UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

October 10, 1989

Docket No. 50-219

LICENSEE: GPU Nuclear Corporation
Jersey Control Power and Light Company

FACILITY: Oyster Creek Nuclear Generating Station

SUBJECT: SUMMARY OF SEPTEMBER 27, 1989 MEETING WITH GPU NUCLEAR CORPORATION (GPUN) TO DISCUSS SITE SPECIFIC SEISMIC RESPONSE SPECTRA FOR THE OYSTER CREEK NUCLEAR GENERATING STATION

On Wednesday, September 27, 1989 a meeting was held at NRC, Rockville, Maryland with GPU Nuclear Corporation (GPUN/the licensee) to discuss matters related to the site specific seismic response spectra (SSRS) for the Oyster Creek Nuclear Generating Station. Enclosure 1 is the list of individuals participating in the discussion.

Enclosure 2 is the licensee's agenda and presentation. The following is a summary of the significant items discussed.

The licensee presented the project status and indicated that there objective was to develop a site specific response spectra for use in the future seismic analyses at Oyster Creek. The immediate usage will be in qualifying some of the supports and their anchorages in accordance with IEBs 79-02 and 79-14. The licensee provided a summary of the development of SSRS for Oyster Creek and stated that as a result of these analyses it was concluded that 1) the epicentral distance has the strongest influence on the final spectrum and 2) GPUN will use the 84 SSRS as Oyster Creek's site specific spectra. The licensee also presented a schedule to complete this effort.

A detailed discussion was held regarding GPUN's analysis and as a result of the discussions the staff advised the licensee of the following:

1) GPUN's schedule is very tight. However, the staff will review the information but could not assure GPUN that their schedule could be met.

2) The staff indicated that GPUN should assure itself that the application of deconvolution in the soil-structure interaction (SSI) analysis is of consistent with assumptions used in determining the site specific spectra.

3) In GPUN's SSI analysis the effect of deconvolution would be limited to no more than 40% reduction.

DF01
1/1

4) The approach GPUN is pursuing appears appropriate. The staff will review the report when it is submitted and will probably have additional questions.

Alexander W. Dromerick, Project Manager
Project Directorate I-4
Division of Reactor Projects - I/II

Enclosures:
1. Attendance List
2. GPUN Agenda and presentation

cc w/enclosures:
See next page

cc:

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ENCLOSURE 1

OYSTER CREEK NUCLEAR GENERATING STATION
DOCKET NO. 50-219

MEETING SETPEMBER 27, 1989

ATTENDANCE LIST

NAMES	ORGANIZATION
A. Dromerick	NRR, PDI-4
Hans Ashar	NRR, ESGB/DET
R. Rothman	NRR, ESGB
George Klimkiewicz	Weston Geophysical
Richard Holf	Weston Geophysical Corp
G. Capodanno	GPU Nuclear
M. Sanford	GPU Nuclear
S. Tumminell	GPU Nuclear
F. Orr	NRR, PDI-4
Suren Singh	N.J. State Dept. of Env. Prot.
Yosh Nagi	GPU Nuclear
John Stolz	NRR/PDI-4
Raman Pichumani	NRR/ESGB/DET
David C. Jeng	NRR/ESGB/DET
Goutam Bachgi	NRR/ESGB/DET
Leo Reiter	NRR/ESGB/DET
Nick DiNucci	N.J. State Dept. of Env. Prot.
M. Leggart	GPU Nuclear

ENCLOSURE 2

OYSTER CREEK
NUCLEAR GENERATING STATION

SITE SPECIFIC
SEISMIC RESPONSE SPECTRA

September 27, 1989

AGENDA

I. PROJECT STATUS AND OBJECTIVES

II. SUMMARY OF DEVELOPMENT OF SITE SPECIFIC RESPONSE SPECTRA FOR OYSTER CREEK NGS.

III. TECHNICAL QUESTIONS

PROJECT STATUS AND OBJECTIVES

1987 — GPUN IDENTIFIED A NEED FOR UNIFICATION OF THE OYSTER CREEK FLOOR RESPONSE SPECTRA AND PROPOSED A NEW SOIL STRUCTURE INTERACTION ANALYSIS (SSI).

12/21/87 — NRC / GPUN MEETING:
NRC RECOMMENDS TWO OPTIONS.
ONE OPTION REQUIRES DEVELOPING A NEW FREE-FIELD SITE-SPECIFIC GROUND MOTION FOR THE OYSTER CREEK PLANT.

9-27-87 — GPUN WILL PRESENT INFORMATION TO SUPPORT THE NEW SITE SPECIFIC GROUND SPECTRA.

FUTURE MEETING:

GPUN WILL PRESENT FLOOR RESPONSE SPECTRA UTILIZING SOIL STRUCTURE INTERACTION (SSI).

CONCLUSION OF PROJECT:

TECHNICALLY JUSTIFIABLE FLOOR RESPONSE SPECTRA FOR OYSTER CREEK.

OCNGS SSRS

OBJECTIVE:

DEVELOP A GROUND LEVEL SITE SPECIFIC RESPONSE SPECTRA FOR USE IN SEISMIC ANALYSES AT OYSTER CREEK

OCNGS SSRS

OPEN NRC CONCERNS FROM MAY 1988

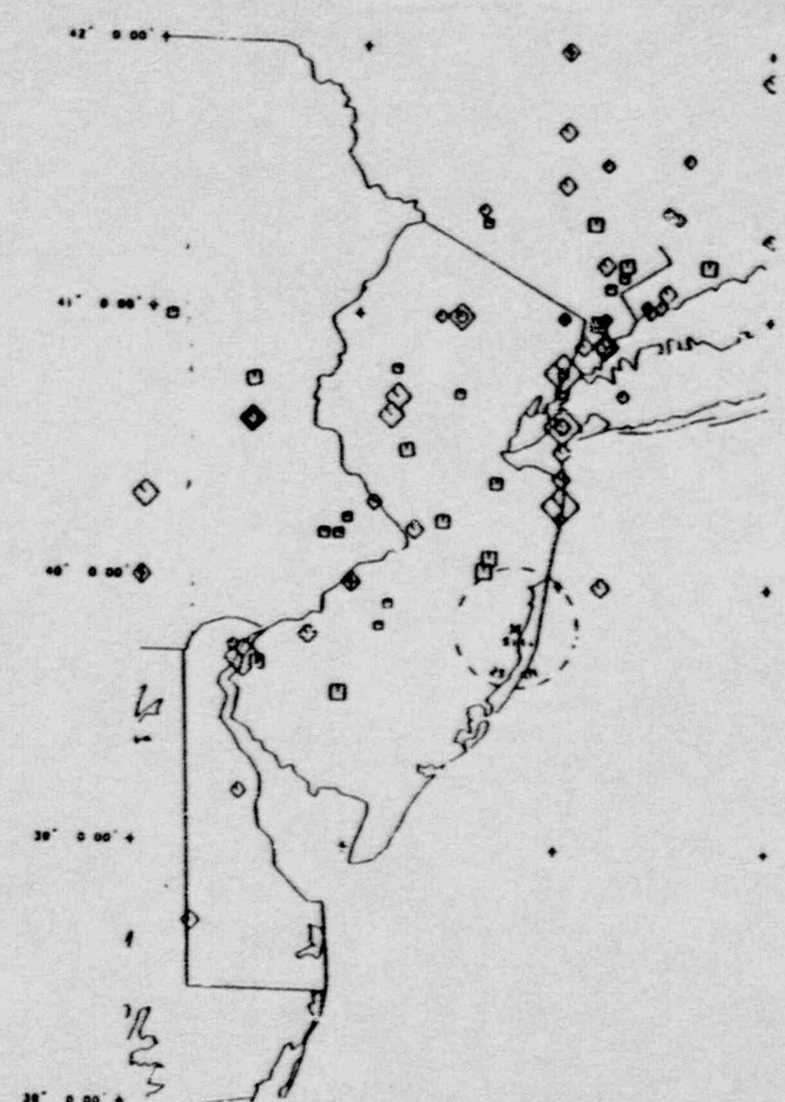
- TALL BUILDING DATA COULD AFFECT RESULTING SPECTRA IN A NON-CONSERVATIVE MANNER
- SITE GEOLOGICAL CONDITIONS WERE NOT PRECISELY MATCHED
- VERTICAL RESPONSE SPECTRA WERE NOT DISCUSSED
- RECENTLY RECORDED EVENTS NOT ADDEQUATELY ADDRESSED
- GEOLOGICAL CHARACTERISTICS OF MORE RECENT ACCELEROGRAPH SITES NOT OBTAINED

OCNGS SSRS
DEVELOPMENT METHODOLOGY

1. DETERMINE THE CRITERIA FOR SELECTING SEISMIC RECORDS APPLICABLE TO OCNGS
2. COLLECT AND CHARACTERIZE APPLICABLE RECORDS
3. COMPILE AND STATISTICALLY ANALYZE THE RESULTING SUITE OF CURVES
4. VALIDATE RESULT AGAINST PROBABILISTIC SEISMIC HAZARD

OCNGS SSRS
DATA APPLICABILITY STUDIES

OYSTER CREEK IS
A LOW SEISMICITY
SITE AS SHOWN BY
THE ABSENSE OF
EARTHQUAKES OVER
ALMOST 300 YEARS



THEREFORE, USING
DATA FROM 0 TO 25
Km DISTANCES IS
VALID

OCNGS SSRS
DATA APPLICABILITY STUDIES

TALL BUILDING (i.e. >3 STORIES) EFFECT EVALUATED BY:

1. SSI STUDY BY DR. YEGIAN OF NORTHEASTERN UNIVERSITY:

   BASED ON 17 SITES, THE RESULTANT SPECTRA ARE INSIGNIFICANTLY INFLUENCED BY SSI

2. COMPARISON OF HOLLYWOOD STORAGE BUILDING BASEMENT RECORDINGS WITH FREE FIELD RECORDINGS:

   SHOWS NEARLY IDENTICAL RESPONSE BELOW 5 HZ

3. COMPARISON OF FINAL DATA SUITE WITH AND WITHOUT TALL BUILDING DATA :

   SHOWS SLIGHT INCREASE IN SPECTRA ABOVE 10 HZ

OCNGS SSRS
DATA APPLICABILITY STUDIES

IMPORTANCE OF PRECISE MATCHING OF SOIL PROPERTIES EVALUATED BY:

1. DR. YEGIAN OF NORTHEASTERN UNIVERSITY STUDY SHOWS SMALL EFFECT (i.e. <6%) FOR VARIATIONS IN THE ORIGINAL (5/88) DATA SET

2. REVIEW OF 6 DATA SETS FROM COALINGA EARTHQUAKE IN 1983 ESSENTIALLY DUPLICATE THE 1987 LLNL RESULTS OF 48 COMPONENTS FROM A VARIETY OF SOURCES

   KEY COMPARISONS:

	MEAN MAGNITUDE	MEAN DISTANCE
LLNL:	5.13 ML	10.9 Km
COALINGA:	5.20 ML	10.2 Km

OCNGS SSRS
RESULTING DATA

BASED ON THE FOLLOWING CRITERIA:

EPICENTRAL DISTANCE	0 - 25 Km
MAGNITUDE	5.3 +/- 0.5
ALLUVIUM SOIL FOUNDATION	

THERE ARE 73 HORRIZONTAL COMPONENTS AVAILABLE INCLUDING 10 FROM TALL BUILDINGS

OCNGS SSRS
DATA SET EVALUATION

AVAILABLE DATA ARE A CONSERVATIVE SET FOR APPLICATION AT OYSTER CREEK

1. DATA ARE HIGHLY WEIGHTED TOWARD CLOSE IN EVENTS

    EPANSION OF NETWORKS IN RECENT YEARS

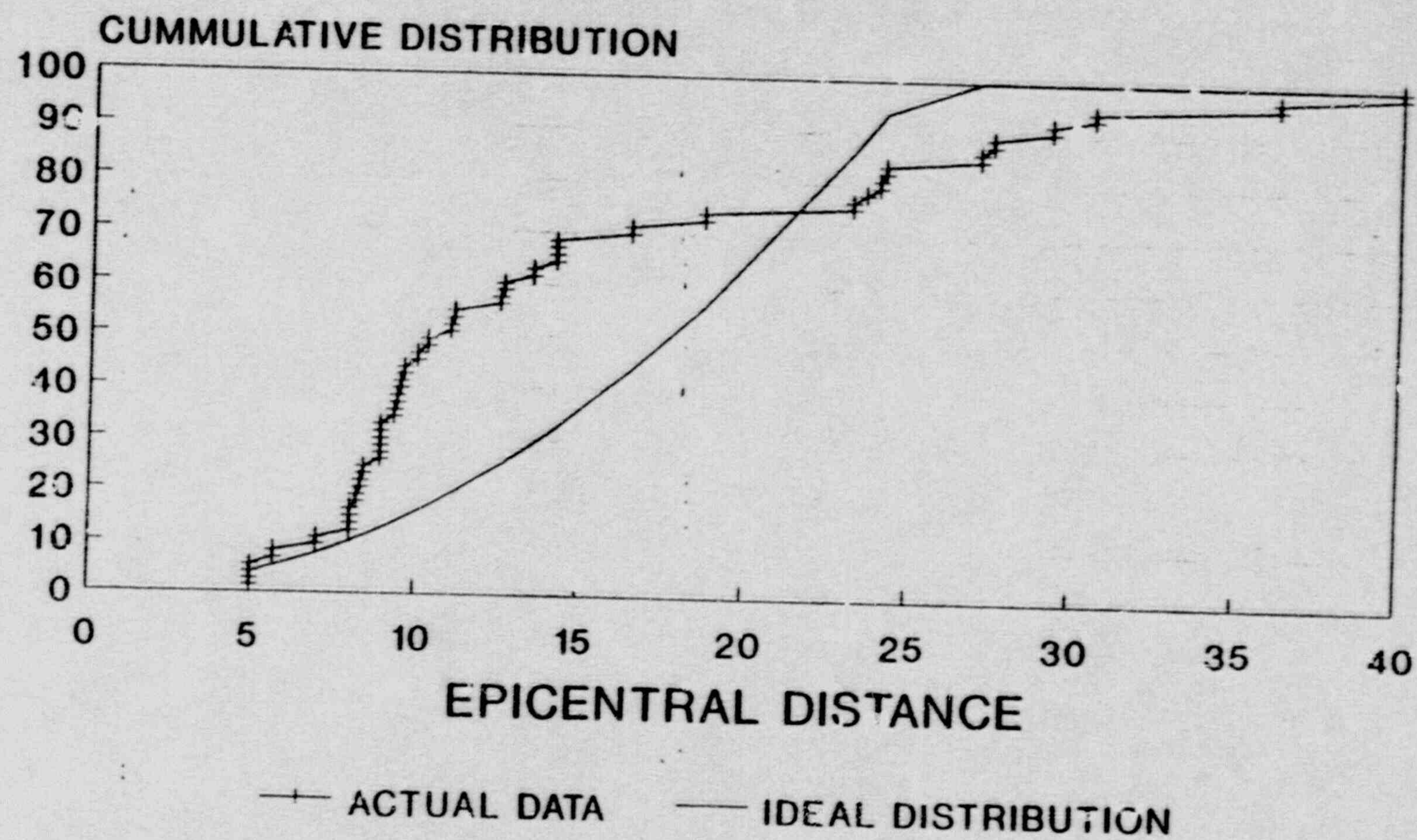
    USE OF TEMPORARY AFTERSHOCK INSTRUMENT

2. RECENT PRACTICES OF ONLY DIGITIZING LARGEST COMPONENTS RESULTS IN

    HIGHER PEAK ACCELERATIONS

    HIGHER SPECTRAL ORDINATES

OCNGS SRSS DATA
DISTANCE DISTRIBUTION

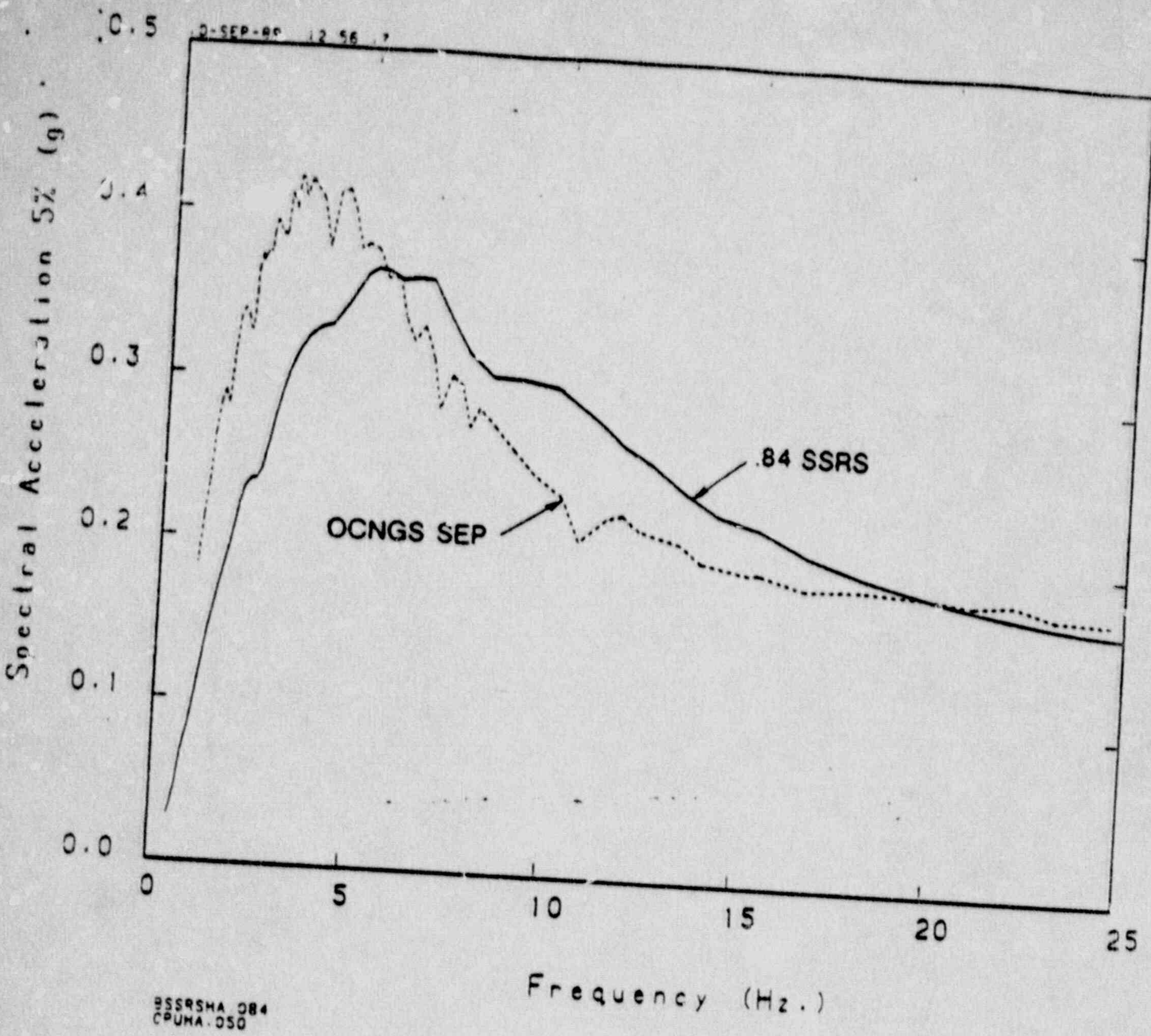


ALL DATA

OCNGS SSRS
RESULTS

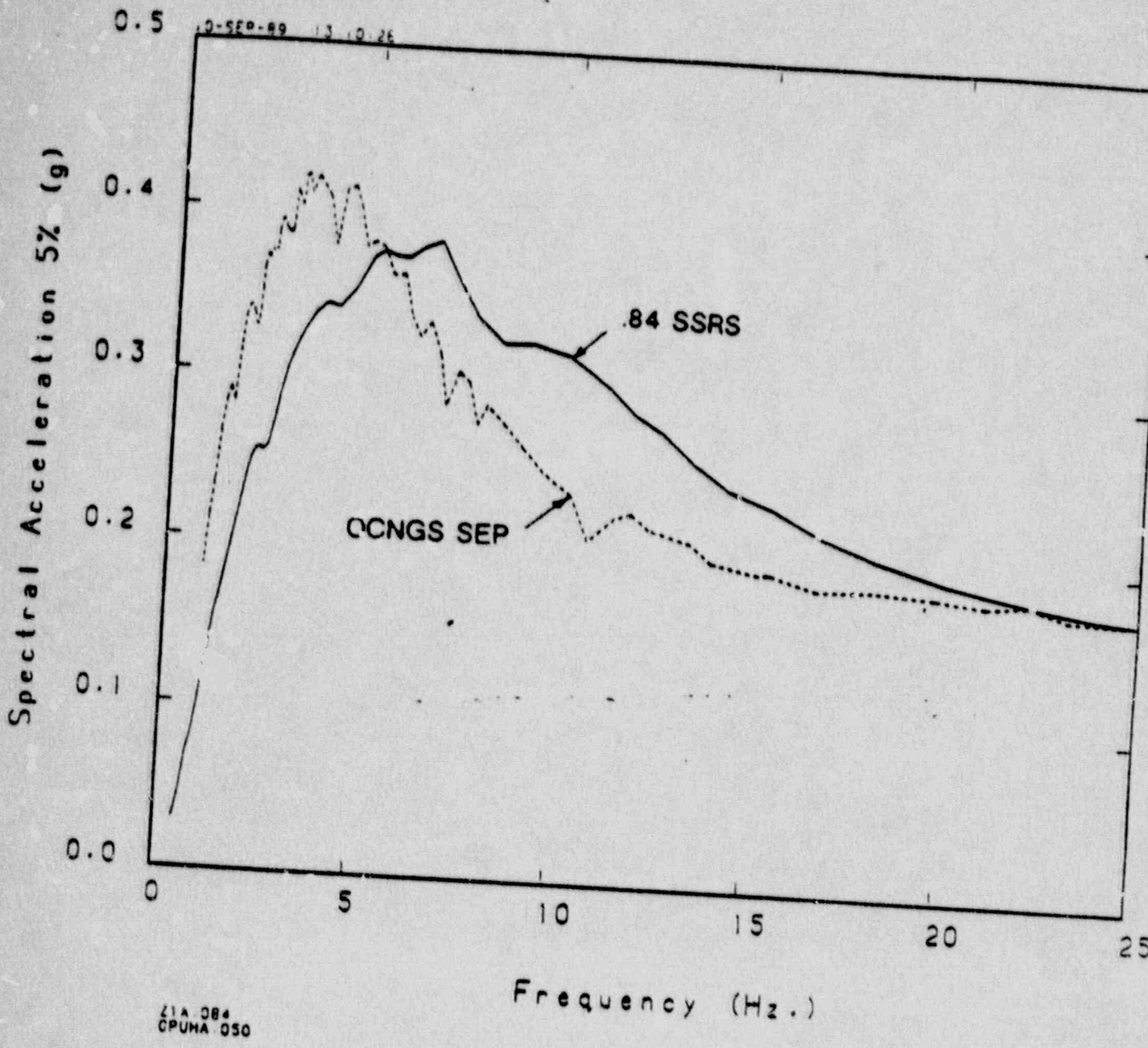
ILLUSTRATED IN FOLLOWING CASES:

1. SPECTRUM USING ALL 73 DATA SETS
2. SPECTRUM WITHOUT TALL BUILDINGS
3. SPECTRUM USING ONLY DATA FROM >12 Km



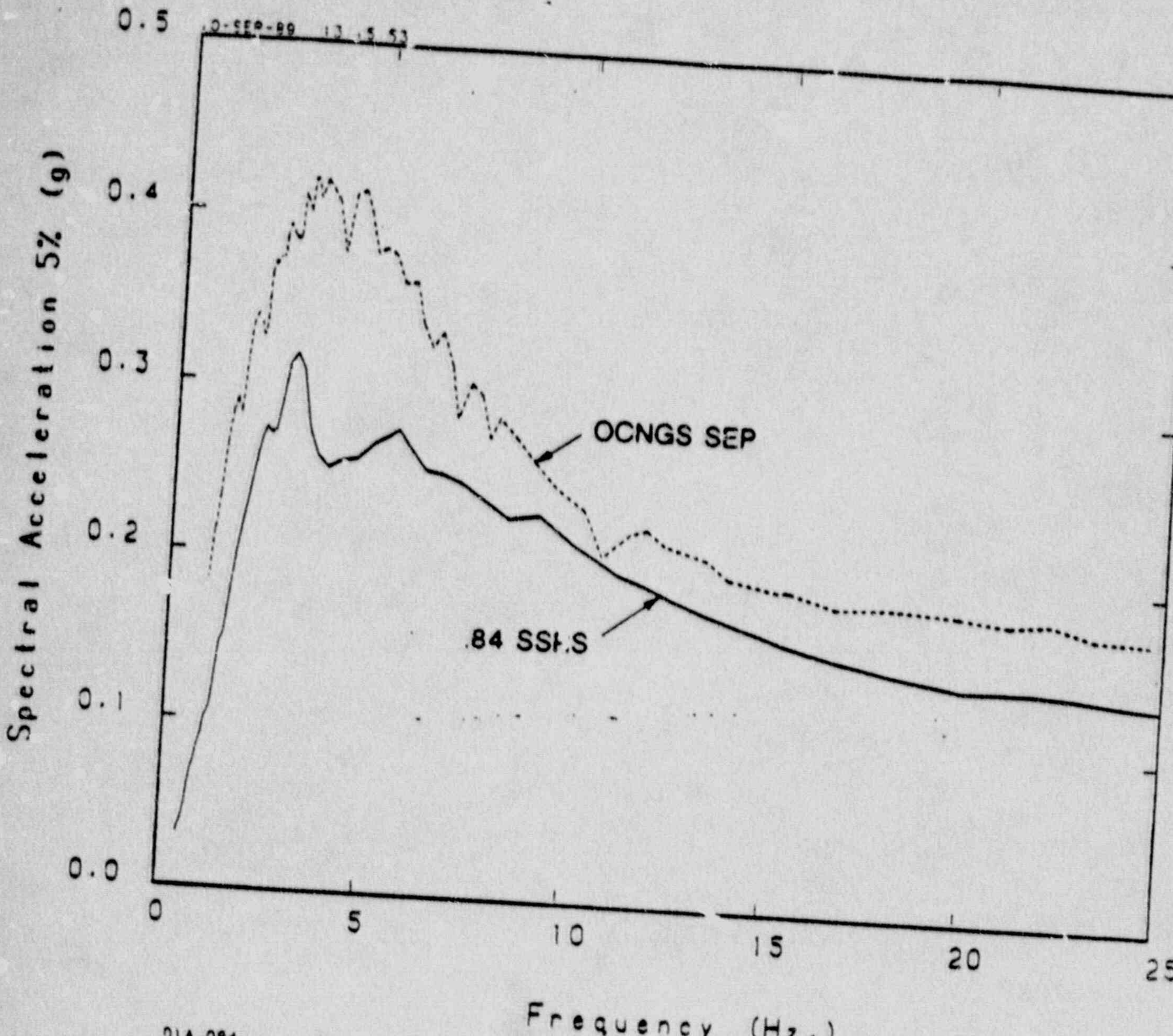
Site Specific Response Spectrum
for the OCNGS: Complete Data Set
Magnitude: 5.3 +/- 0.3
Distance : 15.0 +/- 9.2

Figure 3.12



Site Specific Response Spectrum
for the OCNGS. No Tall Structures
Magnitude: 5.3 +/- 0.3
Distance : 14.4 +/- 9.4

Figure 3.14



DIA.084
CPUHA.050

Site Specific Response Spectrum
for the OCNGS, Distance > 12 km.
Magnitude: 5.4 +/- 0.2
Distance : 22.9 +/- 9.2

Figure 3.16

OCNGS SSRS

CONCLUSIONS

1. EPICENTRAL DISTANCE HAS THE STRONGEST INFLUENCE ON THE FINAL SPECTRUM

2. USE .84 SSRS AS OCNGS SITE SPECIFIC SPECTRA

OCNGS SSRS

RESULT VALIDATION

BASED ON PROBABILISTIC SEISMIC HAZARD ESTIMATE FROM LLNL (NUREG/CR-5250):

OC SEP SPECTRUM LIES NEAR 85TH FRACTILE OF A 10,000 YEAR RETURN PERIOD

PROJECT SCHEDULE

o	PRESENT SSRS TO NRC	SEPTEMBER 1989
o	PRESENT SSI TO NRC (TIME AVAILABLE TO COME TO CLOSURE WITH NRC AND GENERATE ENGINEERING IF NEEDED)	JANUARY 1990
o	ENG RELEASE FOR ANY NEEDED FIELD CHANGE	JULY 1990
o	13R OUTAGE	JANUARY 1991

REPORT OVERVIEW

GEOLOGICAL and SEISMOLOGICAL BACKGROUND

- Review of Geology and Seismicity
- Local Geology & Stratigraphy
- SEP Site Specific Spectrum

SITE SPECIFIC RESPONSE SPECTRA

- Related SSRS Studies
- Data Sources, Quality, Availability
- Sensitivity Analyses
  - Effects of Epicentral Distance
  - Effects of Soil-Structure Interaction
  - Effects of Mis-matched Stratigraphies
- Comparison with Probabilistic Hazard Study
- Observations and Conclusions

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

PROJECT REVIEW

INITIAL MEETING - NRC/NRR - 25 MAY 1988

- Presentation of Initial SSRS Results
- Conclusion:
  "SEP Site-Specific Spectrum for OCNGS was a conservative model for the free-field ground motion at the site."

NRC/NRR STAFF - INITIAL REVIEW COMMENTS

- Certain Records Could Have SSI Effects
- Site Conditions Not Precisely Matched
- Vertical Component SSRS Not Discussed
- Recent Accelerograms Not Included
- Geologic Conditions at Recently Installed Accelerograph Sites Not Discussed

SSRS CRITERIA

Established in letter (Dec. 16, 1987)
to Mr. P. B. Fiedler (GPU)
from Mr. A. W. Dromerick (USNRC)

MAGNITUDE RANGE : 5.3 (+/- 0.5 or less) m_{blg}

DISTANCE RANGE : less than 25 km

SITE CONDITION : Deep Alluvium

RECORD SELECTION PROCEDURE

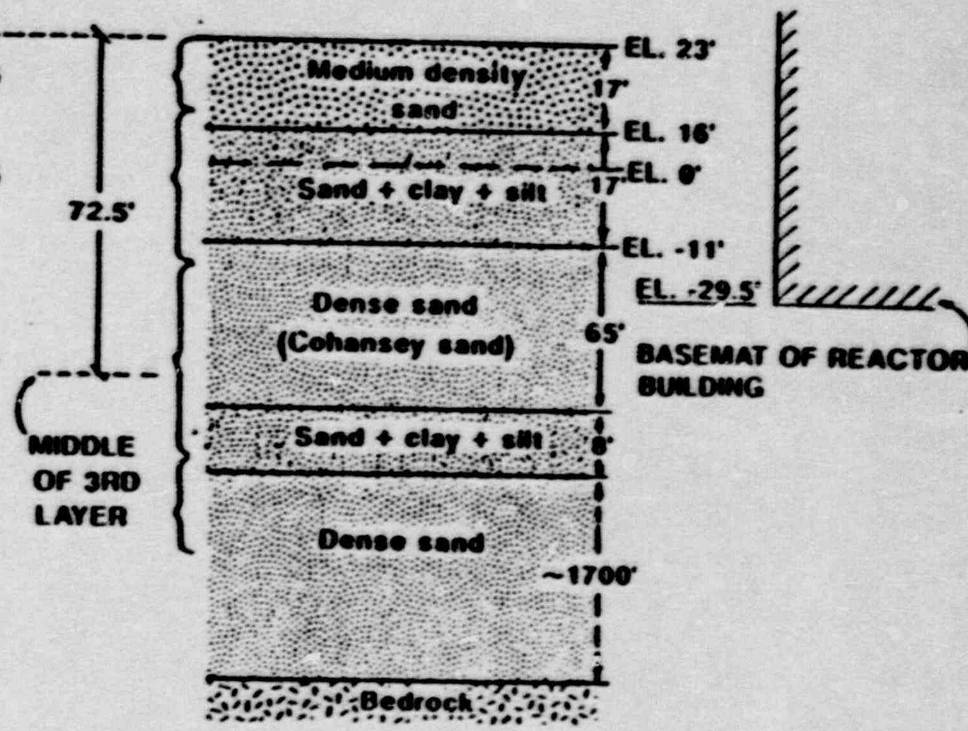
1. Initial search for records in the magnitude range from 4.6 to 5.9 M_L recorded on deep alluvium or alluvium sites at distances less than 40 km.

2. Select most appropriate records for SSRS for the OCNGS by comparison of subsurface conditions for sites that have measured shear wave profiles [e.g. as published in NUREG/CR-1643, /CR-0055 and others, principally for the CIT Vol. 2 Accellerogram data base].

3. Review more recent accelerogram data to identify records that fit the general site condition selection criteria. Accelerograph site conditions are typically reported as Alluvium or Deep Alluvium; no shear wave profiles are given in publications on the more recent strong motion data. Data recorded at sites underlain by Alluvium or Deep Alluvium in the proper magnitude and distance range were compiled for the SSRS analyses.

SOIL SEISMIC WAVE VELOCITY PROFILE
AT OYSTER CREEK PLANT

LAYER NO.	MEASURED P-WAVE VELOCITY VP (FEET/SEC)	MEASURED SHEAR WAVE VELOCITY Vs (FEET/SEC)	POISSON'S RATIO	LAYER DEPTH (FT)
1	1400	600	0.39	15
2	5200	1000	0.48	25
3	5600	1200	0.48	65
4	5900	1400	0.47	35

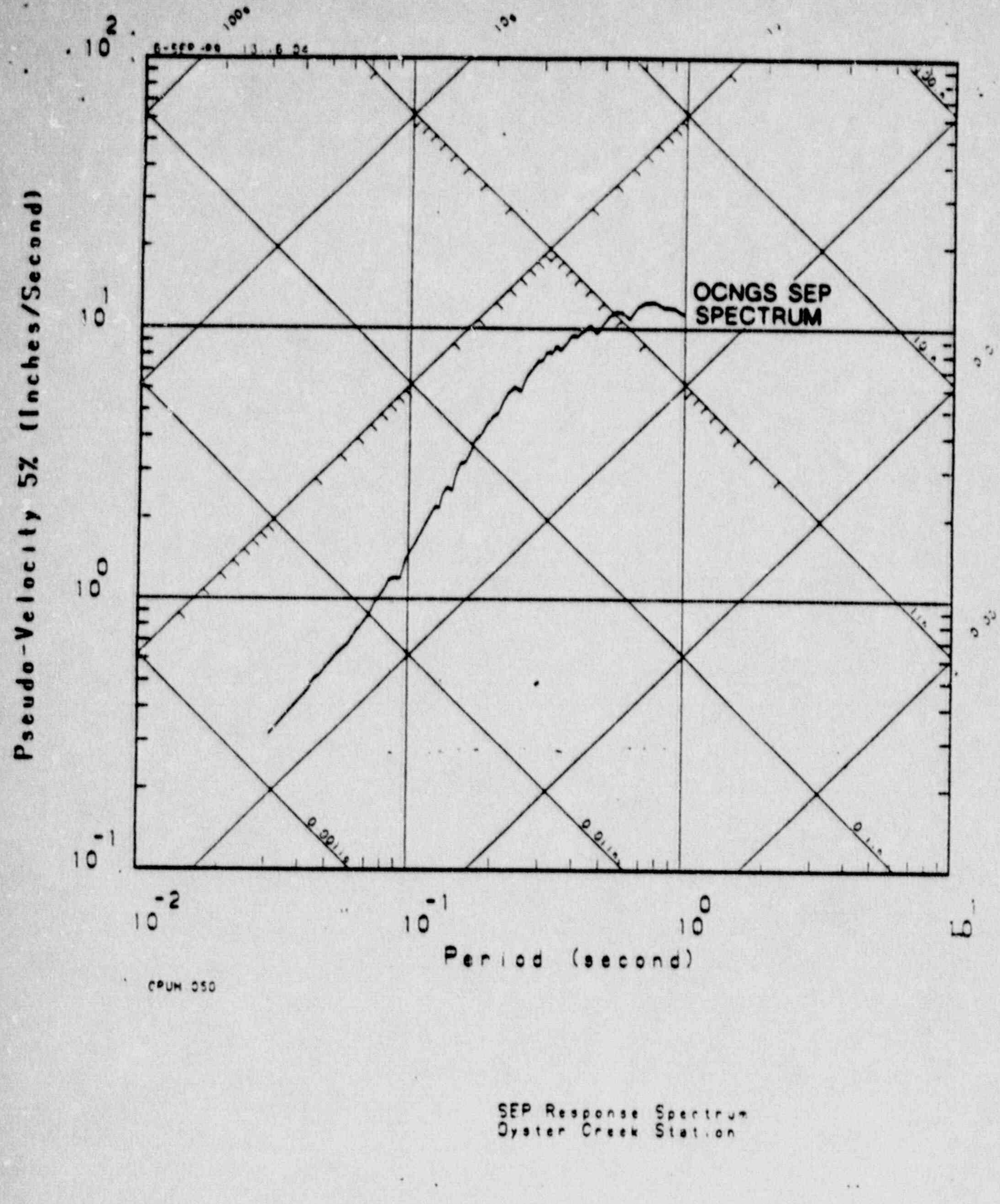


NOTE: WATER TABLE VARIES BETWEEN EL. +3.5' TO +10.0'

Weston Geophysical

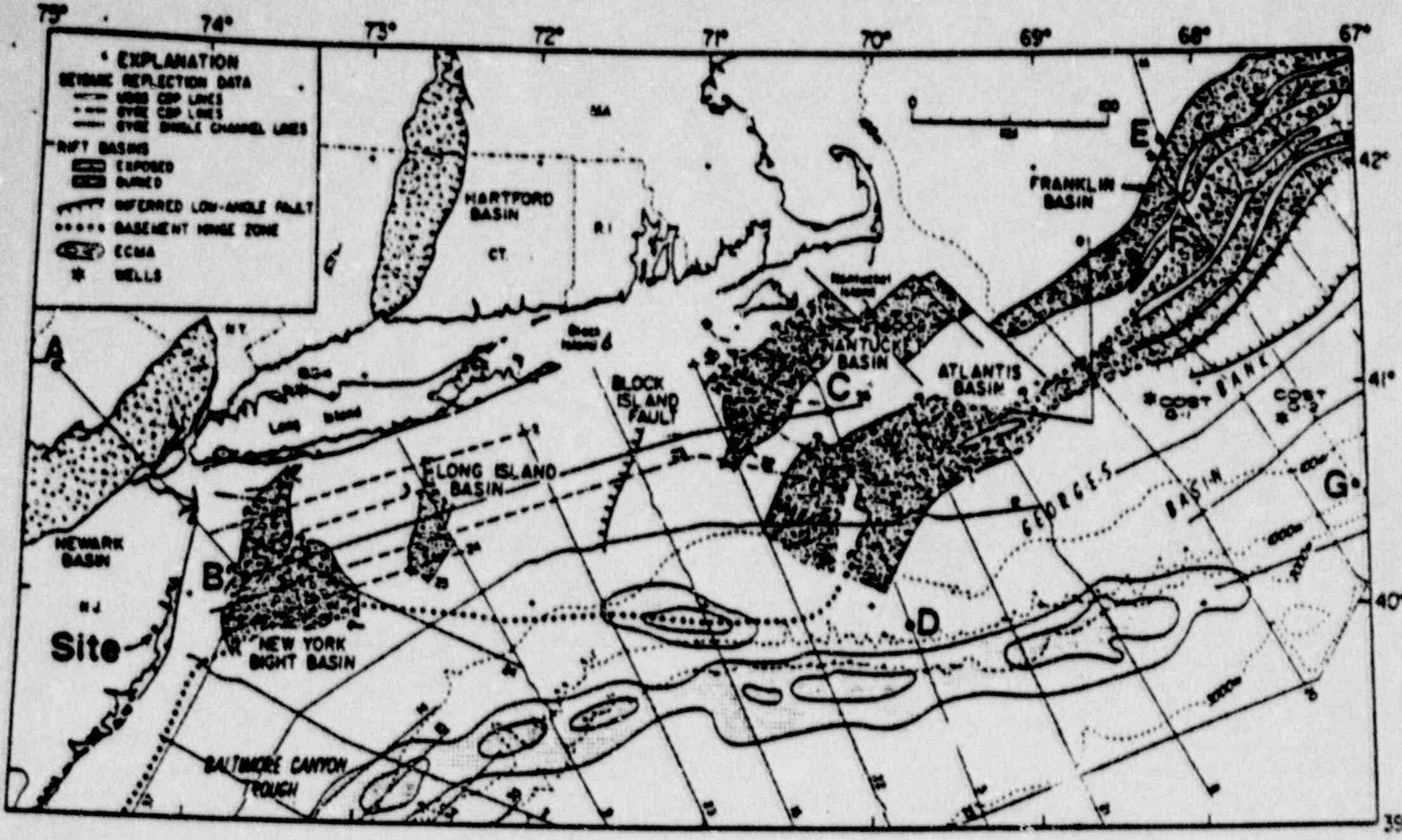
Local Stratigraphic Column
At OCNGS

Figure 2.2

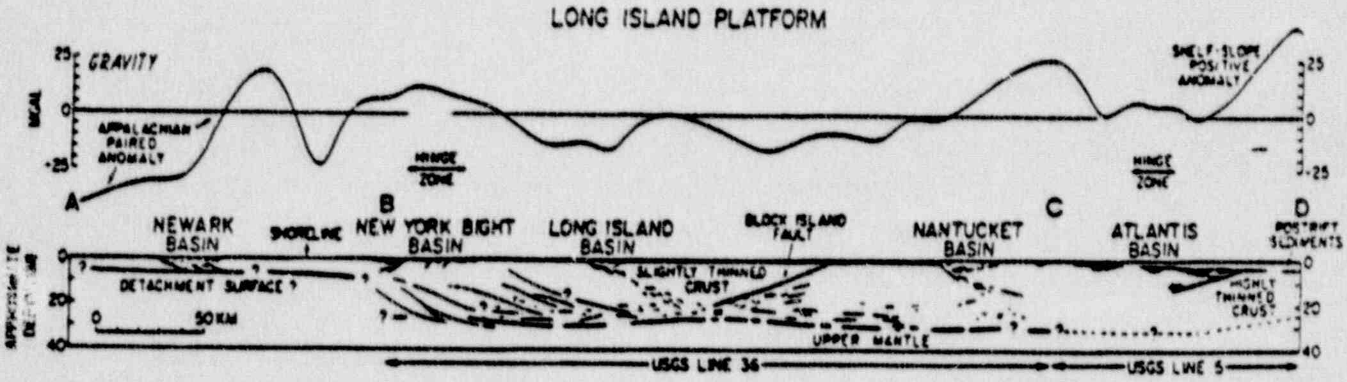


SEP Response Spectrum
Oyster Creek Station

Figure 2.3



Location map of New England and its surrounding continental margin showing exposed and buried rift basins. Tracklines show the distribution of multichannel seismic profiles used in analyzing the buried basins.



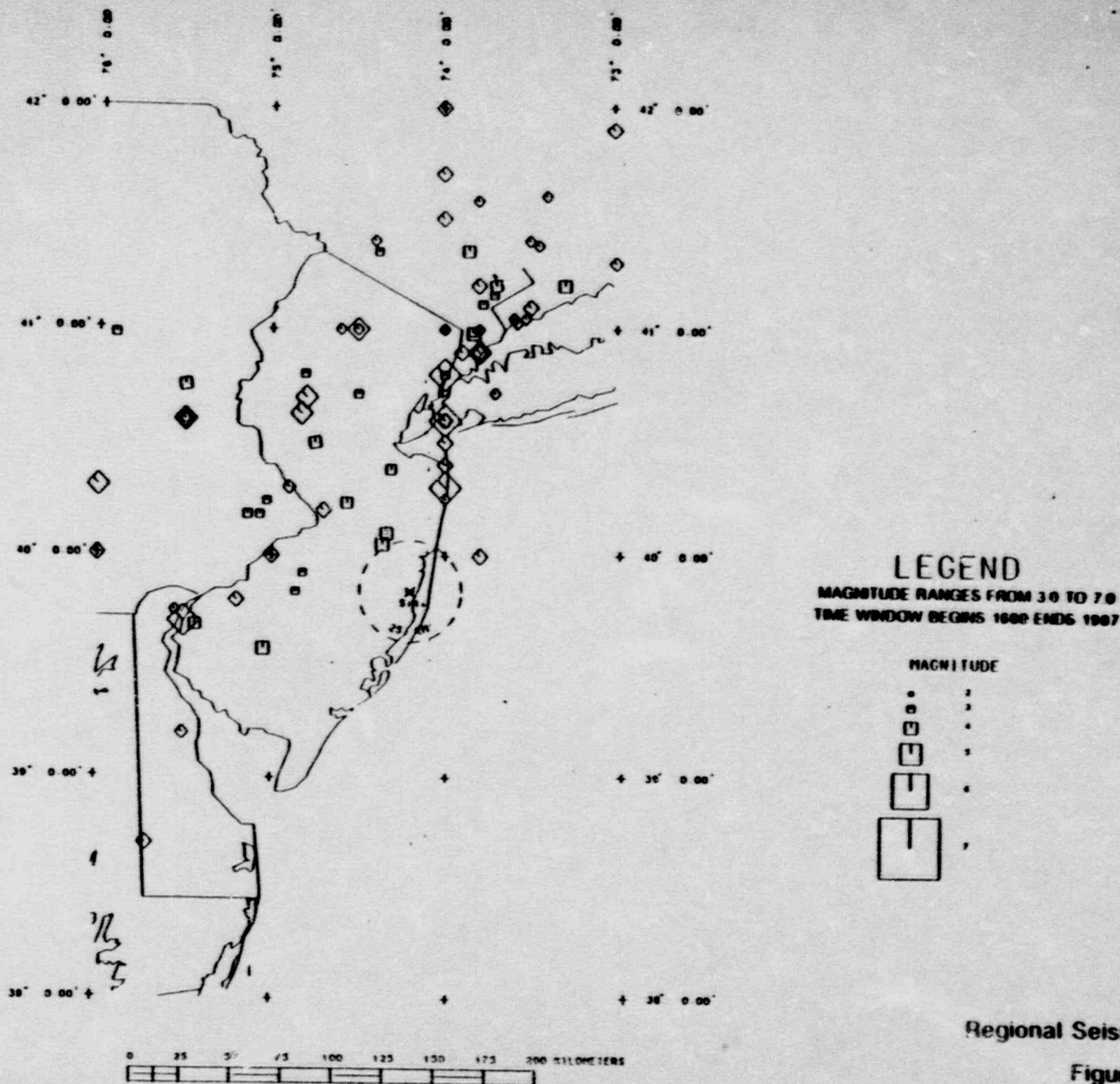
Schematic cross section from the Newark basin in New Jersey across the Long Island platform. From Hutchinson and others (in press).

(reproduced from Hutchinson and Klitgord, 1988)

Regional Tectonic Elements

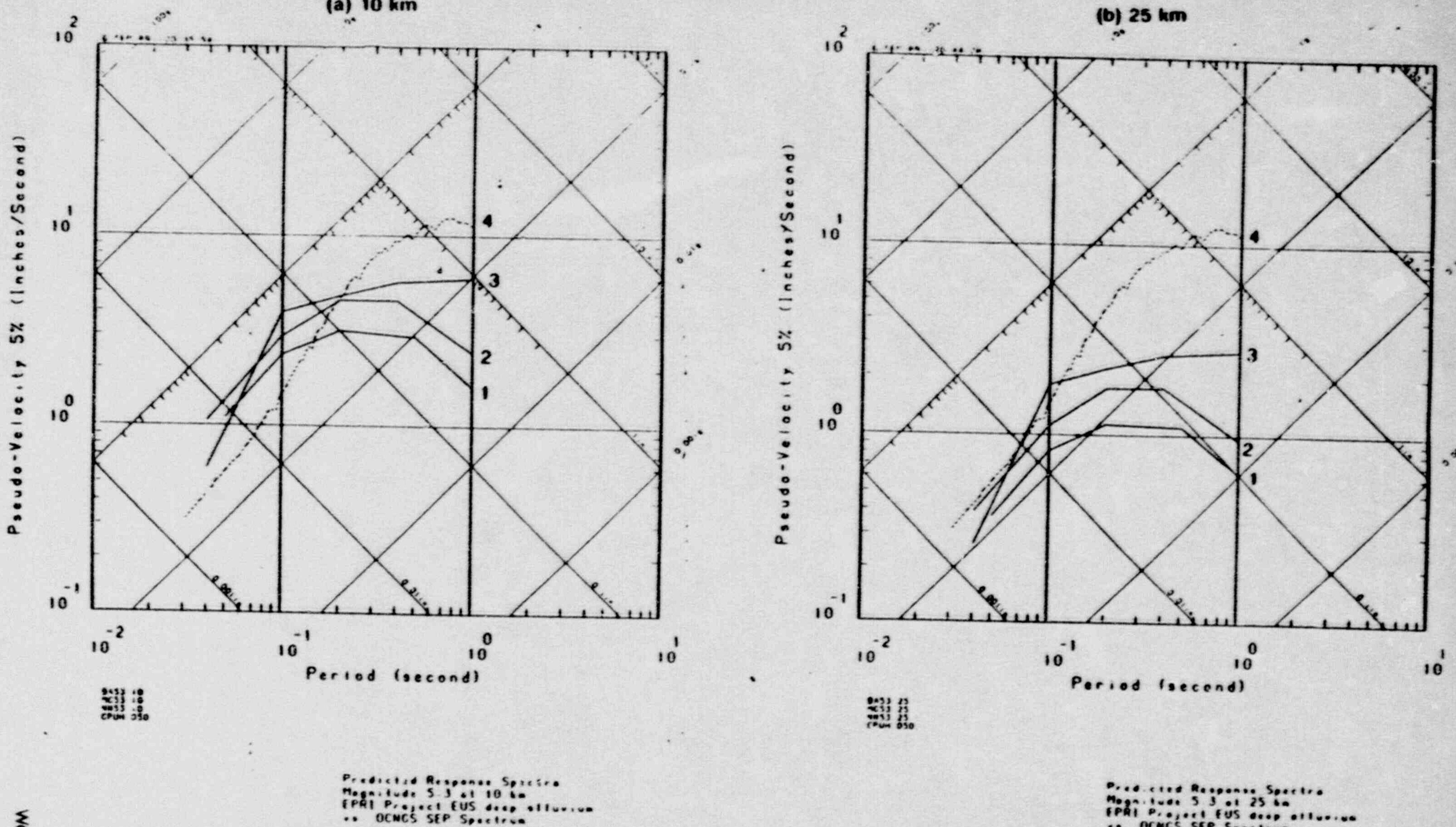
Figure 2.1a

Weston Geophysical



Regional Seismicity

Figure 2.1



1 - Boore and Atkinson
2 - McGuire
3 - Nuttli/Newmark
4 - OCNGS SEP

Deep Soil Amplification Factors Applied to Attenuation Models

Weston Geophysical

Figure 3.3

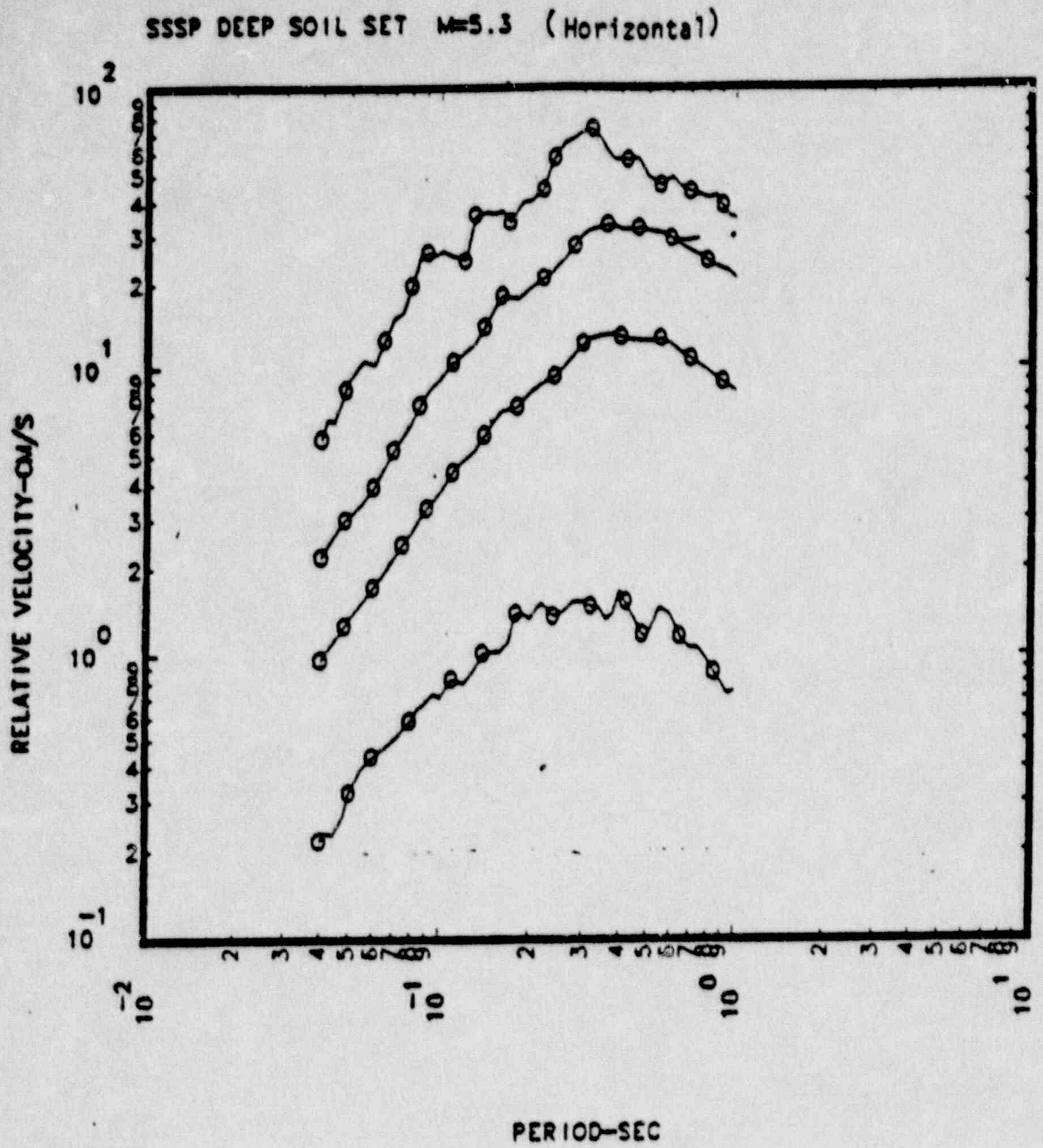
GEOLOGICAL AND SEISMOLOGICAL BACKGROUND

OBSERVATIONS

- Site is Located in Area of Low Seismicity
- No Events within 25 Km (300 Year Record)
- No Known or Inferred Faults Near Site
- Nearest Rift Basin Border Faults (Triassic) > 30-40 Km from Site
- More Seismically Active Region Located > 30 Km West to North of Site

CONCLUSIONS

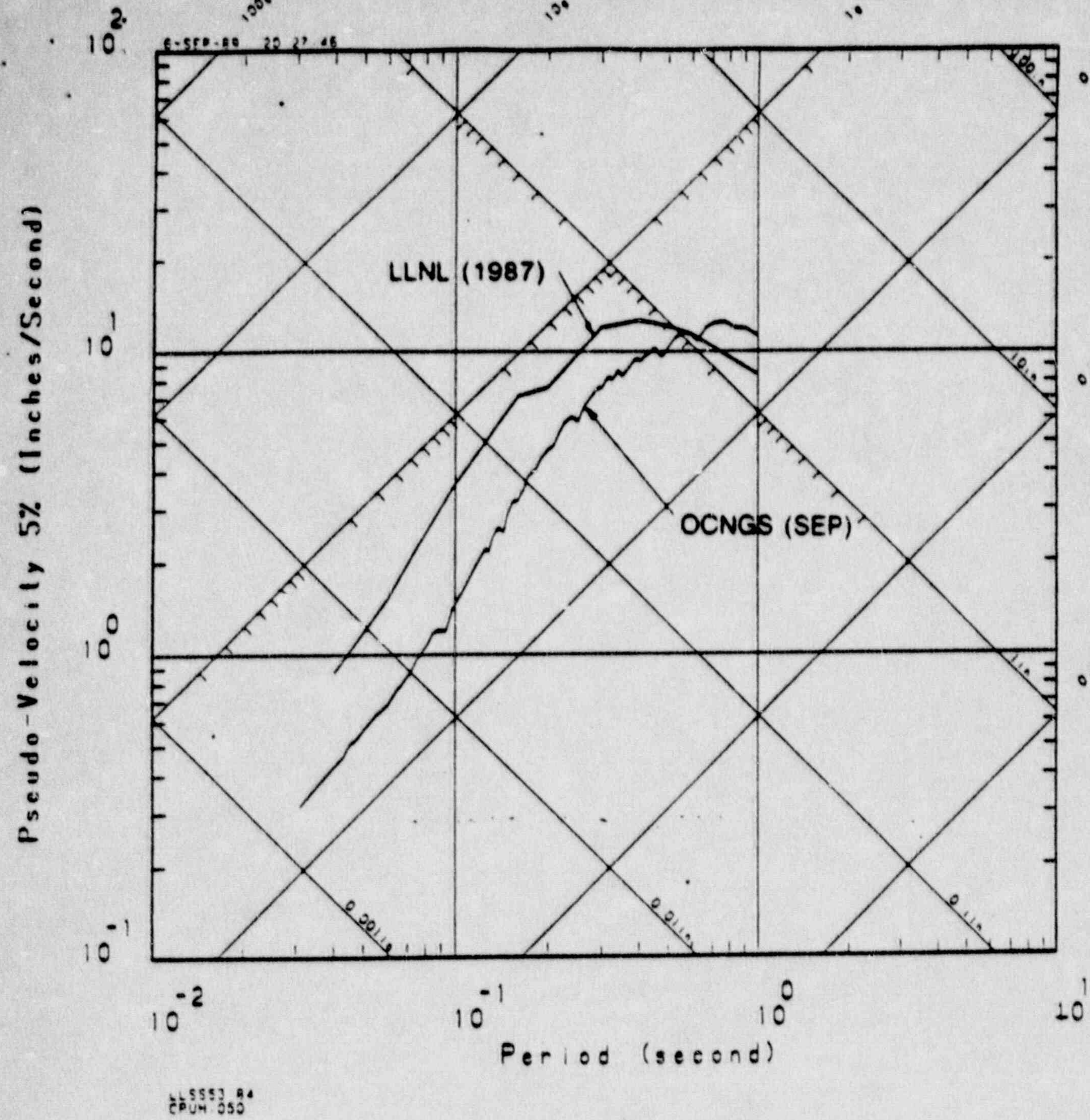
- Seismic Ground Motion at OCNGS Site More Likely to Result from Regional Event, > 25 Km
- Occurrence of Local Event within 10 Km of Site, Assessed to be Extremely Unlikely



Envelope, 84th percentile and median spectra of the set of records falling into the MM VII case for <u>deep</u> soil sites- horizontal components.

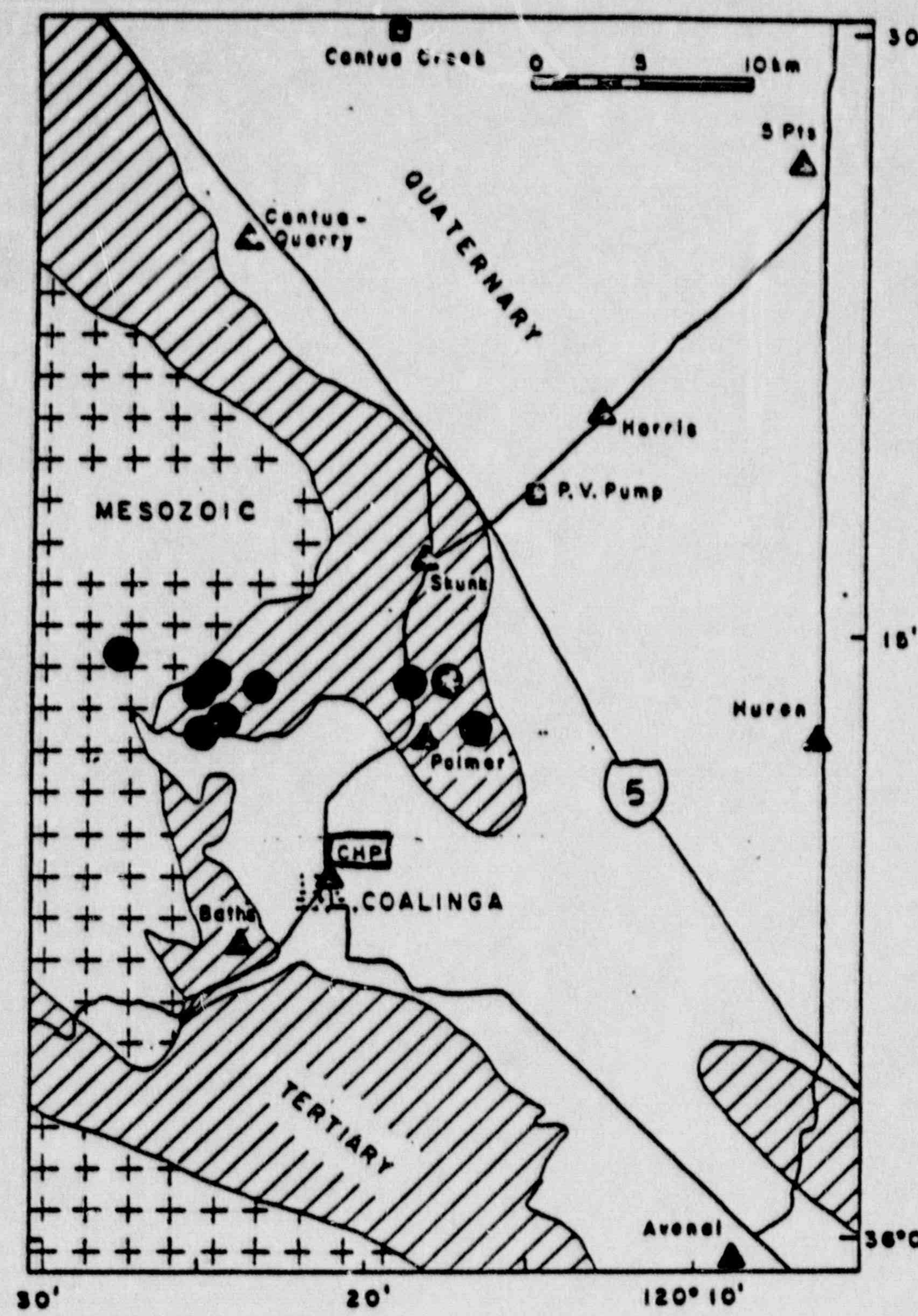
LLNL (1987) Deep Soil SSRS
For M=5.3 Event

Figure 3.1

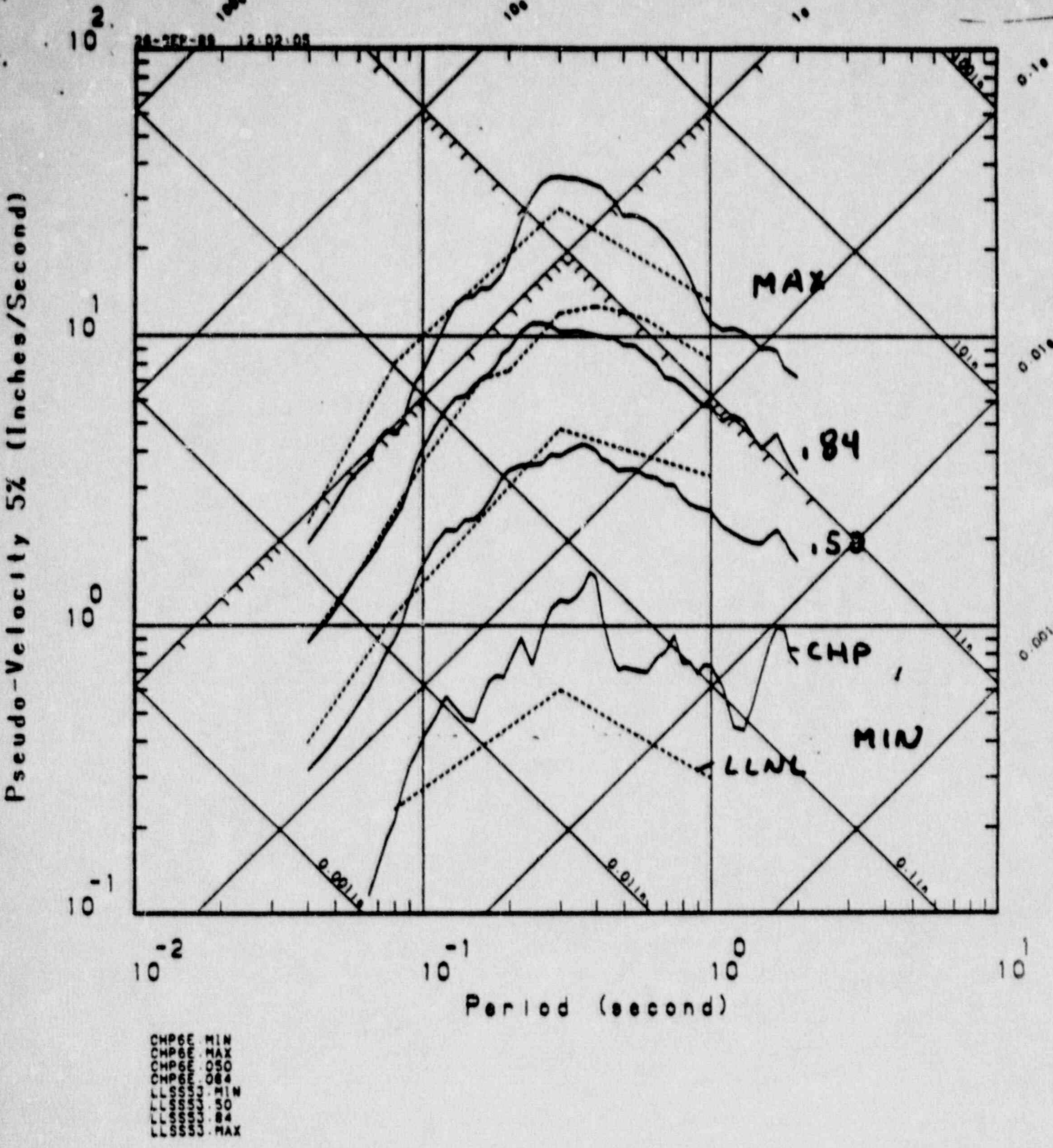


LLNL (Mar 1987) NUREG/CR-4861
SSRS Deep Soil Condition
Magnitude 5.13: Distance 10.9 km
vs. OCNGS SEP Spectrum

Figure 3.2



Accelerograph stations, earthquake epicenters, and local geology in the vicinity of Coalinga. Temporary accelerograph stations (triangles) were deployed to augment the two permanent stations (squares) at Cantua Creek (CDMG) and Pleasant Valley pump station (USGS) which recorded the mainshock. The aftershock epicenters (circles) are numbered from 2 through 9, and are identified in Table 1; the mainshock is indicated by a solid circle.



Site Specific Response Spectrum
LLNL NUREG/CR-4861 Vs.
6 Aftershocks at station CHP
Magnitude: 5.2; Distance: 10 km

CONCLUSIONS

The observed spatial variations of the recorded peak accelerations suggest the following conclusions:

1. The high frequency strong motion amplitudes during the 1 and 4 October 1987 earthquakes in Los Angeles appear to have been very coherent. The variations of the recorded peaks with azimuth and with epicentral distance were governed mainly by the radiation pattern of the earthquake source and by the wave propagation effects through the three-dimensional geology of the area. The proportion of random fluctuations in the recorded peak amplitudes was small, considering that the closest spacing of the adjacent accelerograph stations was more than 2 km.

2. The shape of the average attenuation function and the amplitudes of the observed peak accelerations are consistent with our earlier empirical estimates of the expected peak accelerations for M_L = 5.3 and 5.9 earthquakes in Southern California (Trifunac, 1976).

3. The data presented in this note suggests that if the source mechanism and the effects of the propagation path are introduced into the empirical equations describing attenuation of peak accelerations with distance, that it will be possible to predict peak amplitudes with much higher confidence than what is possible with the presently available methods.

TRIFUNAC (1988)
EQ SPECTRA, Vol. 4, No. 1

CONCLUSIONS

A preliminary analysis of peak horizontal acceleration from the Whittier Narrows earthquake clearly indicates that the ground motions recorded during this earthquake were influenced by a complex interaction of source mechanism, building embedment, site geology, and geography. Source effects may have been responsible for the higher-than-expected accelerations as well as some of the observed azimuthal variation. The correlation of peak acceleration with geography may have been caused in part by the gross geologic structure of the region.

Beyond distances of 20-30 km, the attenuation of peak horizontal acceleration during the Whittier Narrows earthquake was found to be similar to that predicted from the attenuation relationships of Campbell (in press). However, the amplitudes are about 65-percent higher than predicted. Understanding the true causes for the unusually high accelerations will have to await seismological studies of the earthquake, however, it is possible that factors such as a relatively shallow-dipping fault plane, relatively small source dimensions, a relatively large depth of rupture, and an unusually high stress drop may have contributed to this anomaly. Source effects, propagation effects, and/or geologic effects may have contributed to the anomalously high accelerations--relative to other accelerations from the same earthquake--observed at relatively large distances west, east, and north of the epicenter. These azimuths also correspond to lobes in the MM=V intensity contour.

All sites tended to have about the same level of acceleration within about 20 km of the fault, whether they were located on deep soil (>10-m deep), soft rock, or hard rock. Peak accelerations from deep-soil sites fell into clusters that correlated with distance and azimuth.

CAMPBELL, K. W. (1988)
EQ SPECTRA, Vol. 4, No. 1

To see if the observed trends in Figure 9 might be influenced by geography, both *NR* and *R* were plotted as a function of azimuth in Figure 10. This figure indicates that all of the sites beyond 60 km are located north-northwest and east-southeast of the epicenter. Deep-soil sites and soft-rock sites also exhibited relatively high residuals at these azimuths at similar distances. Both of these directions coincide with lobes in the MM=V intensity contour (U.S. Geological Survey, 1987). The northern direction also coincides with an inferred maximum in the shear-wave radiation pattern (Charles Bufe, personal communication, 1987). It is also possible that the relatively high accelerations observed at these distances are the result of multiple phase arrivals and an increased influence of surface waves. Thus, it is inferred that the apparent distance-dependence of the hard-rock residuals--as well as the soft-rock and deep-soil residuals--is due, at least in part, to both source and propagation effects.

Table 3.1

```
*************************************************************
* PROGRAM AVSRS: Response Spectrum Statistics               *
*   OUTPUT FILE: 6SSRSH.OUT                                 *
*          DATE: 10-SEP-85   TIME: 11:26:05   PAGE  1       *
*************************************************************
```

RUN DESCRIPTION..: SSRS for the OCNGS: Complete deep alluvium data set: 4.9 - 5.8 ML

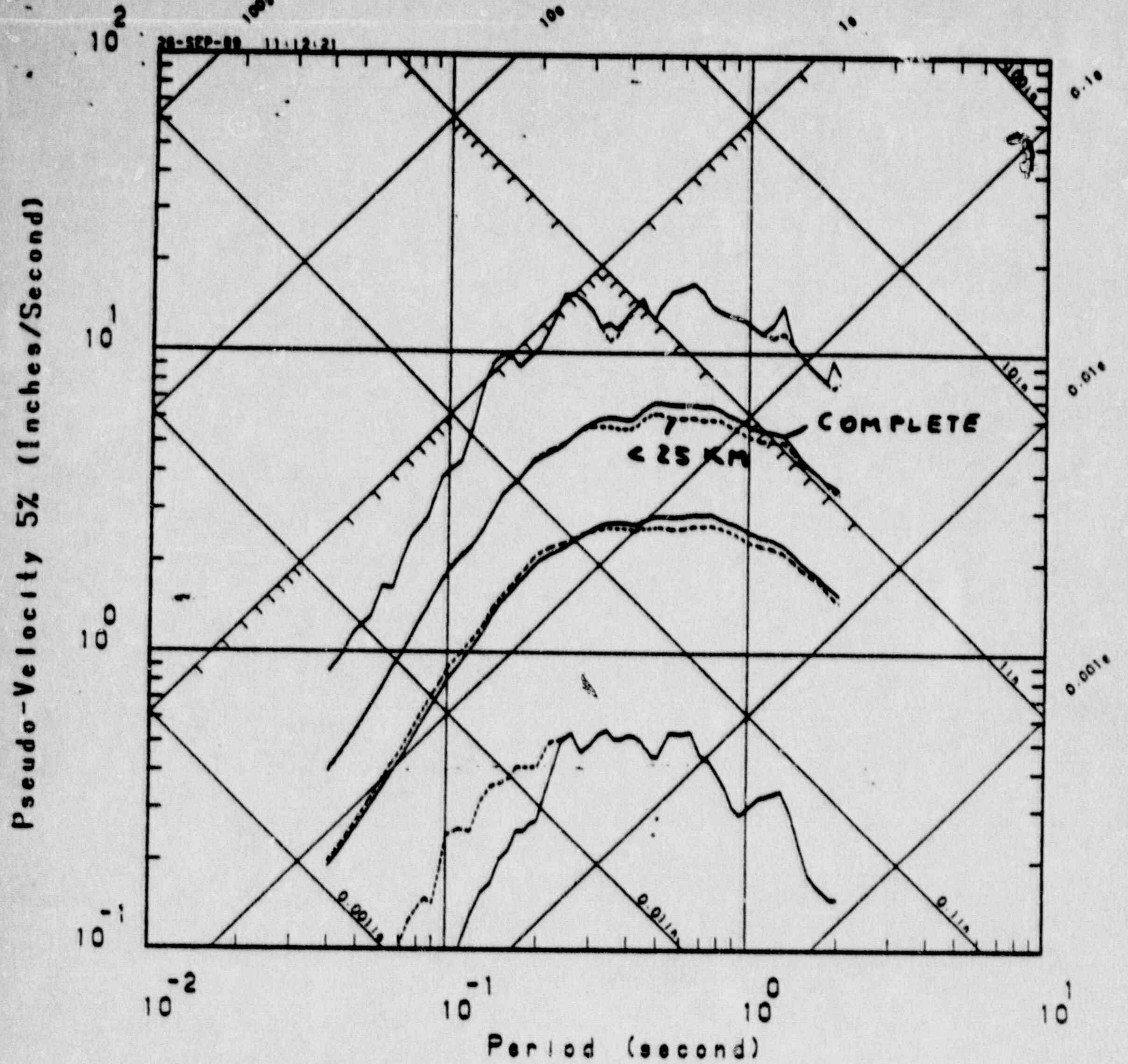
File	Earthquake Identification	Component	Magnitude ML	Distance km	Depth km	PGA cm/sec/sec	PSRV (in/sec) 25	10	1 Hz
WV317M1.050	V317 CHAMBER OF COMMERCE, BSMT., LOS TORRANCE-GARDENA EARTHQUAKE NOV 14,	S50E	5.5	27.1	16.0	14.95	0.04	0.10	1.32
WV317M2.050	V317 CHAMBER OF COMMERCE, BSMT., LOS TORRANCE-GARDENA EARTHQUAKE NOV 14,	S40W	5.5	27.1 26.3→29.9	16.0	11.25	0.03	0.98	1.17
WV316M1.050	V316 PUBLIC UTILITIES BLDG., LONG BEA TORRANCE-GARDENA EARTHQUAKE NOV 14,	NORTH	5.5	5.0	16.0	39.73	0.13	0.31	5.63
WV316M2.050	V316 PUBLIC UTILITIES BLDG., LONG BEA TORRANCE-GARDENA EARTHQUAKE NOV 14,	EAST	5.5	5.0	16.0	53.76	0.14	0.34	7.17
WL301M1.050	U301 PUBLIC LIBRARY, HOLLISTER, CALIF NORTHERN CALIFORNIA EARTHQUAKE MAR 9,	N89W	5.2	29.3	16.0	153.63	0.51	1.43	7.76
WL301M2.050	U301 PUBLIC LIBRARY, HOLLISTER, CALIF NORTHERN CALIFORNIA EARTHQUAKE MAR 9,	S01W	5.2	29.3 30.2→29.3	16.0	119.44	0.39	0.92	5.95
WT287M1.050	T287 EL CENTRO, IMPERIAL VALLEY IRRIG IMPERIAL VALLEY EARTHQUAKE JAN 23, 195	NORTH	5.6	27.5	16.0	39.39	0.09	0.30	2.43
WT287M2.050	T287 EL CENTRO, IMPERIAL VALLEY IRRIG IMPERIAL VALLEY EARTHQUAKE JAN 23, 195	EAST	5.6	27.5 26.9→36.5	16.0	27.56	0.07	0.26	2.52
WT288M2.050	T288 EL CENTRO, IMPERIAL VALLEY IRRIG IMPERIAL VALLEY EARTHQUAKE JUN 13, 195	EAST	5.5	23.6	16.0	35.05	0.09	0.33	3.07
WL305M1.050	U305 PUBLIC LIBRARY, HOLLISTER, CALIF CENTRAL CALIFORNIA EARTHQUAKE APR 25,	N89W	5.4	36.2	16.0	52.02	0.13	0.40	1.91
WL305M2.050	U305 PUBLIC LIBRARY, HOLLISTER, CALIF CENTRAL CALIFORNIA EARTHQUAKE APR 25,	S01W	5.4	36.2 26.9	16.0	40.94	0.12	0.42	3.66
WA010M1.050	A010 SAN JOSE BANK OF AMERICA BASEMEN SAN JOSE EARTHQUAKE SEPT 4, 1955 - 18	N31W	5.5	9.6	16.0	160.16	0.27	0.76	4.43
WA010M2.050	A010 SAN JOSE BANK OF AMERICA BASEMEN SAN JOSE EARTHQUAKE SEPT 4, 1955 - 18	N59E	5.5	9.6	16.0	165.90	0.27	0.93	1.55
WT292M1.050	T292 EL CENTRO, IMPERIAL VALLEY IRRIG IMPERIAL COUNTY EARTHQUAKE DEC 16, 195	NORTH	5.4	23.2	16.0	62.52	0.21	0.93	2.16

Table 3.1 (cont'd)

```
*******************************************************
. PROGRAM AVGRS: Response Spectrum Statistics          .
.   OUTPUT FILE: BSERSM.OLT                            .
.          DATE: 10-SEP-89    TIME: 11:24:05   PAGE  2 .
*******************************************************
```

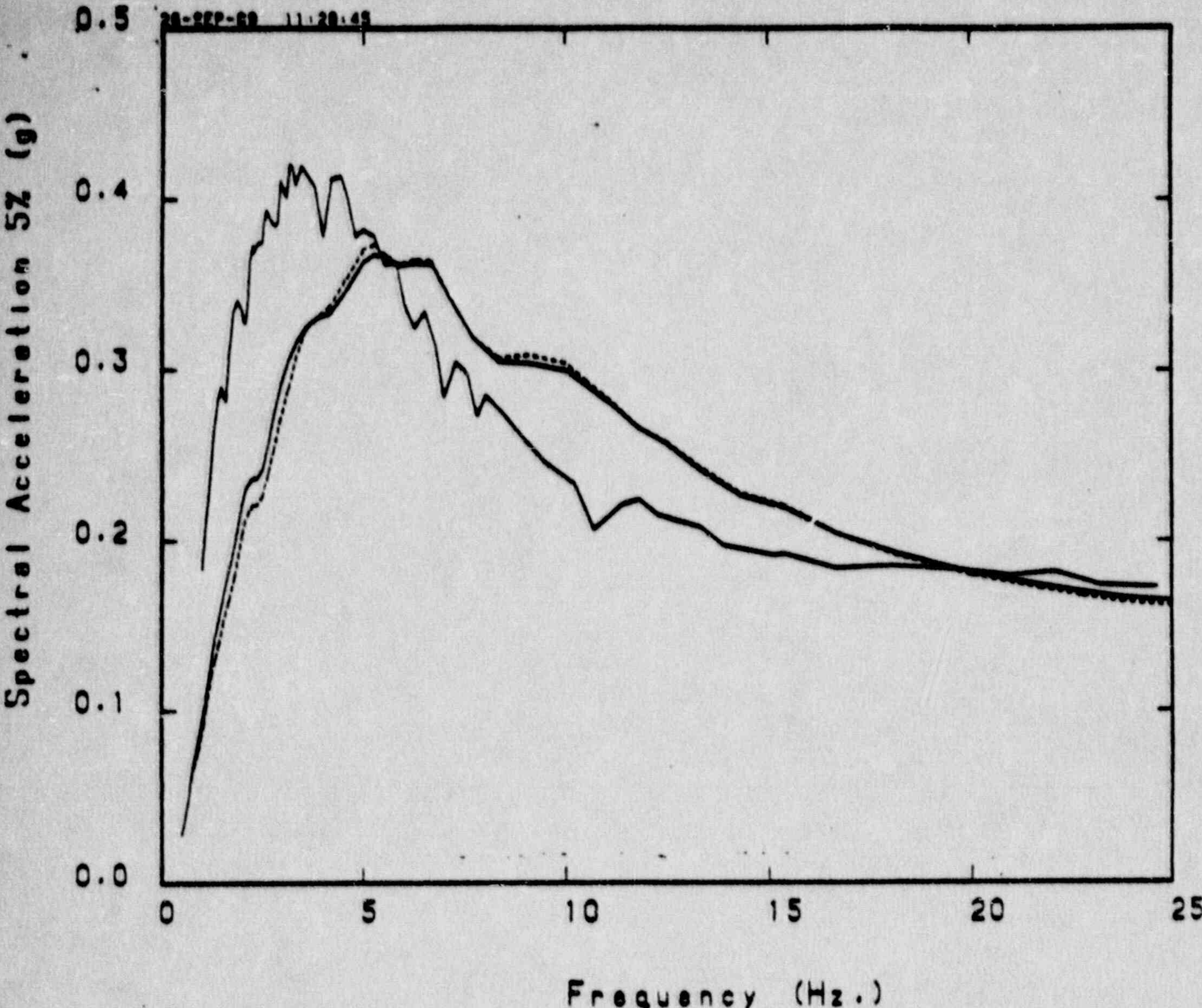
RUN DESCRIPTION..: SSRS for the DCNGS: Complete deep alluvium data set: 4.9 - 5.9 ML

File	Earthquake Identification	Component	Magnitude ML	Distance km	Depth km	PGA cm/sec/sec	PSRV (in/sec) 25	10	1 Hz
W1292H2.050	T292 EL CENTRO, IMPERIAL VALLEY IRRIG IMPERIAL COUNTY EARTHQUAKE DEC 15, 195	EAST	5.4	23.2	16.0	71.96	0.24	0.91	2.29
WA016H1.050	A015 SAN FRANCISCO STATE BLDG BASEMEN SAN FRANCISCO EARTHQUAKE MAR 22, 1957	S09E	5.3	14.2	11.0	83.91	0.23	0.99	1.42
WA016H2.050	A016 SAN FRANCISCO STATE BLDG BASEMEN SAN FRANCISCO EARTHQUAKE MAR 22, 1957	S81W	5.3	14.2	11.0	55.07	0.19	0.65	1.93
WA013H1.050	A013 SAN FRANCISCO SOUTHERN PACIFIC B SAN FRANCISCO EARTHQUAKE MAR 22, 1957	N45E	5.3	16.5	11.0	45.96	0.12	0.41	3.75
WA013H2.050	A013 SAN FRANCISCO SOUTHERN PACIFIC B SAN FRANCISCO EARTHQUAKE MAR 22, 1957	N45W	5.3	16.5	11.0	44.88	0.11	0.36	5.09
WA017H1.050	A017 OAKLAND CITY HALL BASEMENT SAN FRANCISCO EARTHQUAKE MAR 22, 1957	N26E	5.3	24.2	11.0	38.98	0.19	0.35	1.24
WA017H2.050	A017 OAKLAND CITY HALL BASEMENT SAN FRANCISCO EARTHQUAKE MAR 22, 1957	S64E	5.3	24.2	11.0	23.79	0.05	0.30	0.82
WL307H1.050	U307 PUBLIC LIBRARY, HOLLISTER, CALIF CENTRAL CALIFORNIA EARTHQUAKE JAN 19,	N09W	5.0	8.0	24.0	55.52	0.14	0.40	2.61
WL307H2.050	U307 PUBLIC LIBRARY, HOLLISTER, CALIF CENTRAL CALIFORNIA EARTHQUAKE JAN 19,	S01W	5.0	8.9	24.0	35.34	0.11	0.35	2.89
WA018H1.050	A018 HOLLISTER CITY HALL HOLLISTER EARTHQUAKE APR 8, 1961 - 23	S01W	5.7	40.0	11.0	63.41	0.17	0.56	7.39
WA018H2.050	A018 HOLLISTER CITY HALL HOLLISTER EARTHQUAKE APR 8, 1961 - 23	N89W	5.7	40.0 20.9 → 40.0	11.0	175.58	0.45	1.39	9.07
WL312H1.050	U312 CITY HALL, FERNDALE, CALIFORNIA FERNDALE, CALIFORNIA, EARTHQUAKE DEC	N46W	5.8	38.6	15.0	165.97	0.29	1.21	7.72
WL312H2.050	U312 CITY HALL, FERNDALE, CALIFORNIA FERNDALE, CALIFORNIA, EARTHQUAKE DEC	S44W	5.8	30.6 22.9 → 37.6	15.0	222.37	0.41	2.34	5.57
WPECA1H1.050	NEOA1 MANAGUA NICARAGUA ESSO REFINERY MANAGUA AFTERSHOCK DEC 23, 1972 - 0718	SOUTH	5.8	5.7	9.0	171.77	0.43	1.38	2.65



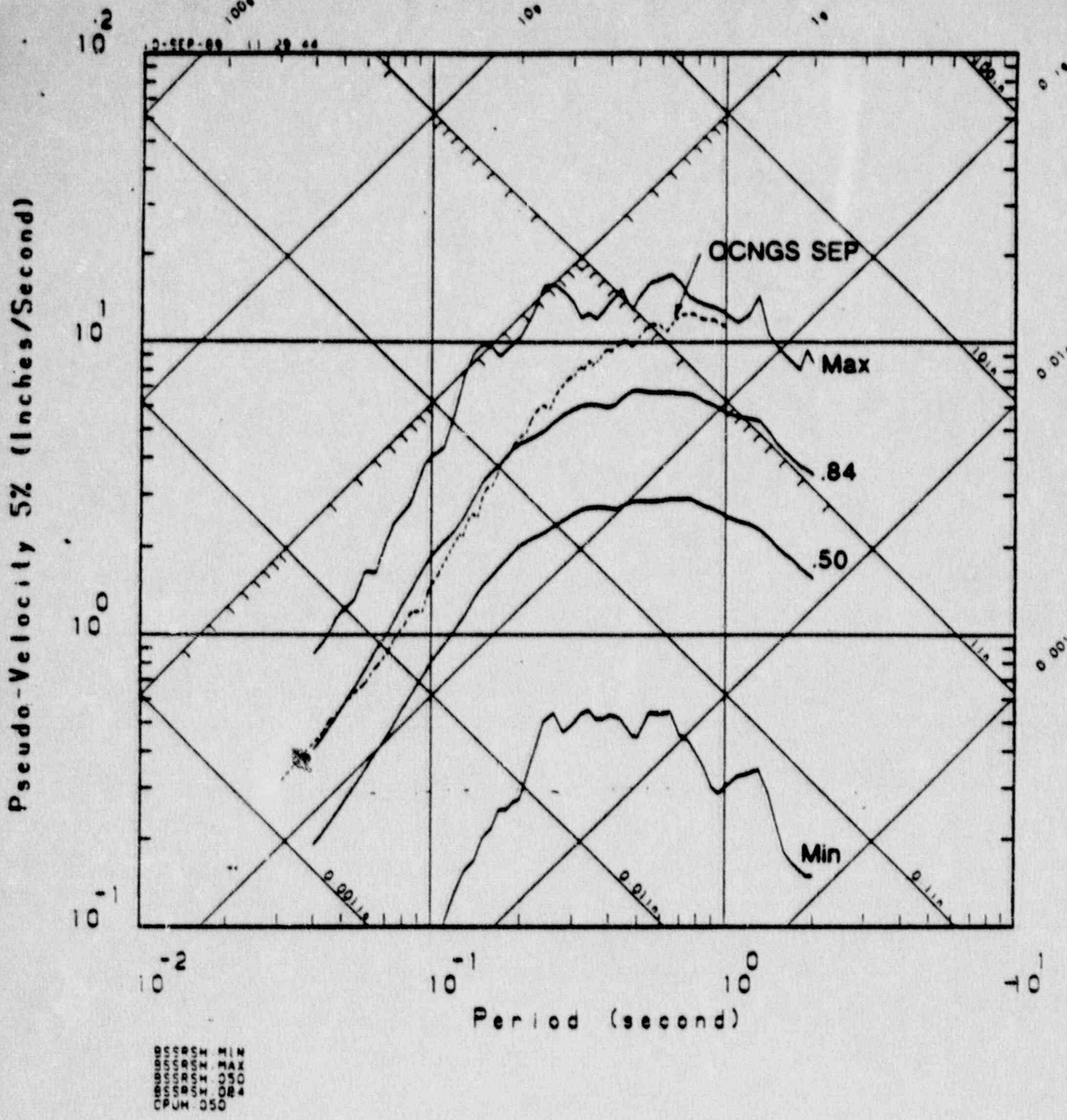
HSET1.MIN
HSET1.MAX
HSET1.050
HSET1.084
HSET1L25.MIN
HSET1L25.050
HSET1L25.084
HSET1L25.MAX

Horizontal Component SSRS
Complete set vs. records < 25km
Magnitude: 5.3; Distance: 15.0
Magnitude: 5.2; Distance: 12.0



MSETIA.084
CPUWA.050
MSETIL25A.084

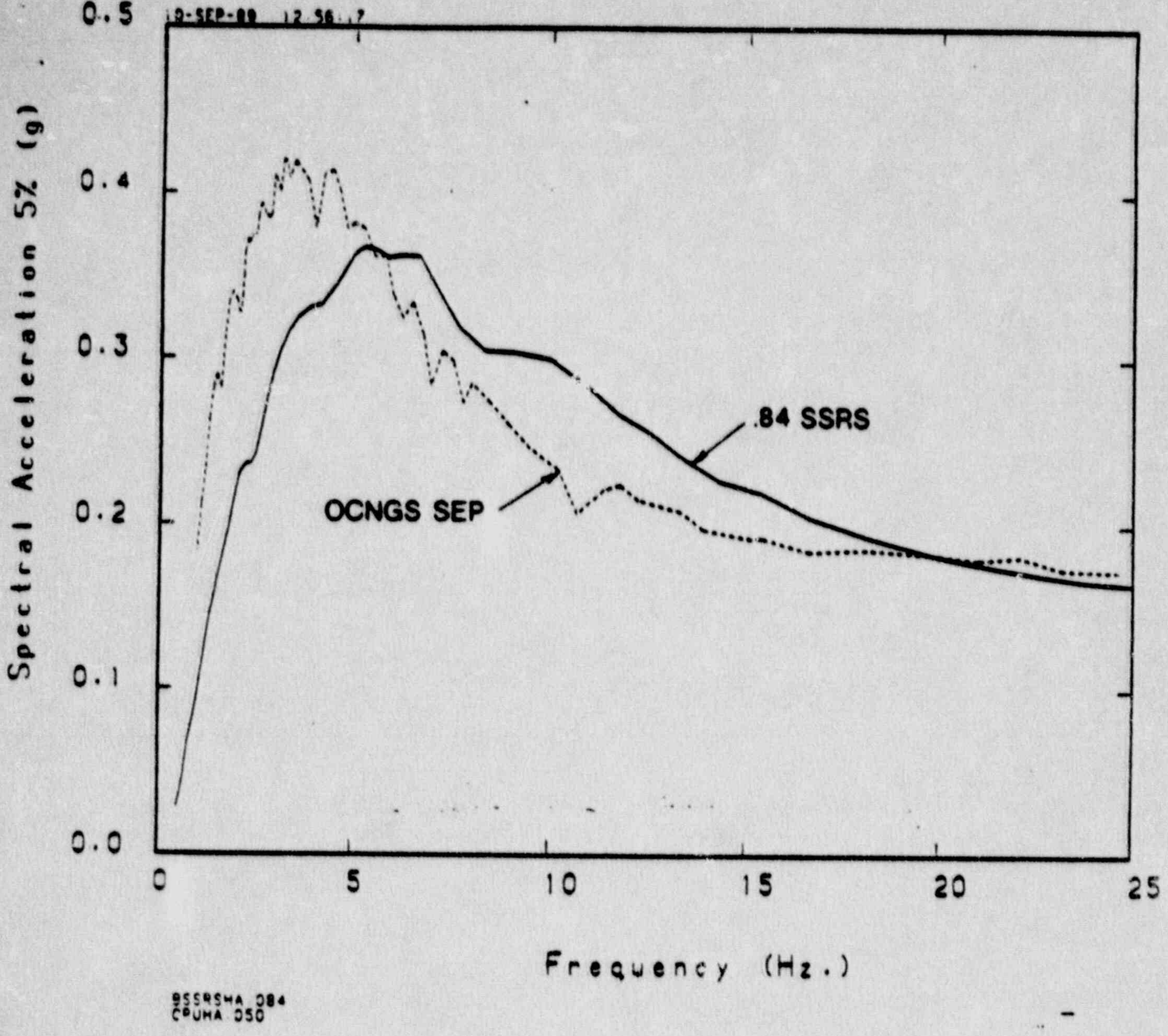
Horizontal SSRS for the OCNGS
Complete data set vs. < 25 km
Magnitude: 5.3; Distance: 15.0
Magnitude: 5.2; Distance: 12.0



Site Specific Response Spectrum
for the OCNGS: Complete Data Set
Magnitude: 5.3 +/- 0.3
Distance : 15.0 +/- 9.2

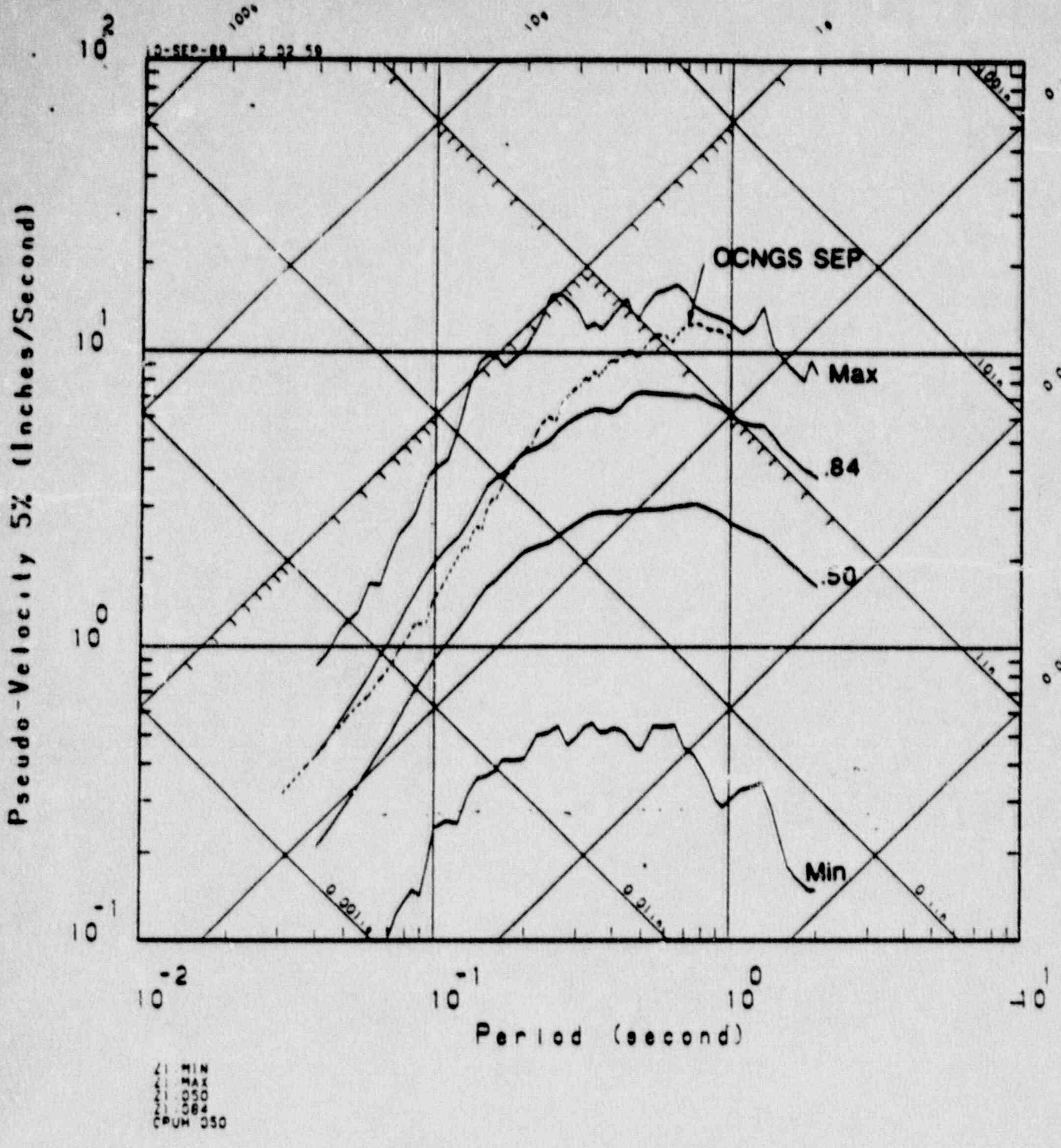
Figure 3.11

Weston Geophysical



Site Specific Response Spectrum
for the OCNGS: Complete Data Set
Magnitude: 5.3 +/- 0.3
Distance : 15.0 +/- 9.2

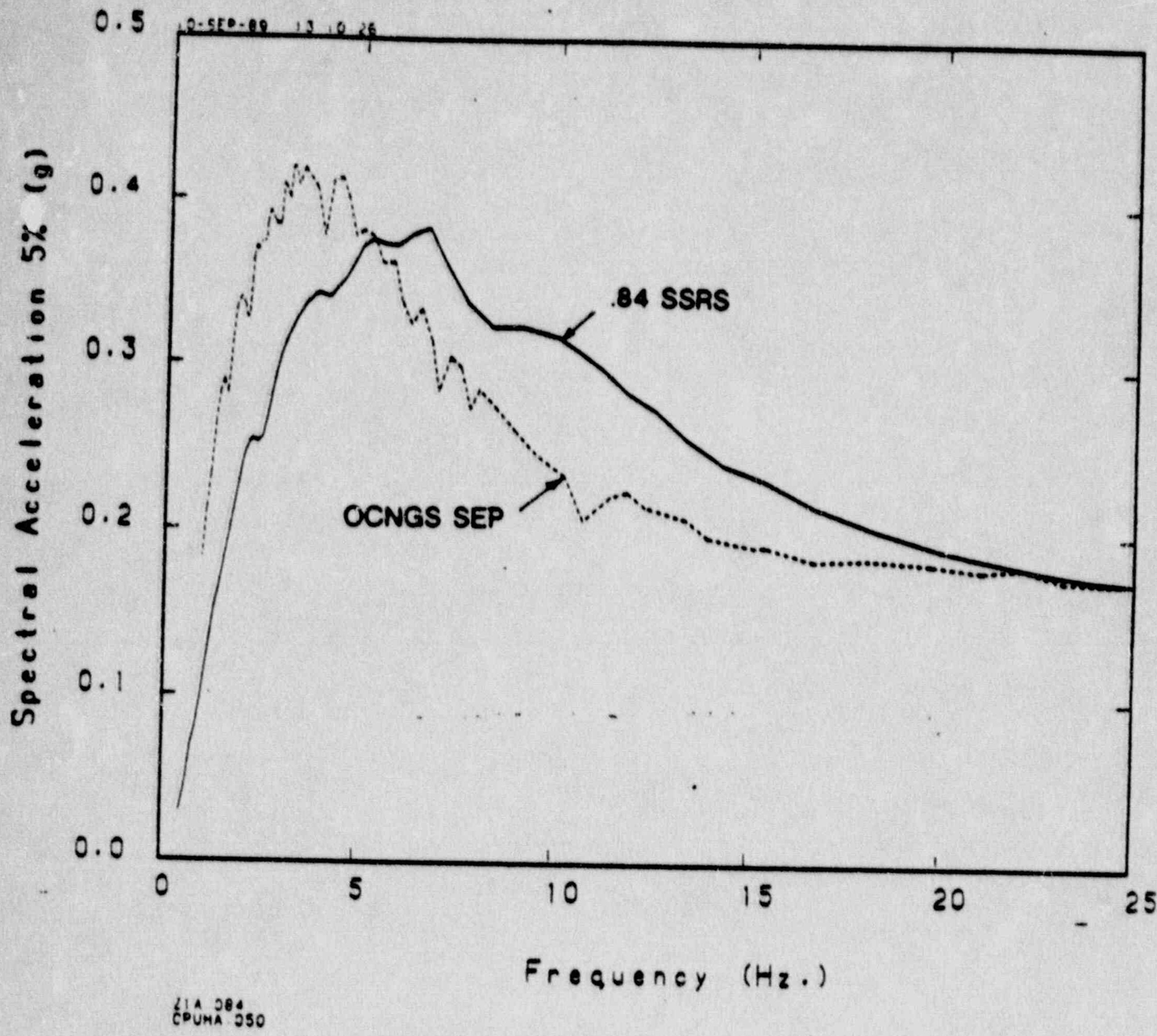
Figure 3.12



Site Specific Response Spectrum
for the OCNGS: No Tall Structures
Magnitude: 5.3 +/- 0.3
Distance : 14.4 +/- 9.4

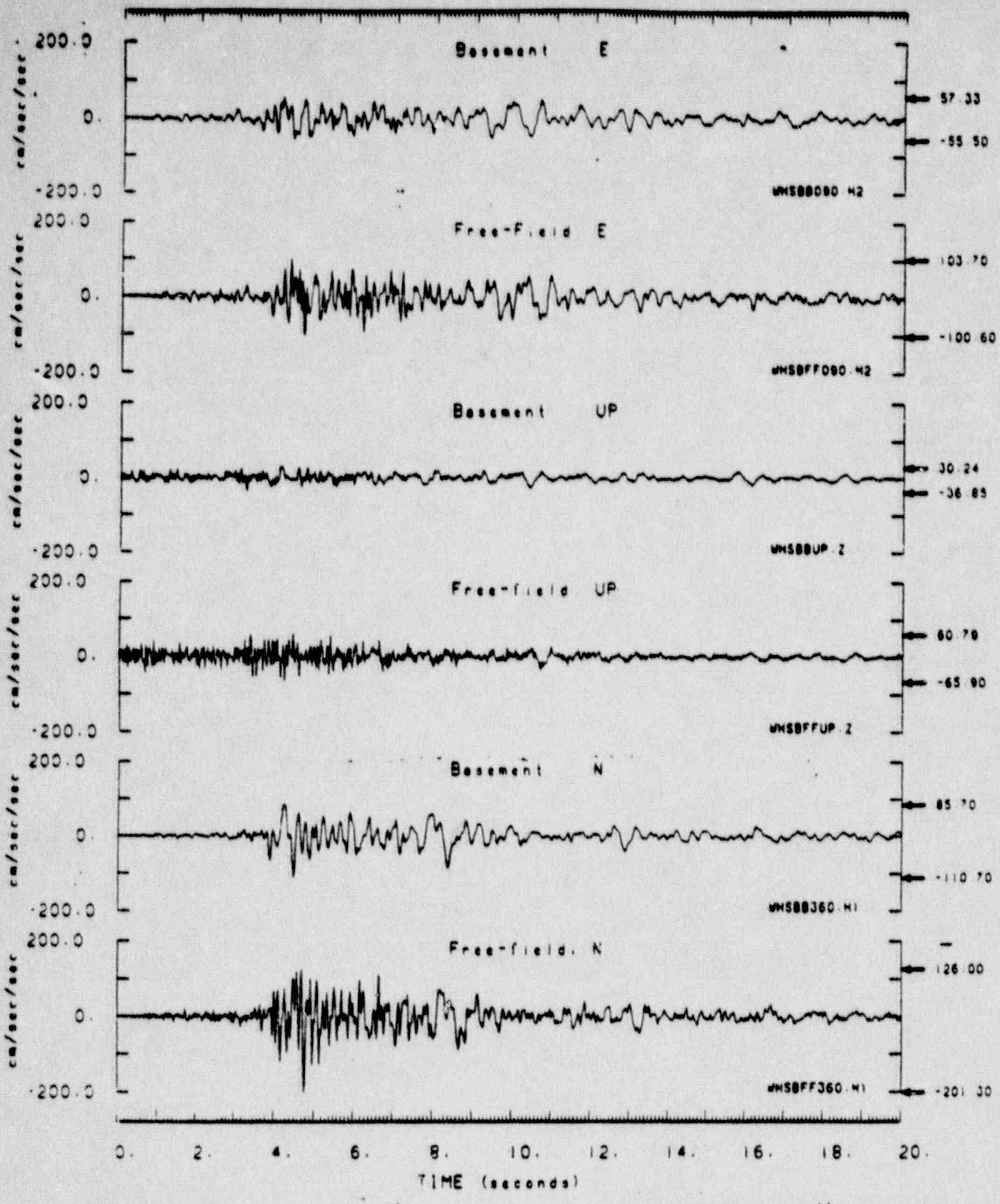
Figure 3.13

Weston Geophysical



Site Specific Response Spectrum
for the OCNGS, No Tall Structures
Magnitude: 5.3 +/- 0.3
Distance : 14.4 +/- 9.4

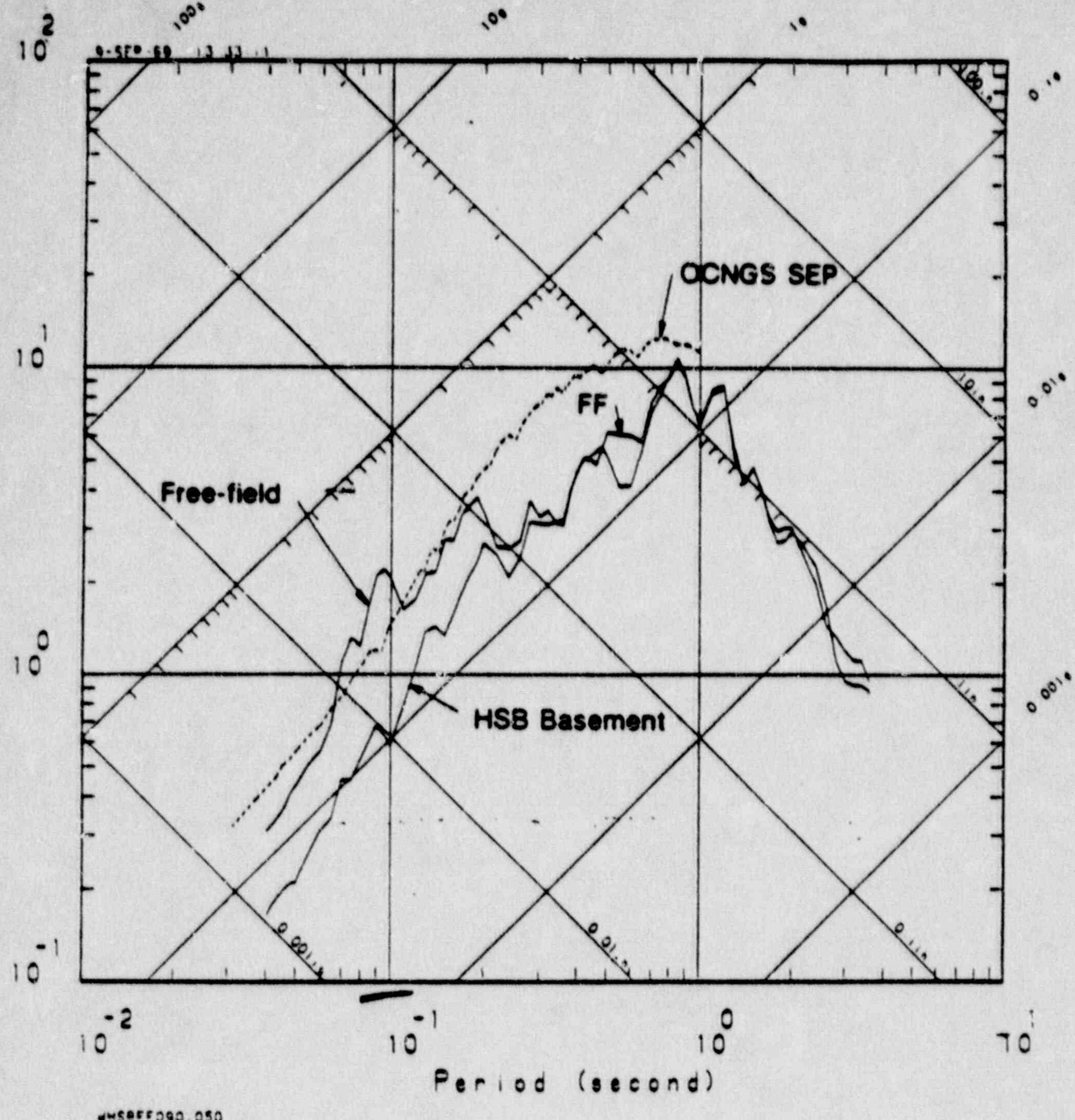
Figure 3.14



Free-Field vs. Basement Accelerograms
at the Hollywood Storage Building
Whittier Main Shock
6.1 M_L at 33 Km

Figure 3.7

Weston Geophysical

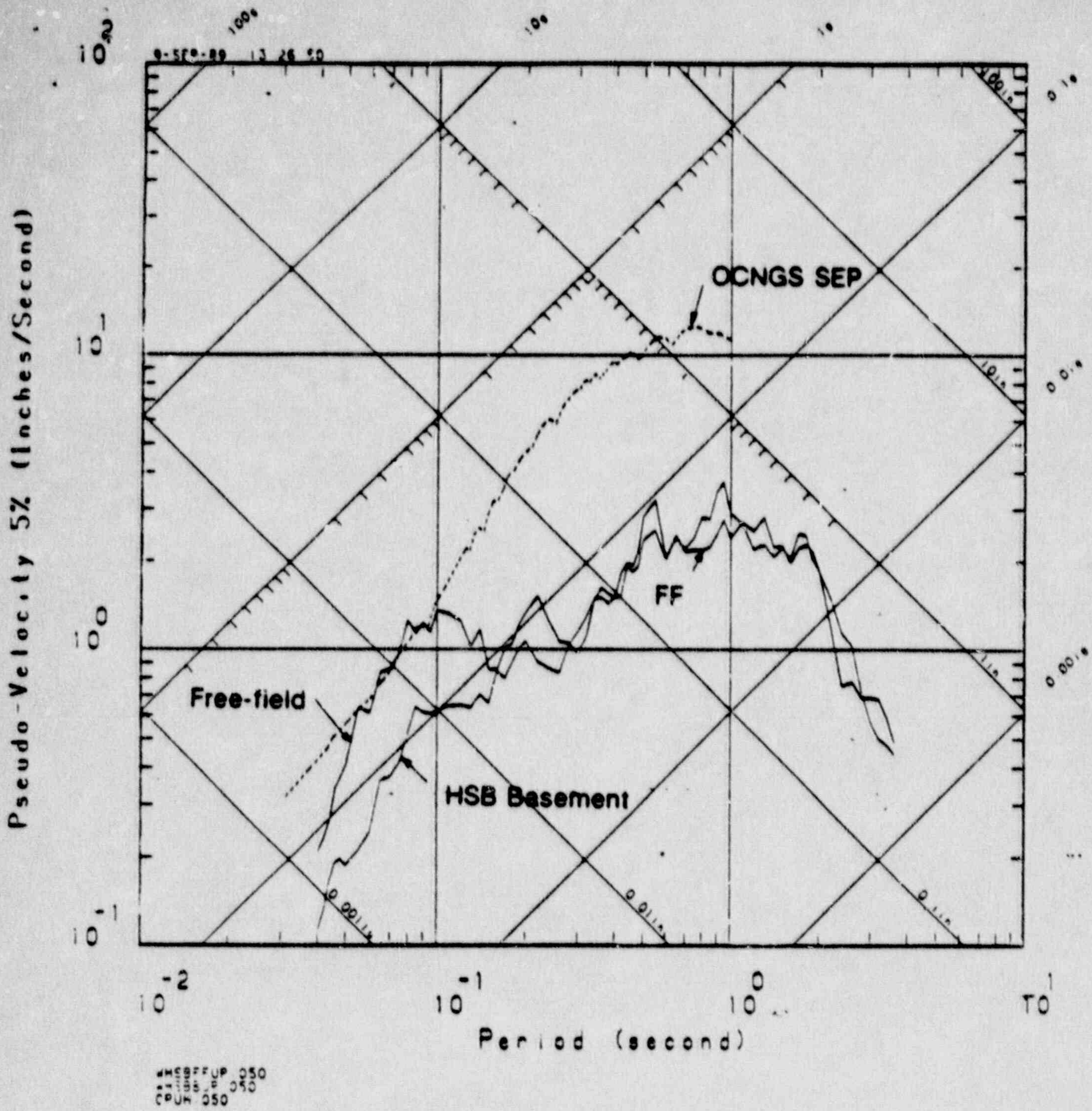


WHSBFF090.050
CPUH 050

Hollywood Storage Building
Soil Structure Interaction
Whittier Main Shock. E Comp.
Magnitude 6.1 ML at 33.1 Km

Figure 3.10

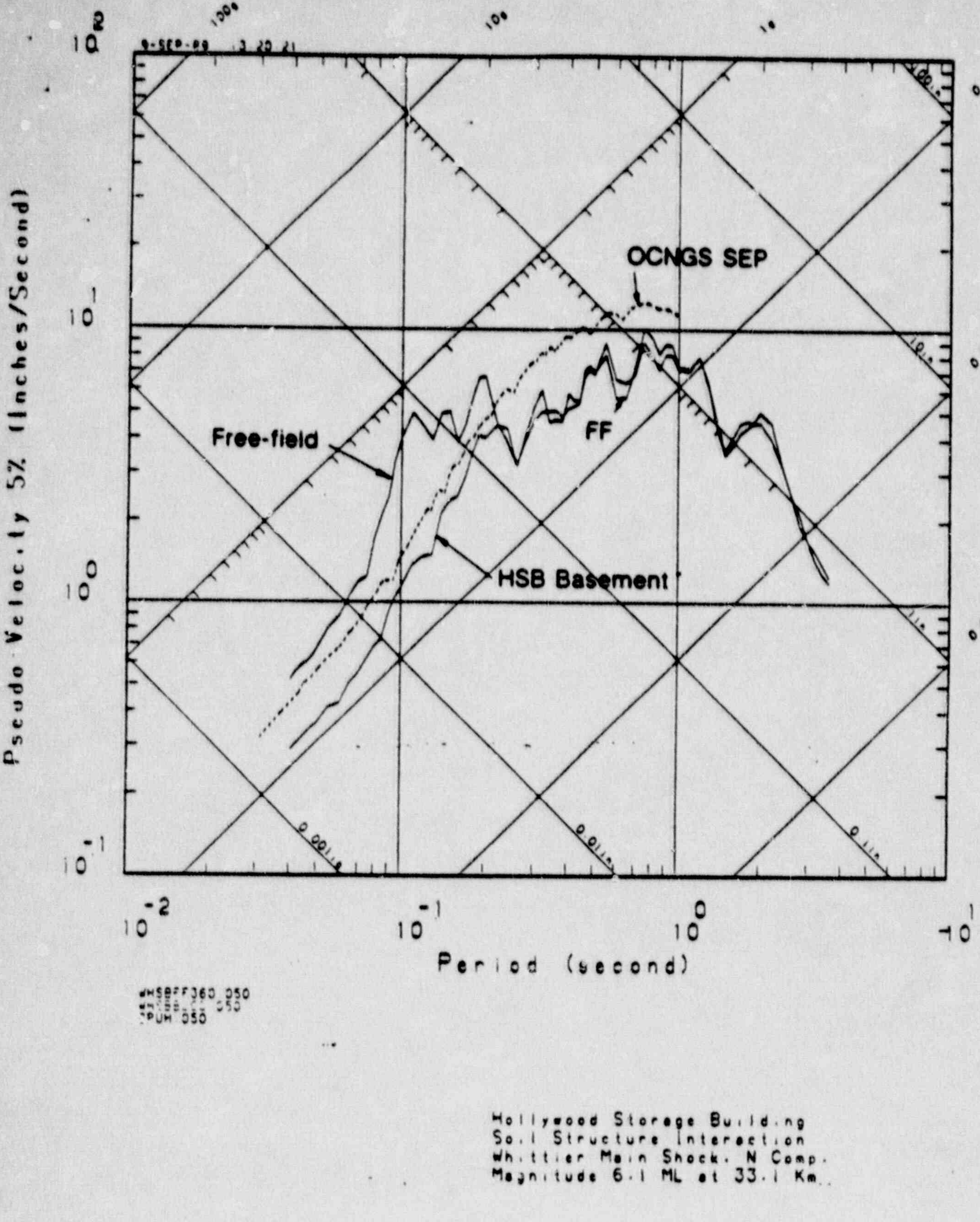
Weston Geophysical



Hollywood Storage Building
Soil Structure Interaction
Whittier Main Shock, UP Comp.
Magnitude 6.1 ML at 33.1 Km

Figure 3.9

Weston Geophysical



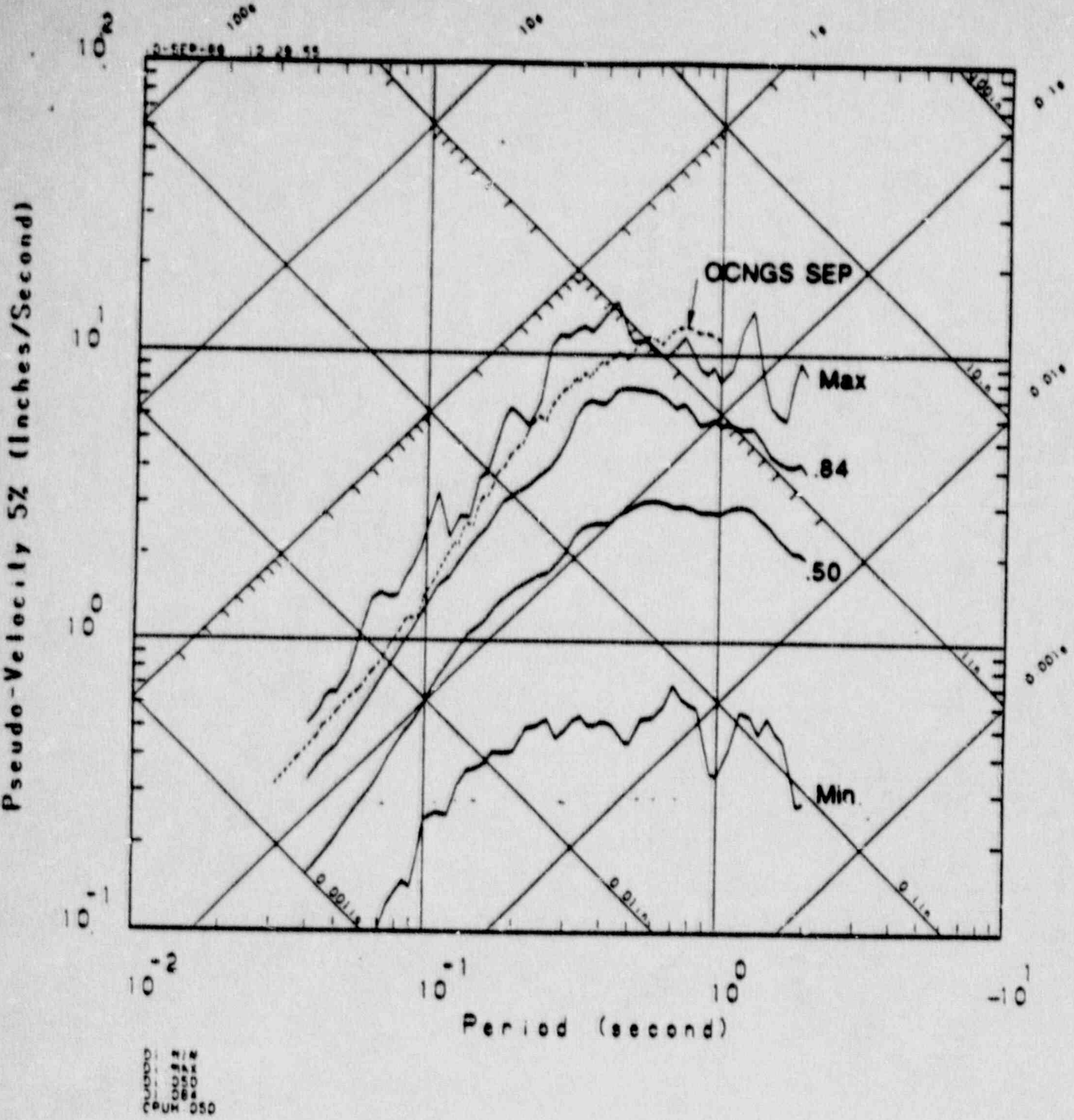
Hollywood Storage Building
Soil Structure Interaction
Whittier Main Shock, N Comp.
Magnitude 6.1 ML at 33.1 Km.

Figure 3.8

Weston Geophysical

Building Height. Plots of *NR* versus building height are displayed in Figure 11. For this purpose, building height is characterized by number of stories, and embedded and ground-level sites have been combined in a single plot. The plots fail to indicate any significant dependence of the residuals on building height.

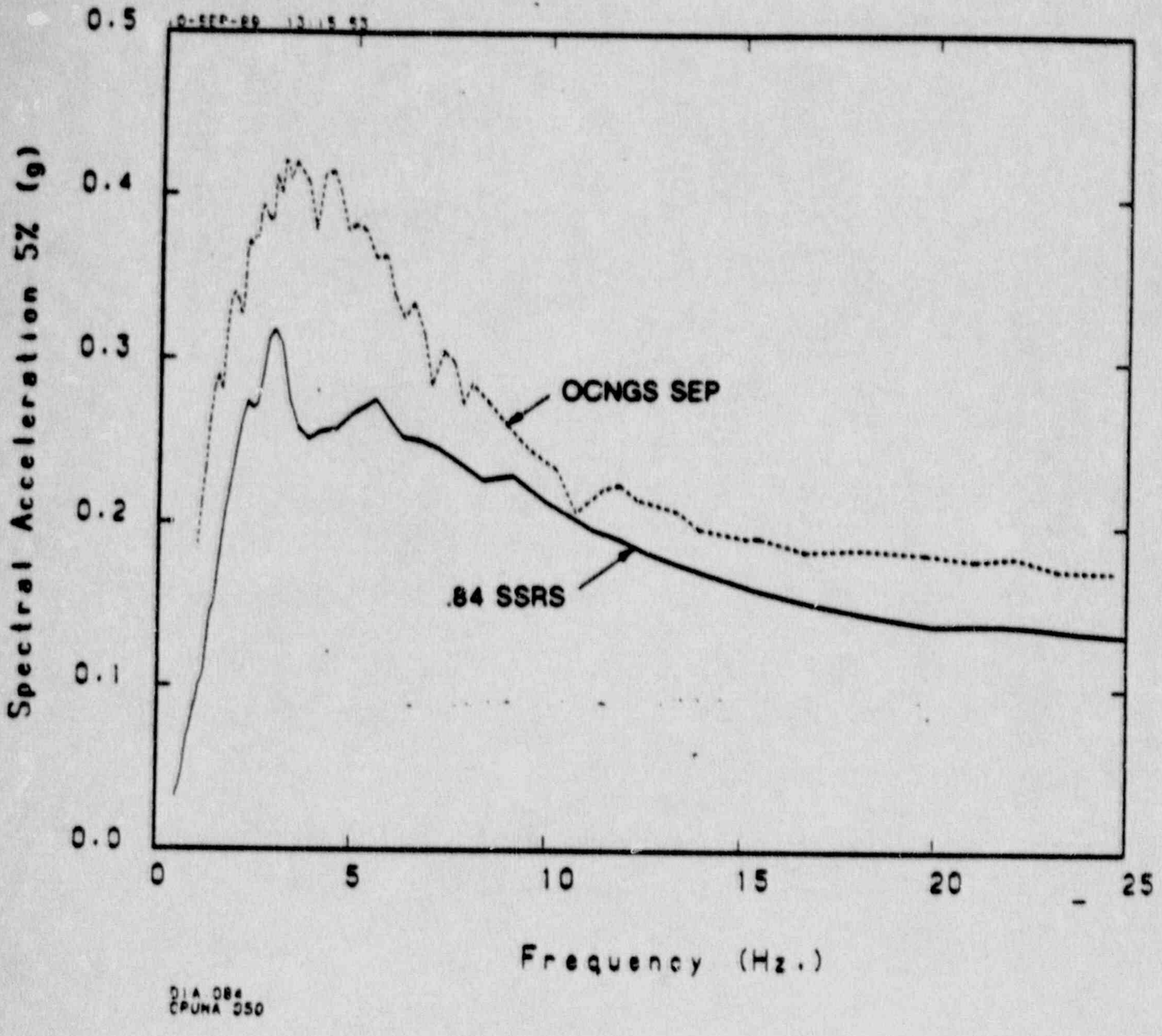
CAMPBELL, K.W. (1988)
EQ SPECTRA Vol. 4, No. 1



Site Specific Response Spectrum
for the OCNGS: Distance > 12 km.
Magnitude: 5.4 +/- 0.2
Distance : 22.9 +/- 9.2

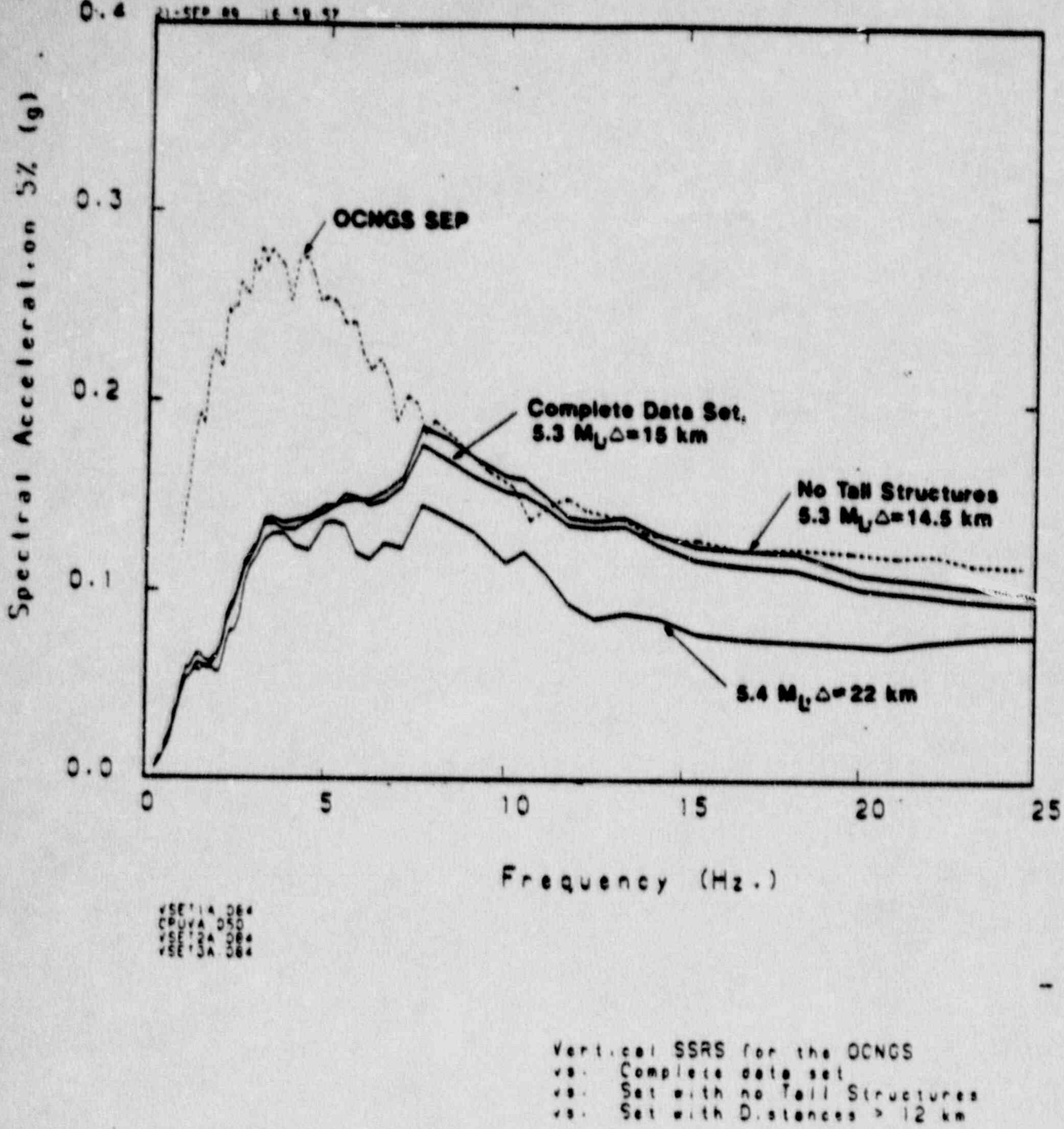
Figure 3.15

Weston Geophysical



Site Specific Response Spectrum
for the OCNGS, Distance > 12 km.
Magnitude: 5.4 +/- 0.2
Distance : 22.9 +/- 9.2

Figure 3.16



Comparison of Vertical Component SSRS

Figure 3.21

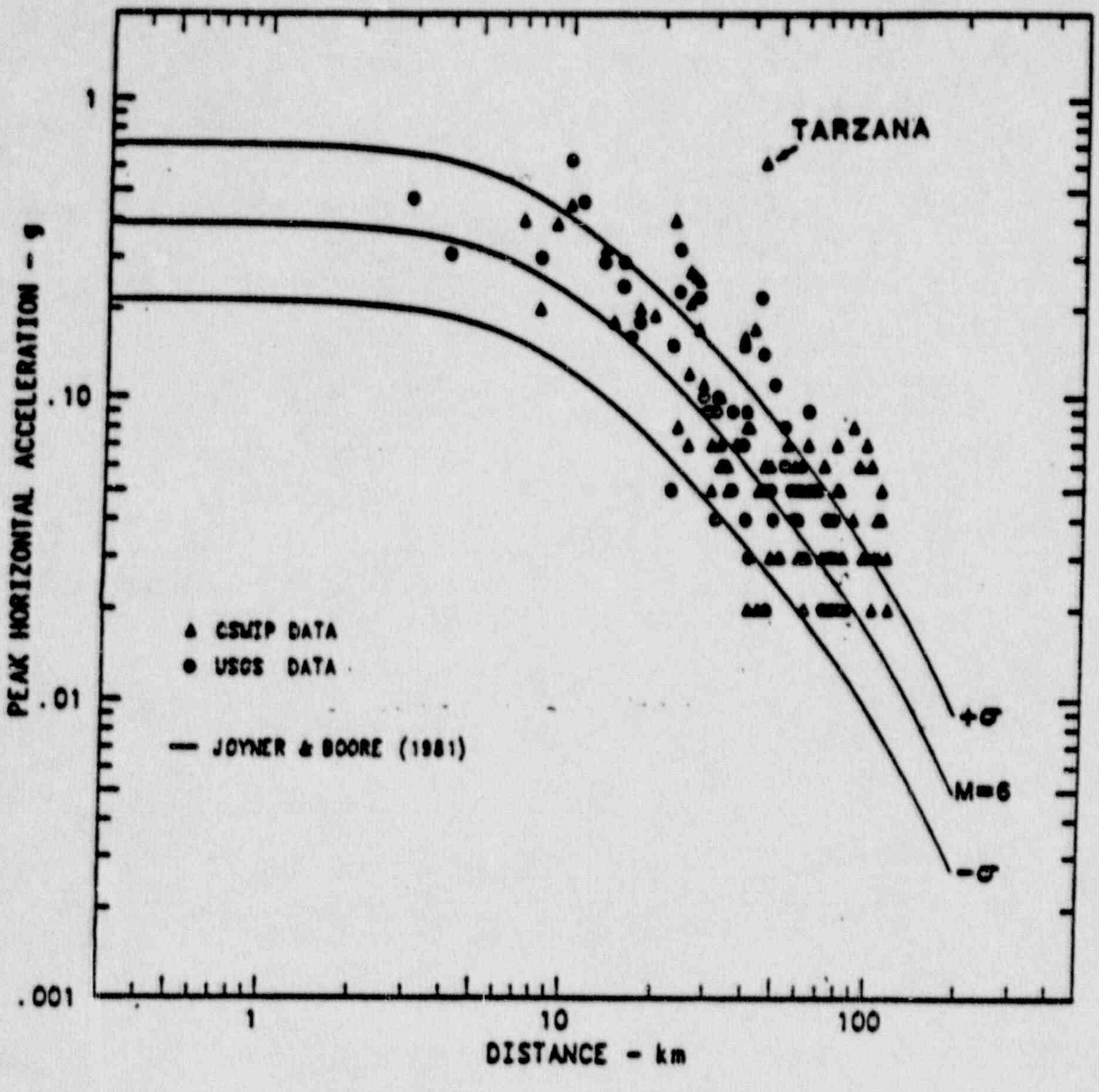
Weston Geophysical

TABLE A1 - Strong Motion Data - Area 1 (Continued)

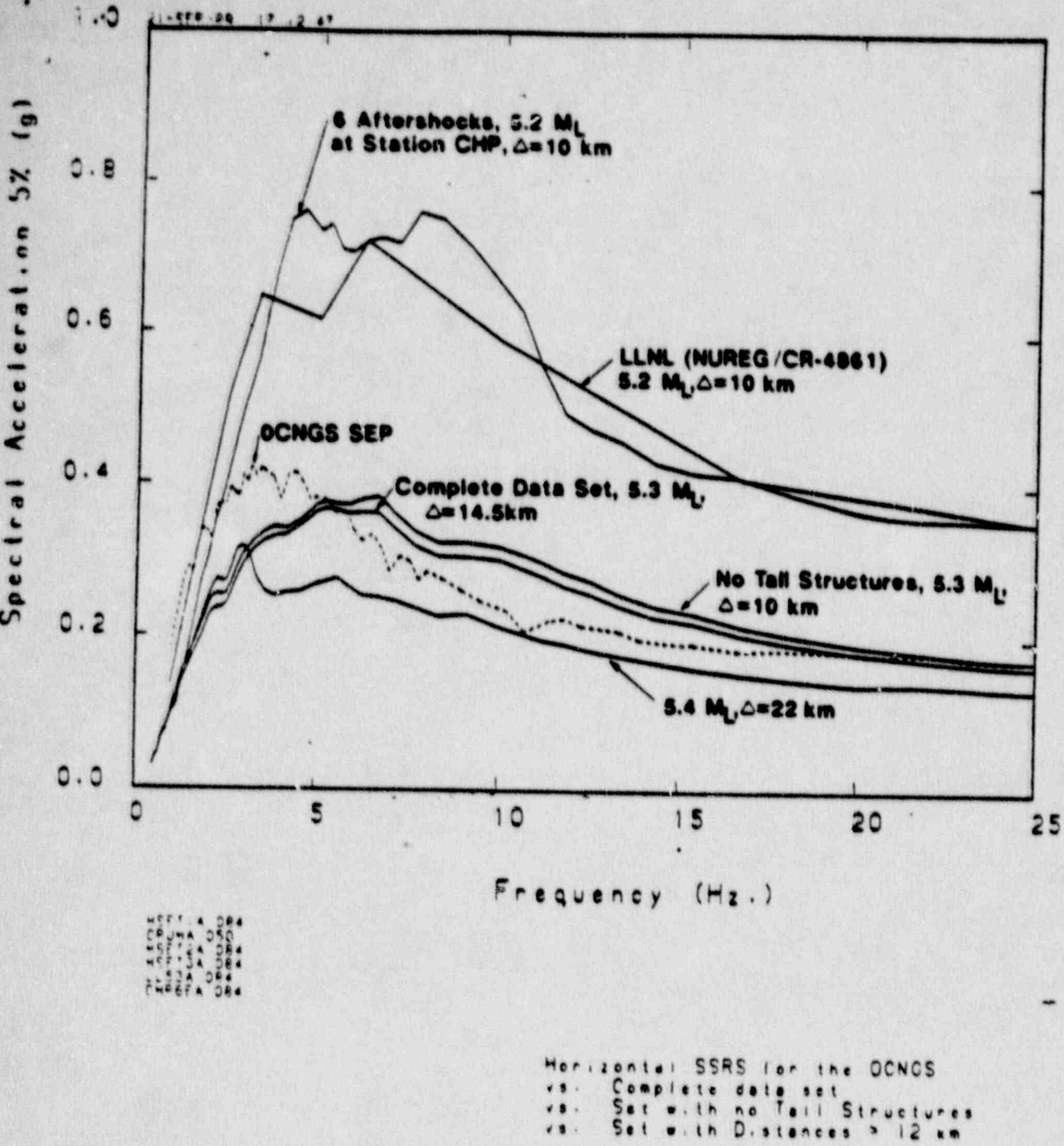
	Station Name	No.	Structure Type, Size*	Epicenter Dist.**	Trigger Time†	Comp.	Max. Acceleration Grnd. (g)	Struct. (g)	Pg.
R	Cogswell Reservoir Cogswell Dam	23210	Earth dam (9 sensors)	23	42.5	150	0.04	0.09	
						Up	0.03	0.07	
						60	0.04	0.10	
TD	Inglewood Union Oil Yard 13707 S. Broadway	14196	Instr. shltr. A	25	43.9	90	0.14		184
						Up	0.07		
						360	0.12		
A	Burbank Cal. Fed. Savings Bldg.	24370	6-story bldg. (13 sensors)	23	---	130	0.12	0.10	
						Up	0.05	--	
						40	0.09	0.06	
A	Burbank Pacific Manor	24385	10-story bldg. (16 sensors)	23	---	40	0.12	0.31	
						Up	0.03	--	
						310	0.09	0.23	
SA	Los Angeles Baldwin Hills	24157	Instr. shltr. A	25	43.7	90	0.14		185
						Up	0.05		
						360	0.07		
R	North Hollywood Sheraton-Universal Hotel	24464	20-story bldg. (16 sensors)	25	42.7	90	0.04	0.07	
						Up	0.02	--	
						360	0.04	0.06	
A	Long Beach Rancho Los Cerritos	14242	Instr. shltr. H	27	44.4	90	0.06		
						Up	0.07		
						360	0.05		
	Los Angeles Century City Bullock Department Store	24332	3-story bldg. (15 sensors)	29	---	51	0.04	0.23	
						Up	0.02	0.03	
						321	0.04	0.12	
	Century City Los Angeles Country Club North	24389	Instr. shltr. H	30	51.6	90	0.02		
						Up	0.01		
						360	0.02		
	Long Beach CSULB Eng. Bldg. 1	14311	5-story bldg. (9 sensors)	32	---	90	0.06	0.20	
						Up	0.02	--	
						360	0.05	0.07	
	Los Angeles UCLA Math-Science Bldg.	24231	6-story bldg. (12 sensors)	32	---	90	0.02	0.02	
						Up	0.02	--	
						360	0.02	0.04	

TABLE A1 - Strong Motion Data - Aftershock of 4 October 1987

	Station Name	No.	Structure Type,Size*	Epicenter Dist.**	Trigger Time†	Max. Acceleration Comp.	Grnd. (g)	Struct. (g)	Pg.
	---------------- MAP AREA 1 ----------------								
A	Alhambra	24461	1-story	5	39.9	270	0.22		181
	Fremont School		bldg.			Up	0.24		
						180	0.18		
A	San Marino	24401	1-story	6	40.0	360	0.21		181
	Southwestern Academy		bldg.			Up	0.09		
	2800 Monterey Rd.					270	0.18		
NA	Los Angeles	24468	8-story	7	---		**		
	CSULA Admin. Bldg.		bldg.						
			(16 sensors)						
A	Los Angeles	24400	1-story	8	41.0	360	0.33		182
	Obregon Park		bldg.			Up	0.09		
						270	0.35		
A	Altadena	24402	1-story	12	42.2	90	0.20		182
	Eaton Canyon Park		bldg.			Up	0.14		
						360	0.30		
NA	Los Angeles	24463	5-story	12	---	350	0.24	0.35	186
	Sears Warehouse		bldg.			Up	0.08	--	
			(13 sensors)			260	0.12	0.18	
DA	Downey	14368	1-story	17	---	270	0.06		183
	County Maint. Bldg.		bldg.			Up	0.07		
	11283 S. Garfield Ave					180	0.06		
R	Mt. Wilson	24399	Seismic	18	41.9	90	0.16		183
	Caltech Seismic		Vault			Up	0.09		
	Station					360	0.15		
TJ	Los Angeles	14403	1-story	22	43.4	360	0.14		184
	116th St. School		bldg.			Up	0.05		
						270	0.15		
A	Los Angeles	24236	14-story	22	---	90	0.04	0.08	
	Hollywood Storage		bldg.			Up	0.03	--	
	Bldg.		(12 sensors)			360	0.07	0.13	
A	Los Angeles	24303	Instr.	22	---	90	0.06		
	Hollywood Storage		shltr. E			Up	0.05		
	Bldg. FF					360	0.08		



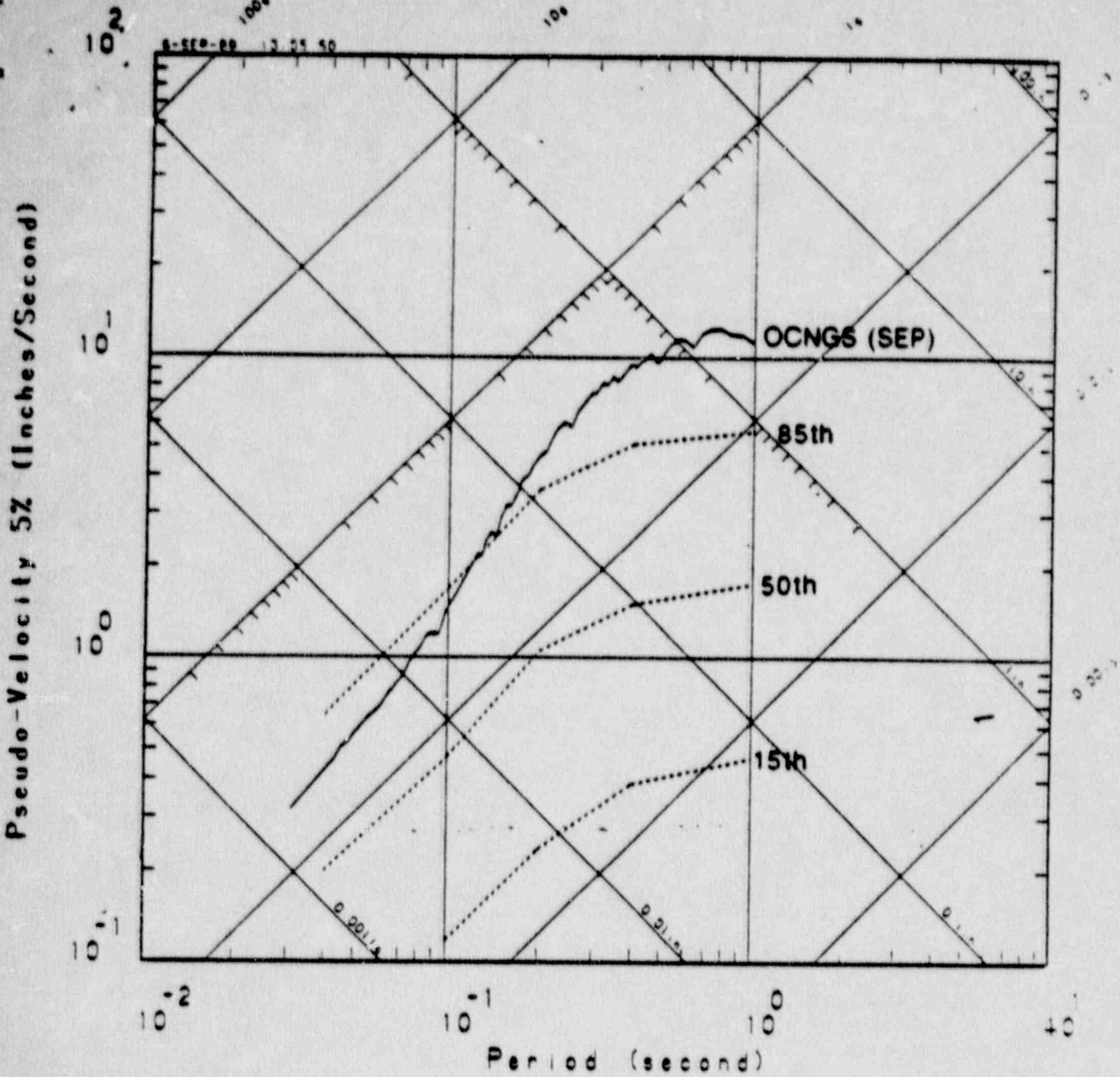
SHAKAL ET AL (1988)
EQ SPECTRA Vol. 4 No. 1



Comparison of Various
Horizontal SSRS

Figure 3.20

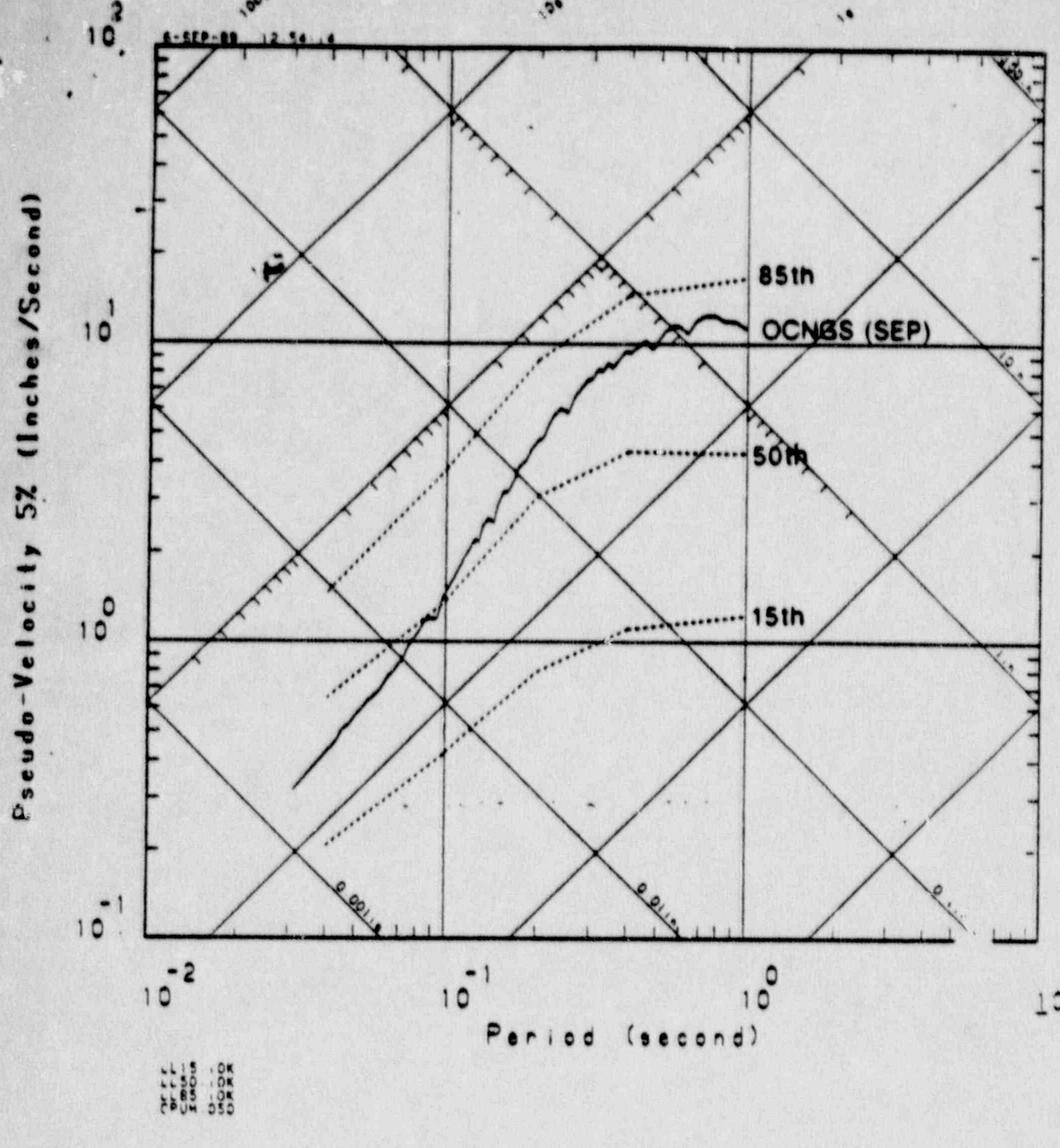
Weston Geophysical



LLNL Probabilistic Spectra
15th, 50th, 85th percentiles
1,000 year return period
vs. OCNGS SEP Spectrum

Figure 2.4

Weston Geophysical



LLNL Probabilistic Spectra
15th, 50th, 85th percentiles
10,000 year return period
vs. OCNGS SEP Spectrum

Figure 2.5

Weston Geophysical

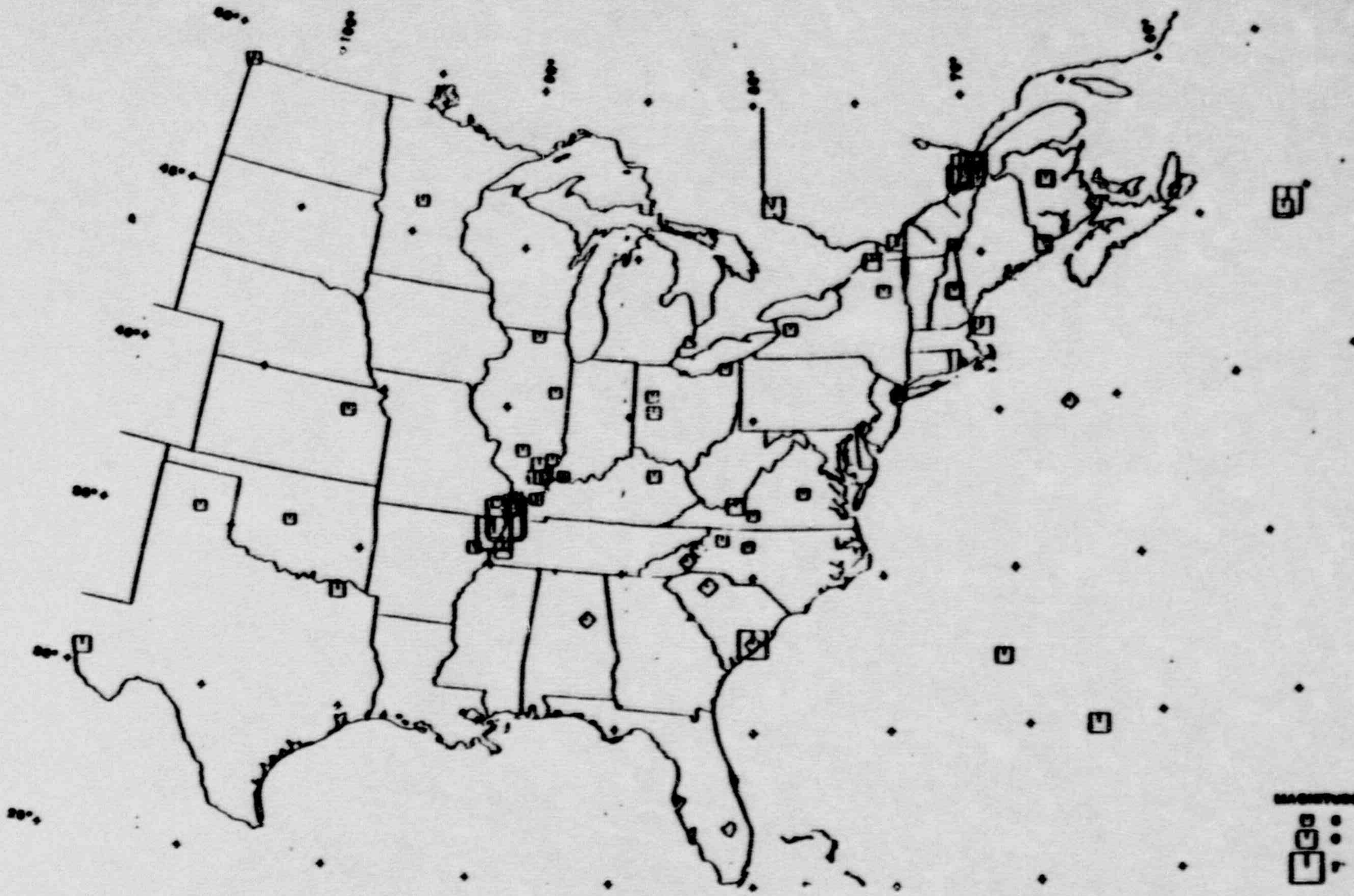


Figure 6-1 Moderate-to-Large Earthquakes in the EUS Study Region

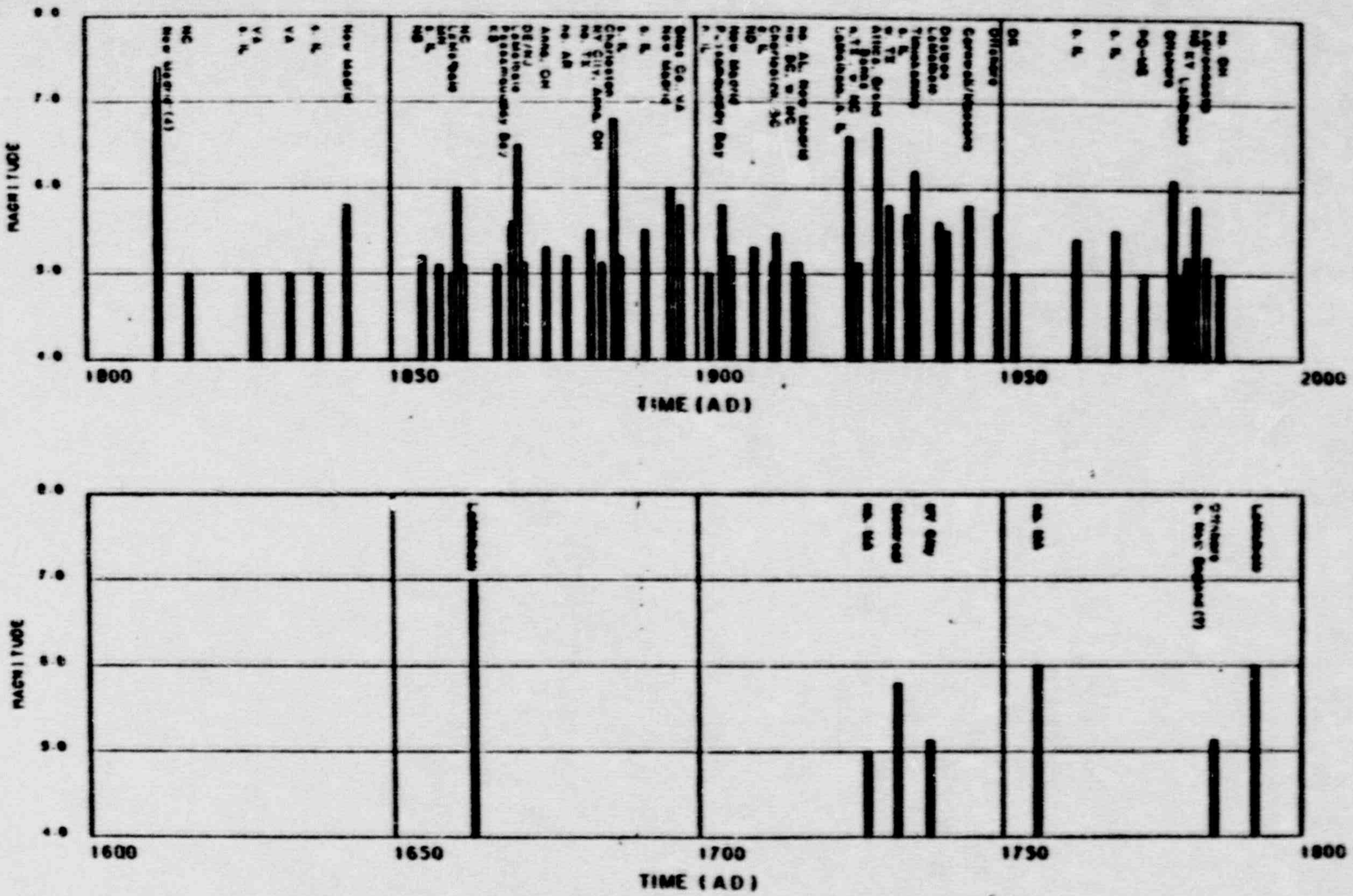


Figure 6-2 Temporal Distribution of Moderate-to-Large Earthquakes in the EUS Study Region

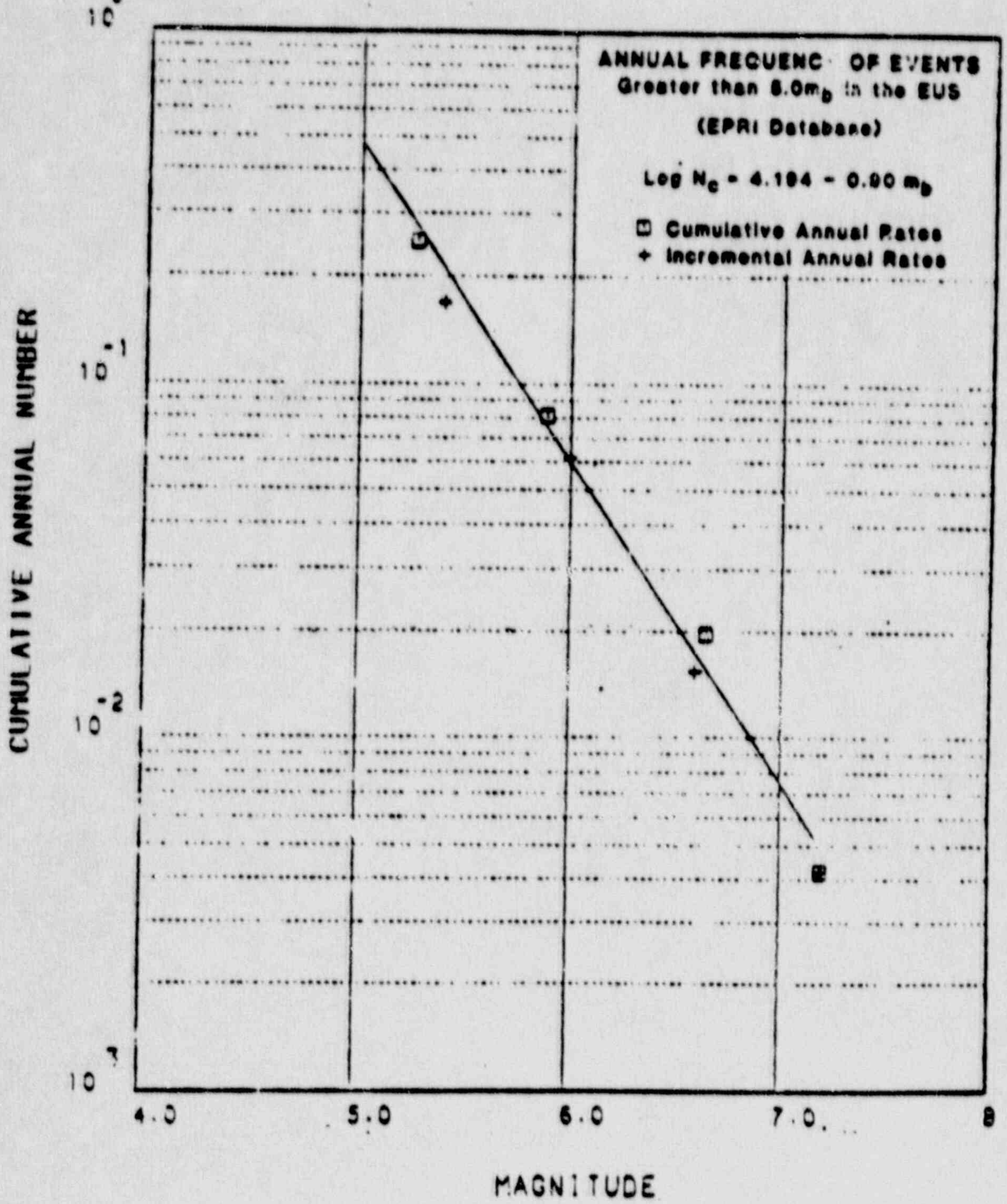


Figure 6-3 Annual Frequency of Moderate-to-Large Earthquakes in the EUS Study Region

EUS EQ STATISTICS

[1] $\log N_c = 4.194 - .90\, m_b$ $\sim 7 \times 10^6\ km^2$

Rate $\geq$ 5.3 = .266 R.P. ~ 4 yrs.

[2] $\log N_c = -.154 - .90\, m_b$ $\sim 314\ km^2$
radius = 10 km

Rate $\geq$ 5.3 = 1.2×10^{-5} R.P. ~ 85,000 yrs.

[3] $\log N_c = 1.119 - .90\, m_b$ $\sim 5{,}891\ km^2$
area: 25-50 km

Rate $\geq$ 5.3 = 2.23×10^{-4} R.P. ~ 4,500 yrs.

SITE SPECIFIC RESPONSE SPECTRA

OBSERVATIONS

- Currently Available Strong Motion Data for Moderate Magnitude Events (~ 5.3 M_L) are Skewed to Near Epicentral Distances
- No Current Efforts to Determine Geologic Conditions at New Accelerograph Installations
- Effect of Epicentral Distance on SSRS is Substantial
- Effect of Using Basement Records in Tall Structures is Small
- Effect of Mis-matched Site Sratigraphies is Small Relative to Distance Effects
- OCNGS SEP Spectrum is Near 85th Fractile of 10,000 Year Return Period Uniform Hazard Spectrum

DISTRIBUTION FOR MEETING SUMMARY DATED: 10/10/89
OYSTER CREEK

Docket File
NRC & Local PDRs
Plant File
S. Norris
OGC
E. Jordan (MNBB 3302)
B. Grimes (9A2)
NRC Participants
A. Dromerick
Hans Ashar
R. Rothman
F. Orr
John Stolz
Raman Pichumani
David C. Jeng
Goutam Bachgi
Leo Reiter
ACRS (10)
B. Clayton (17D19)

DF01
1/1

cc: Licensee/Applicant Service List

4) The approach GPUN is pursuing appears appropriate. The staff will review the report when it is submitted and will probably have additional questions.

/s/
Alexander W. Dromerick, Project Manager
Project Directorate I-4
Division of Reactor Projects - I/II

Enclosures:
1. Attendance List
2. GPUN Agenda and presentation

cc w/enclosures:
See next page

[MTG SUMMARY OC]

LA:PDI-4	PM:PDI-4	PD:PDI-4
SNorris	ADromerick:lm	JStolz
10/6/89	10/10/89	10/10/89