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BOUCHEY,G.D. Washington Public Power Supply System
RECIP.NAME RECIPIENT AFFILIATION
SCHWENCER,A. Licensing Branch 2

SUBJECT: Forwards revised response to NRC Question 361.016 re ground motion.Response informally transmitted on 820510 & will be incorporated into FSAR Amend 27.

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**Washington Public Power Supply System**
P.O. Box 968 3000 George Washington Way Richland, Washington 99352 (509) 372-5000

May 19, 1982
G02-82-454
SS-L-02-CDT-82-060

Docket No. 50-397

Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Schwencer:

Subject: NUCLEAR PROJECT NO. 2
REVISED RESPONSE TO NRC QUESTION 361.016

Enclosed are sixty (60) copies of the revised response to NRC Question 361.016. This response was informally transmitted to the NRC on May 10, 1982, and will be incorporated into FSAR Amendment 27.

Very truly yours,

G D Bouchey

G. D. Bouchey
Deputy Director, Safety and Security

CDT/jca
Enclosures

cc: R Auluck - NRC
WS Chin - BPA
R Feil - NRC Site

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Question 361.16

Estimate the ground motion (including high frequencies) assuming a magnitude $M_L$ = 4.0 (largest swarm event in the Columbia Plateau) occurred at a distance of 3 to 5 kilometers from the site. Compare the response spectra from this event to the SSE response spectra. Also, state your position on how large and close a potential swarm earthquake could come to the site.

RESPONSE

Maximum Swarm Event

Based on the analysis of the Columbia Plateau seismicity presented in Appendix 2.5J to the WNP-2 FSAR, the maximum magnitude associated with shallow seismicity that can be expected to occur within the Columbia River Basalts in close proximity to the site (<5 km) is approximately $M_C$ 3.0. As requested, estimates of the ground motions resulting from a magnitude $M_L$ = 4.0 earthquake occurring at a distance of 3 to 5 km from the site are provided below.

Approach

The ground motions at the WNP-2 site resulting from small magnitude near field earthquakes are estimated using an empirical approach. The approach used is as follows:

- A data set was developed of accelerograms recorded during magnitude $M_L$ 4.0 ± 0.2 earthquakes. The criteria used for selection were similar site conditions to the WNP-2 site (deep, stiff soils) and good quality data for earthquake magnitude and location.

- Using the selected data set, an attenuation relationship was developed for peak ground acceleration. This relationship was used to estimate the peak horizontal accelerations resulting from a magnitude 4 earthquake occurring at a distance of 3 to 5 km from the site.

- The spectral content of the ground motions was estimated by developing a median spectral shape for ground motions recorded at hypocentral distances less than approximately 10 km. This spectral shape was anchored to the estimated peak acceleration to provide an estimate of the spectral accelerations.

Selection of Data Set

In the last 7 years, a large number of small magnitude near field strong ground motion recordings have been obtained, primarily from recordings during 4 aftershock sequences: Oroville, 1975; Friuli, Italy, 1976; Imperial Valley, 1979; and Mammoth Lakes, 1980. Table 361.16-1 lists the available data sets of recordings for earthquakes of magnitude $M_L$ 4.0 ± 0.2. The recordings listed in Table 361.16-1 exist as either digitized but uncorrected accelerograms (including digital recordings) or undigitized film recordings.

All available digitized recordings were obtained for analysis. The accelerograms recorded at hypocentral distances less than approximately 10 km were corrected using standard processing techniques (Trifunac, 1970; Trifunac and Lee, 1973) to remove digitization and long period errors and to correct for instrument response. A time step of 0.005 seconds was used in correcting all of the records to capture the high-frequency motion content of the records. The high pass corner frequency was set at a nominal value of 0.4 Hz. The low pass corner frequency was set at 25 hz for the film recorded accelerograms and 35 Hz for the digitally recorded accelerograms.

1975 Oroville Earthquake. The Oroville earthquake occurred on August 1, 1975, in the western foothills of the Sierra Nevada, California. The main shock was magnitude $M_L$ 5.7 and the focal mechanism was one of primarily normal faulting. Twenty-two recordings were obtained on soil sites for magnitude $M_L$ 4.0 ± 0.2 aftershocks in the distance range of 8 to 15 km. The magnitudes and locations of the aftershocks are generally well constrained.

The site conditions at the recording stations located on soil range from shallow (10 m) stiff soil to deep granular alluvial deposits. All of the soil site records are considered applicable to the conditions at the WNP-2 site and were used in the analysis with the exception of those from station DJR. The soil conditions at the DJR station consist of very shallow (10 m) alluvium layer overlying rock (Toppozada et. al., 1975), which is substantially different from the deep soil deposit at WNP-2.

1976 Friuli, Italy Sequence. The Friuli earthquake sequence occurred during May - September, 1976 in northeastern Italy. The main shock was magnitude $M_L$ 6.2 and three large aftershocks of $M_L \geq 5.9$ were recorded. The focal mechanism for the large events was strike slip. Site conditions at the recording stations located on soil generally consist of stiff soils of varying depths. Fifteen recordings were obtained on soil sites for magnitude $M_L$ 4.0 ± 0.2 earthquakes. The location accuracy of the earthquakes is not well defined but may be of the order of ± 5 km. Because of the possible large errors in the location of the events, the recordings from Friuli were not used in the analysis.

1979 Imperial Valley Earthquake. The Imperial Valley earthquake ($M_L$ 6.6, $M_S$ 6.9) occurred on October 15, 1979. The primary focal mechanism for the main shock was strike slip. The recordings obtained for magnitude $M_L$ 4 events are currently being digitized and processed by the USGS and are not yet available in digitized form. Only peak amplitudes scaled from the film traces are available.

The site conditions at the recording stations consist of very deep deposits of fine grained soils. The soil conditions in the Imperial Valley appear to be substanially softer than the soil profile at the WNP-2 site. Therefore, the recordings from the Imperial Valley were not used in this study.

1980 Mammoth Lakes Sequence. The Mammoth Lakes Sequence occurred during May - June, 1980, near Mammoth Lakes in the Sierra Nevada, California. The main shock was $M_L$ 6.2 and four large aftershocks of $M_L \geq 5.7$ were recorded. The focal mechanism for the large events was strike slip with a large normal component. Fifty-six recordings were obtained from magnitude $M_L$ 4.0 ± 0.2 earthquakes. The magnitudes and locations of the aftershocks are generally well constrained. The magnitudes used in the analysis consist of an average of the $M_L$ values reported by Berkeley and Cal Tech. The differences between the two reported $M_L$ values for each event are generally less than 1/4 magnitude unit.

The recording stations are underlain by generally coarse alluvial soils and/or glacial till. The depth to rock is not known at any one station but may range from a few meters at station CON to several hundred meters at station FIS. Stations FIS and HCF are located on deep deposits of dense alluvium. Station MGE is located in a narrow valley filled with glacial till and station CON is located at the edge of a narrow valley within 10 m horizontally of outcropping bedrock. Figure 361.16-1 compares the median spectral shapes for magnitude $M_L$ 3.5 to 4.5 recordings at four of the Mammoth Lakes recording stations. The median spectral shape is generally similar for all recording stations except CON. The ground motion recordings obtained at CON generally have a much higher frequency content and also have, on an average, a much higher peak acceleration. The higher peak acceleration and frequency content may be due to site response as the soil deposit is probably only a few meters thick. However, because no direct subsurface information is available, the

recordings obtained at the CON station were conservatively included in the analysis.

In summary, on the basis of similar site conditions to that at the WNP-2 site and the quality of the magnitude and distance determinations, the soil site recordings from Mammoth Lakes and Oroville are considered the most applicable for evaluating ground motions at the WNP-2 site from small magnitude near field events. The records from the Oroville recording station DJR were excluded from the data set due to the shallow soil deposit (10 m). It is possible that records from the Mammoth recording station CON should also be excluded for the same reason. However, as the site conditions at CON have not been documented, the records were included in the analysis. The effects of excluding data from station CON were examined in a sensitivity analysis. The selected data set including CON consists of 76 recordings in the distance range of 4 to 26 km. Figure 361.16-2 shows the variation of uncorrected peak acceleration with distance for the selected data set.

The entire data set was used to develop an attenuation relationship for magnitude $M_L$ 4.0 earthquake ground motions. The near field spectral content of $M_L$ 4.0 ground motions was evaluating using a subset of the selected data consisting of 37 recordings obtained at distances less than approximately 10 km.

Attenuation of Peak Horizontal Acceleration

The attenuation relationship for peak horizontal acceleration, a, for magnitude 4 earthquakes is assumed to be of the form:

$$\ln a = A + B \ln (R + C) \qquad (1)$$

where R is hypocentral distance and A, B, and C are constants. Nonlinear regression techniques were used to fit equation (1) to the selected data set. The resulting attenuation equation is:

$$\ln a(g) = 40.58 - 10.03 \quad R\ (km) + 67.4 \qquad (2)$$

with a standard deviation of ln a of 0.70. The above regression equation is superimposed on the data in Figure 361.16-3. At distances of 3 and 5 km, the median and $84^{th}$ percentile peak accelerations obtained using equation (2) are:

| Hypocentral Distance (km) | Peak Acceleration (g's) Median | Peak Acceleration (g's) $84^{th}$ percentile |
|---|---|---|
| 3 | 0.12 | 0.25 |
| 5 | 0.09 | 0.19 |

Because the data are available only in a relatively narrow distance band and there is a large dispersion in the measured accelerations, large variations in the parameters of the attenuation equation produce little change in the error of estimation. Since the available data do not adequately constrain the attenuation relationship, some constraints must be imposed based on previous experience in evaluating attenuation of ground motions. A logical choice is to constrain the far field rate of attenuation (parameter B) based on studies using data from a wider range of distances than available in the small magnitude data set selected for this study.

Appendix 2.5K to the WNP-2 FSAR presents a general attenuation relationship developed for seismic exposure analysis of the plant site from data in the magnitude range 4 to 7 and distances up to 100 km. The results of that study indicate that the far field slope of the attenuation relationship (parameter B) should be

-1.89. The regression analysis was repeated with parameter B fixed at -1.89. The resulting attenuation equation is:

$$\ln a = 2.02 - 1.89 \ln (R + 4.9) \qquad (3)$$

with a standard deviation of 0.71. Figure 316.16-4 compares the median and 16$^{th}$ percentile attenuation equations with the recorded data. The predicted peak accelerations at 3 and 5 km are:

| Hypocentral Distance (km) | Peak Acceleration (g's) | |
|---|---|---|
| | Median | 84$^{th}$ percentile |
| 3 | 0.15 | 0.31 |
| 5 | 0.10 | 0.20 |

These values represent uncorrected peak accelerations. Corrected peak accelerations are 6 percent lower on an average. The corrected accelerations corresponding to the above tabulated values were used to anchor the response spectrum shape described later in this response.

As discussed above, the site conditions at station CON probably consist of only a few meters of alluvium overlying rock, substantially different from those at WNP-2. The impact of the data from station CON on the predicted peak accelerations was examined by repeating the regression analysis with the 22 data points from station CON removed from the data set. The predicted peak accelerations at 3 and 5 km are reduced by approximately 20 percent for the reduced data set.

The sensitivity of the predicted peak accelerations to the imposed constraints was examined by utilizing constraints suggested by the results of three recent studies. Campbell (1981) suggests that the far field rate of attenuation for

magnitude 5 to 7.5 earthquakes should be constrained to -1.75. Idriss (1982) varies the rate of attenuation with magnitude, but imposes a constant value of parameter C = 20 for all magnitudes. Joyner and Boore (1981) impose a magnitude independent form which results in an increasing rate of attenuation with increasing distance. Using each of the above constraints, an attenuation equation was obtained for the $M_L$ 4.0 data set. The predicted $84^{th}$ percentile accelerations at distances of 3 and 5 km are tabulated below.

| Relationship | $84^{th}$ Percentile Peak Acceleration (g's) | |
|---|---|---|
| | 3 km | 5 km |
| Campbell (1981) B = -1.75 | 0.31 | 0.20 |
| Idriss (1982) C = 20.0 | 0.28 | 0.20 |
| Joyner and Boore (1981) | 0.15 | 0.12 |

The predicted peak accelerations are comparable or lower than the results obtained in this study.

Spectral Content

The spectral content of the ground motions was estimated by developing a median spectral shape for the near field recordings.

The effect of distance on spectral shape was examined by computing a median spectral shape for two distance bands, 5 to 7.5 km and 7.6 to 10.5 km. Only records from the Mammoth Lakes sequence were included in this comparison as there were no Oroville aftershocks recorded at distances less than 8 km for magnitude 4.0 ± 0.2 events. Figure 361.16-5 compares the two spectral shapes. As can be seen, they are essentially identical. Consequently, all records in the distance range 0 to 10.5 km were combined to derive a median spectral shape.

Figure 361.16-6 shows the median spectral shapes for the combined Oroville - Mammoth Lakes data set for damping ratios of 2 percent, 5 percent and 7 percent.

The estimated absolute spectral accelerations were obtained by multiplying the median spectral shapes shown in Figure 361.16-6 by the estimated corrected peak accelerations at distances of 3 and 5 km. The attenuation relationship given previously was developed for uncorrected peak acceleration. The average ratio of corrected to uncorrected peak acceleration for records in the distance range of 0 to 10.5 km is 0.94. The corresponding corrected peak accelerations at distances of 3 and 5 km are:

| Distance (km) | Corrected Peak Acceleration (g's) Median | Corrected Peak Acceleration (g's) 84th percentile |
|---|---|---|
| 3 | 0.14 | 0.29 |
| 5 | 0.09 | 0.19 |

Multiplying the above corrected accelerations by the median spectral shape, median and 84th percentile response spectra are obtained. Figures 361.16-7 through 361.16-9 compare the resulting response spectra at distances of 3 to 5 km with the 0.25 g SSE spectrum for 2 percent, 5 percent, and 7 percent spectral damping, respectively. As can be seen, the 0.25 g SSE spectrum is only exceeded for frequencies greater than 10 Hz. It is noted that multiplication of the median peak accelerations by the 84th percentile spectral shape results in lower absolute spectral accelerations than those shown on Figures 361.16-7 through 361.16-9 for periods less than 0.3 seconds. This is because the dispersion in peak acceleration is greater than the dispersion in spectral shape.

## Energy Content

The severity of the ground motions from small magnitude earthquakes can be evaluated by comparing their frequency, energy content, and significant duration with the frequency, energy content and significant duration of motions recorded during a moderate-magnitude earthquake. Data from the 1971 $M_L$ 6.4 San Fernando earthquake have been used for this comparison.

Figure 361.16-10 shows a plot of peak acceleration vs. total energy content (measured by the square of the acceleration integrated over the duration of shaking) for the $M_L$ 4.0 ± 0.2 soil recordings at 4 to 10.5 km and soil site recordings from the $M_L$ 6.4 San Fernando earthquake at distances of 7 to 40 km. For comparable levels of peak acceleration, the energy content of the $M_L$ 4.0 recordings is an order of magnitude lower than the San Fernando recordings. This is due in large part to the short duration of shaking for the small magnitude earthquakes. The significant duration (defined as the time required to transmit 5 to 95 percent of the energy content of the accelerogram) ranges from 1 to 5 seconds for the $M_L$ 4.0 recordings as compared to from 12 to 25 seconds for the San Fernando recordings.

The frequencies at which the recordings contain energy can be examined by passing the accelerograms through a low-pass filter having a corner frequency of 9 Hz. Computation of the energy of the filtered records indicates that nearly half of the energy content of the $M_L$ 4.0 recordings is at frequencies greater than 9 Hz, while only 5 percent of the energy of the $M_L$ 6.4 San Fernando recordings is at frequencies greater than 9 Hz.

The low energy content, short duration, and high frequency nature of ground motions from these small magnitude earthquakes indicate that they have a much lesser engineering significance than ground motions from moderate to large magnitude earthquakes.

## Structural Response

The scope of this study involved the estimation of ground motions associated with a magnitude $M_L$ = 4.0 earthquake occurring at distances of from 3 to 5 km from the WNP-2 site. The ground motion estimates are provided in terms of peak acceleration, spectral acceleration and energy content. In addition, analyses were performed to compare the response of the reactor building to the estimated $M_L$ 4.0 ground motions with the response of the reactor building to the SSE design ground motion.

Two types of structural response analyses were performed: a response spectrum analysis and a time history analysis of the reactor building in the horizontal direction. For the response spectrum analysis, the input consists of the 84$^{th}$ percentile response spectra at a distance of 3 km (the upper solid curve in Figures 361.16-7 through 361.16-9). The input for the time history analysis consists of 3 accelerograms typical of small magnitude ground motions. The selected accelerograms are shown in Figures 361.16-11 through 361.16-13. Appropriate scaling factors were selected for each accelerogram such that the envelope of the response spectra corresponding to the three accelerograms completely envelopes the 84$^{th}$ percentile response spectra for a magnitude 4.0 earthquake at a distance of 3 km. The selected accelerograms were scaled to the following peak accelerations.

| Accelerogram | Scaled Peak Acceleration |
| --- | --- |
| A05S00E | 0.29g |
| N07N90E | 0.31g |
| P05S55E | 0.23g |

The scaled response spectra for the three selected accelerograms are compared with the 84$^{th}$ percentile response spectra in Figure 361.16-14.

The lumped mass response spectrum analysis was used to calculate the moment, shears, and structural accelerations for the reactor building, and the finite element time history analysis was performed to calculate the floor response spectra in the reactor building. The results of these analyses indicate that the responses (moments, shears, accelerations, and the floor response spectra) are below the design basis loads.

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# TABLE 361.16 – 1

## AVAILABLE STRONG MOTION RECORDINGS FROM MAGNITUDE $M_L$ 3.8 – 4.2 EARTHQUAKES

| EARTHQUAKE | DATE Y M D | TIME H M S | MAGNITUDE MD | ML | MS | DEPTH (KM) | RECORDING STATION | USGS STAT NO | SITE CLAS | DISTANCE TO: HYPOC (KM) | EPIC (KM) | RUPT (KM) | RECORD | COMP | PEAK ACCEL VOL 1 (G) | VOL 2 CM/S/S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OROVILLE AFTERS | 75 8 3 | 247 9 | | 4.1 | | 6.8 | CDMG1 CDMG TEMP | 1 | ADD | 12.3 | 10.2 | | D01 | N90E | .044 | 38.2 |
| HOCK D | | | | | | | STAT 1 AT OROVILLE C | | | | | | D01 | N00E | .065 | 57.7 |
| | | | | | | | CDMG3 CDMG TEMP | 3 | ADD | 15.0 | 13.3 | | D03 | N05W | .021 | 18.6 |
| | | | | | | | STAT 3 AT OROVILLE C | | | | | | B03 | S05W | .027 | 22.2 |
| | | | | | | | CDMG4 CDMG TEMP | 4 | ACD | 11.4 | 9.1 | | D04 | N35W | .113 | 101.1 |
| | | | | | | | STAT 4 AT OROVILLE C | | | | | | B04 | S55W | .087 | 79.6 |
| | | | | | | | CDMG5 CDMG TEMP | 5 | ACD | 10.0 | 7.3 | | D05 | S00E | .123 | 107.3 |
| | | | | | | | STAT 5 AT OROVILLE C | | | | | | B05 | N90E | .113 | 107.5 |
| | | | | | | | OMC OROVILLE | 10 | ABB | 8.3 | 4.7 | | D10 | N24W | .086 | 80.6 |
| | | | | | | | MEDICAL CENTER TEMP | | | | | | D10 | S66W | .140 | 146.7 |
| | | | | | | | OAP OROVILLE | 11 | ACD | 12.0 | 9.9 | | D11 | N90W | .103 | 100.2 |
| | | | | | | | AIRPORT TEMP STAT | | | | | | D11 | S00E | .043 | 34.2 |
| | | | | | | | EBH EARL BROADBECK | 13 | ACC | 0.0 | 5.5 | | D13 | N90E | .154 | 146.8 |
| | | | | | | | HOUSE TEMP STAT OROV | | | | | | D13 | N00E | .092 | 86.4 |
| OROVILLE AFTERS | 75 816 | 540 9 | | 4.0 | | 8.8 | CDMG1 CDMG TEMP | 1 | ADD | 12.2 | 8.4 | | P01 | N90E | .120 | 97.1 |
| HOCK P | | | | | | | STAT 1 AT OROVILLE C | | | | | | P01 | N00E | .170 | 144.4 |
| | | | | | | | CDMG4 CDMG TEMP | 4 | ACD | 11.5 | 7.4 | | P04 | N35W | .040 | 33.2 |
| | | | | | | | STAT 4 AT OROVILLE C | | | | | | P04 | S55W | .070 | 60.8 |
| | | | | | | | CDMG5 CDMG TEMP | 5 | ACD | 10.4 | 5.5 | | P05 | S00E | .053 | 49.3 |
| | | | | | | | STAT 5 AT OROVILLE C | | | | | | P05 | N90E | .101 | 93.6 |
| | | | | | | | CDMG7 CDMG TEMP | 7 | ABD | 9.0 | 1.7 | | P07 | N90W | .071 | 59.6 |
| | | | | | | | STAT 7 AT OROVILLE C | | | | | | P07 | S00W | .062 | 54.9 |
| | | | | | | | DJR D. JOHNSON | 9 | AAD | 10.2 | 5.2 | | P09 | N90E | .159 | 137.6 |
| | | | | | | | RANCH TEMP STAT OROV | | | | | | P09 | N00E | .223 | 205.2 |
| | | | | | | | OMC OROVILLE | 10 | ABB | 9.8 | 4.4 | | P10 | N24W | .099 | 90.9 |
| | | | | | | | MEDICAL CENTER TEMP | | | | | | P10 | S66W | .031 | 27.4 |
| | | | | | | | OAP OROVILLE | 11 | ACD | 12.3 | 0.5 | | P11 | N90W | .030 | 31.0 |
| | | | | | | | AIRPORT TEMP STAT | | | | | | P11 | S00E | .030 | 32.4 |
| | | | | | | | EBH EARL BROADBECK | 13 | ACC | 9.6 | 3.0 | | P13 | N90E | .124 | 116.6 |
| | | | | | | | HOUSE TEMP STAT OROV | | | | | | P13 | N00E | .070 | 66.3 |

## TABLE 361.16 — 1 (continued)

| EARTHQUAKE | DATE Y M D | TIME H M S | MAGNITUDE MD | ML | MS | DEPTH (KM) | RECORDING STATION | USGS STAT NO | SITE CLAS | DISTANCE TO: HYPOC (KM) | EPIC (KM) | RUPT (KM) | RECORD | COMP | PEAK ACCEL VOL 1 (G) | VOL 2 CM/S/S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OROVILLE AFTERS | 75 926 | 231 7 | | 4.0 | | 9.4 | CDMG1 CDMG TEMP | 1 | ADD | 13.9 | 10.2 | | T01 | N90E | .091 | 51.3 |
| HOCK T | | | | | | | STAT 1 AT OROVILLE C | | | | | | T01 | N00E | .079 | 67.8 |
| OROVILLE AFTERS | 75 926 | 231 7 | | 4.0 | | 9.4 | CDMG4 CDMG TEMP | 4 | ACD | 12.8 | 8.7 | | T04 | N35W | .050 | 44.4 |
| HOCK T | | | | | | | STAT 4 AT OROVILLE C | | | | | | T04 | S55W | .083 | 74.2 |
| | | | | | | | CDMG5 CDMG TEMP | 5 | ACD | 11.9 | 7.4 | | T05 | S00E | .135 | 97.1 |
| | | | | | | | STAT 5 AT OROVILLE C | | | | | | T05 | N90E | .143 | 123.2 |
| | | | | | | | DJR D. JOHNSON | 9 | AAD | 12.0 | 7.5 | | T09 | N90E | .242 | 238.8 |
| | | | | | | | RANCH TEMP STAT OROV | | | | | | T09 | N00E | .163 | 142.4 |
| | | | | | | | OMC OROVILLE | 10 | ABD | 9.8 | 2.8 | | T10 | N24W | .081 | 75.8 |
| | | | | | | | MEDICAL CENTER TEMP | | | | | | T10 | S66W | .086 | 83.8 |
| | | | | | | | OAP OROVILLE | 11 | ACD | 12.7 | 8.6 | | T11 | N90W | .051 | 43.9 |
| | | | | | | | AIRPORT TEMP STAT | | | | | | T11 | S00E | .052 | 51.6 |
| | | | | | | | EBH EARL BROADBECK | 13 | ACC | 11.2 | 6.0 | | T13 | N90E | .058 | 51.7 |
| | | | | | | | HOUSE TEMP STAT OROV | | | | | | T13 | N00E | .091 | 70.1 |
| FRIULI SEQUENCE | 76 515 | 42616 | | 4.2 | | 16.0 | FORGARIA-CORN., | 8014 | ABB | 26.5 | 21.1 | | F069 | NORT | .015 | |
| | | | | | | | ITALY | | | | | | F069 | EAST | .020 | |
| FRIULI SEQUENCE | 76 6 1 | 172111 | | 4.2 | | 1.0 | FORGARIA-CORN., | 8014 | ABD | 9.3 | 9.2 | | F074 | NORT | .024 | 22.5 |
| | | | | | | | ITALY | | | | | | F074 | EAST | .023 | 21.8 |
| | | | | | | | TOLMEZZO, ITALY | 8012 | ABD | 19.6 | 19.6 | | F076 | NORT | .019 | |
| | | | | | | | -- ENEL FIXED | | | | | | F076 | EAST | .021 | |
| | | | | | | | TOLMEZZO, ITALY | 8013 | ABD | 19.6 | 19.6 | | F075 | NORT | .014 | |
| | | | | | | | -- ENEL MOBILE | | | | | | F075 | EAST | .015 | |
| FRIULI SEQUENCE | 76 6 9 | 184814 | | 4.2 | | 13.0 | FORGARIA-CORN., | 8014 | ABD | 13.7 | 4.4 | | F081 | NORT | .072 | |
| | | | | | | | ITALY | | | | | | F081 | EAST | .064 | |
| | | | | | | | MAIANO A ,ITALY | 8016 | ACD | 16.3 | 9.8 | | F086 | NORT | .015 | |
| | | | | | | | -- FREE FIELD | | | | | | F086 | EAST | .012 | |
| | | | | | | | TOLMEZZO, ITALY | 8012 | ABB | 18.8 | 13.6 | | F083 | NORT | .034 | |
| | | | | | | | -- ENEL FIXED | | | | | | F083 | EAST | .031 | |
| | | | | | | | TOLMEZZO, ITALY | 8013 | ABD | 18.8 | 13.6 | | F082 | NORT | .034 | |
| | | | | | | | -- ENEL MOBILE | | | | | | F082 | EAST | .029 | |
| FRIULI SEQUENCE | 76 714 | 53920 | | 4.2 | | 15.8 | TARCENTO, ITALY | 8011 | ABD | 22.2 | 15.6 | | F113 | NORT | .075 | |
| | | | | | | | | | | | | | F113 | EAST | .066 | |
| | | | | | | | MAIANO A ,ITALY | 8016 | ACD | 29.3 | 24.7 | | F116 | NORT | .011 | |
| | | | | | | | -- FREE FIELD | | | | | | F116 | EAST | .008 | |

## TABLE 361.16 — 1 (continued)

| EARTHQUAKE | DATE Y M D | TIME H M S | MAGNITUDE MD | ML | MS | DEPTH (KM) | RECORDING STATION | USGS STAT NO | SITE CLAS | DISTANCE TO: HYPOC (KM) | EPIC (KM) | RUPT (KM) | RECORD | COMP | PEAK ACCEL VOL 1 (G) | VOL 2 CM/S/S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FRIULI SEQUENCE | 76 715 | 1259 0 | | 3.8 | | 1.0 | TARCENTO, ITALY | 8011 | ABD | 11.7 | 11.7 | | F119 | NORT | .033 | |
| | | | | | | | | | | | | | F119 | EAST | .045 | |
| FRIULI SEQUENCE | 76 9 6 | 192012 | | 4.0 | | 1.0 | TOLMEZZO, ITALY - ENEL FIXED | 8012 | ABB | 14.0 | 14.0 | | F120 | NORT | .021 | |
| | | | | | | | | | | | | | F120 | EAST | .022 | |
| | | | | | | | BUIA, ITALY | 8023 | ABC | 13.4 | 13.4 | | F122 | NORT | .033 | |
| | | | | | | | | | | | | | F122 | EAST | .023 | |
| FRIULI SEQUENCE | 76 915 | 94554 | | 4.1 | | 27.0 | TOLMEZZO, ITALY - ENEL MOBILE | 8013 | ABB | 33.3 | 19.5 | | F180 | NORT | .029 | |
| | | | | | | | | | | | | | F180 | EAST | .018 | |
| | | | | | | | FORGARIA-CORN., ITALY | 8014 | ABB | 27.0 | | | F179 | NORT | .029 | |
| | | | | | | | | | | | | | F179 | EAST | .044 | |
| IMPERIAL AFTERS HOCK A02 | 791015 | 161839 | | 3.8 | | 5.0 | BONDS CORNER | 5054 | ADD | 32.2 | 31.8 | | A02A | S50W | .029 | |
| | | | | | | | | | | | | | A02A | S40E | .129 | |
| | | | | | | | EL CENTRO ARRAY # 6: HUSTON ROAD | 942 | ADD | 11.6 | 10.5 | | A02B | S50W | .167 | |
| | | | | | | | | | | | | | A02B | S40E | .113 | |
| | | | | | | | EL CENTRO ARRAY # 7: IMPERIAL VALLEY | 5028 | ADD | 11.6 | 10.4 | | A02C | S50W | .027 | |
| | | | | | | | | | | | | | A02C | S40E | .021 | |
| | | | | | | | EL CENTRO ARRAY # 8: 95 EAST CRUICKS | 958 | ADD | 12.3 | 11.3 | | A02D | S50W | .042 | |
| | | | | | | | | | | | | | A02D | S40E | .039 | |
| | | | | | | | EL CENTRO DIFFERENTIAL ARRAY: DOGWOOD RO | 5165 | ADD | 13.8 | 12.9 | | A02F | N00W | .047 | |
| | | | | | | | | | | | | | A02F | N90W | .051 | |
| | | | | | | | HOLTVILLE POST OFFICE | 5055 | ADD | 20.9 | 20.3 | | A02G | N45W | .026 | |
| | | | | | | | | | | | | | A02G | S45W | .037 | |
| IMPERIAL AFTERS HOCK A05 | 791015 | 162553 | | 4.0 | | 8.1 | BRAWLEY AIRPORT | 5060 | ADD | 19.5 | 17.7 | | A05A | N45W | .023 | |
| | | | | | | | | | | | | | A05A | S45W | .017 | |
| | | | | | | | EL CENTRO ARRAY # 8: 95 EAST CRUICKS | 958 | ADD | 9.7 | 5.4 | | A05B | S50W | .026 | |
| | | | | | | | | | | | | | A05B | S40E | .022 | |
| IMPERIAL AFTERS HOCK A07 | 791015 | 1655 3 | | 4.2 | | 5.0 | BRAWLEY AIRPORT | 5060 | ADD | 24.9 | 24.4 | | A07A | N45W | .074 | |
| | | | | | | | | | | | | | A07A | S45W | .062 | |
| | | | | | | | EL CENTRO ARRAY # 5: 2801 JAMES ROAD | 952 | ADD | 16.8 | 16.1 | | A07B | S50W | .060 | |
| | | | | | | | | | | | | | A07B | S40E | .059 | |
| | | | | | | | EL CENTRO ARRAY # 6: HUSTON ROAD | 942 | ADD | 14.4 | 13.5 | | A07C | S50W | .124 | |
| | | | | | | | | | | | | | A07C | S40E | .079 | |
| IMPERIAL AFTERS HOCK A10 | 791015 | 172214 | | 4.2 | | 10.0 | BRAWLEY AIRPORT | 5060 | ADD | 10.6 | 3.5 | | A10A | N45W | .170 | |
| | | | | | | | | | | | | | A10A | S45W | .169 | |

TABLE 361.16 — 1 (continued)

| EARTHQUAKE | DATE Y M D | TIME H M S | MAGNITUDE MD | ML | MS | DEPTH (KM) | RECORDING STATION | USGS STAT NO | SITE CLAS | DISTANCE TO: HYPOC (KM) | EPIC (KM) | RUPT (KM) | RECORD | COMP | PEAK ACCEL. VOL 1 (G) | VOL 2 CM/S/S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IMPERIAL AFTERS HOCK A10 | 791015 | 172214 | | 4.2 | | 10.0 | CALIPATRIA FIRE STA (CT40) | 5061 | DDD | 21.6 | 19.1 | | A10B<br>A10B | N45W<br>S45W | .005<br>.011 | |
| | | | | | | | EL CENTRO ARRAY # 2: KEYSTONE ROAD | 5115 | ADD | 10.1 | 15.1 | | A10C<br>A10C | S50W<br>S40W | .018<br>.017 | |
| IMPERIAL AFTERS HOCK A16 | 791015 | 1039 3 | | 4.0 | | 2.0 | BRAWLEY AIRPORT | 5060 | ADD | 5.2 | 4.8 | | A16A<br>A16A | N45W<br>S45W | .080<br>.028 | |
| IMPERIAL AFTERS HOCK A26 | 791015 | 23 439 | | 4.0 | | 8.0 | EL CENTRO ARRAY # 5: 2801 JAMES ROAD | 952 | ADD | 12.1 | 9.1 | | A26A<br>A26A | S50W<br>S40E | .048<br>.041 | |
| | | | | | | | EL CENTRO ARRAY # 8: 95 EAST CRUICKS | 958 | ADD | 13.9 | 11.3 | | A26D<br>A26D | S50W<br>S40E | .047<br>.033 | |
| IMPERIAL AFTERS HOCK A27 | 791015 | 231346 | | 4.1 | | 8.0 | EL CENTRO ARRAY # 5: 2801 JAMES ROAD | 952 | ADD | 13.2 | 10.5 | | A27A<br>A27A | S50W<br>S40E | .077<br>.053 | |
| IMPERIAL AFTERS HOCK A32 | 791016 | 02324 | | 4.2 | | 9.0 | EL CENTRO ARRAY # 5: 2801 JAMES ROAD | 952 | ADD | 11.3 | 6.9 | | A32A<br>A32A | S50W<br>S40E | .048<br>.073 | |
| IMPERIAL AFTERS HOCK A34 | 791016 | 23641 | | 4.0 | | 9.9 | EL CENTRO ARRAY # 5: 2801 JAMES ROAD | 952 | ADD | 14.3 | 10.3 | | A34A<br>A34A | S50W<br>S40E | .077<br>.047 | |
| IMPERIAL AFTERS HOCK A36 | 791016 | 5 146 | | 4.0 | | 14.4 | EL CENTRO ARRAY # 2: KEYSTONE ROAD | 5115 | ADD | 20.1 | 14.0 | | A36A<br>A36A | S50W<br>S40W | .101<br>.046 | |
| | | | | | | | EL CENTRO ARRAY # 5: 2801 JAMES ROAD | 952 | ADD | 15.0 | 4.3 | | A36D<br>A36D | S50W<br>S40E | .137<br>.153 | |
| IMPERIAL AFTERS HOCK A43 | 791017 | 121438 | | 4.1 | | 15.9 | BRAWLEY AIRPORT | 5060 | ADD | 19.4 | 11.2 | | A43A<br>A43A | N45W<br>S45W | .034<br>.040 | |
| MAMMOTH LAKES DIGTAL NO 9 | 80 527 | 2341 4 | | 3.9 | | 7.2 | CONVICT LAKE | CON | AAB | 8.2 | 4.0 | | M009<br>M009 | WEST<br>SOUT | .126<br>.075 | 115.6<br>66.0 |
| | | | | | | | MCGEE CREEK | MGE | AAB | 9.0 | 5.4 | | M009<br>M009 | NORT<br>EAST | .060<br>.059 | 57.1<br>56.3 |
| | | | | | | | FISH AND GAME EXPERIMENTAL STATION | FIS | ABC | 9.9 | 6.8 | | M009<br>M009 | NORT<br>EAST | .042<br>.023 | 40.6<br>23.5 |
| MAMMOTH LAKES DIGTAL NO 10 | 80 527 | 235743 | | 3.9 | | 3.2 | FISH AND GAME EXPERIMENTAL STATION | FIS | ABC | 9.6 | 9.1 | | M010<br>M010 | NORT<br>EAST | .044<br>.034 | 43.2<br>33.3 |
| | | | | | | | MCGEE CREEK | MGE | AAB | 10.4 | 9.9 | | M010<br>M010 | NORT<br>EAST | .011<br>.014 | 10.9<br>13.8 |
| | | | | | | | CASHBAUGH RANCH | CBR | ABC | 15.7 | 15.4 | | M010<br>M010 | NORT<br>EAST | .009<br>.008 | |

## TABLE 361.16 — 1 (continued)

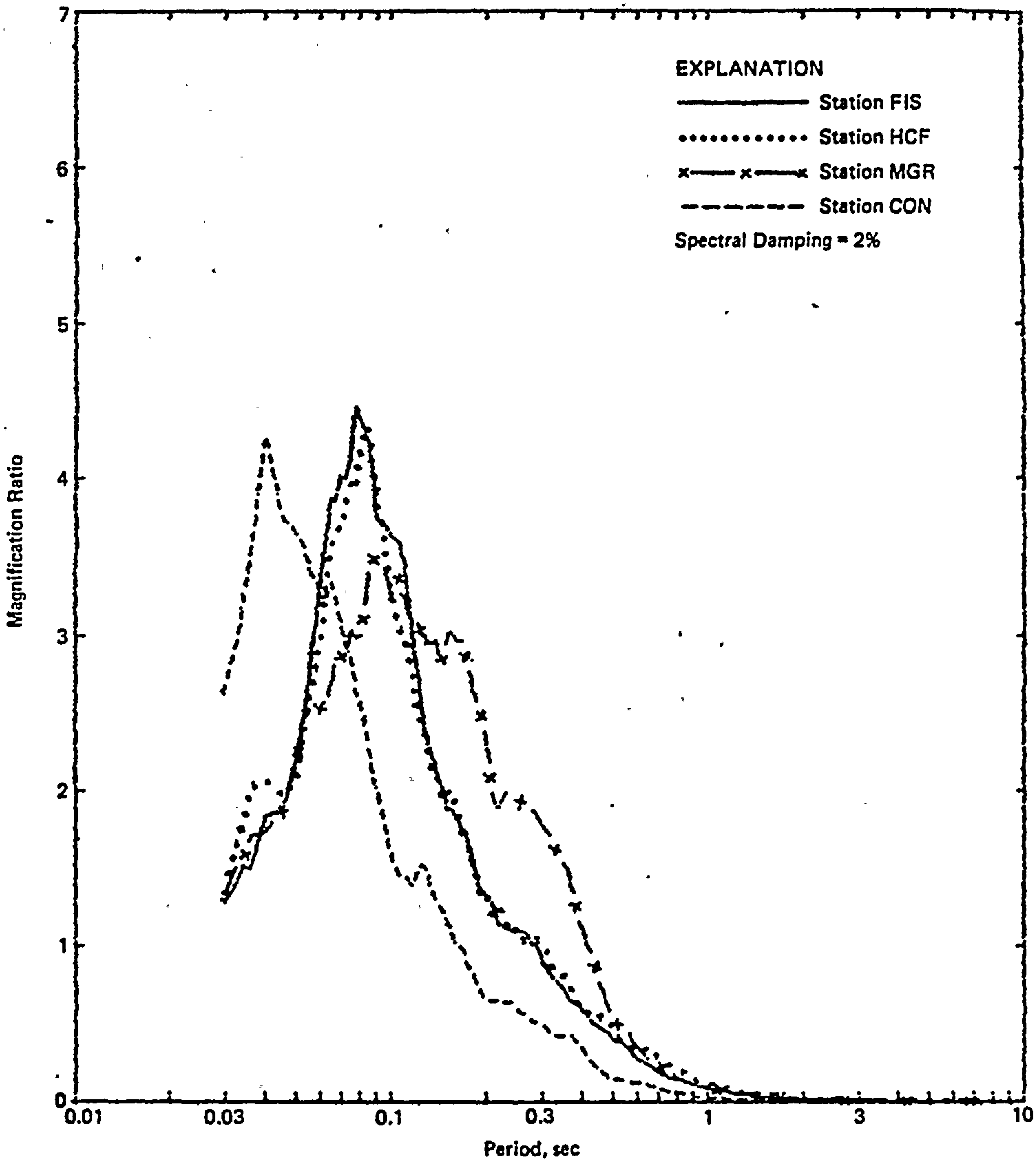
| EARTHQUAKE | DATE Y M D | TIME H M S | MAGNITUDE MD | ML | MS | DEPTH (KM) | RECORDING STATION | USGS STAT NO | SITE CLAS | DISTANCE TO: HYPOC (KM) | EPIC (KM) | RUPT (KM) | RECORD | COMP | PEAK ACCEL VOL 1 (G) | VOL 2 CM/S/S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAMMOTH LAKES DIGTAL NO 11 | 80 528 | 4 258 | | 3.0 | | 4.7 | MCGEE CREEK | MGE | AAB | 5.0 | 3.3 | | M011<br>M011 | NORT<br>EAST | .045<br>.039 | 43.8<br>37.7 |
| MAMMOTH LAKES DIGTAL NO 11. | 80 528 | 4 258 | | 3.0 | | 4.7 | FISH AND GAME EXPERIMENTAL STATION | FIS | ABC | 6.4 | 4.3 | | M011<br>M011 | NORT<br>EAST | .081<br>.081 | 79:3<br>78.6 |
| | | | | | | | HOT CREEK FARM | HCF | ABC | 9.0 | 7.7 | | M011<br>M011 | NORT<br>EAST | .022<br>.023 | |
| | | | | | | | CASHBAUGH RANCH | CBR | ABC | 11.3 | 10.3 | | M011<br>M011 | NORT<br>EAST | .008<br>.006 | |
| MAMMOTH LAKES DIGTAL NO 12 | 80 528 | 42210 | | 3.8 | | ·3.2 | CONVICT LAKE | CON | AAD | 11.8 | 11.4 | | M012<br>M012 | WEST<br>SOUT | .035<br>.025 | |
| | | | | | | | MCGEE CREEK | MGE | AAB | 17.1 | 16.8 | | M012<br>M012 | NORT<br>EAST | .009<br>.008 | |
| MAMMOTH LAKES DIGTAL NO 18 | 80 528 | 115437 | | 4.2 | | 3.4 | MCGEE CREEK | MGE | AAB | 14.1 | 13.7 | | M018<br>M018 | NORT<br>EAST | .042<br>.029 | |
| | | | | | | | CONVICT LAKE | CON | AAB | 16.3 | 15.9 | | M018<br>M018 | WEST<br>SOUT | .006<br>.005 | |
| | | | | | | | FISH AND GAME EXPERIMENTAL STATION | FIS | ABC | 18.9 | 18.6 | | M018<br>M018 | NORT<br>EAST | .014<br>.016 | |
| | | | | | | | CASHBAUGH RANCH | CBR | ABC | 26.1 | 25.9 | | M018<br>M018 | NORT<br>EAST | .007<br>.007 | |
| MAMMOTH LAKES DIGTAL NO 21 | 80 529 | 41852 | | 4.0 | | 11.4 | MCGEE CREEK | MGE | AAB | 12.2 | 4.5 | | M021<br>M021 | NORT<br>EAST | .089<br>.072 | |
| | | | | | | | CONVICT LAKE | CON | AAB | 13.4 | 7.2 | | M021<br>M021 | WEST<br>SOUT | .203<br>.126 | |
| | | | | | | | FISH AND GAME EXPERIMENTAL STATION | FIS | ABC | 14.7 | 9.3 | | M021<br>M021 | NORT<br>EAST | .028<br>.042 | |
| | | | | | | | CASHBAUGH RANCH | CBR | ABC | 19.9 | 16.4 | | M021<br>M021 | NORT<br>EAST | .015<br>.013 | |
| MAMMOTH LAKES DIGTAL NO 26 | 80 529 | 1721 1 | | 4.0 | | 4.2 | MCGEE CREEK | MGE | AAB | 8.3 | 7.1 | | M026<br>M026 | NORT<br>EAST | .052<br>.060 | 51.6<br>57.6 |
| | | | | | | | CONVICT LAKE | CON | AAD | 9.9 | 8.9 | | M026<br>M026 | WEST<br>SOUT | .065<br>.044 | 57.9<br>40.4 |
| | | | | | | | CASHBAUGH RANCH | CBR | ABC | 19.1 | 18.6 | | M026<br>M026 | NORT<br>EAST | .008<br>.006 | |

## TABLE 361.16 — 1 (continued)

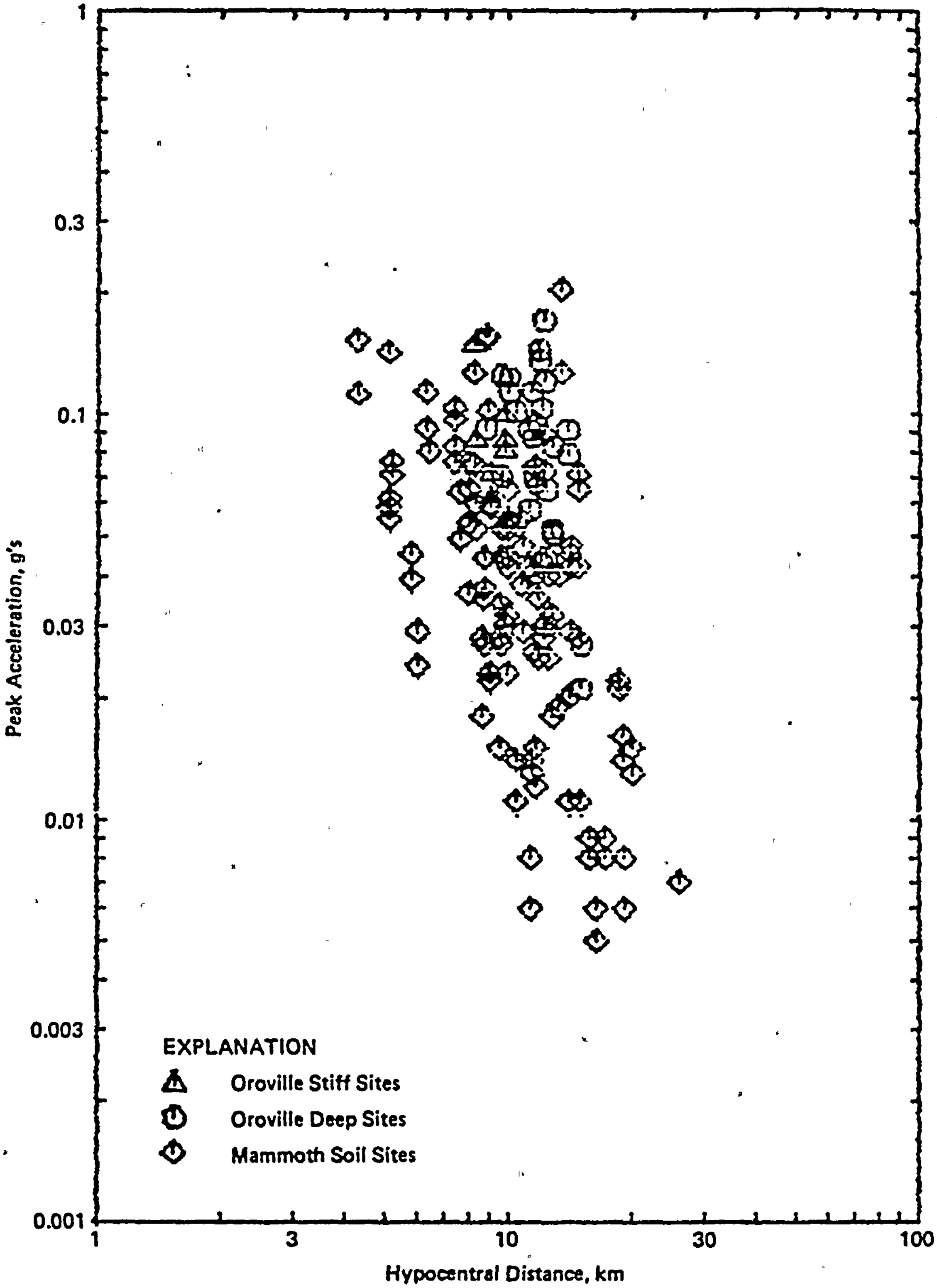
| EARTHQUAKE | DATE Y M D | TIME H M S | MAGNITUDE MD | ML | MS | DEPTH (KM) | RECORDING STATION | USGS STAT NO | SITE CLAS | DISTANCE TO: HYPOC (KM) | EPIC (KM) | RUPT (KM) | RECORD | COMP | PEAK ACCEL VOL 1 (G) | VOL 2 CM/S/S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAMMOTH LAKES DIGTAL NO 38 | 80 530 | 1949 2 | | 3.8 | | 6.3 | CONVICT LAKE | CON | AAB | 7.4 | 3.8 | | M038 | WEST | .076 | 63.7 |
| | | | | | | | | | | | | | M038 | SOUT | .103 | 92.3 |
| MAMMOTH LAKES DIGTAL NO 38 | 80 530 | 1949 2 | | 3.8 | | 6.3 | FISH AND GAME EXPERIMENTAL STATION | FIS | ABC | 9.5 | 7.1 | | M038 | NORT | .028 | 27.3 |
| | | | | | | | | | | | | | M038 | EAST | .015 | 13.4 |
| | | | | | | | MCGEE CREEK | MGE | AAB | 10.0 | 7.8 | | M038 | NORT | .055 | 52.8 |
| | | | | | | | | | | | | | M038 | EAST | .054 | 51.5 |
| | | | | | | | HOT CREEK FARM | HCF | ABC | 11.2 | 9.3 | | M038 | NORT | .042 | |
| | | | | | | | | | | | | | M038 | EAST | .042 | |
| MAMMOTH LAKES DIGTAL NO 42 | 80 531 | 101131 | | 4.1 | | 3.3 | CONVICT LAKE | CON | AAB | 4.3 | 2.8 | | M042 | WEST | .112 | 110.1 |
| | | | | | | | | | | | | | M042 | SOUT | .152 | 146.8 |
| | | | | | | | MCGEE CREEK | MGE | AAB | 5.1 | 3.9 | | M042 | NORT | .062 | 58.1 |
| | | | | | | | | | | | | | M042 | EAST | .059 | 58.2 |
| | | | | | | | FISH AND GAME EXPERIMENTAL STATION | FIS | ABC | 5.1 | 3.9 | | M042 | NORT | .142 | 140.5 |
| | | | | | | | | | | | | | M042 | EAST | .055 | 51.7 |
| | | | | | | | HOT CREEK FARM | HCF | ABC | 8.0 | 7.3 | | M042 | NORT | .054 | |
| | | | | | | | | | | | | | M042 | EAST | .036 | |
| | | | | | | | CASHBAUGH RANCH | CBR | ABC | 11.6 | 11.1 | | M042 | NORT | .015 | |
| | | | | | | | | | | | | | M042 | EAST | .012 | |
| MAMMOTH LAKES DIGTAL NO 51 | 80 531 | 152019 | | 3.9 | | 6.6 | MCGEE CREEK | MGE | AAB | 7.6 | 3.7 | | M051 | NORT | .064 | 60.2 |
| | | | | | | | | | | | | | M051 | EAST | .049 | 48.3 |
| | | | | | | | FISH AND GAME EXPERIMENTAL STATION | FIS | ABC | 8.0 | 4.5 | | M051 | NORT | .076 | 74.6 |
| | | | | | | | | | | | | | M051 | EAST | .065 | 61.3 |
| | | | | | | | CONVICT LAKE | CON | AAB | 8.9 | 6.0 | | M051 | WEST | .102 | 89.7 |
| | | | | | | | | | | | | | M051 | SOUT | .155 | 152.1 |
| | | | | | | | CASHBAUGH RANCH | CBR | ABC | 12.1 | 10.1 | | M051 | NORT | .030 | |
| | | | | | | | | | | | | | M051 | EAST | .020 | |
| MAMMOTH LAKES DIGTAL NO 55 | 80 531 | 231529 | | 3.9 | | 11.4 | FISH AND GAME EXPERIMENTAL STATION | FIS | ABC | 11.5 | 1.1 | | M055 | NORT | .074 | |
| | | | | | | | | | | | | | M055 | EAST | .026 | |
| | | | | | | | CONVICT LAKE | CON | AAB | 11.6 | 2.3 | | M055 | WEST | .095 | |
| | | | | | | | | | | | | | M055 | SOUT | .067 | |
| | | | | | | | MCGEE CREEK | MGE | AAB | 13.2 | 6.6 | | M055 | NORT | .040 | |
| | | | | | | | | | | | | | M055 | EAST | .019 | |
| | | | | | | | CASHBAUGH RANCH | CBR | ABC | 14.1 | 8.2 | | M055 | NORT | .047 | |
| | | | | | | | | | | | | | M055 | EAST | .045 | |

## TABLE 361.16 — 1 (continued)

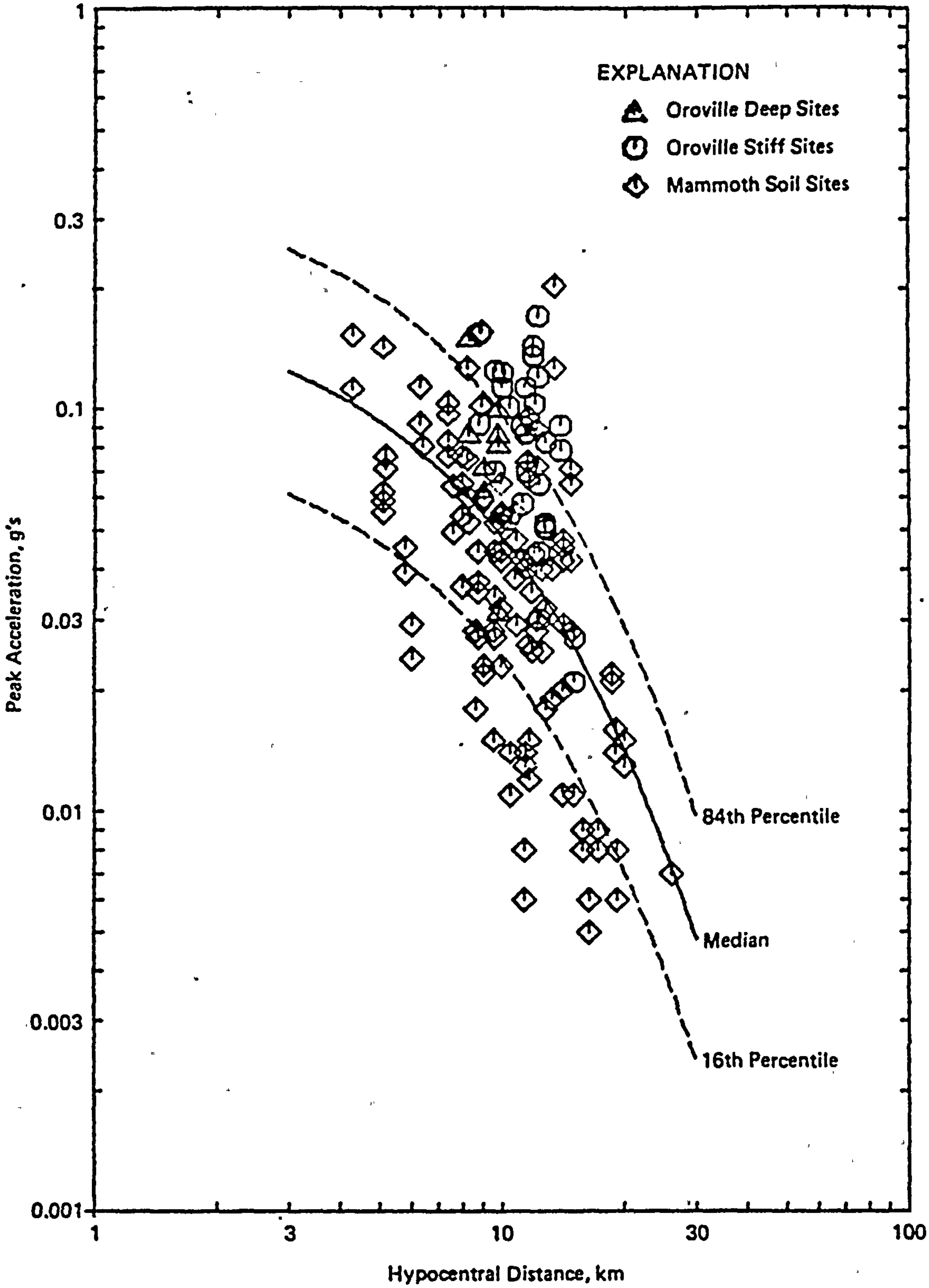
| EARTHQUAKE | DATE Y M D | TIME H M S | MAGNITUDE MD | ML | MS | DEPTH (KM) | RECORDING STATION | USGS STAT NO | SITE CLAS | DISTANCE TO: HYPOC (KM) | EPIC (KM) | RUPT (KM) | RECORD | COMP | PEAK ACCEL VOL 1 (G) | VOL 2 CM/S/S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAMMOTH LAKES DIGTAL NO 65 | 80 6 2 | 102220 | | 4.1 | | 4.6 | CONVICT LAKE | CON | AAB | 7.4 | 5.8 | | M065 | WEST | .097 | 85.4 |
| | | | | | | | | | | | | | M065 | SOUT | .083 | 80.2 |
| MAMMOTH LAKES DIGTAL NO 65 | 80 6 2 | 102220 | | 4.1 | | 4.6 | FISH AND GAME EXPERIMENTAL STATION | FIS | ABC | 9.6 | 8.4 | | M065 | NORT | .052 | 50.3 |
| | | | | | | | | | | | | | M065 | EAST | .027 | 28.2 |
| | | | | | | | HOT CREEK FARM | HCF | ABC | 9.9 | 8.7 | | M065 | NORT | .032 | |
| | | | | | | | | | | | | | M065 | EAST | .052 | |
| | | | | | | | MCGEE CREEK | MGE | AAB | 12.8 | 11.9 | | M065 | NORT | .032 | |
| | | | | | | | | | | | | | M065 | EAST | .018 | |
| | | | | | | | CASHBAUGH RANCH | CDR | ABC | 14.0 | 13.2 | | M065 | NORT | .020 | |
| | | | | | | | | | | | | | M065 | EAST | .011 | |
| MAMMOTH LAKES DIGTAL NO 67 | 80 6 2 | 203414 | | 3.9 | | 5.0 | CONVICT LAKE | CON | AAB | 6.3 | 3.9 | | M067 | WEST | .113 | 96.5 |
| | | | | | | | | | | | | | M067 | SOUT | .092 | 85.0 |
| | | | | | | | FISH AND GAME EXPERIMENTAL STATION | FIS | ABC | 8.7 | 7.1 | | M067 | NORT | .037 | 36.0 |
| | | | | | | | | | | | | | M067 | EAST | .027 | 25.2 |
| | | | | | | | MCGEE CREEK | MGE | AAB | 8.7 | 7.2 | | M067 | NORT | .044 | 42.4 |
| | | | | | | | | | | | | | M067 | EAST | .035 | 34.6 |
| | | | | | | | HOT CREEK FARM | HCF | ABC | 10.7 | 9.5 | | M067 | NORT | .038 | |
| | | | | | | | | | | | | | M067 | EAST | .055 | |
| | | | | | | | CASHBAUGH RANCH | CDR | ABC | 14.9 | 14.0 | | M067 | NORT | .011 | |
| | | | | | | | | | | | | | M067 | EAST | .011 | |
| MAMMOTH LAKES DIGTAL NO 112 | 80 6 7 | 231752 | | 3.9 | | 4.3 | HOT CREEK FARM | HCF | ABC | 5.2 | 3.0 | | M112 | NORT | .071 | |
| | | | | | | | | | | | | | M112 | EAST | .076 | |
| | | | | | | | FISH AND GAME EXPERIMENTAL STATION | FIS | ABC | 6.0 | 4.2 | | M112 | NORT | .029 | 27.0 |
| | | | | | | | | | | | | | M112 | EAST | .024 | 22.5 |
| | | | | | | | CASHBAUGH RANCH | CDR | ABC | 8.6 | 7.5 | | M112 | NORT | .028 | 27.2 |
| | | | | | | | | | | | | | M112 | EAST | .018 | 18.4 |
| | | | | | | | MCGEE CREEK | MGE | AAB | 11.4 | 10.6 | | M112 | NORT | .014 | |
| | | | | | | | | | | | | | M112 | EAST | .013 | |
| MAMMOTH LAKES DIGTAL NO 113 | 80 6 8 | 62527 | | 3.9 | | 8.0 | MCGEE CREEK | MGE | AAB | 10.8 | 7.3 | | M113 | NORT | .047 | |
| | | | | | | | | | | | | | M113 | EAST | .029 | |
| | | | | | | | FISH AND GAME EXPERIMENTAL STATION | FIS | ABC | 12.5 | 9.6 | | M113 | NORT | .040 | |
| | | | | | | | | | | | | | M113 | EAST | .025 | |
| | | | | | | | HOT CREEK FARM | HCF | ABC | 14.7 | 12.4 | | M113 | NORT | .071 | |
| | | | | | | | | | | | | | M113 | EAST | .065 | |
| | | | | | | 8.0 | CASHBAUGH RANCH | CDR | ABC | 18.6 | 16.8 | | M113 | NORT | .022 | |
| | | | | | | | | | | | | | M113 | EAST | .021 | |




| WASHINGTON PUBLIC POWER SUPPLY SYSTEM<br>Nuclear Project No. 2 | MEDIAN SPECTRAL SHAPES FOR MAMMOTH LAKES RECORDING STATIONS: $M_L$ 3.5–4.5, HYPOCENTRAL DISTANCE 0–10.5 km | Figure 361.16-1 |
|---|---|---|




| WASHINGTON PUBLIC POWER SUPPLY SYSTEM<br>Nuclear Project No. 2 | RECORDED PEAK ACCELERATIONS FOR SELECTED DATA SET $M_L$ 3.8–4.2, SOIL SITES | Figure 361.16-2 |
|---|---|---|

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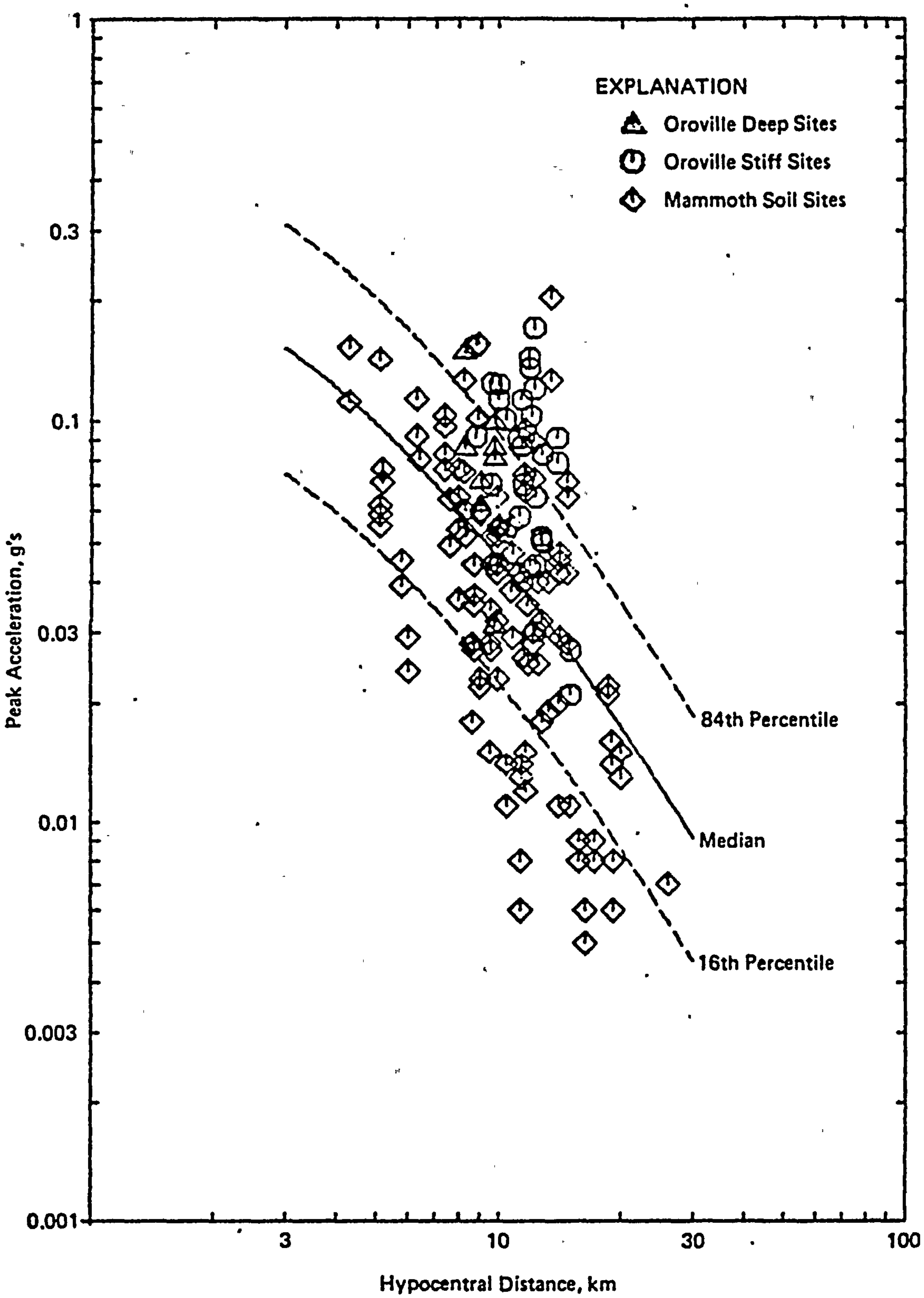
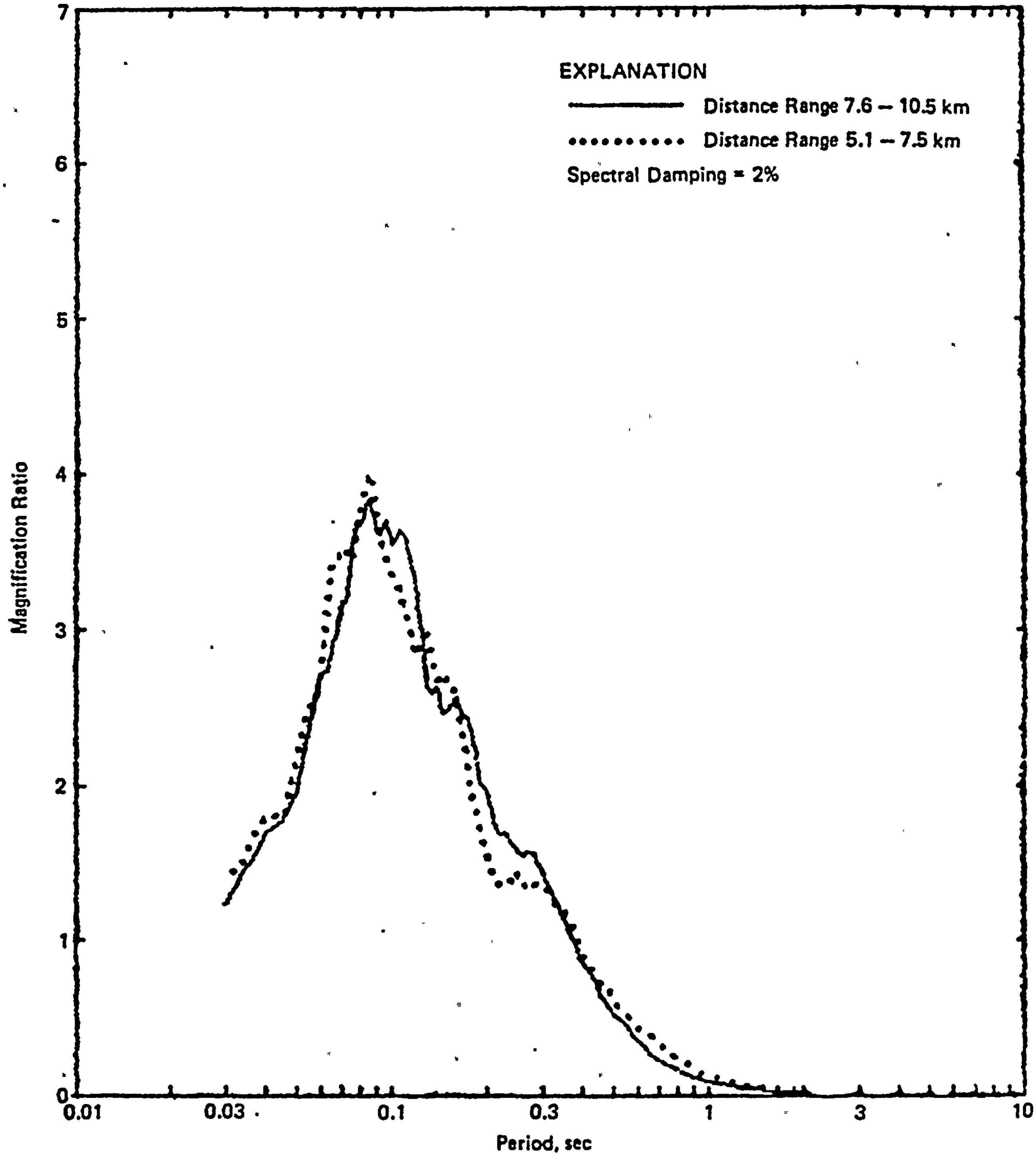
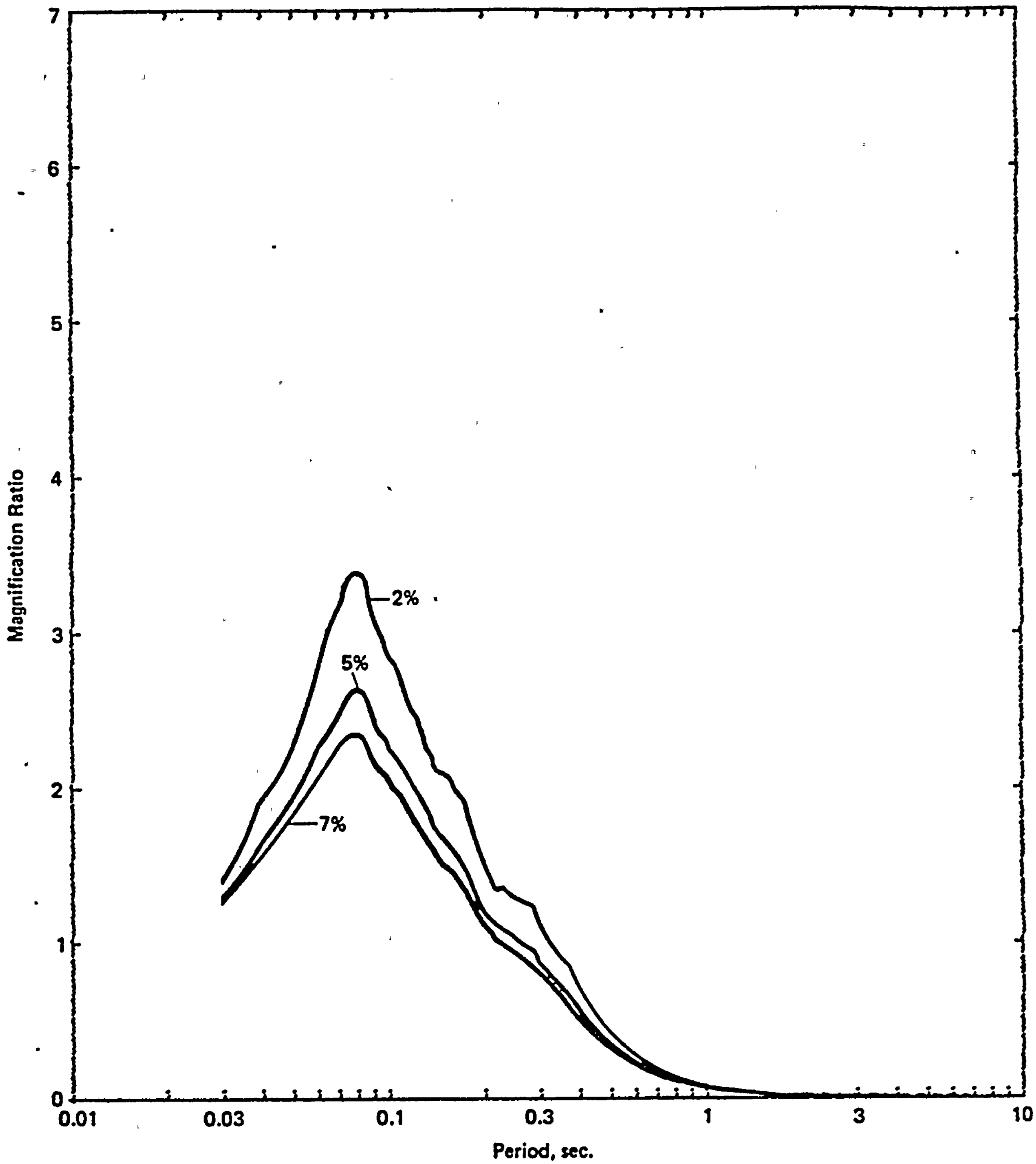
| WASHINGTON PUBLIC POWER SUPPLY SYSTEM<br>Nuclear Project No. 2 | ATTENUATION RELATIONSHIP FOR $M_L$ 4.0 EARTHQUAKES OBTAINED BY NONLINEAR REGRESSION | Figure 361.16-3 |



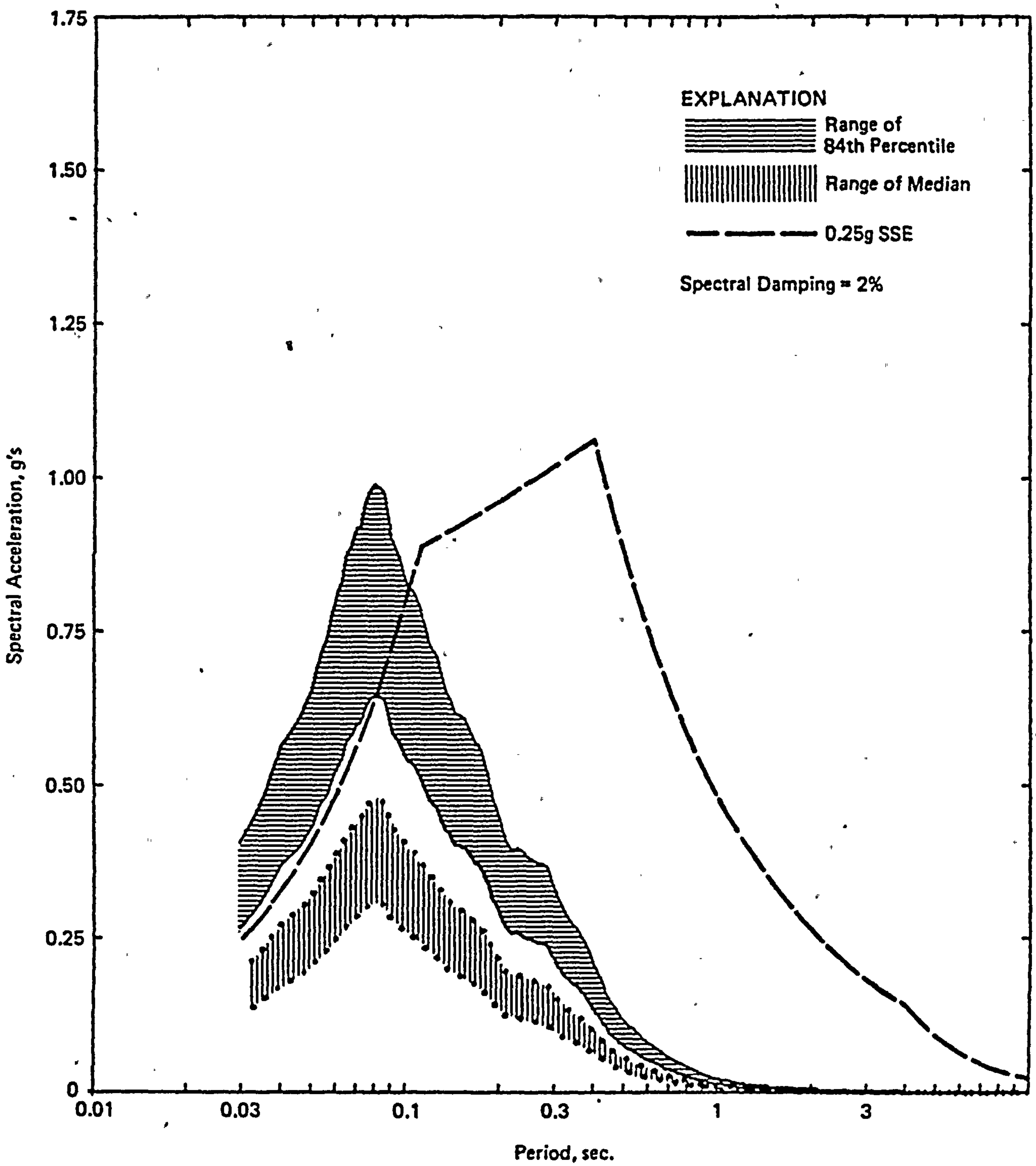

| WASHINGTON PUBLIC POWER SUPPLY SYSTEM<br>Nuclear Project No. 2 | ATTENUATION RELATIONSHIP FOR $M_L$ 4.0 EARTHQUAKES WITH B CONSTRAINED TO - 1.89 | Figure 361.16-4 |
|---|---|---|



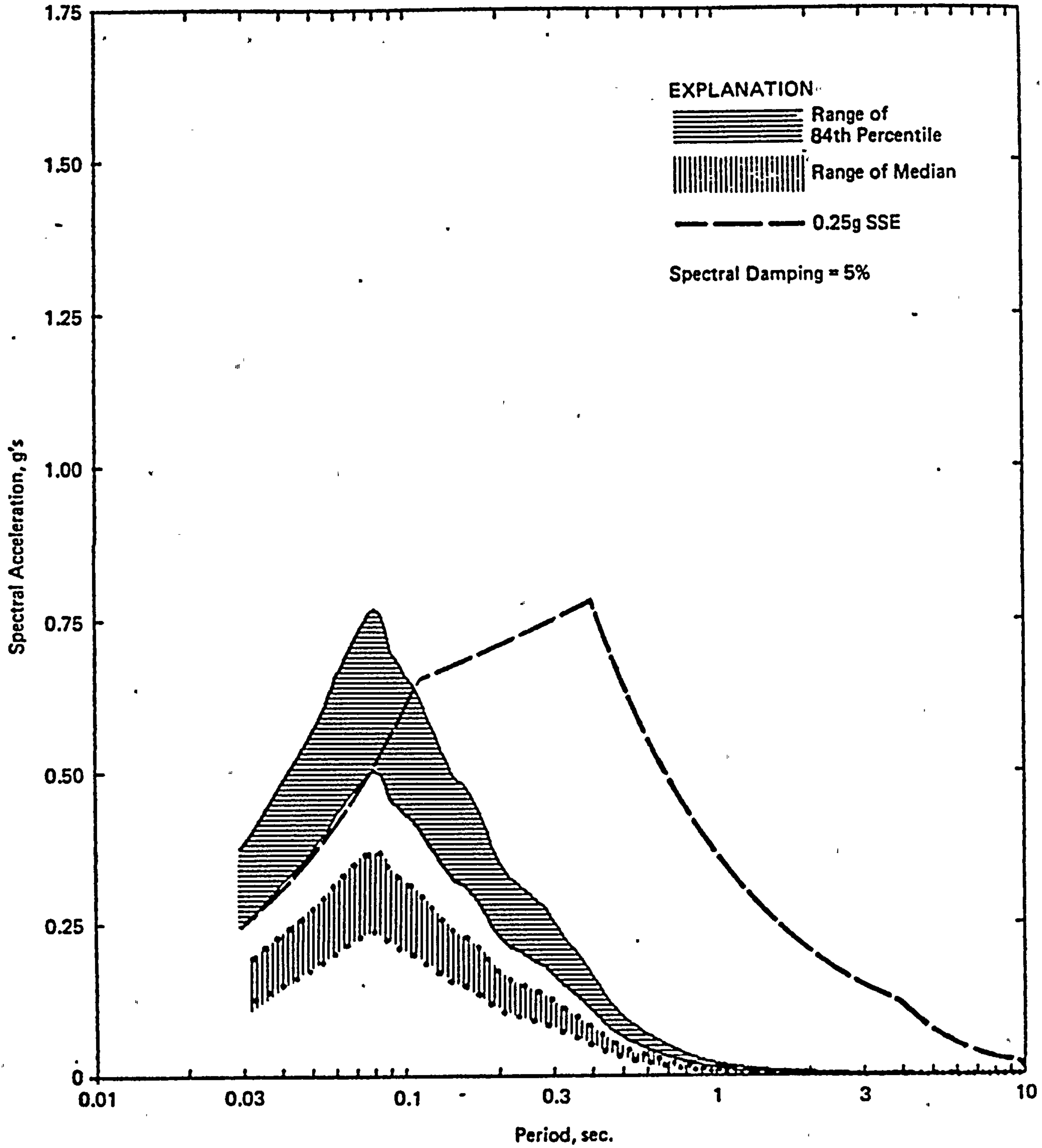

| WASHINGTON PUBLIC POWER SUPPLY SYSTEM<br>Nuclear Project No. 2 | EFFECT OF HYPOCENTRAL DISTANCE ON SPECTRAL SHAPES: MAMMOTH LAKES RECORDINGS $M_L$ 3.8–4.2 | Figure 361.16-5 |
|---|---|---|



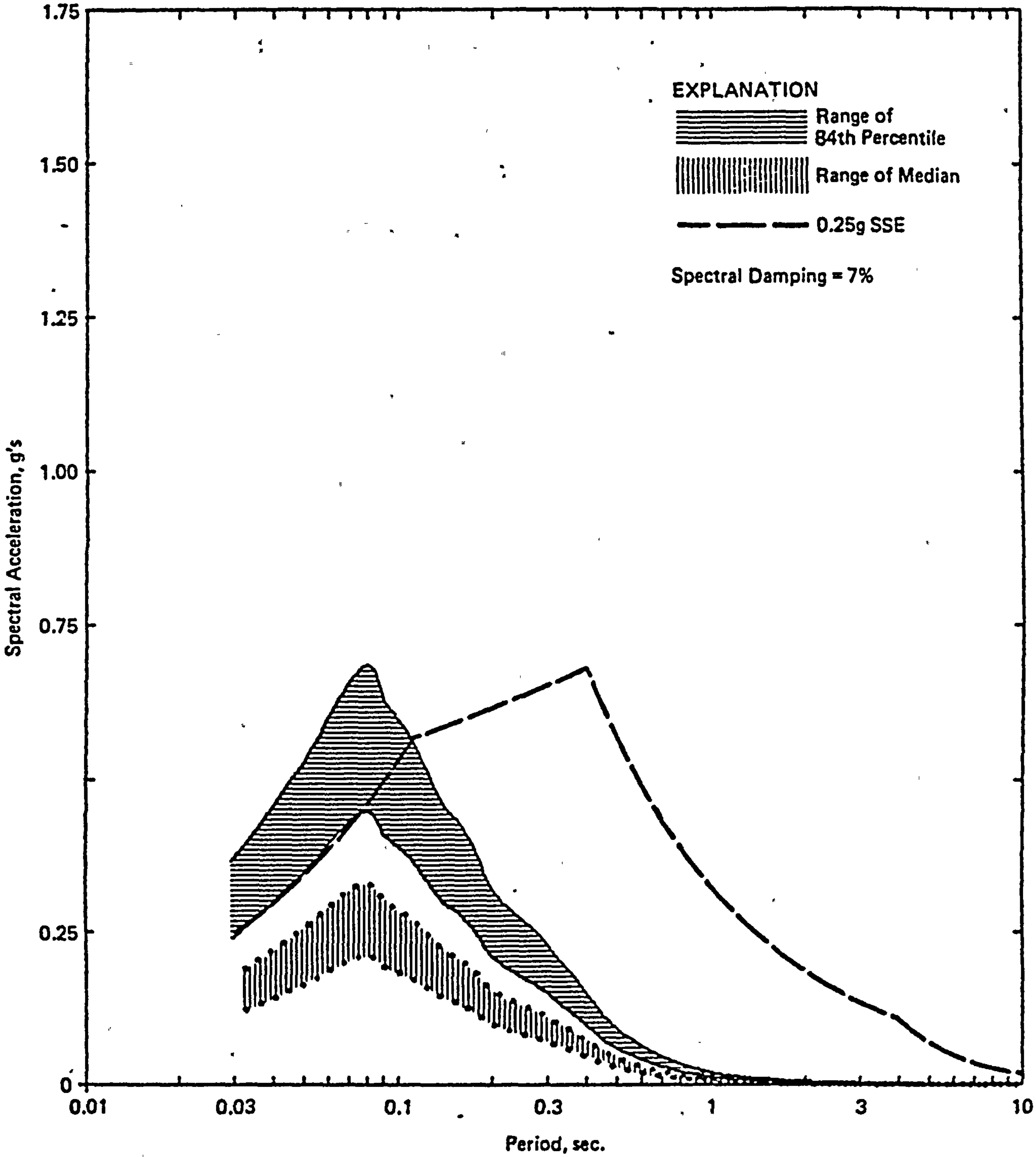

| WASHINGTON PUBLIC POWER SUPPLY SYSTEM<br>Nuclear Project No. 2 | MEDIAN SPECTRAL SHAPES FOR MAGNITUDE $M_L$ 4 EARTHQUAKE: 2%, 5% AND 7% SPECTRAL DAMPING | Figure 361.16-6 |
|---|---|---|



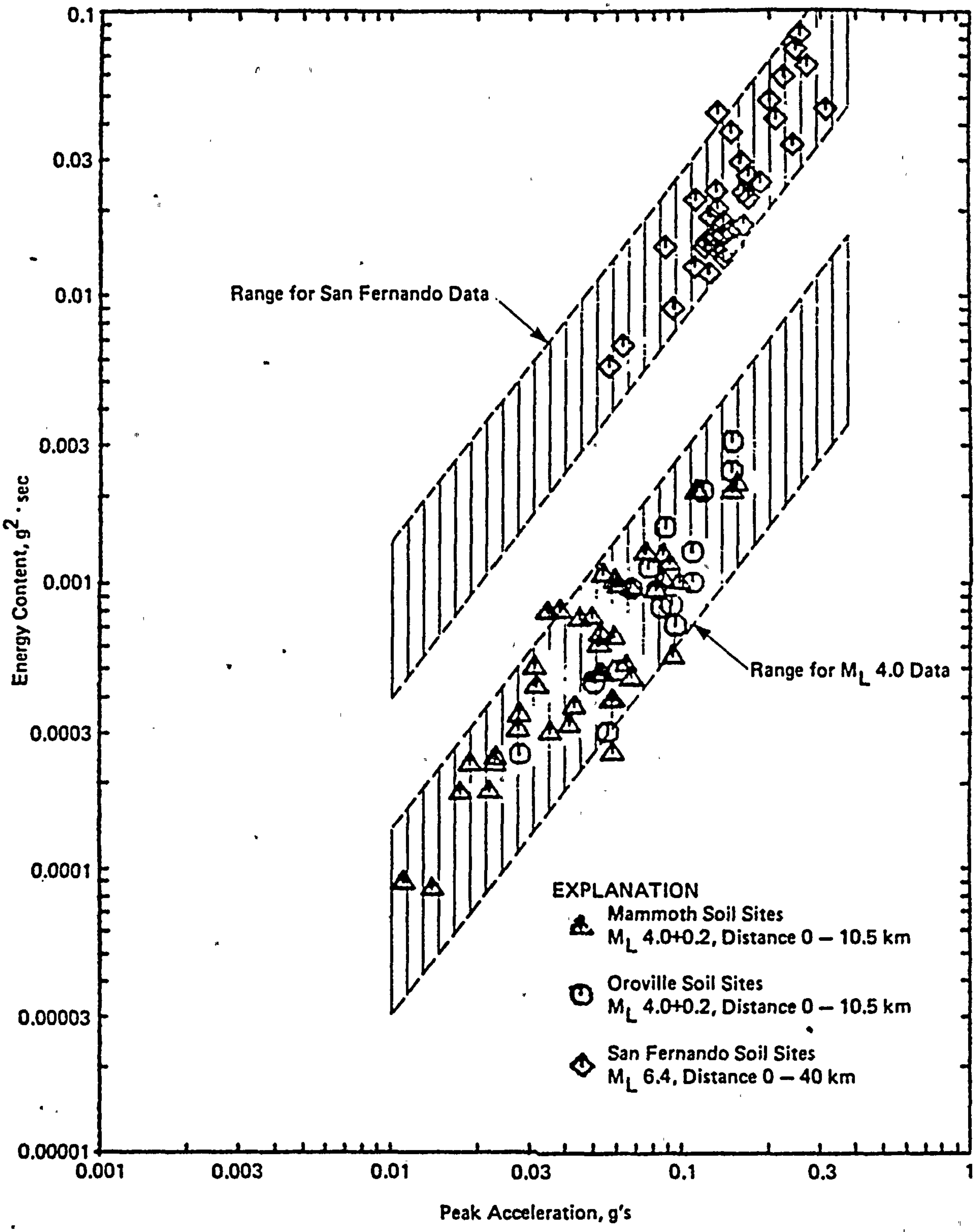

| WASHINGTON PUBLIC POWER SUPPLY SYSTEM<br>Nuclear Project No. 2 | ESTIMATED RESPONSE SPECTRA FOR $M_L$ 4.0 EARTHQUAKE IN DISTANCE RANGE 3 – 5 km: 2% SPECTRAL DAMPING | Figure 361.16-7 |
|---|---|---|



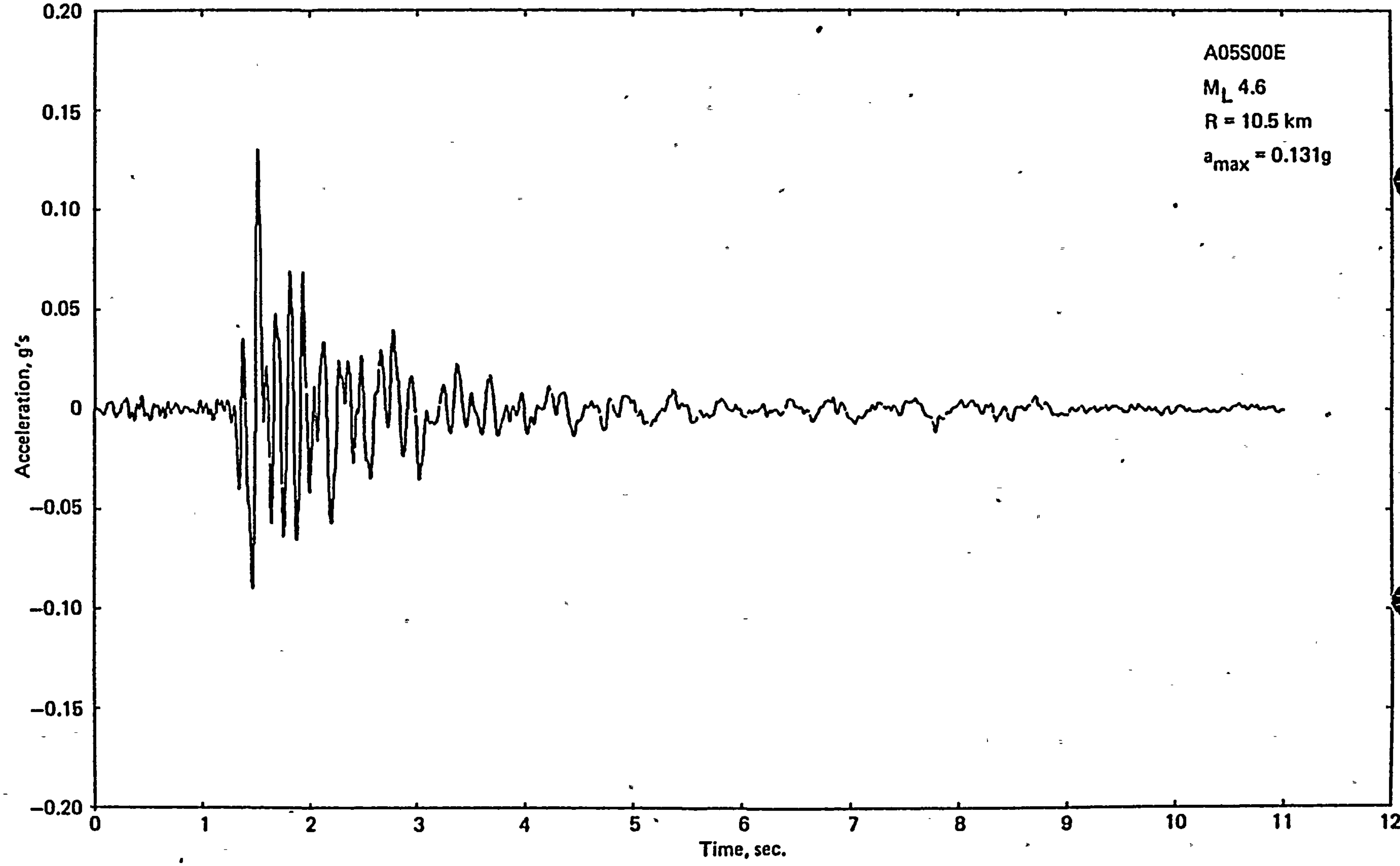

| WASHINGTON PUBLIC POWER SUPPLY SYSTEM<br>Nuclear Project No. 2 | ESTIMATED RESPONSE SPECTRA FOR $M_L$ 4.0 EARTHQUAKE IN DISTANCE RANGE 3 — 5 km: 5% SPECTRAL DAMPING | Figure 361.16-8 |
|---|---|---|




| WASHINGTON PUBLIC POWER SUPPLY SYSTEM<br>Nuclear Project No. 2 | ESTIMATED RESPONSE SPECTRA FOR $M_L$ 4.0 EARTHQUAKE IN DISTANCE RANGE 3 – 5 km: 7% SPECTRAL DAMPING | Figure 361.16-9 |
|---|---|---|




| WASHINGTON PUBLIC POWER SUPPLY SYSTEM<br>Nuclear Project No. 2 | PEAK ACCELERATION VERSUS TOTAL ENERGY CONTENT FOR $M_L$ 4 AND 6.4 EARTHQUAKE RECORDINGS | Figure 361.16-10 |
|---|---|---|




WASHINGTON PUBLIC POWER SUPPLY SYSTEM
Nuclear Project No. 2

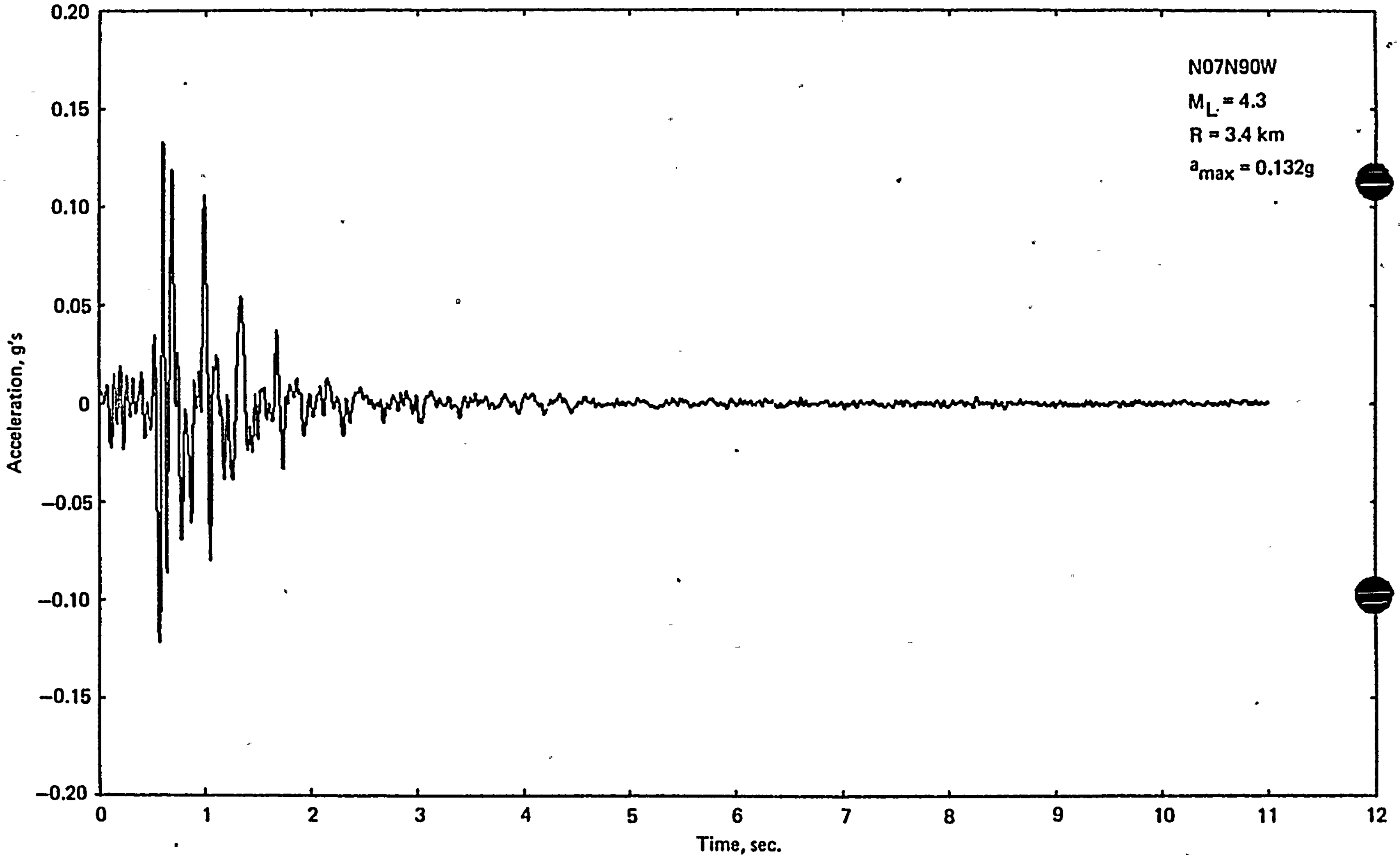
OROVILLE AFTERSHOCK ACCELEROGRAM A05S00E

Figure 361.16-11

WASHINGTON PUBLIC POWER SUPPLY SYSTEM
Nuclear Project No. 2

OROVILLE AFTERSHOCK ACCELEROGRAM N07N90W

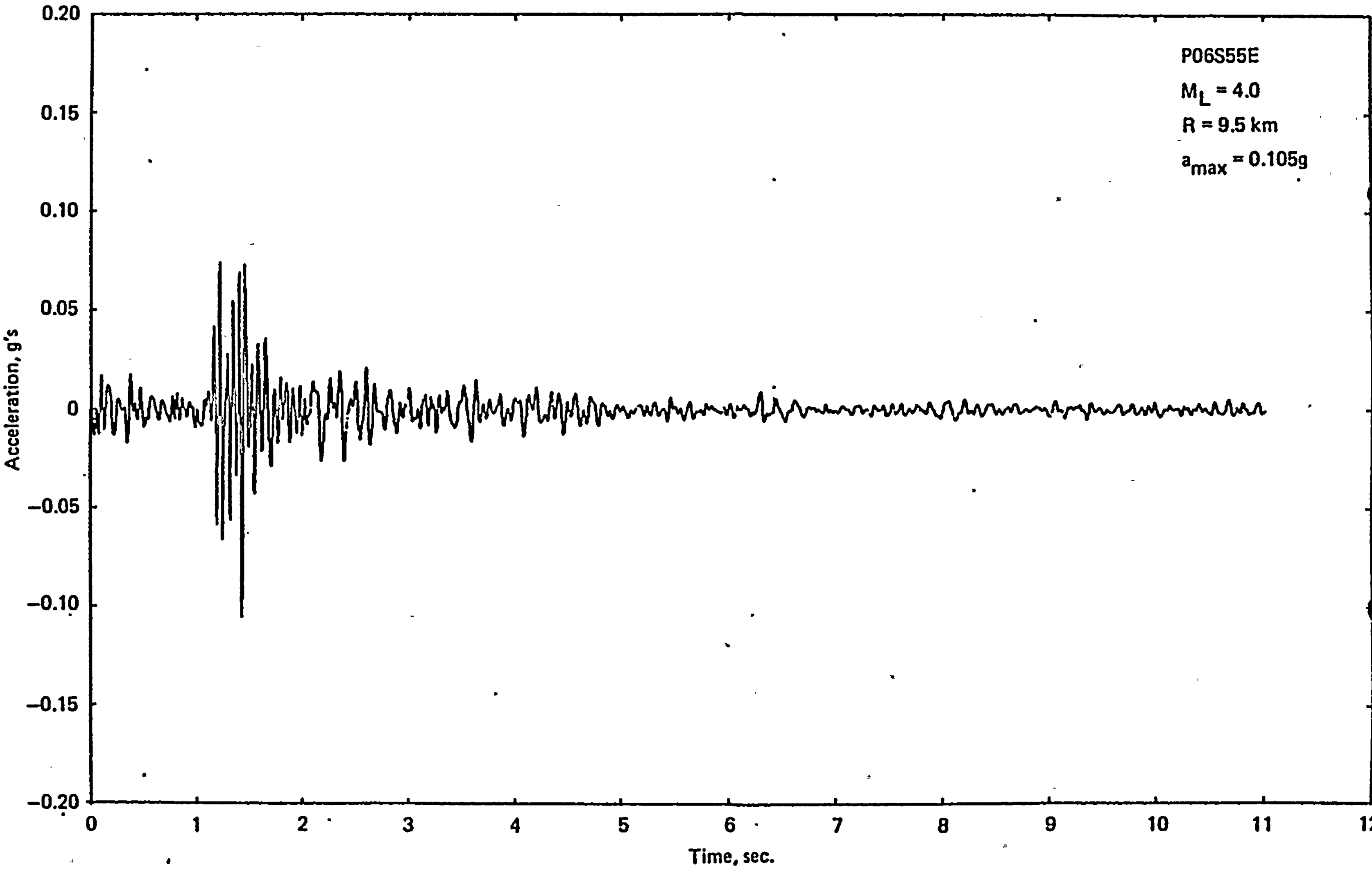
Figure 361.16-12

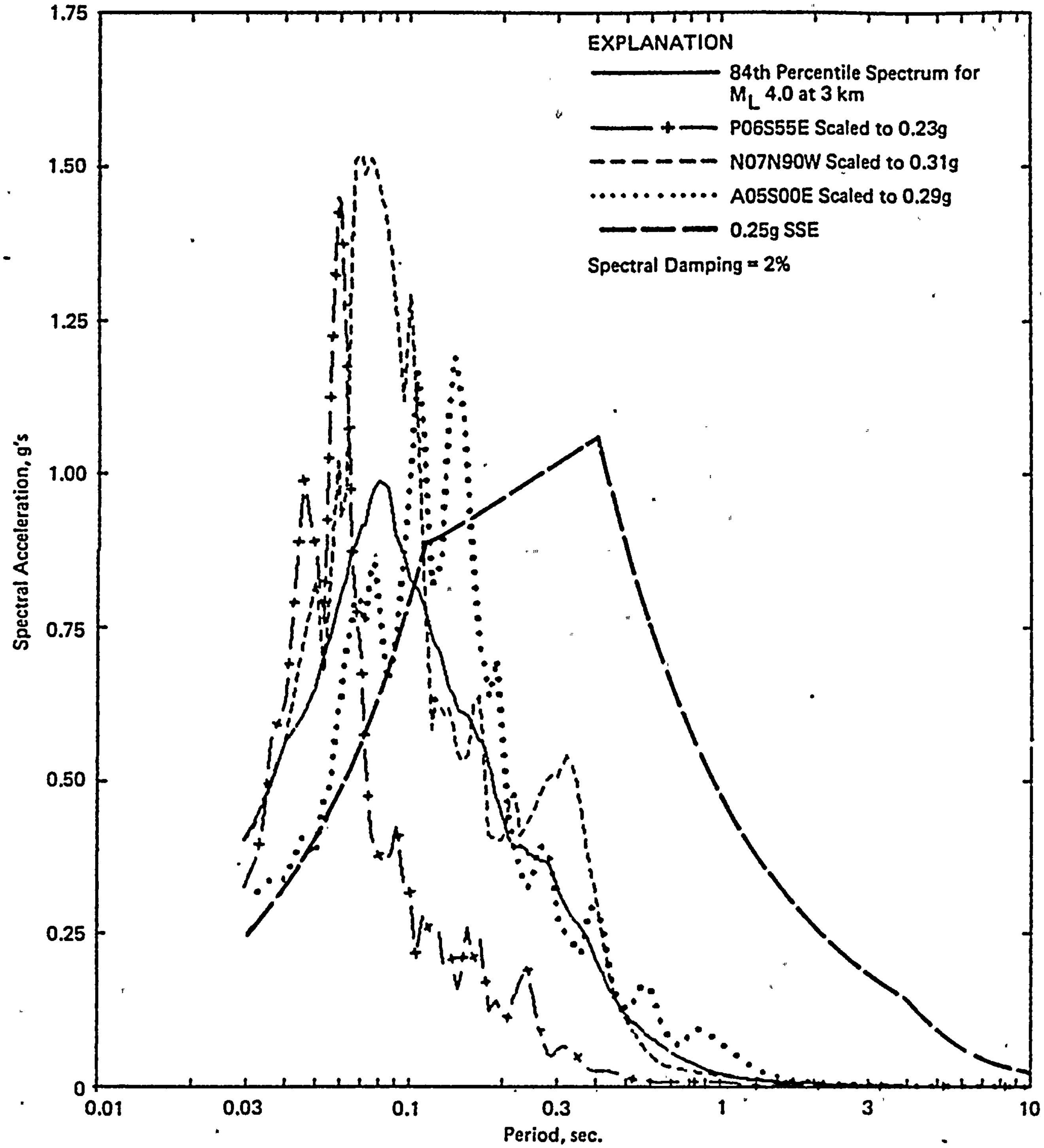


WASHINGTON PUBLIC
POWER SUPPLY SYSTEM
Nuclear Project No. 2

OROVILLE AFTERSHOCK
ACCELEROGRAM P06S55E

Figure
361.16-13






| WASHINGTON PUBLIC POWER SUPPLY SYSTEM<br>Nuclear Project No. 2 | COMPARISON OF SCALED OROVILLE AFTERSHOCK SPECTRA WITH 84th PERCENTILE SPECTRUM FOR $M_L$ 4.0 EARTHQUAKE | Figure 361.16-14 |
|---|---|---|