ATTACHMENT 2

PRELIMINARY REPORT OF
SEISMOLOGICAL & GEOLOGICAL
INVESTIGATIONS CONDUCTED IN EPICENTRAL
AREA OF JANUARY 31, 1986 EARTHQUAKE
IN NORTHEASTERN OHIO

Weston Geophysical
CORPORATION

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I. INTRODUCTION

Within twelve hours of the January 31, 1986 earthquake in northeastern Ohio, Weston Geophysical seismologists and geologists began the deployment of seismic recorders to monitor aftershock activity. Thereafter, geologists began surveying accessible outcrop in the epicentral area for indications of earthquake-induced structures or surficial disturbances. A warming trend, along with accompanying rain produced high stream flows, which combined with ice jams, limited accessibility of stream bank outcrops. However, several quarries, local roadside outcrops, and several smaller bedrock-floored streams were examined for identifiable structures.

During the geologic field reconnaissance, observations of significant external damage to structures were also noted. Several of the more severe cases were followed up by personal interviews with local residents.

The most recent United States Geological Survey [USGS] epicenter location, according to Dewey, for the January 31, 1986 earthquake is plotted on Figure 1. It is located south of Aylworth Creek in Leroy Township of Lake County. Several aftershocks have been recorded and their locations are also shown on Figure 1. The locations of events shown on Figure 1 are based on preliminary hypocentral determinations through February 15, 1986.

It is understood that these locations may be further updated. For further information, the mainshock location as determined by the National Earthquake Information Center [NEIC] is also indicated on Figure 1. Table 1 is a list of the most recent solutions for recorded events.

II. RESULTS OF INVESTIGATIONS

A. Geologic Reconnaissance

A brief reconnaissance of accessible outcrops in the epicentral area was conducted by two Weston Geophysical geologists during the two weeks following the January 31, 1986 earthquake in northeastern Ohio. Bedrock outcrops and overlying surficial deposits were examined for evidence of structures or deformation which could be related to the main seismic event. Stream channels provide the most readily observable outcrop in the region. Elsewhere, thick surficial deposits including till and extensive lake sediments obscure the bedrock, particularly north of the escarpment to Lake Erie. High stream flows and ice jams restricted access along the larger streams such as Paine Creek and the Grand River. Several smaller streams, locally accessible stream banks, quarries, and road cuts were examined. The majority of the traverses were conducted by vehicle. On-foot surveys were made of areas such as streams and quarries otherwise inaccessible. Observations of faults, joints, fractures, and slope failures were made. Descriptions of the more significant occurrences are presented below.

B. Felt Intensity Investigation

A questionnaire survey has been conducted to evaluate the distribution of effects including personal observations and damage accounts that may have been incurred. The questionnaires were distributed using several parallel approaches to attain broad coverage of the affected areas. Analysis and compilation of questionnaire results will be used to produce an "isoseismal map" or plot of various intensity levels, as measured on the Modified Mercalli Scale. The purpose of such a map is to enable a comparison of effects of the present event with a well-known epicenter to the effects of some other historical events located in the site area that have no well-determined instrumental epicenter.

Distribution of questionnaires includes a CEI company-wide circulation. It has been requested that employees document the effects at their places of residence and to describe the felt perception by family or friends present there during the occurrence of the earthquake. In addition, other Cleveland Electric staff have been in contact with area town officials including police, fire or emergency personnel, and building inspectors to provide documentation of damage, if any, from their respective towns.

Personnel of Weston Geophysical Corporation have conducted personal interviews on perception and other effects of the earthquake in the epicentral region. Questionnaires have been distributed at establishments such as fire departments, grocery stores, schools, etc. with instructions to distribute these to persons in the town to recover information on the range of effects in the towns nearer to the earthquake epicenter.

Weston Geophysical has received approximately 700 completed questionnaires. A preliminary evaluation of a small fraction of these questionnaires indicates that the earthquake is properly rated as an intensity VI although a few instances of damage could be rated as high as VII on the discrete Modified Mercalli Scale. Maximum observed or reported effects include instances of damaged chimneys above the roof-line, cracks in concrete and cinder block walls, cracked or fallen plaster, and few broken windows. Some disturbances of well- water have also been reported. Formal presentation of intensity analyses including map presentations are forthcoming.

III. DESCRIPTIONS OF SELECTED STOP LOCATIONS

During the program of geologic reconnaissance and felt intensity investigations, Weston Geophysical personnel visited areas of previous PSAR/FSAR investigations as well as others. The yellow outline on Figure 1 represents both road and on-foot traverses conducted by Weston geologists. Locations of several of these "selected stop locations" are identified on Figure 1; each location has been assigned a stop letter A through N. Observations at each stop are described in the following section.

A 14329 Girdled Road - Concord Township

Geologists observed chimney damage to a residential house at this isolated location. In addition, plaster cracking and damage to a door frame were recorded. An interview revealed that the house is approximately 125 years old with its original chimney. No other house on Girdled Road in this vicinity suffered similar damage. This single incidence is not characteristic of the intensity felt in this vicinity.

B Abandoned Sand and Gravel Pit

Sidley's pit is located approximately two miles south of the Town of Thompson, consisting of large exposures of the Sharon Conglomerate. At the base of the pit, exposures were up to 50 feet high. Prominent joint orientations were measured to be N20E and N40E dipping 70° SE [Photograph 1].

C Hell Hollow - Steep Stream Embankment of Paine Creek

The site of three previously mapped faults [PNPP-PSAR Appendix 2L] in the eastern slop of Paine Creek Valley was checked for earthquake- related structures or disturbance. No significant features were observed. No evidence of recent fault motion or slumping of loose slide-prone material was observed. Photographs show ice hanging from massive siltstone beds which remained essentially undisturbed. Small faults or fractures in the ditch below the steep slope were not offset [Photographs 2 and 3].

D Phelps Creek - Bedrock-floored Stream

Extensive outcrop along Phelps Creek showed no evidence of recent tectonic deformation. Three minor rock slides were observed on oversteepened stream banks. Long linear joints and fractures occuring in the stream showed no evidence of recent offset. Swales and swells of the gently dipping and occasionally ripple-marked bedrock surface are caused by normal depositional processes in a shallow water environment.

E Best Sand Corporation

This active quarry is located approximately two miles south of the Town of Chardon. Quarry walls are intact. There was no report of any fracturing as a result of the event. Prominent joint planes orient at N75°E. The base of the sand pit is approximately two feet above the contact between the Berea Sandstone and the Bedford Shale.

F Grey Shale Outcrop

On Callow Road, approximately 100 yards south of its intersection with Girdled Road, exposures were observed in a small gulley on the east side of the road. Prominent joint planes were measured to be N20°E and N68°W [Photograph 4].

G 7806 Callow Road

Approximately 300 yards north of Aylworth Creek, chimney damage was noticed, dislodged bricks were lying on the rooftop. No other house in the vicinity showed similar damage. An owner damage report was not available for the house shown on Photograph 5.

H On Callow Road

South of Aylworth Creek, less than 200 yards on east side of road, there is evidence of recent slumping. However, slumping is very localized; upper part of slope is stable [Photograph 6].

I Aylworth Creek

Shale exposure exists along Aylworth Creek. Joint orientations were measured to be N24E and N63W. Similar orientations were recorded from outcrop to the west of Callow Road along Aylworth Creek. Banks and slopes along Aylworth Creek were undisturbed and stable [Photograph 7].

J Arctic Cat/Polaris

A sand and gravel pit [active] is located south off Girdled Road between Brakeman Road and Callow Road. Minor joints were observed on quarry walls. No tectonic structures or disturbance was observe in Berea Sandstone or in surficial materials. It may be noted that this sand and gravel pit is a large fresh exposure within the epicentral region.

K Jenks Creek

Exposure of the Bedford Shale outcrop along both sides of Jenks Creek northeast of Robinson Road in Leroy Township. Shale beds are continuous along the southwest facing bank. Along the creek, siltstone layers are interbedded among the shale and also continuous. Prominent joint orientations are N12°E and N69°W.

L Pearl Road

Exposures of the Bedford Shale continue south along Jenks Creek at the intersection of Pearl Road. Similar orientations were measured on prominent joint planes as described above in Stop Location K.

M Lake Erie Shoreline Bluff North of PPNP

The shoreline was examined for evidence of faulting or slumping induced by earthquake vibration or fault motion. The area is extensively eroded with numerous slumps and slump scarps of various ages preserved in the tills and overlying lake sediments comprising the bluff. No indications of faults or associated motion was observed. Warm weather during the week of February 2, 1986 apparently triggered numerous mud flows and mud slides which were continuing during the site visit on February 6. One or two large slump blocks were relatively fresh based on the relationship of mud over fresh snow fall [just prior to January 31]. It could not be determined if these blocks fell as a result of earthquake vibration or melting conditions which followed. No structures of any direct tectonic significance were observed in the sediments of the bluff.

N Warners [Bates] Creek

This location is one of two locations in the epicentral region with previously documented faulting visible at the surface. Due to seasonable weather conditions, the area of outcrop described in Figure 6 of the PNPP-PSAR Appendix 2L was obscured by snow cover. Alluvial stream deposits overlying Bedford Shale appears to be very stable. Much of the outcrop was obscured by snow cover. Observed sections of the outcrop reveal thinly-bedded, grey shales interbedded with layers of siltstone. Due to poor viewing conditions, no determination regarding direct or indirect earthquake effects can be made.

IV. CONCLUSIONS

Based on limited observations of accessible outcrops during the two weeks following the January 31, 1986 earthquake in northeastern Ohio, the following preliminary conclusions are offered relative to the epicentral area:

1. No significant tectonic structures were observed in bedrock or overlying surficial deposits.

2. No unusual joint orientations were observed.

3. Minor slumps and rock falls were locally observed on steep slopes particularly along undercut stream banks, which may be attributed to physical/chemical weathering or secondary ground motion.

4. Previously described faults in Leroy Township showed no evidence of recent diplacements, however one slope was obscured by snow cover.

5. The earthquake, based on a preliminary evaluation, is assigned an intensity of VI. Further analysis are required to determine an isoseismal plot of contours for the earthquake.

TABLE

TABLE 1

EVENT	DATE	TIME [UT] HR MN	LATITUDE	LONGITUDE	SOURCE
Main Shock	01/31/86	16:46	41.650N	81.162W	USGS
Aftershocks	02/01/86	18:54	41.640N	81.167W	WGC
	02/02/86	03:22	41.640N	81.160W	WGC
	02/03/86	19:47	41.650N	81.168W	WGC
	02/05/86	06:34	41.663N	81.154W	WGC
	02/06/86	18:36	41.645N	81.160W	WGC
	02/07/86	15:20	41.654N	81.153W	WGC
	02/10/86	19:06	41.650N	81.153W	WGC

USGS United States Geological Survey

WGC Weston Geophysical Corporation

FIGURE

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SEE APERTURE CARDS

NUMBER OF PAGES: 1

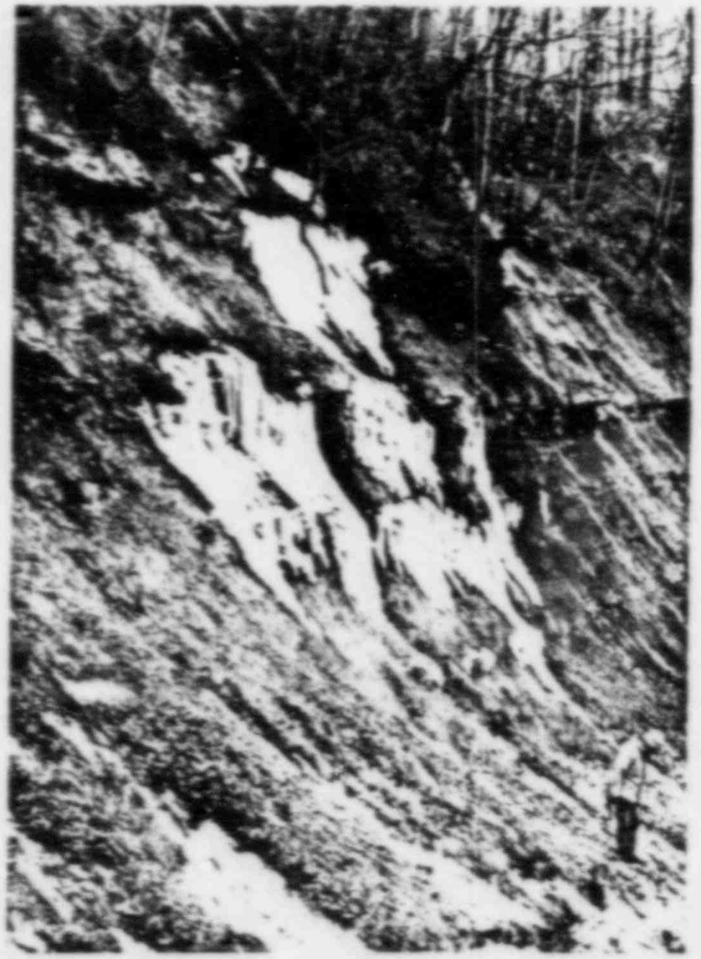
ACCESSION NUMBER(S):

8603040478-01

APERTURE CARD/HARD COPY AVAILABLE FROM RECORD SERVICES BRANCH, TIDC
FTS 492-8989

PHOTOGRAPHS

PHOTOGRAPH #1 - Abandoned sand and gravel pit. Joint oriented N20E 70SE



PHOTOGRAPH #2

PHOTOGRAPH #3

Hell Hollow, stream embankment on Paine Creek

PHOTOGRAPH #4 - Callow Road / Girdled Road stream outcrop. Joint face N20E

PHOTOGRAPH #5 - Callow Road.

PHOTOGRAPH #6

PHOTOGRAPH #7

Alyworth Creek, soil slump and jointing N63W.

ATTACHMENT 3

EQUIPMENT SEISMIC

QUALIFICATION EVALUATION

Equipment Seismic Qualification Evaluation

I. Introduction

The 1986 Ohio earthquake has short duration, high frequency, low velocity, small displacement, and no engineering significance on structures and equipment. The recorded spectra have peak accelerations at 20 Hz. It is the objective of this report to quantify the design adequacy of the active equipment.

II. Method of Selecting Equipment

There are four sets of recorded response spectra at the following locations:

1. Reactor Building Mat elevation 574'-10"
2. Reactor Building Platform Elevation 630'
3. Containment Vessel elevation 686'
4. Auxiliary Building Mat elevation 568'

There is no equipment at location 1 because of the suppression pool. At the Reactor Building 630' and 686' elevations, the single records available at each location may be biased by secondary effects of adjacent equipment on the building response. The Auxiliary Building Mat elevation 568' has two seismic instruments which provided confirmation of the measured response. Thus, the location selected for comparison is at Auxiliary Building Mat elevation 568'.

III. Method of Margins Qualification

The envelope of Engdahl/PSR-1200 instrument No. D51-R180 & D51-R190 records were used as recorded spectra. The highest frequency on the record is at 25.4 Hz. The spectra are extended to ZPA values as recorded by Engdahl/PAR-400 instrument No. D51-R120 & D51-R140 at 40 Hz and as shown in Figures 1, 2, & 3. The peaks of 2% damping spectra were reduced by 12% to obtain the peaks of 3% damping spectra. The 12% reduction came from the ratio of 2% and 3% spectra of Kinemetrics/SMA-3 instruments.

The complete set of active components as shown in the attached Table 1 are used in the margin study as follows:

1. Instrument Racks

These racks were qualified by testing. The testing response spectra far exceed the recorded spectra. An example of the comparison is shown in Figure 4.

2. Pressure Transmitters & Flow Transmitters

The recorded spectra were amplified to represent the transmitter locations inside the racks. The test response spectra also envelop the amplified recorded spectra. An example of the comparison is shown in Figure 5.

3. Pumps & Motors

These pumps and motors are G.E. equipment and were qualfied by analyses. These analyses were re-run with recorded spectra as input. It was found that when the effects of the earthquake loads were combined with piping nozzle loads and maximum operating loads the equipment was within the design allowable stresses. A dynamic finite element analysis of each piece of equipment was performed using the response spectra method. The SAP finite element program was used for these dynamic models. The earthquake loads derived from the dynamic modeling were combined with previously determined static loads such as piping nozzle loads, deadweight, maximum operating pressure, and pump operating loads.

These static and dynamic loads were combined at critical locations to determine resulting stresses, loads, accelerations, and displacements. It was found that at most locations total loads were increased over those in previous qualification analyses, however, at all locations critical parameters were below the allowables as shown in Table 2. Thus the original design is more than adequate to accomodate this 1986 Ohio earthquake.

IV. Margins of Other Equipment

Although the above comparisons were made at the foundation level of the Auxiliary Building, equipment and components at other locations have adequate design capability to accomodate the 1986 Ohio earthquake for the following reasons:

1. The typical comparisons of test response spectra against the recorded response spectra indicate ample margins, as shown in Figures 4 & 5.

2. The analyzed pump and motor have a natural frequency at 18.7 Hz which is in resonance with the peak region of the recorded response spectra after 15% broadening. This resonance results in the most critical comparison in terms of the resulting stresses.

3. The floor response spectra have higher peak values at upper elevations when the building response is dominated by the fundamental mode. The mode corresponding to the 20 Hz peak measured in the earthquake is not a fundamental mode. The floor response spectra at upper elevations are not significantly higher than those at lower elevations for high frequency content earthquakes.

4. BWR 6 equipment and components are over-qualified in the high frequency region because of the conservative assumptions of simultaneous occurence of seismic and hydrodynamic loads.

5. The majority of the equipment was qualified by the vendors for the generic applications, enveloping much higher SSE values for other sites.

6. Margin studies for other plants, e.g. V.C. Summer, demonstrated sufficient margins in the high frequency region. The average margin between seismic response spectra and qualification response spectra was a factor of approximately 2.5.

The quantification of qualification margins of other active components will be a part of the confirmatory program. The applicant will provide the scope and schedule of the confirmatory program with the NRC staff by March 10, 1986.

V. Further Evaluations

To further demonstrate the adequacy of equipment seismic design capability, an evaluation was completed at the equipment located at approximately 686' elevation at the containment vessel. As previously stated, the recorded seismic data available at this location may be biased by secondary effects of adjacent equipment on the building response (in this case, the possibility of movement of the polar crane). Nonetheless, equipment located at this upper elevation was reviewed to identify the critical active components for equipment qualification comparisons to the recorded data.

The components selected were the purge and vacuum relief system containment isolation valves and actuator assemblies. Since the valves and motor operators are supported from the piping systems, the response at the valves is modified by the piping sytem. There is a short length of piping for the purge system (M14) and the fundamental frequency at the system is at 41.6 Hz. At this high frequency, the accelerations are comparable between the recorded spectra and the design spectra. Similarly, for the vacuum relief system (M17) the fundamental frequency is at 32 Hz. In this case, the combined response spectrum value at this elevation envelops the recorded spectrum value.

As shown in the attached Table 3, the acceleration at the valve assembly as determined by the piping analysis for both the M14 and M17 systems bounds the recorded data at this fundamental frequency. The resultant acceleration at the valve associated with the recorded earthquake are well within the qualifications of the valve and actuator which were determined by analysis and/or testing. Thus, the qualification of the valves and actuators envelops the estimated accelerations based on the recorded data as demonstrated in the comparison based on fundamental frequencies.

In addition, the following active components were picked to compare qualification spectra with estimated floor response spectra for other types of equipment in different buildings at different elevations than evaluated above.

a. 4.16 KV Metal Clad Switchgear at Control Complex elevation 620', Brown Boveri Electrical Industries Model No. 5HK-350, GAI MPL No. 1R22 S006, 1R22 S007, 1R22 S009.

b. MSIV Leakage Control System Blower at Auxiliary Building elevation 620', Generla Electric/LOMPOC Model No. 2Ch-6-041-1U, GAI MPL No. 1E21-C0001, 1E21-C0002B, 1E32-C0002F

c. Recirculation Pump Trip Control Switchgear at Intermediate Building elevation 620', General Electric Model No. Power/VAC,GAI MPL No. 1R22-S0012, 1R22-S0013, 1R22-S0014, 1R22-S0015.

The estimated spectra were based on the recorded spectra at the Auxiliary Building foundation, modified to reflect the predicted amplification ratio of the Reactor Building. The estimated spectra versus the testing response spectra at proper elevations are as shown in Figures 6, 7 and 8. These comparisons indicate ample margin to accommodate this recorded earthquake.

VI. Conclusion

The recorded spectra of the 1986 Ohio earthquake were used in comparison with original testing spectra or used in analyses. The results of the comparison and analyses indicated the original design was more than adequate to accomodate the 1986 Ohio earthquake. In addition, the original design at other locations also has adequate design capability.

TABLE 1
EQUIPMENT LIST AT AUXILIARY BUILDING ELEVATION 568'

1H22P0001	LPCS	Instrument Rack	
1H22P0017	RCIC	Instrument Rack	
1H22P0018	RHR	Instrument Rack	
1H22P0021	RHR	Instrument Rack	A
1H22P0055	RHR	Instrument Rack	B
			C
1C61N0001		Differential Press Transmitter	
1E12N0007A,B		Differential Press Transmitter	
1E12N0015A,B,C		Differential Press Transmitter	
1E12N0026A,B		Pressure Transmitter	
1E12N0028		Pressure Transmitter	
1E12N0050A,B		Pressure Transmitter	
1E12N0051A,B		Pressure Transmitter	
1E12N0052A,B,C		Differential Press Transmitter	
1E12N0055A,B,C		Pressure Transmitter	
1E12N0056A,B,C		Pressure Transmitter	
1E12N0058 C		Pressure Transmitter	
1E21N0003		Pressure Transmitter	
1E21N0050		Pressure Transmitter	
1E21N0051		Pressure Transmitter	
1E21N0052		Pressure Transmitter	
1E21N0053		Pressure Transmitter	
1E21N0054		Pressure Transmitter	
1E31N0075A		Pressure Transmitter	
1E31N0077A		Pressure Transmitter	
1E31N0083A,B		Pressure Transmitter	
1E31N0003		Differential Press Transmitter	
1E51N0050		Pressure Transmitter	
1E51N0051		Differential Press Transmitter	
1E51B0053		Pressure Transmitter	
1E51N0055A,B,E,F		Pressure Transmitter	
1E51N0056A, E		Pressure Transmitter	
1E12C002A	RHR	Pump & Motor	
1E12C002B	RHR	Pump & Motor	
1E12C002C	RHR	Pump & Motor	
1E21C001	LPCS	Pump & Motor	
1E22C001	HPCS	Pump & Motor	

TABLE 2

Critical Locations	Perry LPCS Stress Ratio	Perry LPCS Stress Ratio (new)	Perry RHR Stress Ratio	Perry RHR Stress Ratio (new)	Perry HPCS Stress Ratio	Perry HPCS Stress Ration (new)
Stress Evaluation						
1. Suction barrell shell at max. location	0.279	0.283	0.522	0.524	0.288	0.289
2. Discharge head shell adjacent disc. and suct. nozzles (Suct. Disch) S	0.588	0.651	0.889	0.961	0.361	0.380
D	0.413	0.466	0.806	0.871	0.420	0.436
3. Discharge tee adjacent to disc head cover, disc support ribs or tee junc.	0.880	0.881	0.743	0.754	0.759	0.758
4. Pump top case, series case, & first stage case at min. section	0.486	0.486	0.309	0.309	---	---
	0.486	0.486	0.293	0.293	0.765	0.765
	0.266	0.267	0.309	0.309	---	---
5. Suction barrel head/pin interface (RHR & LPCS only)	0.033	0.069	0.050	0.089	N/A	N/A
	0.153	0.222	0.165	0.220	N/A	N/A
6. Discharge column (RHR & LPCS only (due to rib)	0.822	0.824	0.576	0.650	N/A	N/A
	0.636	0.648	0.473	0.473	N/A	N/A
7. Discharge column flange & bolting (RHR & LPC only)	0.890	0.921	0.918	0.974	N/A	N/A
8. Discharge head flange & bolting thread engagement	0.446	0.533	0.731	0.988	0.493	0.529
9. Pump top case, series case, and first stage case flanges & bolting thread engagement	0.856	0.866	0.822	0.854	0.698	0.789
	0.863	0.863	0.752	0.770	0.998	0.798
	0.908	0.958	0.766	0.806	---	---
10. Suction barrel mounting flange and bolting	0.538	0.643	0.975	0.908	0.598	0.641
11. Motor bolting, thread engagement	0.053	0.136	0.075	0.200	0.149	0.220
12. Motor stand at cover plate and at windows	0.039	0.073	0.035	0.065	0.037	0.049
	0.299	0.747	0.437	0.267	0.294	0.578
13. Foundation bolting	0.132	0.170	0.297	0.473	0.219	0.246
	0.056	0.063	0.160	0.191	0.088	0.093

TABLE 2

		Perry LPCS		Perry RHR		Perry MPCS	
Stress Evaluation		Stress Ratio	Stress Ratio (new)	Stress Ratio	Stress Ratio (new)	Stress Ratio	Stress Ration (new)
14. Discharge support rib		0.722 0.116	0.759 0.131	0.712 0.165	0.844 0.202	0.119 0.879	0.120 0.912
15. Seismic support ribs		0.089	0.212	0.115	0.206	0.133	0.128
16. Pump shaft bearings at max load location		0.029	0.061	0.391	0.218	0.37	0.370
17. Pump shaft		0.307	0.308	0.273	0.273	0.267	0.299
18. Small piping (as applicable)		0.459	0.461	0.459	0.505	0.227	0.227
19. Heat exchanger bolts (RWR pump only)		N/A	N/A	0.001	0.001	N/A	N/A
Load Evaluation							
20. Interface load at pin &/or support (as supplied)		0.254	0.493	0.470	0.615	0.559	0.592
21. Vertical thrust load on motor	Mom down Mom up	0.922 0.250	0.816 0.000	0.960 0.305	0.960 0.305	0.939 0.770	0.939 0.770
22. Acceleration at top motor bearing	H V	0.194 0.154	0.467 0.024	0.234 0.139	0.523 0.070	0.22 0.128	0.283 0.019
Displacement Evaluation							
23. Relative horizontal displacement impeller and bowl		0.661	0.172	0.636	0.298	0.075	0.104
24. Relative vertical displacement between first stage impeller & bowl		0.048	0.044	0.063	0.063	0.031	0.025
25. Relative horizontal displacement shaft & mechanical seal		0.175	0.432	0.185	0.447	0.404	0.584
26. Relative vertical displacement between shaft & mechanical seal		0.020	0.019	0.026	0.026	0.04	0.035
27. Separation between operating speed & system resonant frequencies (disp. assuming coincident freq)		0.343	0.343	0.343	0.343	0.343	0.343
28. Relative displacement between shaft & throttle bushing		0.524	0.198	0.663	0.307	0.753	0.242

TABLE III

CONTAINMENT VALVES AND ACTUATORS COMPARISON DATA

	NATURAL FREQUENCY OF PIPING SYSTEM	SPECTRUM VALUE OF RECORDED EARTHQUAKE	DESIGN SPECTRUM ACCELERATION	VALVE DESIGN ACCELERATION	EXTRAPOLATED VALVE ACCELERATION DUE TO RECORDED EARTHQUAKE	ACTUATOR QUALIFICATION ACCELERATION	VALVE QUALIFICATION ACCELERATION
Purge Valves (42" Henry Pratt) of M14 System with Bettis Pneumatic Actuator MPL Nos. M14-F040 M14-F090 Model No. T-420-SR2	41.6 Hz	NS 0.55 EW 0.18 V 0.30	0.48 0.48 0.28	0.63 0.48 0.54	0.72 0.18 0.58 SRSS 0.94	1.4 1.5 0.57 SRSS 2.13	3.0 3.0 3.0 SRSS 5.2
Vacuum Relief Valve (24" Henry Pratt) of M17 System with Limit Torque Actuator MPL Nos. M17-F015 M17-F025 M17-F035 M17-F045 Model No. SMB-0015-H38C	32 Hz	NS 1.76 EW 0.46 V 0.50	1.94 1.94 0.73	0.74 0.73 0.53	0.67 0.17 0.36 SRSS 0.80	0.74 0.73 0.53 SRSS 1.17	5.0 5.0 5.0 SRSS 8.7

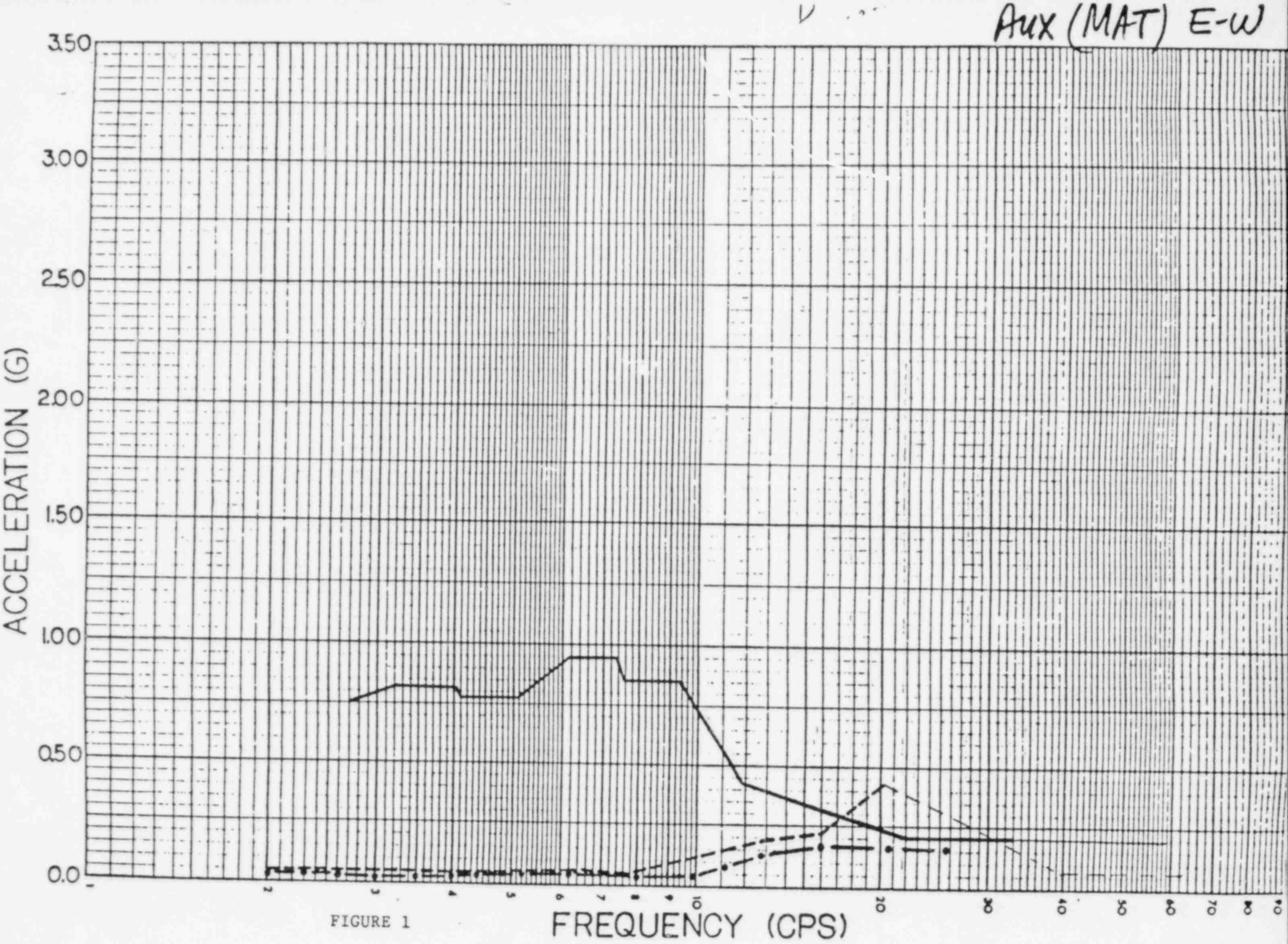

Aux (MAT) E-W
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.0
ACCELERATION (G)
FREQUENCY (CPS)

FIGURE 1

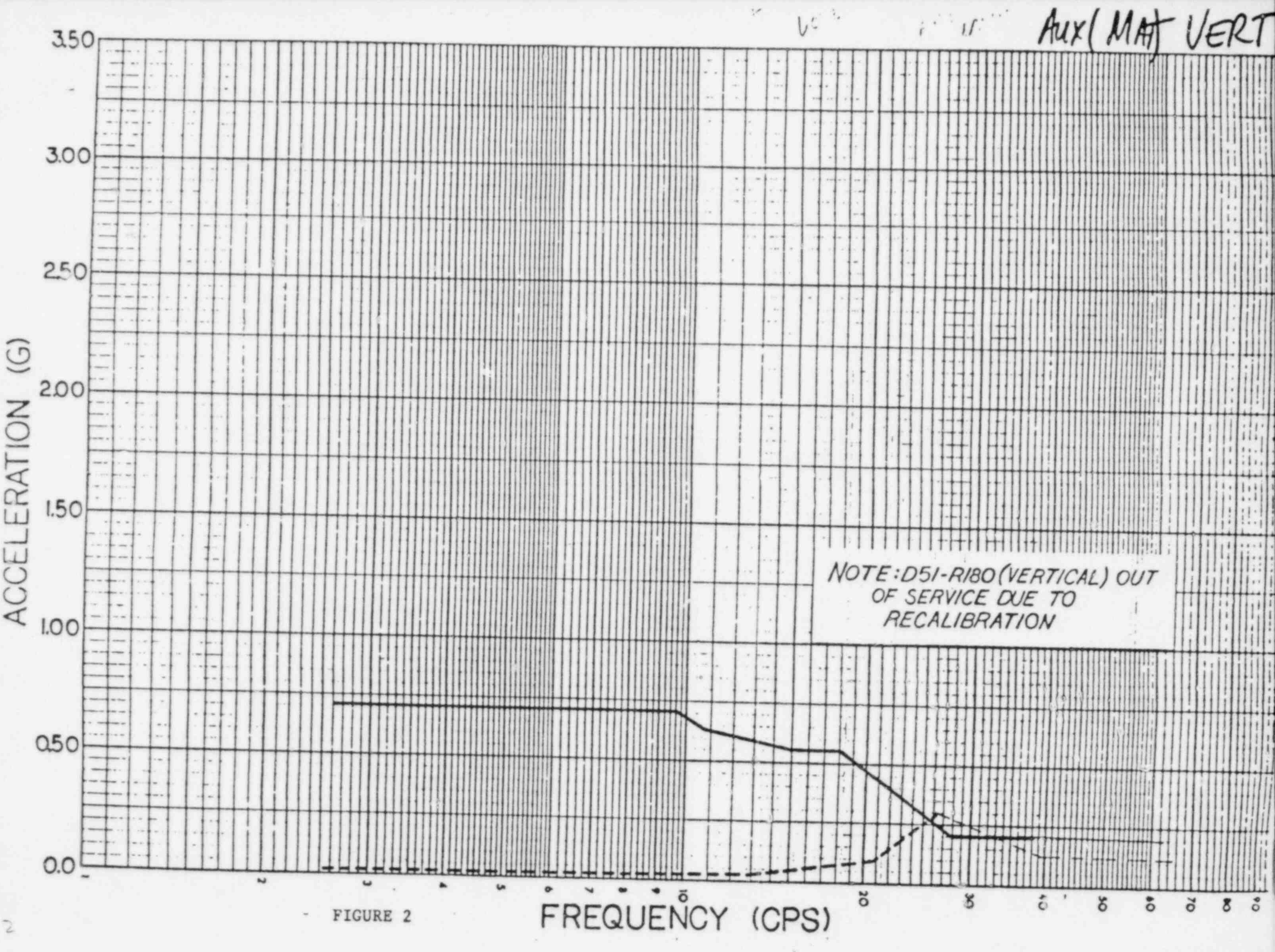

Aux (MAT) VERT
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.0
ACCELERATION (G)
NOTE: D51-R180 (VERTICAL) OUT OF SERVICE DUE TO RECALIBRATION
FREQUENCY (CPS)

FIGURE 2

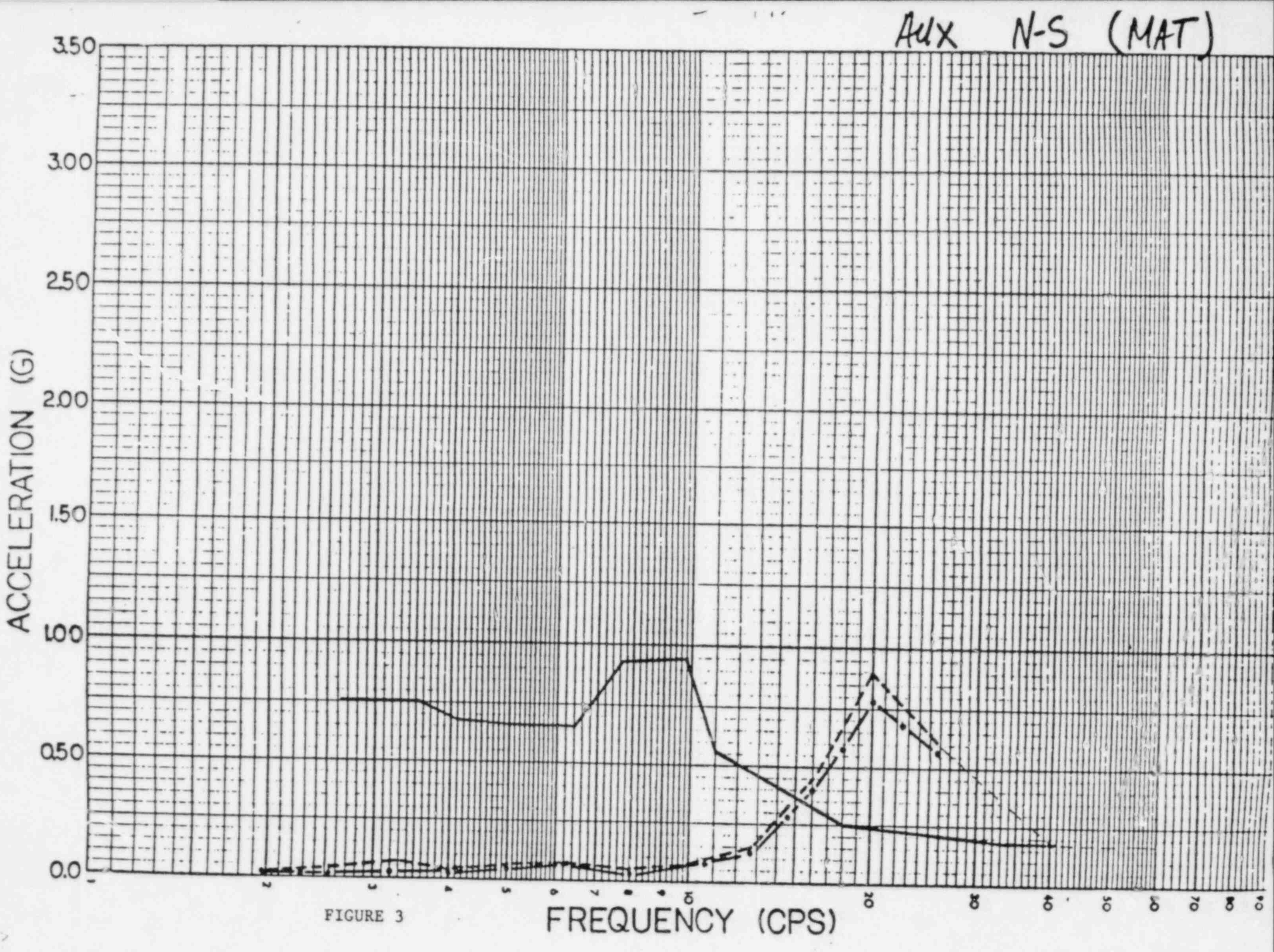
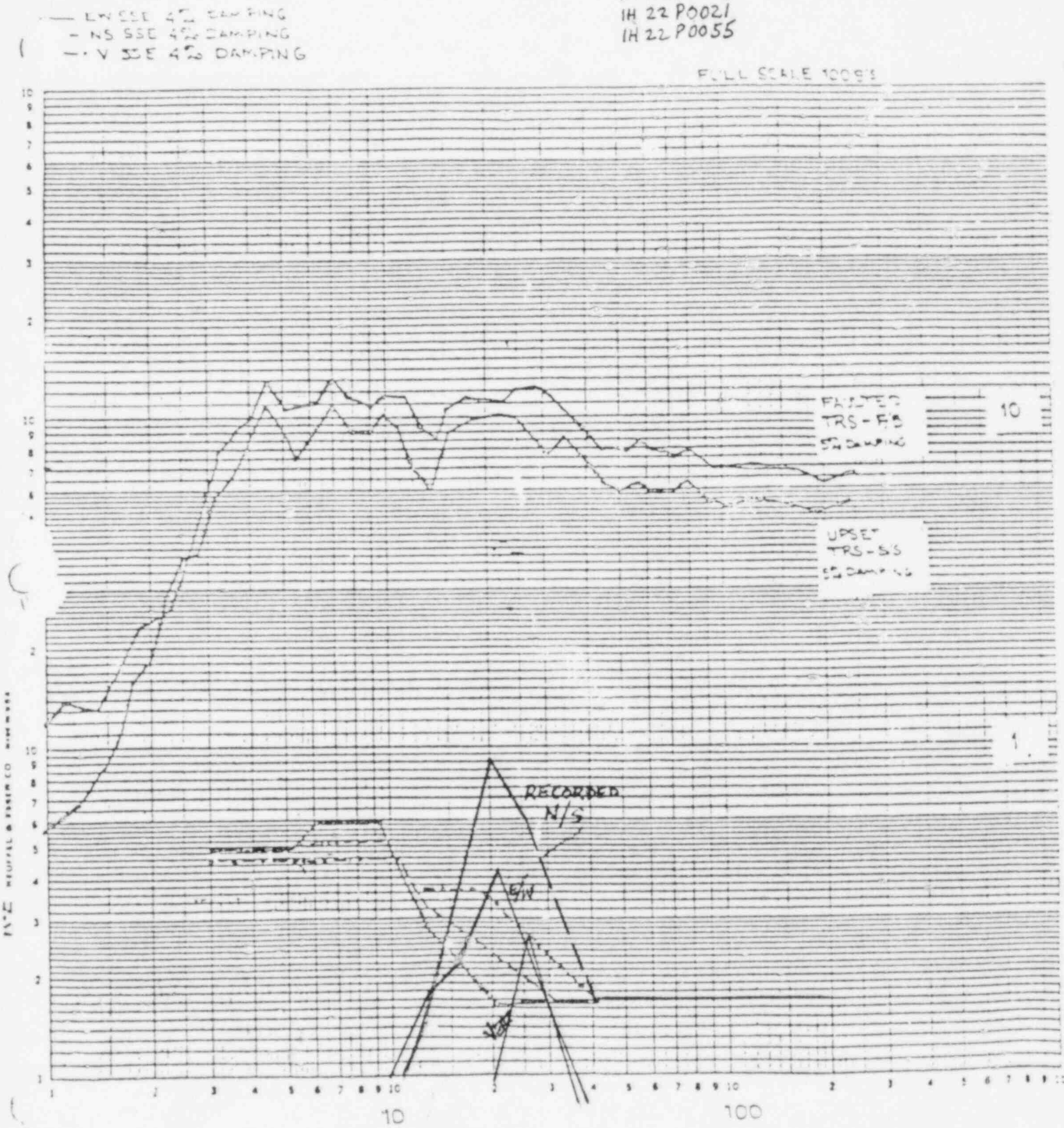

Aux N-S (MAT)
ACCELERATION (G)
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.0
FREQUENCY (CPS)

FIGURE 3

INSTRUMENT RACKS

MPL's 1H22P0001
1H22P0017
1H22P0018
1H22P0021
1H22P0055

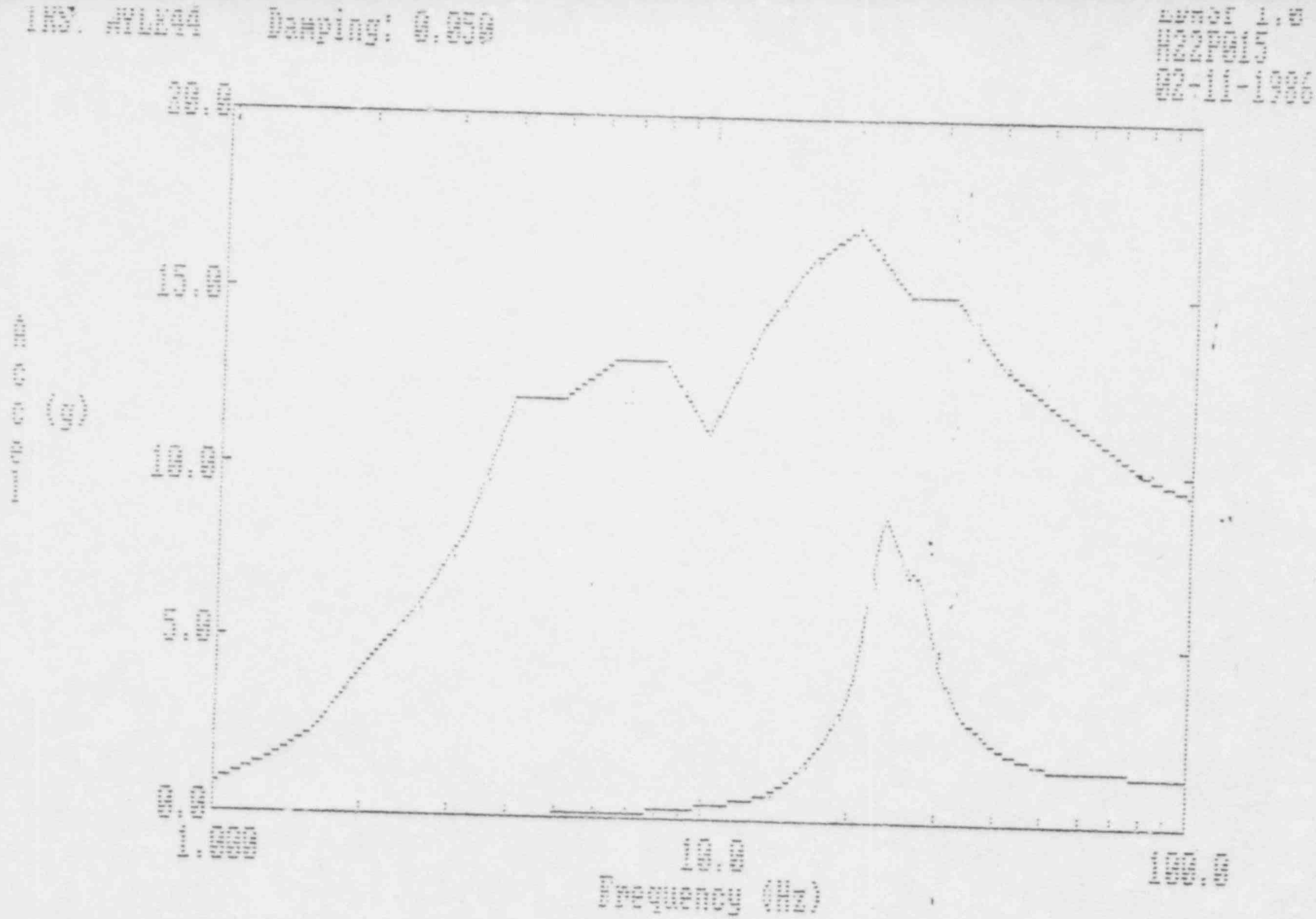
AB-6 EL574' 0"



RECORDED R.S.
FOR AUX BLD 568

FIGURE 4

172



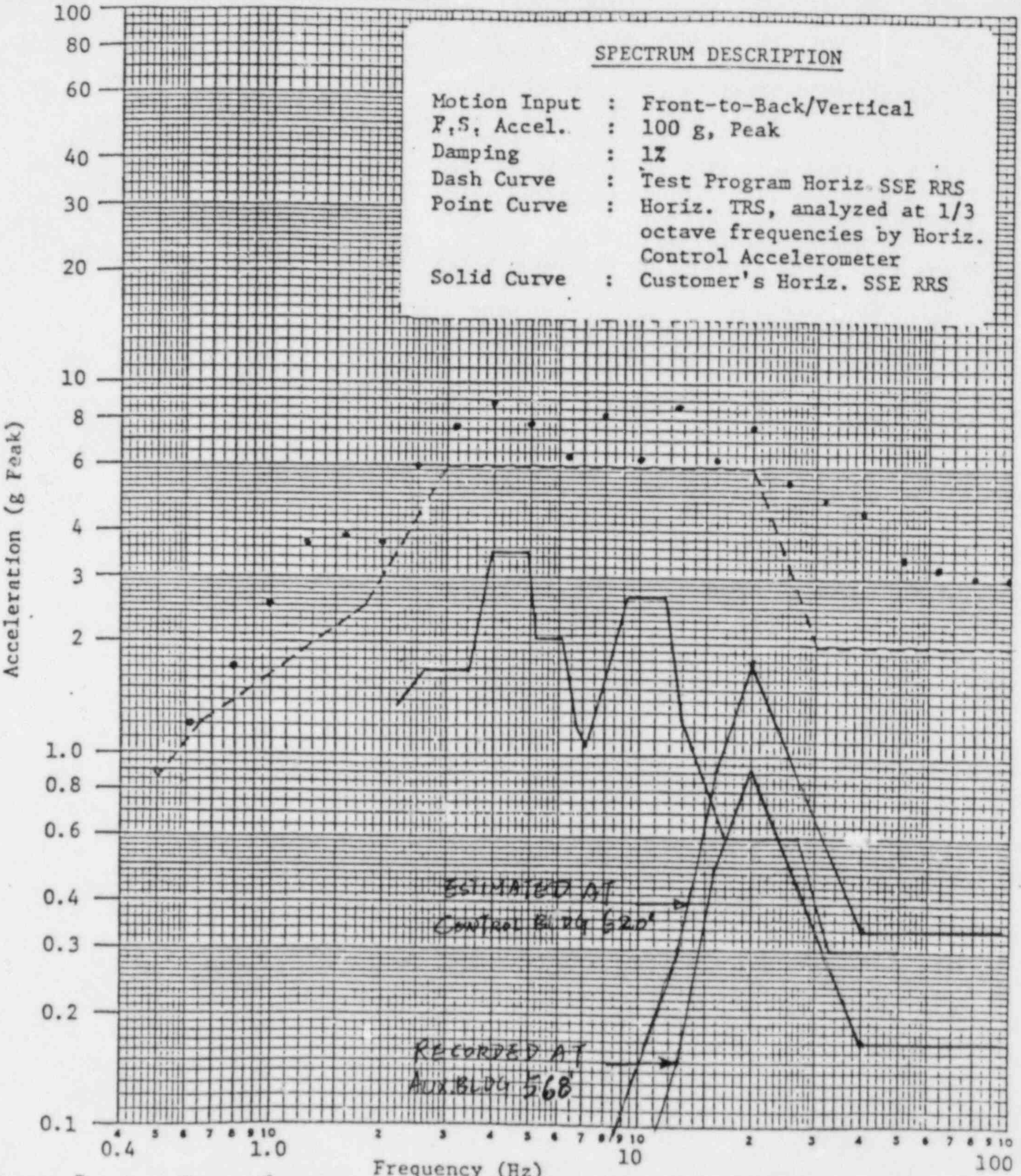
ARS FOR RACK H22 P0021 (FOR TRANSMITTERS)
HORZ. (Z-DIR.) - 5% DAMPING

FIGURE 5

COMPONENT : 4.16 KV METAL CLAD SWITCHGEAR
LOCATION : CONTROL BLD. E.L. 620'
SYSTEM : 4.16 KV DISTRIBUTION SYSTEM

Figure 6

SP-552-00-2



BROWN BOVERI ELECT. IND. —— MODEL # 5HK-350

Figure 6

COMPARISON OF THE CUSTOMER'S HORIZONTAL SSE RRS TO THE HORIZONTAL FRONT-TO-BACK TRS OF THE 5HK-350 SWITCHGEAR TEST SPECIMEN

GAI MPL # 1R22S006, 1R22S007, 1R22-S009

COMPONENT

NEDE-30292

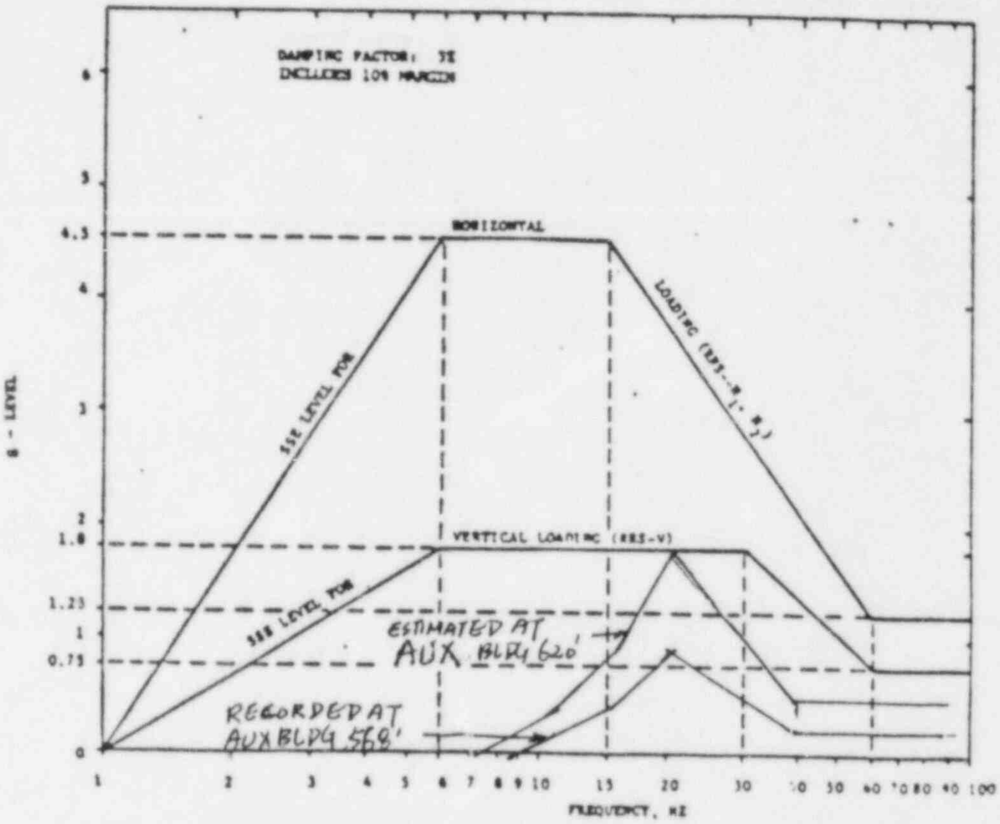
MSIV LEAKAGE CONTROL SYSTEM BLOWER

NUCLEAR ENERGY BUSINESS OPERATIONS — GENERAL ELECTRIC [2] | 324.0996AII SH NO. 25 | REV A of 27

FAULTED EVENT DYNAMIC LOADING (SSE)

LOCATION : AUXILIARY BLDG E.L. 620'

SYSTEM : MSIV LEAKAGE CONTROL SYSTEM.



GENERAL ELECT./LOMPOC — MODEL # 2CH-6-041-1U

GAI MPL # 1E32-C0001, 1E32C0002B, 1E32C0002F.

CONTROL COPY

MPL E32-C001

FIGURE 7

COMPONENT: RECIRC PUMP TRIP CONTROL SWITCHGEAR

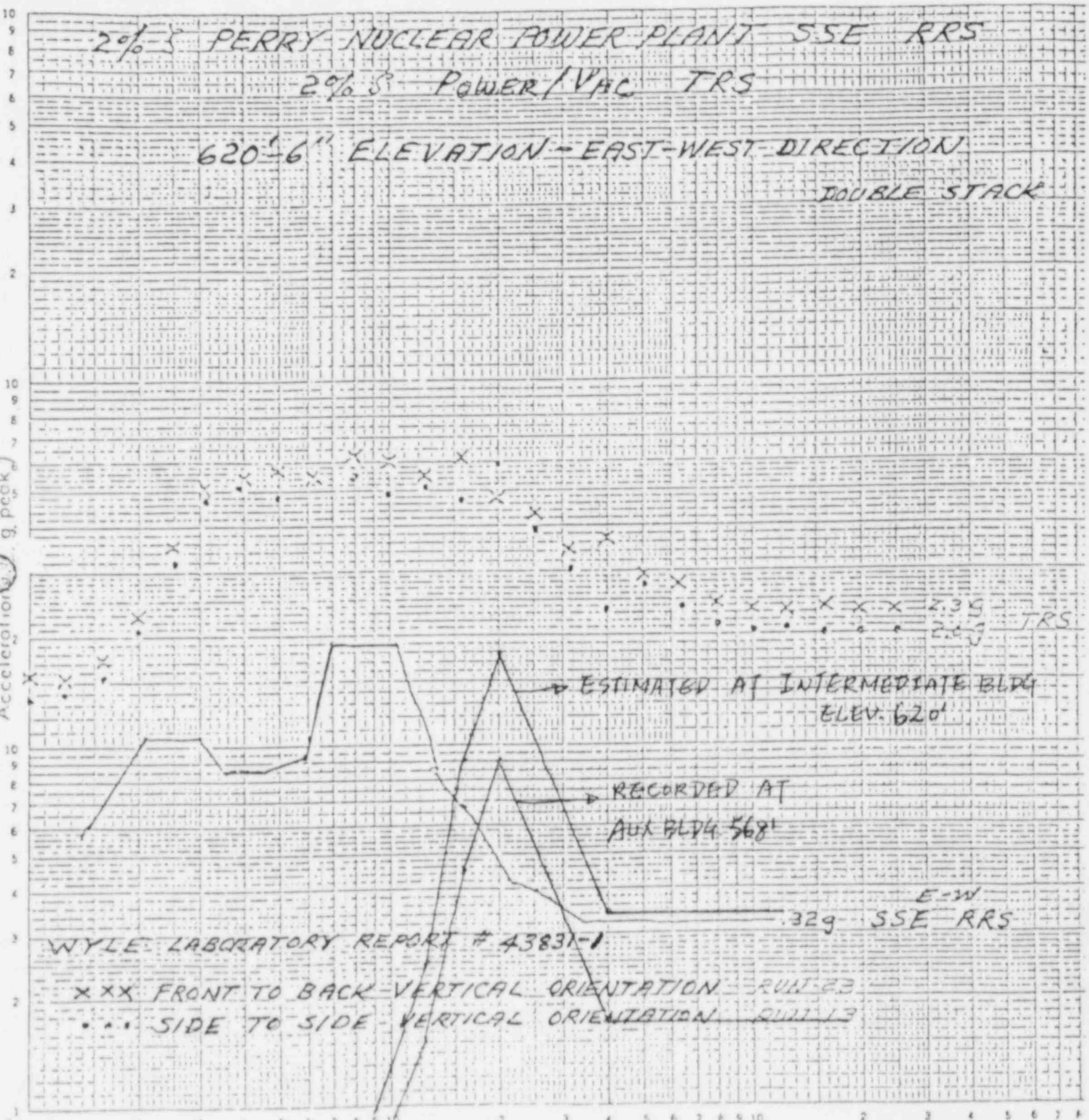
FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

LOCATION: INTERMEDIATE BLD E.L. 620'

SYSTEM: REACTOR RECIRC SYSTEM

DAMPING 2 %



GENERAL ELECT — MODEL # POWER/VAC

GAI MPL # 1R22S0012, 1R22S0013, 1R22S0014, 1R22S0015

AXIS HORIZONTAL

LOCATION NO. HCA

John K. Mickinnin
12/7/81

FIGURE 8

ATTACHMENT 4

INSTRUMENTATION

Suppression Pool Level Instrumentation

As noted in Section 3 of the Seismic Event Evaluation Report an indicated 1-1/2 inch increase in suppression pool level was being investigated. It was found that this increase was due to the discharge of air that had been previously trapped in the sensing line for the transmitters. Appropriate corrective measures are being taken to prevent this situation in the future.

CEI has performed an analysis of the earthquake and how it should have affected the Rosemount differential transmitters. We have found that the event was within the environmental qualification of the instrument, and that they responded as expected. This evaluation is substantiated in that there were no other instruments other than the suppression pool level that showed an abnormal indication during or after the event. No other recorders or differential pressure instruments were observed to exhibit similar or any other anomalies.

The actual level of the suppression pool was surveyed, and the results show that all of the instruments are currently indicating approximately thirteen sixteenths inch (13/16") lower than actual level. The instruments did have a 3/8-3/4 inch positive zero offset which make the instruments sensing actually about an inch to inch and one half (1-1/2") lower than actual level. This difference is most likely due to some amount of air still being entrapped in the sensing lines. The air entrapment was due to incomplete filling and venting of the existing lines from the sensing tap to the instrument.

Proper techniques will be described in the procedure for refilling the sensing line to ensure proper filling of these lines any time they are drained. This system will be modified by the addition of high point vent in the lines to facilitate proper filling and thus prevent air from being trapped in the future. This modification will be completed by the first refueling outage.

PROPOSED RELOCATION OF SEISMIC INSTRUMENT #D51-R170

Reference: U.S. NRC Regulatory Guide 1.12, "Instrumentation for Earthquakes", Revisons 1 - April, 1974

Discussion:

Seismic instrumentation requirements for Nuclear Power Plants are specified by the referenced Regulatory Guide. The subject seismic instrument (D51-R170) as located on the 630' platform inside drywell of the Reactor Building is intended to satisfy Item C.1.c.1 of Regulatory Guide 1.12. In specific, this item states..."one triaxial response-spectrum recorder capable of measuring both horizontal motions and the vertical motion should be provided at ... a selected location on the reactor equipment or piping supports."

Instrument D51-R170 satisfied this requirement in that it is attached to platform structural steel directly adjacent to a pipe support of the RHR piping system. Due to multiple other attachments to the same platform steel in the immediate area of instrument D51-R170, significant seismic interaction is possible thus rendering interpretation of seismic traces on the instrument extremely difficult. It is thus desirable to relocate D510R170 to a location which aides recorded data analysis. This is consistent with Section B of Regulatory Guide 1.12 which states in part..."It is desirable that these strong motion accelerographs be located so as to facilitate the engineering analysis of the recorded traces following an earthquake.

Proposed Relocation

Instrument D51-R170 will be relocated to a rigid bracket attached directly to the outside surface of the Biological Shield Wall of the Reactor Building. The instrument will be located adjacent to a pipe support on a system such as the Feedwater or Reactor Recirculation piping. The relocated position will still satisfy Item C.1.c.1 of the Regulatory Guide 1.12 but will enhance engineering analysis of any recorded data since the possibility of seismic interaction between structure and attached components is greatly reduced.

PROPOSED REVISION TO FSAR TABLE 3.7-14

As part of our post earthquake evaluation, the setpoints of the triaxial response spectrum recorder, (Instrument No. D57-R160), were reviewed. As a result of this review, the FSAR Table 3.7-14 list of setpoints is being revised to show the corresponding frequency and the appropriate two-thirds of OBE and OBE design spectrum values that illuminate the amber and red light control room indicators. Attached is a revised table.

TABLE 3.7-14

SETPOINTS OF THE TRIAXIAL RESPONSE SPECTRUM RECORDER[1]

Horizontal Axis			Vertical Axis		
	Setpoint Value (g)			Setpoint Value (g)	
Freq.(CPS)	Amber Signal[2]	Red Signal[3]	Freq.(CPS)	Amber Signal[2]	Red Signal[3]
2.0	.23	.35	2.0	.14	.21
2.5	.28	.42	2.5	.17	.26
3.2	.29	.44	3.2	.21	.31
4.0	.27	.40	4.0	.23	.35
5.0	.23	.35	5.0	.26	.39
6.4	.23	.35	6.4	.27	.41
8.0	.23	.35	8.0	.38	.57
10.1	.23	.34	10.1	.43	.65
12.7	.21	.31	12.7	.37	.55
16.0	.19	.28	16.0	.19	.29
20.2	.18	.27	20.2	.09	.13
25.4	.08	.12	25.4	.07	.11

NOTE:

1. Instrument No. D51-R160
2. Two-thirds of OBE
3. OBE

JANUARY 31, 1986 EARTHQUAKE
SEISMIC EVENT EVALUATION

ERRATA PAGES

Appendix B	- Pages attached
Appendix C Page 7, Second paragraph, third line from the bottom	Change "in connection with short duration, high energy ground motions ....., to " in connection with short duration, high <u>frequency</u> ground motions..."
Appendix D	Figures 4, 5, 6 attached

KINEMETRICS SYSTEMS

February 19, 1986

Mr. Frank Stead
Cleveland Electric Illuminating Co.
Perry Nuclear Power Plant
10 Center Road
North Perry, OH 44081

RECEIVED
FEB 22 1986
F. R. STEAD

Re: Earthquake Data Report,
Your Requisition No. NED-E-860006

Dear Mr. Stead:

We have made minor revisions to our report entitled "Strong-Motion Data Report for the M_L 5.0 Earthquake of 1147 EST, January 31, 1986, Perry, Ohio". New pages with the revisions are enclosed and marked as Revision 1.

* Title sheet; "February 19, 1986, Revision 1 " has been added.

* Page 1; "triaxial" trigger has replaced "vertical" trigger.

* Page 1; a nominal trigger level of "0.01g" has been replaced by "0.005g", the correct value.

* Page 2; the words "Compensator" and "Application" were misspelled and have been corrected.

* Page 2; the phrase "at 256 samples per second" has been added for clarity.

We have mailed a copy of these pages directly to Mr. Jay E. Silberg, Esq.

Very truly yours,

K.L. Benuska
Vice President/General Manager

KLB:jav
Enclosures

cc: Mr. Jay E. Silberg
Shaw, Pittman, Potts & Trowbridge
1800 M Street, N.W.
Washington, DC 20036

STRONG-MOTION DATA REPORT

for the

M_L 5.0 EARTHQUAKE

of

1147 EST, JANUARY 31,1986

PERRY, OHIO

RECORDED ON THE

PERRY NUCLEAR POWER PLANT

STRONG MOTION ACCELEROGRAPHS

for

Cleveland Electric Illuminating Company

Requisition No. NED-E-860006

by

Kinemetrics/Systems
222 Vista Ave.
Pasadena, CA 91107

Sales Order C-K6028

February 4, 1986

February 19, 1986, Revision 1

1.0 INTRODUCTION

On January 31, 1986, a (M_L 5.0) local earthquake was recorded by the strong-motion instrumentation at Perry Nuclear Power Plant, Perry, Ohio. The FM analog magnetic tape cassette records from two Kinemetrics Model SMA-3 accelerographs were retrieved from the instruments and provided to Kinemetrics for analysis.

This report describes the processing of these strong-motion records and presents the results. Included are the uncorrected accelerograms, corrected acceleration, velocity and displacement time series, and response spectra.

2.0 INSTRUMENTATION

2.1 Model SMA-3 Accelerograph

The SMA-3 is a multi-channel, centralized recording, FM analog magnetic tape accelerograph system designed to detect and record strong local earthquakes and record the three orthogonal acceleration signals on cassette tape. The SMA-3 remains in a standby mode until its triaxial trigger detects an earthquake. △1
The trigger then actuates recording in less than .10 seconds.

The force balance accelerometers in the SMA-3 have a nominal natural frequency of 50 Hz and damping of 65% critical, providing flat (-3dB) response from DC to 50 Hz. The nominal sensitivity of each of the three channels is 2.5 volts/g with a full scale response of 1.0g. The dynamic range of the accelerograph is nominally 40 dB, giving it a resolution of approximately .01g.

The trigger in the SMA-3 has a flat (-3dB) response from 1 to 10 Hz and a nominal trigger level of 0.005g. △1

Power is supplied to the SMA-3 by internal rechargeable batteries. These batteries are kept in a charged state by 120 VAC line power.

2.2 Calibration Data

The three Model SMA-3 accelerographs which recorded the event were factory calibrated in January, 1985, and the sensors were recalibrated for sensitivity by the Perry NPP personnel in December of 1985. These most current calibration data are given in Table 1 below.

Ser. No.	Channel	Sens., v/g	Nat. Freq., Hz	Damping % critical
165-1	long	2.48	52.3	65
	tran	2.49	53.7	65
	vert	2.47	50.6	64
165-2	long	2.48	52.6	67
	tran	2.48	52.2	72
	vert	2.65	50.5	66

TABLE 1: Calibration Data

3.0 DATA PROCESSING

Data from the Model SMA-3 accelerographs were played back using a Kinemetrics Model SMP-1 Playback System through a Data Compensator, digitized using a Kinemetrics Model DDS-1105 Digital Data System and processed as described in Kinemetrics' Application Note No. 7 "Conditioning and Correction of Strong Motion Data on Analog Magnetic Tapes", appended to this report. ⚠1 ⚠1

3.1 Digitization

The magnetic tapes were digitized using the DDS-1105. The 1024 Hertz FM time reference recorded on channel 4 of the cassette is output from the SMP-1 and divided down by four (256 Hz ± deviation) and used as the timing signal for the digital conversion time interval. The multiplexed uncorrected time series are written on 9-track computer-compatible tape at 256 samples per second. ⚠1

DAMPING VALUES ARE 2 PERCENT OF CRITICAL

DATE PLOTTED 2-20-86

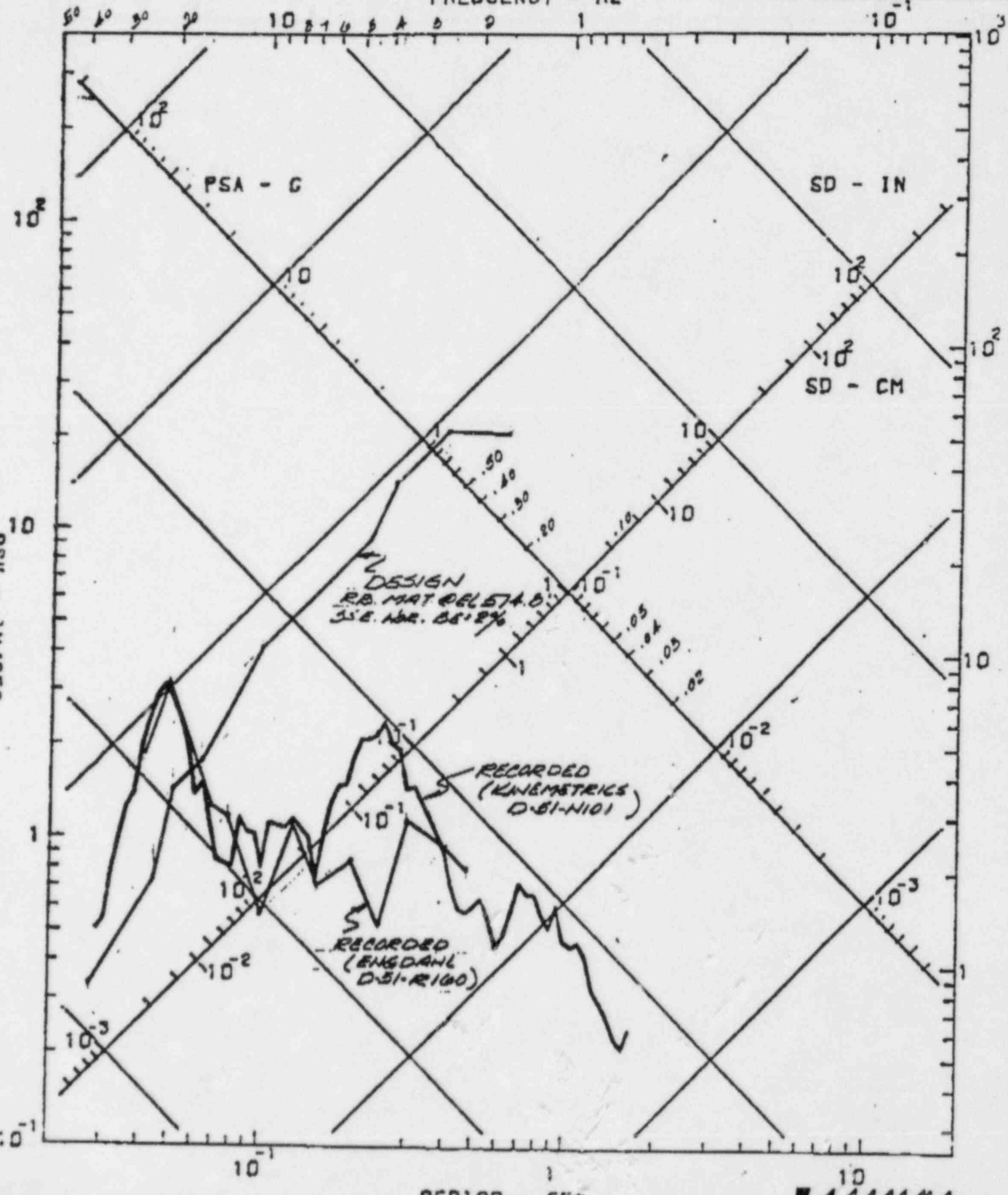


FIGURE D-4

KINEMETRICS

ML 5.0 EARTHQUAKE JANUARY 31. 1986

IIA8001 PERRY NUCLEAR POWER PLANT COMP WEST SMA3S/N 165-1T

DAMPING VALUES ARE 2 PERCENT OF CRITICAL **DATE PLOTTED 2-20-86**

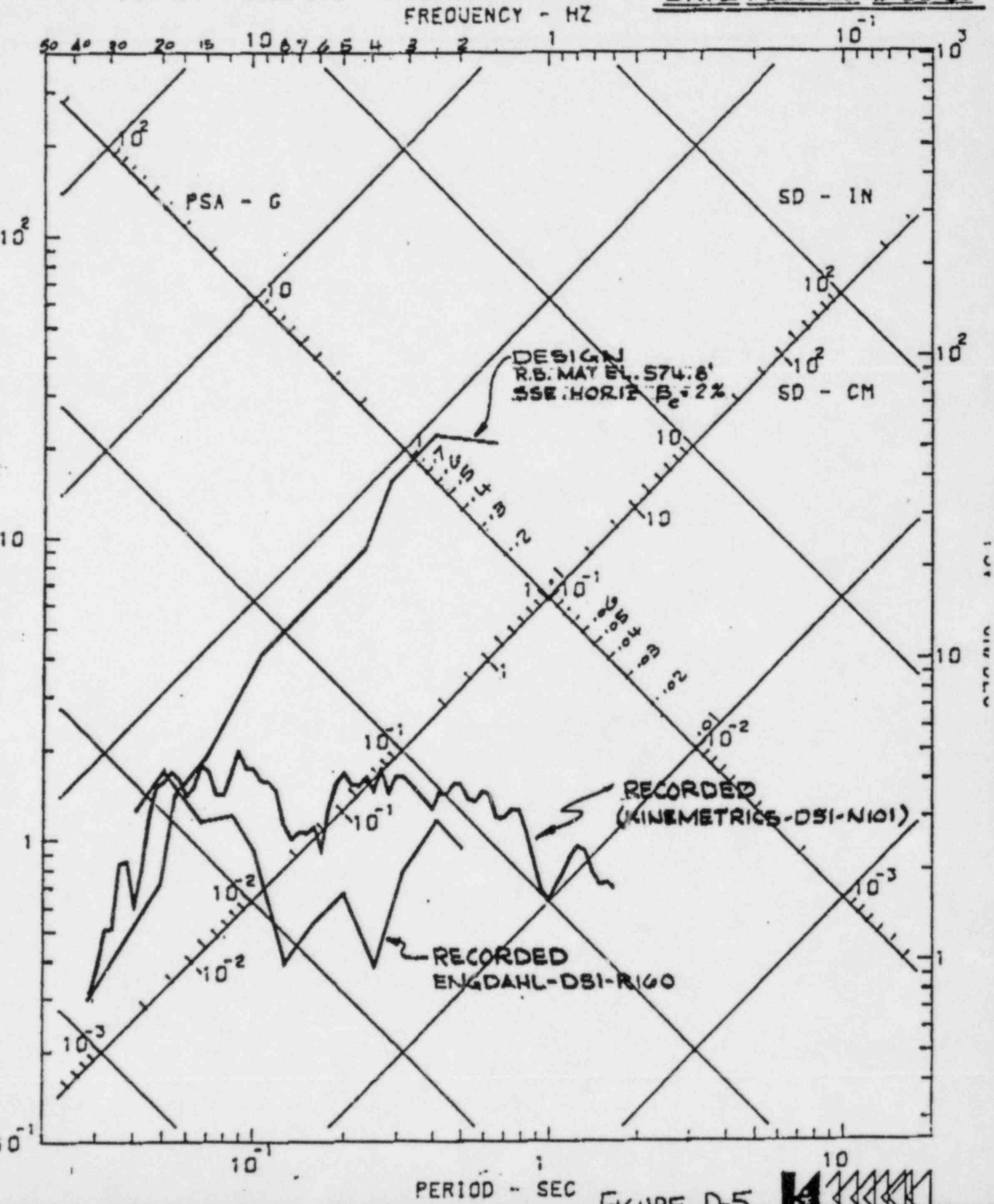


FIGURE D-5

ML 5.0 EARTHQUAKE JANUARY 31, 1986

IIA8001 PERRY NUCLEAR POWER PLANT COMP UP SMA3S/N 165-1V

DAMPING VALUES ARE 2 PERCENT OF CRITICAL

DATE PLOTTED 2-20-86

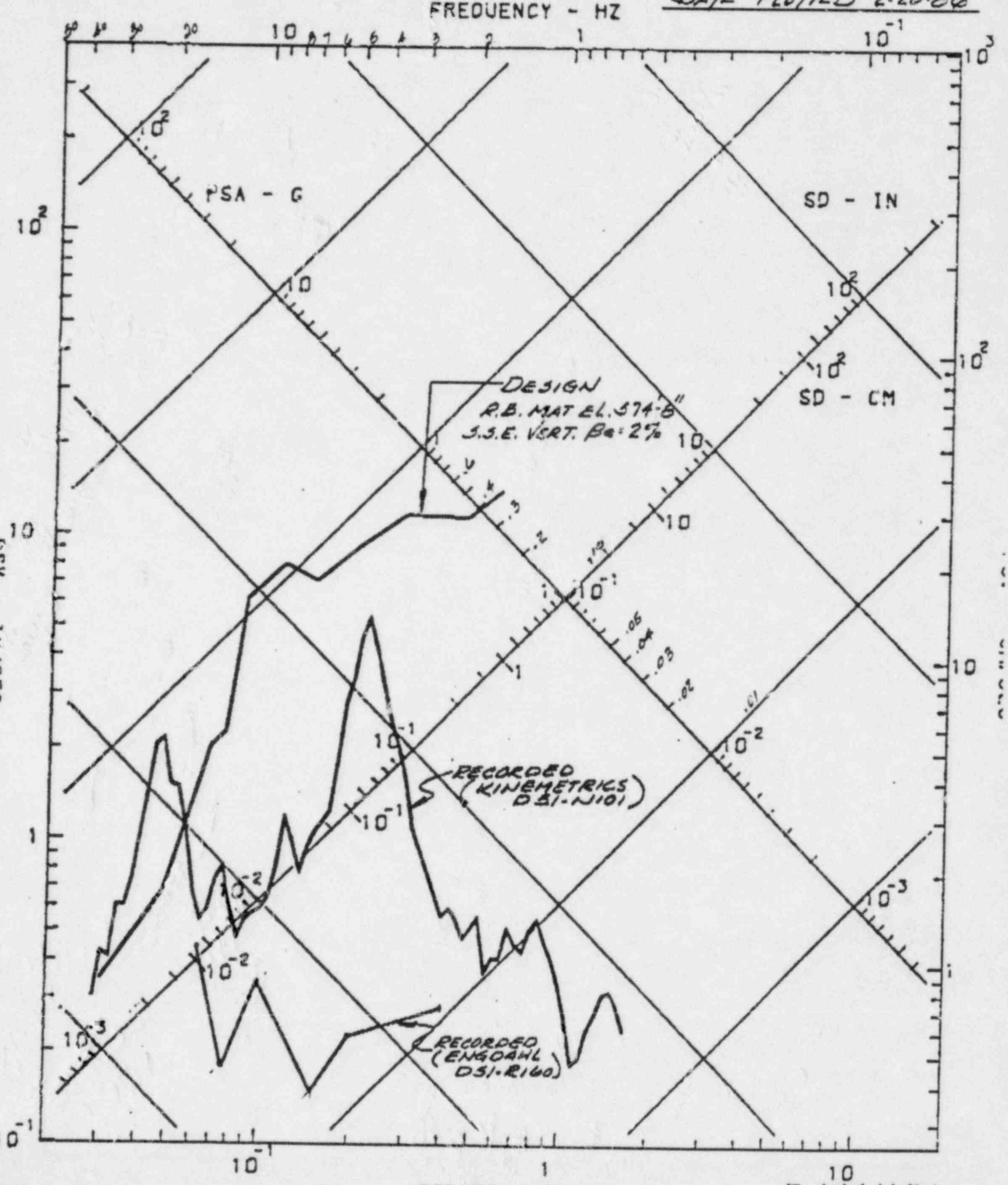


FIGURE D-6