3645 Warrensville Center Road
Cleveland, Ohio 44122
216-991-8841

**Woodward-Clyde Consultants**

May 25, 1979

Mr. K. N. Jabbour
Division of Operating Reactors
Mail Stop 542
Washington, D.C. 20555

Dear K:

As you requested during our site visit to Milstone in support of the Dresden #2 seismic evaluation effort, I recommend that EGG perform the analysis of three piping systems, recirculation, LPCI suction and seismic example problem #1 identified as being typical of the three methods used to seismically qualified Dresden 2 piping systems. Specifically, I recommend the following analyses be performed:

A. Recirculation System

1. Analyze system using best estimate of support stiffness and analysis methods with seismic input from the J. Blume response spectral curves shown in Figure 1 assumed acting first in the nominal N-S and then in the E-W horizontal directions plus 2/3 this spectrum in the vertical direction. Moment resultants are to be combined on both the SRSS and ABS bases. Resultant seismic stresses to be compared to J. Blume resultant seismic stresses at at least 3 common points. Seismic reaction forces in supports should also be determined and compared to J. Blume results if available. Stress intensification factors of NC 3600 should be used. This effort has essentially been already completed in the summary report by M. E. Nitzel except that the response spectra used as shown in Fig. 1 has been smoothed and broadened somewhat from the original Blume curves shown in Fig. 2 and the response spectra has been normalized to a 0.2g ZPGA rather than 0.1g OBE ZPGA which was used by Blume. The purpose of this analysis is to evaluate the adequacy and accuracy of the original Blume analysis which is also applicable to steam and feedwater systems.

2. Analyze recirculation system as in (1) above except assume supports are rigid and compare results with J. Blume.

3. Analyze recirculation system using best estimate of support stiffness and using current multi-degree of freedom model and modal analysis methods for the revised EDAC SSE (0.2g ZPGA) response spectral curves shown in Figures 3 and 4



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(with torsion-interpolated) for 3 percent damping assumed acting both in the nominal N-S and E-W horizontal directions plus 2/3 of Figure 3 spectrum in the vertical directions. Seismic moment resultants are to be combined on a SRSS basis. Total stresses in the piping system to be determined in accordance with Eq. 9 of NC 3600 for Condition D stress limits. Total reaction forces in the supports should also be determined. Resultant stress or load ratings in the pipe and supports should be compared with Condition D ASME code allowables. In the analysis the stresses and reaction loads induced by deadweight, pressure and seismic should be identified separately.

B. LPCI Suction

1. Analyze the LPCI Suction system using seismic coefficient of 0.7g applied statically to the system in the horizontal plane perpendicular to the piping local longitudinal axis. Simultaneously apply a seismic coefficient of 0.067g to the system in the vertical direction. Determine resultant seismic stresses in piping using the stress intensification factors of NC 3600 plus seismic reactions in pipe supports. Assume all supports are rigid.

2. Analyze the LPCI suction system using best estimate of support stiffness and using current multi-degree of freedom model and modal analysis methods for the revised EDAC SSE (0.2g ZPGA) response spectral curves shown in Figures 5 and 6 (with torsion-interpolated) for 3 percent damping assumed acting both in the nominal N-S and E-W horizontal directions plus 2/3 of the Figure 6 spectrum in the vertical direction. Seismic moment resultants to be combined on a SRSS basis. Total stresses in the piping system to be determined in accordance with Eq. 9 of NC 3600 for ASME Condition D stress limits. Total reaction forces in the supports should also be determined. Resultant stresses or load ratings in the pipe and supports should be compared with Condition D code allowables. In this analysis the stresses and reaction loads induced by deadweight, pressure and seismic should be identified separately.

C. Seismic Test Example #1

1. Analyze system in test example 1 shown in Figure 7 attached assuming supports rigid and using current multi-degree of freedom model and modal analysis methods for the revised EDAC SSE (0.2g ZPGA) response spectral curves shown in Fig. 6 (without torsion) for 2 percent damping assumed acting both in the normal N-S and E-W horizontal directions plus 2/3 of the Figure 6 spectrum in the vertical direction.

Seismic moment resultants to be combined on a SRSS basis. Seismic stresses in the piping system to be determined in accordance with Eq. 9 of NC 3600 for Condition D stress limits. Seismic reaction forces in the supports should also be determined.

2. Repeat the analysis of (1) above assuming (a) vertical supports as not active (b) all supports have a stiffness equal to 10 times the bending stiffness of the pipe spaning between adjacent supports.

The analyses described herein will provide quantitative assessment of seismic design margins and thereby should support the qualitative judgement in Chapter 6 of the seismic design adequacy of the Dresden 2 Category I piping systems required for safe shutdown of the RCS and engineered safeguards. I will complete Chapter 6 of the Dresden report assuming that the results of the EGG piping analysis outlined herein will be available as an Appendix to the report which serves to further substanciate the conclusion reached in Chapter 6 that the seismic Category I piping are capable of withstanding SSE seismic loads plus other applicable loads using current analysis and evaluation methods without loss of safety function.

Please advise if you require any clarification of my recommendations. Please also note by copy of this letter, I have transmitted this same information to Mr. Saffell of EGG in order to expedite this piping evaluation effort assuming you concur with my recommendation.

Sincerely,

John D. Stevenson

John D. Stevenson
General Manager

JDS/ijz

cc: Mr. B. C. Saffell, Jr.
1179 Cresent Ave.
Idaho Falls, Idaho 83401

H. Levine - NRC

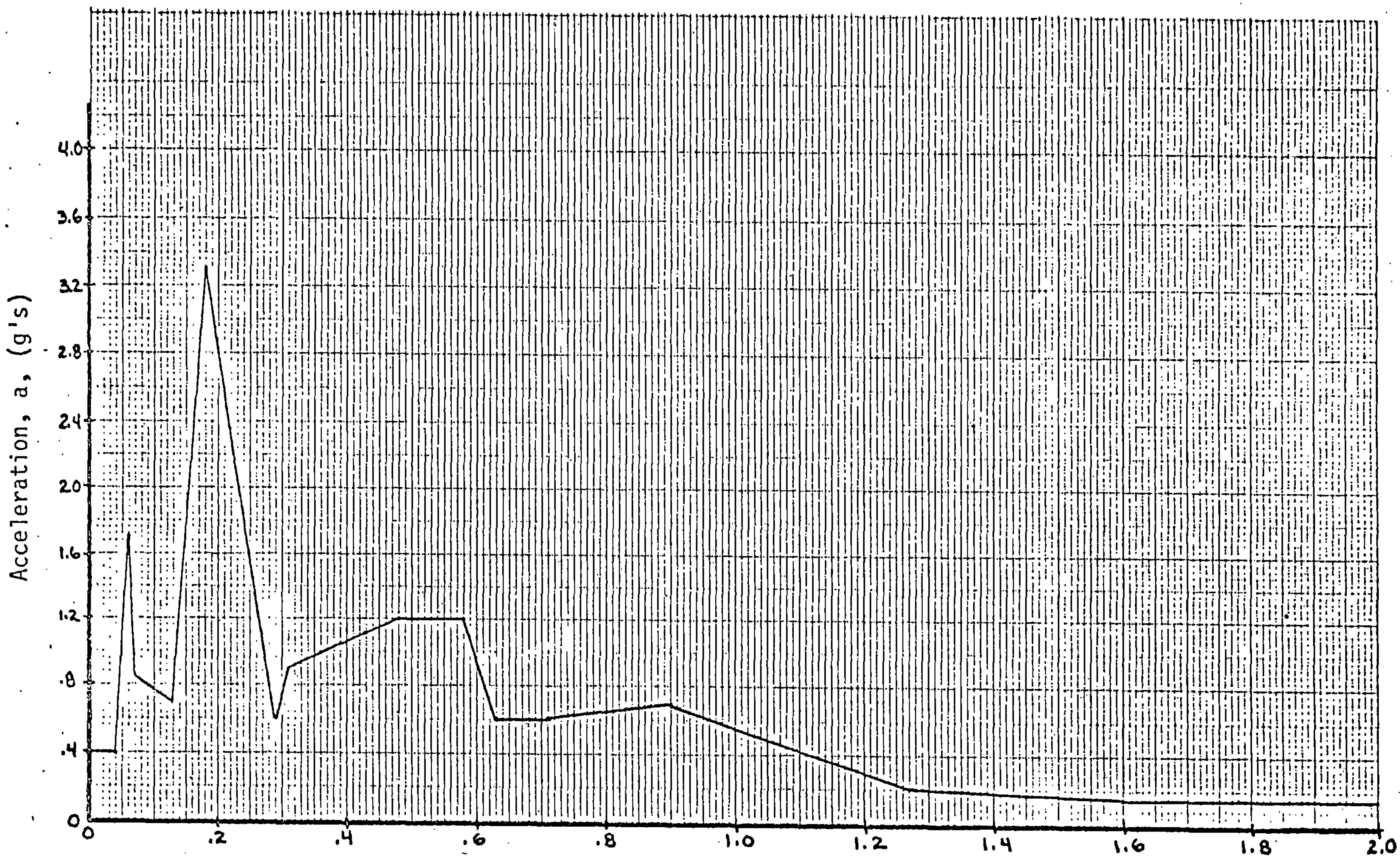



FIGURE 1

PERIOD (SECONDS)

Figure 4
Response Spectrum Envelope, Mass Point 7 Dresden Recirculation Loop Piping
(This curve replotted from original John A. Blume & Assoc., Engineers, data)

5

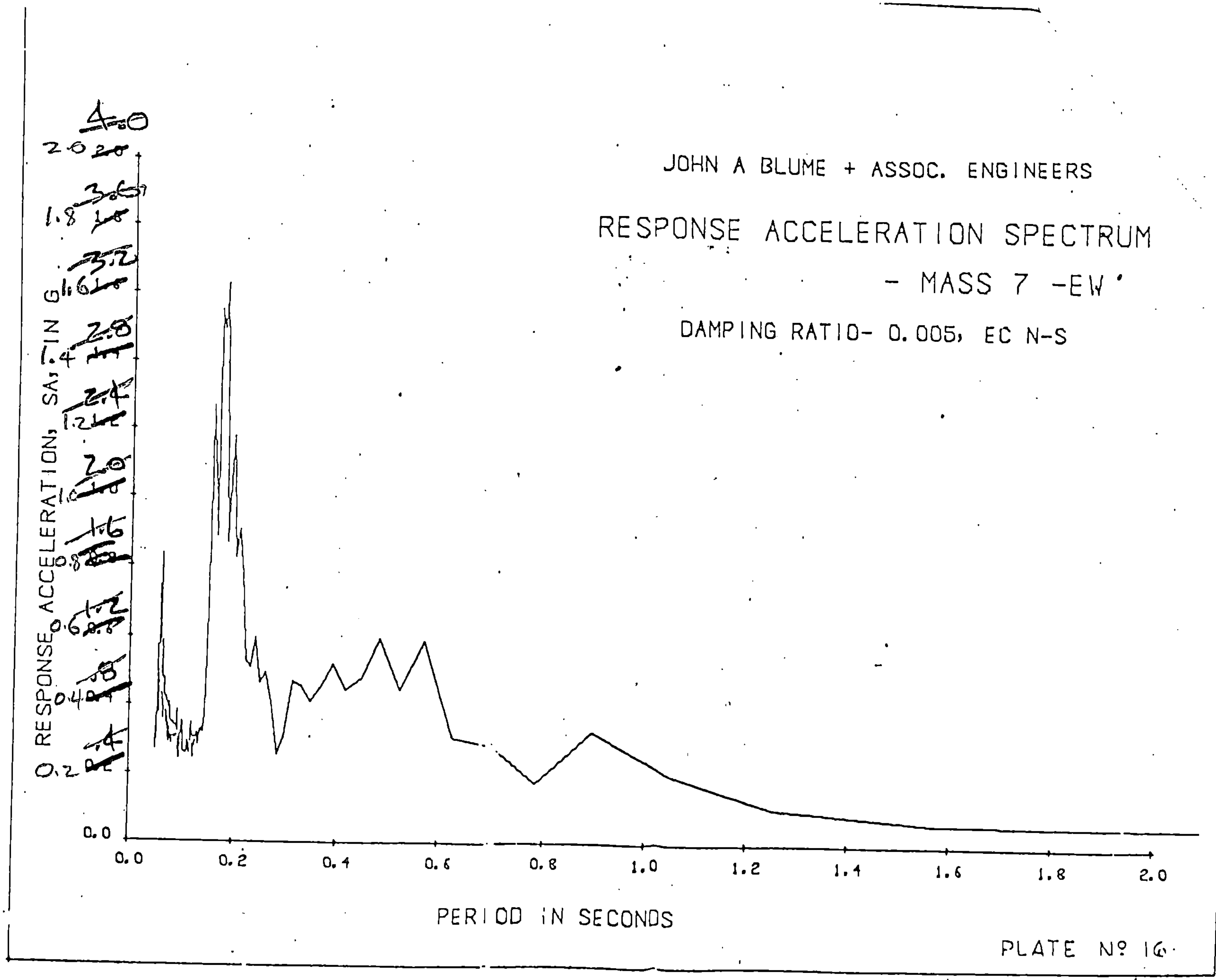



FIGURE 2

Figure 3-39 Response Acceleration Spectrum - Mass 7 - EW (Reference 17)

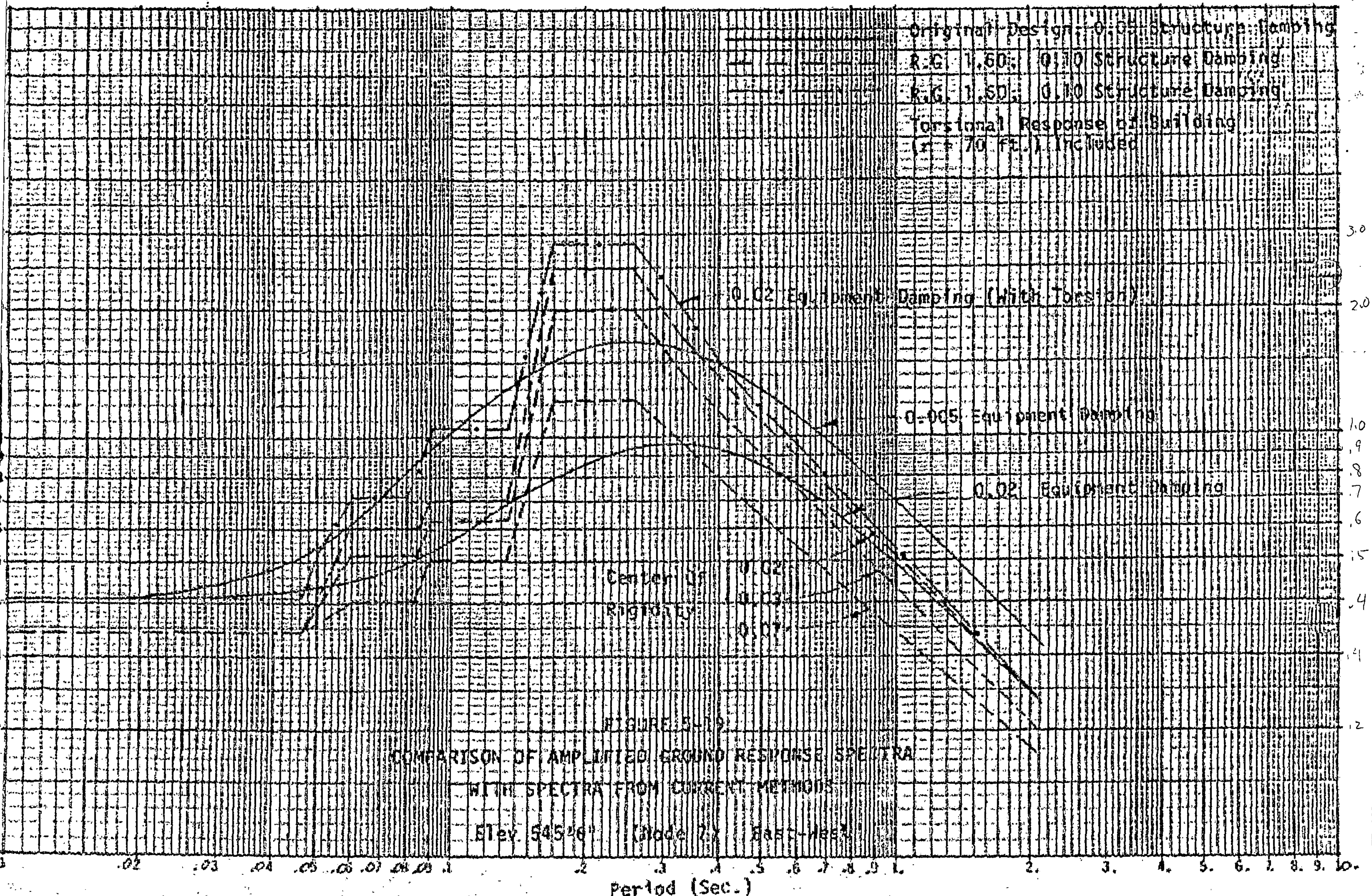

Original Design, 0.04 Structure Damping
R.G. 1.60, 0.10 Structure Damping
R.G. 1.60, 0.10 Structure Damping
Torsional Response of Building
(r = 70 ft.) Included
0.02 Equipment Damping (With Torsion)
0.005 Equipment Damping
0.02 Equipment Damping
Center of
Rigidity
0.02
FIGURE 5-19
COMPARISON OF AMPLIFIED GROUND RESPONSE SPECTRA
WITH SPECTRA FROM CURRENT METHODS
Elev. 545'6" (Node 2) East-West
Period (Sec.)

FIGURE 3

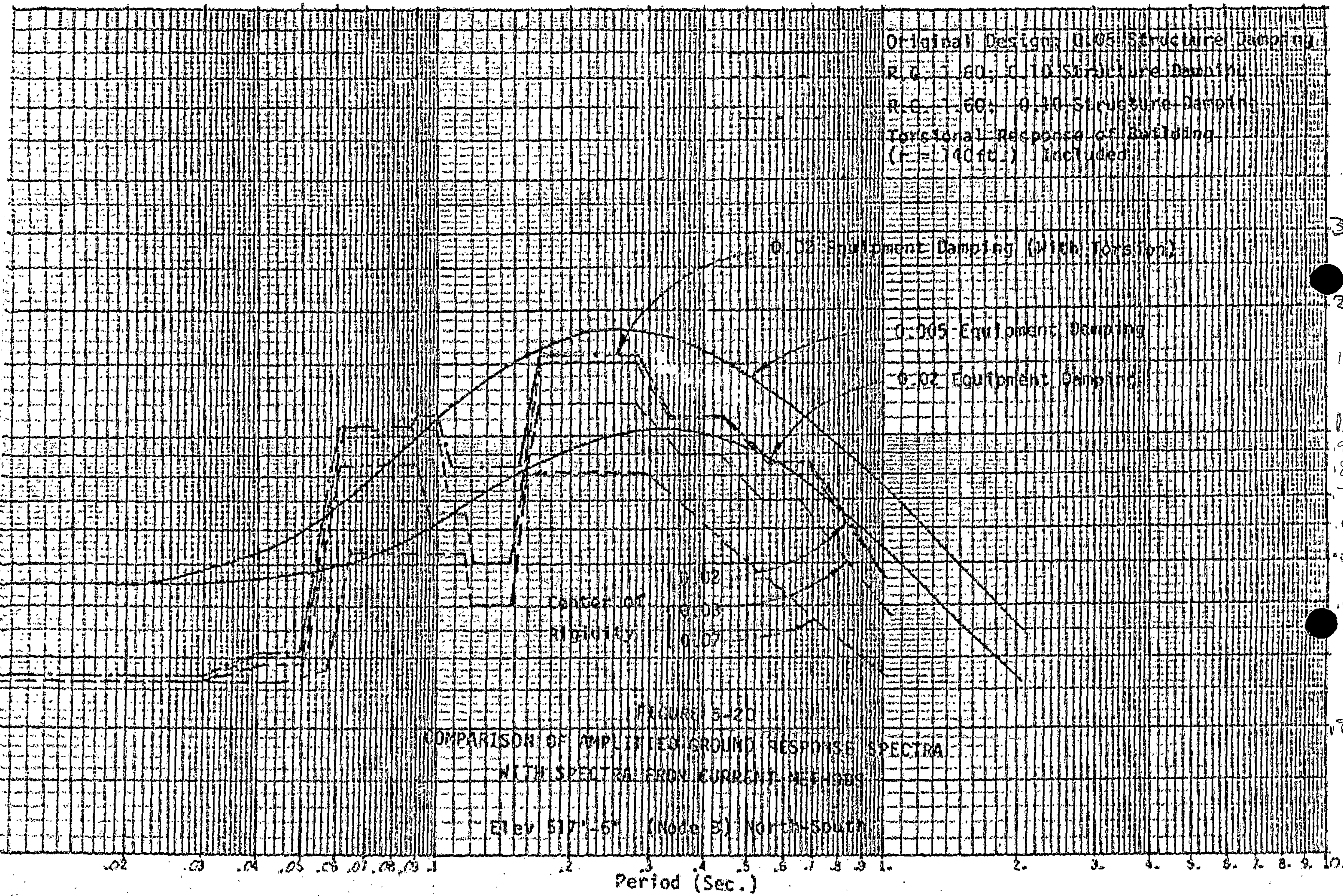



FIGURE 5-20

COMPARISON OF AMPLIFIED GROUND RESPONSE SPECTRA WITH SPECTRA FROM CURRENT METHODS

Elev 517'-6" (Node 3) North-South

FIGURE 5

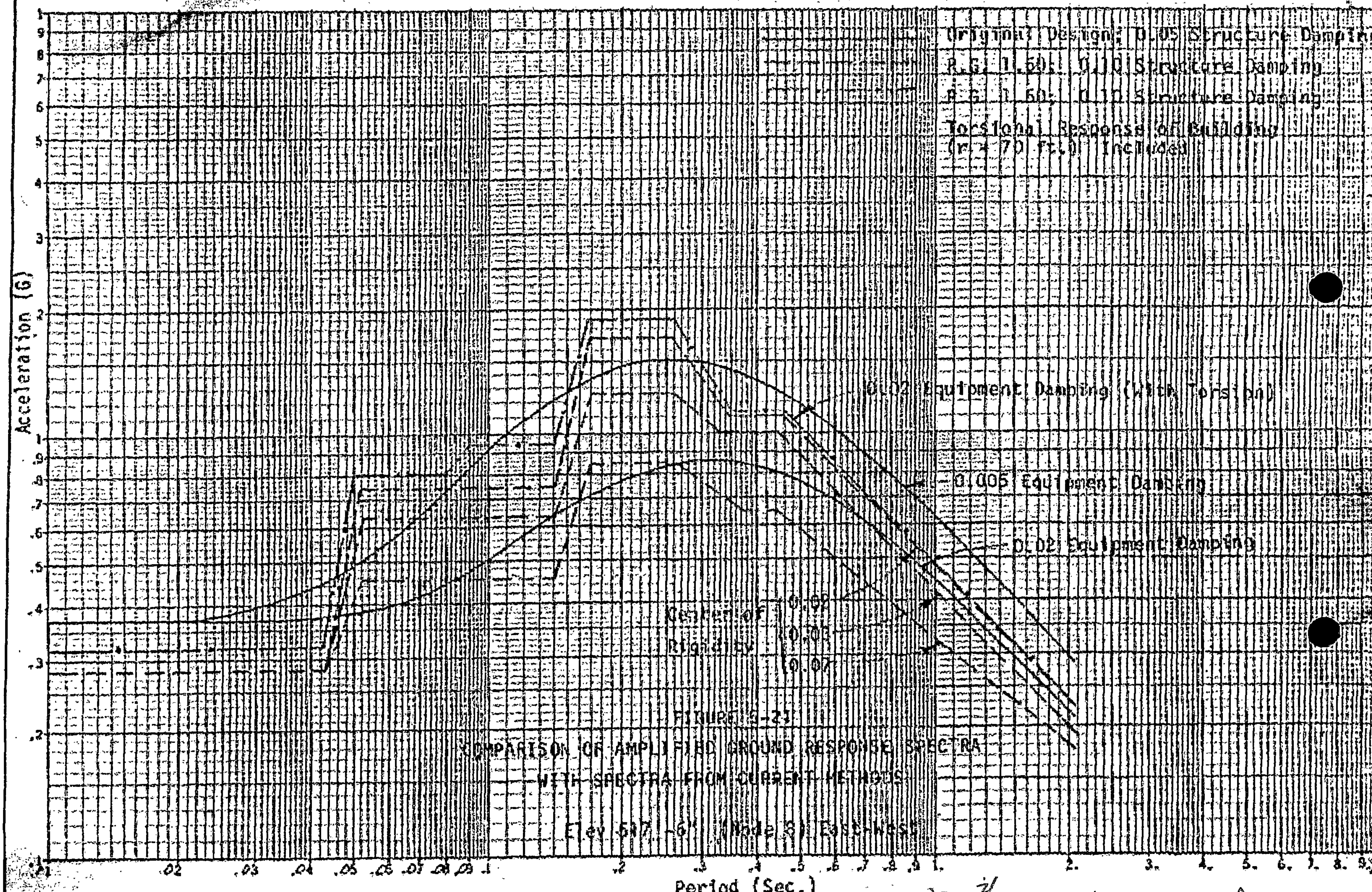



FIGURE 9-2
COMPARISON OF AMPLIFIED GROUND RESPONSE SPECTRA
WITH SPECTRA FROM CURRENT METHODS
Elev 587'-6" (Node 3) East-West

FIGURE 6 — USE 2/3 FOR VERTICAL AS WELL

SARGENT & LUNDY ENGINEERS

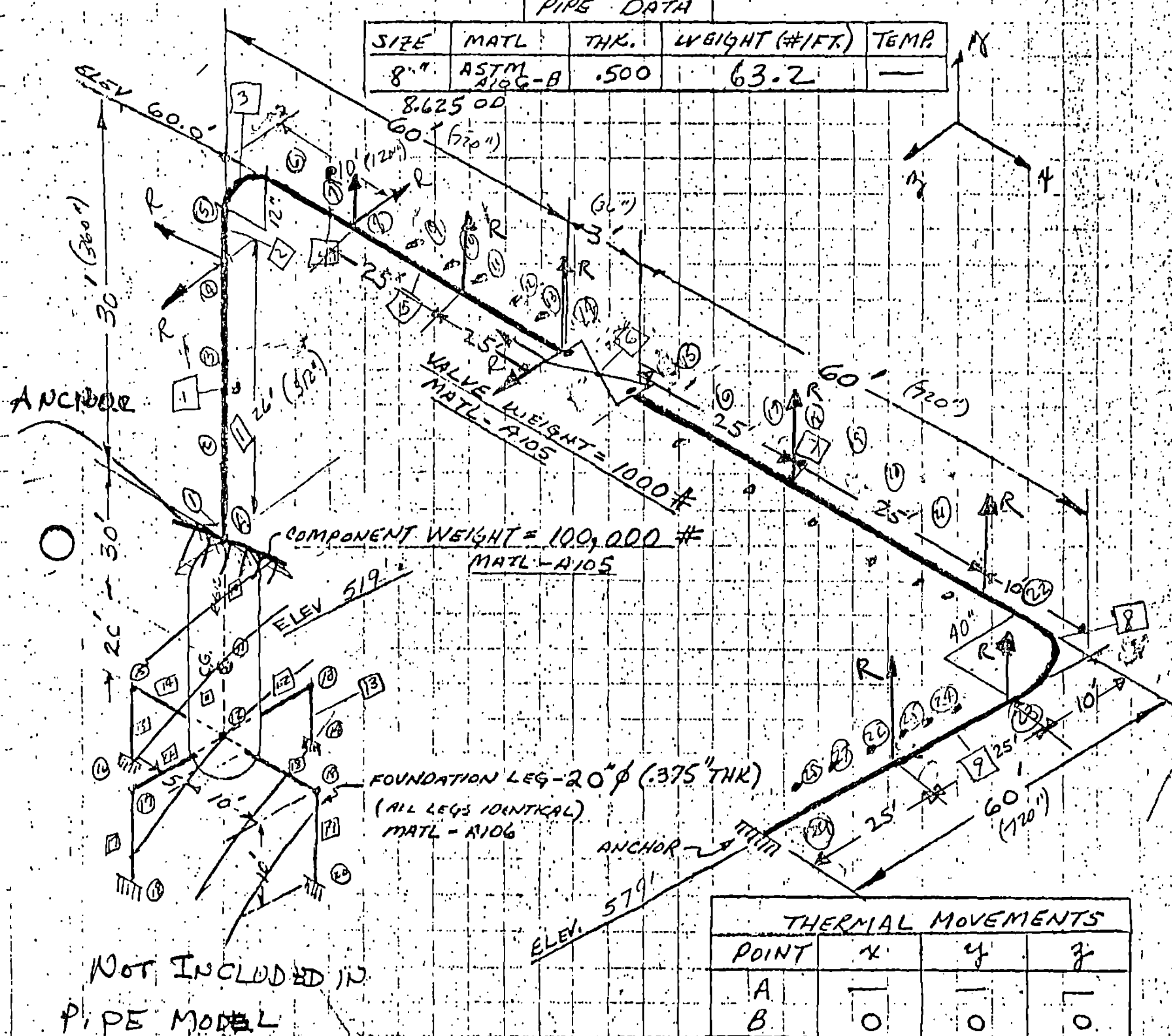
CLIENT GE
PROJECT QUAD CITIES JOB NO.
DESIGN BY E.B.B. DATE 2-24-70
CHECKED BY DATE SHEET 1 OF

CALCS. FOR USING GE RULES 1-7-70 DYNAPIPE CODED

PIPE DATA

| SIZE | MATL | THK. | WEIGHT (#/FT.) | TEMP. |
|---|---|---|---|---|
| 8" | ASTM A106-B | .500 | 63.2 | — |

8.625 OD




| THERMAL MOVEMENTS | | | |
|---|---|---|---|
| POINT | x | y | z |
| A | — | — | — |
| B | 0 | 0 | 0 |

NOT INCLUDED IN PIPE MODEL

FIGURE 7

TYPICAL PIPING RUN

TEST PROB. #1

FIG. NO. 1

Remarks:

EMD FILE

EBB 2-26-69

SHEET