**Commonwealth Edison**
1400 Opus Place
Downers Grove, Illinois 60515

January 15, 1992

Dr. Thomas Murley, Director
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Document Control Desk

Subject: NRC Evaluation of the Commonwealth Edison Response to Generic Letter 87-02, Supplement 1, "Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors", SQUG Resolution of USI A-46.

Dresden Nuclear Power Station
NRC Docket 50-237/249 and TAC M69442/69443
Quad Cities Nuclear Power Station
NRC Docket 50-254/265 and TAC M69476/69477
Zion Nuclear Power Station
NRC Docket 50-295/304 and TAC M69492/69493

References:
(1) SQUG Response to GL 87-02 dated August 21, 1992 to J.G. Partlow from N.P. Smith
(2) Commonwealth Edison response to GL 87-02 dated September 21, 1992 to Dr. T. E. Murley from M. A. Jackson.
(3) NRC Safety Evaluation of Commonwealth Edison's response to GL 87-02 dated November 20, 1992 to T. J. Kovach from C. P. Patel.

Generic Letter 87-02, Supplement 1 required that each licensee: 1) either commit to use both the SQUG commitments and the implementation guidance or provide an alternative method, 2) provide an implementation schedule to implement GIP-2, 3) provide detailed information on procedures and criteria used to generate the in-structure response spectra and 4) inform the staff if they intend to change their licensing basis to reflect a commitment to the GIP methodology for verifying seismic adequacy of mechanical and electrical equipment, prior to receipt of the staff's plant-specific safety evaluation to resolve USI A-46.

Commonwealth Edison's submittal to Generic Letter 87-02, Supplement 1 was provided in reference 2. The Nuclear Regulatory Commission's (NRC) safety evaluation of the CECo submittal was provided in reference 3. The purpose of this letter is to provide a response that addresses the NRC staff's questions presented in reference 3. Specifically, this response provides the following;

1) a clarification of CECo's commitment to the Seismic Qualification Utility Group (SQUG) commitments and the implementation guidance as described in the Generic Implementation Procedure, revision 2 (GIP-2), and
2) the requested additional information regarding the In-Structure Response Spectra (ISRS) for Dresden and Quad Cities stations.





A025

The NRC safety evaluation found that the CECo responses regarding the ISRS for Zion station, and the implementation schedules for the three USI A-46 CECo plants, Dresden, Quad Cities and Zion stations are acceptable. However, the NRC staff stated that the response was unclear as to whether CECo intends to use both the SQUG commitments and the implementation guidance. The staff did interpret our response as a commitment to the entire GIP-2 including both the SQUG commitments and the implementation guidance, and therefore, considered it acceptable. In the original submittal CECo committed to the GIP, in its entirety, including clarifications, interpretations, and exceptions identified in SSER-2 as clarified in the reference (1) August 21, 1992 letter with no exceptions.

For purposes of further clarification, CECo will use Part I, Section 1.3 of the GIP, revision 2 with regard to full implementation of all provisions of the guidance sections. Additionally, as the staff has suggested, for implementing the GIP-2, CECo will not merely follow the August 21, 1992 SQUG letter but also will follow the Attachment to the safety evaluation (reference 3), which is the staff's response to the SQUG August 21, 1992 letter.

The NRC requested additional information regarding the Dresden and Quad Cities in-structure response spectra. This information is enclosed in the Attachment to this letter.

As indicated in the original submittal (reference 1), the current schedules may be affected by coordination with the seismic IPEEE response, the completion of the SQUG training, significant outage schedule changes, and the availability of industry resources committing to support the large number of licensees implementing this program. The current approved implementation schedules are also dependent upon the NRC Staff approval of the enclosed in-structure response spectra (ISRS) for Dresden and Quad Cities stations. Accordingly, please provide your acceptance of the ISRS by March 15, 1993.

If you have any questions regarding this letter, please contact me at (708) 663-7287.

Respectfully,

Marcia A. Jackson

Marcia A. Jackson
Nuclear Licensing Administrator
Generic Issues

Maryellen D. Long

" OFFICIAL SEAL "
MARYELLEN D. LONG
NOTARY PUBLIC, STATE OF ILLINOIS
MY COMMISSION EXPIRES 8/11/93

1-18-93

cc: A. B. Davis, Regional Administrator, RIII
J. Dyer, Project Director, NRR
B. Siegel, Dresden Project Manager, NRR
C. Patel, Quad Cities Project Manager, NRR
C. Shiraki, Zion Project Manager, NRR
W. Rogers, Dresden SRI
T. Taylor, Quad Cities SRI
J. Smith, Zion SRI

# ADDITIONAL INFORMATION ON IN-STRUCTURE RESPONSE SPECTRA FOR DRESDEN - UNITS 2 & 3 AND QUAD CITIES - UNITS 1 & 2

## I. Introduction

Dresden and Quad Cities are considered sister plants, with very similar structural arrangements, situated in the same seismological province with very similar earthquake history and similar rock foundations. As stated in Commonwealth Edison Company's (CECo) letter dated September 21, 1992 to the NRC, two of the most comprehensive and recent studies for seismic risk at nuclear power plant sites, located east of the Rocky Mountains, have been performed by Lawrence Livermore Lab (LLL) and Electric Power Research Institute. The LLL study was sponsored by the NRC. Both studies showed that, in terms of uniform hazard spectra and probability of exceedance of peak ground acceleration, Quad Cities has a slightly lower seismic risk than that of Dresden.

Based on the above, CECo believes that the SSE ground motion at Quad Cities should be the same at Dresden, if not slightly lower. However, in deference to the position stated in your letter dated November 20, 1992, CECo will use the higher peak ground acceleration (PGA) of 0.24g for Quad Cities - Units 1 & 2.

The following sections describe the ground response spectrum, time history, building models and damping value used for In-Structure Response Spectra (ISRS) generation for both Dresden and Quad Cities stations.

## II. Ground Response Spectrum

The site specific SSE spectrum anchored at 0.13g has been approved for Dresden - Unit 2 under the Systematic Evaluation Program (SEP) by the NRC. However, for the resolution of USI A-46, Commonwealth Edison Company (CECo) will use the conservative design basis SSE ground spectrum anchored at 0.2g. The Dresden design-basis SSE ground response spectra are smoothed Housner-type spectra. Figure 1 shows Housner-type response spectra, for various damping values, anchored to 0.10g PGA. The 5% damped ground response spectrum, anchored to 0.20g PGA, will be used for A-46 work on Dresden - Units 2 & 3. At Quad Cities - Units 1 & 2, the ground spectrum to be used for A-46 work will be of the same shape as for Dresden (shown in Figure 1); however, it will be scaled up by anchoring at 0.24g.

III. <u>Time-History Used for In-Structure Response Spectra (ISRS) Generation</u>

The design basis ISRS for Dresden - Units 2 & 3 were generated using a time-history method of analysis. El. Centro 1940 earthquake, N-S component, anchored to 0.10g was used to generate the ISRS for OBE. For SSE design, the spectral values were obtained by doubling the OBE spectra (See also Section VI below). A comparison of the design ground spectrum and the spectrum of El. Centro 1940 earthquake N-S component, both anchored to 0.10g, is shown in Figure 2. It can be seen that the El. Centro N-S component envelops the design ground spectrum quite conservatively for most of the frequencies.

IV. <u>Building Model Used for ISRS Generation</u>

The building models used for Dresden - Unit 2 & 3 ISRS generation are shown in Figures 3 & 4 for N-S and E-W directions, respectively. The mass and stiffness properties are also shown in the above figures.

The Quad Cities - Units 1 & 2 were designed as sister units to Dresden - Units 2 & 3 by the same NSSS supplier, using the same architect/engineer. A review of the plants structural drawings for parameters which affect the seismic models (i.e., mass and stiffness) has confirmed that the two plants are quite similar in terms of their seismic behavior. The review included comparison of building dimensions, major floor slab elevations, plan dimensions, thickness of slabs and concrete walls, and steel bracing dimensions which constitute to the horizontal stiffness of the buildings. Based upon this comparison between the two plant's seismic building characteristics, CECo has concluded that the building model used at Dresden is acceptable to be used for Quad Cities.

Since both the plants are founded on rock, there is no soil-structure interaction effect considered.

The mathematical models shown in Figures 3 & 4 represent the combined reactor-turbine building complex. The buildings and models are described briefly in the following paragraphs.

For both plants the reactor buildings are made up of a reinforced concrete structure supporting a steel superstructure and roof. The concrete portions of structures begin at the foundation located approximately 41 feet below grade and extend to approximately 95 feet above grade. The steel superstructure is supported on top of the concrete structure and extends to the roof located approximately 141 feet above grade.

For both plants the turbine buildings are also made up of a reinforced concrete structure supporting a steel superstructure and roof. The concrete portions of structures begin approximately at grade and extend to about 44 feet above grade. The steel structure begins at about 44 feet above grade and extends to the turbine building roof approximately 105 feet above grade.

For the dynamic response analysis, an equivalent lumped mass model was developed for the buildings in each direction. In the N-S direction, the reactor and turbine building models are connected at two points: (1) at about 44 feet above grade, representing the operating floor of the turbine building; and (2) at about 105 feet above grade, representing the roof of the turbine building. In the E-W direction, the two building models are connected at one point only, at about 44 feet above grade representing the operating floor of the turbine building. Each story level mass represents the mass of concrete and equipment at each floor and the tributary mass of the equipment and concrete walls between adjacent floors. The top story masses are similarly developed but include the tributary mass of the walls, steel frame, and the mechanical equipment of the story. The average area and moment of inertia of the structural elements between floors is used to determine the stiffness characteristics between masses.

The lines interconnecting the masses in Figure 3 represent weightless N-S springs having a stiffness equal to the stiffness of the actual structure in that direction. Likewise, the lines in Figure 4 represent E-W springs having a stiffness equal to the stiffness of the actual structure in that direction.

## V. Damping Values

A 5% modal damping value was used in the time-history analysis of the building model. This damping value is consistent with the Operating Basis Earthquake (OBE) level. No separate building analysis was done with higher damping values corresponding to SSE; the ISRS generated for OBE were conservatively doubled for use in SSE design.

## VI. In-Structure Response Spectra

The original horizontal ISRS for Dresden - Units 2 & 3 were generated for OBE, only for 0.5% spectral damping value. The ISRS for SSE design were obtained by doubling the OBE ISRS.

Subsequently, the horizontal design response spectra for additional damping values of 1%, 2%, and 5% for both the OBE and the SSE were generated. Synthetic time histories consistent with the 1/2% damping original unwidened spectra were obtained for each floor elevation by iterations using the El. Centro 1940 N-S earthquake record as the starting point. A typical comparison of the synthetic time history response spectrum and the original unwidened response spectrum is shown in Figure 5. These synthetic time histories were then used to generate OBE and SSE response spectra. The peaks of the spectra were widened by 15% on each side. Typical SSE in-structure response spectra are shown in Figures 6 through 13. Since these ISRS were generated using conservative time history and damping values, for A-46 work, they (the 5% damped spectra) will be used as 'conservative, design' ISRS as defined in GIP-2.

For Quad Cities, the ISRS will be obtained by scaling up the 5% damped Dresden ISRS for SSE by a factor of 0.24g/0.2g, which is the ratio of Quad Cities SSE PGA to Dresden SSE PGA, and used as 'conservative, design' spectra for A-46 work. An example of such a spectrum obtained by scaling the 5% damped Dresden ISRS (Figure 12) by a factor of 1.2 is shown in Figure 14.

a:jain1.pka

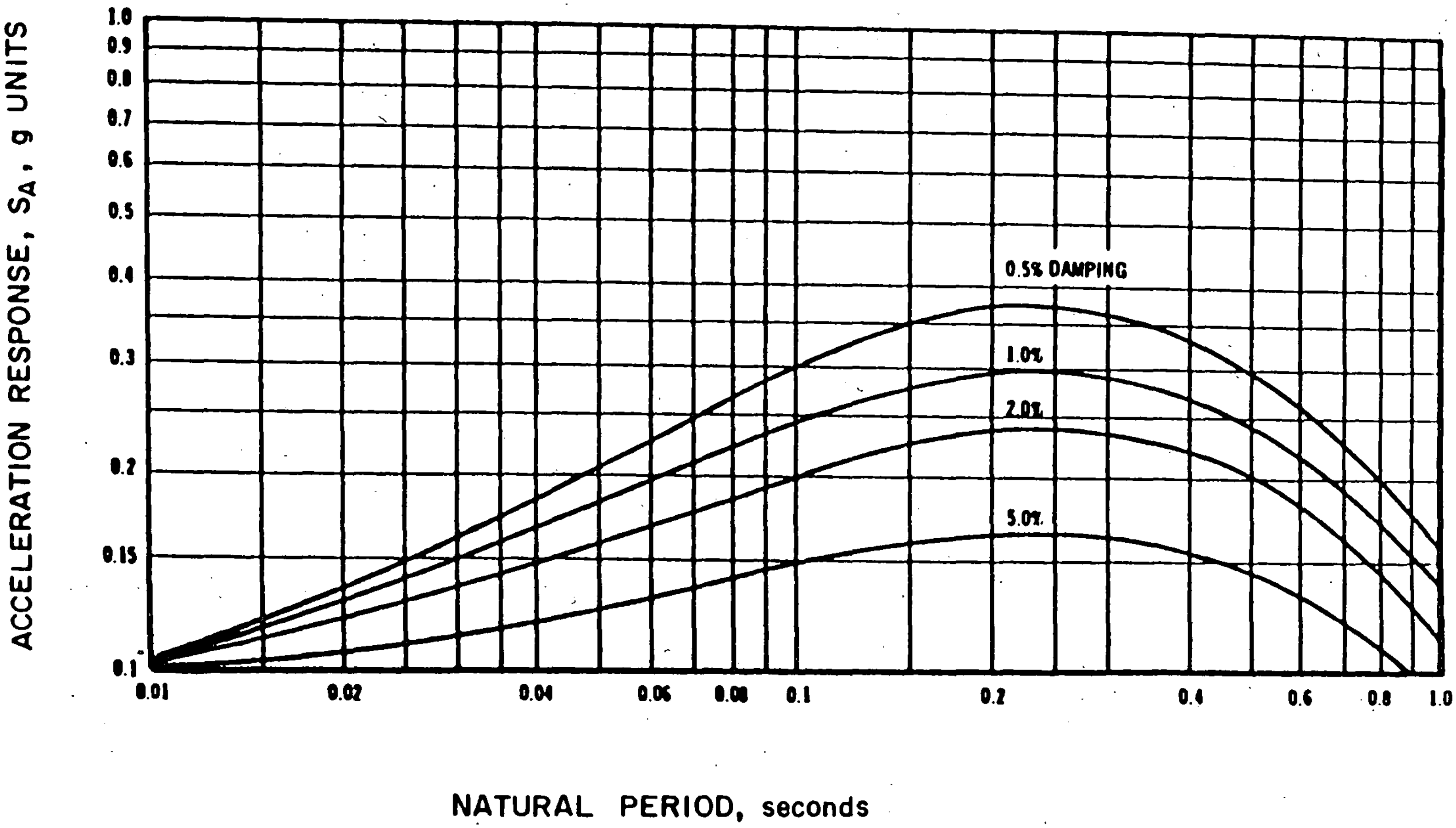



FIGURE 1 **ACCELERATION RESPONSE SPECTRUM, LOG-LOG SCALE**

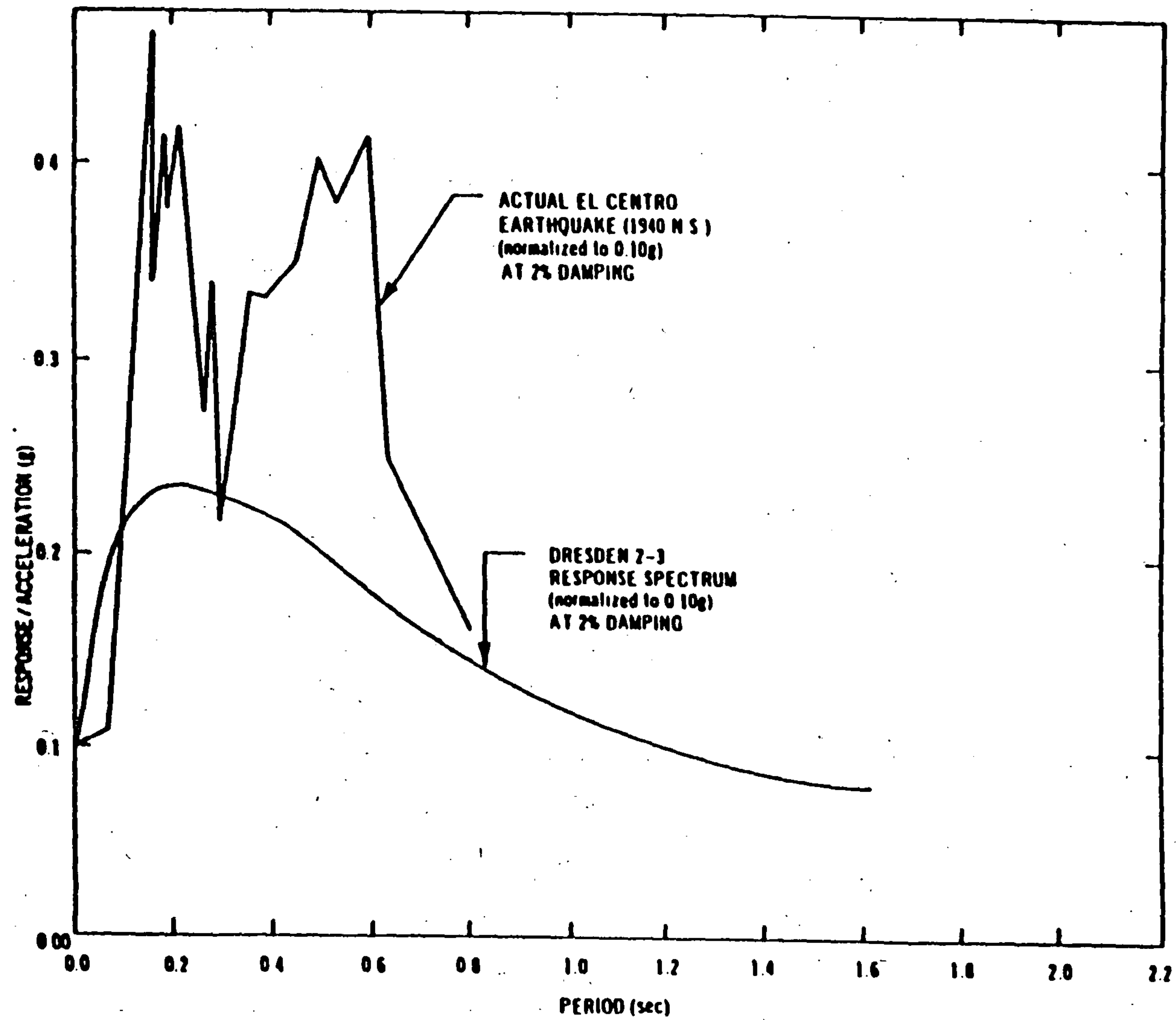



FIGURE 2 RESPONSE SPECTRA CURVE FOR EL CENTRO EARTHQUAKE

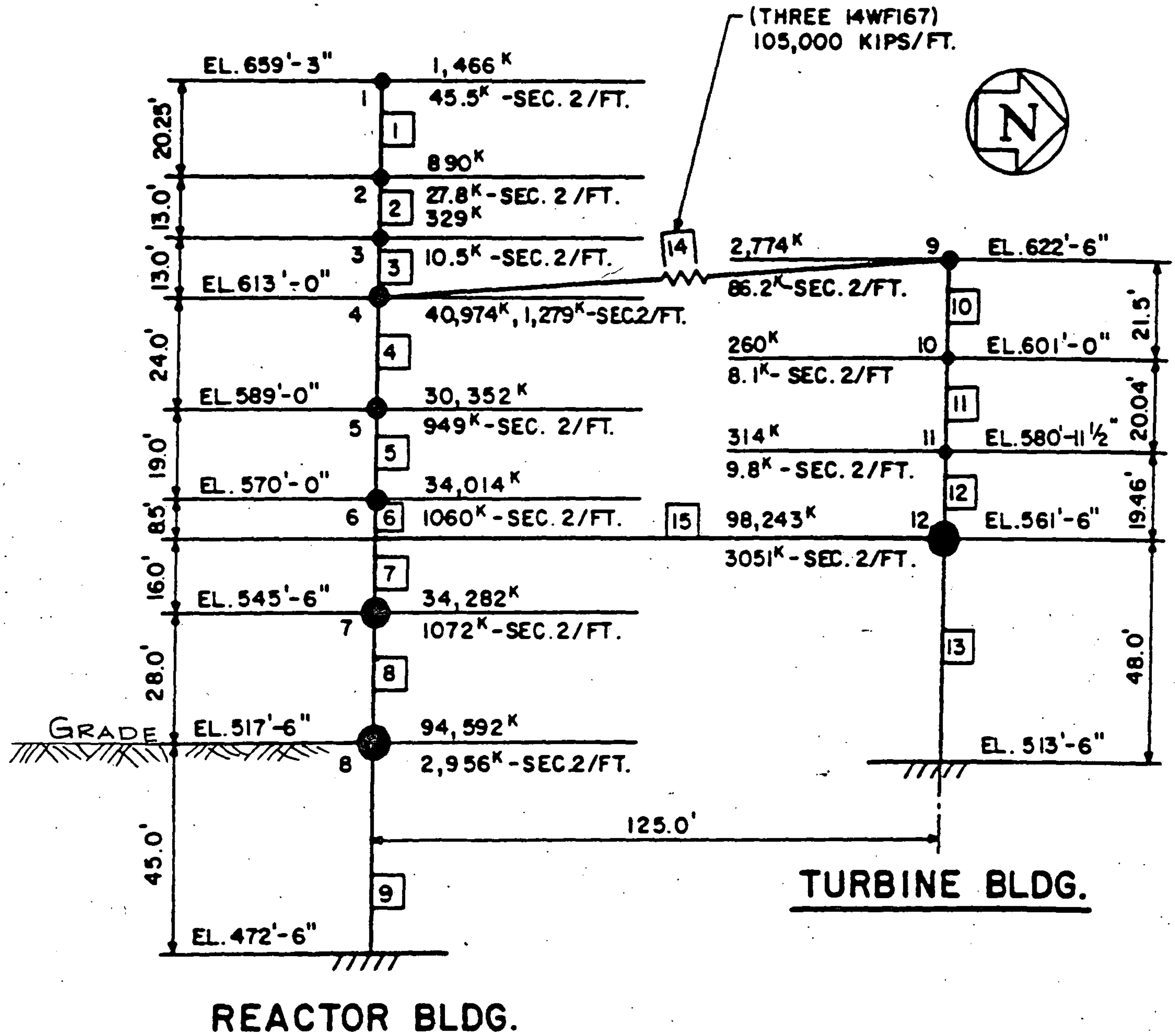



FIGURE 3 COMBINED REACTOR-TURBINE BUILDING HORIZONTAL SEISMIC MODEL-N-S DIRECTION

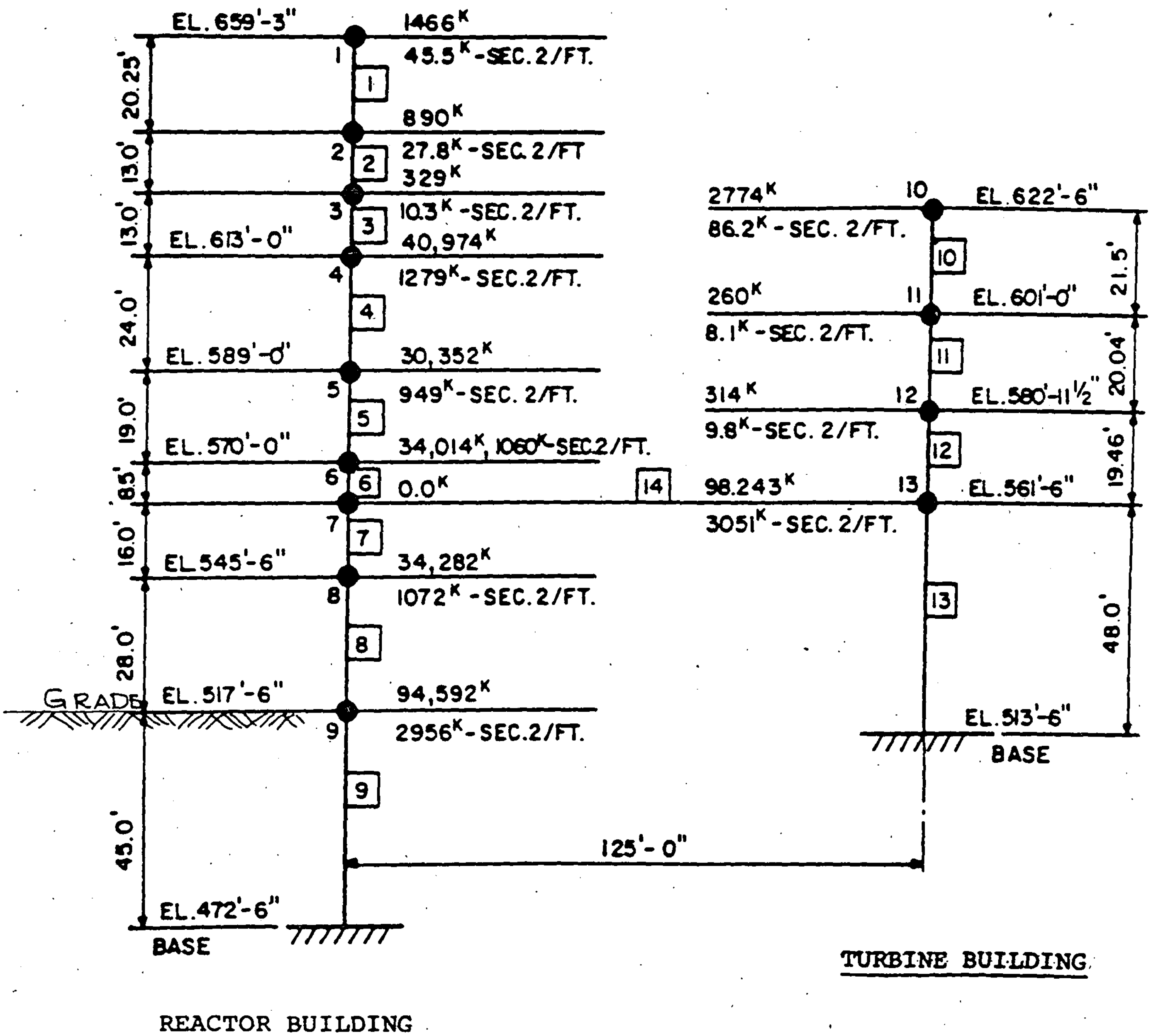



FIGURE 4 COMBINED REACTOR-TURBINE BUILDING HORIZONTAL SEISMIC MODEL - E-W DIRECTION

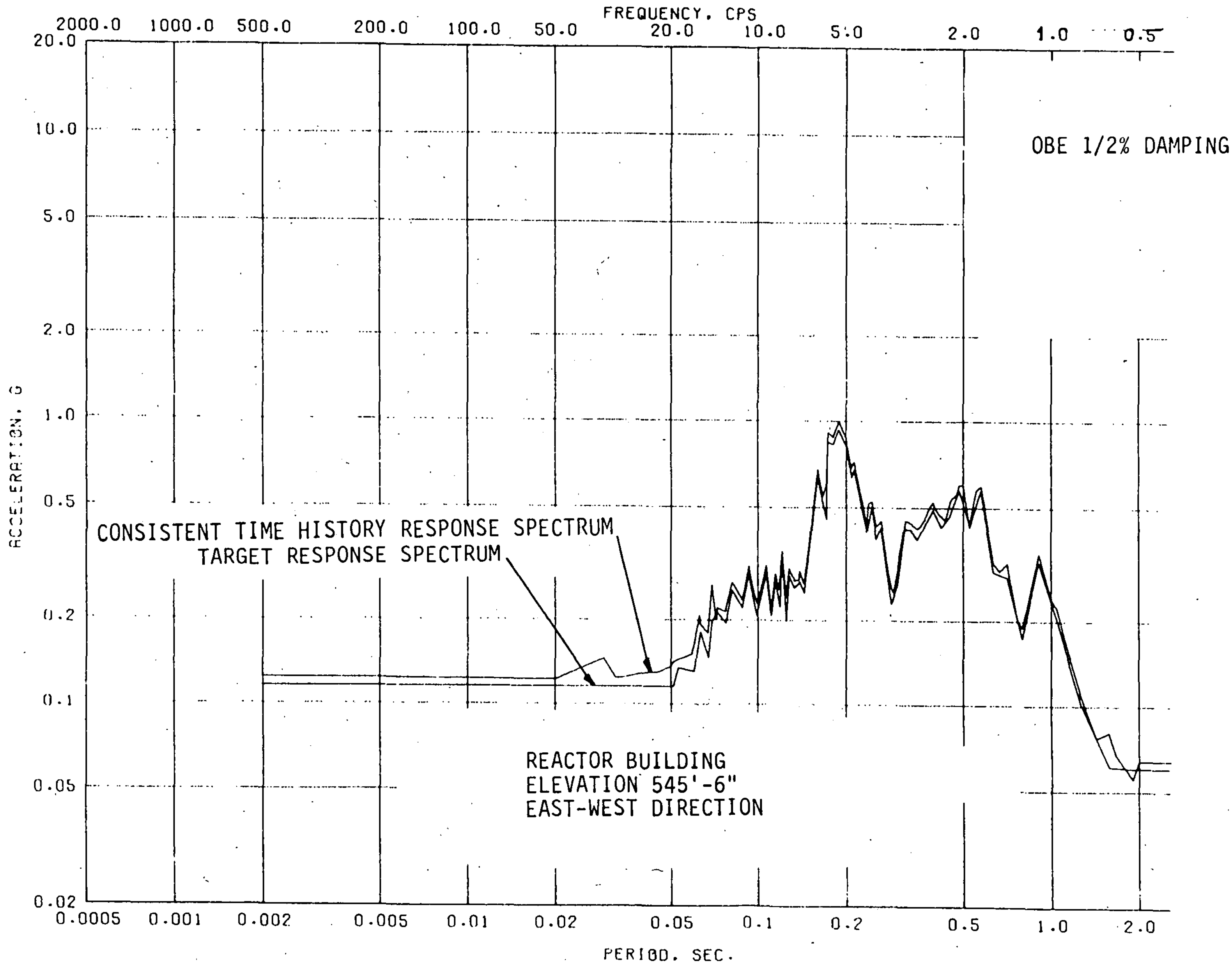
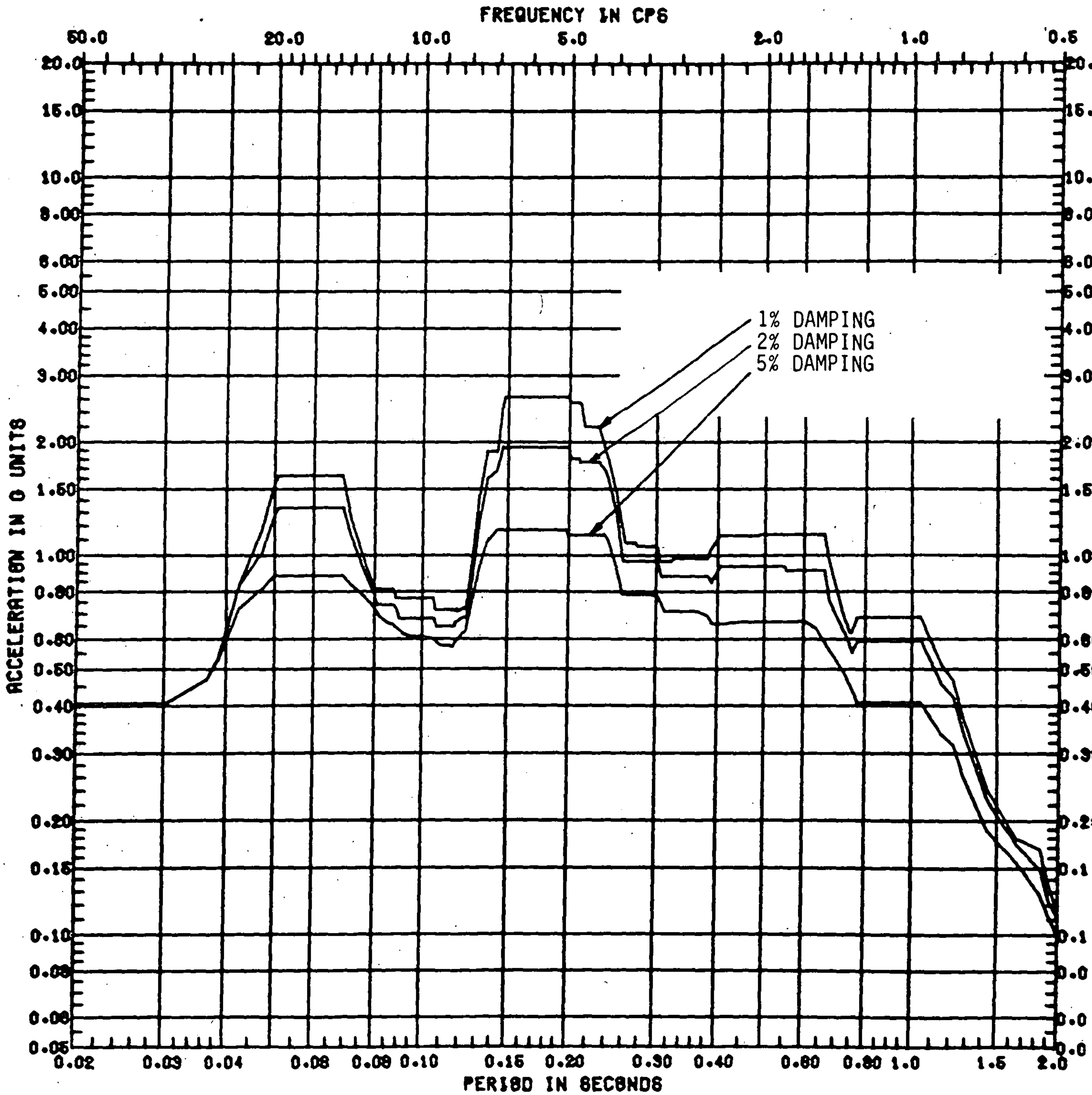



FIGURE 5 RESPONSE SPECTRA CURVE BASED ON SYNTHETIC TIME HISTORY

SARGENT & LUNDY
ENGINEERS

CALC NO. 7355-E8-S SAFETY RELATED
PROJECT DRES UNITS 2&3
PROJECT NO. 7355
PEAKS WIDENED BY 15% ON EACH SIDE
DAMPING 0.010 0.020 0.050

FIGURE 6




SEISMIC SPECTRA - SSE

NODE 7

DIRECTION N-S

ELEVATION 545'-6''

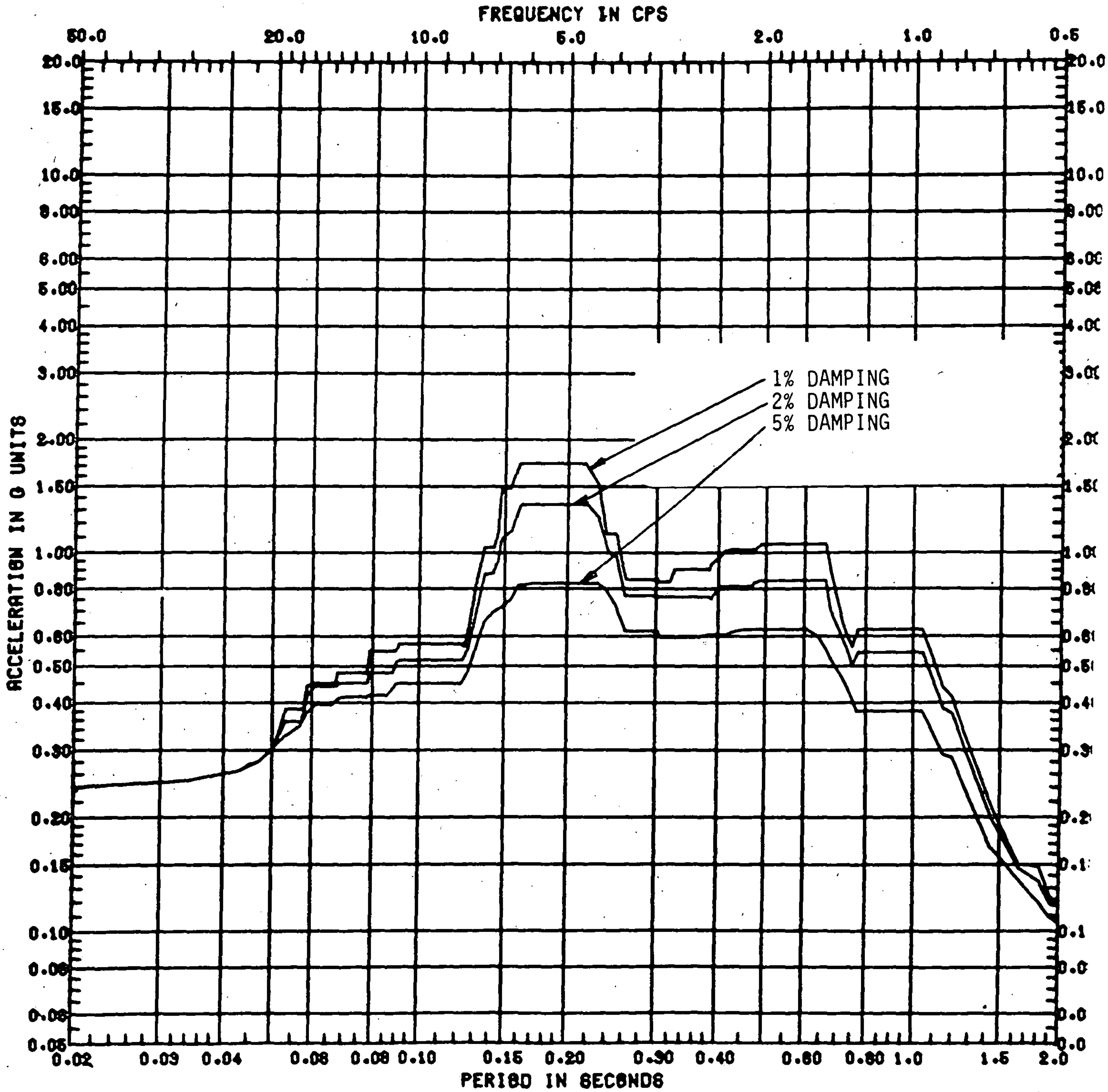
LOCATION REACTOR BUILDING

*

SARGENT & LUNDY ENGINEERS

CALC NO. 7355-E8-5 SAFETY RELATED
PROJECT DRES UNITS 2&3
PROJECT NO. 7355
PEAKS WIDENED BY 15% ON EACH SIDE
DAMPING 0.010 0.020 0.050

FIGURE 7




SEISMIC SPECTRA - SSE

NODE 8

DIRECTION E-W

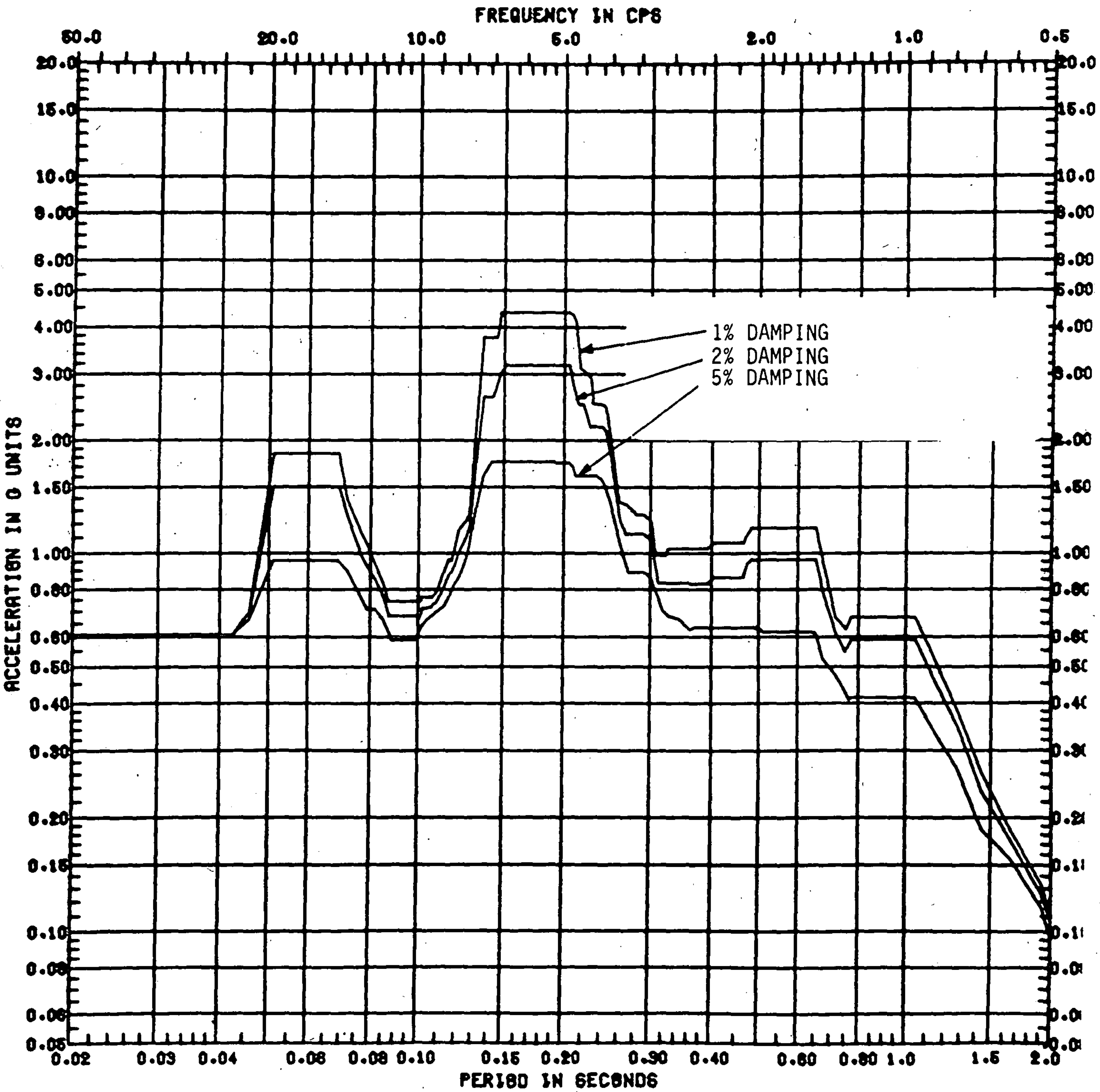
ELEVATION 545'-6"

LOCATION REACTOR BUILDING

SARGENT & LUNDY
ENGINEERS

CALC NO. 7355-E8-S SAFETY RELATED
PROJECT DRES UNITS 2&3
PROJECT NO. 7355
PEAKS WIDENED BY 15% ON EACH SIDE
DAMPING 0.010 0.020 0.050

FIGURE 8




SEISMIC SPECTRA - SSE

NODE 6

DIRECTION N-S

ELEVATION 570'-0"

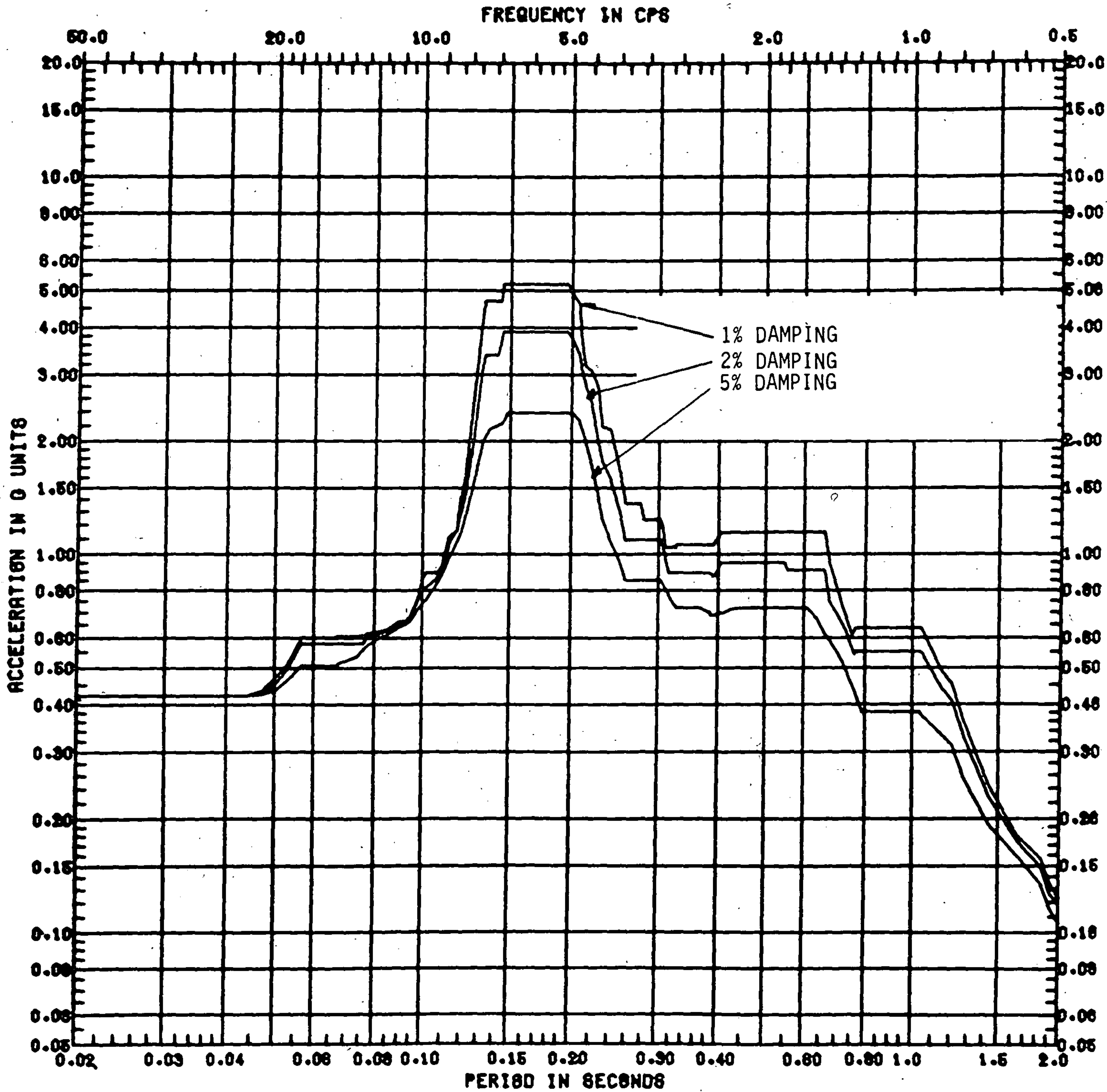
LOCATION REACTOR BUILDING

*

SARGENT & LUNDY ENGINEERS

CALC NO. 7355-E8-S SAFETY RELATED
PROJECT DRES UNITS 2&3
PROJECT NO. 7355
PEAKS WIDENED BY 15% ON EACH SIDE
DAMPING 0.010 0.020 0.050

FIGURE 9




SEISMIC SPECTRA - SSE

NODE 6

DIRECTION E-W

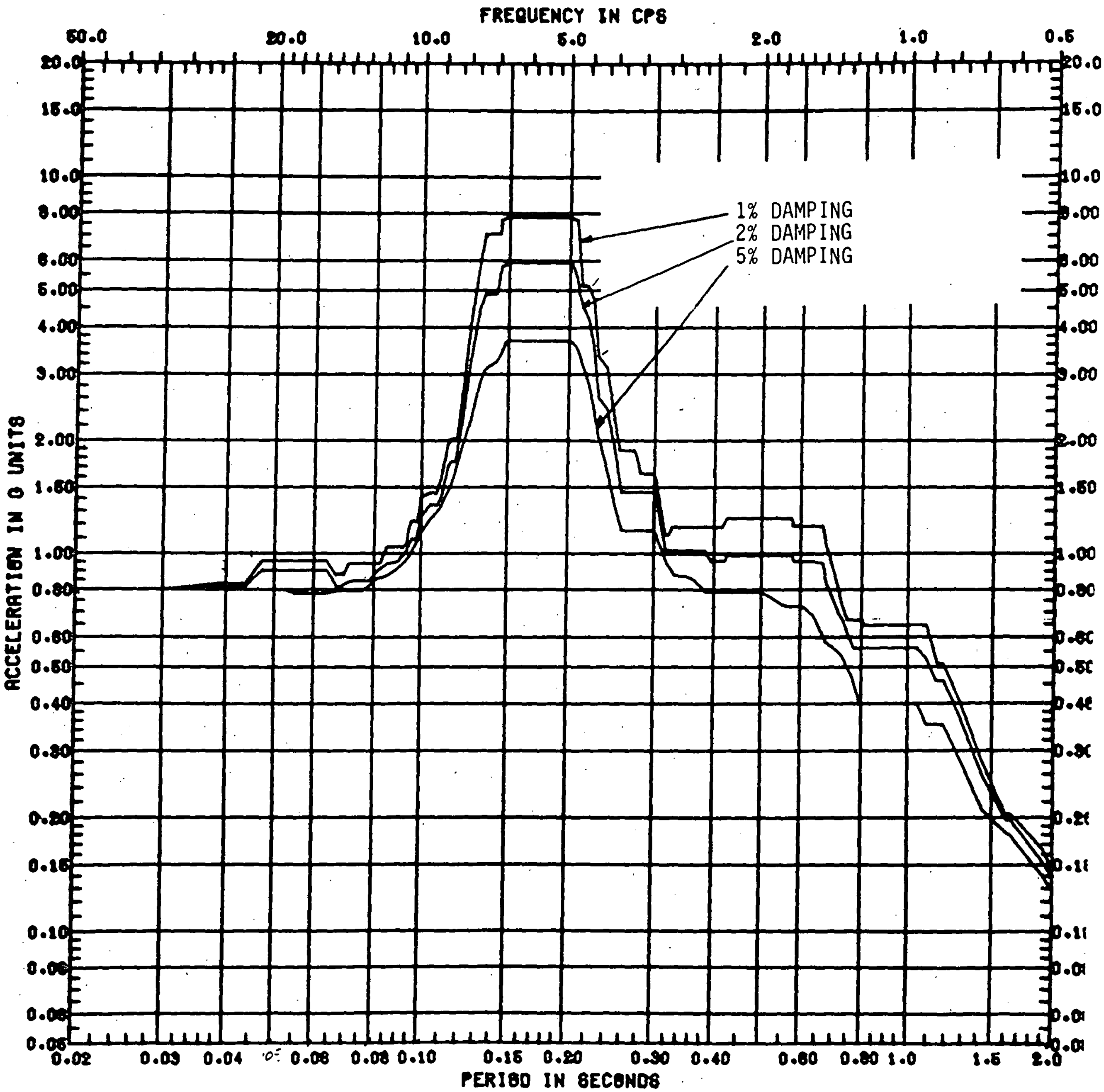
ELEVATION 570'-0''

LOCATION REACTOR BUILDING

SARGENT & LUNDY
ENGINEERS

CALC NO. 7355-E8-S SAFETY RELATED
PROJECT DRES UNITS 2&3
PROJECT NO. 7355
PEAKS WIDENED BY 15% ON EACH SIDE
DAMPING 0.010 0.020 0.050

FIGURE 10




SEISMIC SPECTRA - SSE

NODE 5

DIRECTION N-S

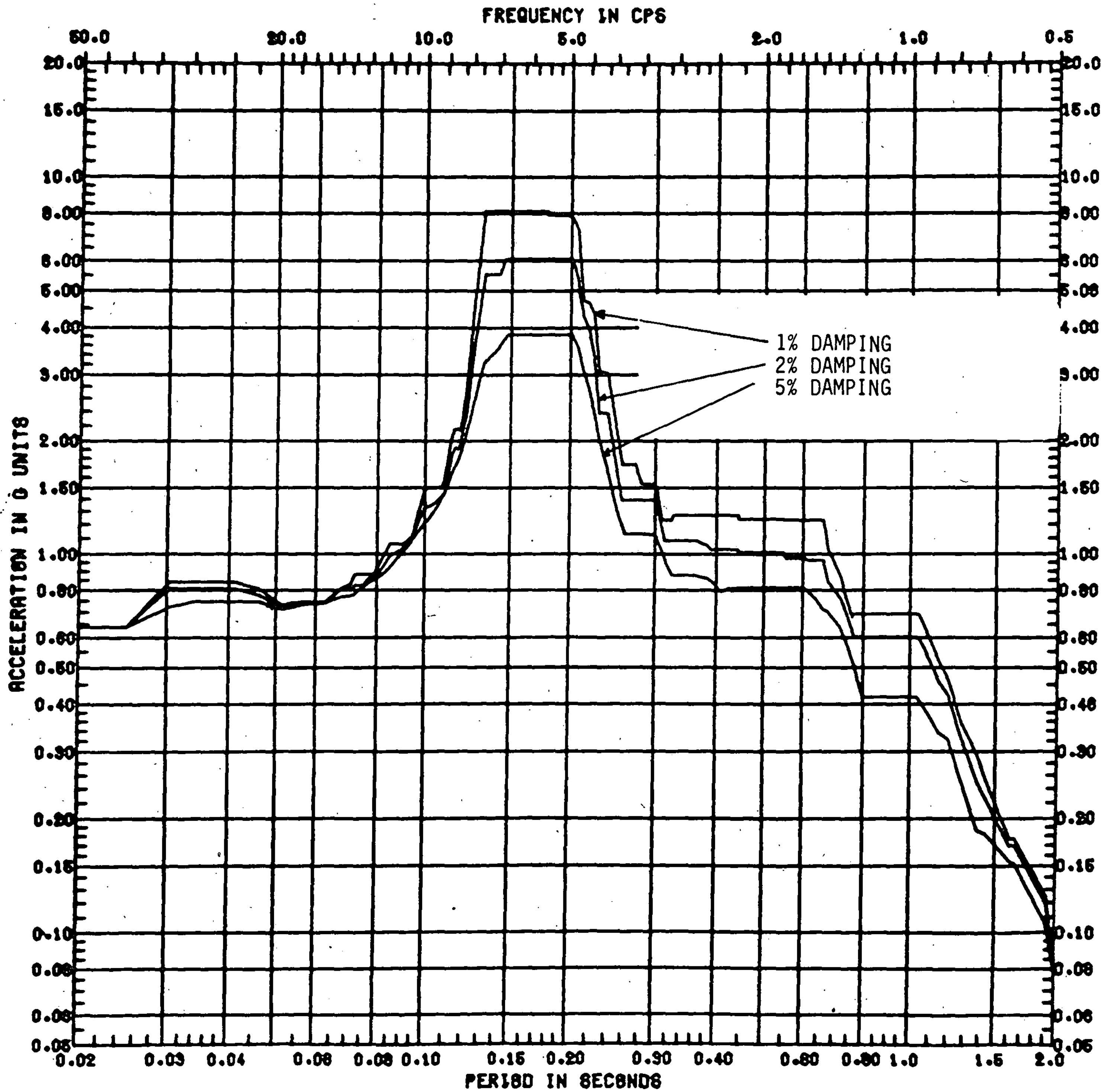
ELEVATION 589'-0''

LOCATION REACTOR BUILDING

SARGENT & LUNDY
ENGINEERS

CALC NO. 7355-E0-S SAFETY RELATED
PROJECT DRES UNITS 2&3
PROJECT NO. 7355
PEAKS WIDENED BY 15% ON EACH SIDE
DAMPING 0.010 0.020 0.050

FIGURE 11




SEISMIC SPECTRA - SSE

NODE 5 ELEVATION 589'-0''

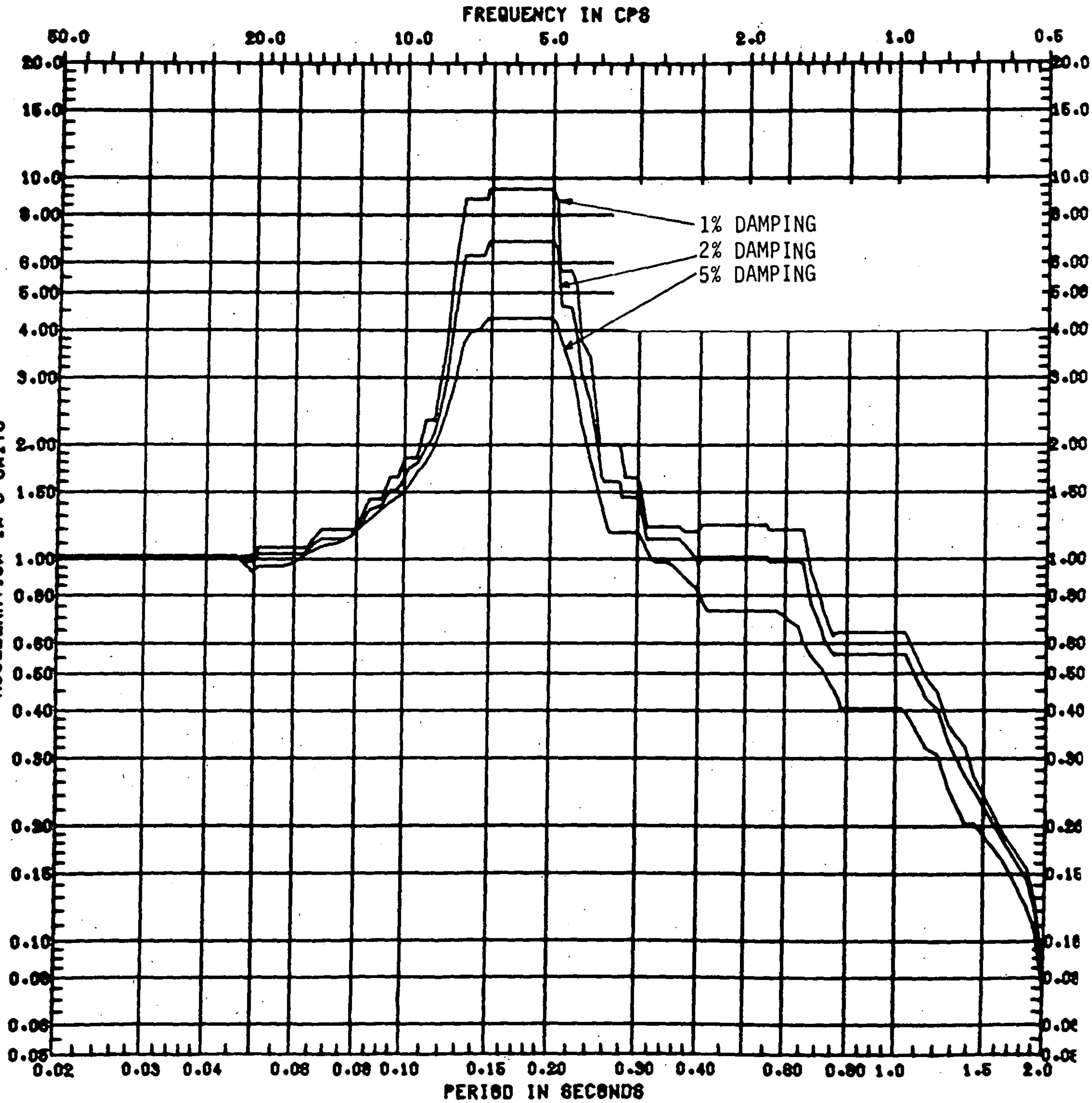
DIRECTION E-W LOCATION REACTOR BUILDING

*

SARGENT & LUNDY
ENGINEERS

CALC NO. 7355-E8-6 SAFETY RELATED
PROJECT DRES UNITS 2&3
PROJECT NO. 7355
PEAKS WIDENED BY 15% ON EACH SIDE
DAMPING 0.010 0.020 0.050

FIGURE 12




SEISMIC SPECTRA - SSE

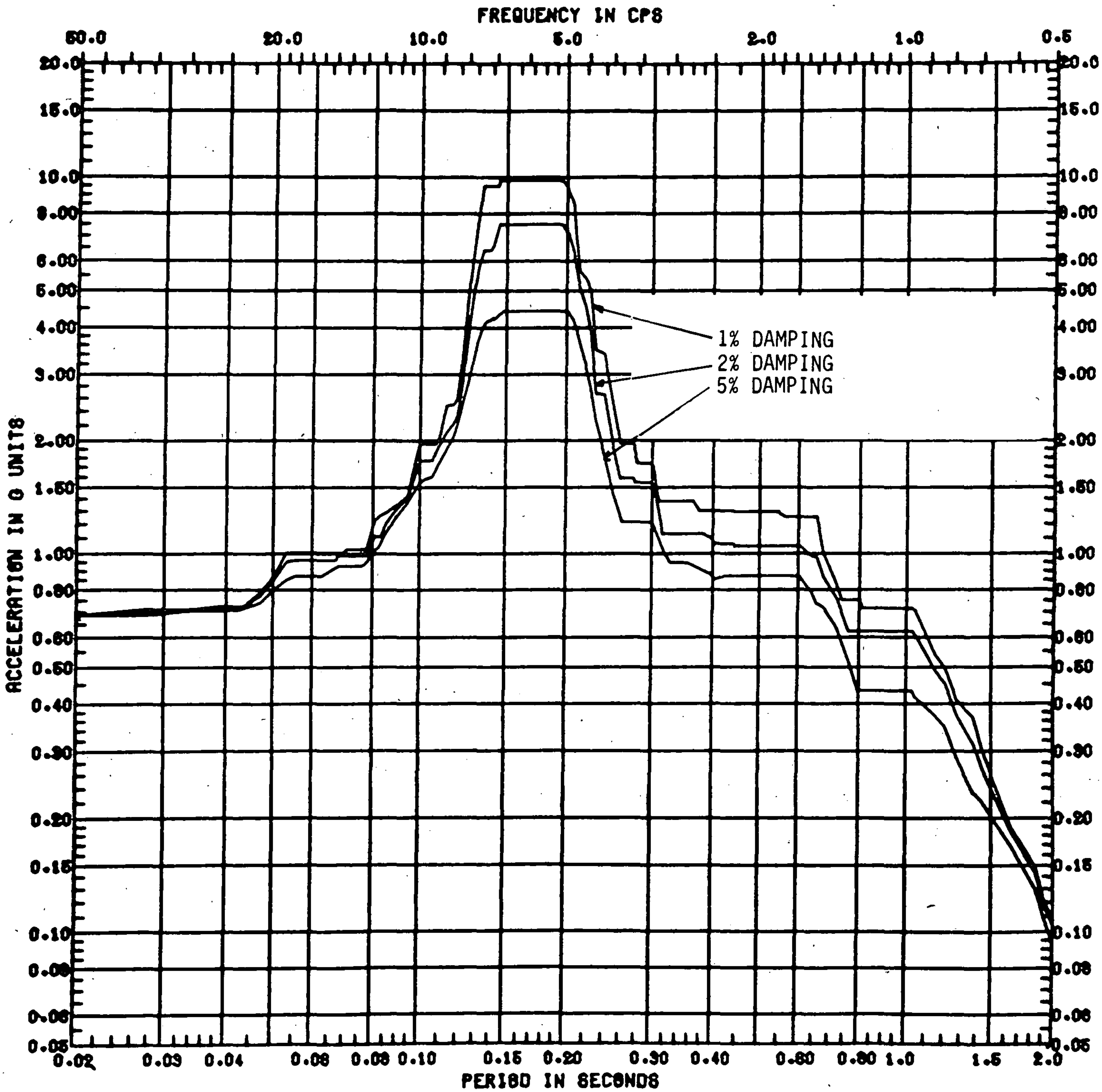
NODE 4 ELEVATION 613'-0"

DIRECTION N-S LOCATION REACTOR BUILDING

SARGENT & LUNDY
ENGINEERS

CALC NO. 7355-EG-S SAFETY RELATED
PROJECT DRES UNITS 2&3
PROJECT NO. 7355
PEAKS WIDENED BY 15% ON EACH SIDE
DAMPING 0.010 0.020 0.050

FIGURE 13




SEISMIC SPECTRA - SSE

NODE 4

DIRECTION E-W

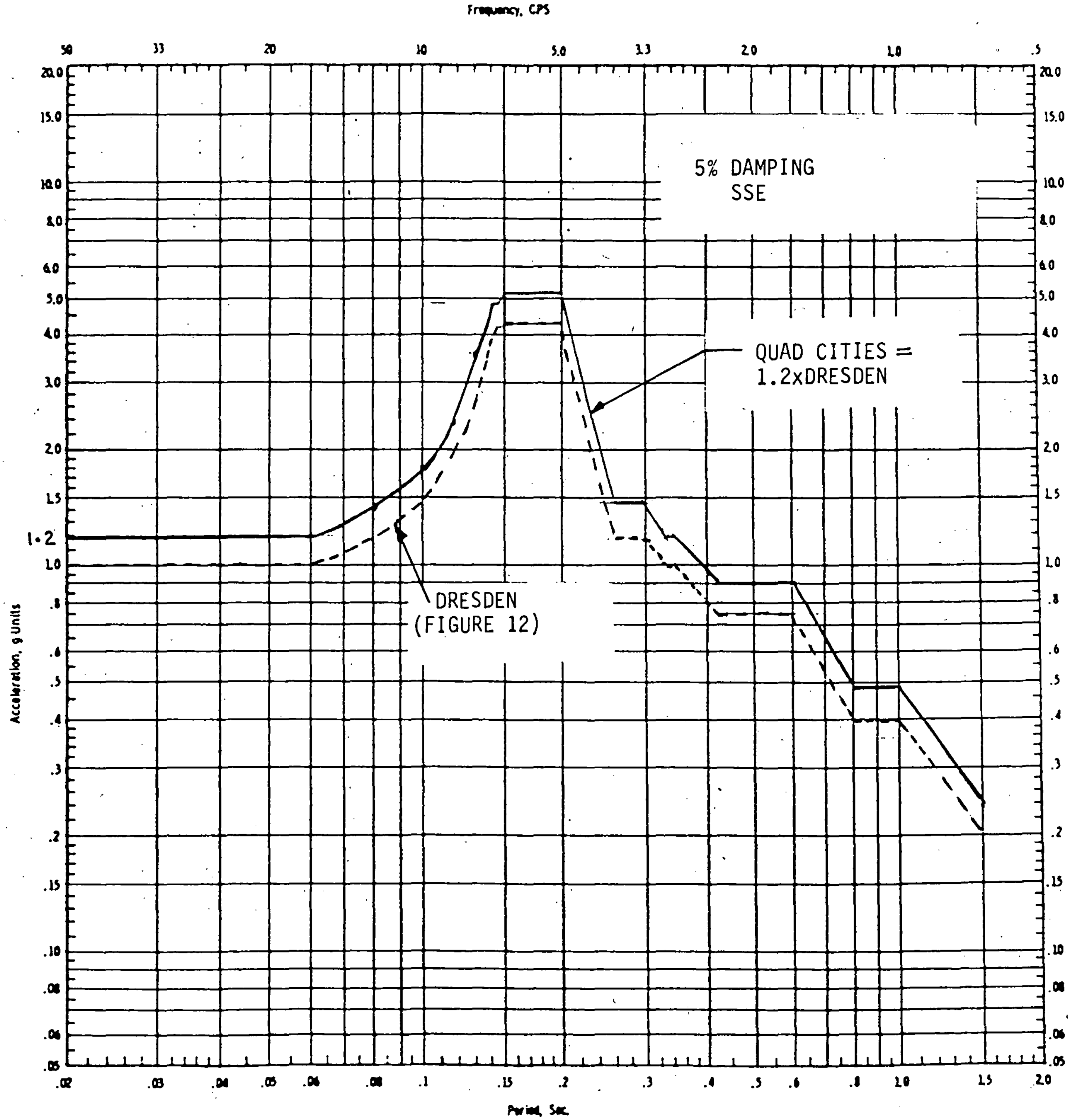
ELEVATION 613'-0''

LOCATION REACTOR BUILDING

26998

SARGENT & LUNDY
ENGINEERS
CHICAGO

FIGURE 14




EXCITATION N-S (DRESDEN)
E-W (QUAD CITIES)

LOCATION: REACTOR BUILDING

95' ABOVE GRADE ELEVATION: 613'-0" (DRESDEN)
690'-6" (QUAD CITIES)