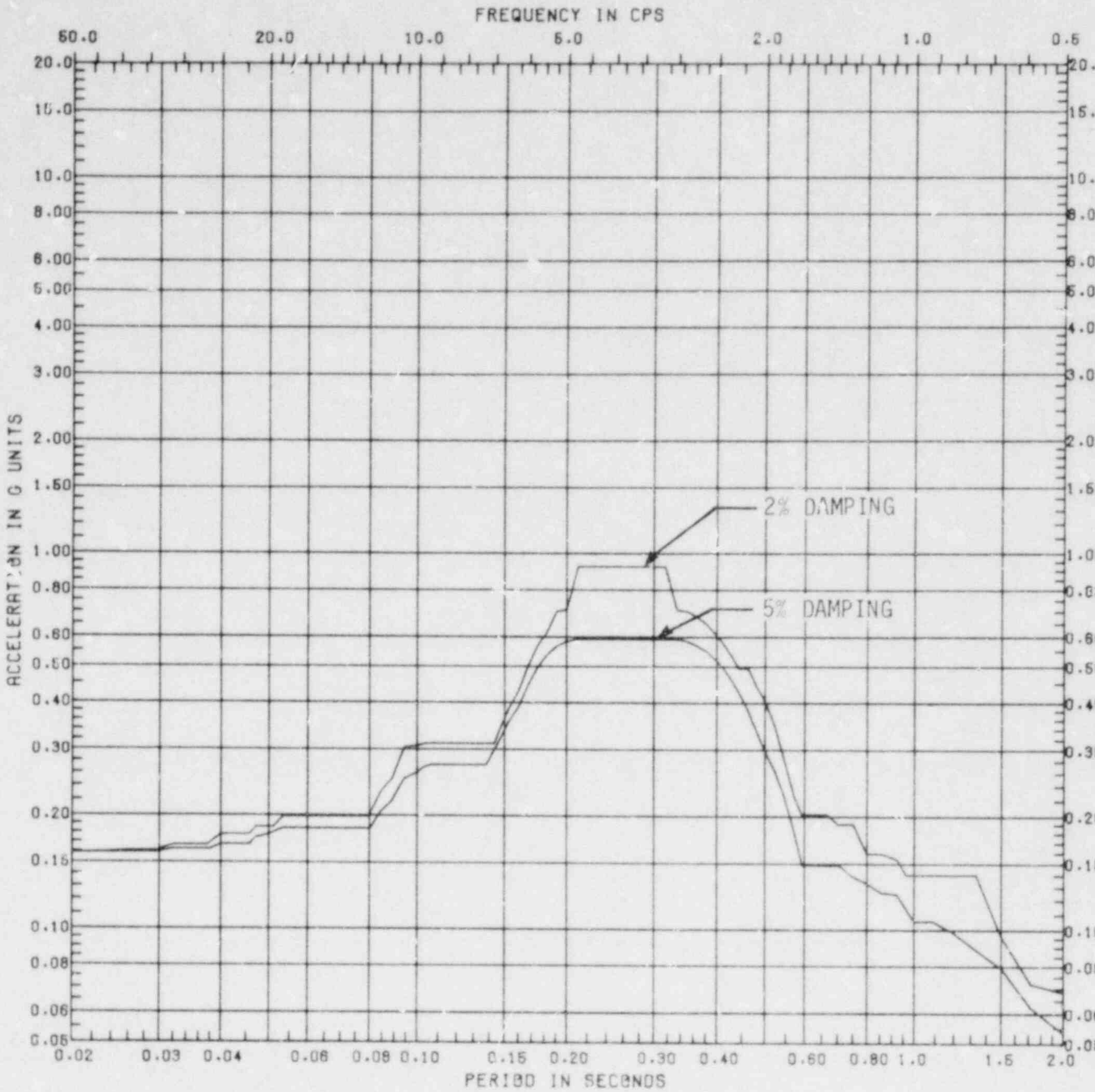

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FIGURE C.4-5

OBE VERTICAL FOUNDATION
INTERACTION SPECTRA (20% WIDENED)
ELEVATION 465'

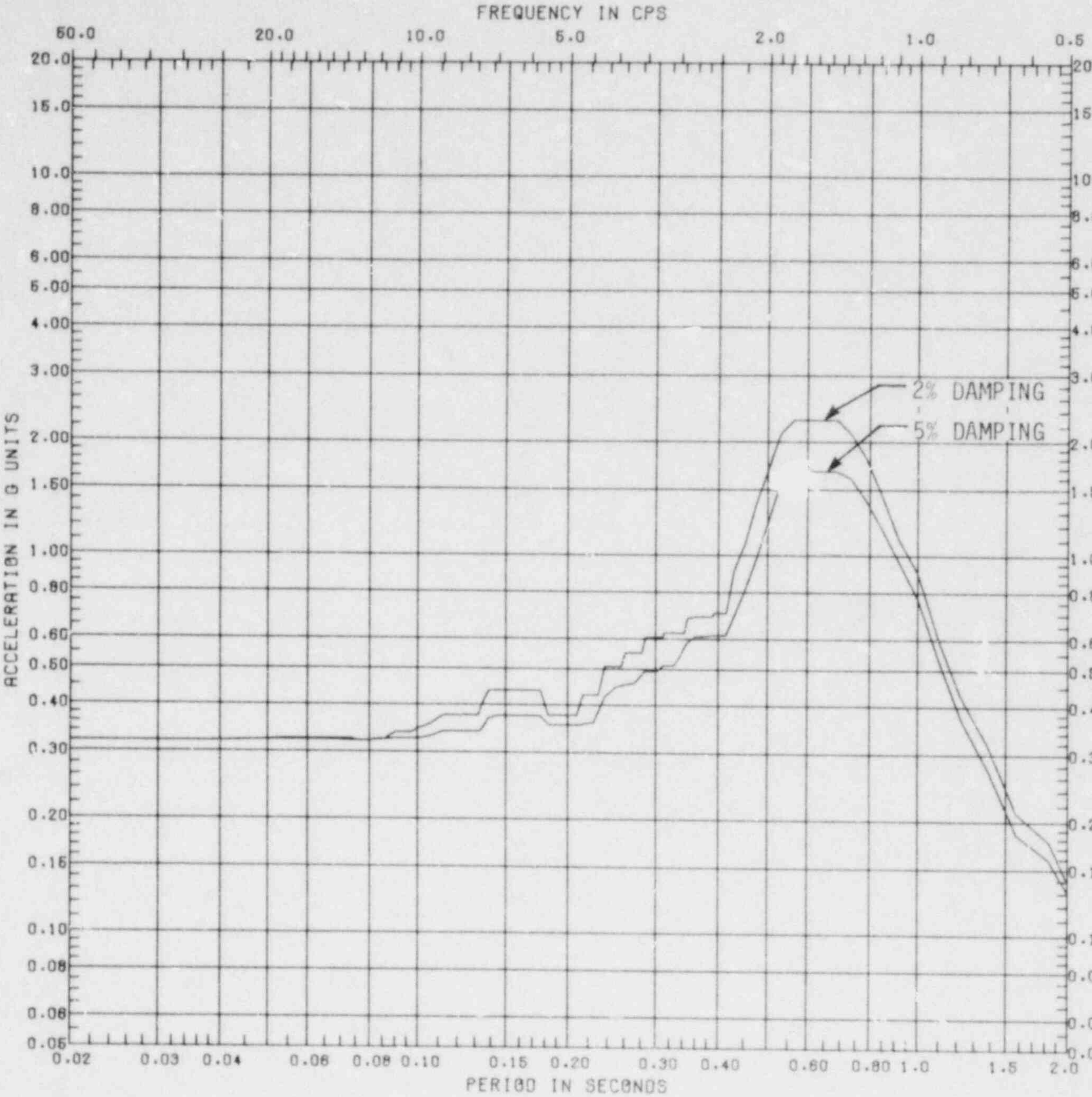

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FIGURE C.4-6

HORIZONTAL SSE N-S FOUNDATION INTERACTION SPECTRA (10% WIDENED) ELEVATION 465'

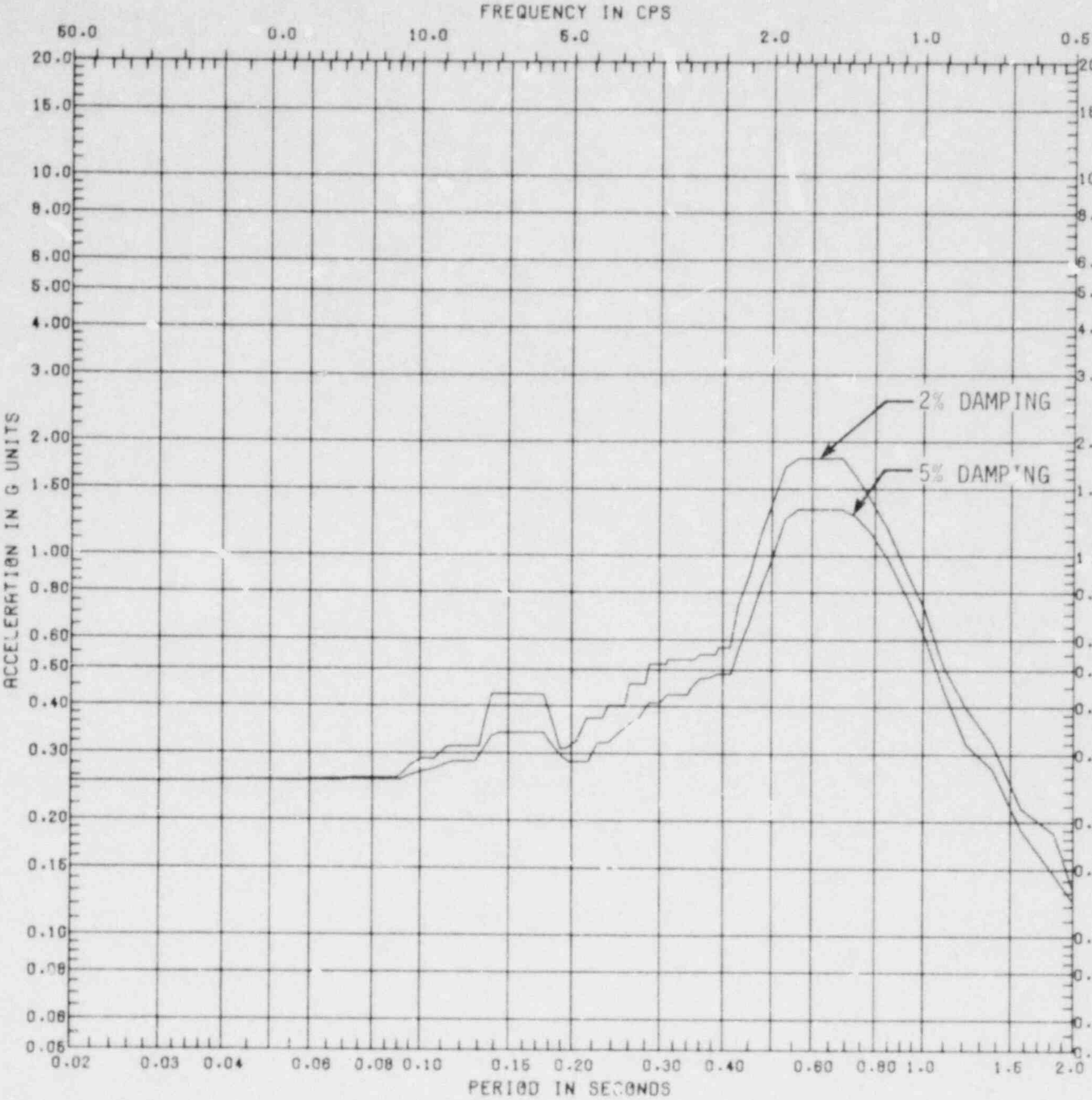

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FIGURE C.4-7

SSE HORIZONTAL E-W FOUNDATION
INTERACTION SPECTRA (10% WIDENED)
ELEVATION 465'

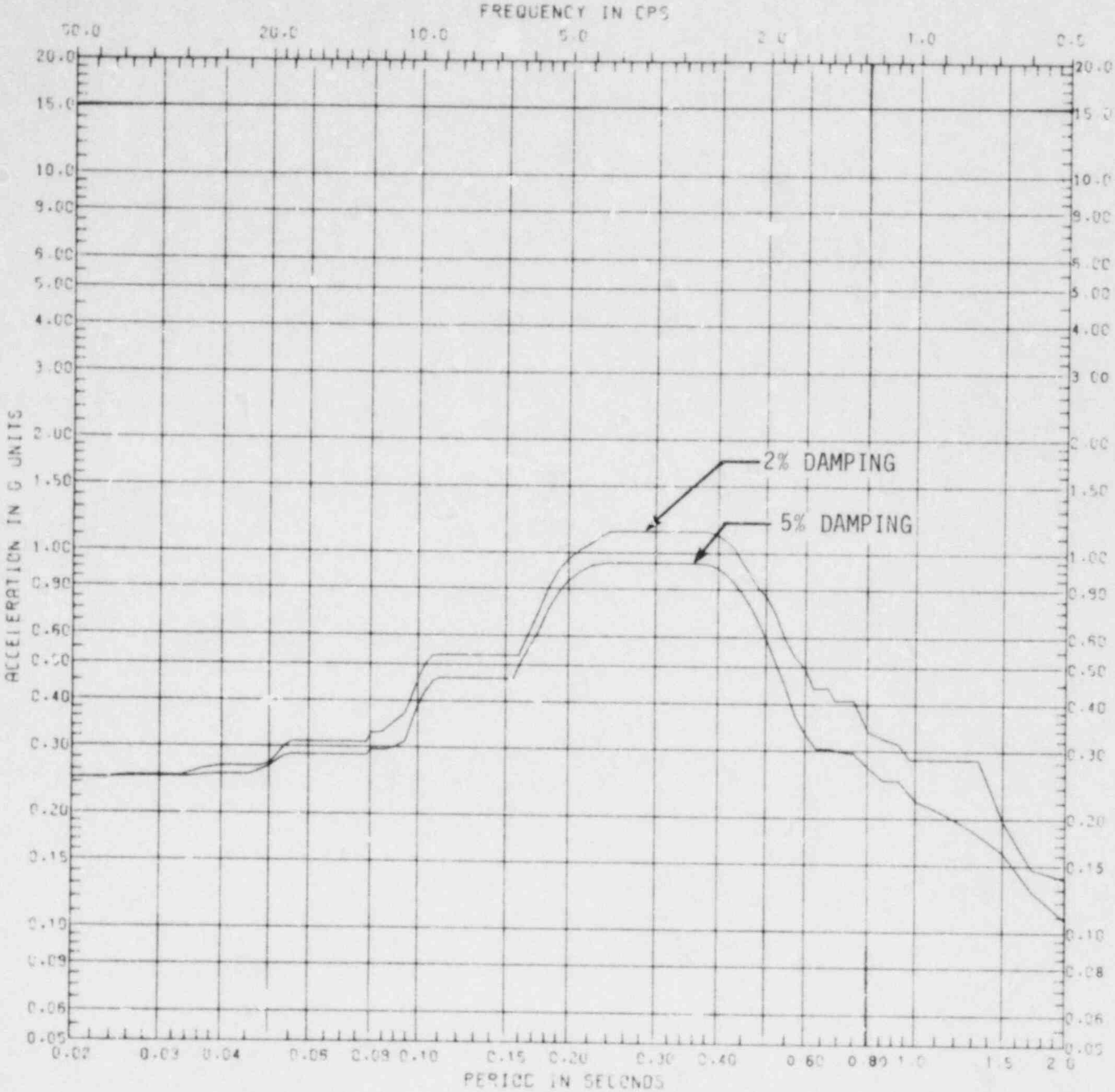

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FIGURE C.4-8

SSE VERTICAL FOUNDATION
INTERACTION SPECTRA (20% WIDENED)
ELEVATION 465'

APPENDIX I

LEAD PLANT CO AND CHUGGING DEFINITION REPORT

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LEAD PLANT CO AND CHUGGING DEFINITION REPORT

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APPENDIX I - LEAD PLANT CO AND CHUGGING DEFINITION REPORT

I.1 INTRODUCTION

In mid-1979, the state of construction and schedule of the Wm. H. Zimmer Power Station (ZPS-1) was such that finalization of the design loads was required to prevent costly delays in completion of the plant. In order to minimize the impact of future revisions to the pool dynamic loads and to maximize the safety of the plant, the ZPS-1 "three-pronged" approach was adopted. The three facets of this approach were:

a. Expedite construction based on conservative loads and upgrade immediately to containment capability where possible.

b. Assess the plant for the Zimmer Empirical Load Design Basis which is expected to bound any future changes in pool dynamic loads.

c. Confirm adequacy of design with results of the Zimmer in-plant SRV test and the long-term Mark II program. 16

The major uncertainty in the pool dynamic loads was the area of LOCA steam condensation loads. Concern about the adequacy of the condensation oscillation loads led the Mark II Owners' Group to perform additional single-cell steam condensation tests at the 4T test facility. The facility was modified to provide more prototypical Mark II test conditions. Because the results of these 4TCO tests would not be available on a schedule compatible with Zimmer design and construction, a very conservative CO load was postulated for use in the Zimmer Empirical Load Design Basis. This load is fully defined in Section 2.1.3 of the ZPS-1 Design Assessment Report (DAR).

In order to confirm the adequacy of the Empirical Load design basis, the results of the 4TCO test were analyzed by the Mark II lead plants and, in early July of 1980, a lead plant CO load definition was submitted to the NRC. After review of this load definition, the NRC in October 1980 concurred that the lead plant approach taken by the Zimmer Station was adequate to demonstrate the conservatism of the Empirical Load design bases.

A chugging load based on the 4TCO data was also defined in July 1980 and subsequently revised and finalized in September 1980. After review of this lead plant chugging load the NRC agreed that this load was adequate to proceed with construction and licensing with the provision that an assessment be made with the Mark II Generic Chugging Load Definition when it becomes available.

This appendix demonstrates the adequacy and conservatism of the Zimmer Empirical Load by comparison of the design-basis response spectra with response spectra resulting from the Lead Plant (4TCO) Condensation Oscillation and Chugging Loads. From these comparisons it is concluded that the Zimmer Empirical Loads did provide a conservative design basis and resulted in a design which will accommodate all postulated Mark II steam condensation loads. 16

1.2 LEAD PLANT CONDENSATION OSCILLATION (CO) AND CHUGGING LOAD DEFINITIONS BASED ON 4TCO

In order to confirm the adequacy of the Zimmer design basis in light of the results of the Mark II Owners' Group 4TCO test and the JAERI (Japanese Full-Scale Multivent LOCA) test, load definitions developed from the 4TCO data and verified as conservative with the available JAERI data were compared to the design basis. These load definitions were generated to permit this assessment and do not alter the Zimmer Design Basis.

1.2.1 Lead Plant (4TCO) Condensation Oscillation Load Definition

The CO load definition developed from the 4TCO data for Lead Plant assessment is fully described in Reference 1. The load definition is a set of pressure time histories which bound all the applicable 4TCO Condensation Oscillation data.

There are two parts of the CO load definition. The first is a load definition which bounds all the 4TCO data taken under blowdown conditions which could be conservatively predicted to occur during a LOCA in the Zimmer station. This load was defined using all the 4TCO Condensation Oscillation data except for a small amount of data taken with a pool temperature well above that which could occur during the CO regime of a LOCA in the Zimmer station. 16

The maximum applicable temperature for Zimmer under the most conservative conditions is predicted to be less than 135° F during CO. All of the CO data recorded with pool temperatures not exceeding 140° F was used in the definition of the Lead Plant CO Load.

Predictions of the Zimmer LOCA transients were examined to determine the conditions which might exist during the actuation of the Automatic Depressurization System (ADS). This indicated that ADS discharge will not occur coincident with CO loading. However, to ensure conservatism and to be consistent with the Zimmer Empirical Load the predicted conditions corresponding to ADS were expanded and a CO load was defined from the corresponding 4TCO data. This second CO load was used to assess the impact of load combinations including both ADS and CO.

I.2.2 Lead Plant (4TCO) Chugging Load Definition

The lead plant chugging load definition based on the 4TCO chugging data is fully described in Reference 2. The load definition is a set of averaged time histories which conservatively represent the most severe loads anticipated in the Zimmer station.

All of the 4TCO chugging data was considered in formation of the Lead Plant load definition. The largest amplitude chugs were identified and a region of approximately constant blowdown conditions was defined for each large chug. To account for the wide variation of chug amplitudes, the largest chug was reduced in amplitude by an averaging factor derived by averaging the peak overpressure in the defined region. The resulting averaged chugs were compared to the Japanese multivent data from the JAERI facility. Additional chugs were then added to more conservatively represent the low frequency portion of the load.

The assessment reported in the appendix demonstrates that the Zimmer station Empirical Load design basis is sufficiently conservative to accommodate this chugging load definition based on the 4TCO test data and is conservative when compared to full-scale multivent data obtained from the JAERI tests. 16

I.2.3 Geometric Load Factors

The Lead Plant Condensation Oscillation (CO) and Chugging Loads are based on the 4TCO test data. Because of the geometric differences between the 4TCO facility and the Zimmer containment, it is necessary to adjust the 4TCO data pressure amplitudes to values appropriate to the Zimmer Plant. The methodology used to derive the adjustment factors is to compare the predicted loads in the region of the Zimmer pool with the most tightly packed vents to the predicted loads in the 4TCO pool using an acoustic model. This is similar to the approach taken for the La Salle analysis in Reference 1. The results show that a multiplicative factor of 0.80 can be used for Zimmer.

I.3 RESPONSE SPECTRA COMPARISONS

Response spectra, resulting from application of the loads based on 4TCO data and verified as conservative with the JAERI data, were compared to the design-basis response spectra at seven typical locations in the Zimmer containment as shown in Figure I.3-1. This was done to verify that the Empirical Load design basis is conservative.

I.3.1 Load Combinations Considered

To simplify the comparison, envelopes of the design controlling load combinations were generated using the design-basis LOCA loads [illegible] the 4TCO LOCA loads described in Section I.2. These enve[illegible] are compared in Figures I.3-2 through I.3-8. In some instances the Zimmer plant has been designed to an envelope of load combinations while in other cases the individual load combinations were used. Either method of comparison, envelopes or individual load combinations, will yield equivalent qualitative results. Comparisons of vertical response spectra are shown here because the 4TCO LOCA load definitions are symmetric loads.

Curve 1 on the comparison plots is the envelope of the empirical design-basis loads. The individual load combinations 16
are combined by the conservative absolute sum methodology. The following load combinations are included:

OBE + SRVLSP + Empirical Design CO1
SSE + SRVLSP + Empirical Design CO1
OBE + SRVADS + Empirical Design CO2
SSE + SRVADS + Empirical Design CO2
OBE + SRVADS + Empirical Design Chugging
SSE + SRVADS + Empirical Design Chugging

The seismic (SSE and OBE), SRV (LSP-Low Setpoint, ADS-Automatic Depressurization System), and LOCA (CO-Condensation Oscillation, Chugging) loads are the loads used for design of the Zimmer plant. More information on the SRV and LOCA loads can be found in Chapter 2.0 - Zimmer Empirical Loads.

Curve 2 on the comparison plots is the envelope of the corresponding load combinations including the LOCA loads based on the 4TCO test data and verified as conservative with the JAERI data results which are described in Section I.2. These loads were combined using the Square Root of the Sum of the Squares (SRSS) method which is approved by the NRC for use on Mark II design. The following load combinations are included in the envelope:

OBE + SRVLSP + 4TCO1
SSE + SRVLSP + 4TCO1
OBE + SRVADS + 4TCO2

SSE + SRVADS + 4TCO2
OBE + SRVADS + 4TCO Chugging
SSE + SRVADS + 4TCO Chugging

The LOCA loads in the above combination are as described in Section I.2 and all other loads are identical to those in the empirical load design basis.

I.3.2 Response Spectra Comparison Results

Figures I.3-2 through I.3-8 demonstrate that the Zimmer Empirical Load design basis is more conservative than is required to accommodate all current seismic, LOCA, and SRV load requirements and to accommodate any potential revisions to these loads based on the 4TCO and JAERI tests. The Zimmer Empirical Load design basis response spectra always bounds the response spectra generated using the loads derived from the 4TCO test, as described in Section I.2, at frequencies less than about 60 hertz and this bound is generally by a large margin. At certain locations, the response based on the 4TCO load, as described in Section I.2, is higher than the design basis at frequencies above about 60 hertz but the exceedence is generally small and at low acceleration levels. 16

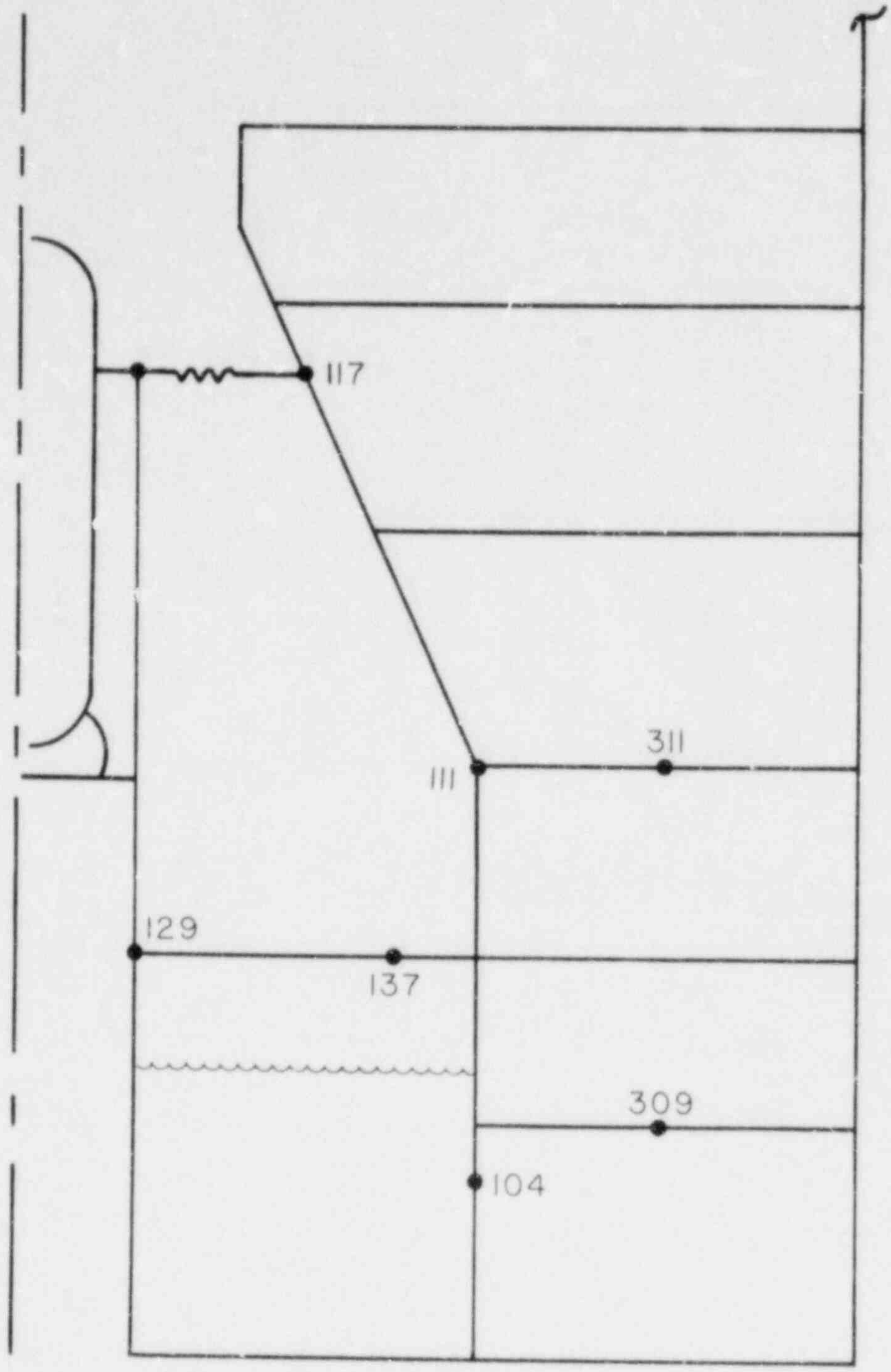

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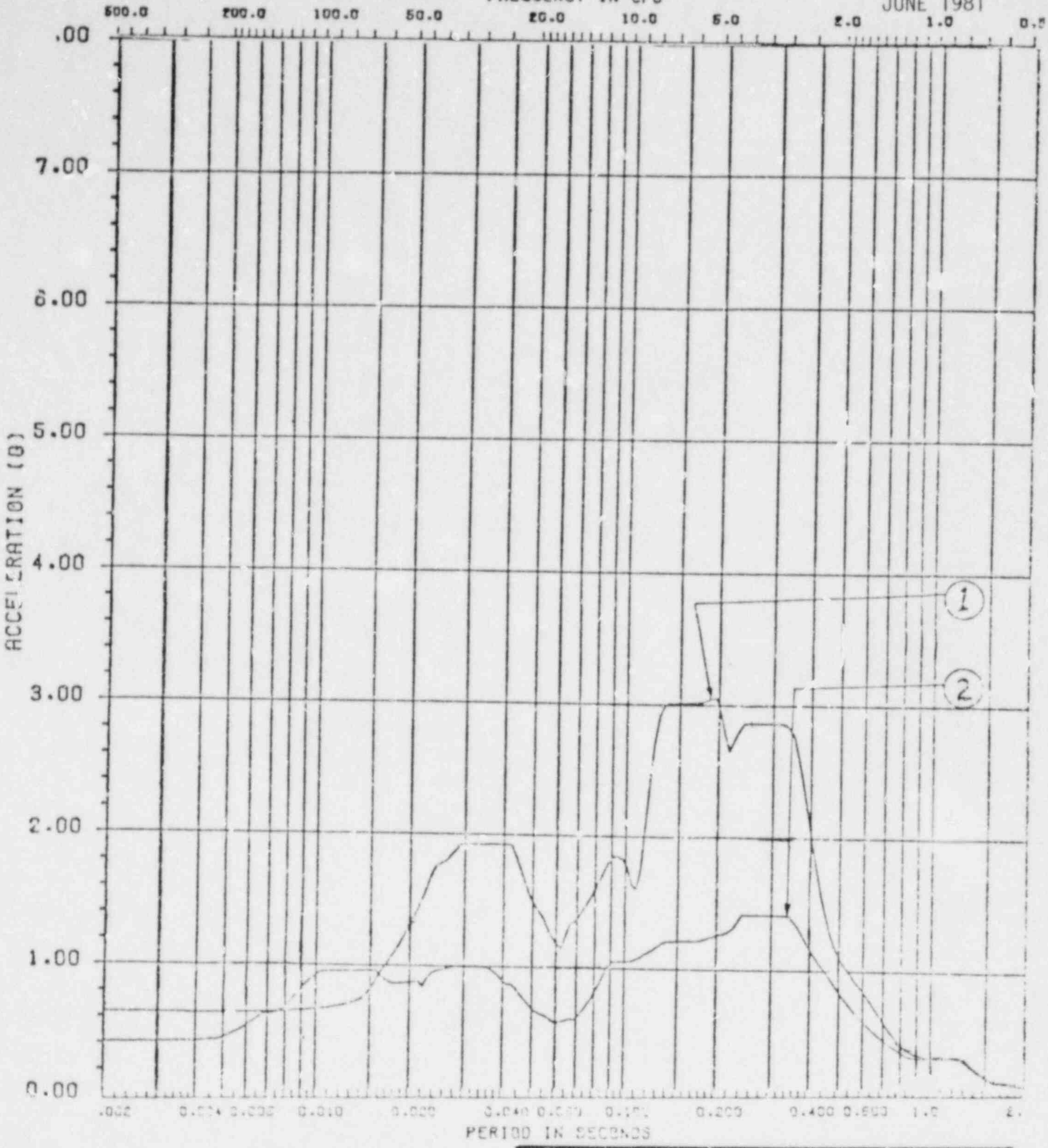
FIGURE I.3-1

ZIMMER PLOT LEGEND



KEY: 1 - ZIMMER EMPIRICAL LOADS DESIGN BASIS

2 - LOAD COMBINATION WITH 4TCO LOCA LOADS

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FIGURE I.3-2

RESPONSE SPECTRA COMPARISON
DESIGN LOC 104 VERT

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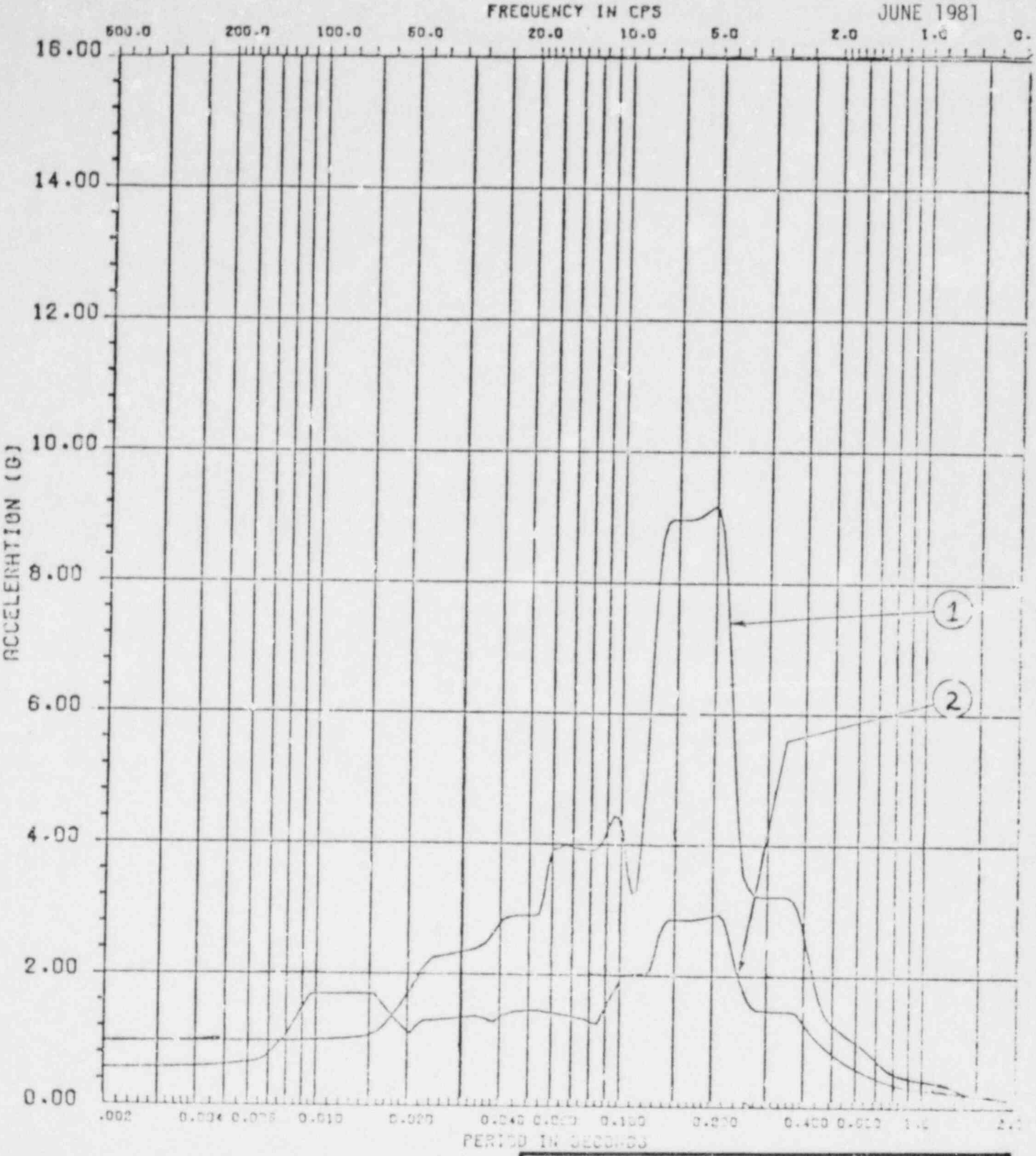

KEY: 1 - ZIMMER EMPIRICAL LOADS DESIGN BASIS

2 - LOAD COMBINATION WITH 4TCO LOCA LOADS

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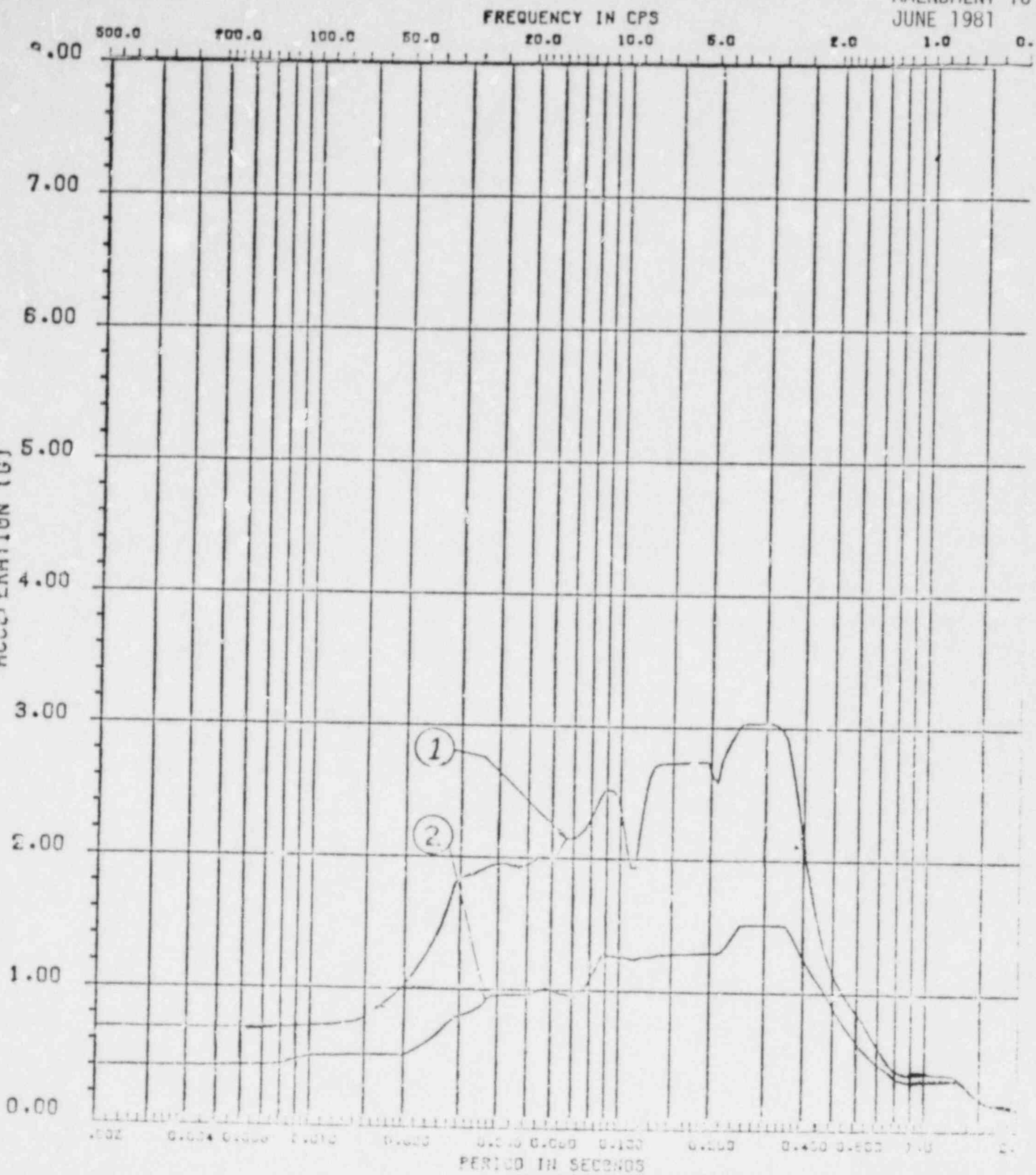
FIGURE I.3-3

RESPONSE SPECTRA COMPARISON
DESIGN LOC 129 VERT

POOR ORIGINAL



KEY: 1 - ZIMMER EMPIRICAL LOADS
DESIGN BASIS

2 - LOAD COMBINATION WITH
4TCO LOCA LOADS

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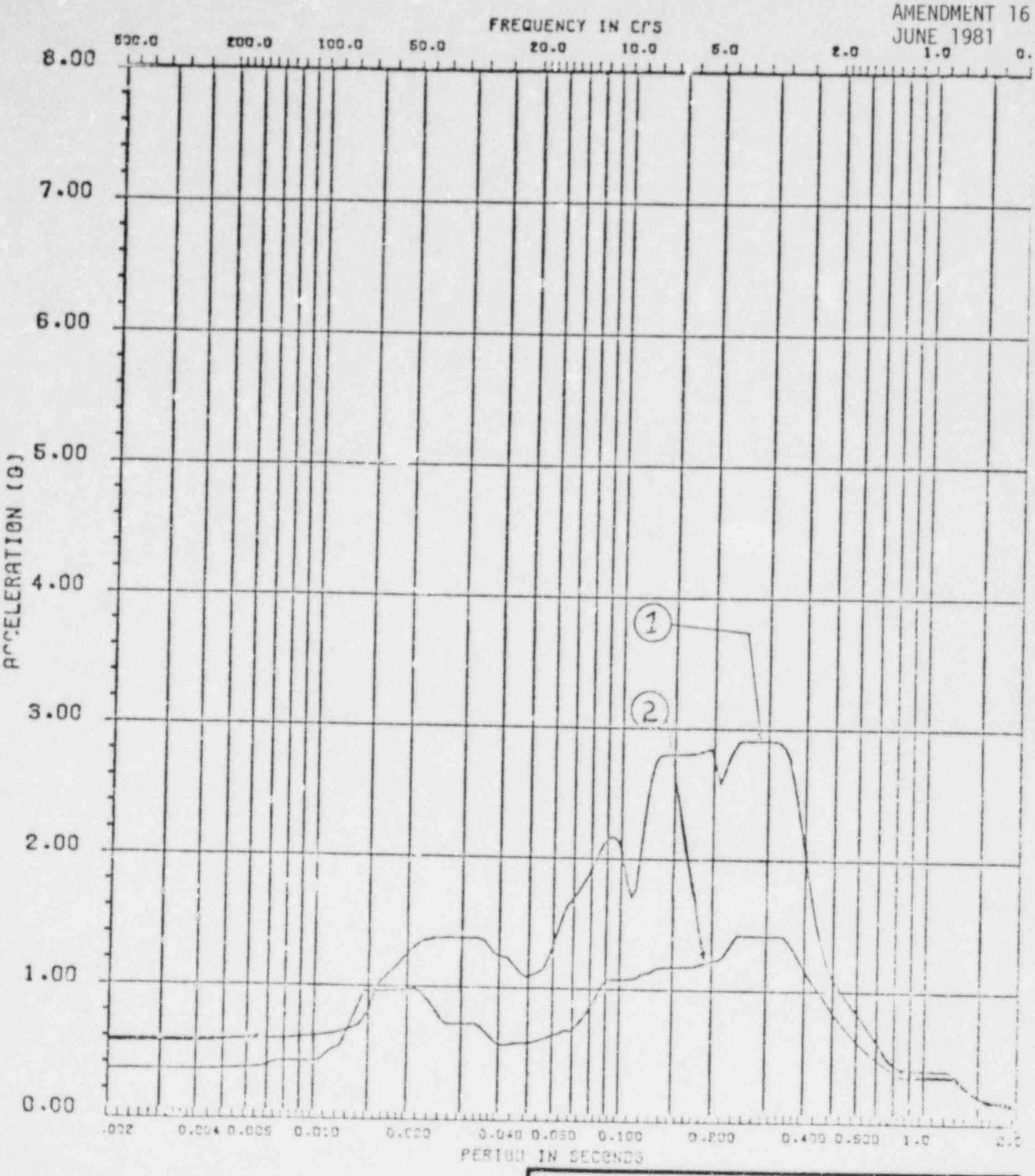
FIGURE I.3-4

RESPONSE SPECTRA COMPARISON
DESIGN LOC 117 VERT

POOR ORIGINAL



KEY: 1 - ZIMMER EMPIRICAL LOADS DESIGN BASIS

2 - LOAD COMBINATION WITH 4TCO LOCA LOADS

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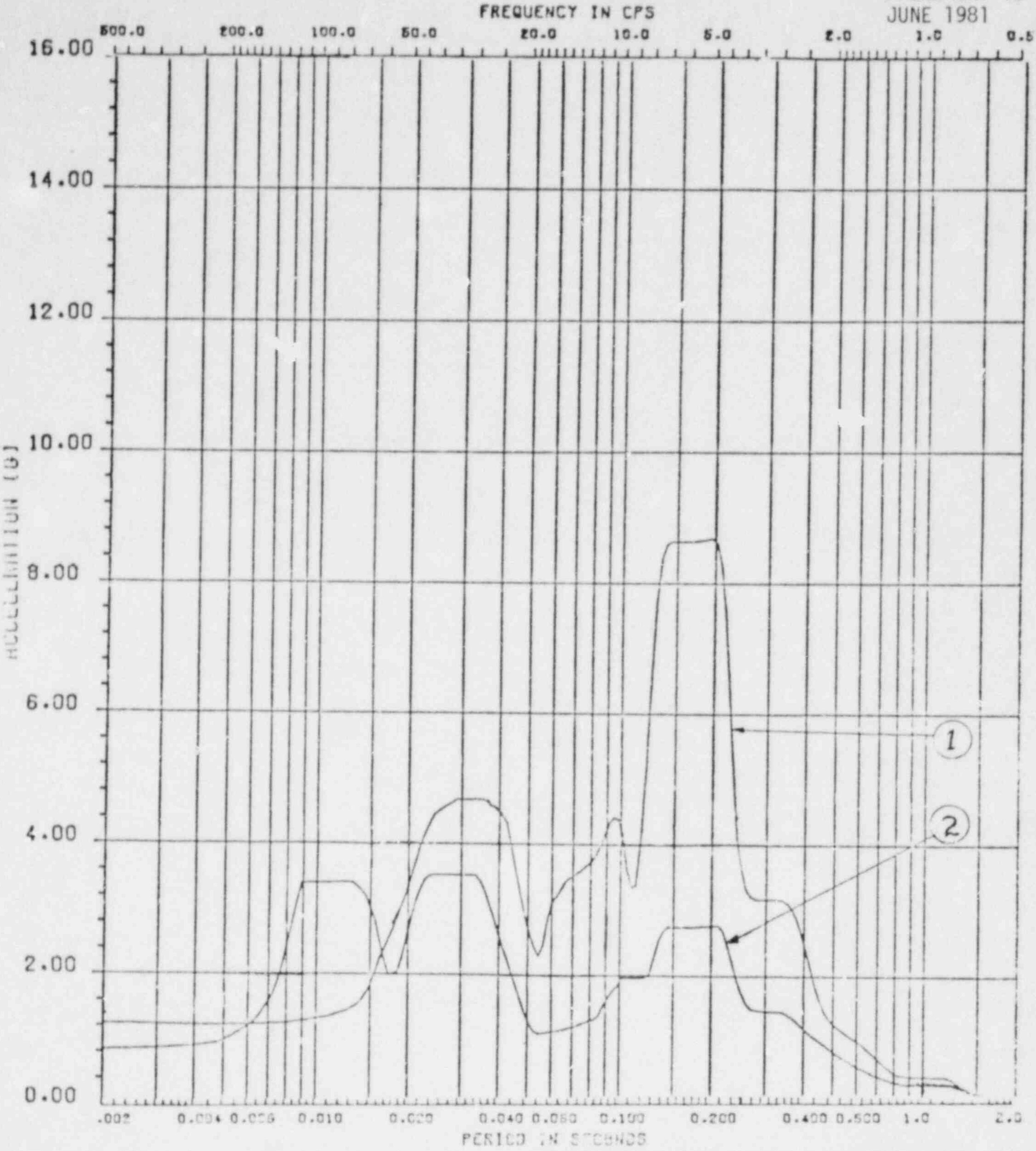
FIGURE I.3-5

RESPONSE SPECTRA COMPARISON DESIGN LOC 111 VERT

POOR ORIGINAL



KEY: 1 - ZIMMER EMPIRICAL LOADS DESIGN BASIS

2 - LOAD COMBINATION WITH 4TCO LOCA LOADS

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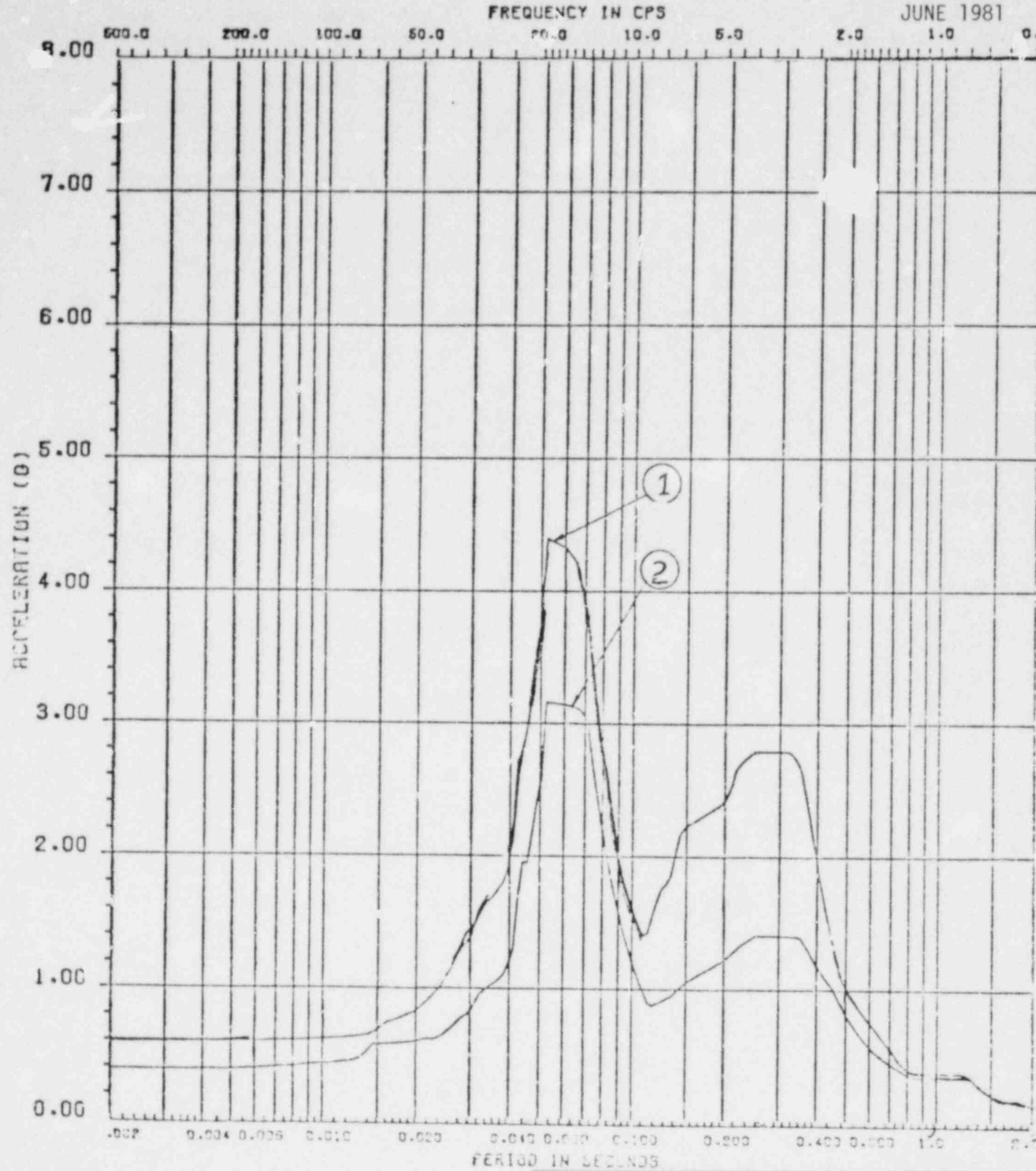
FIGURE I.3-6

RESPONSE SPECTRA COMPARISON
DESIGN LOC 137 VERT

POOR ORIGINAL



KEY: 1 - ZIMMER EMPIRICAL LOADS DESIGN BASIS

2 - LOAD COMBINATION WITH 4TCO LOCA LOADS

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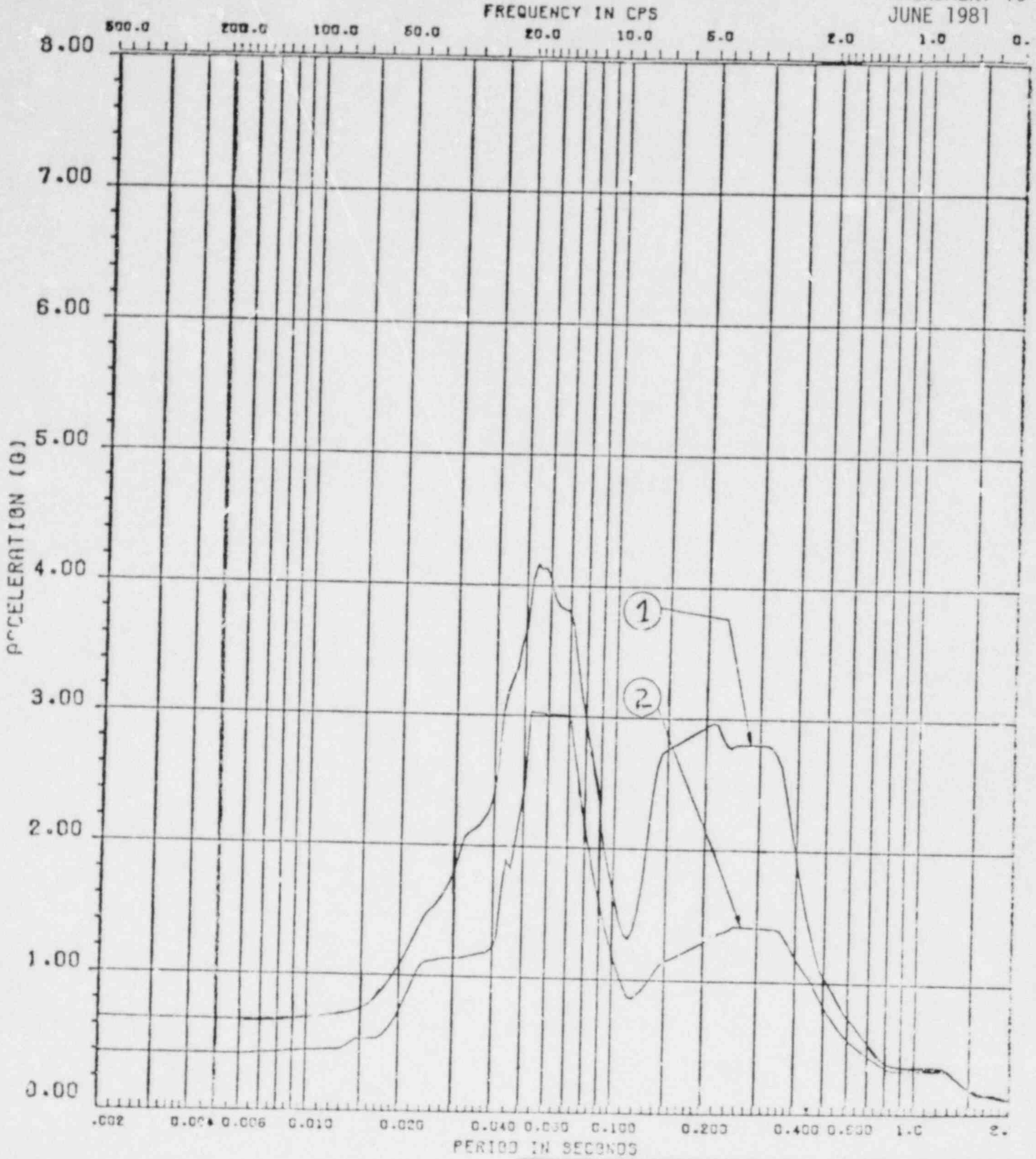
FIGURE I.3-7

RESPONSE SPECTRA COMPARISON
DESIGN LOC 309 VERT

POOR ORIGINAL



KEY: 1 - ZIMMER EMPIRICAL LOADS DESIGN BASIS

2 - LOAD COMBINATION WITH 4TCO LOCA LOADS

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FIGURE I.3-8

RESPONSE SPECTRA COMPARISON
DESIGN LOC 311 VERT

POOR ORIGINAL

I.4 CONCLUSIONS

The comparisons presented here demonstrate that the Zimmer Power Station Empirical Load design is significantly more conservative than required to accommodate all current
seismic, LOCA, and SRV load requirements and to accommodate 16
any potential revisions to these loads based on the 4TCO and JAERI tests. The small high frequency exceedences which occur at some locations are judged to be insignificant. Assessment of the currently available SRV and LOCA loads, therefore, confirms that the Zimmer Empirical Load approach has resulted in a conservative design basis.

I.5 REFERENCES

1. "Condensation Oscillation (CO) Load Data for La Salle," General Electric Company and S. Levy, Inc., July 1980.

2. "Chugging Loads for Assessment of the 4TCO Data," Creare (Report No. TN-322) and S. Levy, Inc., (Report No. SLI-8075-1), September 1980. 16