ILLINOIS POWER COMPANY

U-0378
L30-81 (12-03)-6

500 SOUTH 27TH STREET, DECATUR, ILLINOIS 62525

December 3, 1981

Mr. James R. Miller, Chief
Standardization & Special Projects Branch
Division of Licensing
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Miller:

Clinton Power Station Unit 1
Docket No. 50-461

Enclosed are the following materials which were handed out at the December 3, 1981 Clinton Project meeting on seismic:

Enclosure 1: Presentation by R. J. Holt on seismicity and zonation of the New Madrid region.

Enclosure 2: Presentation by E. Levine on site conditions of appropriate strong motion recording locations as compared with Clinton, strong motion records selected for site specific response spectra, and site specific response spectra for M_b = 5.3 and M_b = 5.8.

Enclosure 3: Presentation by G. Klimkiewicz on parameters for the hazard analysis:

- site locations for relative hazard analysis
- source models

attenuation models

- pseudohistorical analysis

It was agreed at the December 3, 1981 meeting that the NRC Staff would provide comments on the enclosed materials by December 10, 1981.

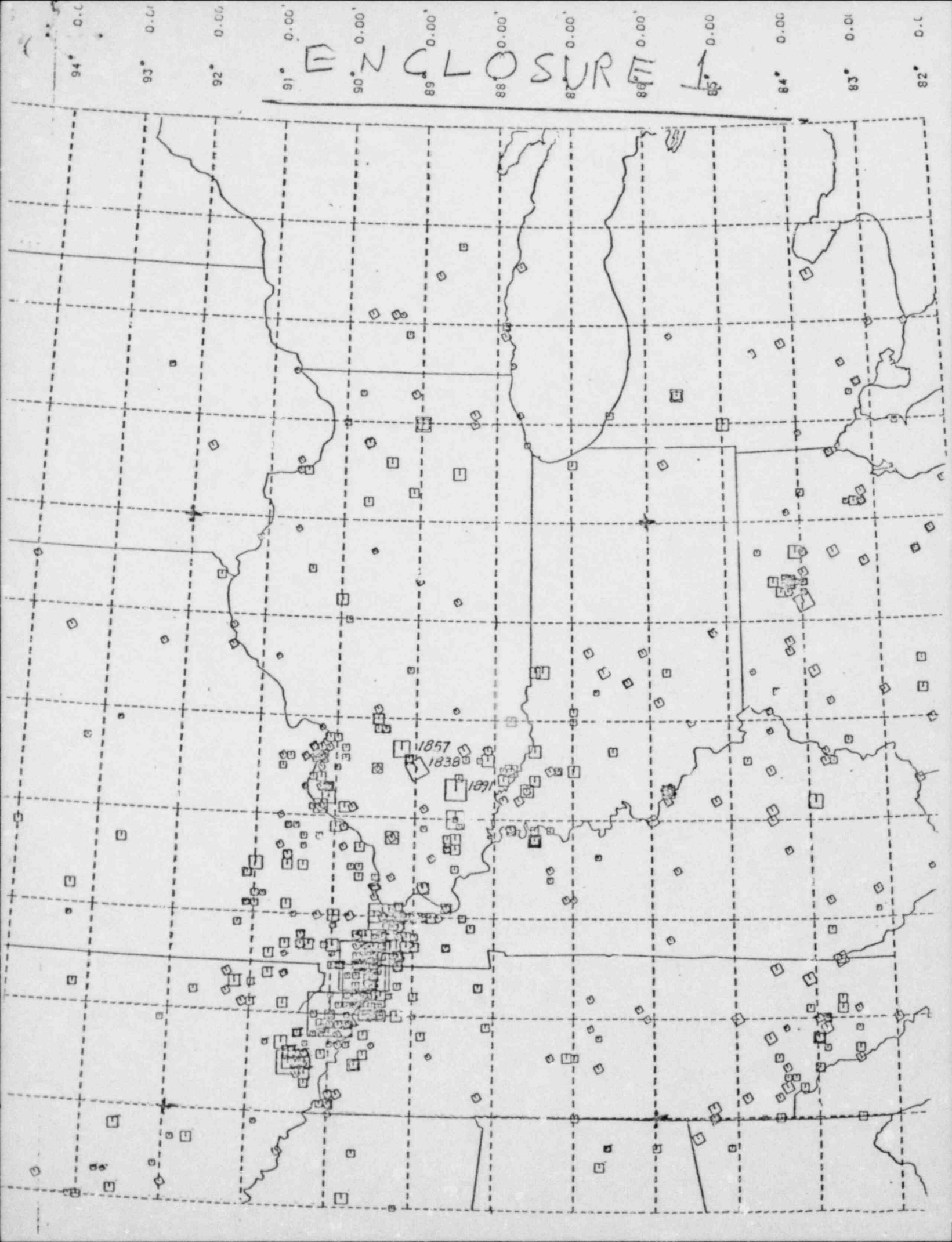
Sincerely,

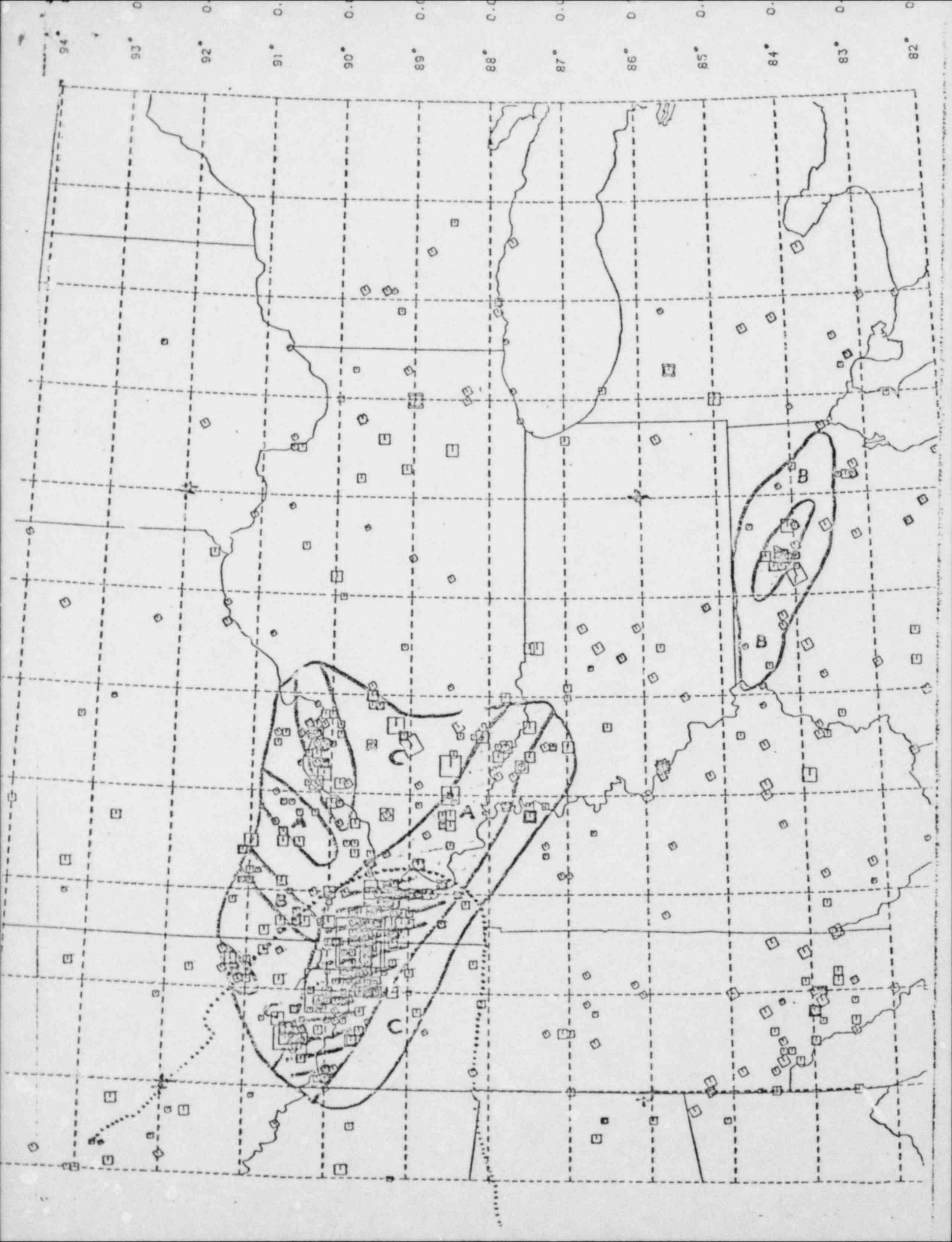
B001
s
1/1

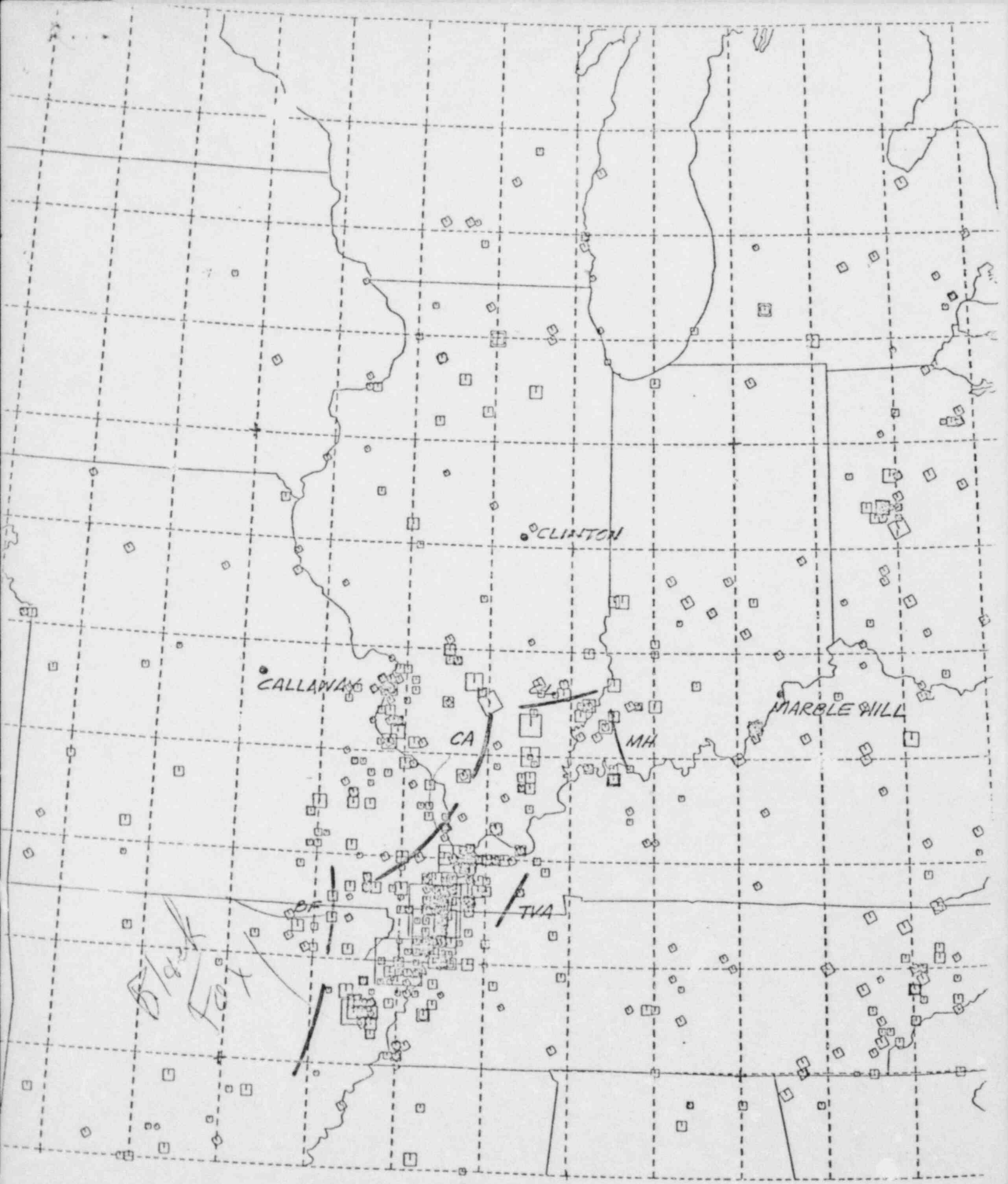
J.D. Geier
Manager, Nuclear Station Engineering

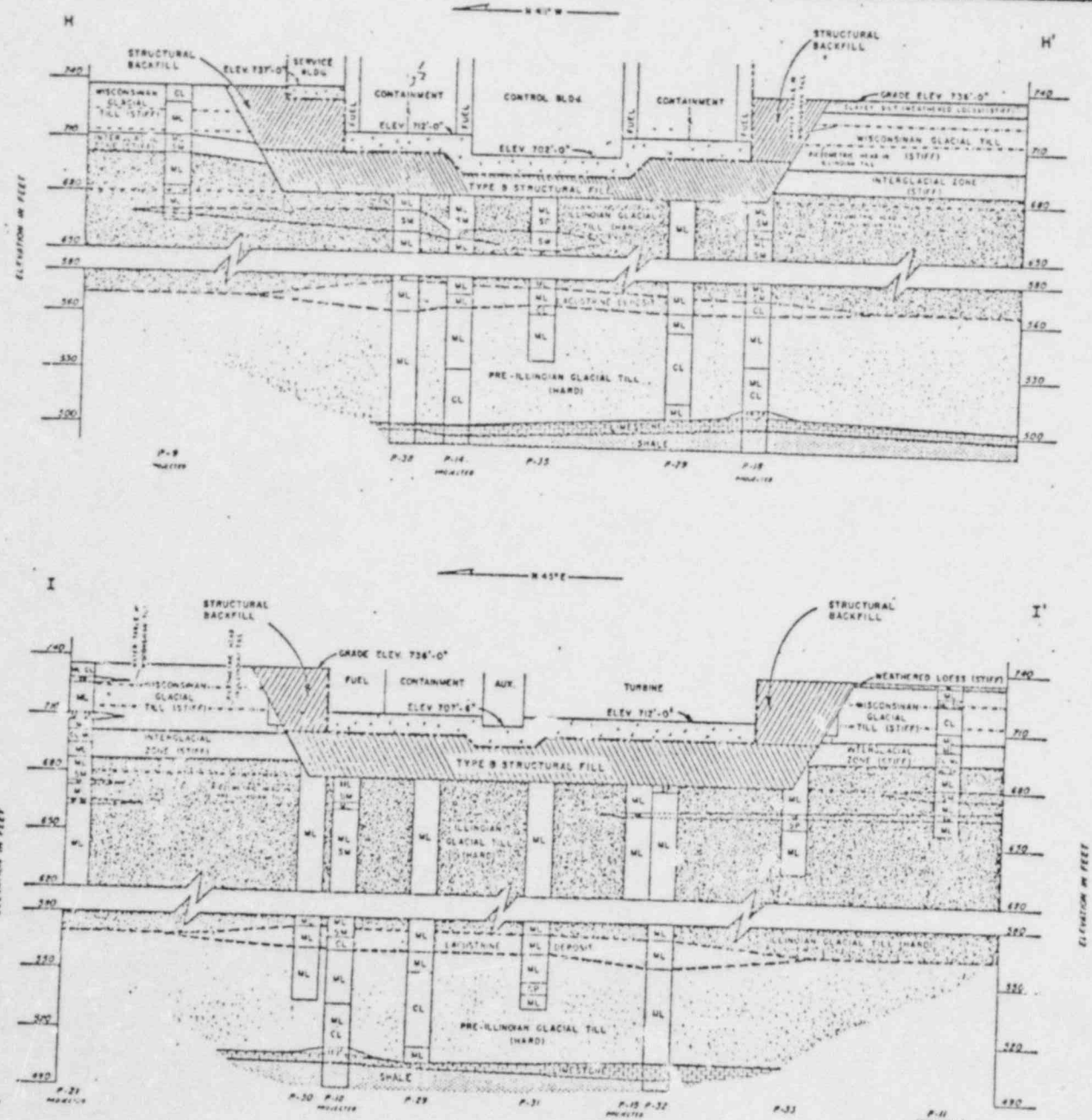
Attachments
cc: J.H.Williams, NRC Clinton Project Manager
R.Jackson, NRC Chief Geosciences Branch
G.Giese-Koch, NRC Geosciences Branch
H.H.Livermore, NRC Resident Inspector

ENCLOSURE 1




94°
93°
92°
91°
90°
89°
88°
87°
86°
85°
84°
83°
82°
A
B
B
B
C
C


CLINTON
CALLAWAY
CA
MH
MARBLE HILL
TVA
SCALE 1:5000000
0
50
100
150
200
250
300 MILES



LEGEND

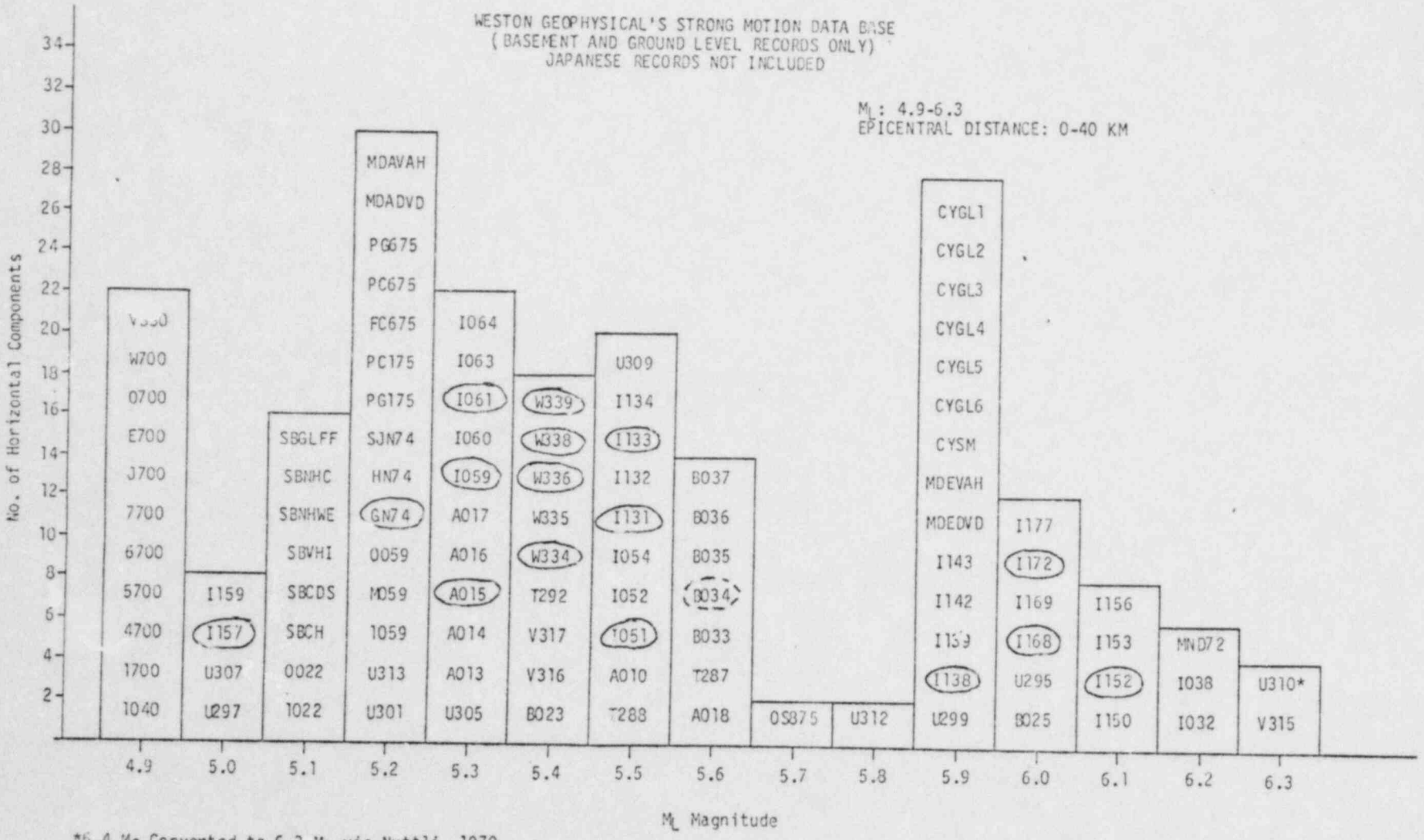
NOTES

ENCLOSURE 2

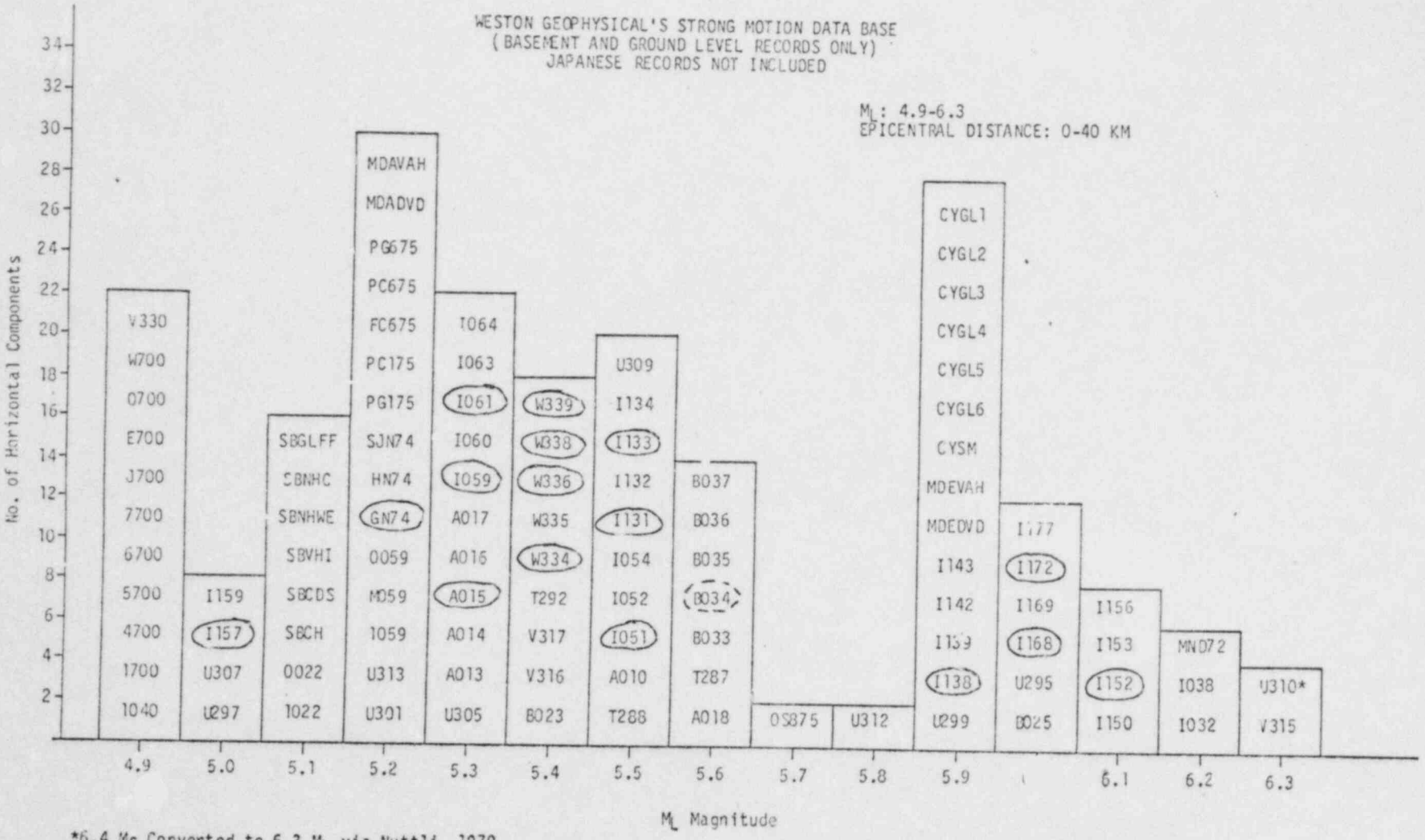
CLINTON POWER STATION
FINAL SAFETY ANALYSIS REPORT

FIGURE 2.5-372

GEOLOGIC SECTIONS H-H' AND I-I' - STATION SITE



*6.4 M_S Converted to 6.3 M_L via Nuttli, 1979

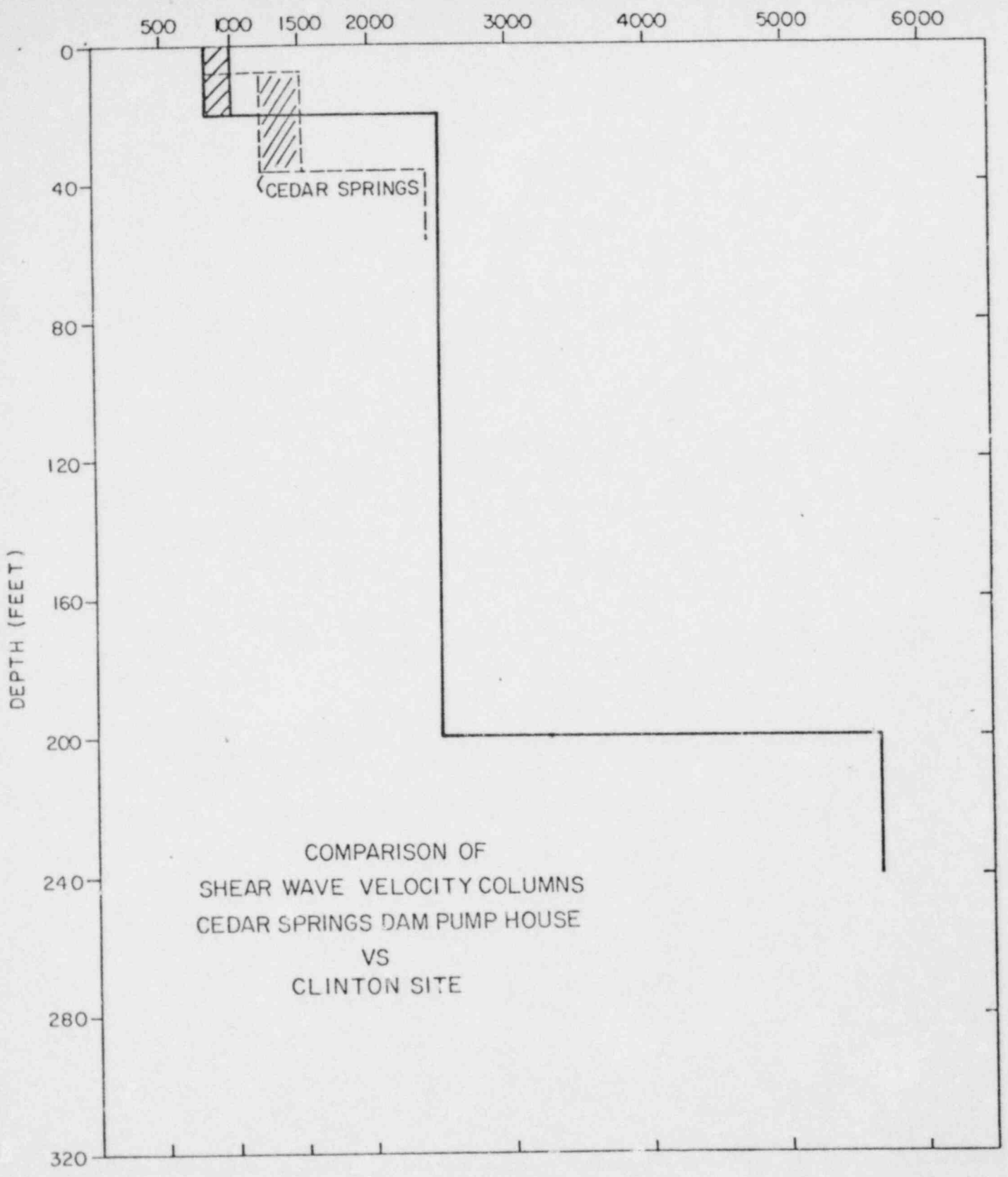


*6.4 M_S Converted to 6.3 M_L via Nuttli, 1979

Weston Geophysical's
Strong Motion Data Base - 6.4 M_L
Epicentral Distance Less Than 40km

Ref. ID	Distance/Type	Station
U300	29.8/EP	Ferndale City Hall, Ferndale
C041	3.2/CA	Pacoima Dam, Pacoima
C048	7.7/CA	8244 Orion Blvd., LA
D056	26./CA	Old Ridge Route, CWR Site, Castaic
D057	23./CA	Hollywood Storage Bldg., LA
D058	23./CA	Hollywood Storage Bldg. Parking Lot, LA
D059	23./CA	1901 Avenue of the Stars, LA
D065	25./CA	3710 Wilshire, LA
D068	22./CA	7080 Hollywood, LA
E072	27.5/CA	4680 Wilshire, LA
E075	25./CA	3470 Wilshire, LA
E081	29./CA	Outlet Works, Santa Felicia Dam
E083	25./CA	3407 W 6th Street, LA
F088	18./CA	633 E. Broadway, Glendale
F095	22.5/CA	120 N. Robertson, LA
G106	19./CA	CIT Seismo. Lab. Pasadena
G107	24./CA	CIT Athenaeum, Pasadena
G108	24./CA	Millikan Library, CIT, Pasadena
G110	15.5/CA	J.P.L., Pasadena
G114	28./CA	Fire Station, Palmdale
H115	13./CA	15250 Ventura, LA
I128	22.5/CA	435 N. Oakhurst, Beverly Hills
I131	22.5/CA	450 N. Roxbury, Beverly Hills
I134	23./CA	1800 Century Park East, LA
I137	12./CA	15910 Ventura, LA
J141	25./CA	Lake Hughes Array, Station 1
J142	24./CA	Lake Hughes Array, Station 4
J143	23./CA	Lake Hughes Array, Station 9
J144	21./CA	Lake Hughes Array, Station 12
J145	10.5/CA	15107 Van Owen, LA
J148	25./CA	616 S. Normandie, LA
L166	16.5/CA	3838 Lankershim, LA
N188	38.9/EP	1880 Century Park East, LA
N192	26./CA	2500 Wilshire, LA
O198	18./CA	Griffith Park Observatory, LA
O207	26./CA	Fairmont Reservoir, CA
P214	22.5/CA	4867 Sunset, LA
P217	25./CA	3345 Wilshire, LA
Q233	13./CA	14724 Ventura, LA
Q236	22./CA	1760 N. Orchid, LA
Q239	24./CA	9100 Wilshire, Beverly Hills
R246	22.5/CA	6464 Sunset, LA
R248	22.5/CA	6430 Sunset, LA
R249	23./CA	1900 Avenue of the Stars, LA
S255	26./CA	6200 Wilshire, LA
S261	24./CA	1177 Beverly Drive, LA
S262	26./CA	5900 Wilshire, LA
S265	25./CA	3411 Wilshire, LA
S266	25./CA	3550 Wilshire, LA

EP: Epicentral Distance.
CA: Closest approach.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1000
1500
2000
3000
4000
5000
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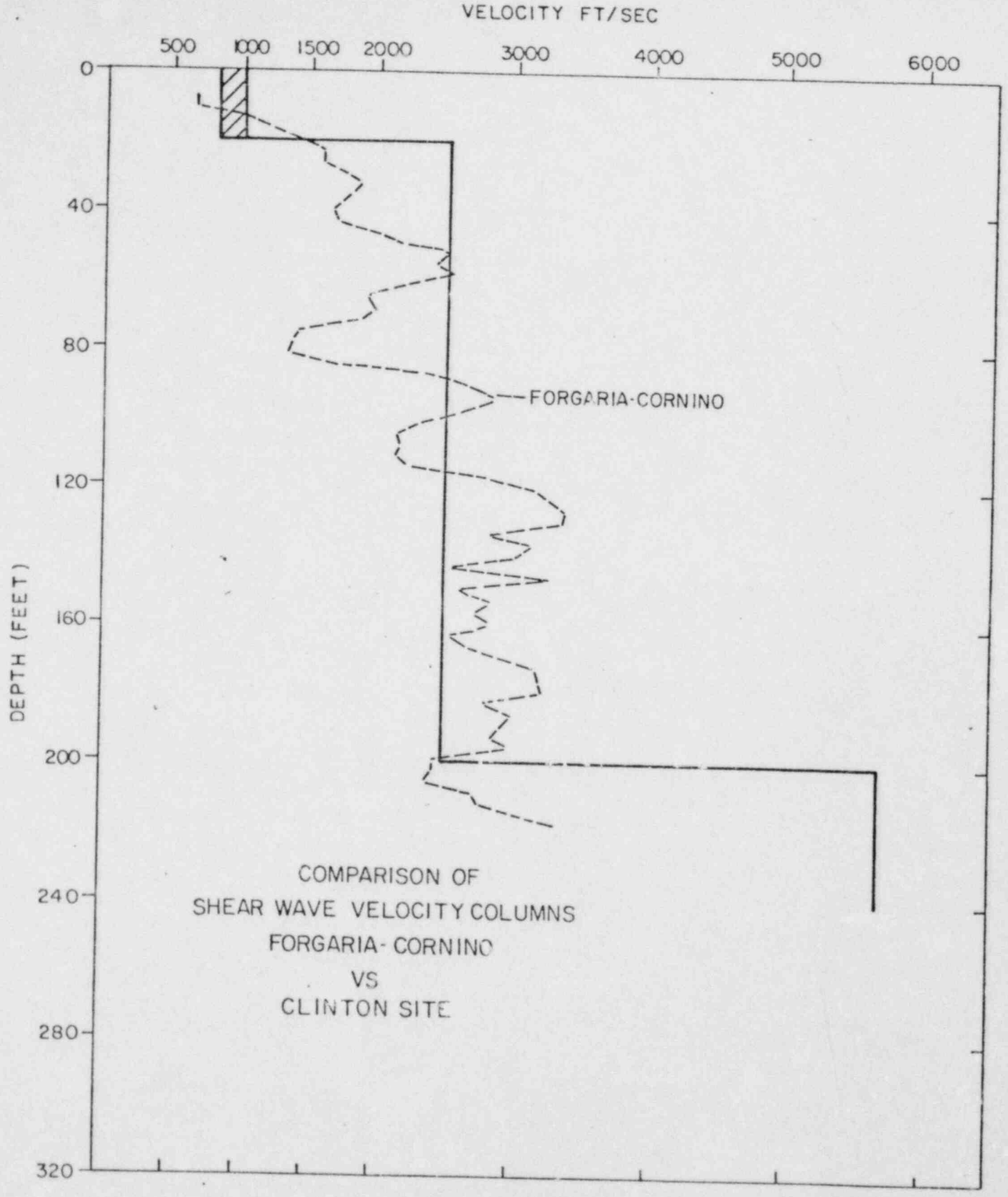
40
80
120
160
200
240
280
320
DEPTH (FEET)
CEDAR SPRINGS
COMPARISON OF
SHEAR WAVE VELOCITY COLUMNS
CEDAR SPRINGS DAM PUMP HOUSE
VS
CLINTON SITE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160
200
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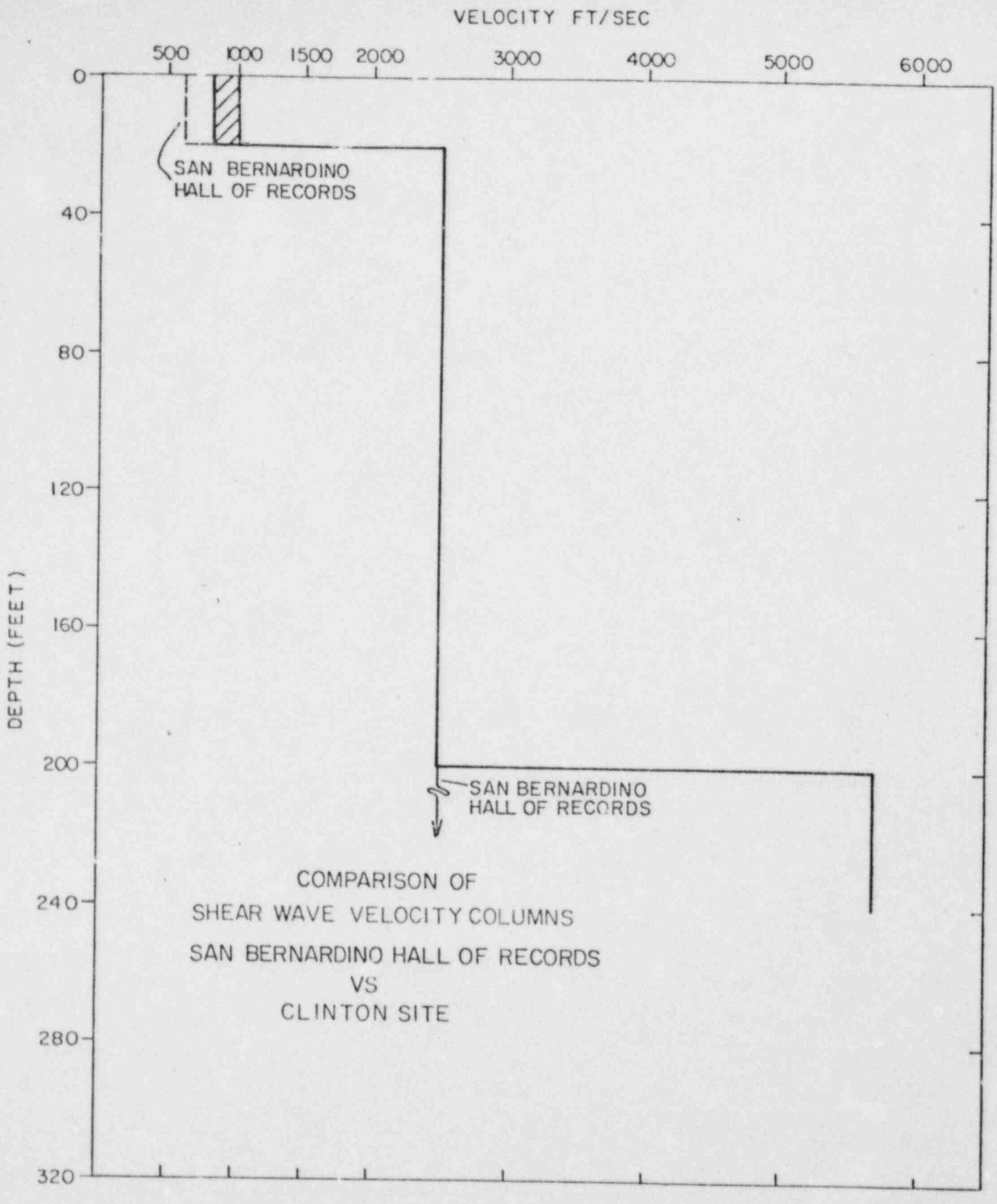
DEPTH (FEET)
FORGARIA-CORNINO
COMPARISON OF
SHEAR WAVE VELOCITY COLUMNS
FORGARIA - CORNINO
VS
CLINTON SITE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1000
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2000
3000
4000
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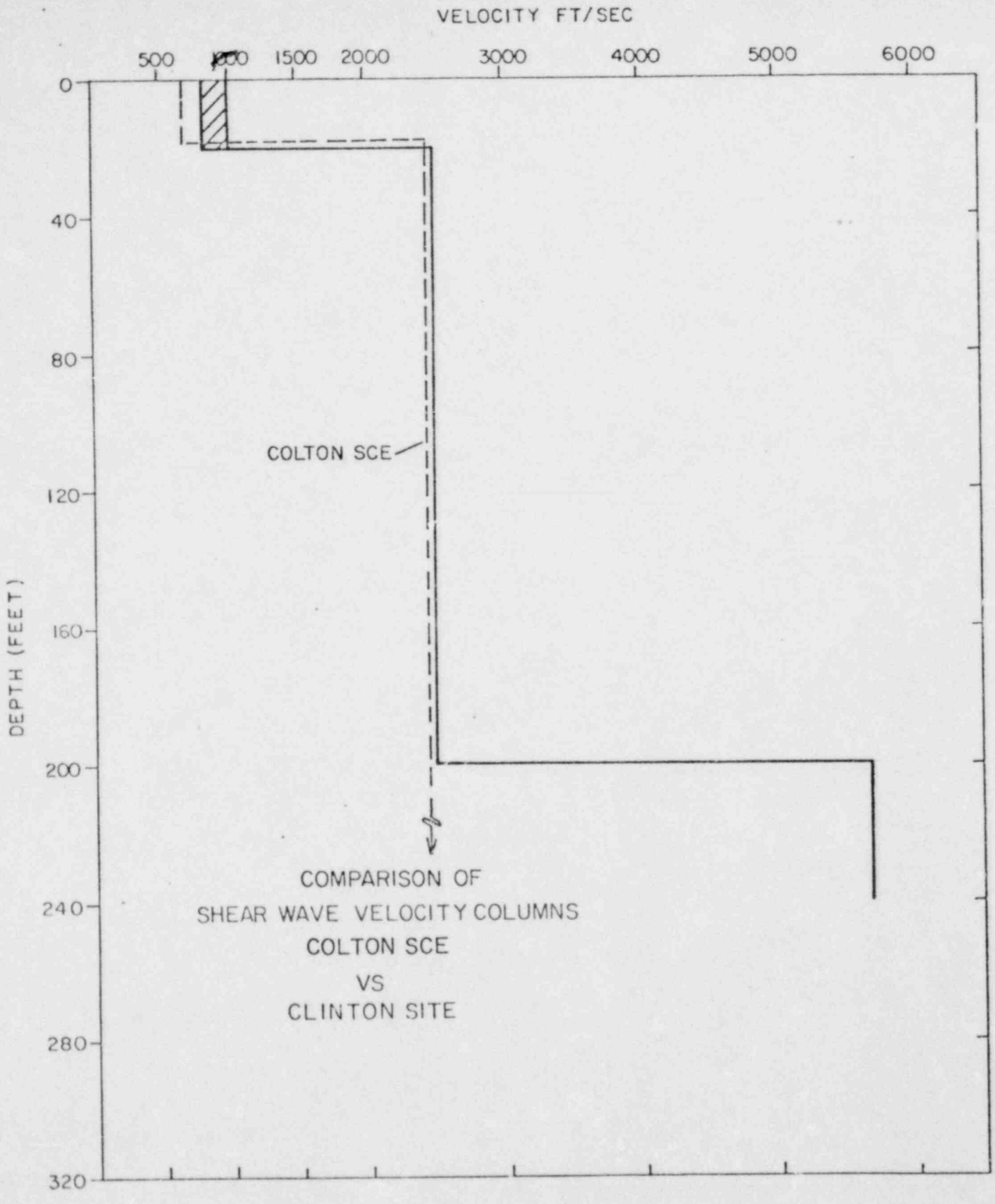
40
80
120
160
200
240
280
320
DEPTH (FEET)
SAN BERNARDINO
HALL OF RECORDS
SAN BERNARDINO
HALL OF RECORDS
COMPARISON OF
SHEAR WAVE VELOCITY COLUMNS
SAN BERNARDINO HALL OF RECORDS
VS
CLINTON SITE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2000
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4000
5000
6000
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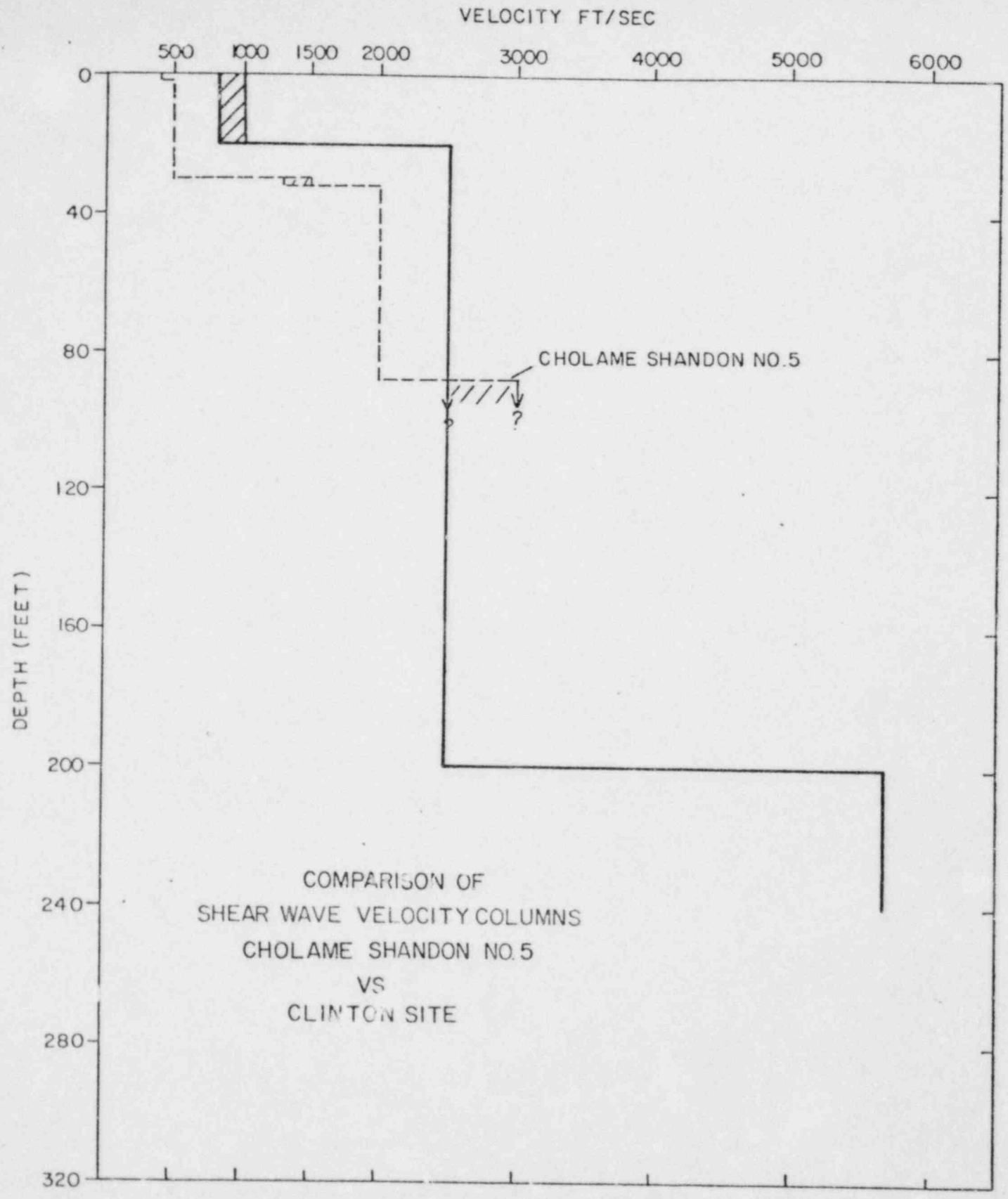
40
80
120
160
200
240
280
320
DEPTH (FEET)
COLTON SCE
COMPARISON OF
SHEAR WAVE VELOCITY COLUMNS
COLTON SCE
VS
CLINTON SITE


VELOCITY FT/SEC
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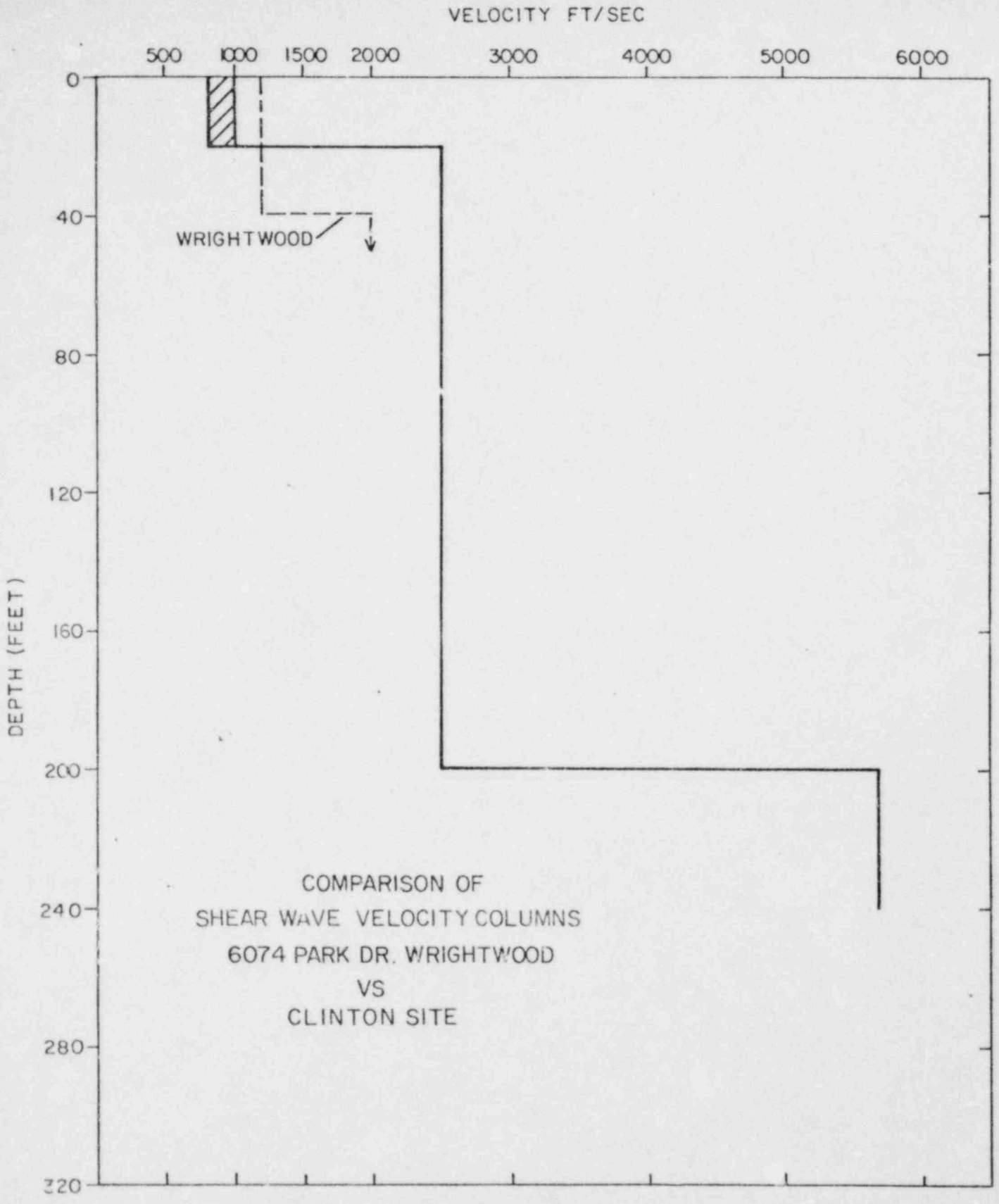
1500
2000
3000
4000
5000
6000
0
40
80
120
160
200
240
280
320
DEPTH (FEET)
CHOLAME SHANDON NO.5
?
COMPARISON OF
SHEAR WAVE VELOCITY COLUMNS
CHOLAME SHANDON NO.5
VS
CLINTON SITE


VELOCITY FT/SEC
500
1000
1500
2000
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4000
5000
6000
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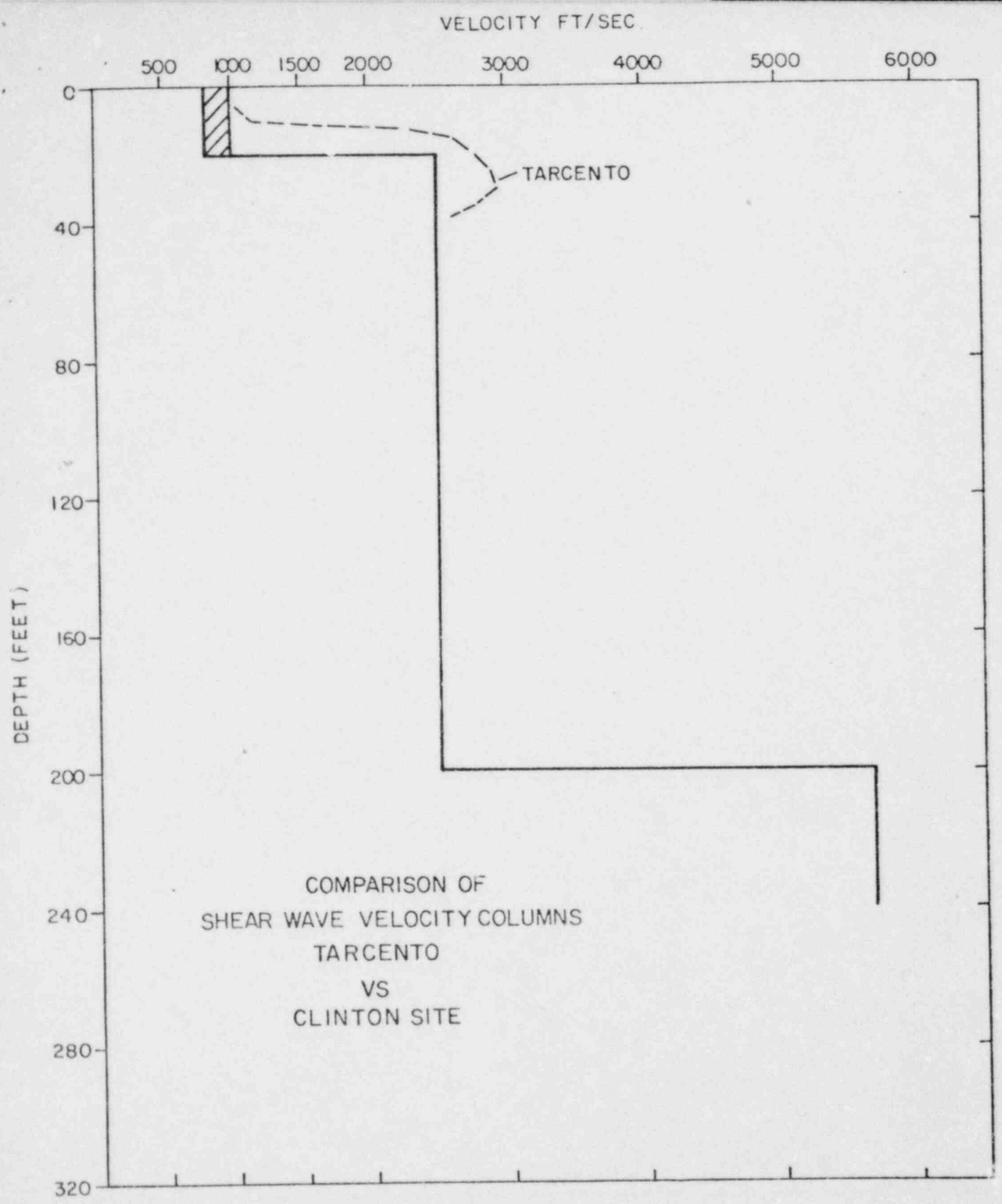
40
80
120
160
200
240
280
320
DEPTH (FEET)
WRIGHTWOOD
COMPARISON OF
SHEAR WAVE VELOCITY COLUMNS
6074 PARK DR. WRIGHTWOOD
VS
CLINTON SITE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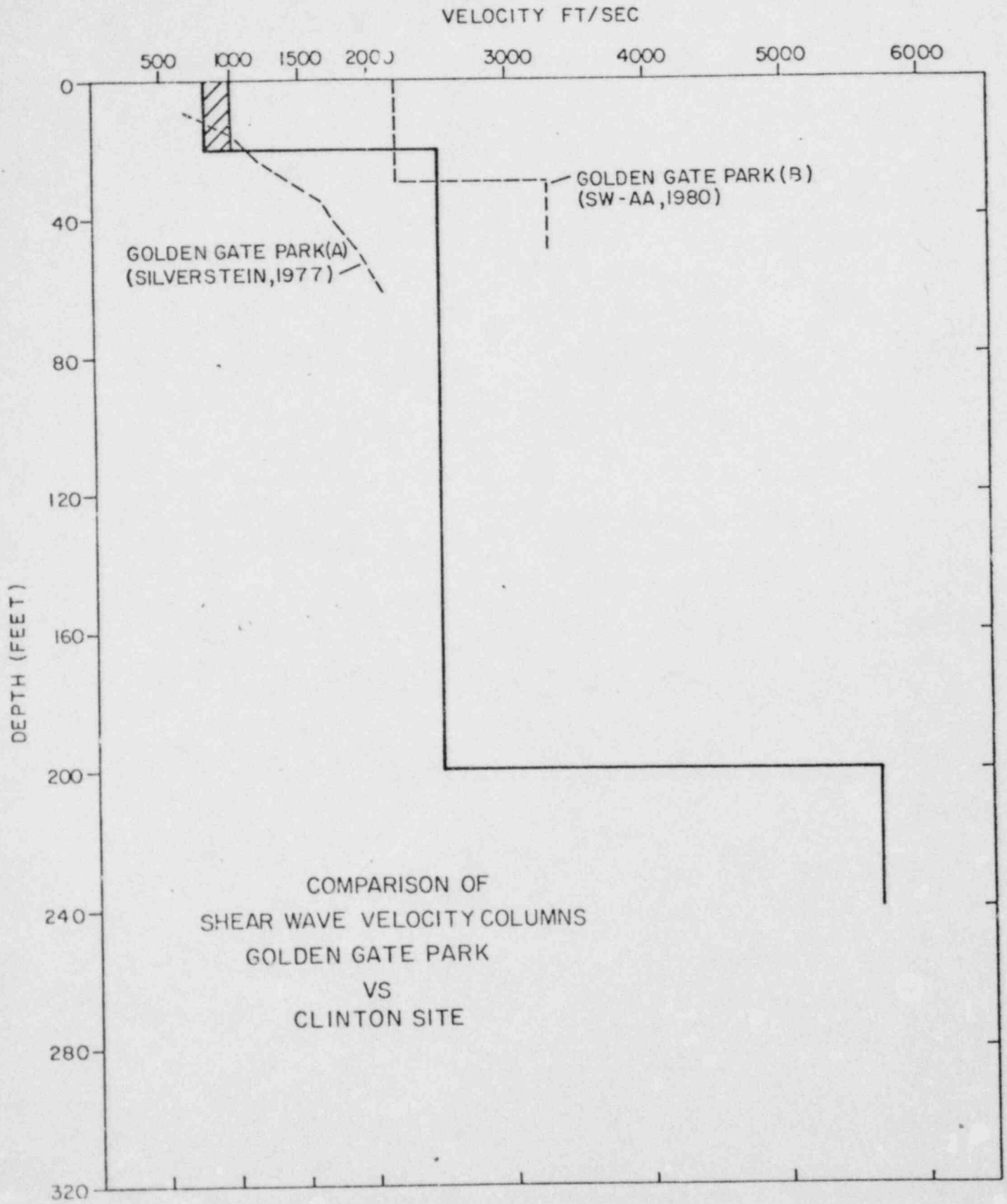
DEPTH (FEET)
TARCENTO
COMPARISON OF
SHEAR WAVE VELOCITY COLUMNS
TARCENTO
VS
CLINTON SITE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1000
1500
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3000
4000
5000
6000
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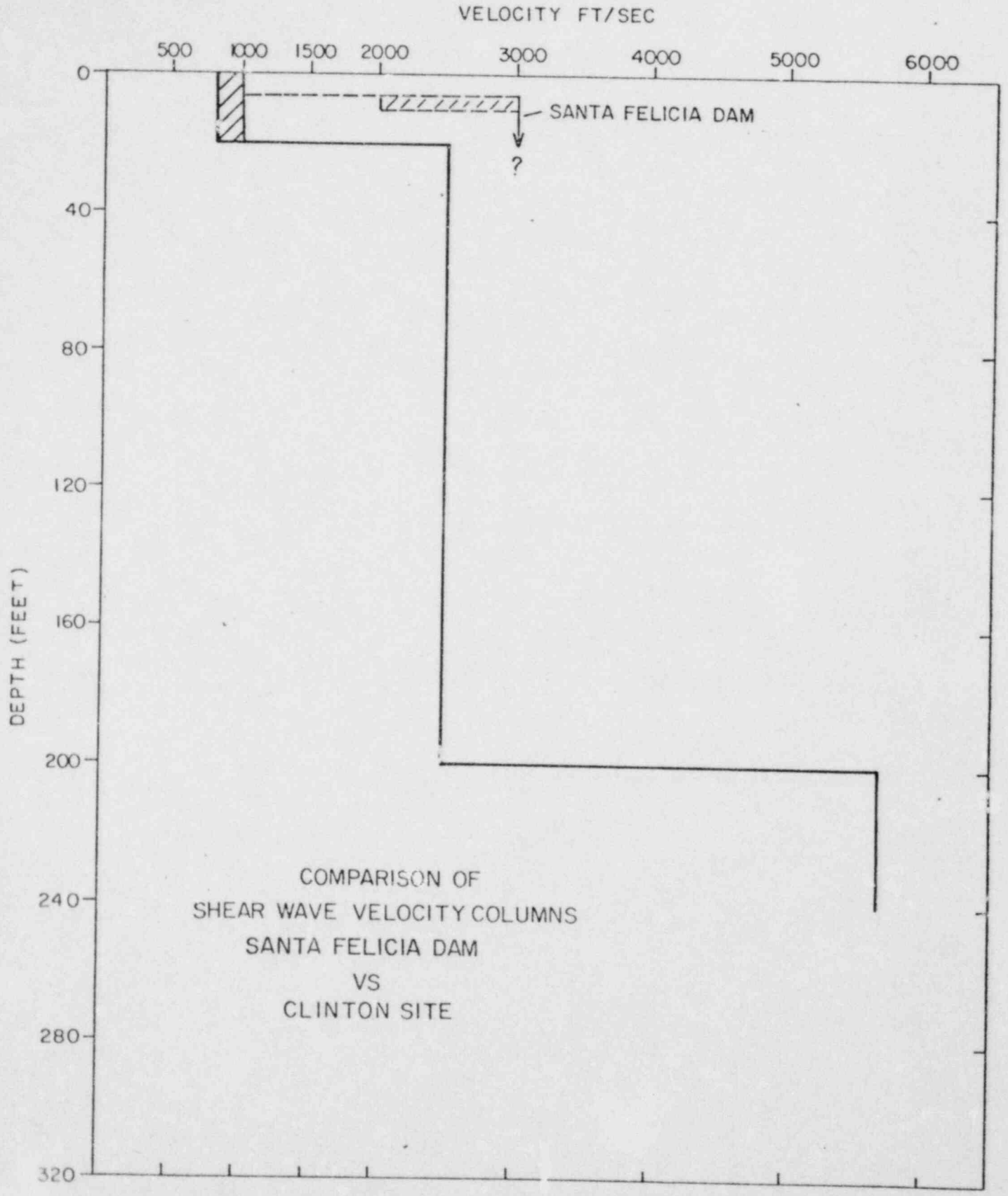
40
80
120
160
200
240
280
320
DEPTH (FEET)
GOLDEN GATE PARK(A)
(SILVERSTEIN,1977)
GOLDEN GATE PARK(B)
(SW-AA,1980)
COMPARISON OF
SHEAR WAVE VELOCITY COLUMNS
GOLDEN GATE PARK
VS
CLINTON SITE


VELOCITY FT/SEC
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1000
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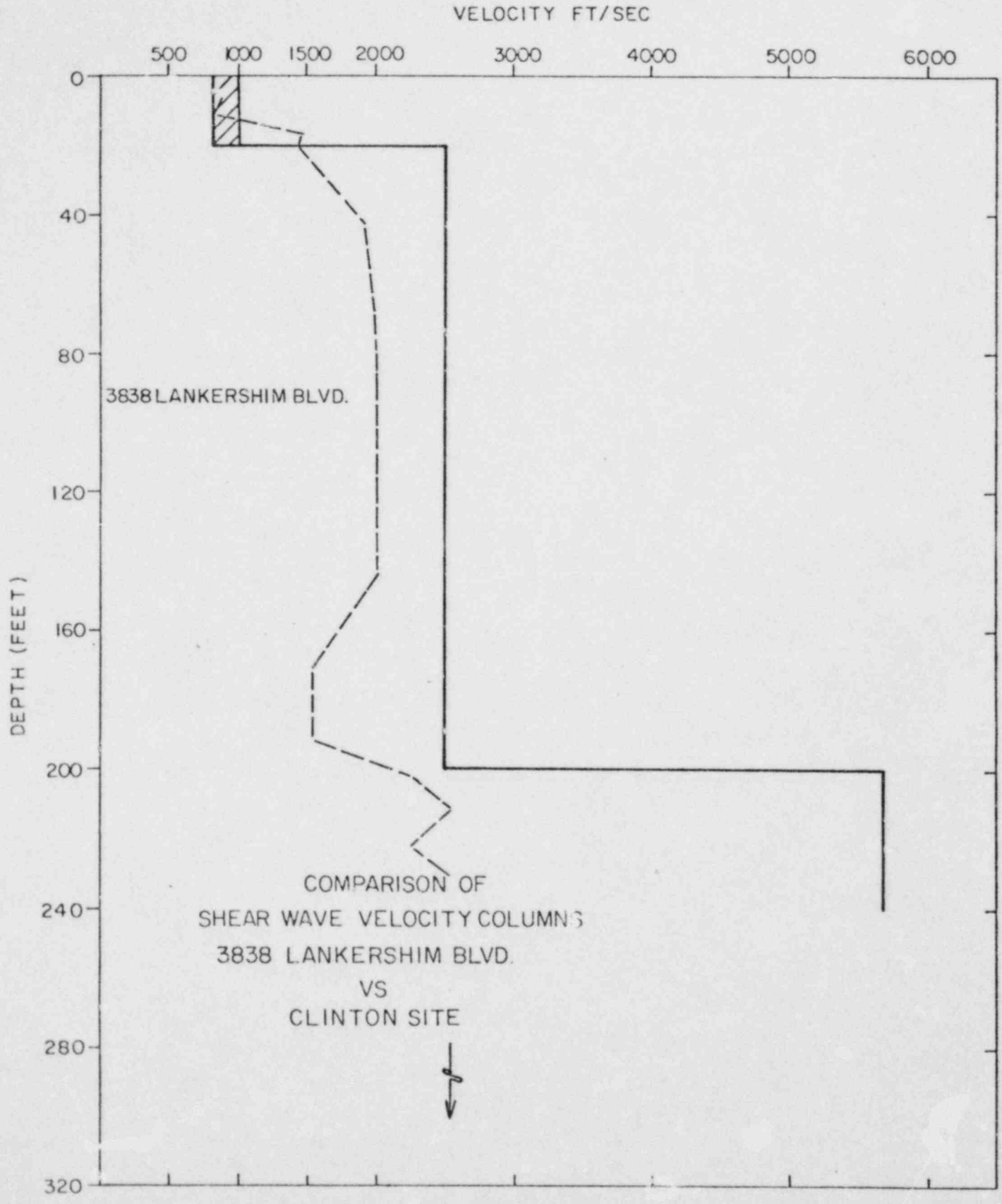
120
160
200
240
280
320
DEPTH (FEET)
SANTA FELICIA DAM
?
COMPARISON OF
SHEAR WAVE VELOCITY COLUMNS
SANTA FELICIA DAM
VS
CLINTON SITE


VELOCITY FT/SEC
500
1000
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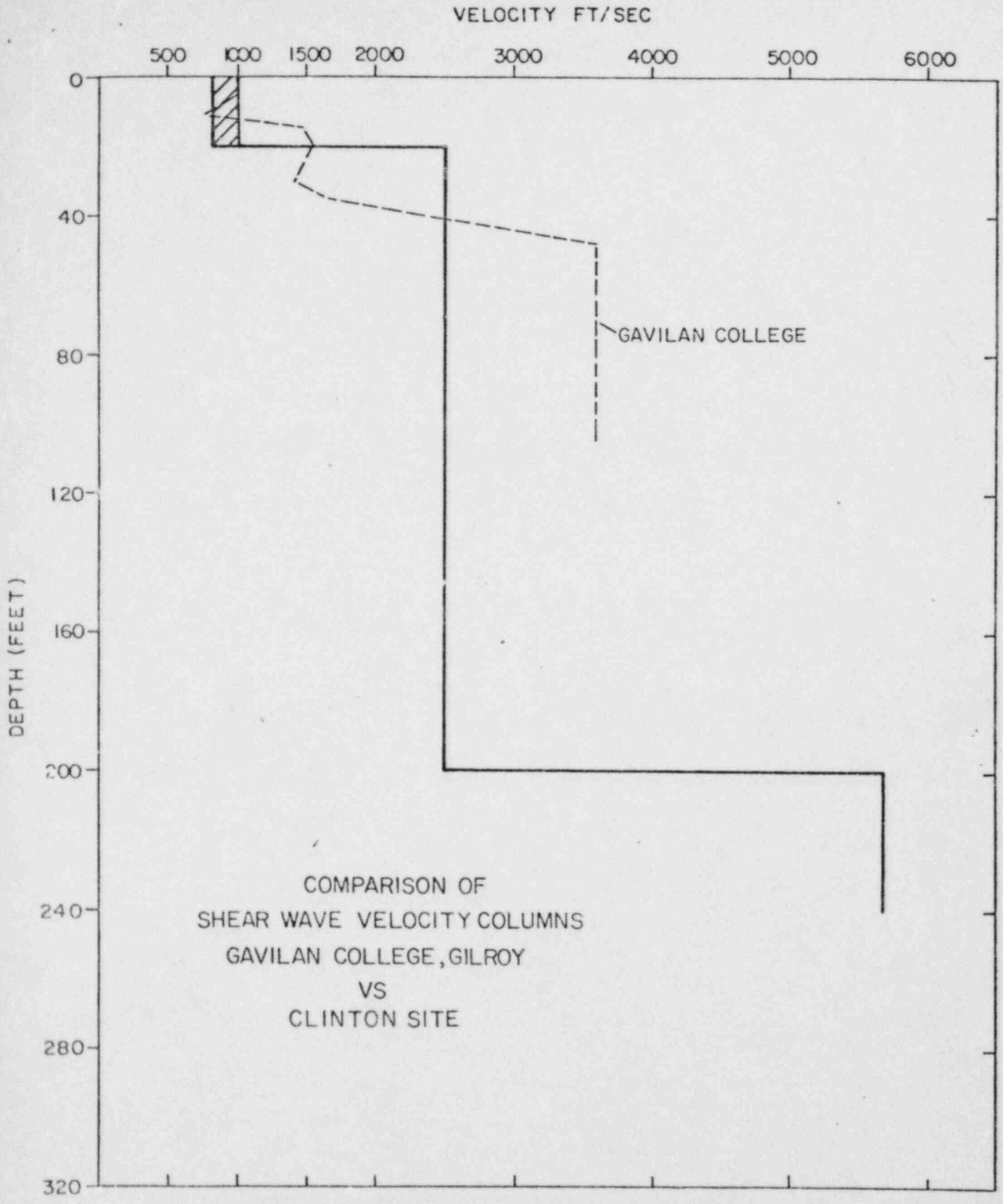
200
240
280
320
DEPTH (FEET)
3838 LANKERSHIM BLVD.
COMPARISON OF
SHEAR WAVE VELOCITY COLUMNS
3838 LANKERSHIM BLVD.
VS
CLINTON SITE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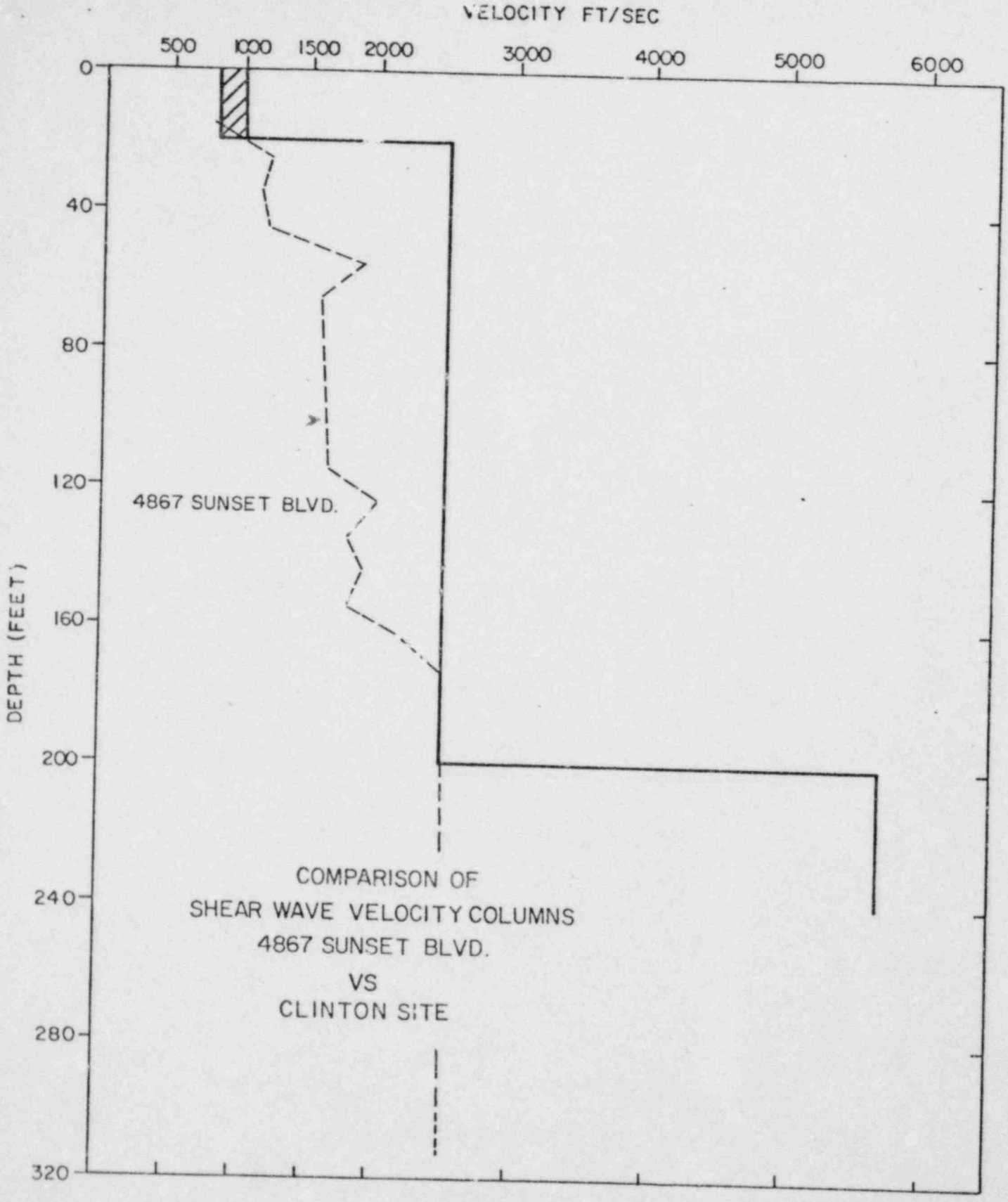
DEPTH (FEET)
GAVILAN COLLEGE
COMPARISON OF
SHEAR WAVE VELOCITY COLUMNS
GAVILAN COLLEGE, GILROY
VS
CLINTON SITE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240
280
320
DEPTH (FEET)
4867 SUNSET BLVD.
COMPARISON OF
SHEAR WAVE VELOCITY COLUMNS
4867 SUNSET BLVD.
VS
CLINTON SITE

TABLE

ACCELEROGRAMS SELECTED FOR CLINTON SITE SPECIFIC SPECTRA

Code+	Date	Time(UT)	m_b	M_L	Depth (km)	I_o	Location	Ref. No.	Epic. Dist. (km)	Hypo. Dist. (km)	Peak Acc. (gals)	Comp.	Station	Other Distance* (km)
A,B,E	MAR 23 1957	19:44:21	5.1	5.3	11.0	VII	San Francisco, CA	A015	11.6	16.1	81.8 102.8	N10°E S80°E	Golden Gate Park	8.0
A,B,C D,E,F,G	JUN 28 1966	04:26:14	5.8	5.6	possible surface rupture	VII	Parkfield, CA	B034	9.3*	9.3*	347.8 425.7	N05°W N85°E	Cholame #5	9.3
A,B,C D,E,F,G	SEP 12 1970	14:30:52	5.2	5.4	9.0	VIII	Lytle Creek	W334	13.4	16.1	139.0 194.0	S25°W	Wrightwood	15.0
A,B,C D,E,F,G	SEP 12 1970	14:30:52	5.2	5.4	9.0	VIII	Lytle Creek	W336	23.8	25.4	55.9 69.4	S36°W	Cedar Springs Pump House	18.0
A,B,C D,E,F,G	SEP 12 1970	14:30:52	5.2	5.4	9.0	VIII	Lytle Creek	W338	22.9	24.6	113.0 57.5	NS EW	San Bernardino Hall of Records	28.0
D,E,F	SEP 12 1970	14:30:52	5.2	5.4	9.0	VIII	Lytle Creek	W339	31.5	32.8	40.2 35.3	NS EW	SCEC Colton	29.0
F,G	FEB 09 1971	14:00:42	6.2	6.4	13.0	XI	San Fernando	L166	30.8	33.4	164.2 147.6	N00°E S90°W	3838 Lankershim Blvd. (LA)	16.5
F	FEB 09 1971	14:00:42	6.2	6.4	13.0	XI	San Fernando	E081	32.9	35.4	213.0 198.3	S08°E S82°W	Santa Felicia Dam	29.0
F,G	FEB 09 1971	14:00:42	6.2	6.4	13.0	XI	San Fernando	P214	36.2	38.5	154.0 156.0	S89°W S01°E	4867 Sunset Blvd. (LA)	22.5
F,G	FEB 09 1971	14:00:42	6.2	6.4	13.0	XI	San Fernando	R246	35.7	38.0	115.0 106.0	NS EW	6464 Sunset Blvd. (LA)	22.5
F,G	FEB 09 1971	14:00:42	6.2	6.4	13.0	XI	San Fernando	R248	35.7	38.0	184.0 174.0	NS EW	6430 Sunset Blvd. (LA)	22.5

TABLE__ (Continued)
ACCELEROGRAMS SELECTED FOR CLINTON SITE SPECIFIC SPECTRA

Code+	Date	Time(UT)	m_b	M_L	Depth (km)	I_o	Location	Ref. No.	Epic. Dist. (km)	Hypo. Dist. (km)	Peak Acc. (gals)	Comp.	Station	Other Distance* (km)
A,B D,E	NOV 28 1974	23:01:25	5.0	5.2	9.0	VI	Gilroy, CA	GN74	9.0	12.7	134.7 94.1	S67°W S23°E	Gavilan College	10.8
A,B,C D,E,F,G	MAY 09 1976	00:53:45	5.0	5.5	1.0	IX	Friuli, Italy	I051	25.2	25.2	38.6 35.6	NS EW	Forgaria	-
A,B D,E	MAY 11 1	2:44:00	4.9	5.3	19.0	VIII	Friuli, Italy	I059	9.7	21.3	206.8 178.7	NS EW	Forgaria	-
A,B D,E	MAY 11 1976	22:44:00	4.9	5.3	19.0	VIII	Friuli, Italy	I061	11.7	22.3	31.0 61.0	NS EW	Tarcento	-
A,B,C D,E,F,G	SEP 11 1976	16:31:12	5.0	5.5	9.0	VIII-IX	Friuli, Italy	I131	15.8	18.2	93.0 102.3	NS EW	Forgaria	-
A,B,C D,E,F,G	SEP 11 1976	16:31:00	5.0	5.5	9.0	VII-IX	Friuli, Italy	I133	7.5	11.7	158.0 79.1	NS EW	Tarcento	-
A,B,C D,E,F,G	SEP 11 1976	16:35:00	5.3	5.9	6.0	XI	Friuli, Italy	I138	14.0	15.2	119.7 220.0	NS EW	Forgaria	-
A,B,C E,F,G	SEP 15 1976	03:15:18	5.7	6.1	9.0	VIII-IX	Friuli, Italy	I152	9.0	12.8	257.9 213.8	NS EW	Forgaria	-
D	SEP 15 1976	04:38:53	4.8	5.0	21.5	VII	Friuli, Italy	I157	13.6	25.4	54.4 49.6	NS EW	Forgaria	-

TABLE (Continued)
ACCELEROGRAMS SELECTED FOR CLINTON SITE SPECIFIC SPECTRA

Code+	Date	Time(UT)	m_b	M_L	Depth (km)	I_o	Location	Ref. No.	Epic. Dist. (km)	Hypo. Dist. (km)	Peak Acc. (gals)	Comp.	Station	Other Distance* (km)
B,C E,F,G	SEP 15 1976	09:21:18	5.4	6.0	11.7	IX	Friuli, Italy	I168	20.0	23.2	346.2 329.5	NS EW	Forgaria	-
B,C E,F,G	SEP 15 1976	09:21:18	5.4	6.0	11.7	IX	Friuli, Italy	I172	19.0	22.3	128.8 103.7	NS EW	Tarcento	-

+Dataset Code is as follows:
A - M_L=4.9 to 5.9, Distance restricted to 25 km and less.
B - M_L=5.1 to 6.1, Distance restricted to 25 km and less.
C - M_L=5.4 to 6.4, Distance restricted to 25 km and less.
D - M_L=4.9 to 5.9, Maximum distance = 36.2 km.
E - M_L=5.1 to 6.1, Maximum distance = 36.2 km.
F - M_L=5.4 to 6.4, Maximum distance = 36.2 km.
G - M_L=5.4 to 6.4, Maximum distance = 25 km when closest approach distances used for San Fernando Records.

* Other distances quoted are those computed by taking the closest approach of the station to the generative fault or the closest approach of the station to the surface projection of the generative fault. Calculations are from various authors tabulated in the Lawrence Livermore Laboratory, September, 1980, compilation of strong motion data (see references).

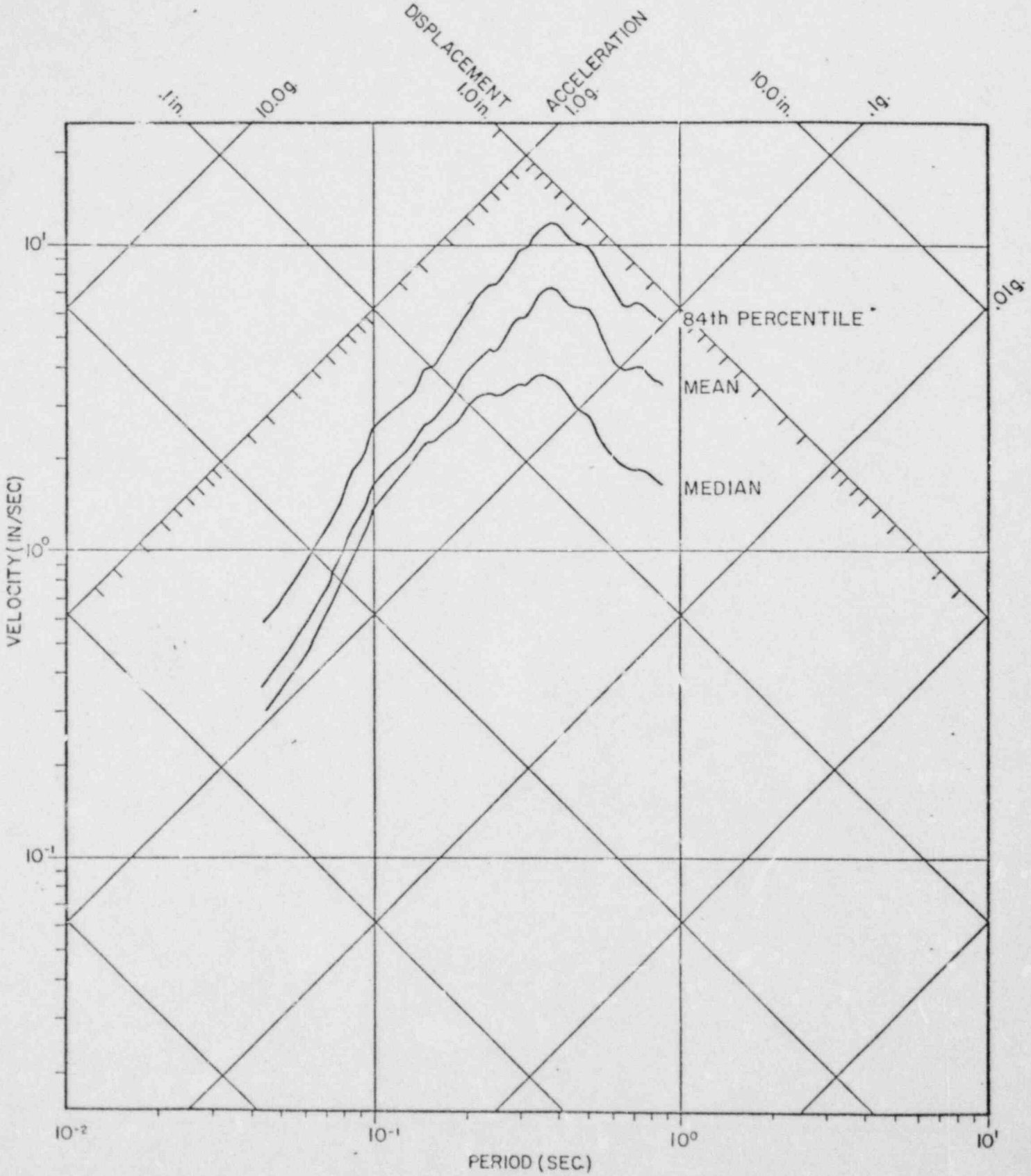
TABLE ___

PARAMETERS OF RESPONSE SPECTRA DATASETS

Run Id	Description of Run	M_L Range	Average M_L	Average Epic. Distance (Km)	Median Peak Acc. (cm/sec^2)	Mean Peak Acc. (cm/sec^2)	Peak Acc. 84th Percentile (cm/sec^2)	No. of Components	No. of Stations	No. of Earthquakes
A	Distance ≤ 25 km Parkfield included	4.9-5.9	5.41	14.4	100.9	128.3	201.8	2[illegible]	8	9
A'	Distance ≤ 25 km Parkfield excluded	4.9-5.9	5.39	14.9	90.2	107.6	163.4	24	7	8
B	Distance ≤ 25 km Parkfield included	5.1-6.1	5.56	14.8	121.2	154.6	243.5	30	8	10
B'	Distance ≤ 25 km Parkfield excluded	5.1-6.1	5.56	15.2	111.6	137.4	212.7	28	7	9
C	Distance ≤ 25 km Parkfield included	5.4-6.4	5.66	16.4	129.6	166.3	262.6	22	6	7
C'	Distance ≤ 25 km Parkfield excluded	5.4-6.4	5.67	17.1	116.2	142.9	221.0	20	5	6
D	Distance ≤ 36.2 km Parkfield included	4.9-5.9	5.41	15.7	94.0	121.5	192.3	28	9	9
D'	Distance ≤ 36.2 km Parkfield excluded	4.9-5.9	5.39	16.2	84.35	102.1	156.4	26	8	8
E	Distance ≤ 36.2 km Parkfield included	5.1-6.1	5.55	15.9	112.7	147.5	234.6	3[illegible]	9	10
E'	Distance ≤ 36.2 km Parkfield excluded	5.1-6.1	5.55	16.3	103.8	130.9	205.1	30	8	9

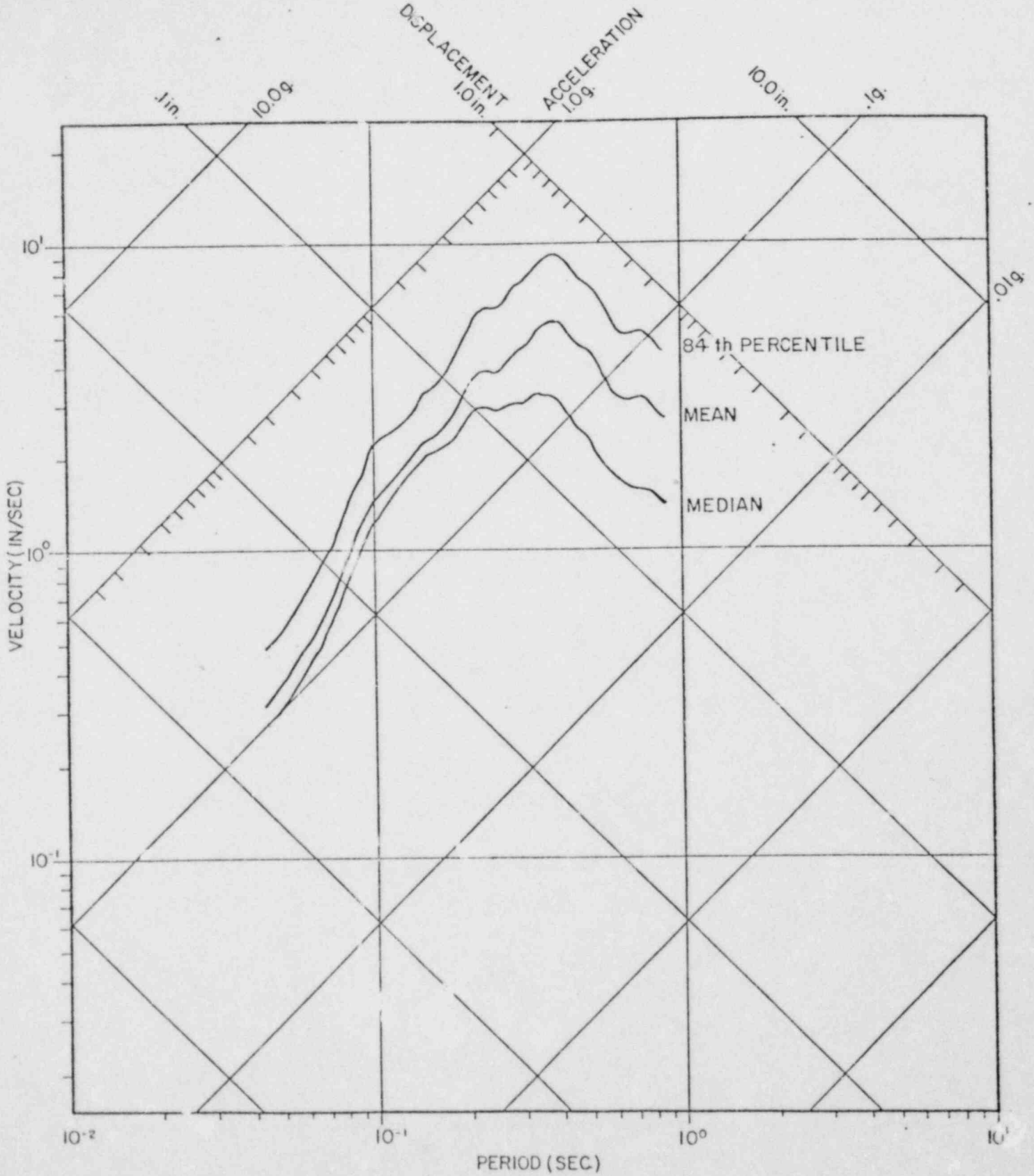
TABLE ___

Run Id	Description of Run	M_L Range	Average M_L	Average Epic. Distance (Km)	Median Peak Acc. (cm/sec^2)	Mean Peak Acc. (cm/sec^2)	Peak Acc. 84th Percentile (cm/sec^2)	No. of Components	No. of Stations	No. of Earthquakes
F	Distance $\leq$ 36.2 km Parkfield included	5.4-6.4	5.86	22.5	127.7	158.7	247.0	34	12	8
F'	Distance $\leq$ 36.2 km Parkfield excluded	5.4-6.4	5.88	23.3	119.2	144.1	220.6	32	11	7
G	Closest approach Distance $\leq$ 25 km for San Fernando records Parkfield included	5.4-6.4	5.86	17.6	134.2	161.8	247.4	30	10	8
G'	Closest approach Distance $\leq$ 25 km for San Fernando records Parkfield excluded	5.4-6.4	5.88	18.2	124.5	145.5	217.8	28	9	7



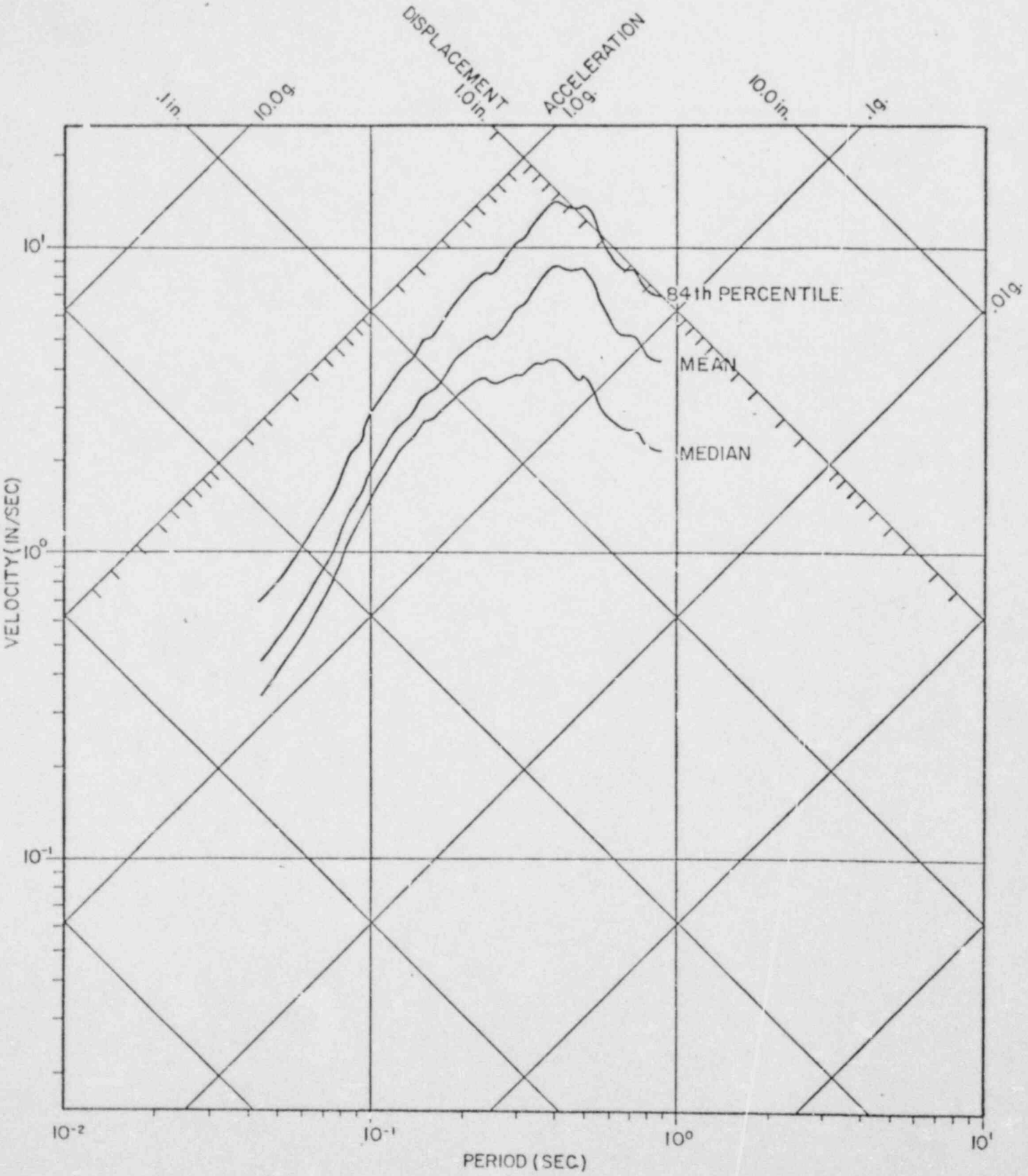
SITE SPECIFIC RESPONSE SPECTRA FOR CLINTON POWER PLANT
MEDIAN, MEAN AND 84TH PERCENTILE

(A - M_L=4.9 to 5.9, Distance Restricted to
25 km and less.)



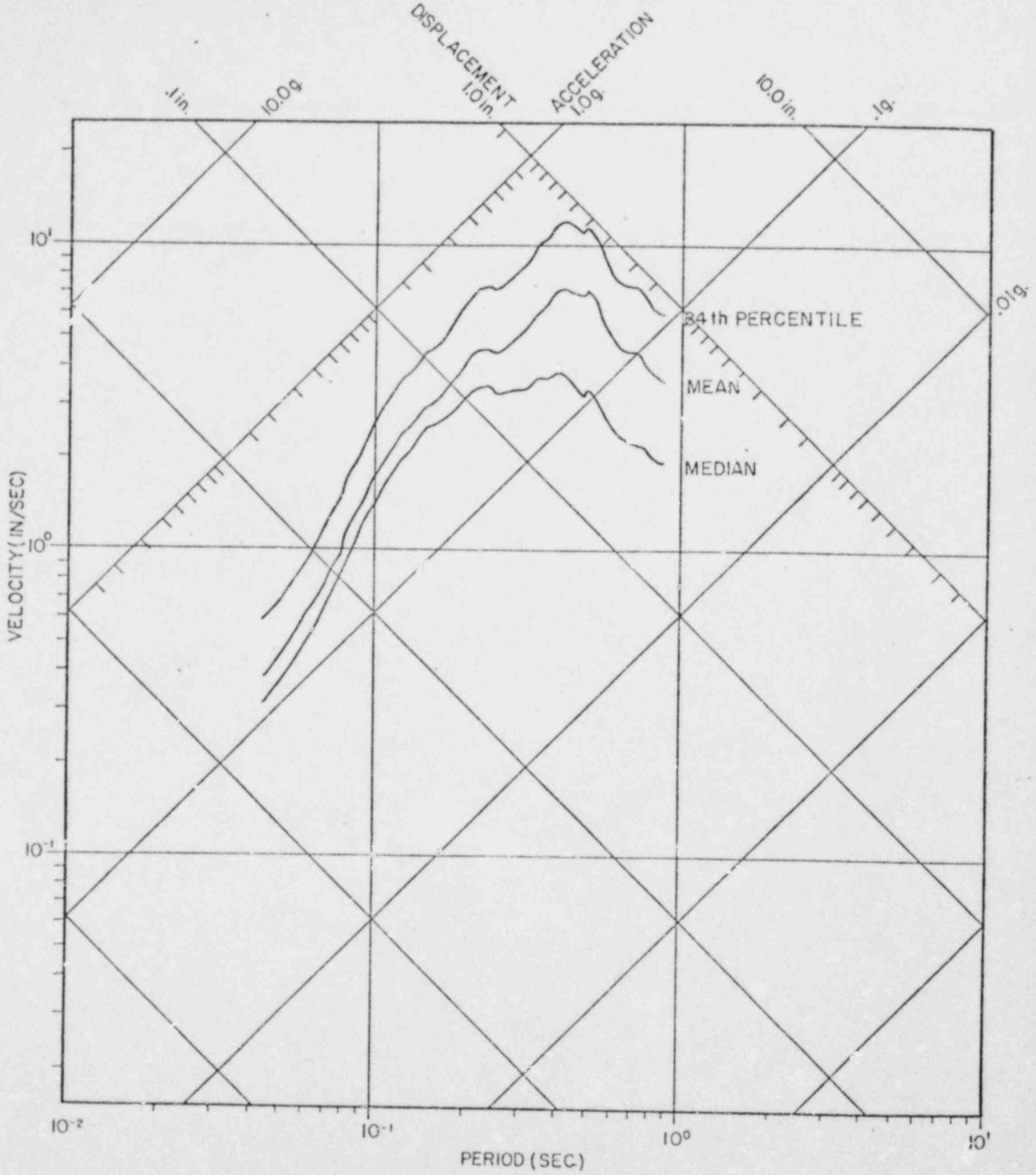
SITE SPECIFIC RESPONSE SPECTRA FOR CLINTON POWER PLANT
MEDIAN, MEAN AND 84TH PERCENTILE

(A' - M_L=4.9 to 5.9, Distance Restricted to
25 km and less. Parkfield Excluded)



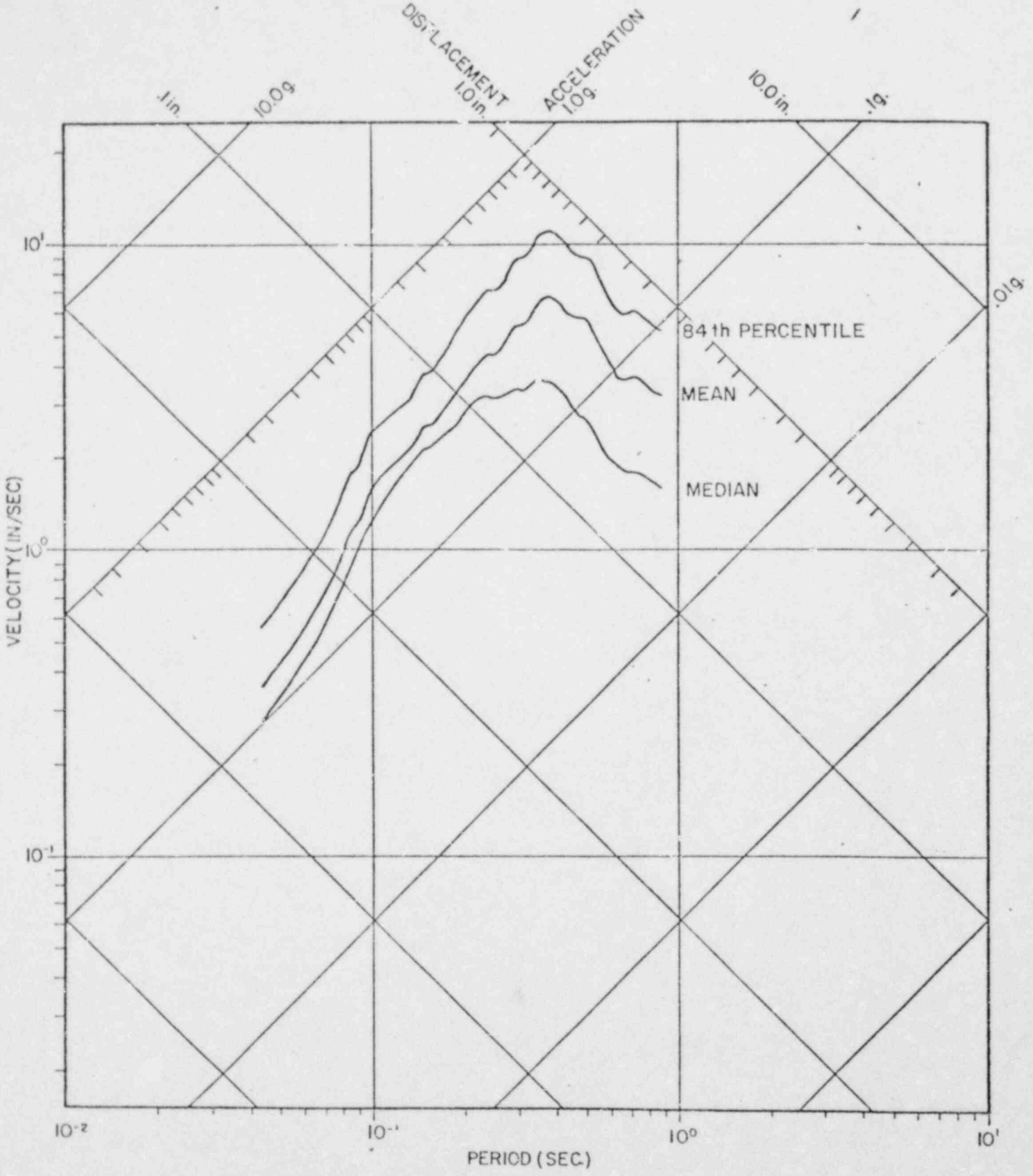
SITE SPECIFIC RESPONSE SPECTRA FOR CLINTON POWER PLANT
MEDIAN, MEAN AND 84TH PERCENTILE

(B - M_L=5.1 to 6.1, Distance Restricted to
25 km and less.)



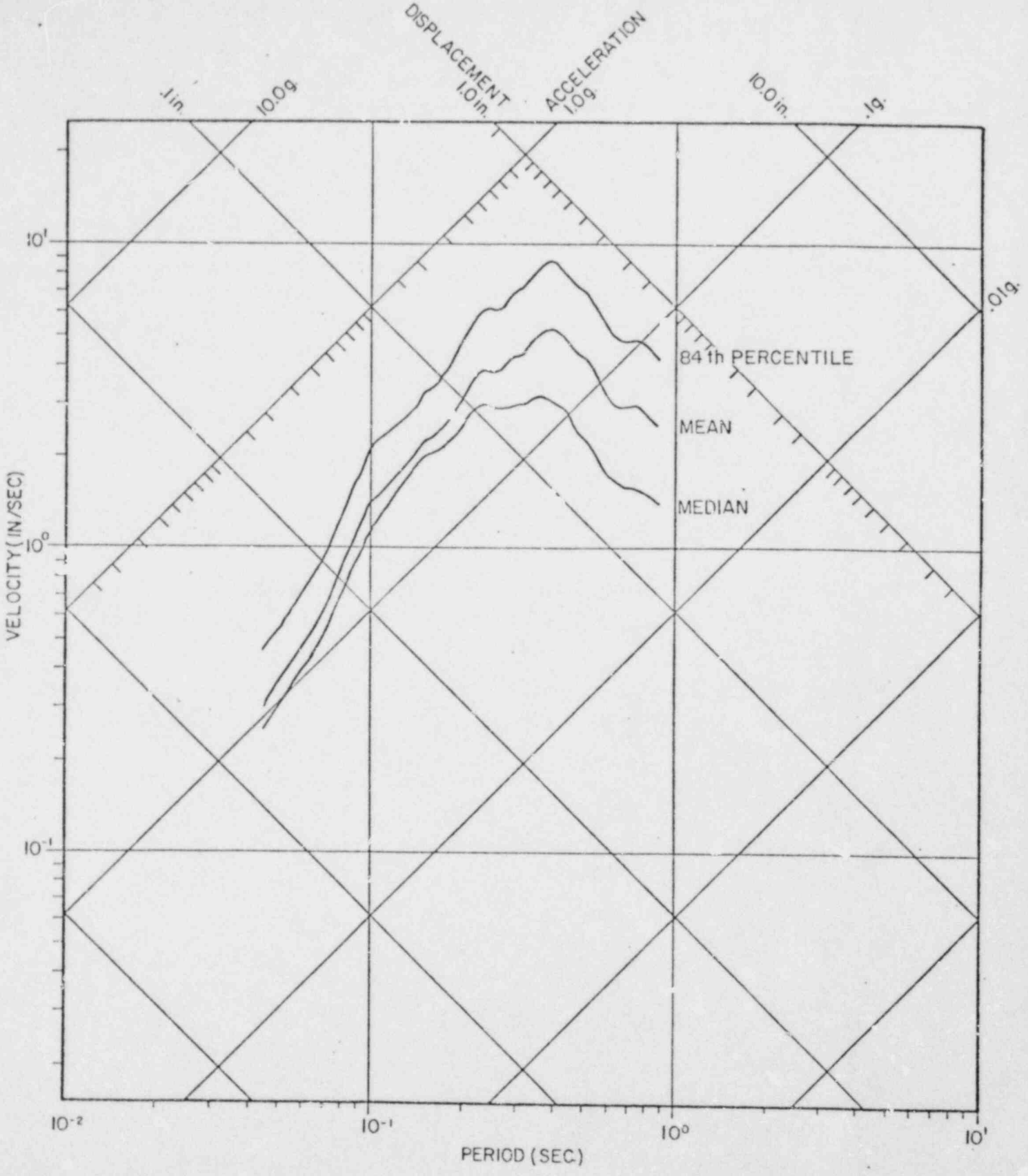
SITE SPECIFIC RESPONSE SPECTRA FOR CLINTON POWER PLANT
MEDIAN, MEAN AND 84TH PERCENTILE

(B' - M_L=5.1 to 6.1, Distance Restricted to
25 km and less. Parkfield Excluded)



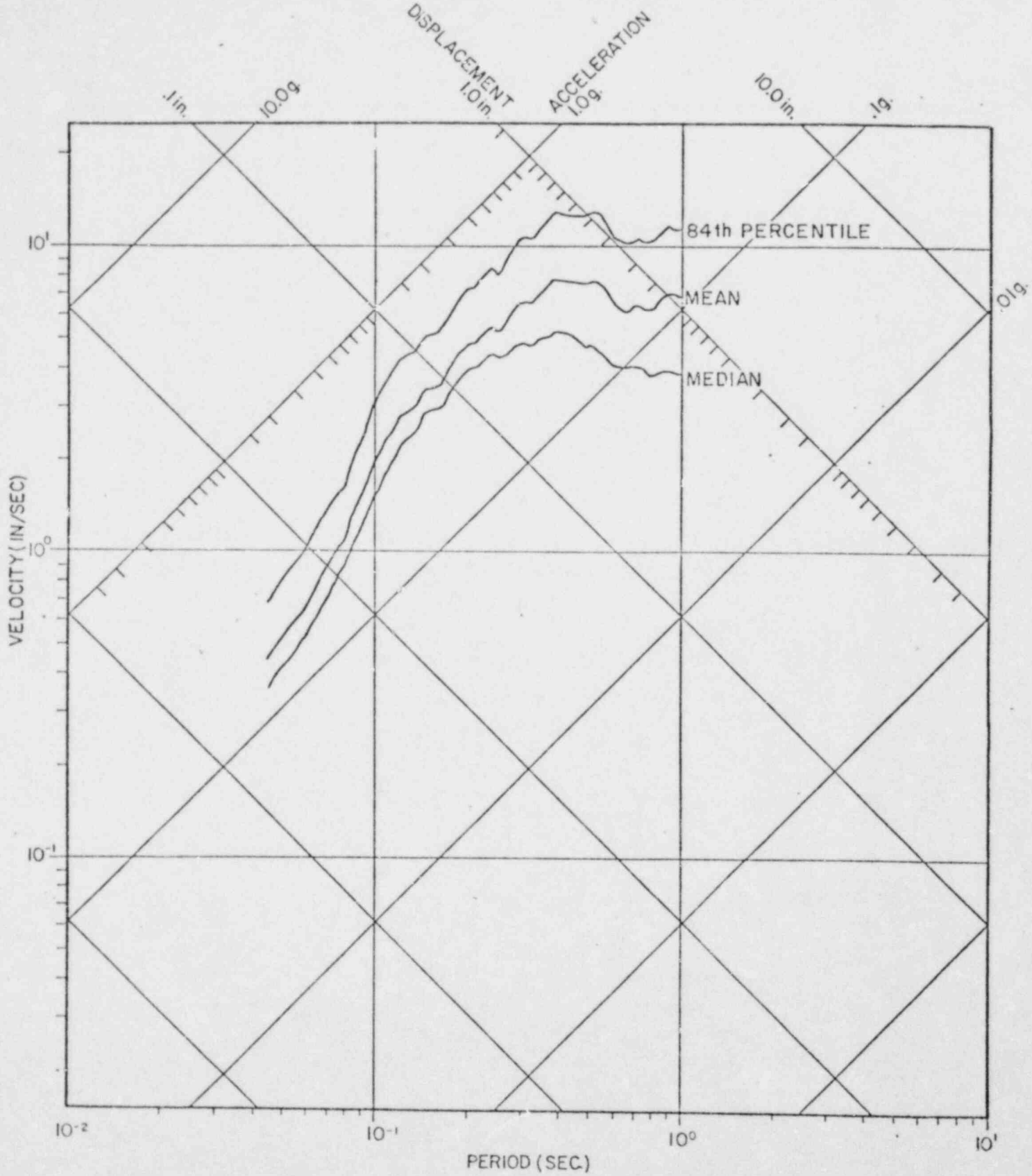
SITE SPECIFIC RESPONSE SPECTRA FOR CLINTON POWER PLANT
MEDIAN, MEAN AND 84TH PERCENTILE

(D - M_L=4.9 to 5.9, Maximum Distance = 36.2 km.)



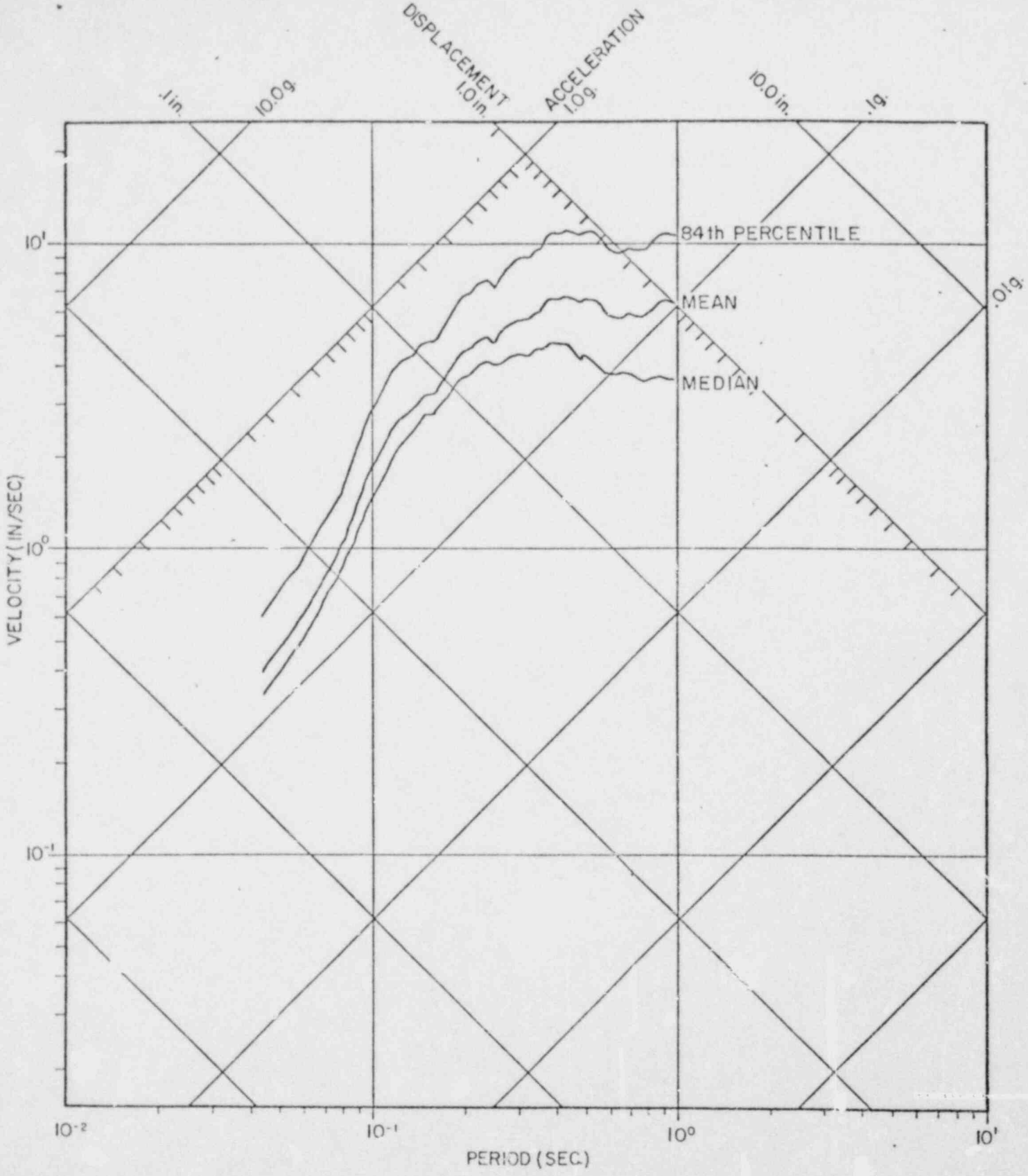
SITE SPECIFIC RESPONSE SPECTRA FOR CLINTON POWER PLANT
MEDIAN, MEAN AND 84TH PERCENTILE

(D' - M_L=4.9 to 5.9, Maximum Distance = 36.2 km.
Parkfield Excluded)



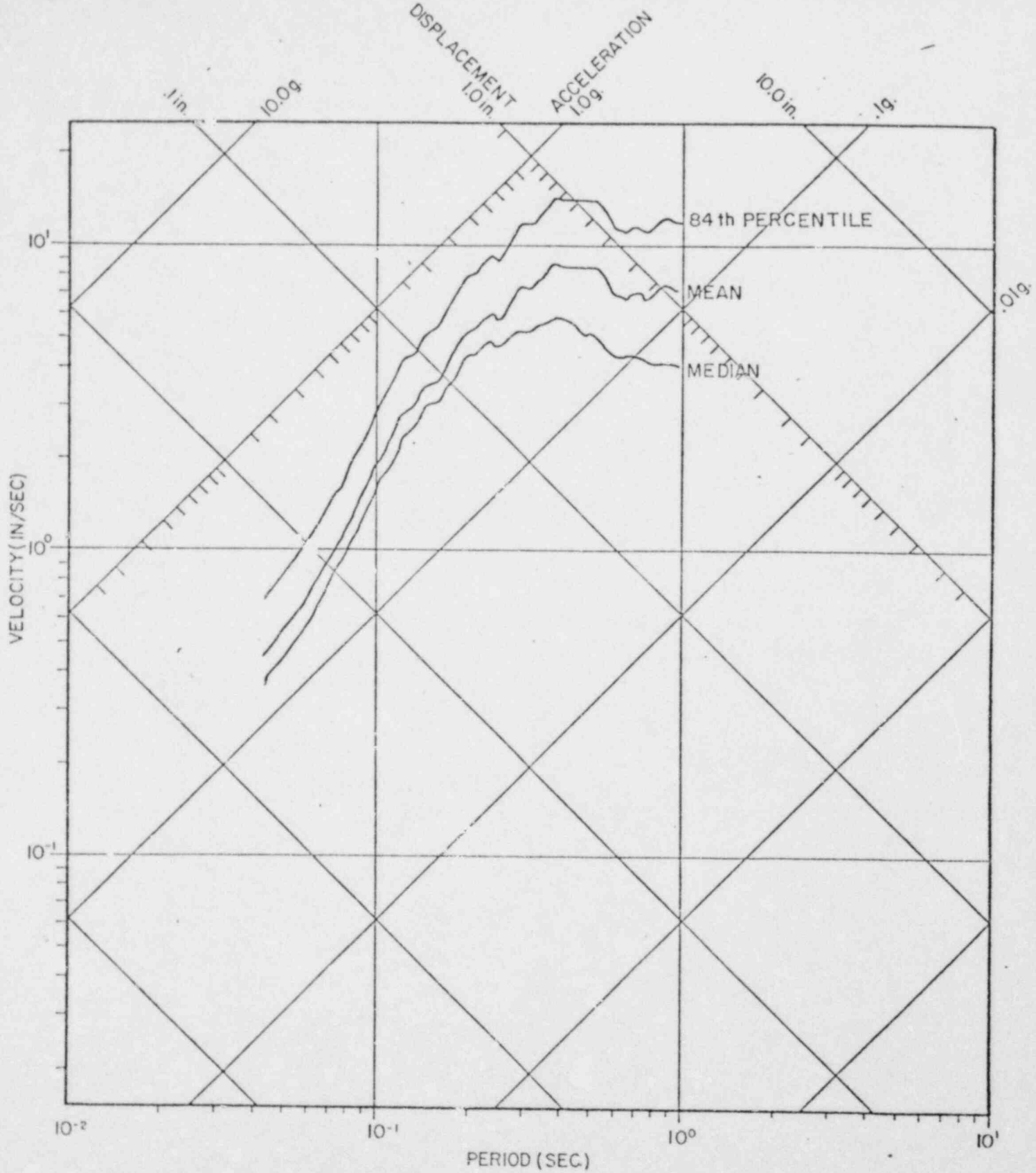
SITE SPECIFIC RESPONSE SPECTRA FOR CLINTON POWER PLANT
MEDIAN, MEAN AND 84TH PERCENTILE

(F - M_L=5.4 to 6.4, Maximum Distance = 36.2 km.)



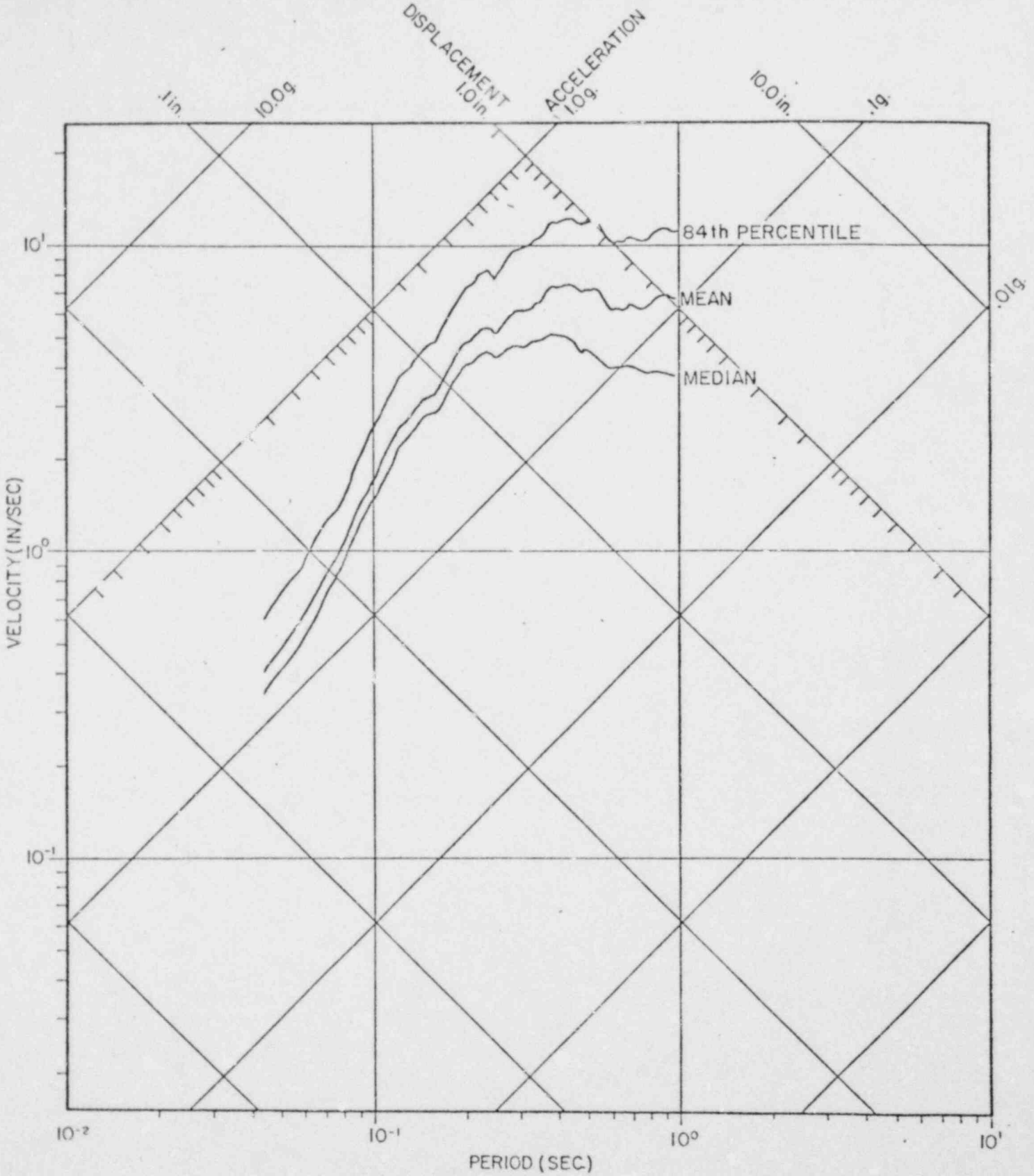
SITE SPECIFIC RESPONSE SPECTRA FOR CLINTON POWER PLANT
MEDIAN, MEAN AND 84TH PERCENTILE

(F' - M_L=5.4 to 6.4, Maximum Distance = 36.2 km.
Parkfield Excluded)



SITE SPECIFIC RESPONSE SPECTRA FOR CLINTON POWER PLANT
MEDIAN, MEAN AND 84TH PERCENTILE

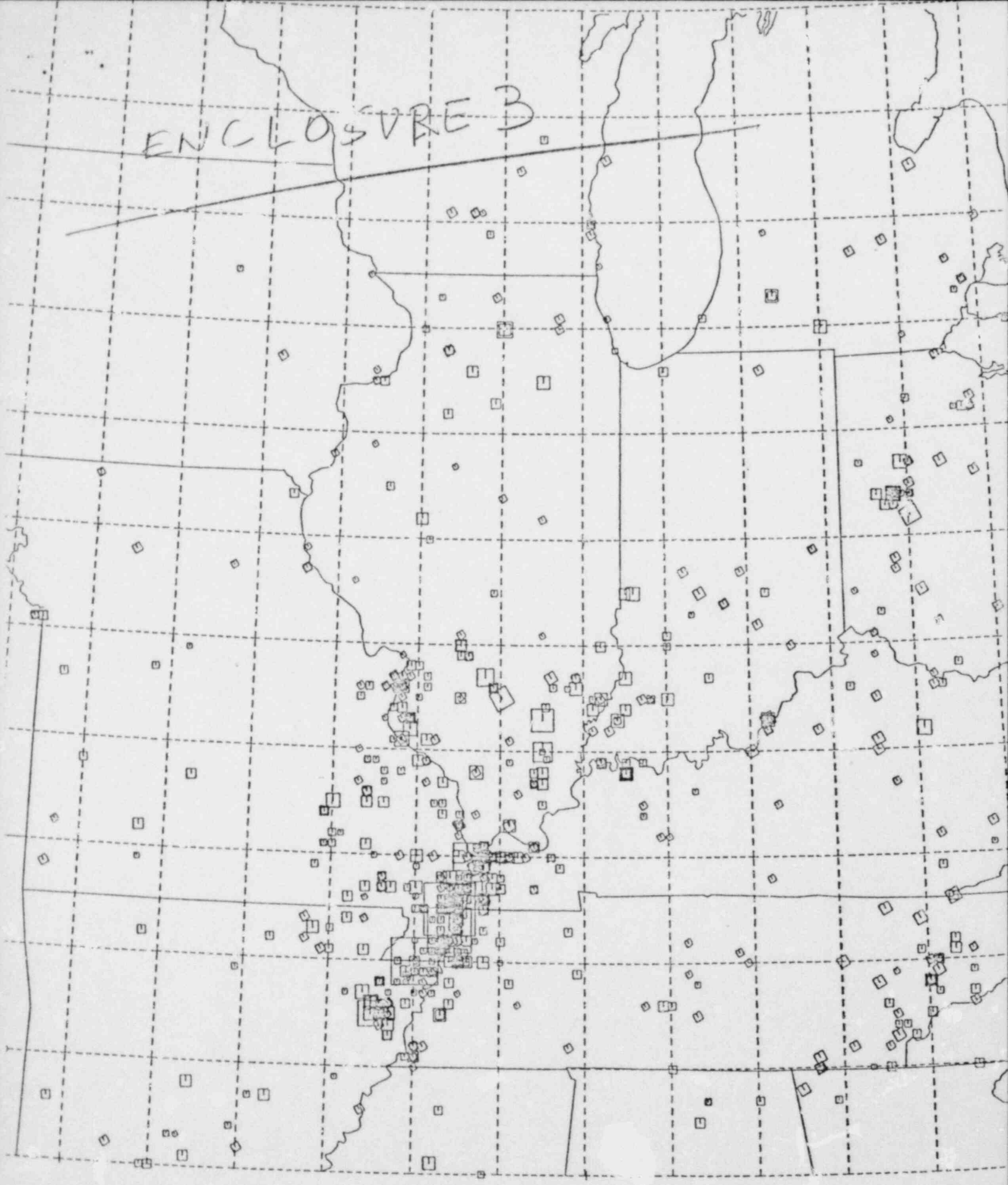
(G - M_L =5.4 to 6.4, Maximum Distance = 25 km
when closest approach distances used for for
San Fernando Records.)



SITE SPECIFIC RESPONSE SPECTRA FOR CLINTON POWER PLANT
MEDIAN, MEAN AND 84TH PERCENTILE

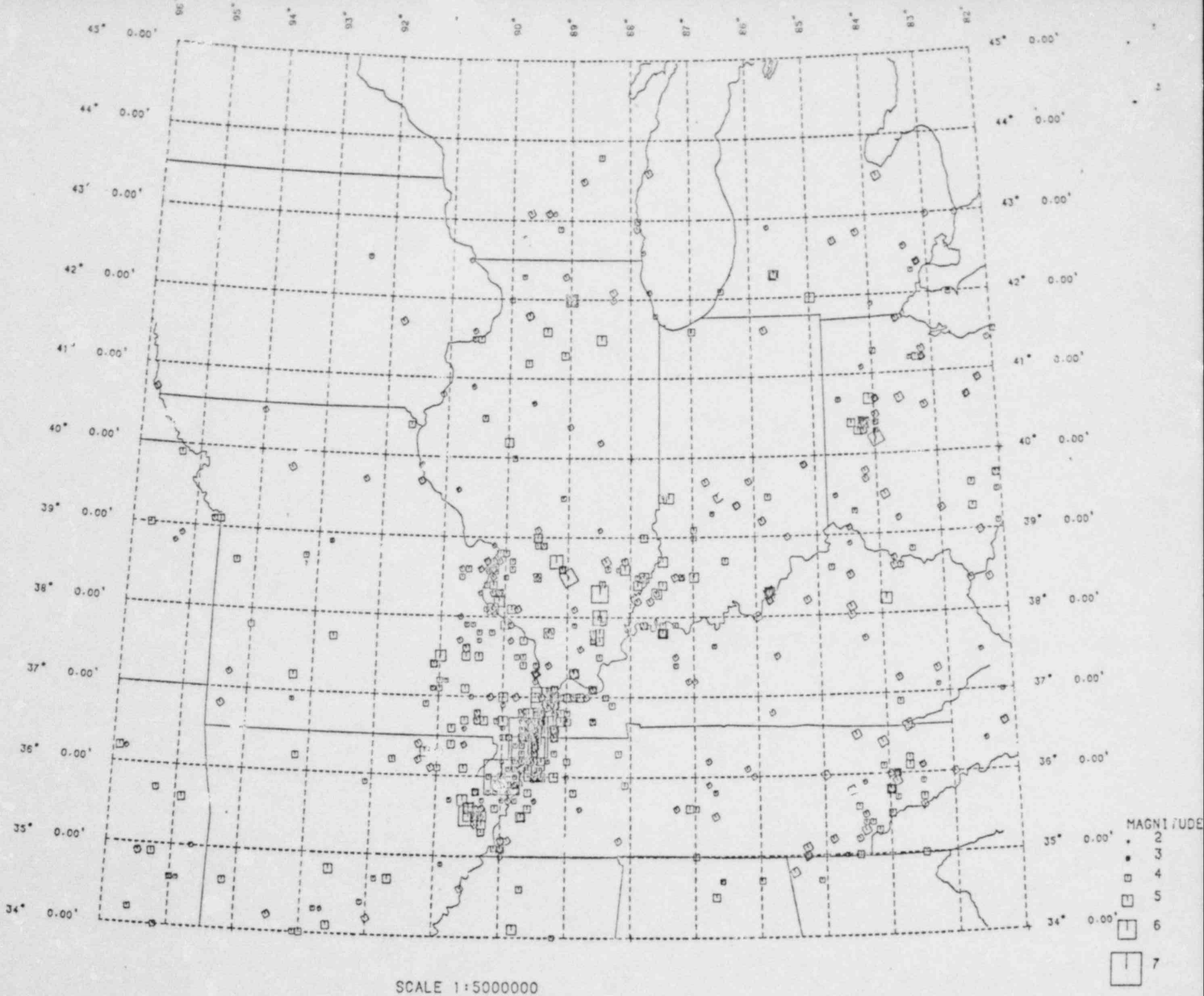
(G' - M_L=5.4 to 6.4, Maximum Distance = 25 km
when closest approach distances used for for
San Fernando Records. Parkfield Excluded)

ENCLOSURE 3



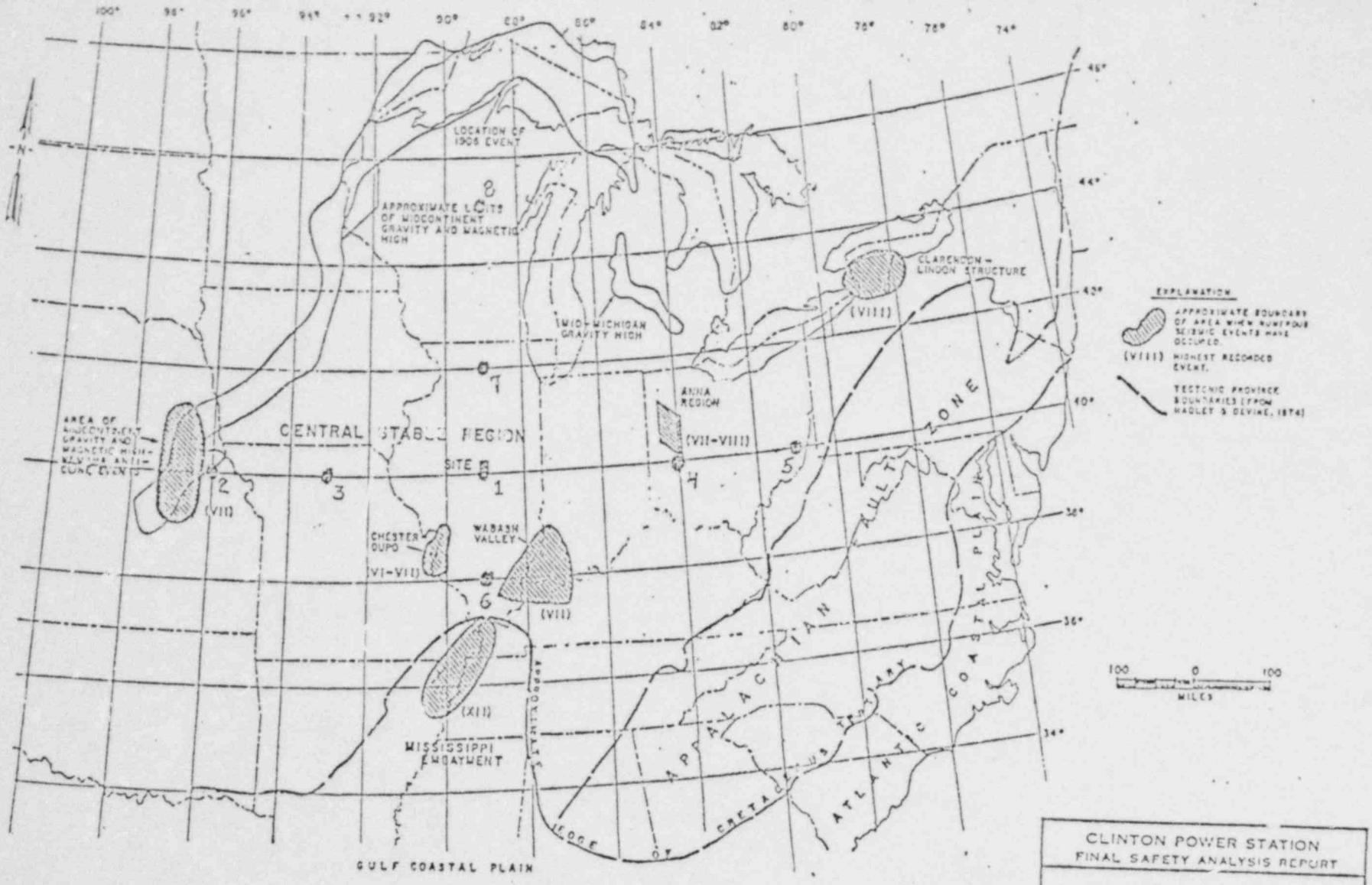
SCALE 1:5000000

0 50 100 150 200 250 300 MILES


MAGNITUDE
2
3
4
5
6
7
SCALE 1:5000000
0 50 100 150 200 250 300 MILES

Proposed Site Locations for
Relative Seismic Hazard Analysis

No.	Lat. N	Long. W	Remarks
1	40.0	89.0	Approx. Clinton Site
2	40.0	96.0	S. E. Nebraska
3	40.0	93.0	N. Missouri
4	40.0	84.0	W. Ohio
5	40.0	81.0	E. Ohio
6	38.0	89.0	S. Illinois
7	42.0	89.0	N. Illinois
8	45.0	89.0	Central Wisconsin

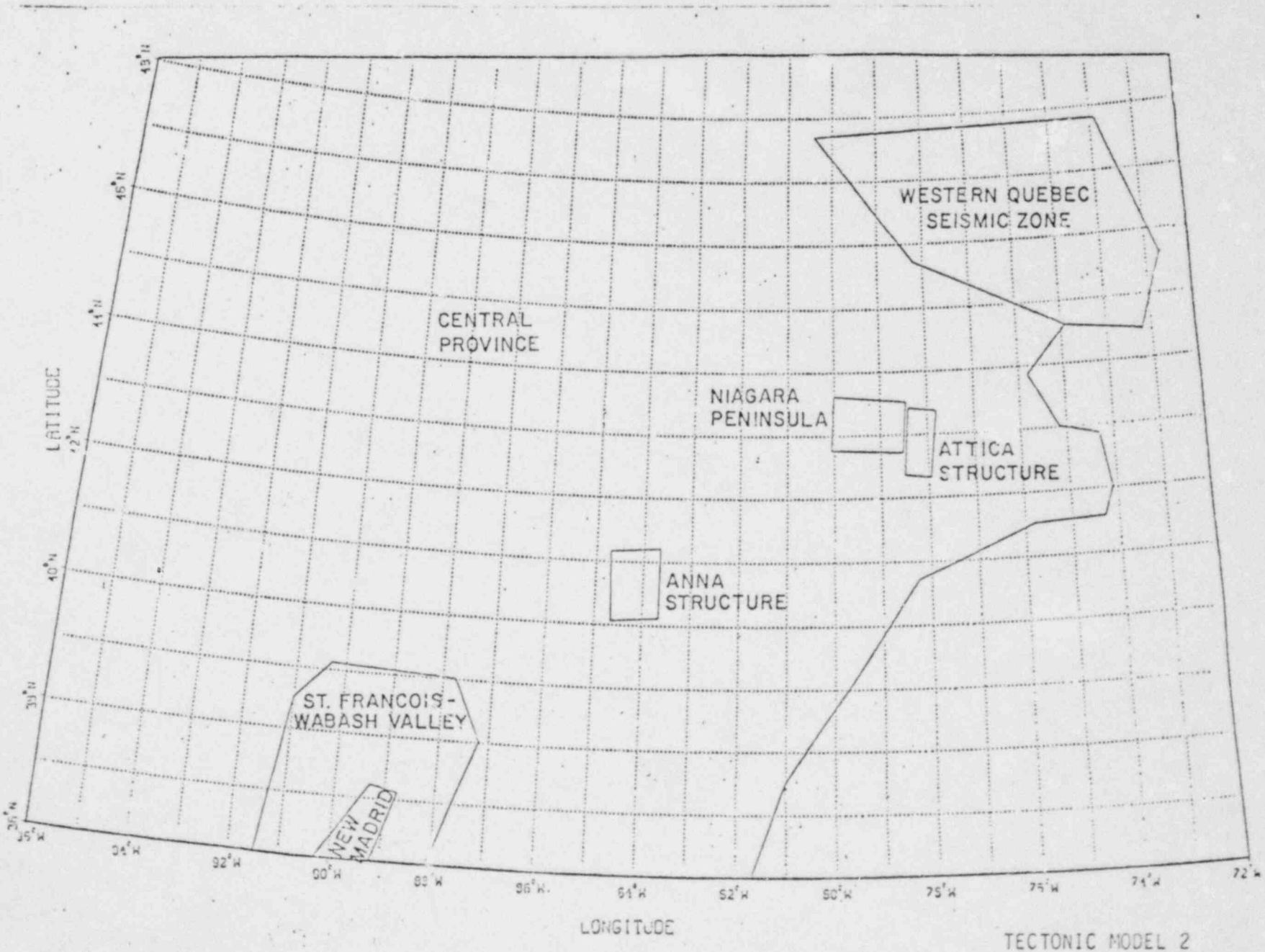


CLINTON POWER STATION
FINAL SAFETY ANALYSIS REPORT

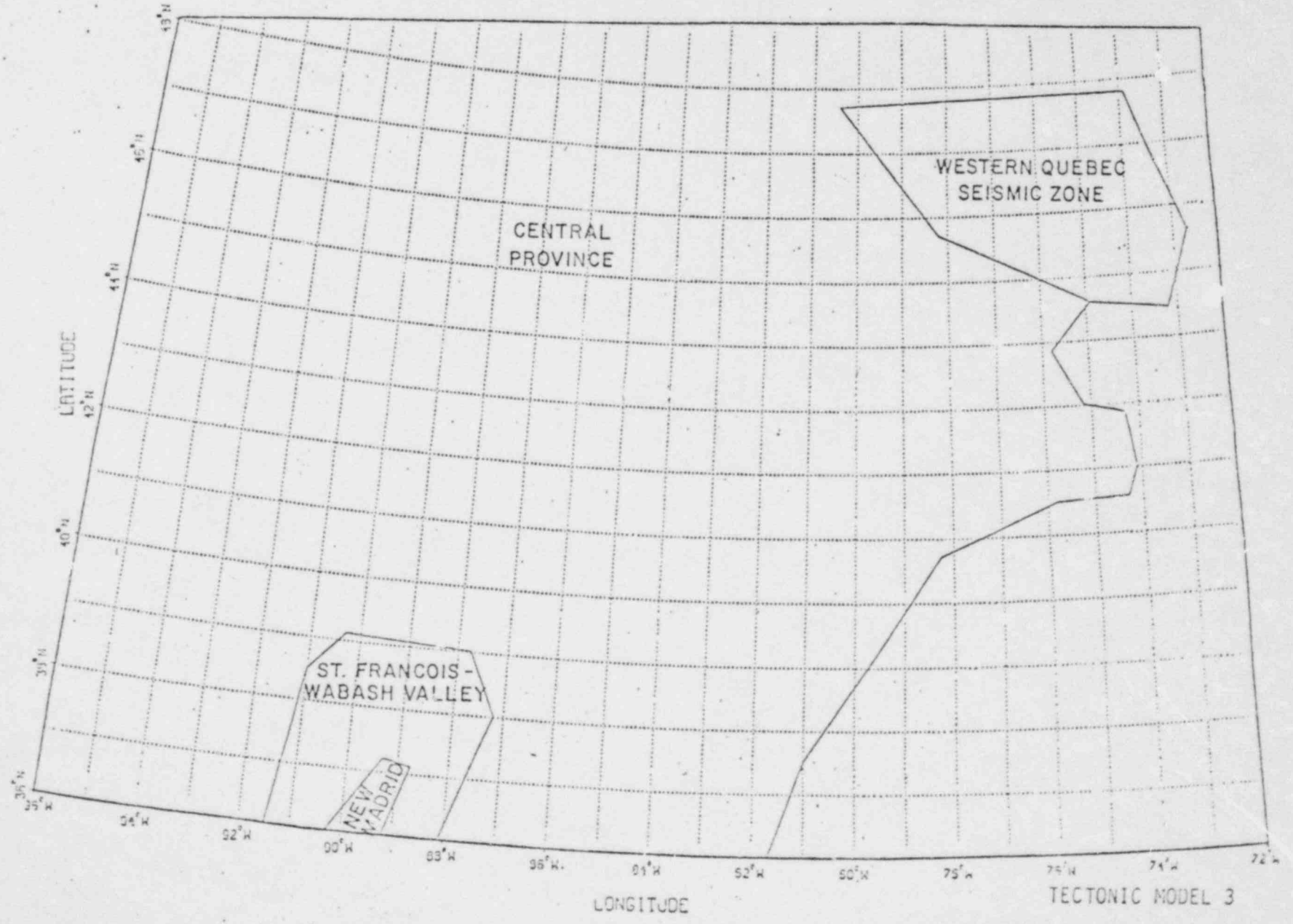
FIGURE 2.5-234

AREAS OF RELATIVELY HIGH SEISMICITY IN CENTRAL UNITED STATES

Proposed Site Locations for
Relative Seismic Hazard Analysis



TECTONIC MODEL 2



TECTONIC MODEL 3

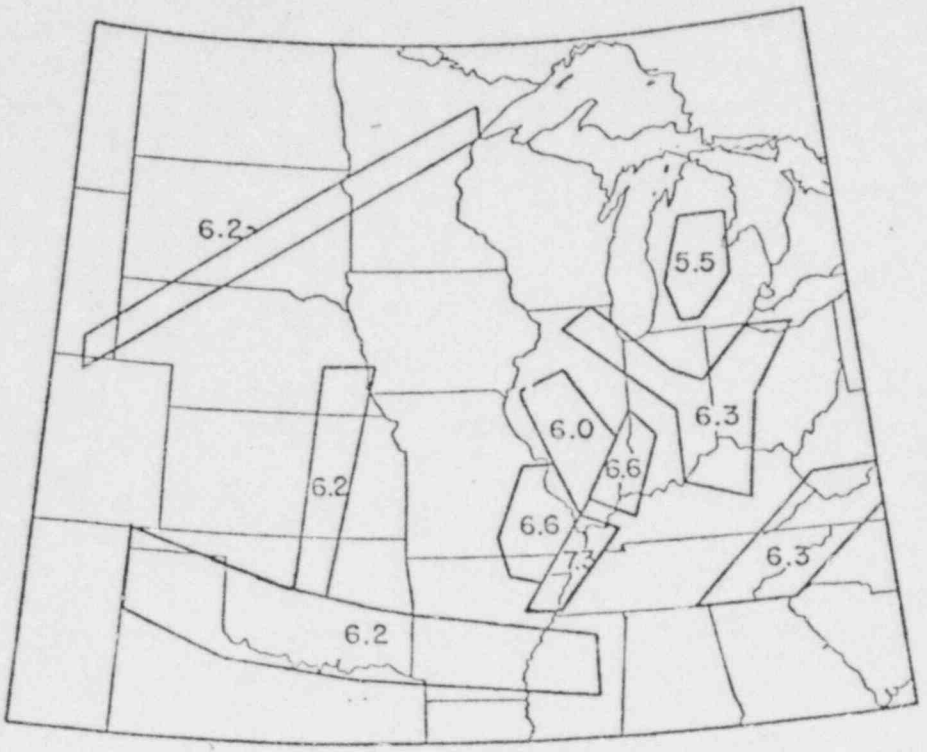
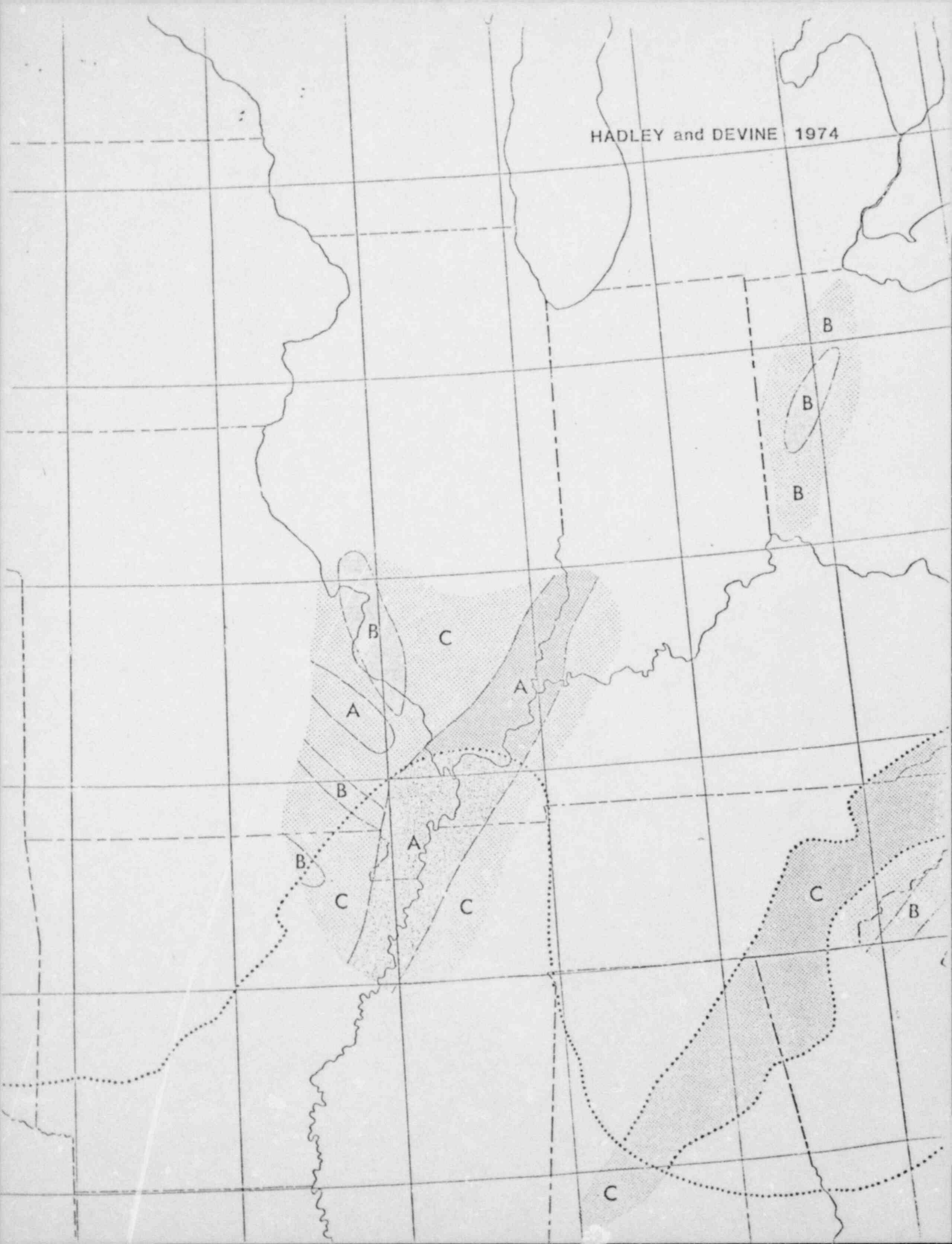


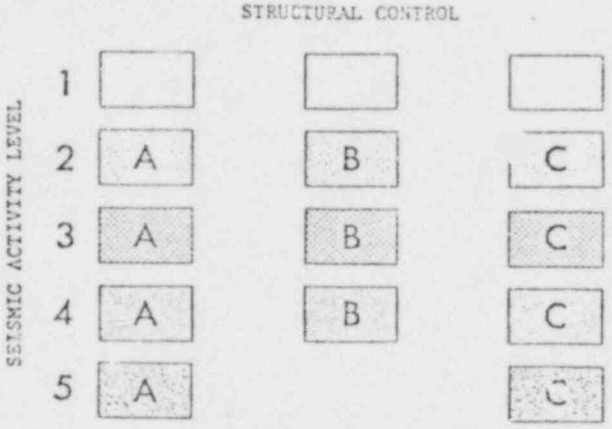
Figure 5. Earthquake Source Zones of the Central United States, after Nuttli and Brill (11), and Body-Wave Magnitudes of Earthquakes with a Recurrence Time of 1000 Years.


HADLEY and DEVINE 1974
B
B
B
B
C
A
A
B
A
B
C
C
C
B
C

EXPLANATION

Tectonic province boundary
Dashed where concealed by younger deposits

Very approximate limits of seismic activity areas and (or) structurally controlled areas



SEISMIC ACTIVITY LEVEL

Level 1

Seismic frequency in epicenters is less than 8 per $10^4 km^2$. Includes large areas in which seismic frequency is 0. All areas of this level are indicated without pattern, because information about historical seismicity is insufficient to make structural analysis possible.

Level 2

Seismic frequency is generally more than 8 but less than 32, and no earthquake in the area has a maximum epicentral intensity greater than MM VI. Used locally for areas of seismic frequency higher than 32 around and between areas whose epicentral pattern indicates structural control

Level 3

Applies generally to areas where seismic frequency is more than 8 but less than 32 and at least one earthquake of epicentral intensity VII or VIII is recorded. Commonly restricted to areas where epicentral distribution or relation to known structure indicates a limiting structural factor. Applies also to some areas where seismic frequency is 32 or more if no epicenters of intensity greater than VI are recorded, notably in central Virginia and the Adirondack-St. Lawrence area

Level 4

Seismic frequency is 32 or more and earthquakes of intensity VII or VIII have been recorded. Locally extended along fault trends into areas of somewhat lower seismic frequency

Level 5

Areas where one or more epicenters of intensity IX or higher are present and seismic frequency is more than 32. Where seismic frequency drops below 32 along structural trends, level 3 applies because both maximum intensity and seismic frequency decrease. No areas exist where the seismic frequency is less than 32 and earthquakes of intensity greater than VIII have been recorded

STRUCTURAL CONTROL

A

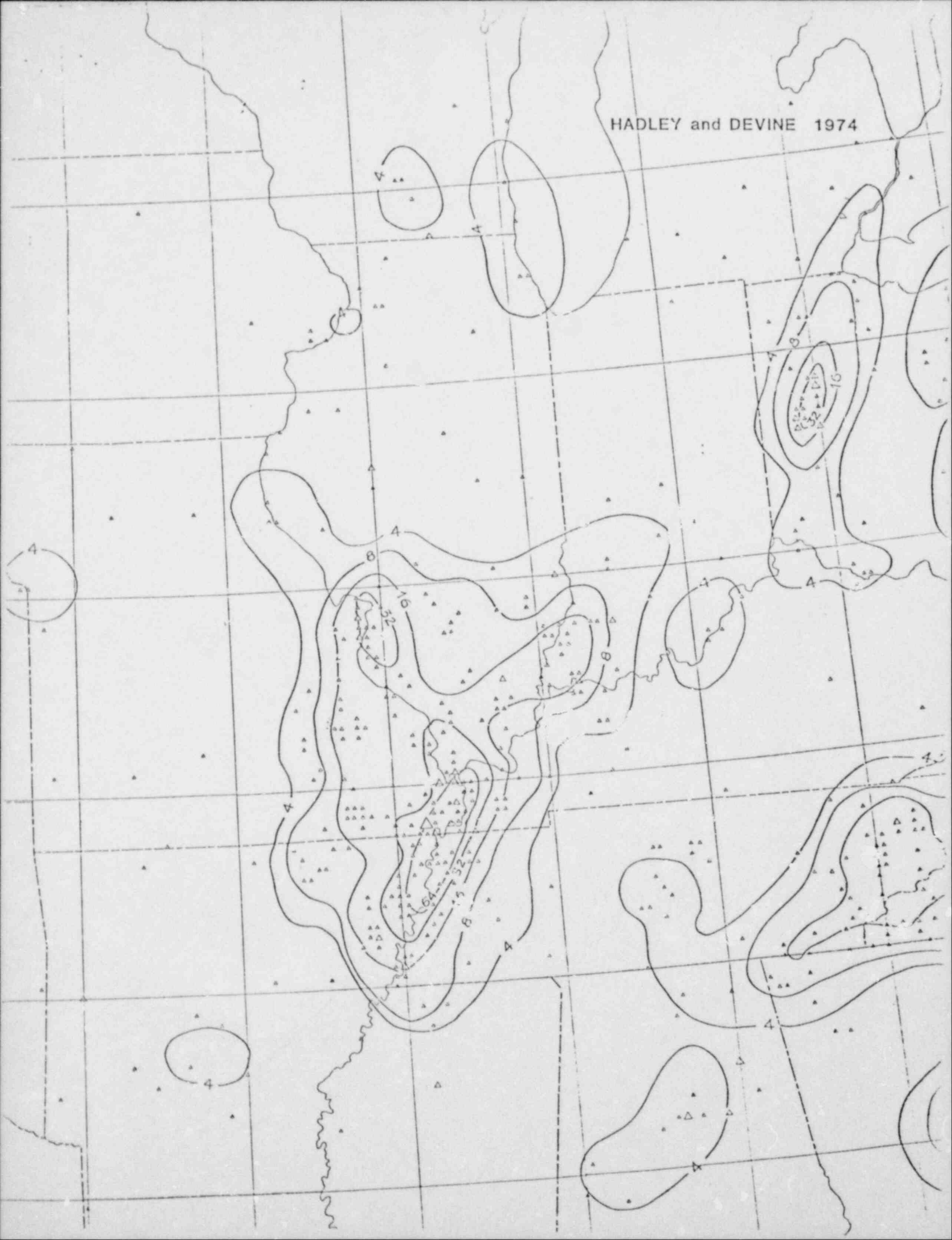
Areas in which known faults are associated with epicentral alinements or distribution, in such a way as to indicate that movements on the known faults or closely related faults have been the source of recorded earthquakes

B

Areas in which major faults are not known, but epicentral concentration and alinement indicate that movements on unrecognized or concealed faults have been the source of recorded earthquakes

C

Areas in which major faults are known, but the epicentral distribution does not indicate that they are the source of recorded earthquakes. Also, areas in which major faults or other seismically active structures are not known or indicated


HADLEY and DEVINE 1974

EXPLANATION

Modified Mercalli Intensity

▲
III to VI

△
VII

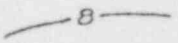
△
VIII

△
IX-X

△
XII

A single epicenter of intensity XII is shown near New Madrid, Missouri

The center of each triangular symbol indicates the epicentral location of one or more seismic events, plotted to the nearest 0.1 degree of latitude and longitude. The intensity shown is maximum Modified Mercalli (MM) intensity in the epicentral area of the largest event at the plotted location. Most locations are based on observations of intensity rather than on instrumental records



Seismic frequency contour represents the areal distribution of earthquake epicenters with epicentral intensity of MM III and greater, as indicated by the total number per $10^4 km^2$ during the period 1800-1972. Contour intervals are 0-4, more than 4 but less than 8, more than 8 but less than 16, more than 16 but less than 32, more than 32 but less than 64, and more than 64. The contours are considerably generalized and are shown only as a guide for estimating regional seismicity. They have no value for precise location of seismic boundaries

NOTE: This map was compiled in 1973 from earthquake data of the Environmental Data Service of the National Oceanic and Atmospheric Administration and from data of the Dominion Observatory, Ottawa, Canada

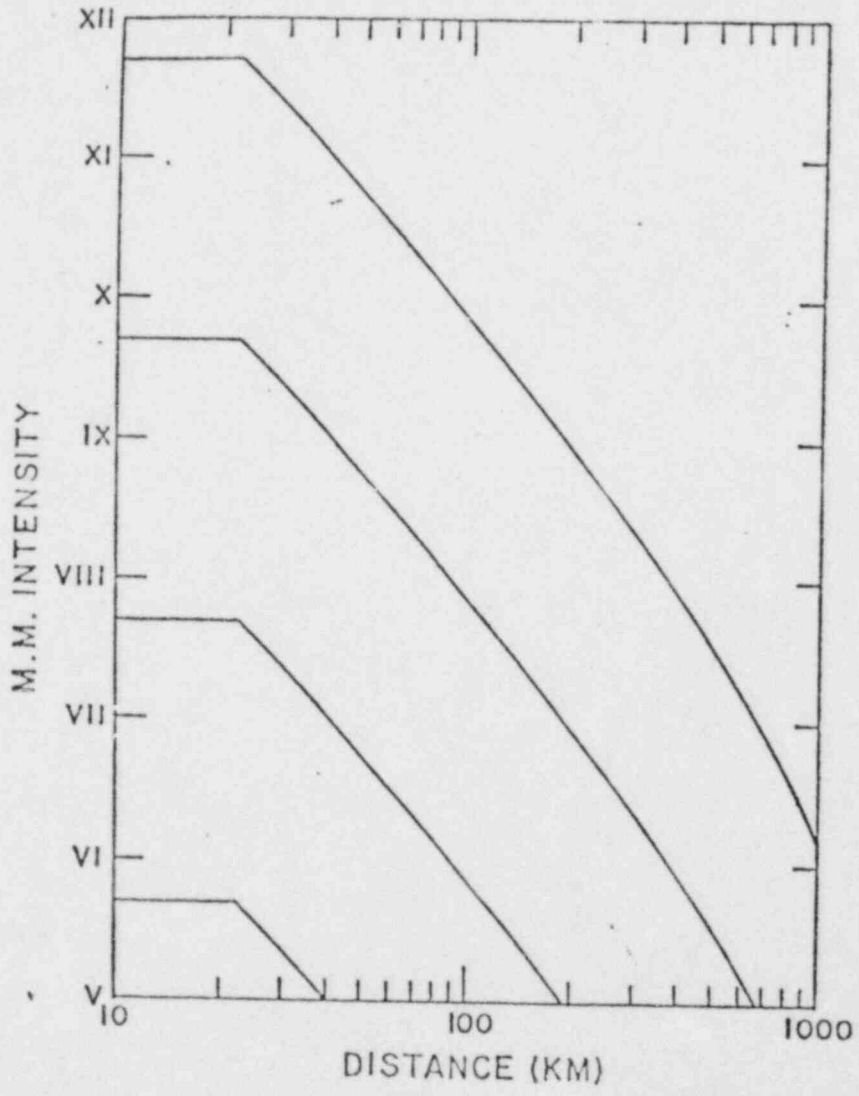


Figure 2. Modified Mercalli (M.M.) Intensity Attenuation Curves for the Central United States.

NUTTLI and HERRMANN 1981

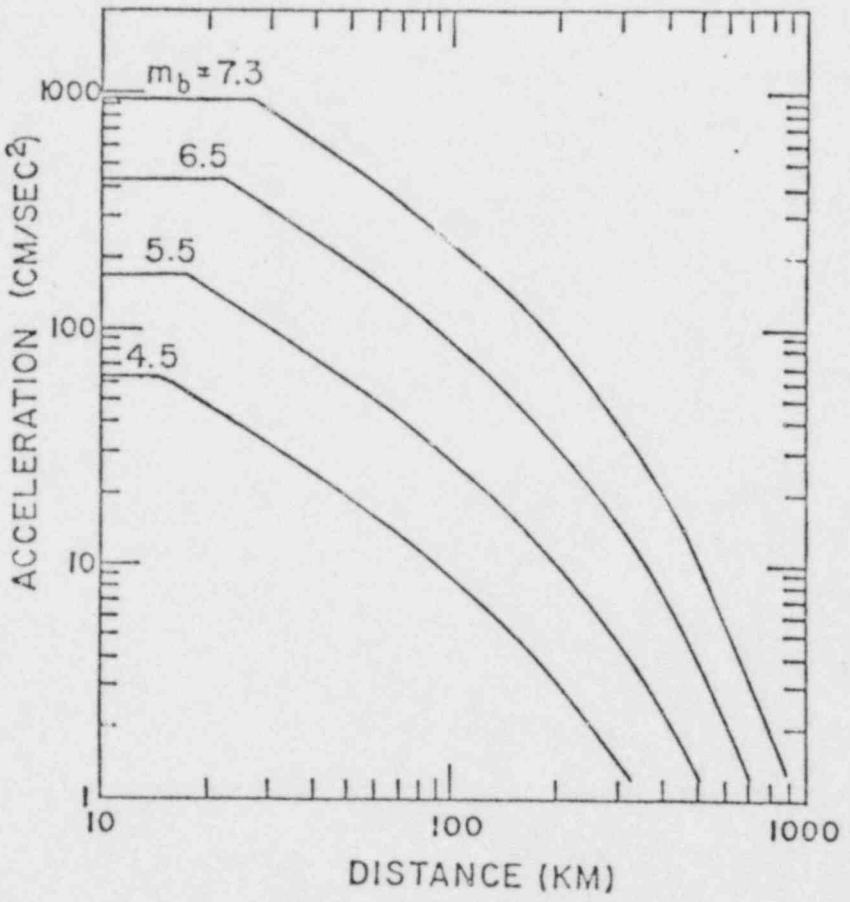


Figure 3. Peak Horizontal Acceleration (Average of Two Components) as a Function of Epicentral Distance and Body-Wave Magnitude (m_b) for the Central United States.

NUTTLI and HERRMANN 1981

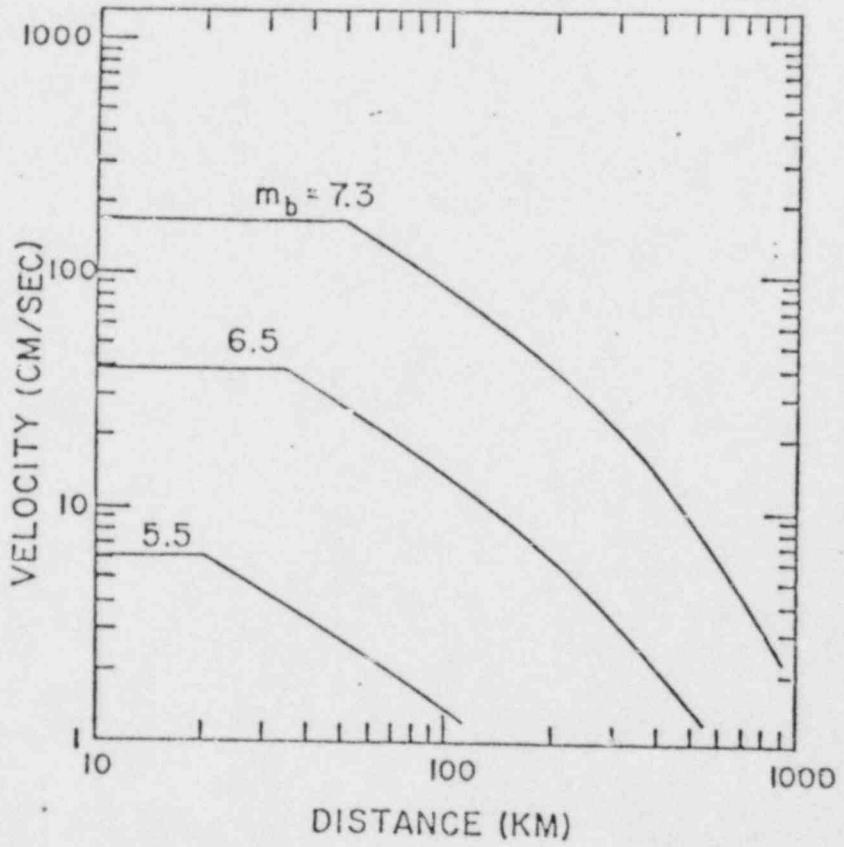


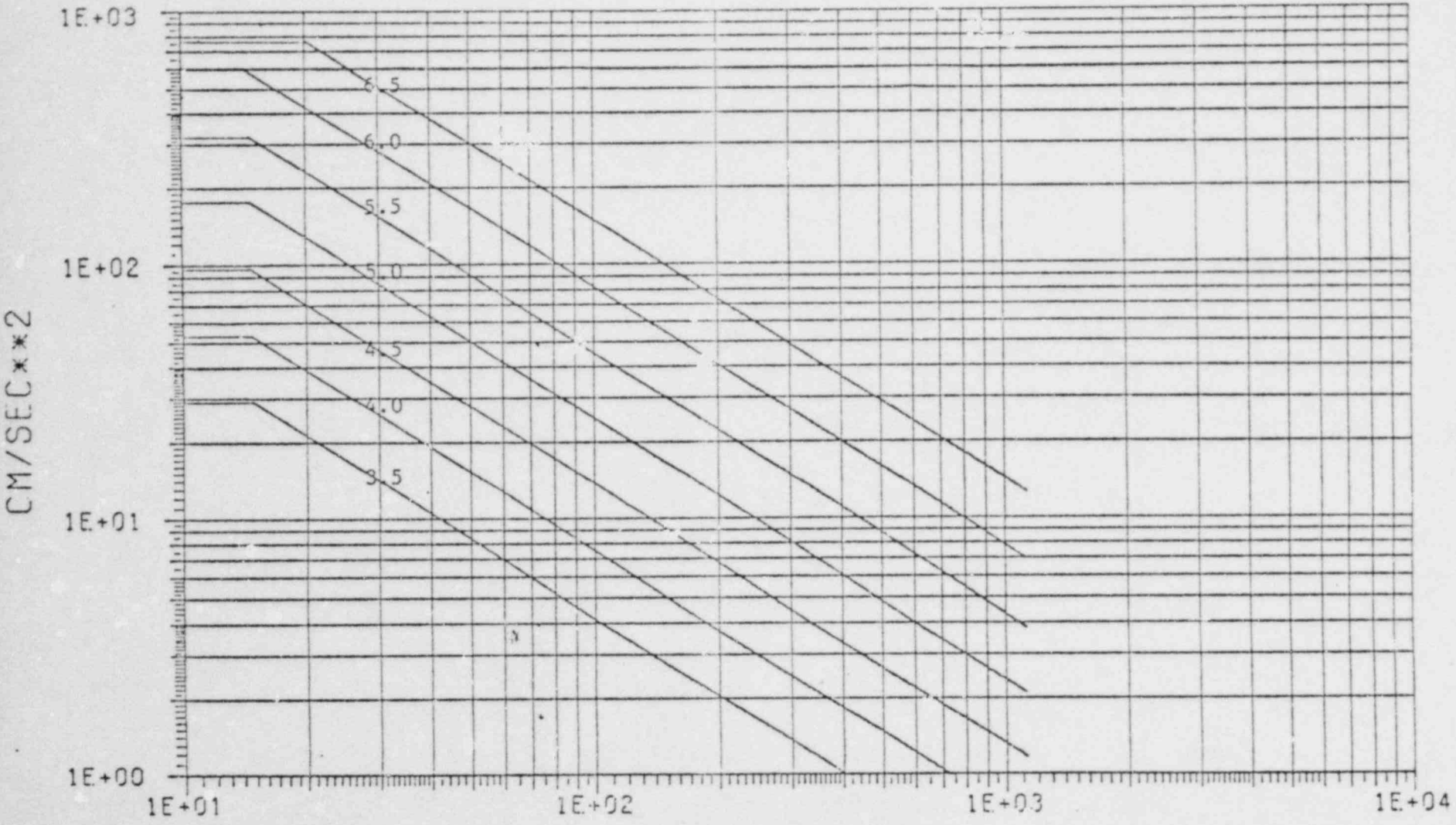
Figure 4. Peak Horizontal Velocity (Average of Two Components) as a Function of Epicentral Distance and Body-Wave Magnitude (m_b) for the Central United States.

NUTTLI and HERRMANN 1981


NUREG/CR-1577
WISCONSIN
MICHIGAN
IOWA
ILLINOIS
INDIANA
OHIO
MISSOURI
KENTUCKY
TENNESSEE
ARKANSAS
MISSISSIPPI
ALABAMA
ILLINOIS BASIN
ANTICLINAL AREA
KANKAKEE ARCH
CINCINNATI ARCH
NASHVILLE DOME
OZARK UPLIFT
64
128
32
16
8
4
2

Nuttli/Herrmann 1978
Miscellaneous Papers
Waterways Experiment Station

$\ell n A_p = 1.930 + 1.196 m_b - 1.02 \ell n R$



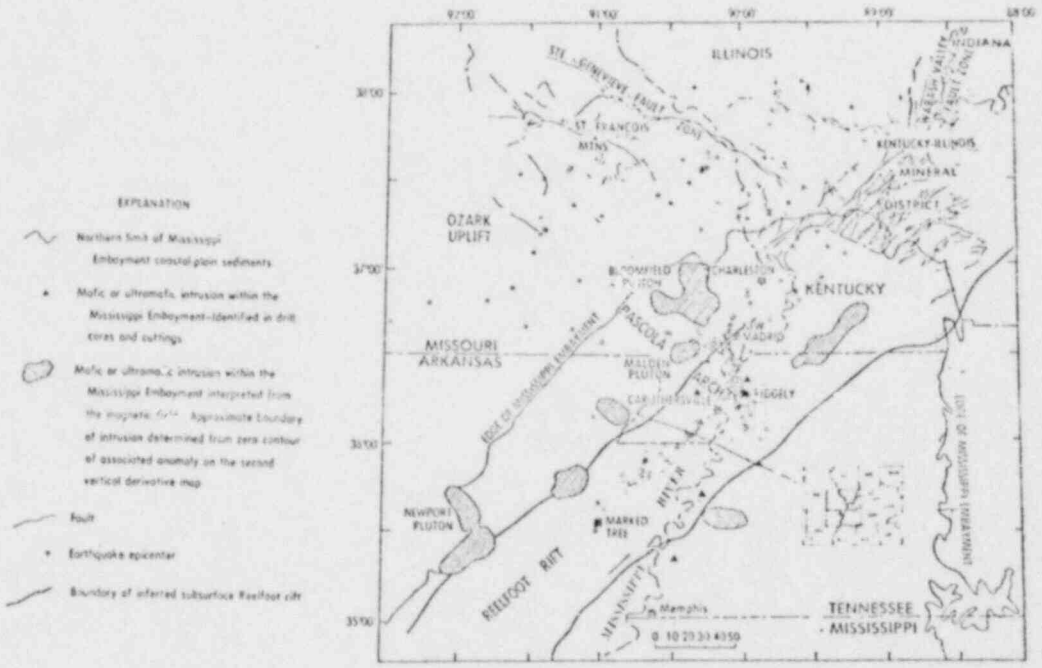
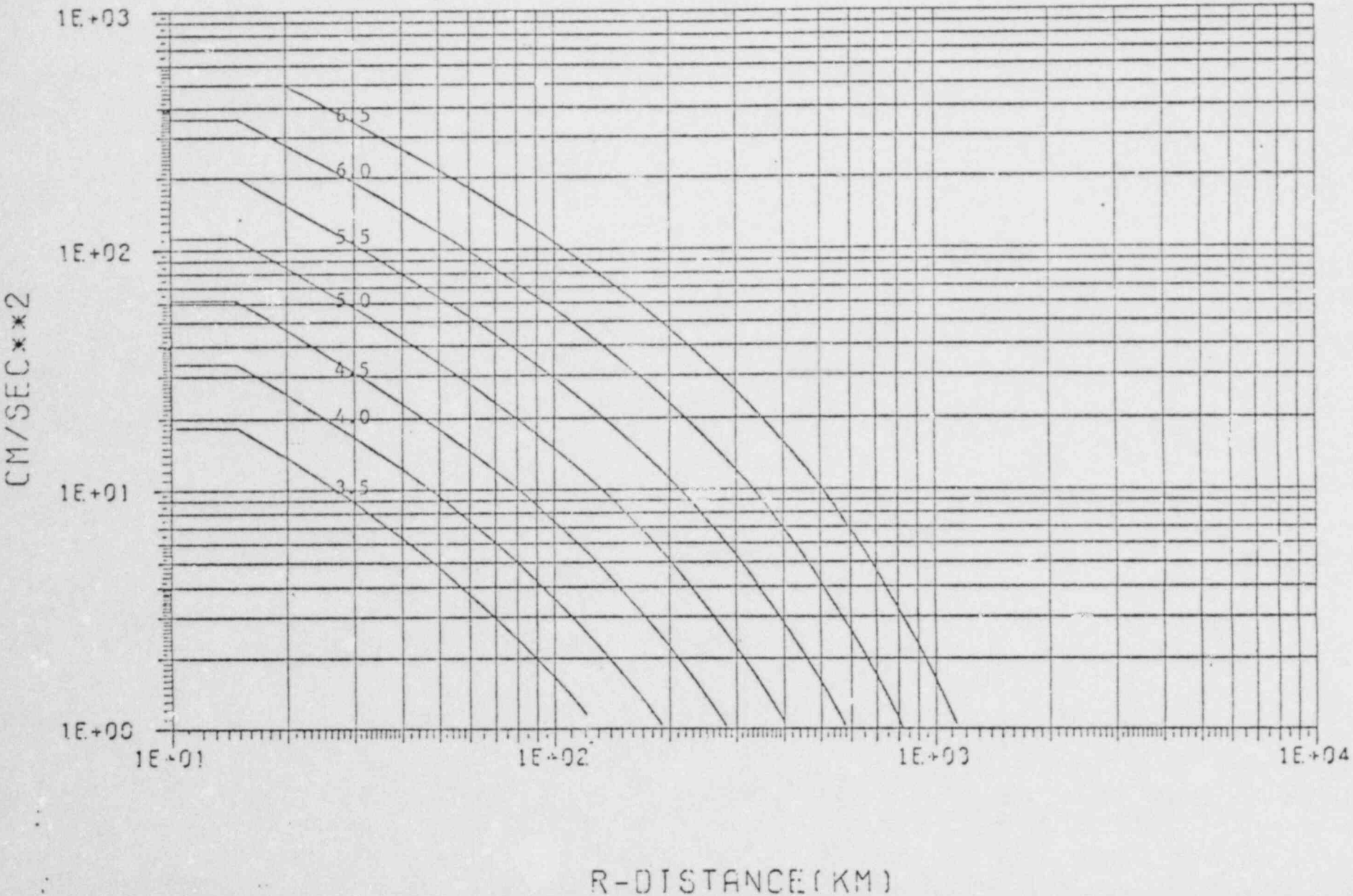


Figure 1.

(Russ, 1981)

Nuttli Theoretical 1981 Earthquake Conference
(Knoxville, Tennessee)
Nuttli stated that all curves from Nuttli-
Theoretical 1979 be adjusted down by .2m_b.



INTENSITY ATTENUATION

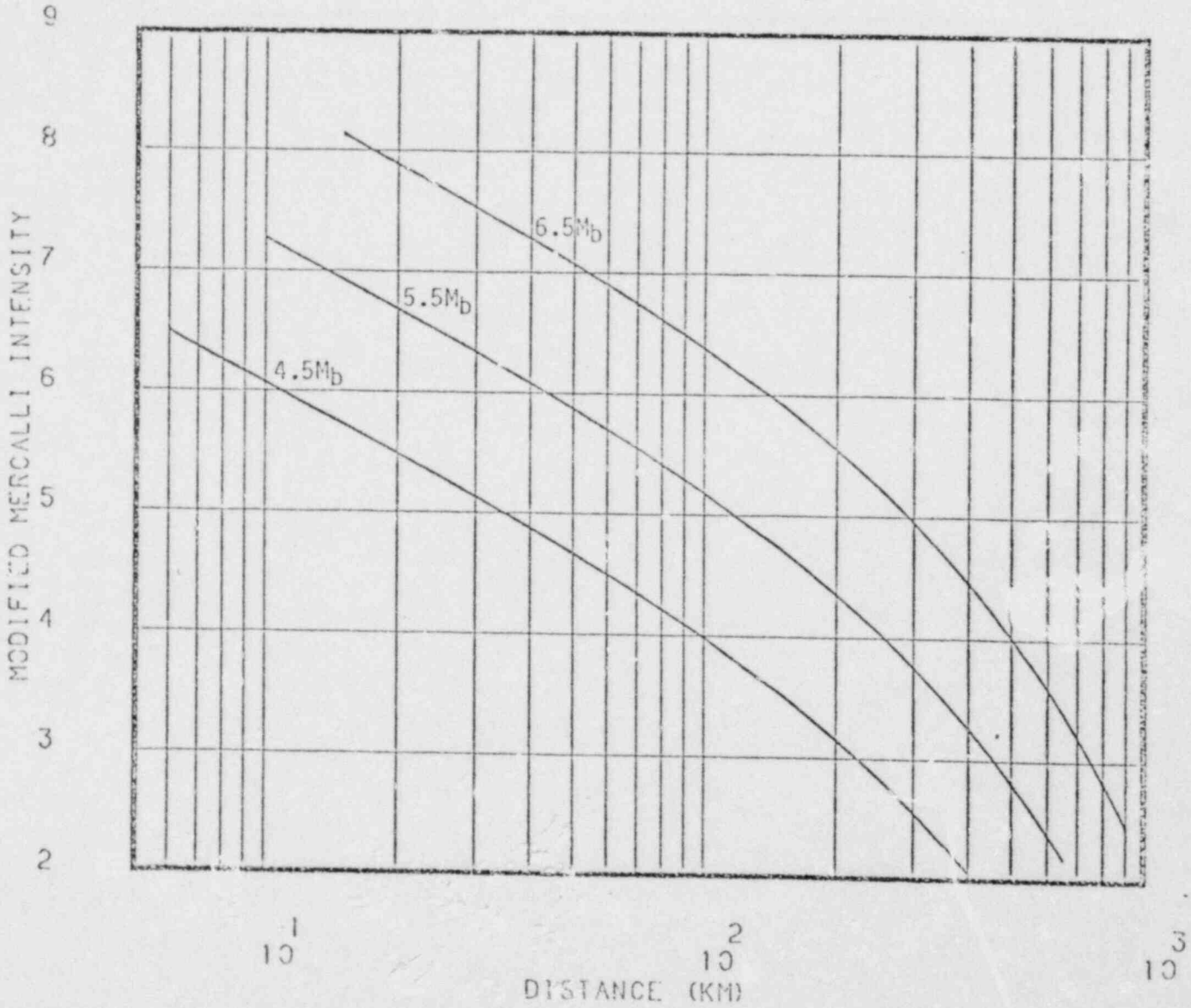


FIGURE 26

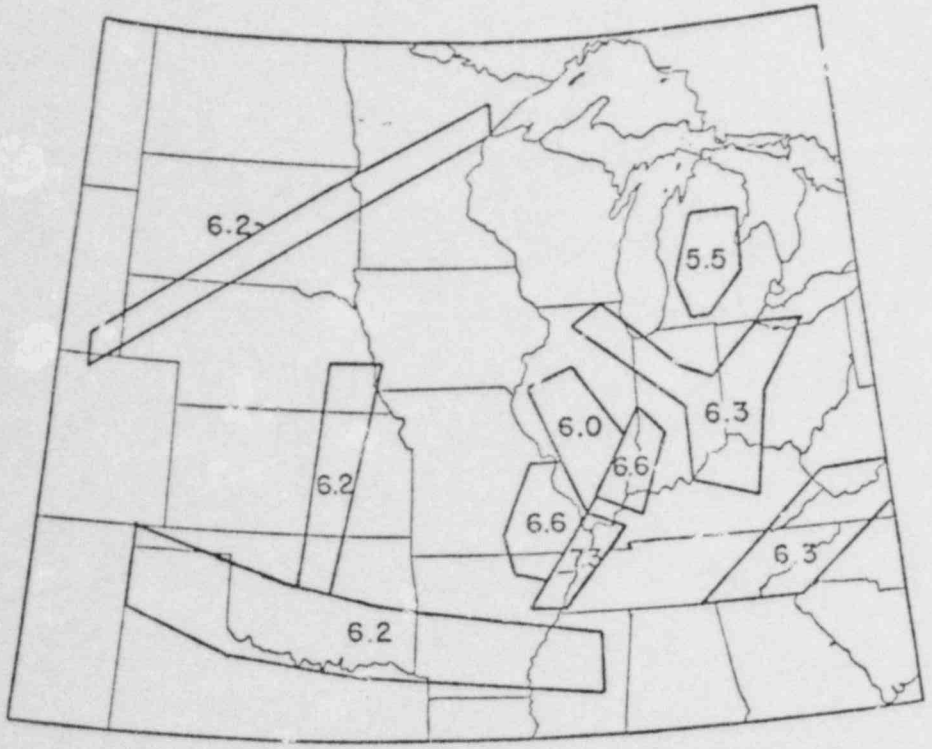


Figure 5. Earthquake Source Zones of the Central United States, after Nuttli and Brill (11), and Body-Wave Magnitudes of Earthquakes with a Recurrence Time of 1000 Years.

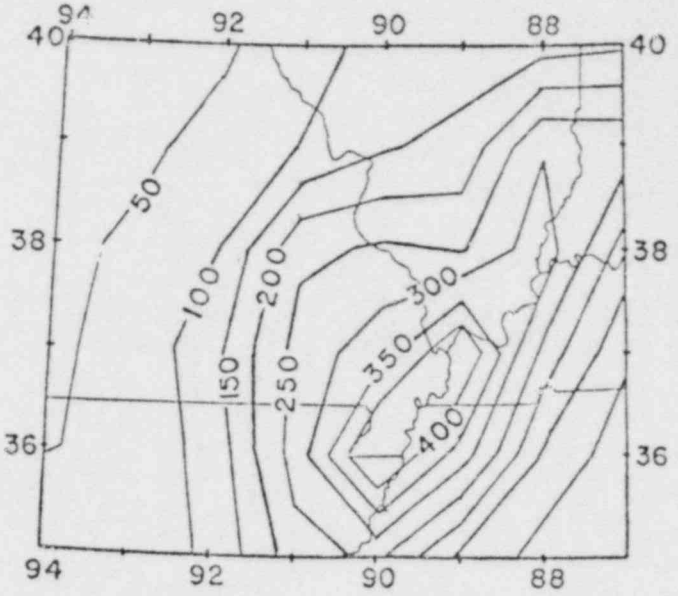


Figure 6. Peak Horizontal Acceleration (Average of Two Components) with an Annual Probability of Exceedance of 0.001.

INTENSITY ATTENUATION

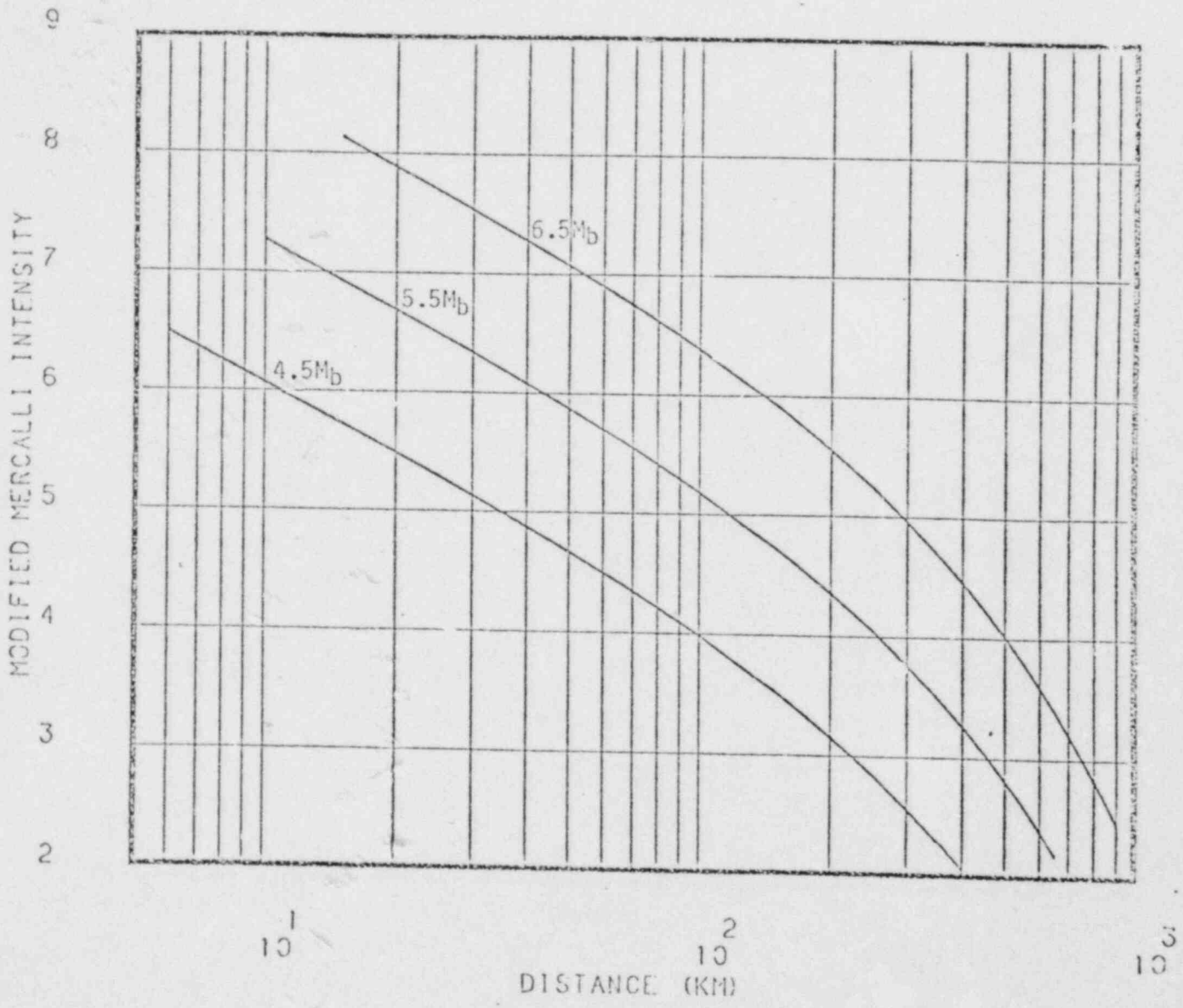


FIGURE 26

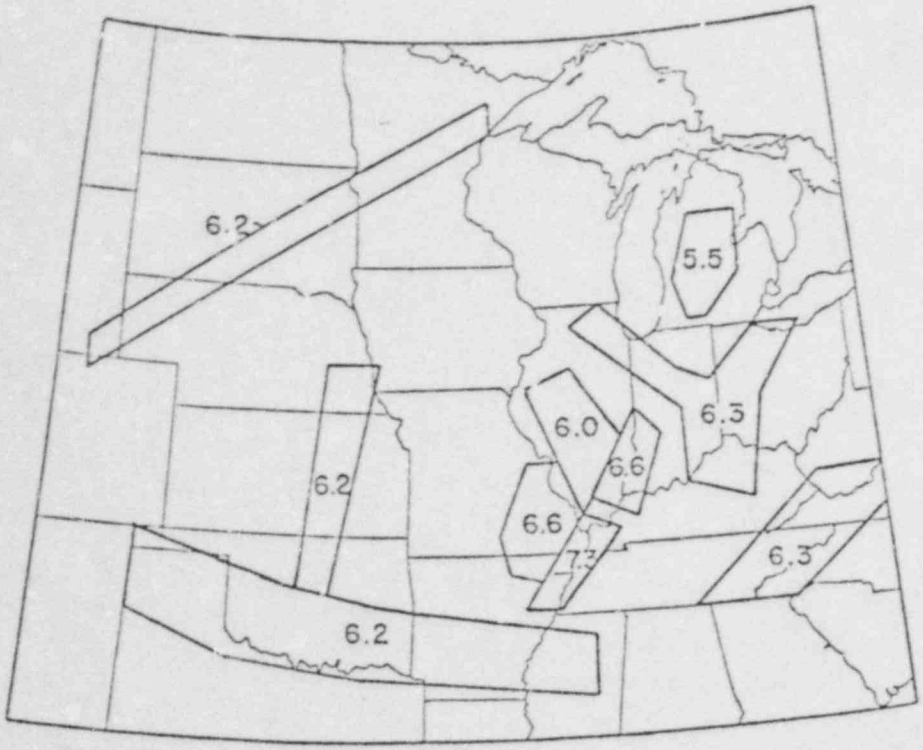


Figure 5. Earthquake Source Zones of the Central United States, after Nuttli and Brill (11), and Body-Wave Magnitudes of Earthquakes with a Recurrence Time of 1000 Years.

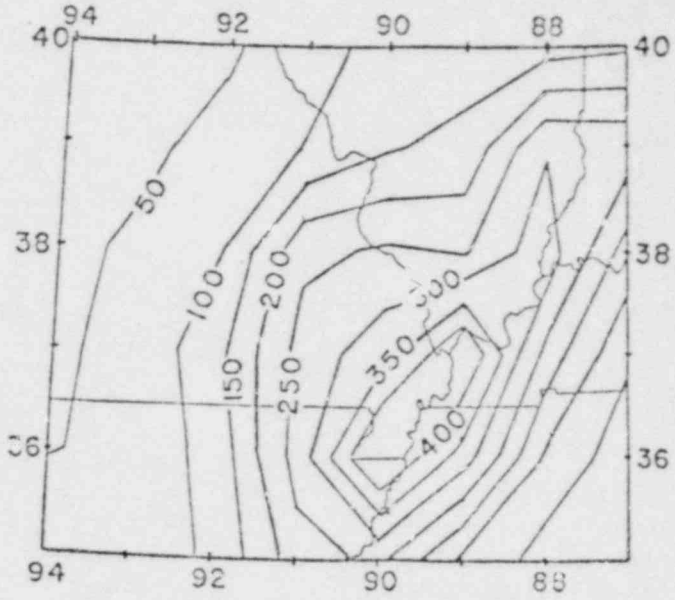
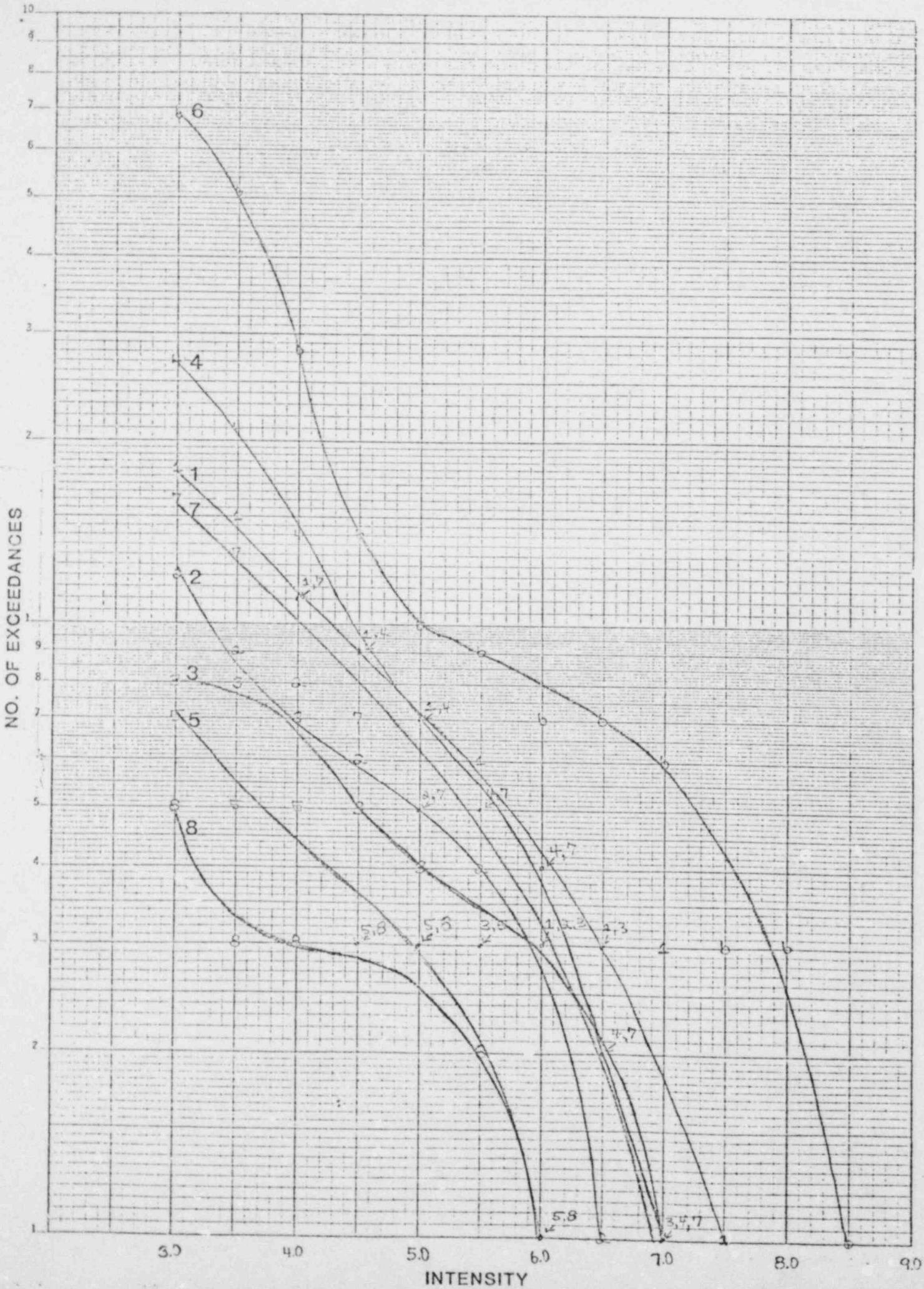
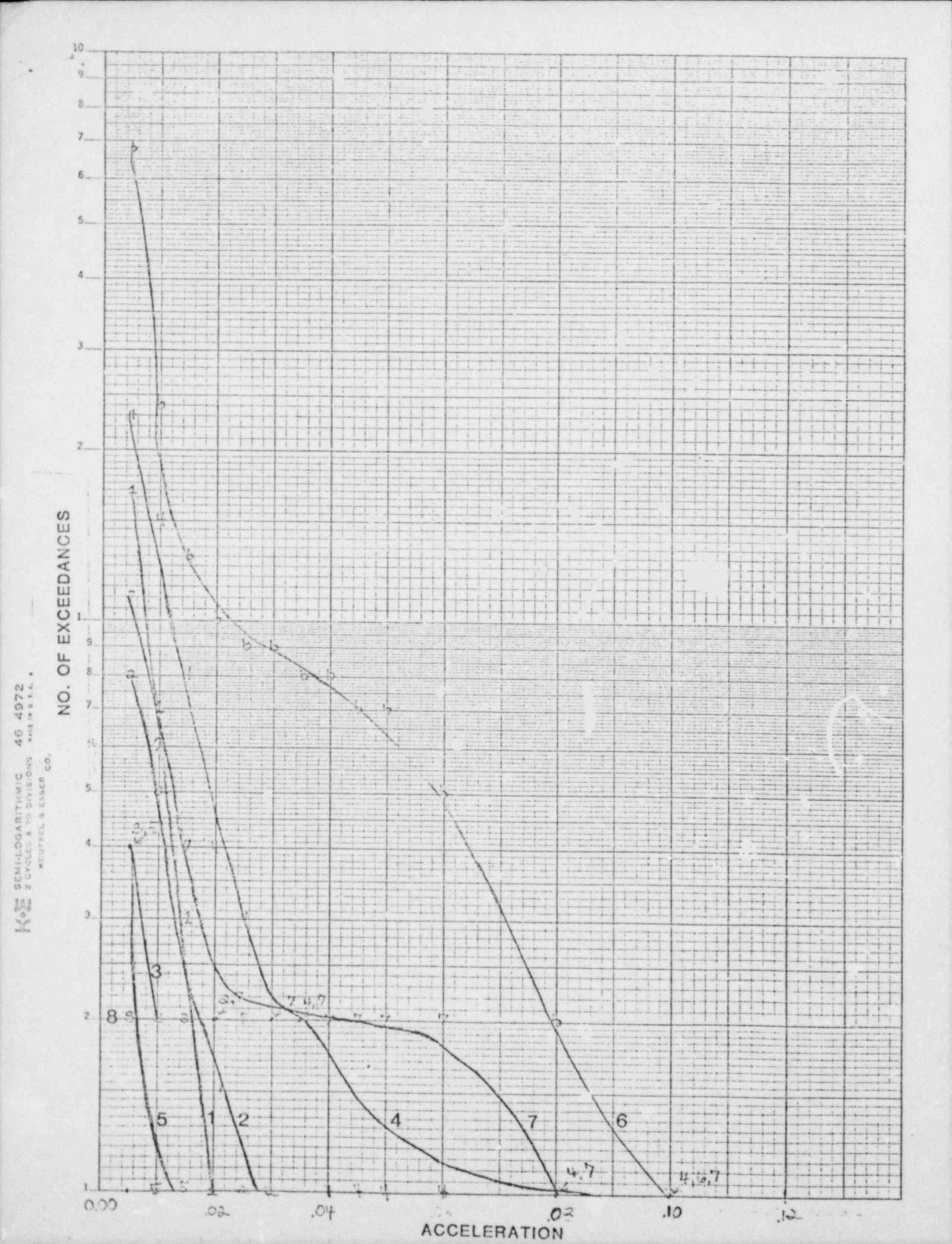
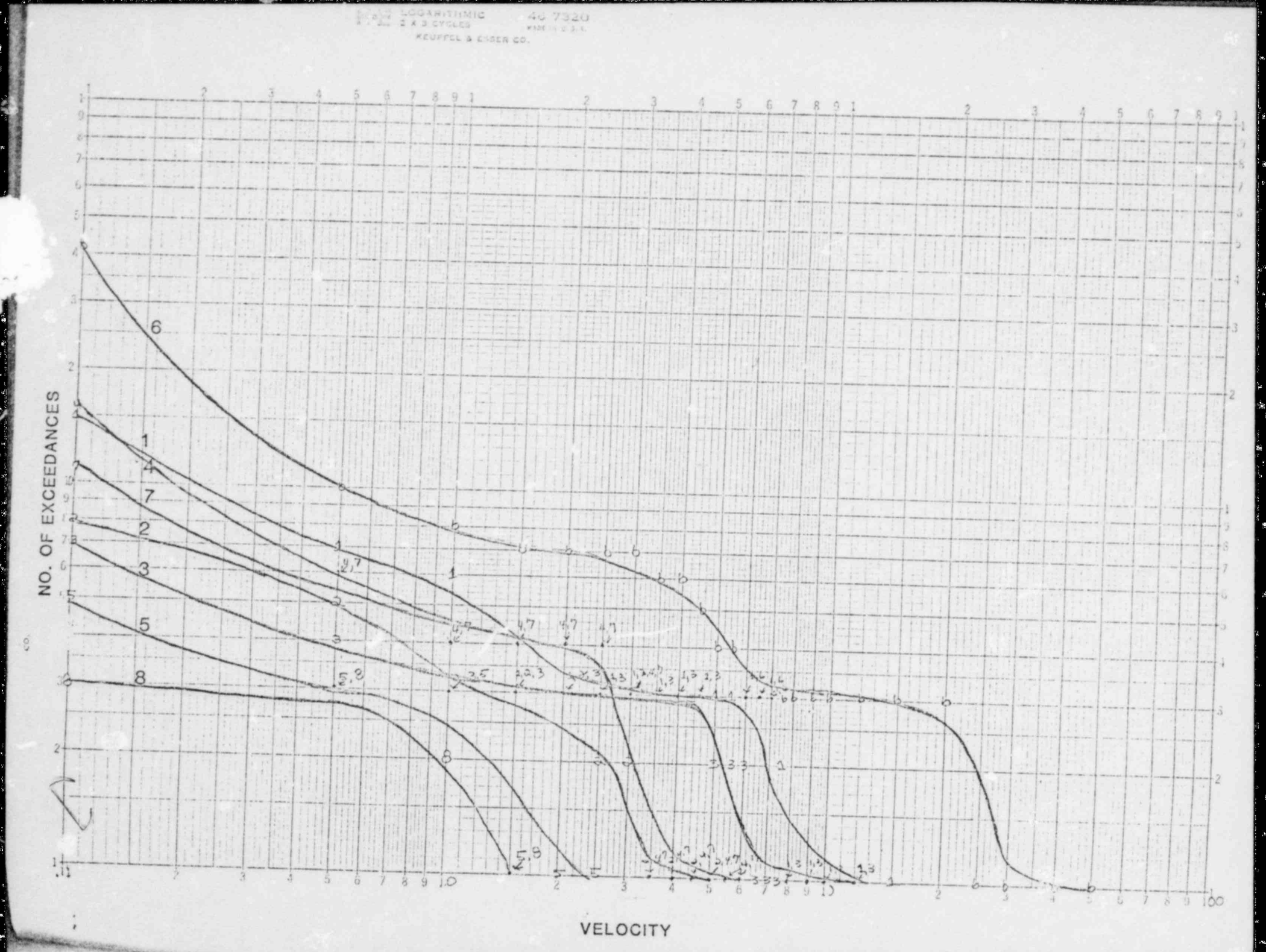


Figure 6. Peak Horizontal Acceleration (Average of Two Components) with an Annual Probability of Exceedance of 0.001.


NO. OF EXCEEDANCES
INTENSITY
3.0
4.0
5.0
6.0
7.0
8.0
9.0
6
4
1
7
2
3
5
8


NO. OF EXCEEDANCES
ACCELERATION
0.00
.02
.04
.02
.10
.12
1
2
3
4
5
6
7
8
4,7
4,7
4,7
4,7
SEMI-LOGARITHMIC 46 4972
2 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.


LOGARITHMIC
2 X 3 CYCLES
KEUFFEL & ESSER CO.
NO. OF EXCEEDANCES
VELOCITY