SITE CHARACTERIZATION AND SITE RESPONSE EFFECTS AT CSMIP STATIONS: TARZANA AND LA CIENEGA NEAR THE SANTA MONICA FREEWAY (I-10)

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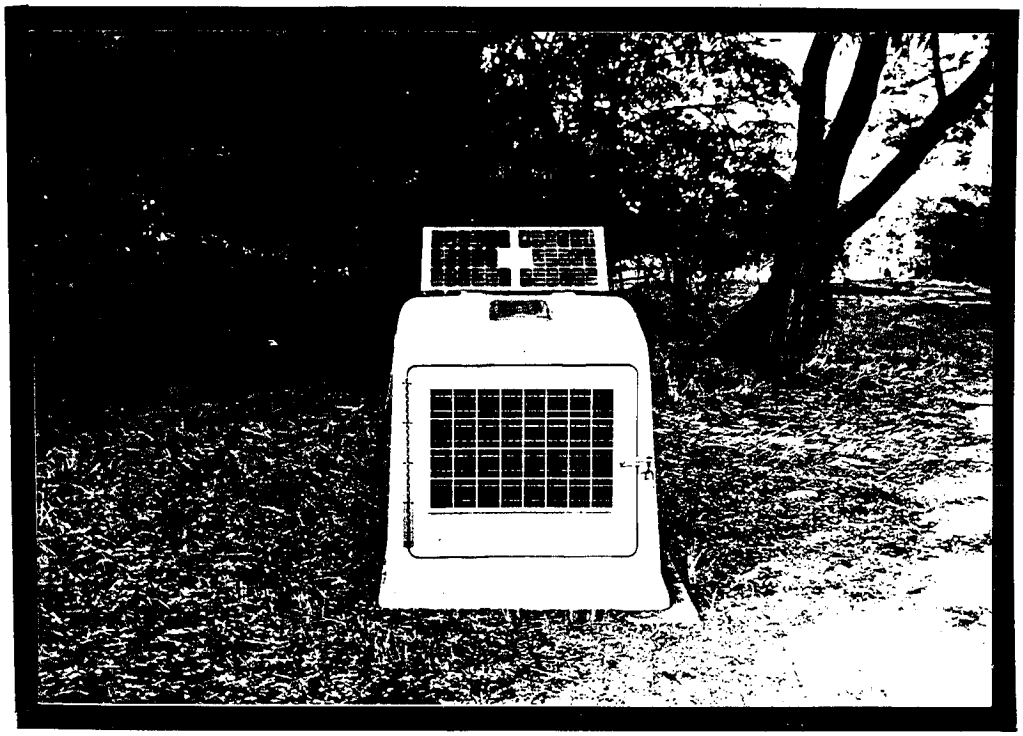

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TARZANA - Cedar Hill Nursery A

Introduction

The Tarzana - Cedar Hill Nursery ground-response station is located about 5 km south of the 1994 Northridge epicenter. The mainshock record shows repeated accelerations over 1 g for 7-8 seconds (Figure 1). The peak horizontal accelerations is about 1.9 g (Appendix A). All three components had peak accelerations over 1 g. The instrument-corrected peak velocity was over 100 cm/sec at Tarzana (Figure 1); velocities this high were also observed in the San Fernando Valley at Sylmar and the Los Angeles Department of Water and Power's Rinaldi Receiving station. These peak values are among the highest ever recorded. Other strong-motion instruments located within several kilometers of Tarzana recorded significantly smaller peak accelerations of about 0.5 g, with peak velocities lower than 60 cm/sec from the mainshock (Darragh et al., 1994b, 1995). For reference, the processed data for Tarzana - Cedar Hill Nursery from the Northridge mainshock are included as Appendix A.

Despite the strong shaking, only moderate damage was observed in the vicinity of Tarzana - Cedar Hill Nursery during the mainshock (Shakal et al., 1996; Spudich et al., 1996). However, structural types in the area are limited to one and two story residential and nursery buildings. Most of these buildings are wood frame.

Large seismic response at this station was also identified during the magnitude 5.9 Whittier Narrows earthquake (Shakal et al., 1988). A peak acceleration at Tarzana of 0.62 g was recorded at a distance of 44 km from the epicenter. This acceleration value is high given that less than 0.45 g was recorded at several close-in stations (Shakal et al., 1987). The peak acceleration was a factor near 10 greater than most other observations at equal epicentral distance and was considerably higher than predicted from attenuation curves (Shakal et al., 1988). However, large response (peak acceleration of only 0.09 g) was not observed in the magnitude 5.3 Whittier Narrows aftershock on October 4th (Shakal et al., 1988) nor several other events (Darragh and Shakal, 1996). The peak acceleration during the Whittier aftershock was a factor of only 2 greater than stations with similar epicentral distances. In addition, directional topographic site response resonances are observed in strong-motion recordings from the Whittier Narrows sequence (Vidale et al., 1991), and weak motion recordings of Northridge aftershocks (Spudich et al., 1996 and Hartzell et al., 1996).

The strong-motion instrumentation (SMA-1) at the Tarzana - Cedar Hill Nursery was installed in 1974 by the Strong Motion Instrumentation Program (SMIP) of the California Division of Mines and Geology (CDMG). The instrumentation was moved in January of 1987 to the current location on the Nursery grounds

(Figure 2). The ground response station is housed in a small lightweight equipment shelter (T-hut), shown on the cover of this report. Four mainshocks, with peak accelerations ranging from 0.07 to 1.9 g, have been recorded by the analog instrumentation. These are the 1987 Whittier Narrows (and aftershock on October 4, 1987), 1991 Sierra Madre, 1992 Landers and 1994 Northridge (and aftershocks on January 17 and March 20, 1994). On January 19, 1994, a digital instrument was collocated with the analog instrument in the T-hut to record Northridge aftershocks. Since this time several earthquakes have been recorded by the digital and analog instrumentation. The largest record is from the March 20, 1994 Northridge aftershock with a peak horizontal acceleration of 0.37 g.

Site Description

The Tarzana - Cedar Hill Nursery station is located in the northern foothills of the Santa Monica Mountains on the south side of the San Fernando Valley near the crest of a low (15 to 20 m) natural hill with gentle slopes (Figure 2). The ridge that underlies the station may represent an uplifted valley floor that formed adjacent to the Santa Monica Mountains. Hoots (1931) and Jennings and Strand (1969) show a buried fault locally trending north-east to south-west along the southeast flank of the hill that may have uplifted the ridge (R. Sydnor and R. McJunkin, written communication).

The hill is about 500 m in length by 130 m in width with a strike near N78°E (Figure 2). The ground surface is near-horizontal on the crest of the hill which has been graded (Ralph Herman, personal communication). On the south side of Cedar Hill, the hill slopes gently about 6 to 8° to a golf course, about 14 m below the top of the hill. On the north side the slopes descend at about 18 to 20° to the Tarzana alluvial plain, about 25 m below the hill crest. The gentle hilltop is apparently well-drained in four directions. The ground water table is near the base of the hill where Caballero Creek drains northward in a concrete drainage culvert (Figure 2) (R. Sydnor, written communication).

Previously, Geosoils (1992) performed an extensive geological mapping of the Tarzana Nursery area (Figure 2). The strong-motion site is underlain by a variable thickness of colluvial soil (silty clay) estimated to be about 0.5 to 1.5 m in thickness. The soil is derived by in-place weathering of a soft claystone and siltstone of the upper member of the Modelo Formation, which underlies the soil. The Modelo formation (Tm in Figure 2) is exposed on the flanks of the hill, while the base is covered by 1 to 2 m of Quaternary slope wash (Qsw in Figure 2) (Geosoils, 1992).

The upper member of the Modelo formation consists of light gray claystone and siltstone, moderately to vaguely bedded,

crumbly where weathered (Dibblee, 1992). It is of Late Miocene age, Delmontian to Late Mohnian Stages, and is probably on the order of hundreds of feet in thickness. The upper member of the Modelo formation dips isoclinally northward at 11 to 17° with an east-west strike (roughly parallel to the strike of the hill). This is the northern limb of the Santa Monica Mountains anticline which also trends east-west. Directly underlying the Modelo formation is the white siliceous shale of the Monterey Formation, with a thickness on the order of thousands of feet. (R. Sydnor, written communication).

Drilling to 100 m (298') depth was completed by a SMIP subcontractor in December 1996 as a part of this NSF project (Appendix E). The borehole is located on the crest of the hill less than 50 m to the west of the T-hut. Low shear-wave velocities (about 200 m/sec) were found in the top 4 m (13.5') in colluvial soil (soft, silty diatomaceous clay). This soil is derived by in-place weathering of the soft claystone, siltstone and shale of the underlying Modelo Formation. Decomposed shale is found from 4 to 12 m (13.5 to 40'). Highly to slightly weathered shale of the Modelo formation was found from the 12 to 100 m (40 to 297'). Gypsum crystals were observed in the drill cuttings near 6 m. Velocities generally increased gradually to near 750 m/sec near 80 m depth, except in several zones of hard shale and at the water table. The water table is inferred to be near the base of the hill at a depth of 17 m. Further discussion is in the Site Characterization section of this report.

Analyses of the Northridge Mainshock Response

Figure 3 shows the location of five nearby strong-motion stations to Tarzana that recorded the Northridge mainshock. These five stations are Encino - Ventura Blvd #1, Encino Reservoir, Encino - Ventura Blvd #9, Tarzana - Ventura Blvd #10 and Woodland Hills - Oxnard Blvd #4. All of these stations with the exception of Encino Reservoir are located on Quaternary alluvium. The Encino Reservoir station is located on the left abutment of the dam and is part of the network operated by the Los Angeles Department of Water and Power. It is sited on the Topanga formation that consists of a well cemented conglomerate at this location (Spudich et al., 1996). The digitized and processed data at four of these stations are described in (Darragh et al., 1994b and 1995). The Encino Reservoir digitized data was provided by David Wald of the U. S. Geological Survey (USGS) and preliminarily processed to velocity, displacement and spectra by SMIP. These five stations form a 14 km long profile along the southern San Fernando Valley that provides a comparison of the mainshock shaking recorded in the vicinity of the Tarzana nursery.

Tarzana - Ventura Blvd #10, located 1.1 km to the north of the Tarzana - Cedar Hill Nursery, is the closest strong-motion site and is on Quaternary alluvium in the San Fernando Valley

(Figure 3). At the base of this 10-story building the peak accelerations, velocities and displacements of 0.47 g, 47 cm/sec and 16 cm were observed, respectively (Table 1). These peak values are amplified at the Nursery by a factor of 2 to 5, 1½ to 5, and 1 to 3 for acceleration, velocity and displacement (Table 1 and Figures 4 to 6). The north-south displacement waveforms are quite similar (Figure 6) in waveform and amplitude at Tarzana and several of the nearby stations (Figure 6) showing that the long period motions were not greatly affected by the Tarzana site. We infer from this observation that at long periods the ground motion amplification is negligible in the north-south direction for the Northridge earthquake. In addition, the other time histories generally have a similar shape with differences primarily in amplitude, duration and response near 0.3 seconds.

The north-south acceleration, velocity and displacement time histories along the profile are shown in Figures 4, 5 and 6, respectively. All of the nearby records have lower peak accelerations, velocities and displacements than recorded at Tarzana (Table 2). The average amplification factor is 5, 3 and 1.5 for peak acceleration, velocity and displacement, respectively. The acceleration, velocity and displacement time histories at the Encino Reservoir are lower than the waveforms at the other stations. In agreement with the time history analysis, the spectra for Tarzana and the sites along the profile are similar at long periods (greater than about 2 seconds) but show an amplification of near 5 at short periods (near 0.3 second). The east-west mainshock time histories show greater variability than the north-south motions (see Appendices A and B). These waveforms document significant differences in shaking at stations in the San Fernando Valley and on the Tarzana hill over distances from 1 to 7 km, especially at short periods (frequencies > 3 Hz).

Figures 4 and 5 also show that the duration of strong shaking is greater at Tarzana than at the nearby stations. The Tarzana accelerations (Figure 4) have a strong arrival about 10 to 12 seconds into the record that is only weakly recorded at the other stations. We agree with Spudich et al. (1996) who consider this arrival to be a source effect amplified by the Tarzana site response because it is seen at several stations with different amplitude.

Analyses of the Response from Large Earthquakes

Figure 7 shows the spectral acceleration of the east-west component recorded at Tarzana from seven large earthquakes: the 1994 Northridge, 1987 Whittier Narrows, 1987 Whittier Narrows aftershock on October 4, 1991 Sierra Madre, 1992 Landers and 1994 Northridge aftershocks on January 17 and March 20. Table 3 tabulates the magnitude, epicentral distance and peak parameters from these earthquakes at Tarzana. The earthquakes range in magnitude from 5.3 to 7.2 with peak velocities ranging from 4 to 100 cm/sec.

In Figure 7, a spectral peak near 0.3 second (3 Hz) is observed in records from the Northridge mainshock, Whittier Narrows mainshock and the two largest Northridge aftershocks (see Table 3). Also this peak is observed in several smaller Northridge aftershocks (discussed in the next section) and the extensive study of weak-motion recordings of Northridge aftershocks performed by the U. S. Geological Survey (Spudich et al., 1996). However, a spectral peak near 0.3 second (3 Hz) is not observed in the October 4, 1987 Whittier Narrows aftershock, the Sierra Madre and Landers mainshocks, and several smaller Northridge aftershocks (discussed in the next section). This peak is observed in the four largest earthquakes (in terms of spectral acceleration levels recorded at the site), and may be a general feature of the site response at Tarzana.

Northridge Aftershock Recordings

SMIP installed two additional digital accelerographs near Tarzana after the Northridge earthquake to help study the site effects. Also, a digital accelerograph was collocated with the original analog accelerograph in the T-hut. Numerous aftershock records have been obtained, one with peak acceleration as high as 0.37 g. The closest reference site (Tarzana - Clubhouse) is located about 150 m from the Tarzana - Cedar Hill Nursery station. This strong-motion station is located off the gentle hill on shallow Quaternary alluvium (Figure 2). At a test pit site about 35 m from the station the top of the Modelo formation was located at 3 m depth (Geosoils, 1992). This reference site been in operation since January 25, 1994 to present. Ground motions from these two stations show large variability over a distance of only 150 m that are a source of some of the scatter in peak accelerations relationships versus distance.

A report "CSMIP Processed Strong-Motion Data at Tarzana, California Recorded during Northridge Aftershocks" (Darragh et al., 1996, Appendix C) presents the processed time histories and spectra from twenty-one accelerograms recorded at these two nearby stations. The accelerograms were obtained during eleven Northridge aftershocks with local magnitudes ranging from 3.2 to 5.9. Table 4 lists the location, origin time and magnitude for these eleven aftershocks as determined by the California Institute of Technology. Figure 8 shows the locations of the Tarzana Nursery and Clubhouse and the eleven aftershock epicenters.

Nineteen of the 21 accelerograms were recorded on digital instruments (12-bit, 0.25 g maximum acceleration recorder) installed several days after the Northridge mainshock. Two accelerograms were recorded on the analog instrument at Tarzana - Cedar Hills Nursery. The processed data from the analog accelerogram from the magnitude 5.9 aftershock that occurred about one minute after the mainshock on January 17, 1994 are presented. This record is from the largest Northridge

aftershock. The peak acceleration and velocity are 0.35 g and 15 cm/sec, respectively. Also, included in Appendix C are the processed data from the analog accelerogram from the March 20, 1994 magnitude 5.3 aftershock. During this earthquake the motions were clipped on the digital recorder when the acceleration exceeded 0.25 g. The peak acceleration from the analog recorder is 0.37 g. The instrument and baseline-corrected peak velocity and displacements are 13 cm/sec and 1 cm, respectively.

Table 5 lists peak values at Tarzana Nursery and Clubhouse for the eleven aftershocks. The mainshock peak values at the Nursery are also listed for comparison. During these aftershocks peak accelerations range from 0.01 to 0.37 g at the Nursery. Corresponding values at the nearby Clubhouse range from 0.005 to 0.285 g. Peak velocity ranged from 0.6 to 13 cm/sec and from 0.2 to 7.2 cm/sec at the Nursery and Clubhouse, respectively. Peak displacements are less than 1.5 cm at both sites.

Analyses of the Northridge Aftershock Response

Figure 9 shows the peak acceleration ratio computed from twenty-one aftershocks recorded at the Nursery and at the two nearby temporary stations. Site B is the Tarzana - Clubhouse station, which is located 150 m from the Nursery (Figure 2). Site C is located about 1.5 km to the north of the Nursery in the San Fernando Valley and is sited on Quaternary alluvium.

Peak horizontal accelerations at the Nursery range from 0.004 to 0.37 g. For comparison, the peak horizontal accelerations at Site B (Clubhouse) and Site C range from 0.003 to 0.29 g and from 0.003 to 0.21 g, respectivley. The Nursery peak accelerations are larger than the accelerations at the Clubhouse by a factor ranging from 1 to 3. The average ground motion amplification is 1.8 over a distance of 150 m. The Nursery peak acceleration is larger than the Site C acceleration by a factor ranging from 0.5 to 5.6. The average site amplification is 2.1 over a distance of 1.5 km. As an example, the Tarzana amplification of peak acceleration is a factor of 1.3 at the Clubhouse and 1.76 at Site C during the largest aftershock motion recorded on March 20, 1994. These observations show large variability of ground motion over 150 m to 1.5 km near the Tarzana - Cedar Hill Nursery. These observations are in agreement with the earlier report of Darragh et al. (1994c) that reported that the Tarzana site amplified peak acceleration by a factor near two for many of the aftershocks.

The acceleration data from ten aftershocks recorded at both the Nursery and the Clubhouse have been processed to velocity, displacement and spectra (Darragh et al., 1996). Table 5 shows that peak horizontal acceleration and velocity both increase by a factor of 2 from the Clubhouse to the Nursery. Peak horizontal displacement increased by a factor of 1.7 from the base of the

hill (Clubhouse) to the top of the hill (Nursery). As expected, the long periods are less affected by the local variations in geology, topography and three-dimensional structure.

Figures 10 and 11 show instrument and baseline corrected acceleration (a and b), velocity (c) and displacement (d) waveforms in the east-west direction at the Nursery and Clubhouse during the ten aftershocks that were recorded at both sites, respectively. Uniform scaling of the accelerograms (Figures 10a and 11a) documents the range of recorded amplitudes that vary by a factor near 30 for the smallest to the largest aftershock. Dynamic scaling of the accelerograms (Figures 10b and 11b) allows detailed comparison of the waveforms at both Tarzana stations. These waveforms confirm the increased peak acceleration amplitude at the Nursery compared to the Clubhouse as well as the greater duration of shaking at the Nursery due to increased response near 0.3 second. Velocity waveforms (Figures 10c and 11c) at the Nursery and Clubhouse also show differences in amplitude and duration. As expected, a comparison of the displacement waveforms (Figures 10d and 11d) show more similarity especially in the first arriving S-waves motions. These motions reflect the movement at the earthquake source.

The ground motion amplification factors for these ten aftershocks are generally less than observed in the mainshock at nearby strong-motion stations (Tables 1 and 2). Note that the Clubhouse and Site C are located 150 and 1500 m from the Nursery, respectively, while the nearby stations that recorded the mainshock are located from 1100 to 7000 m. The variation of strong shaking, due to differences in geology, topography, three-dimensional structure and other factors, produces a factor of 2 to 5 difference in acceleration between Tarzana and other nearby strong-motion stations. Spudich et al, (1996) also observed a similar spatial variation of ground motion over scales from 25 to 2000 m.

A comparison of the response spectra at the top of the hill (Figure 12) to those at the base of the hill (Figure 13) show significant amplification, especially at periods less than 0.35 seconds. Figure 14 shows the mean and ± 1 standard deviation site response estimated from rotated response spectral ratios of the Nursery to the Clubhouse. The top and bottom figures are for motion transverse and parallel to the strike of the hill, respectively. The amplification factors computed from the 5% damped response spectra vary significantly as a function of period. Amplification transverse to the strike of the hill is significantly larger than amplification parallel to the hill near 0.3 second. The transverse spectra also show larger scatter. The largest site amplification is near 5 and 2 for motions transverse and parallel to the hill. These observations are in agreement with those of Spudich et al. (1996) and Hartzell et al. (1996).

Site Characterization

The Tarzana site has been drilled by a SMIP subcontractor to a depth of about 100 m (298') in December 1996 as part of this NSF contract. This borehole is located less than 50 m (160') west of the T-hut and is on the crest of the gentle hill. The geology of the holes was logged during drilling (Appendix E) and velocity surveys were performed (Figures 15 and 16). Appendix E is the complete report from the subcontractor, Agbabian Associates, on the drilling, geotechnical logging and velocity measurements at Tarzana.

The drill site is underlain 4 m (13.5') of silty clay and diatomaceous silt (colluvial soil) (Appendix E). The soil is derived by in-place weathering of the soft claystone, siltstone and shale of the Modelo Formation. The grayish brown silty clay is dry and friable with a low dry strength. Measured shear-wave velocities in the silty soil are between 200 and 250 m/sec.

Decomposed and deeply weathered shale of the Modelo formation underlies the soil from 4 to 12 m (14' to 40'). The rock is thinly laminated and tan to reddish-brown in color. Gypsum crystals are first observed in the shale at 6 m (20'). Shear-wave velocities in this zone range from near 100 m/sec to almost 300 m/sec (Figures 15 and 16). P-wave velocities are near 550 m/sec.

From 12 to 100 m (40 to 297') the lithology in the borehole consists of highly to slightly weathered shale with several very hard layers. White hard rock chips were observed during the drilling in this depth range. The shale is described as finely bedded, fractured with some layers of clay (perhaps indicating several zones of intense weathering). The water table inferred from a large increase in P-wave velocity, color change and loss of gypsum minerals to solution was near the base of the hill at a depth of 17 m. S-wave and P-wave velocities generally increase uniformly from 20 to 86 m to near 1000 and 2500 m/sec near the hole bottom. However, sharp peaks in the shear and compressional velocities near 17, 31, 46 and 61 m, for example, correspond to more difficult drilling and harder shale.

These results are consistent with the measurements of Fumal et al. (1981) that are reproduced in Figure 17. The USGS borehole is located about 140 m north of the Tarzana strong-motion instrument and is shown on Figure 2. This borehole extended only to a depth of 30 m (100'). The top 6 m of this hole consists of Quaternary slope wash, colluvial soil (an olive colored and very stiff silty clay loam with slight plasticity) above deeply weathered Modelo shale with visible parting. The average downhole S-wave velocity was about 380 m/sec in the upper 6 m. Soft to firm black, fresh shale was found from 6 to 30 m (total depth). The shale had very close horizontal parting on bedding planes and close to very close fracture spacing. Average downhole S-wave and P-wave velocities of about 390 and 1660 m/sec

were measured (Fumal et al., 1981). The Poisson's ratio is 0.47, characteristic of a soft bedrock formation. At greater depths, the Modelo formation has a P-wave and S-wave velocities estimated to be 3350 and 1800 m/sec, respectively (Drake and Mal, 1972).

Also, Catchings and Lee (1995, 1996) measured seismic velocities from five explosive sources at a north-south (200 m in length) and east-west (500 m in length) array of seismographs. The data indicates S-wave velocity between 200 and 600 m/sec in the upper 70 m. The corresponding P-wave velocity is estimated to from 900 to 1650 m/sec. These velocity measurements are consistent with the velocities measured in this study (Figures 15 and 16) and by Fumal et al. (1981) (Figure 17).

The variation in topography, geology across the hill (Geosoils, 1992) and velocity structure (Fumal et al., 1981; Catchings and Lee (1995, 1996); this report) are reflected in the lateral variation in motion and attenuation observed during Northridge aftershocks (Spudich et al., 1996; this report). Using the site classification proposed by Boore et al. (1993) the Tarzana - Cedar Hill Nursery is site class C for approximately the top 17 m (above the water table) over site class B. Tarzana - Cedar Hill Nursery is classified as a soft-rock site.

Summary

Ground motion amplification has been observed at Tarzana in many earthquakes and for both strong and weak motions. Both the Whittier Narrows and Northridge mainshocks produced larger than expected motions at the Tarzana - Cedar Hill Nursery. The peak acceleration, velocity and displacement during the Northridge mainshock was amplified by factors of 5, 3 and 1.5, respectively, compared to nearby sites. The peak horizontal acceleration recorded during the Whittier Narrows mainshock was amplified by a factor from 5 to 10 compared to sites at a similar distance. In addition, several Northridge aftershocks amplified peak acceleration, velocity and displacement by factors near 2. Also, response spectra were amplified by a factor of 4.5 near 0.3 second (3.2 Hz). In contrast, the Landers and Sierra Madre mainshocks, Whittier Narrows aftershock and some Northridge aftershocks did not produce significant site amplifications near this frequency.

This ground motion amplification at Tarzana is also dependent on frequency. For example, Spudich et al. (1996), Hartzell et al. (1996) and this study document a predominance of 2 to 6 Hz motion in weak and strong motion recordings at Tarzana compared to other nearby stations.

In an effort to study the site amplification the Tarzana site was characterized to a depth of 100 m during this study. A low shear-wave velocity near the surface of 100 m/sec increasing to near 750 m/sec at 100 m depth was measured. The 20 m high

hill was found to be well drained with a water table near 17 m. Modelo formation (extremely weathered at the surface) to fresh at depth is underneath hill. The subsurface geology and velocities obtained allow classification of this location as a soft-rock site.

The source of the site amplification that produces large motions at Tarzana is still under investigation. The following causes have been proposed: topography (Çelebi (1995)); three-dimensional shape including topography (Spudich et al. (1996) and Bouchon and Barker (1996)); variations in site geology and S-wave velocity (Spudich et al. (1996) and Catchings and Lee (1995, 1996)); and resonance during active downslope sliding of the Tarzana hill (Rial, 1996). Specifically, Bouchon and Barker (1996) showed that the topographic effect at this site can amplify ground motion by factors ranging from 30% to 100%. In addition, Wennerberg et al. (1994) studied aftershock response that suggested large linear site amplification at the Nursery.

In summary, the structure (topography, shear-wave velocity profile and three dimensional geometry) of the site all contribute in part to the higher amplification of ground motion at the top of Tarzana hill. Tarzana - Cedar Hill Nursery is classified as a soft-rock site. It is site class C for the top 17 m (above the water table) over site class B using the site classification scheme proposed by Boore et al. (1993).

TABLE 1
CLOSEST MAINSHOCK STRONG-MOTION DATA TO TARZANA - CEDAR HILL NURSERY*

	East-West	Vertical	North-South
Peak Acceleration (g)			
Tarzana - Cedar Hill Nursery	1.93	1.15	1.14
Tarzana - Ventura Blvd #10	0.37	0.35	0.47
Ratio	5.2	3.3	2.4
Peak Velocity (cm/sec)			
Tarzana - Cedar Hill Nursery	110.2	72.3	77.2
Tarzana - Ventura Blvd #10	23.1	12.9	46.8
Ratio	4.7	5.6	1.7
Peak Displacement (cm)			
Tarzana - Cedar Hill Nursery	19.9	5.6	16.1
Encino - Ventura Blvd #10	5.8	3.8	15.8
Ratio (Usable Data Bandwidth to 6 sec*)	3.4	1.5	1.0

* The Tarzana - Ventura Blvd #10 station is located 1.1 km north of Tarzana - Cedar Hill Nursery. The records from the base of a 10-story building sited on Quaternary alluvium used in this comparison. The instrument and baseline corrected displacement time histories have the same Usable Data Bandwidth from 0.04 to 6.0 seconds (see Appendix D). For reference, the processed data from Tarzana - Cedar Hill Nursery and Tarzana - Ventura Blvd #10 for the Northridge mainshock are shown in Appendices A and B, respectively.

TABLE 2
NORTHRIDGE MAINSHOCK MOTIONS NEAR TARZANA

Station Name	Peak Accel. g	Peak Veloc. cm/s	Peak Displ. cm	Distance to Nursery km	Surface Geology
Tarzana - Cedar Hill Nursery	1.93	110.2	20.0	0	Weathered Siltstone
Tarzana - Ventura Blvd #10	0.47	46.8	15.8	1	Alluvium (Qal)
Encino Reservoir	0.20	20.0	4.9	2	Conglomerate
Encino - Ventura Blvd #9	0.46	34.3	12.6	4	Alluvium (Qal)
Encino - Ventura Blvd #1	0.54	56.9	15.5	5	Alluvium (Qal)
Woodland Hills - Oxnard Blvd #4	0.44	55.9	14.7	7	Alluvium (Qal)
Average Amplification Factor at Tarzana	4.6	2.6	1.6		

Note: For these stations the instrument and baseline corrected velocity and displacement time histories all have the same Usable Data Bandwidth from 0.04 to 6.0 seconds (see Appendix D).

TABLE 3
MAINSHOCKS AND LARGE AFTERSHOCKS RECORDED AT TARZANA - CEDAR HILL NURSERY

Earthquake Name	Mag	Dist km	PGA g	PGV cm/s	PGD cm	Spectral Peak near 3.2 Hz
Northridge	6.7	5	1.93	110	29.2	Yes
Whittier Narrows	5.9	44	0.61	24	1.4	Yes
Northridge Aftershock (3/20/94)	5.3	10	0.37	13	1.0	Yes
Northridge Aftershock (1/17/94)	5.9	14	0.35	15	1.3	Yes
Sierra Madre	5.9	50	0.10	4	0.3	No
Whittier Aftershock	5.3	44	0.08	4	0.3	No
Landers	7.2	175	0.07	9	4.8	No

TABLE 4
SUMMARY OF NORTHRIDGE AFTERSHOCK INFORMATION*

Date	Origin Time (hr:min:sec)	Epicenter Coordinates (°N)	(°W)	Depth (km)	Magnitude (M_L)
Jan 17, 1994	12:31:57.8	34.279	118.474	0	5.9
Jan 27, 1994	17:19:58.8	34.274	118.563	15	4.6
Mar 20, 1994	21:20:12.2	34.231	118.475	13	5.3
May 3, 1994	00:30:46.3	34.181	118.566	7	3.2
May 16, 1994	08:40:46.7	34.330	118.619	14	3.8
May 25, 1994	12:56:57.0	34.312	118.393	7	4.4
May 28, 1994	17:15:12.3	34.355	118.682	12	3.6
Jun 2, 1994	03:27:14.4	34.277	118.457	11	3.8
Jun 15, 1994	05:59:48.6	34.311	118.398	7	4.2
Jul 11, 1994	06:50:49.6	34.260	118.692	16	3.7
Jun 26, 1995	08:40:28.9	34.394	118.669	13	5.0

* The earthquake information is from the California Institute of Technology

TABLE 5
PEAK PARAMETERS AND RATIOS FROM NORTHRIDGE
EARTHQUAKES RECORDED AT TARZANA

		TARZANA - NURSERY			TARZANA - CLUBHOUSE			PEAK RATIO		
EVENT DATE	M_L	PGA g	PGV cm/s	PGD cm	PGA g	PGV cm/s	PGD cm	ACC	VEL	DIS
1/17/94	6.7	1.927	110.2	29.2						
1/17/94	5.9	0.345	14.6	1.3						
3/20/94	5.3	0.374	12.8	0.99	0.285	7.2	0.62	1.5	1.7	1.5
1/27/94	4.6	0.117	5.4	0.29	0.039	1.8	0.15	3.0	3.1	1.9
6/26/95	5.0	0.104	4.4	0.26	0.053	1.8	0.14	2.0	2.4	1.9
5/03/94	3.2	0.035	0.8	0.04	0.019	0.4	0.02	1.8	2.1	2.5
5/25/94	4.4	0.035	0.9	0.06	0.017	0.6	0.04	2.1	1.6	1.4
5/16/94	3.8	0.031	0.9	0.03	0.017	0.4	0.02	1.8	2.0	1.8
6/15/94	4.2	0.028	1.0	0.07	0.022	0.6	0.05	1.3	1.6	1.4
7/11/94	3.7	0.026	0.6	0.03	0.015	0.4	0.02	1.7	1.7	1.4
6/02/94	3.8	0.016	0.6	0.04	0.011	0.3	0.02	1.5	2.0	1.3
5/28/94	3.6	0.013	0.6	0.02	0.005	0.2	0.01	3.2	2.6	2.3
							Average:	2.0	2.1	1.7

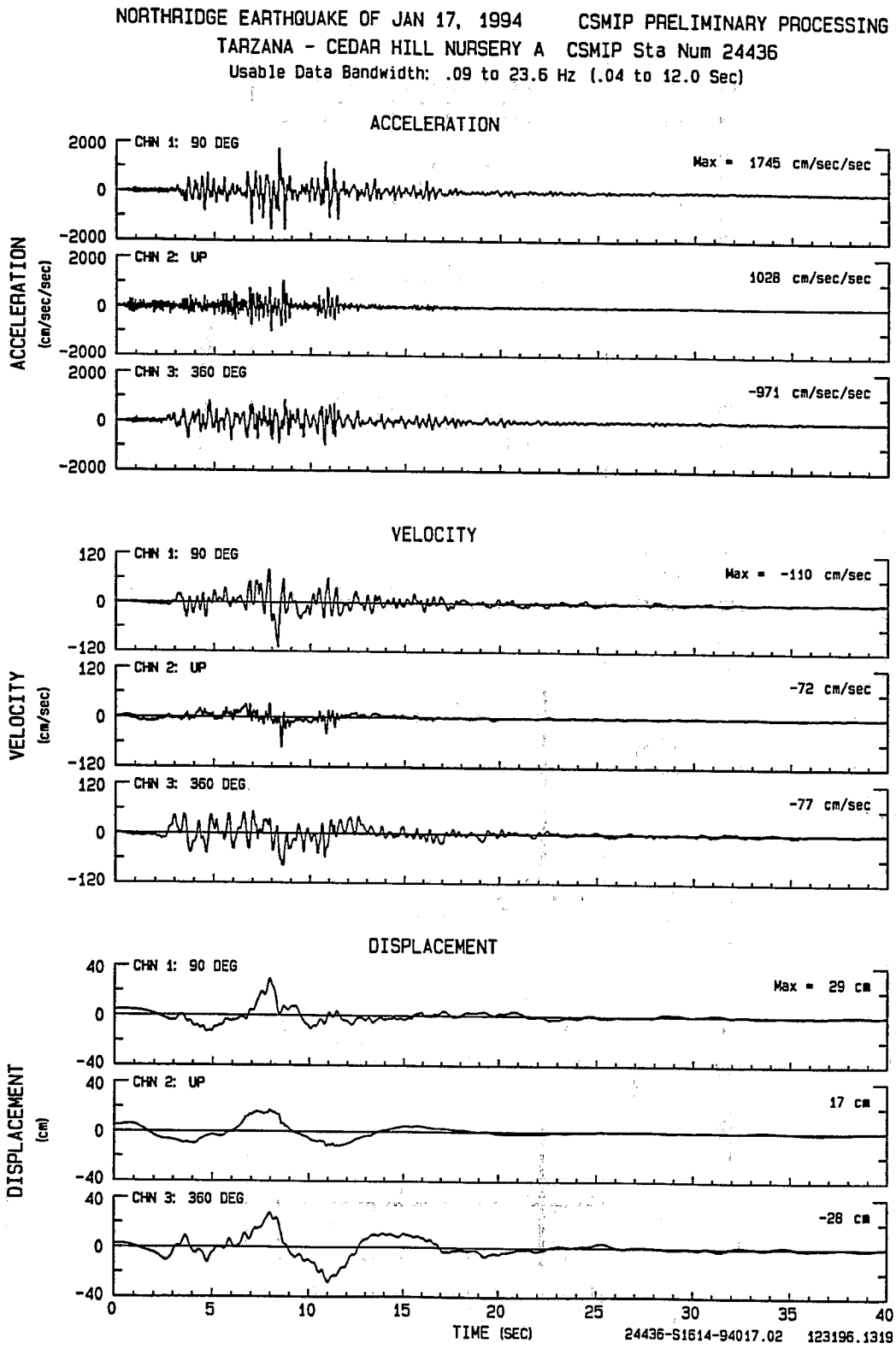


Figure 1. The three components of instrument and baseline-corrected acceleration, velocity and displacement at Tarzana - Cedar Hill Nursery from the Northridge mainshock. The processed data from Tarzana - Cedar Hill Nursery for the Northridge mainshock are shown in Appendix A.

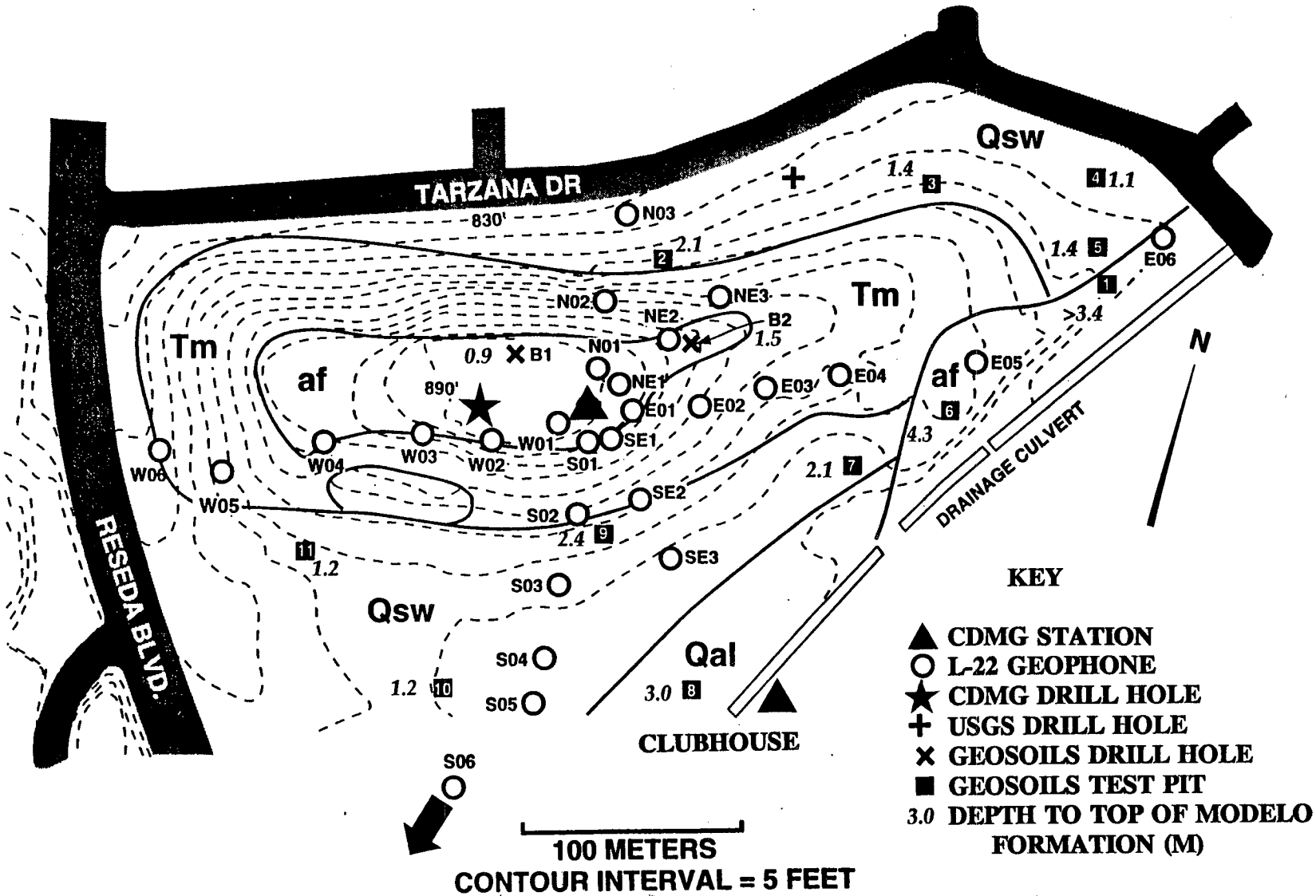


Figure 2. Map showing the locations of Tarzana - Cedar Hill Nursery station and Tarzana - Clubhouse (reference site). The Clubhouse is located about 150 m from the Cedar Hill station. The borehole is located about 49 m (160') from the Cedar Hill station. The location of the geologic contacts (solid lines) are approximate. The geologic units artificial fill (af), Quaternary slope wash (Qsw), Quaternary alluvium (Qal) and the Miocene Modelo formation (Tm) are shown (Geosoils, 1992). (The basemap is modified from Spudich et al., 1996).

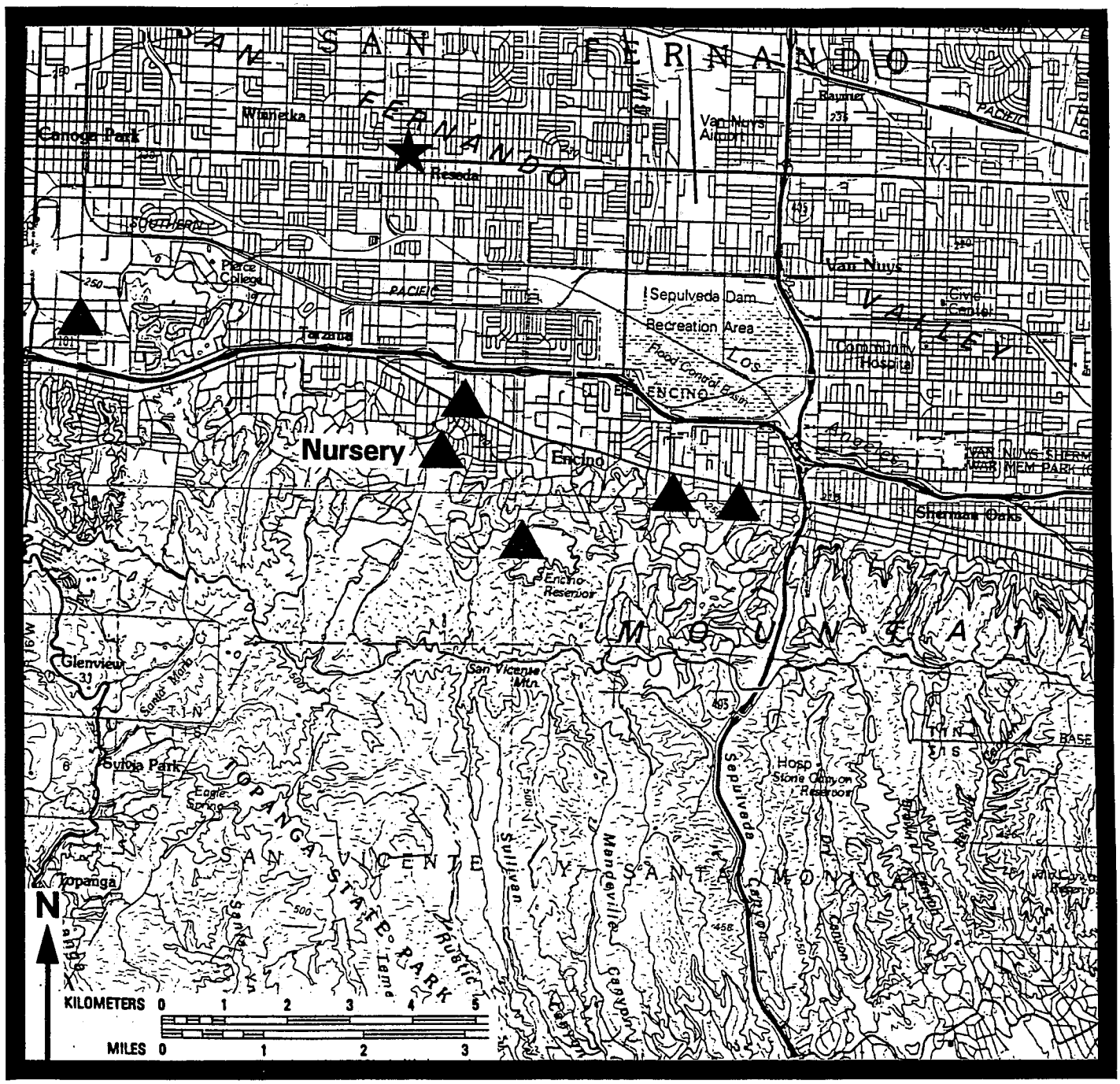


Figure 3. Map showing the location of six strong-motion stations (indicated by solid triangles) that recorded the Northridge mainshock whose epicenter is shown as a solid star. The stations, located along the southern San Fernando Valley, are from west to east: Woodland Hills - Oxnard Blvd #4, Tarzana - Cedar Hill Nursery, Tarzana - Ventura Blvd #10, Encino Reservoir, Encino - Ventura Blvd #9, and Encino - Ventura Blvd #1.

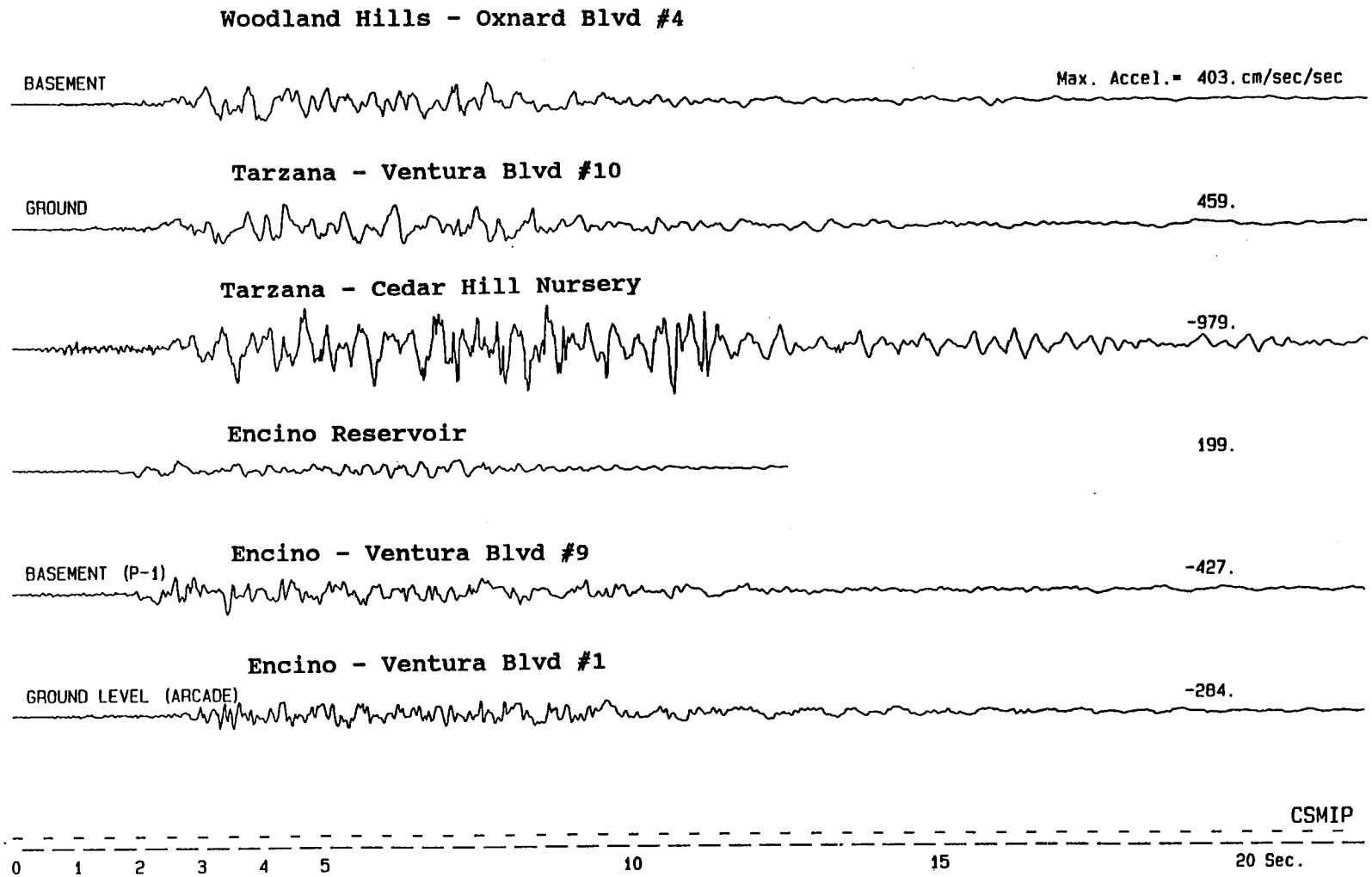


Figure 4. Horizontal acceleration waveforms along the east-west profile. The north-south (approximate) component is shown. The acceleration records are not aligned in absolute time. The stations from top (east) to bottom (west) are: Woodland Hills - Oxnard Blvd #4, Tarzana - Ventura Blvd #10, Tarzana - Cedar Hill Nursery, Encino Reservoir, Encino - Ventura Blvd #9, and Encino - Ventura Blvd #1. For this comparison the instrument and baseline corrected acceleration time histories have the same Usable Data Bandwidth from 0.04 to 6.0 seconds (see Appendix D).

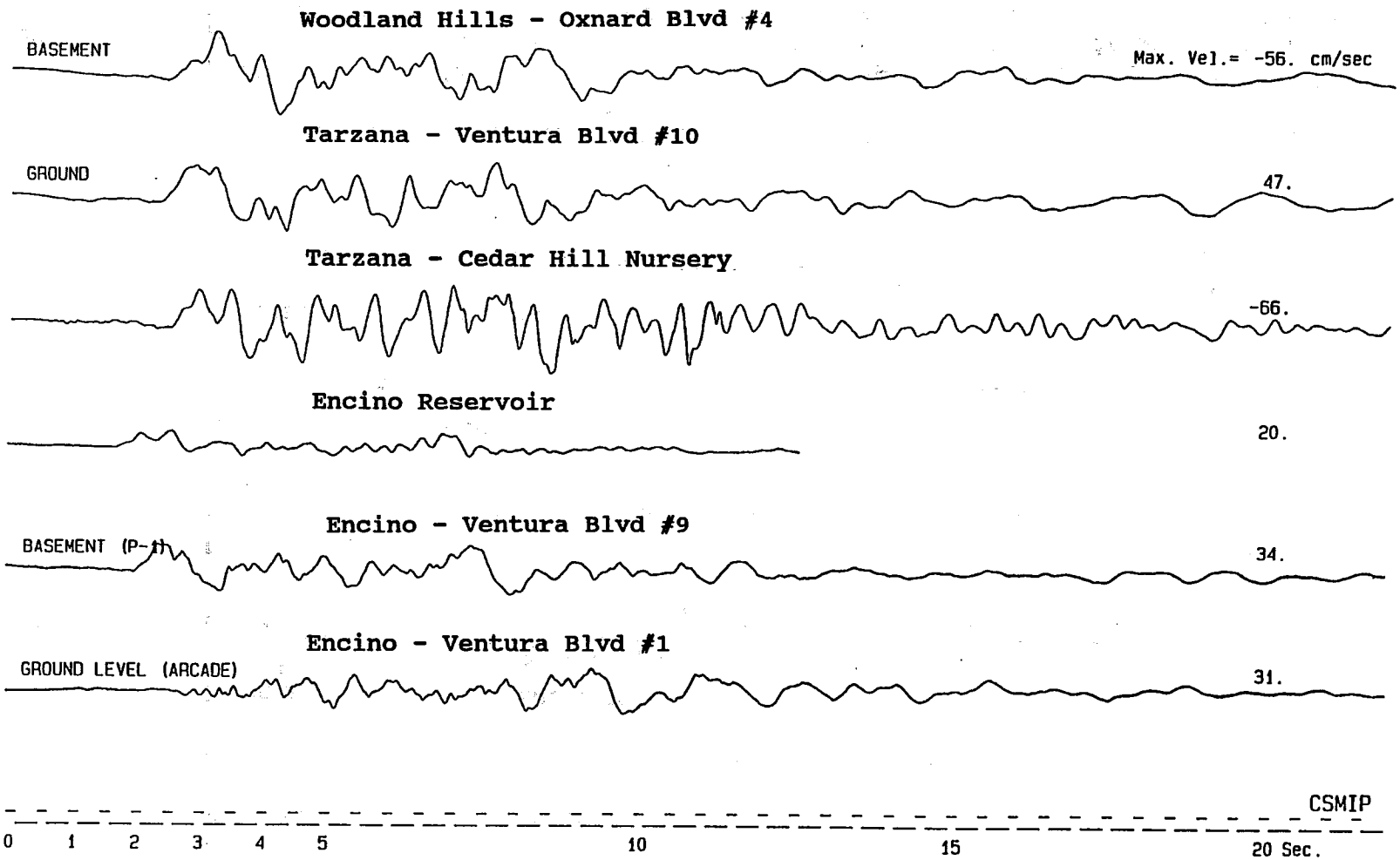


Figure 5. Horizontal velocity waveforms along the east-west profile. The north-south (approximate) component is shown. The velocity records are not aligned in absolute time. The stations from top (east) to bottom (west) are: Woodland Hills - Oxnard Blvd #4, Tarzana - Ventura Blvd #10, Tarzana - Cedar Hill Nursery, Encino Reservoir, Encino - Ventura Blvd #9, and Encino - Ventura Blvd #1. For this comparison the instrument and baseline corrected velocity time histories have the same Usable Data Bandwidth from 0.04 to 6.0 seconds (see Appendix D).

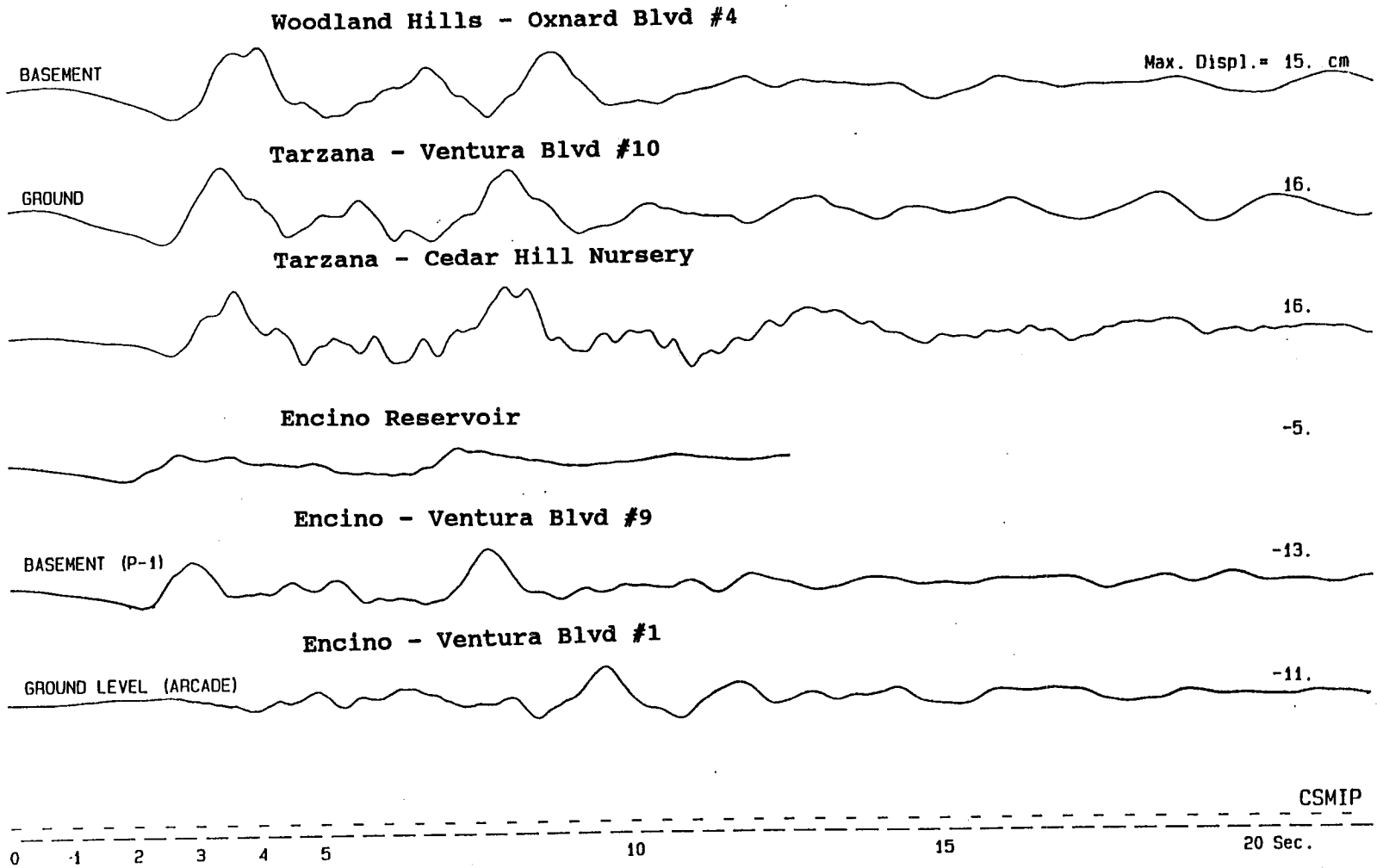


Figure 6. Horizontal displacement waveforms along the profile. The north-south (approximate) component is shown. The displacement records are not aligned in absolute time. The stations from top (east) to bottom (west) are: Woodland Hills - Oxnard Blvd #4, Tarzana - Ventura Blvd #10, Tarzana - Cedar Hill Nursery, Encino Reservoir, Encino - Ventura Blvd #9, and Encino - Ventura Blvd #1. For this comparison the instrument and baseline corrected displacement time histories have the same Usable Data Bandwidth from 0.04 to 6.0 seconds (see Appendix D).

TARZANA - CEDAR HILL NURSERY A CSMIP Sta Num 24436

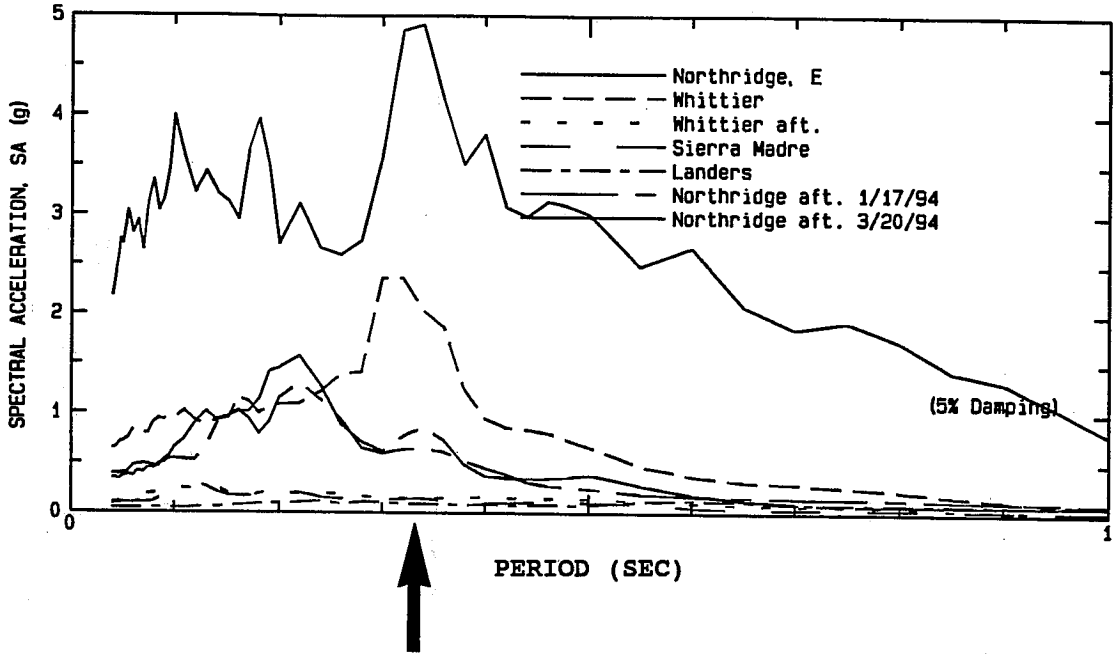


Figure 7. Spectra acceleration (5% damping) versus period at Tarzana - Cedar Hill Nursery for seven large earthquakes. The east-west component is shown. The location of a large site resonance is shown by the arrow at 3.2 Hz.

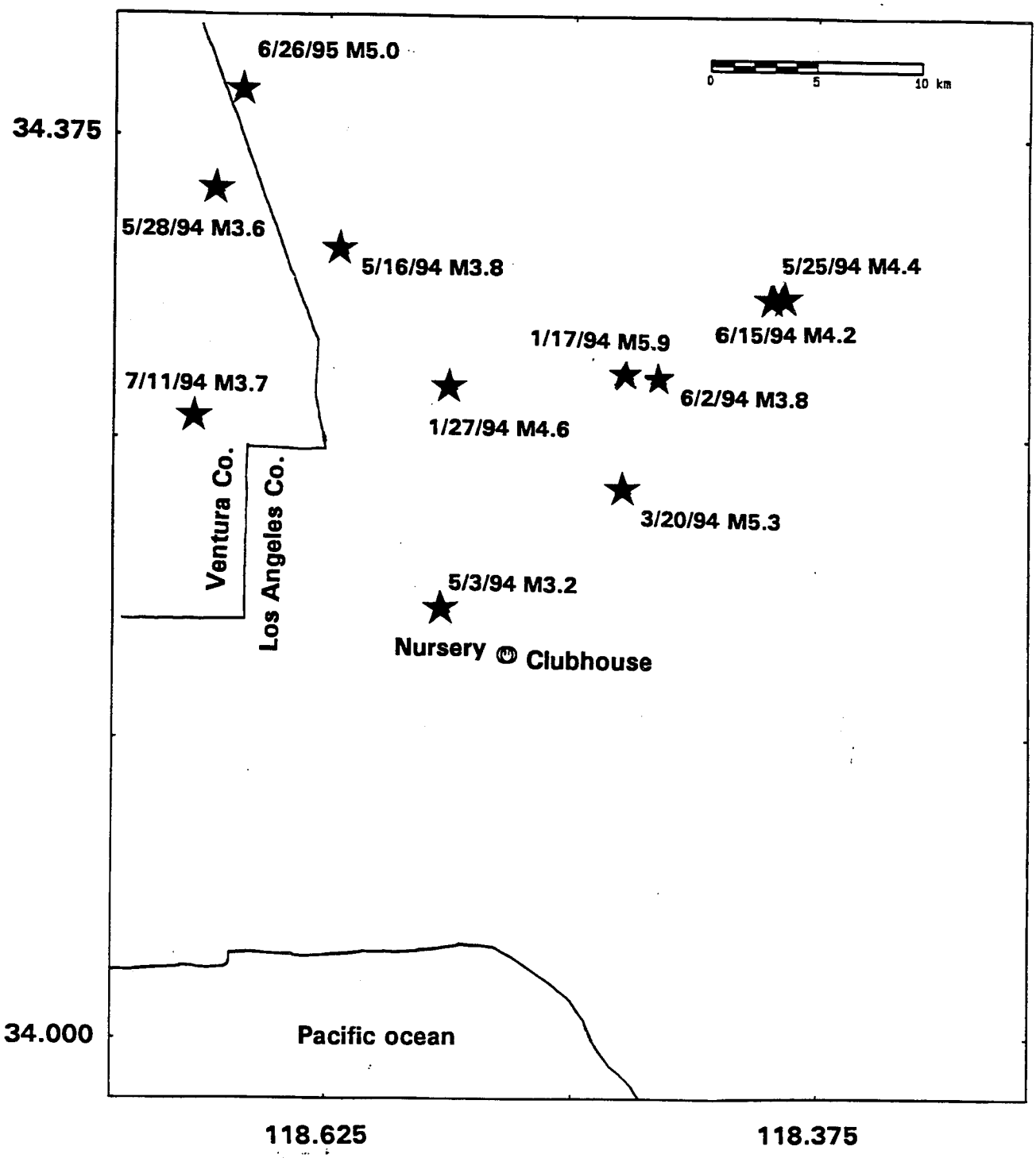


Figure 8. Map showing the locations of Tarzana - Cedar Hill Nursery station (436) and the reference site at Tarzana - Clubhouse (T03). The Clubhouse is located about 150 m from the Cedar Hill station. The location of the eleven Northridge aftershocks are shown as stars.

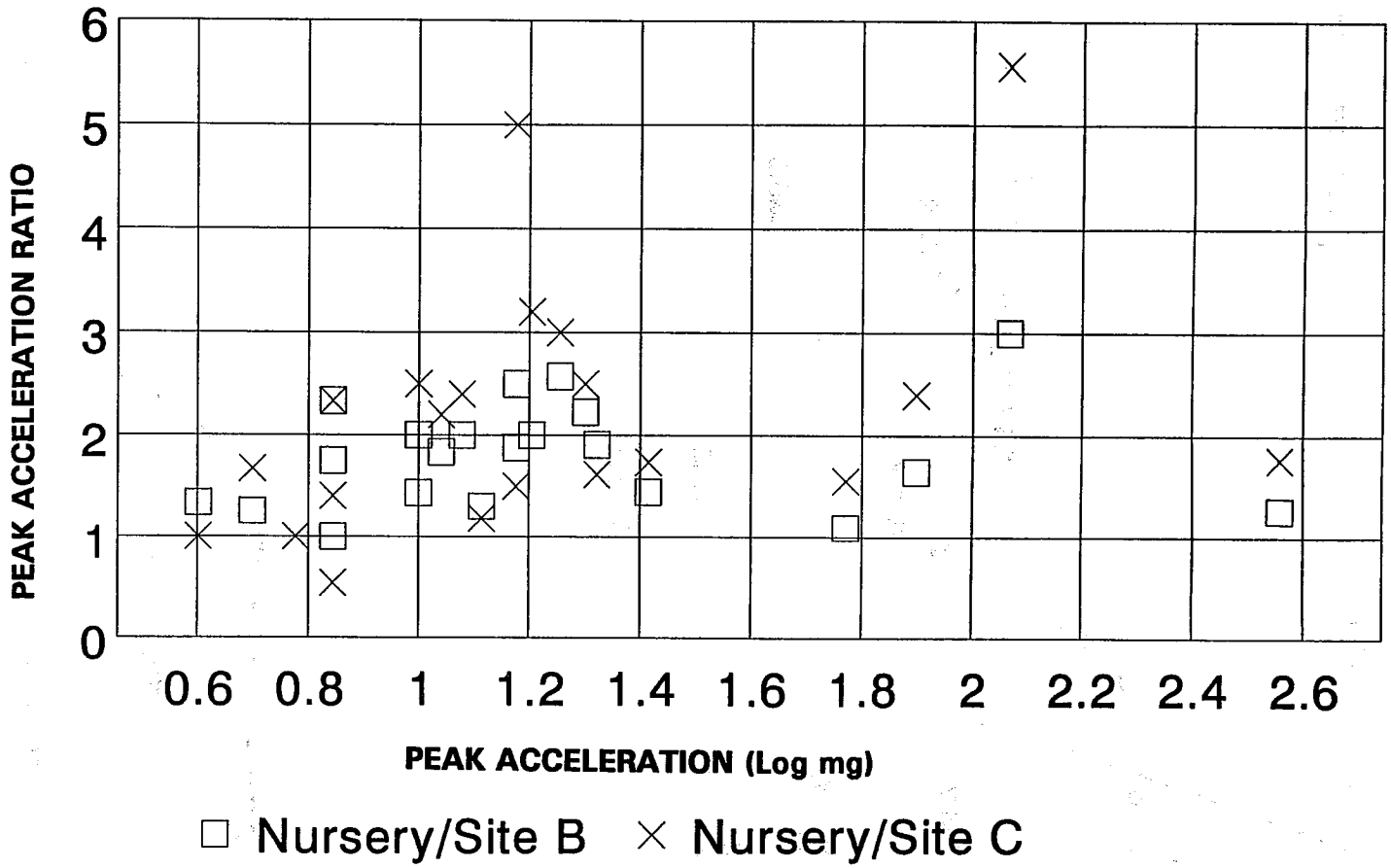


Figure 9. Tarzana - Cedar Hill Nursery peak acceleration ratio to the peak acceleration recorded at two nearby reference stations for 21 Northridge aftershocks. The Tarzana - Clubhouse station is Site B. The units for the x-axis are $\log_{10}$ (acceleration) at the Nursery. The units of acceleration are 10^{-3} g.

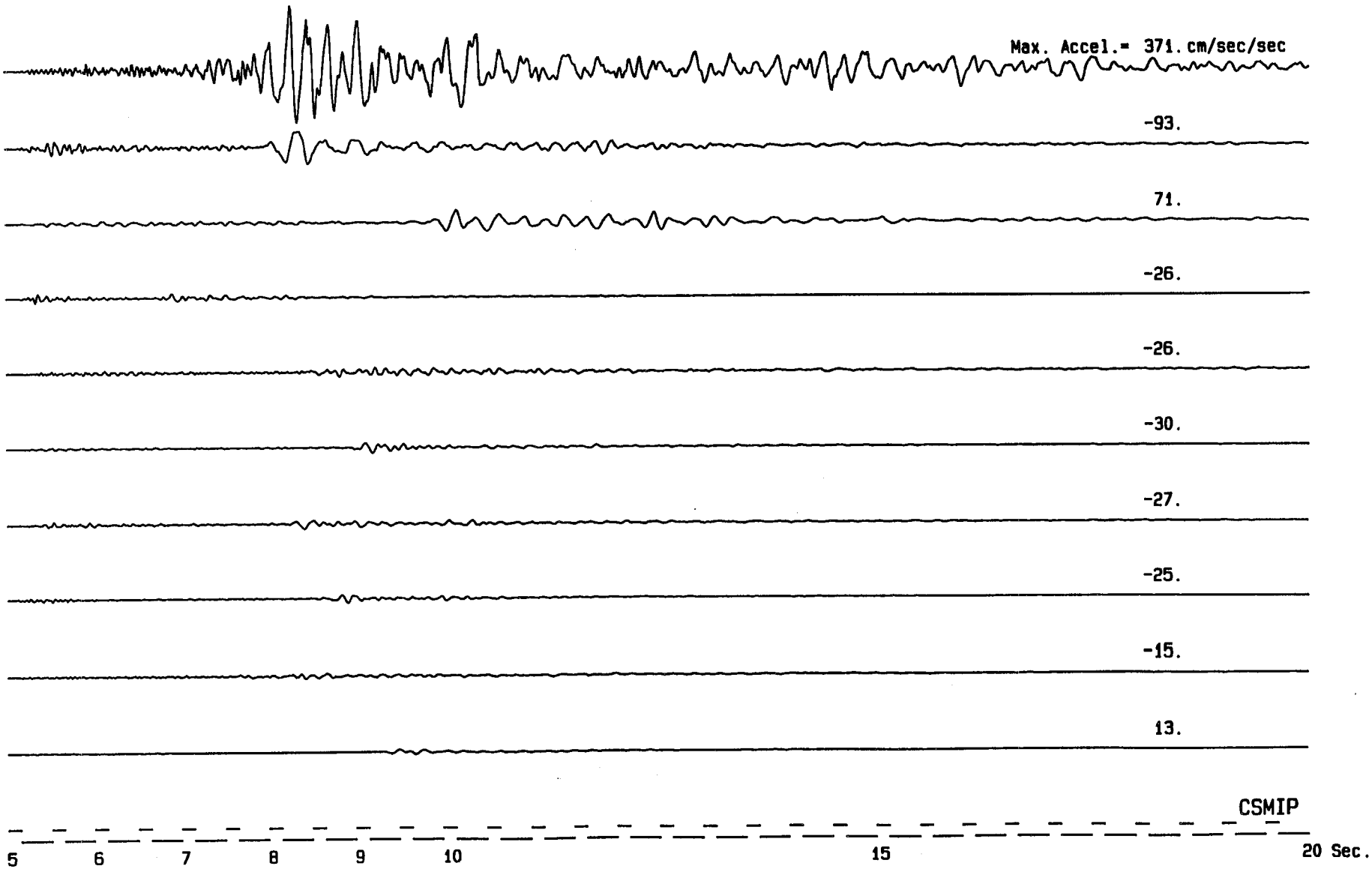


Figure 10a. Tarzana - Cedar Hill Nursery acceleration waveforms from ten Northridge aftershocks with uniform scaling.

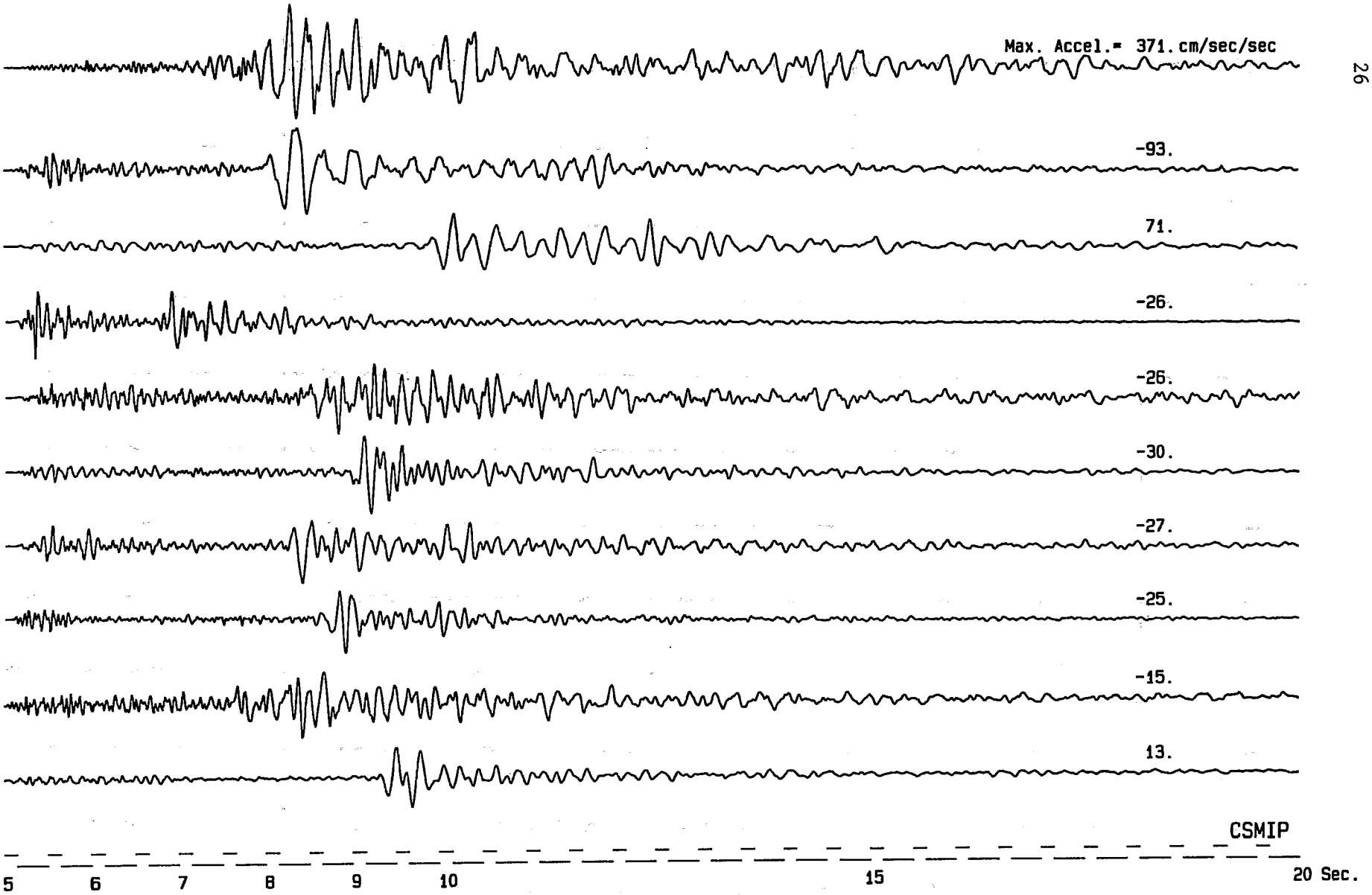


Figure 10b. Tarzana - Cedar Hill Nursery acceleration waveforms from ten Northridge aftershocks with each accelerogram individually scaled so record details can be observed.

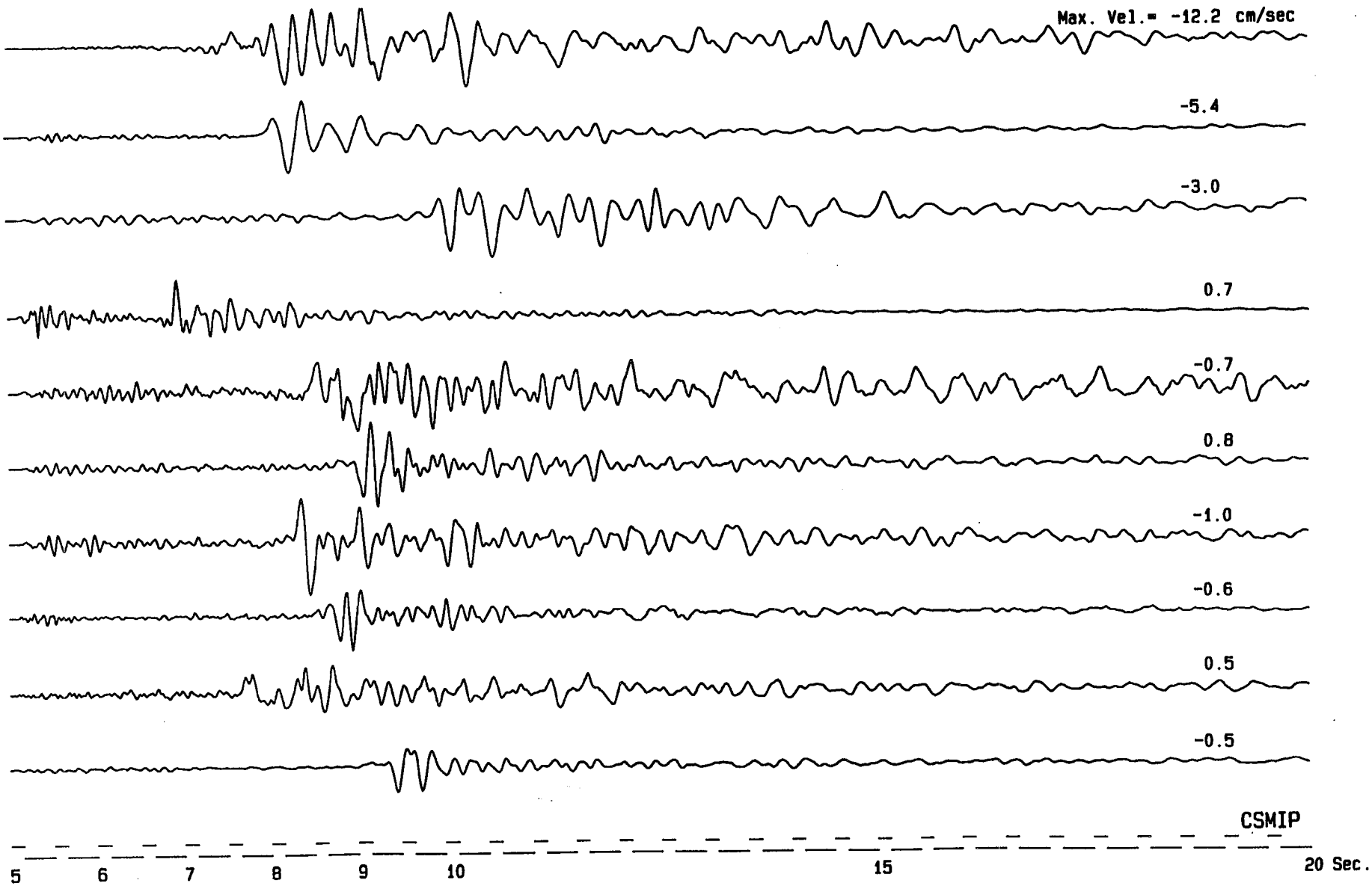


Figure 10c. Tarzana - Cedar Hill Nursery velocity waveforms from ten Northridge aftershocks with each record individually scaled so record details can be observed.

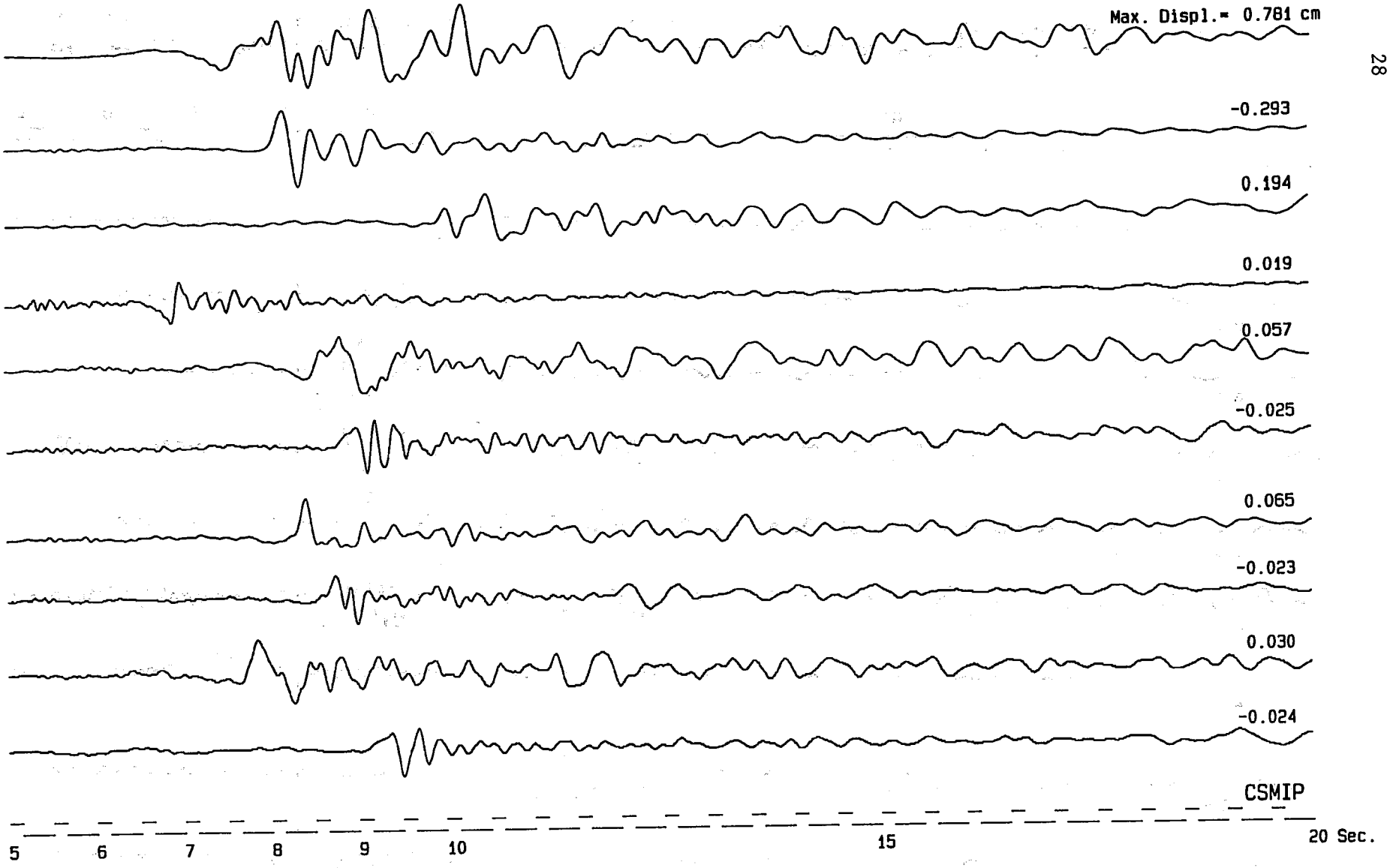


Figure 10d. Tarzana - Cedar Hill Nursery displacement waveforms from ten Northridge aftershocks with each record individually scaled so record details can be observed.

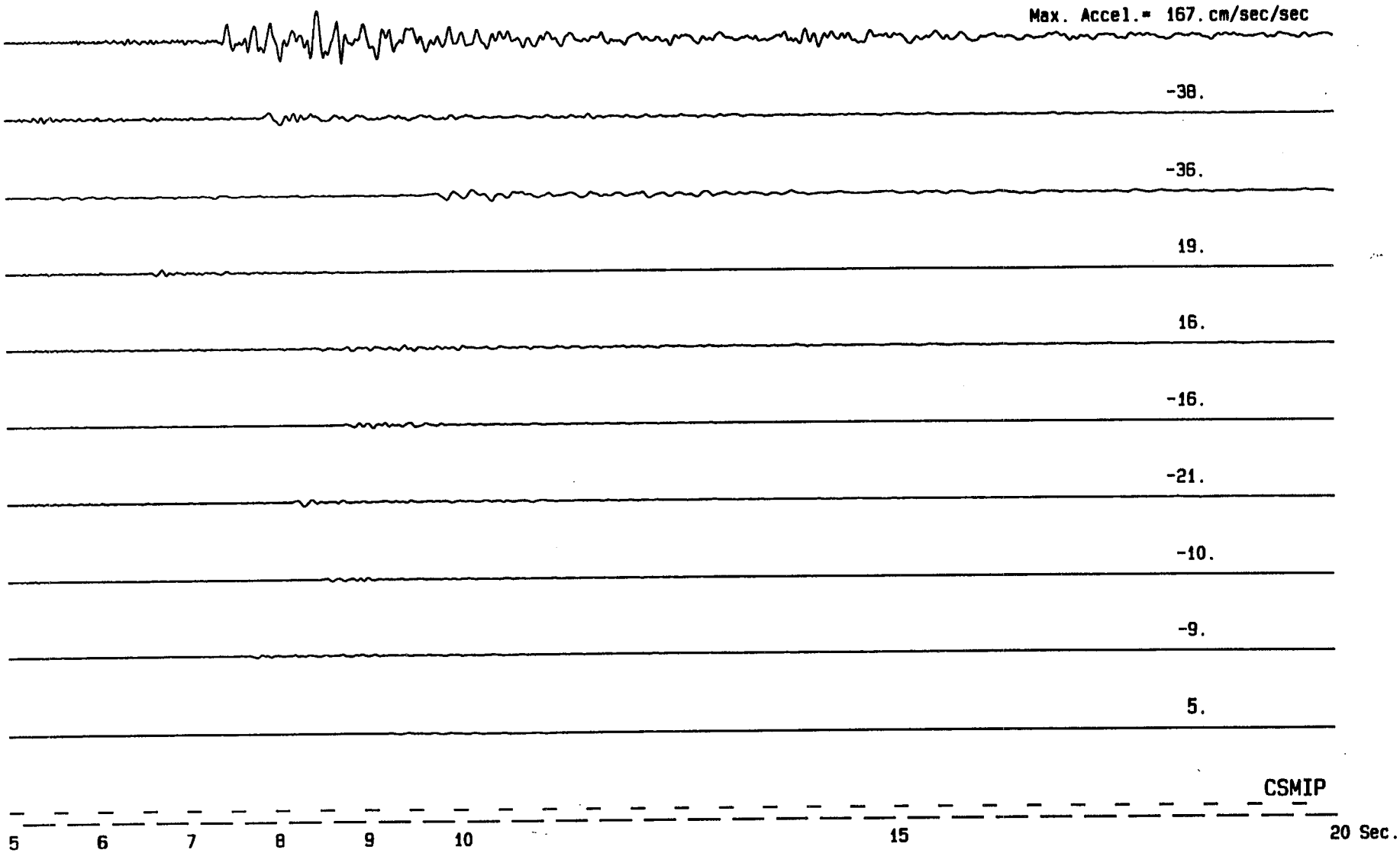


Figure 11a. Tarzana - Clubhouse acceleration waveforms from ten Northridge aftershocks with uniform scaling.

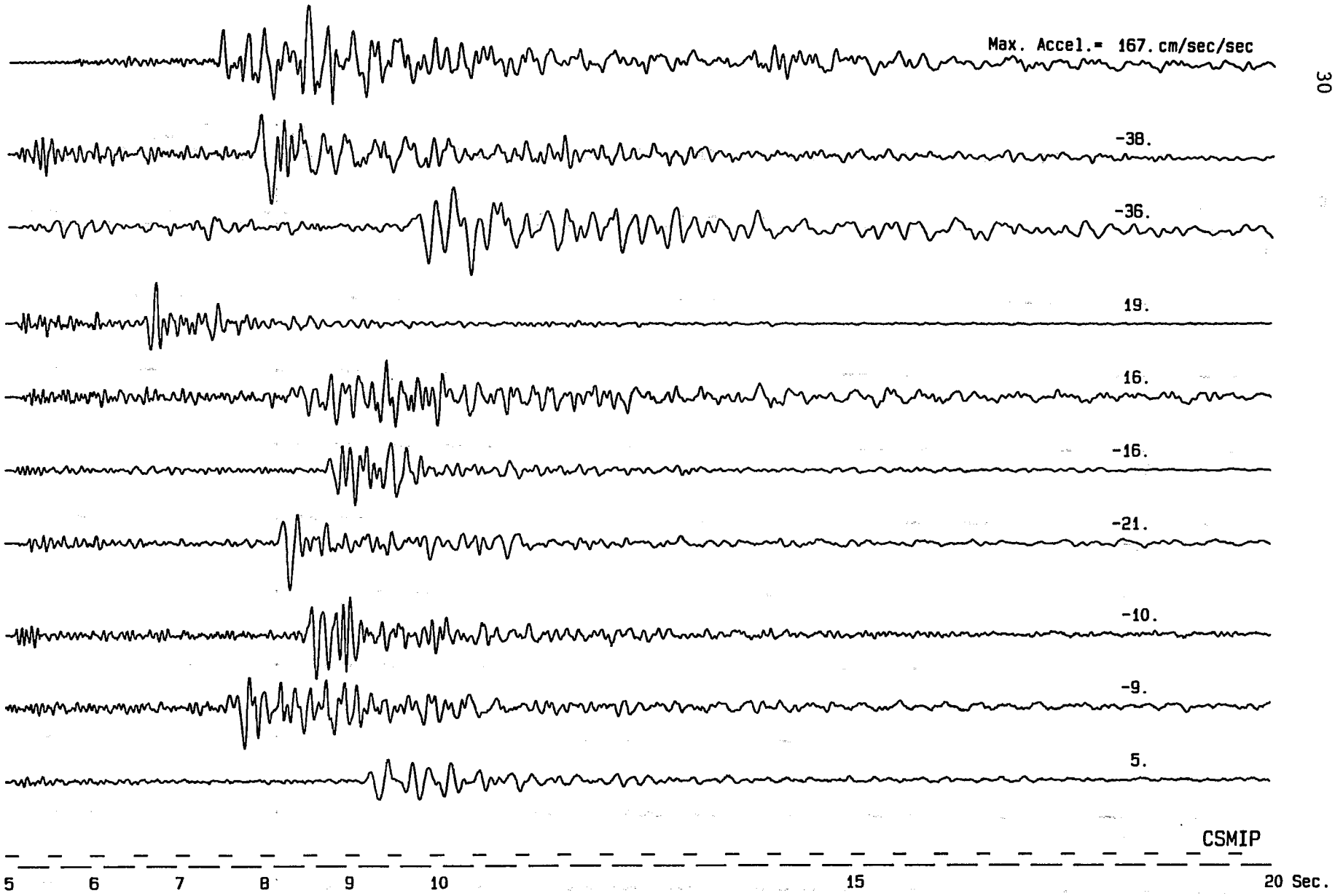


Figure 11b. Tarzana - Clubhouse acceleration waveforms from ten Northridge aftershocks with each accelerogram individually scaled so record details can be observed.

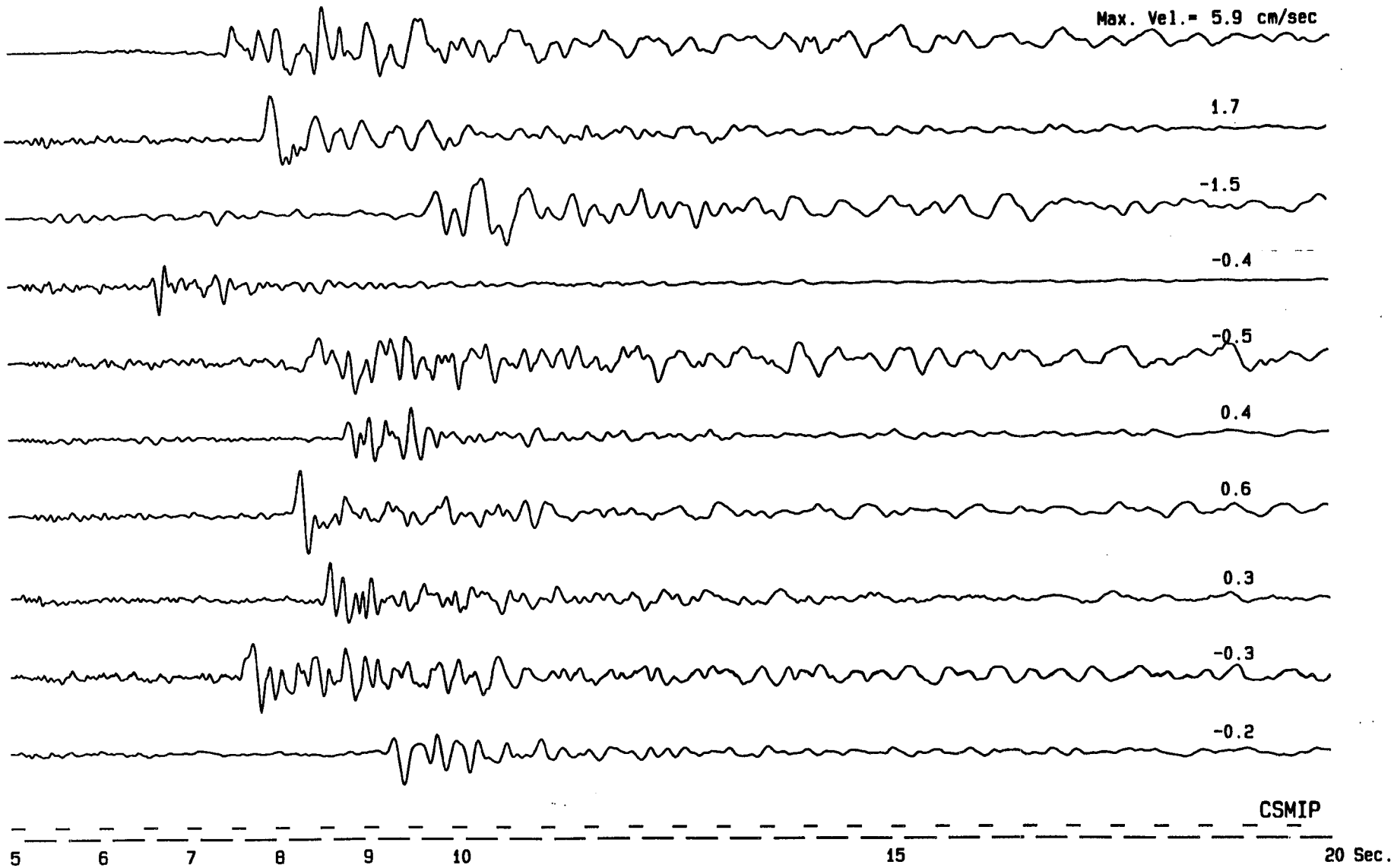


Figure 11c. Tarzana - Clubhouse velocity waveforms from ten Northridge aftershocks with each record individually scaled so record details can be observed.

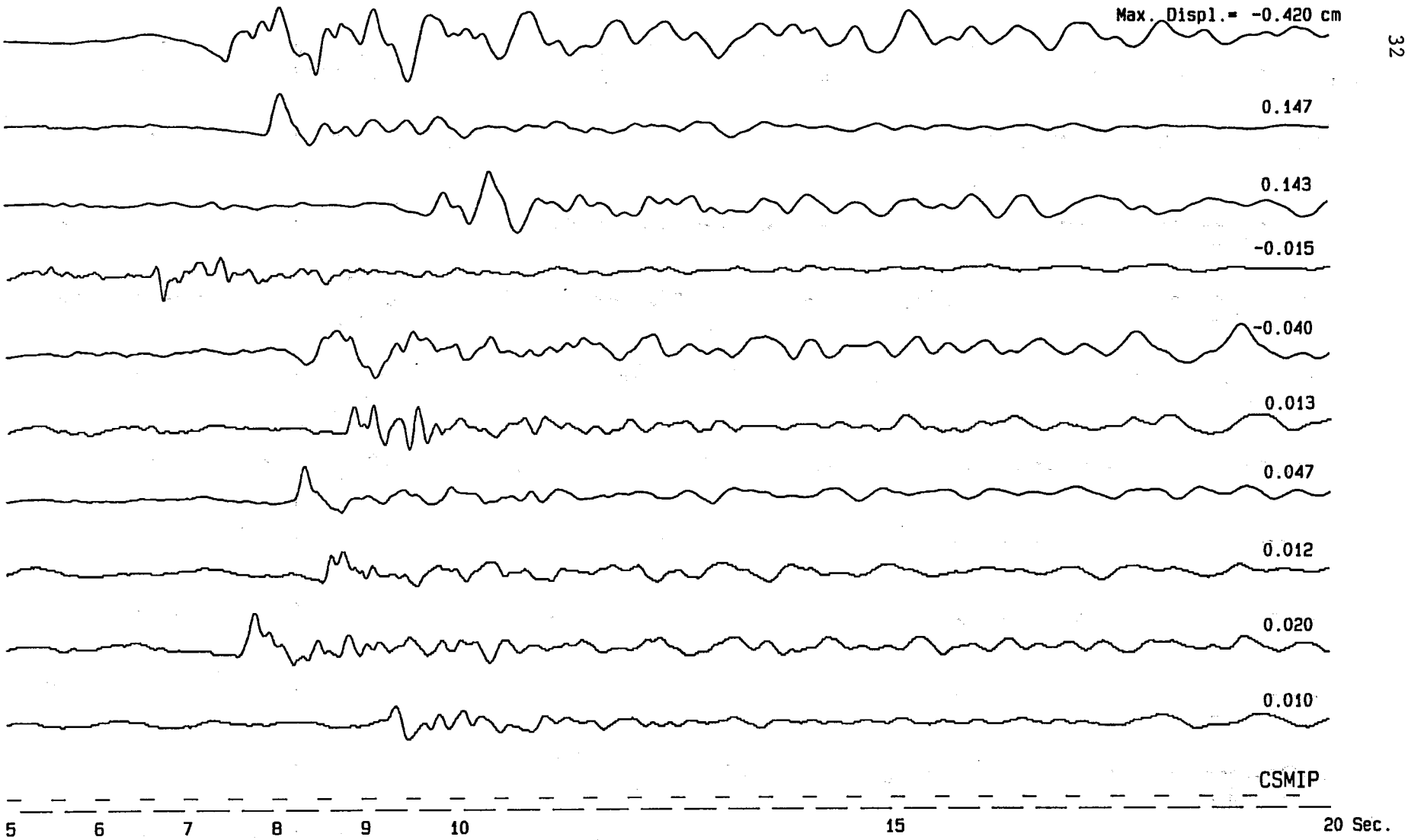


Figure 11d. Tarzana - Clubhouse displacement waveforms from ten Northridge aftershocks with each record individually scaled so record details can be observed.

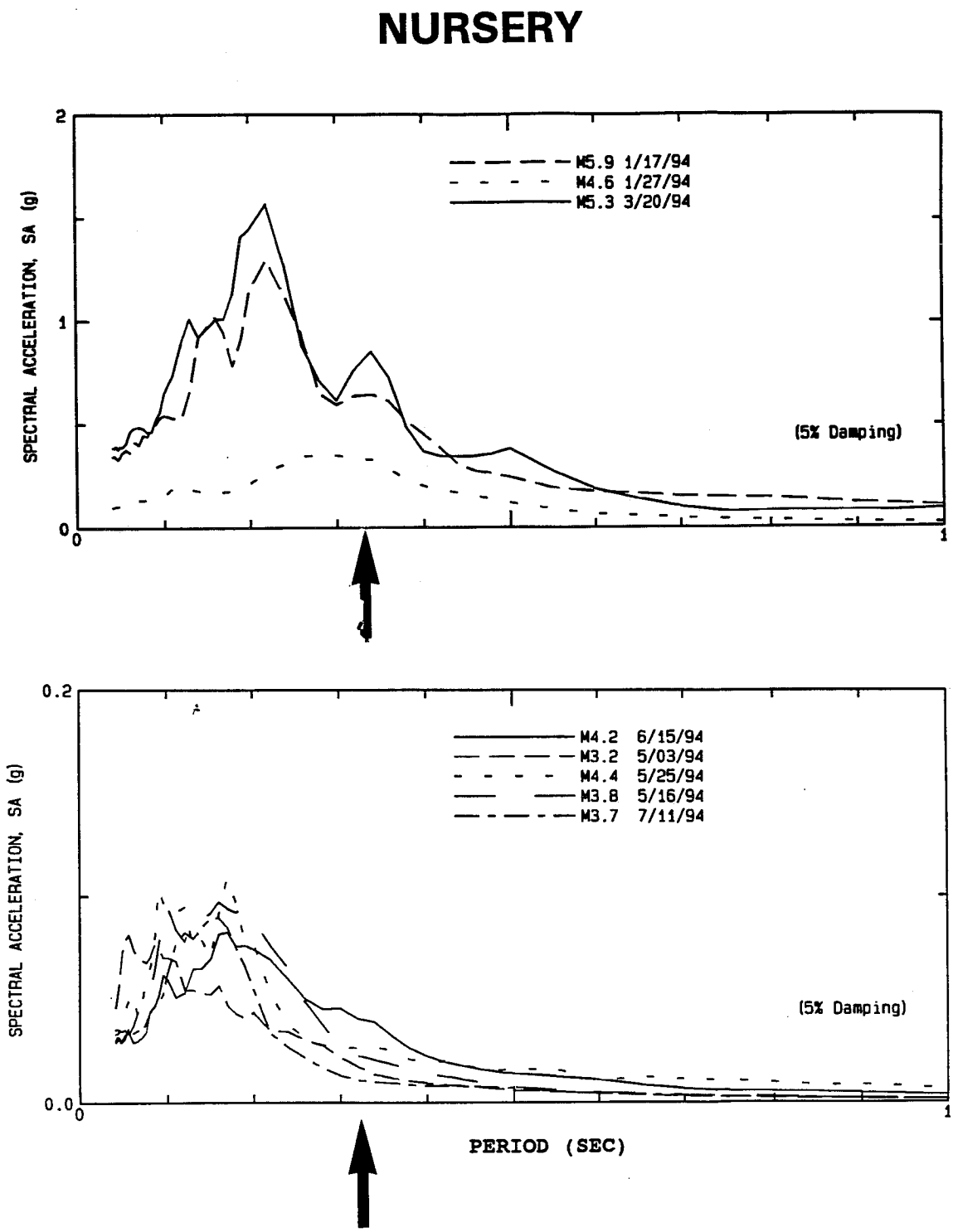


Figure 12. Damped (5%) response spectral acceleration computed for the eight largest aftershocks at Tarzana - Cedar Hill Nursery.

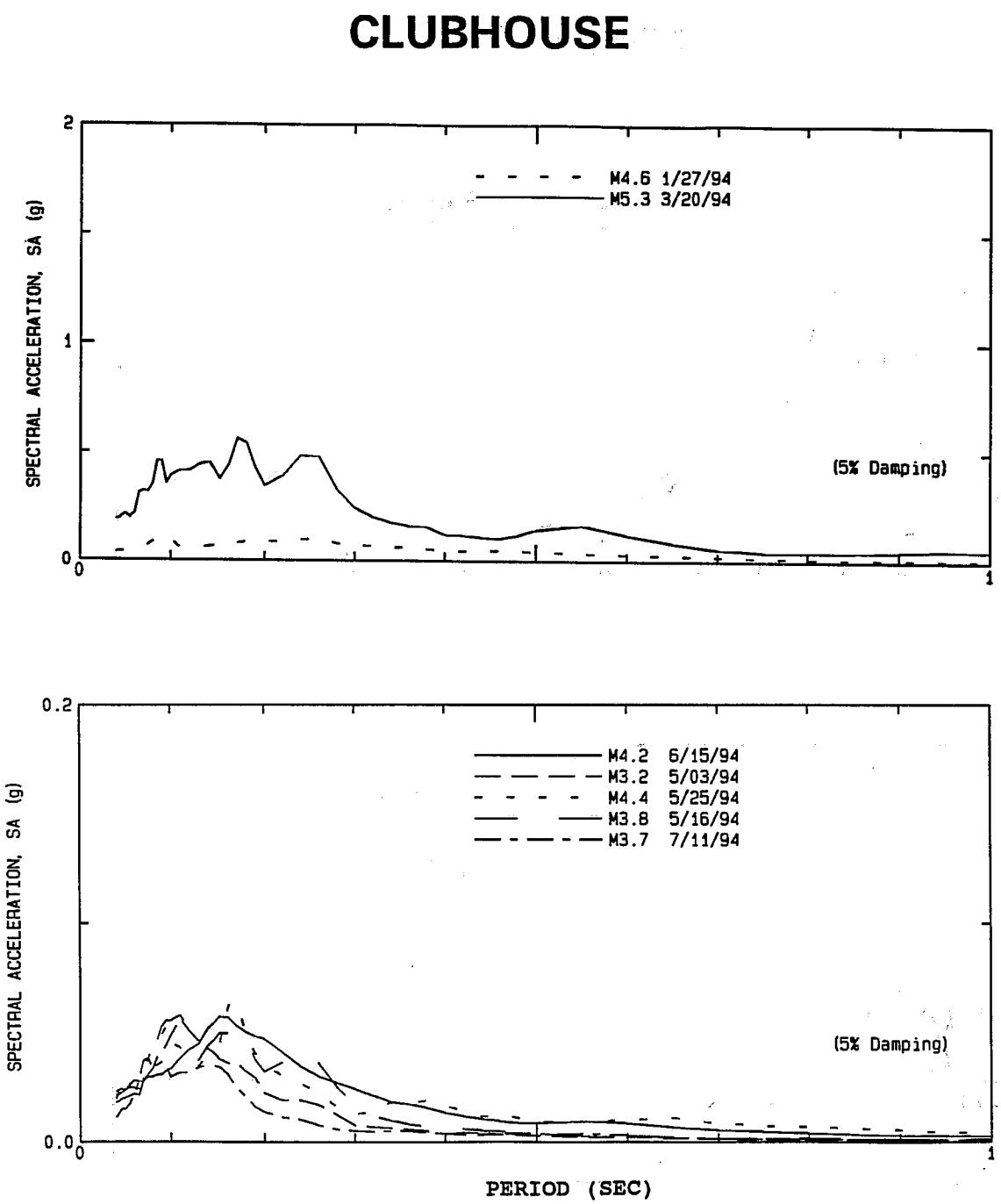


Figure 13. Damped (5%) response spectral acceleration computed for the seven largest aftershocks at Tarzana - Clubhouse.

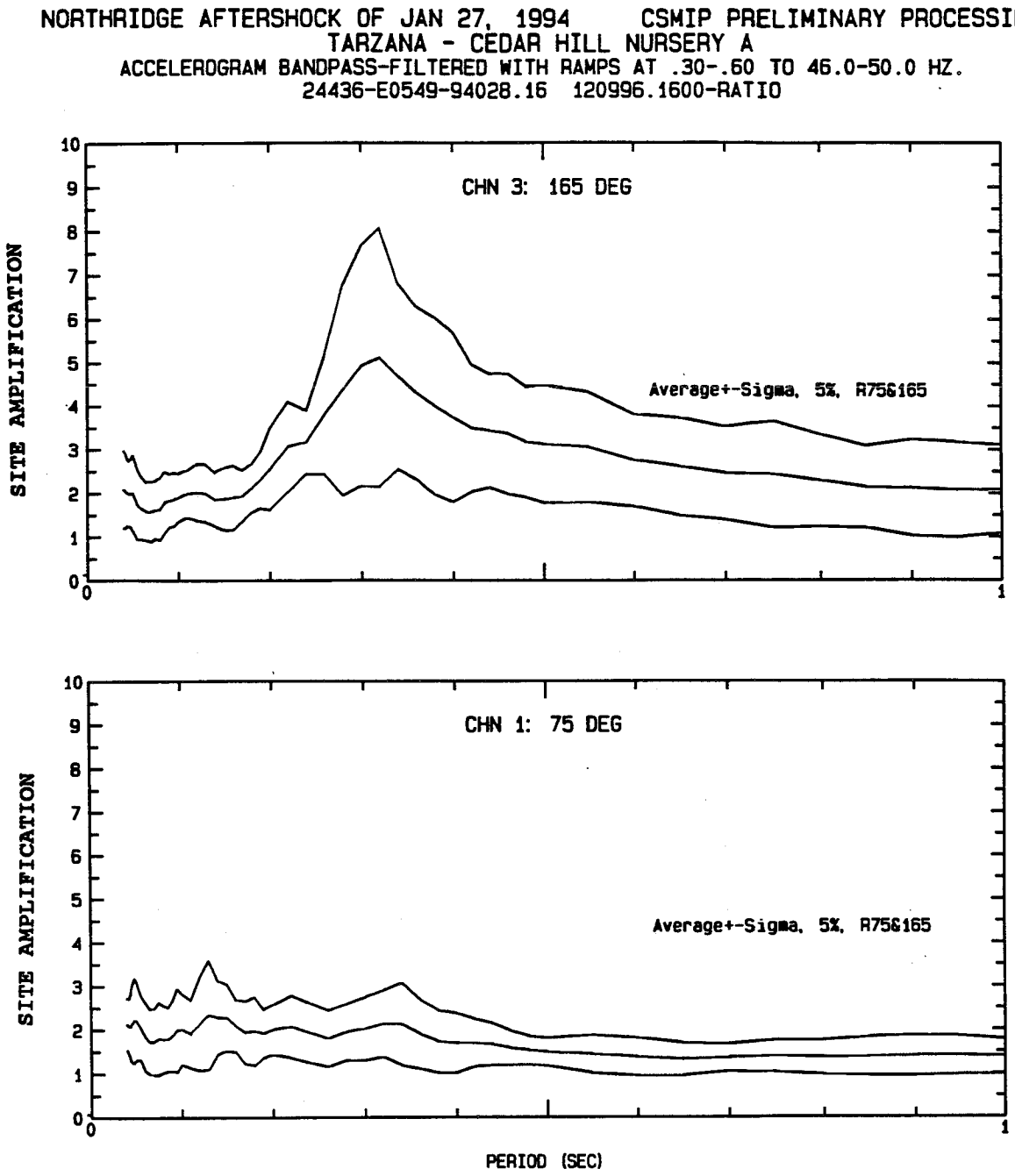


Figure 14. Site response estimated from response spectral ratios of the Nursery/Clubhouse. The average and $\pm$ 1 σ curves computed from 10 aftershocks are shown. The spectra are computed from time histories at both sites that have been rotated to 165° (transverse to the strike of the Tarzana hill) and 75° (parallel to the strike of the Tarzana hill).

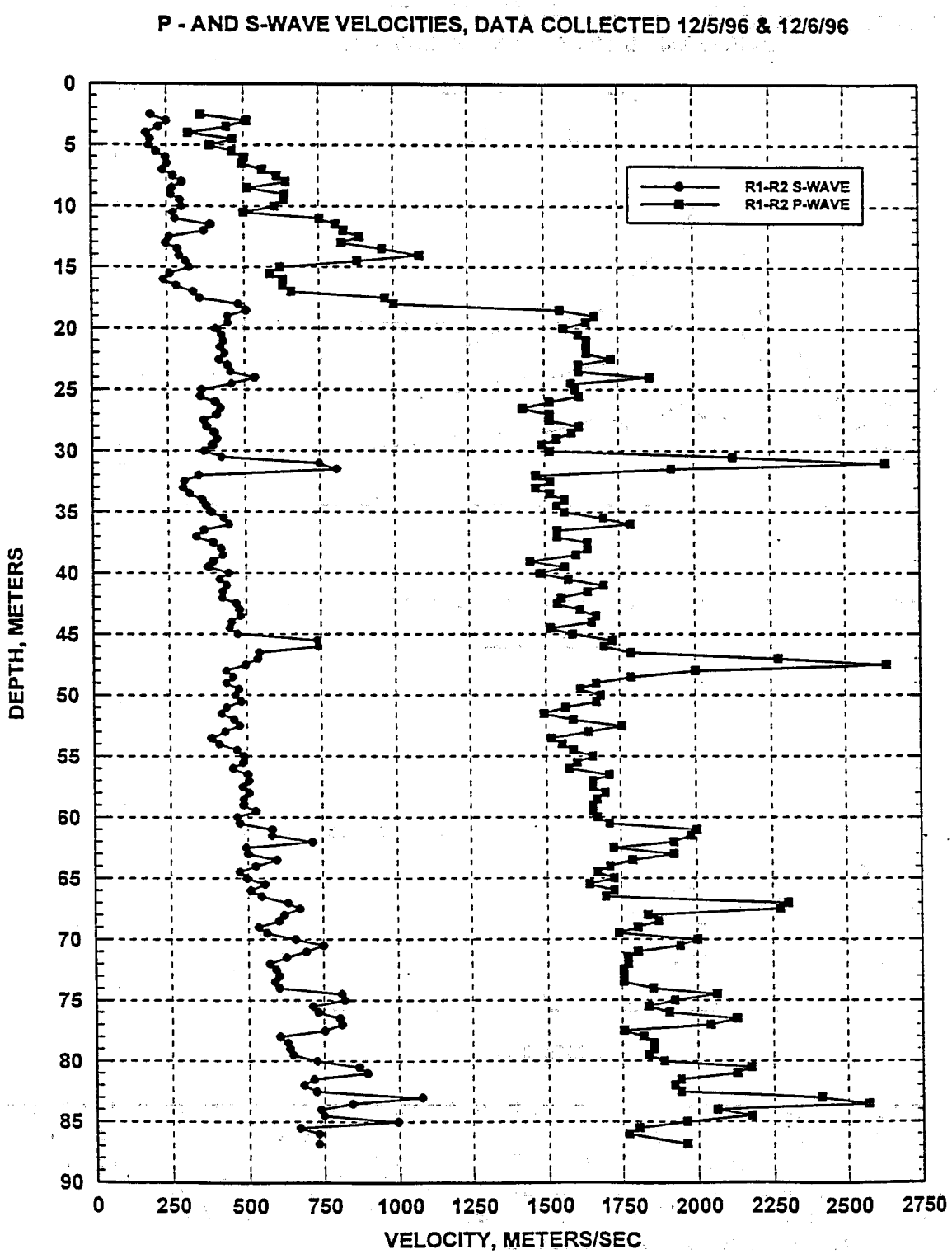


Figure 15. P- and S-wave velocities at Tarzana - Cedar Hill Nursery.

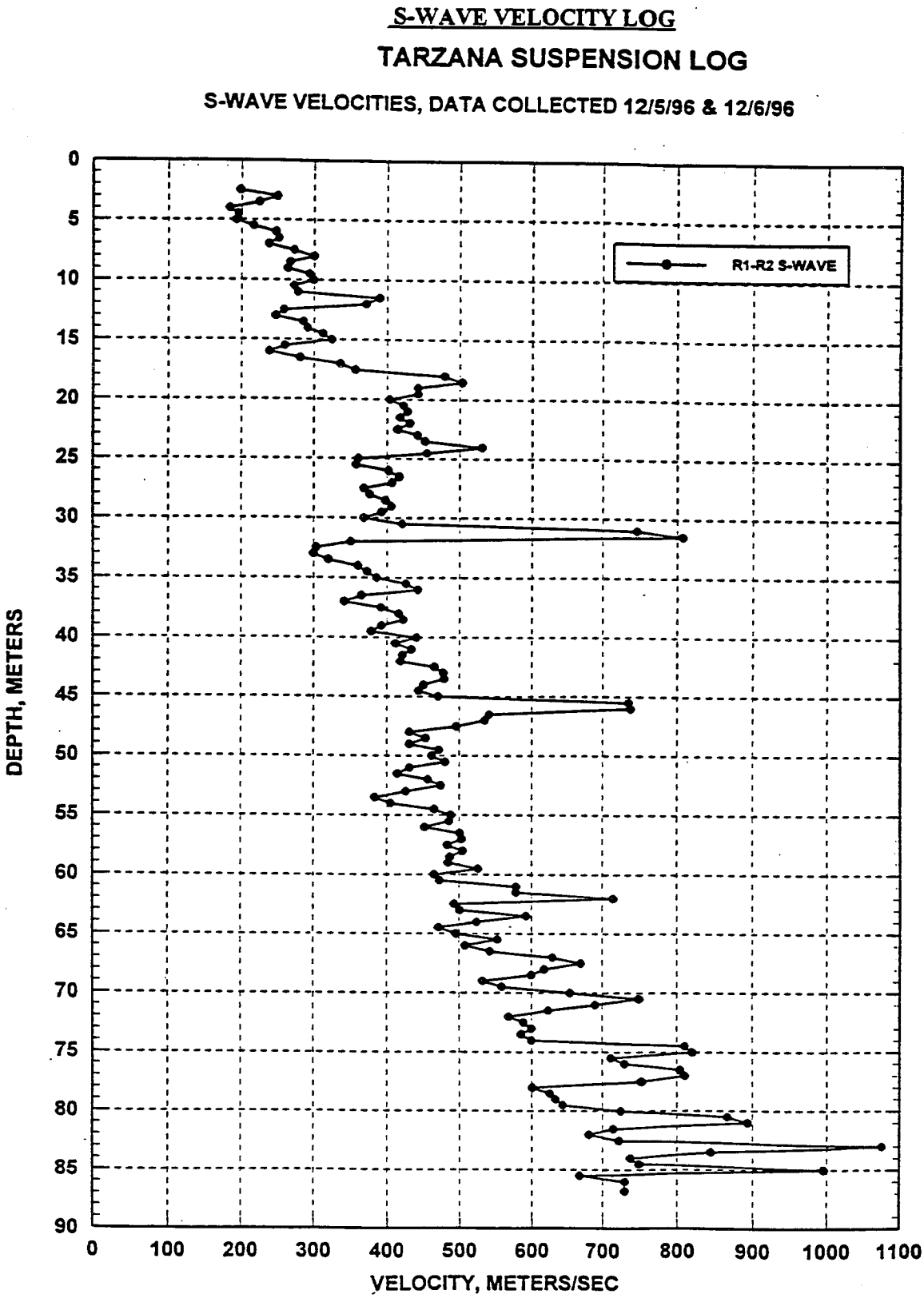


Figure 16. S-wave velocities at Tarzana - Cedar Hill Nursery.

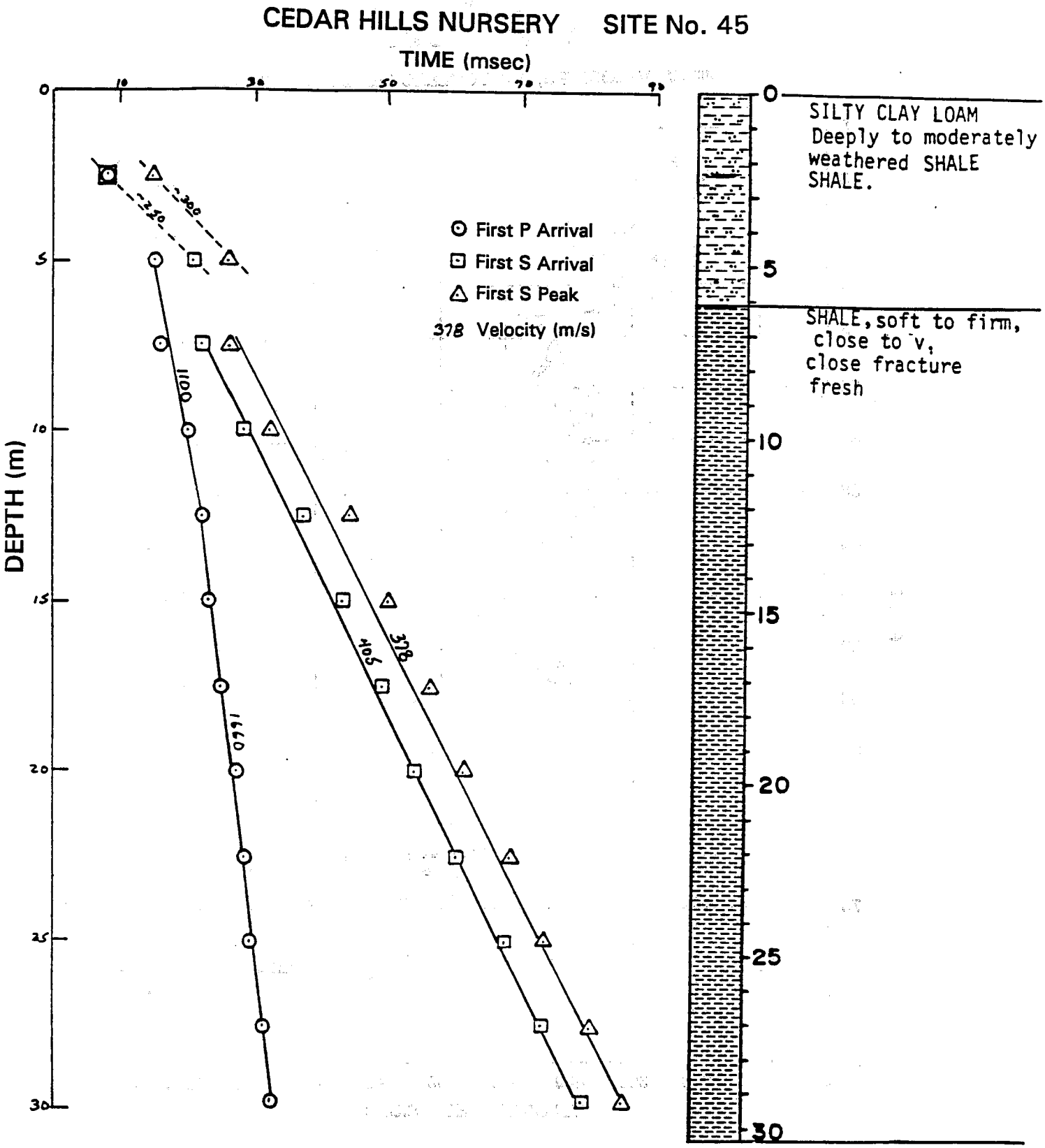


Figure 17. Lithology and P-and S-wave arrival times in the USGS borehole near Tarzana - Cedar Hill Nursery (From Fumal et al. (1981)).

LA CIENEGA NEAR THE SANTA MONICA FREEWAY (I-10)

Introduction

Unfortunately, the Northridge mainshock was not recorded at the collapsed Santa Monica freeway (I-10) near La Cienega. However, three stations recorded the shaking during the Northridge earthquake within 6 km. A peak horizontal acceleration of 0.24 g was recorded at Baldwin Hills which is located about 3.5 km to the south (Shakal et al., 1994). This station is underlain by less than 5 m of alluvium and fill over shale. Also, the University of Southern California network stations 91 (deep alluvium) and 18 (alluvium) (Anderson and others, 1981) are located about 2 and 6 km north of the Santa Monica freeway, respectively. Stations 91 and 18 recorded peak horizontal accelerations of 0.44 and 0.25 g, respectively (Trifunac and Todorovska, 1996).

Topographic maps from 1902 and 1926 (R. Sydnor, written communication) show small lakes and marshy ground on the surface near the site of the collapsed Santa Monica freeway. La Cienega means "the swamp" in Spanish. The Santa Monica freeway near La Cienega is sited on deep alluvium as determined from boreholes. The deepest hole to 284 m (930') did not reach bedrock.

Aftershock Recordings

To understand the site response SMIP installed additional accelerographs near the Santa Monica freeway (I-10) at La Cienega after the Northridge earthquake. These 12-bit low-gain instruments were collocated with the analog accelerograph at Baldwin Hills that had recorded the mainshock, and at two locations near to the Santa Monica freeway at La Cienega in order to study local site effects. Numerous aftershocks with low-levels of motion have been recorded by all stations. One of the temporary stations has been in operation from 2/1/94 to present. Extensive analyses of these records were not performed due to the instrumentation of the cooperative SMIP/Caltrans La Cienega Geotechnical Array discussed in the next sections.

Site Characterization

Caltrans (California Department of Transportation) drilled two holes to depths of 18 and 100 m near Santa Monica freeway (I-10) at La Cienega. A deeper borehole was drilled in September and October 1996 to a depth of 283.5 m (930') with funding provided by NSF, Caltrans and Electric Power Research Institute (EPRI) to the Resolution of Site Response Issues from the Northridge Earthquake (ROSRINE) Project. Rock was not reached in this deep borehole. Extensive site characterization information from this borehole are still being developed and are outside of

the scope of this report.

The geology of the two shallow holes was logged during drilling by Robert Sydnor of SMIP (Figure 18). The lithology consists of sands, silts, clays and gravels. The profile consists of recent fluvial deposits of about 30 m in thickness over marine deposits. Both Caltrans and the U. S. Geological Survey performed P-wave and S-wave velocity surveys in the 100 m hole. The results of the USGS S-wave velocity survey are shown in Figure 18 (J. Gibbs, written communication). S-wave velocities are near 140 m/sec at the surface and increase to over 400 m/sec at 100 m. Using the site classification proposed by Boore et al. (1993) the La Cienega Geotechnical Array is a deep soft soil site (site class D). As a function of depth, the site class varies as the soil stiffens. It is a site class D for depths less than 9 m (30'). For depths between 9 to 30 m (30 to 100') the La Cienega site class is C, and for greater depths the classification is B.

Analyses of Aftershock Response

SMIP in cooperation with Caltrans has installed an array of strong-motion sensors at the Santa Monica freeway (I-10) near La Cienega. The cooperative SMIP/Caltrans La Cienega Geotechnical Array consists of three 16-bit instruments located at the surface (0 m), 18 and 100 m depth. The lowest level of acceleration able to be recorded on the system is approximately 0.06 cm/sec^2. The array was completed in December 1994. Recordings from this array provide a direct measure of the site response near the Santa Monica freeway (I-10) at La Cienega.

Low-levels of motion have been recorded at the array from two earthquakes. A 4.9 M_L (Richter magnitude) earthquake occurred about 48 km north of the array, at 1:40 a.m. on June 26, 1995 (Table 6). A 2.0 M_L earthquake occurred about 6 km north of the array, at a depth of 5.5 km, under the Santa Monica Mountains, at 2:35:00 p.m. on September 27, 1996 (Table 6). The accelerograms from these earthquakes have been processed to velocity, displacement and spectra for analyses.

Figures 19 to 21 show amplification of the low-strain motion from 100 m to the surface, especially at higher frequencies for the June 26, 1995 earthquake. The peak horizontal acceleration, velocity and displacements are small, near 0.01 g, 0.6 cm/sec and 0.09 cm, respectivley (Table 7). These low amplitude motions clearly document the site amplification of ground motion. Peak horizontal acceleration increases by a factor of 2.5 to 3.5 from 100 m to the surface (Table 8). Correspondingly, the peak horizontal velocity increases by a factor of 2 to 2.5. Peak horizontal displacement increased by a factor near 1.5 from 100 m to the surface.

The response spectra (Log S_v) for each of the 9 channels and

for 5 dampings are shown in Figures 22 to 24 from the June 26th earthquake. For this earthquake the response peaks between 0.2 and 2 seconds period (5 to 0.5 Hz). The site response is estimated by taking ratios of the 5% damped spectra. These response spectral ratios are shown in Figures 25 - 27. Large amplifications (greater than 4) are observed on the horizontal components near 1 second and below 0.3 second (3.3 Hz). At periods longer than 2 seconds the horizontal spectral ratios are close to one. At this site most of the horizontal response near 1 second is produced between 100 and 18 m. Between 18 m and the surface most of the response at shorter periods is produced.

The vertical response spectral ratios show less site amplification than the horizontal ratios. In addition, the largest amplification is near 0.6 second (1.7 Hz). This reflects the stiffer response in the vertical direction due to the motion on the vertical component consisting primarily of P-waves. (Using the equation T=4H/V (where T is the fundamental period, H is layer thickness and V is velocity) it follows that the fundamental vertical response will be at shorter periods or at higher frequencies than for the horizontal components since the P-wave velocity is greater than the S-wave velocity. Most of the vertical response near 0.6 second is again produced between 100 and 18 m. Also, between 18 m and the surface most of the response at shorter periods is produced.

Figures 28, 29 and 30 show the array acceleration, velocity and displacement time histories plotted for all three depths (0, 18 and 100 m) for the September 27, 1996 earthquake. The peak acceleration at the surface was about 0.8% g, on both horizontal components (Table 7). Peak horizontal velocity and displacements are 0.28 cm/sec and 0.012 cm. These are low levels of motion, especially on the vertical component at depth where peak accelerations less than 0.1% g (1 cm/sec) were measured. The usable data bandwidth (Appendix D) of the motions from this earthquake are limited to periods less than 1.5 seconds due to the small earthquake source and signal to noise considerations.

The duration of the motions is short at the surface from this magnitude 2 earthquake. This is due to a combination of short source duration and few long period surface waves present on the records. This observation is in contrast to the longer duration observed in the June 26, 1995 earthquake (Figures 19 to 21). In addition, the records (Figures 28 to 30) show two S-wave packets on the horizontal components. The second packet is probably due to reflection/refraction in the geologic structure. The effect is to increase the duration at depth. If this site always produces later arriving energy this could be an indication of longer durations during larger events.

Again, amplification of the low-strain horizontal motions from 100 m to the surface is observed in peak acceleration (factor of 3 to 6) and peak velocity (factor of 3 to 5) (Table 8). A factor of 3 to 5 increase in peak horizontal displacements

is also observed from 100 m to the surface. However, since periods longer than 1.5 seconds have been filtered out of the time histories these values may not be representative of the long-period response.

The response spectra (Log S_v) for each of the 9 channels and for 5 dampings are shown in Figures 31 to 33. For this earthquake the response spectra has a narrow peak near 0.2 seconds (5 Hz). The response spectra are lower in amplitude than the spectra from the June 26th Northridge aftershock reflecting the small size of the earthquake source.

The site response is again estimated by taking ratios of the 5% damped spectra. These response spectral ratios are shown in Figures 34 - 36. Amplifications (greater than 4) are observed on the horizontal components below 0.35 seconds (3 Hz). The horizontal spectral ratios are not estimated at periods longer than 1.5 seconds due to the small signal. The vertical response spectral ratios show less site amplification than the horizontal ratios.

Summary

Mainshock motions were not recorded at La Cienega during the Northridge earthquake. However, from three nearby stations the peak acceleration can be estimated at between 0.25 and 0.45 g. The subsurface geology and velocities obtained allow classification of this location as a deep soft-soil site.

Clear site amplification effects are observed in motions from two aftershocks recorded at the cooperative SMIP/Caltrans La Cienega Geotechnical Array in Los Angeles. The effect of the top 100 m of soils (sands, gravels, clays and gravels) is to produce an amplification from depth to the surface of 4 and greater on the horizontal components near 1 second for the June 26th aftershock. In addition, increased duration of shaking is observed at depth due to the delay in arrival of the reflected wave from the free surface at depth from the September earthquake.

TABLE 6
SUMMARY OF EARTHQUAKE INFORMATION*

Date	Origin Time (hr:min:sec)	Epicenter Coordinates (°N)	(°W)	Depth (km)	Magnitude (M_L)
Jun 26, 1995	08:40:28.9	34.394	118.669	13	5.0
Sep 27, 1996	21:35:00.0	34.089	118.364	5.5	2.0

* The earthquake information is from the California Institute of Technology

TABLE 7
PEAK GROUND MOTIONS AT THE LA CIENEGA GEOTECHNICAL ARRAY*

June 26, 1995 Earthquake:

Channel No.	Depth (m)	Orientation	Accel. (cm/sec^2)	Peak Velocity (cm/sec)	Displacement (cm)
1	0	90°	11.4	0.56	0.086
2	0	Up	2.4	0.13	0.043
3	0	360°	9.0	0.50	0.072
4	18	90°	3.1	0.39	0.071
5	18	Up	1.4	0.13	0.039
6	18	360°	3.8	0.34	0.065
7	100	90°	3.1	0.22	0.050
8	100	Up	1.5	0.10	0.032
9	100	360°	3.4	0.24	0.059

September 27, 1996 Earthquake:

Channel No.	Depth (m)	Orientation	Accel. (cm/sec^2)	Peak Velocity (cm/sec)	Displacement (cm)
1	0	90°	8.2	0.28	0.012
2	0	Up	2.0	0.05	0.002
3	0	360°	8.4	0.24	0.010
4	18	90°	2.6	0.09	0.004
5	18	Up	0.7	0.02	0.001
6	18	360°	2.2	0.10	0.005
7	100	90°	2.5	0.09	0.004
8	100	Up	0.9	0.03	0.001
9	100	360°	1.3	0.05	0.002

* The La Cienega Geotechnical Array is a cooperative effort between SMIP and Caltrans.

TABLE 8
PEAK ACCELERATION, VELOCITY AND DISPLACEMENT RATIOS AT THE LA CIENEGA GEOTECHNICAL ARRAY*

June 26, 1995 Earthquake:

Channel	Ratio Depth	Ratios of Peak Accel.	Velocity	Displacement
1/7	0/100 m	3.7	2.5	1.7
2/8	0/100 m	1.6	1.3	1.3
3/9	0/100 m	2.6	2.1	1.2
4/7	18/100 m	1.0	1.8	1.4
5/8	18/100 m	0.9	1.2	1.2
6/9	18/100 m	1.1	1.4	1.1
1/4	0/18 m	3.7	1.4	1.2
2/5	0/18 m	1.7	1.1	1.1
3/6	0/18 m	2.4	1.5	1.1

September 27, 1996 Earthquake:

Channel	Ratio Depth	Ratios of Peak Accel.	Velocity	Displacement
1/7	0/100 m	3.4	3.2	3.
2/8	0/100 m	2.2	2.0	2.
3/9	0/100 m	6.4	5.0	5.
4/7	18/100 m	1.1	1.0	1.
5/8	18/100 m	0.8	0.7	1.
6/9	18/100 m	1.7	2.1	2.5
1/4	0/18 m	3.1	3.2	3.
2/5	0/18 m	2.7	2.7	2.
3/6	0/18 m	3.8	2.4	2.

* The La Cienega Geotechnical Array is a cooperative effort between SMIP and Caltrans.

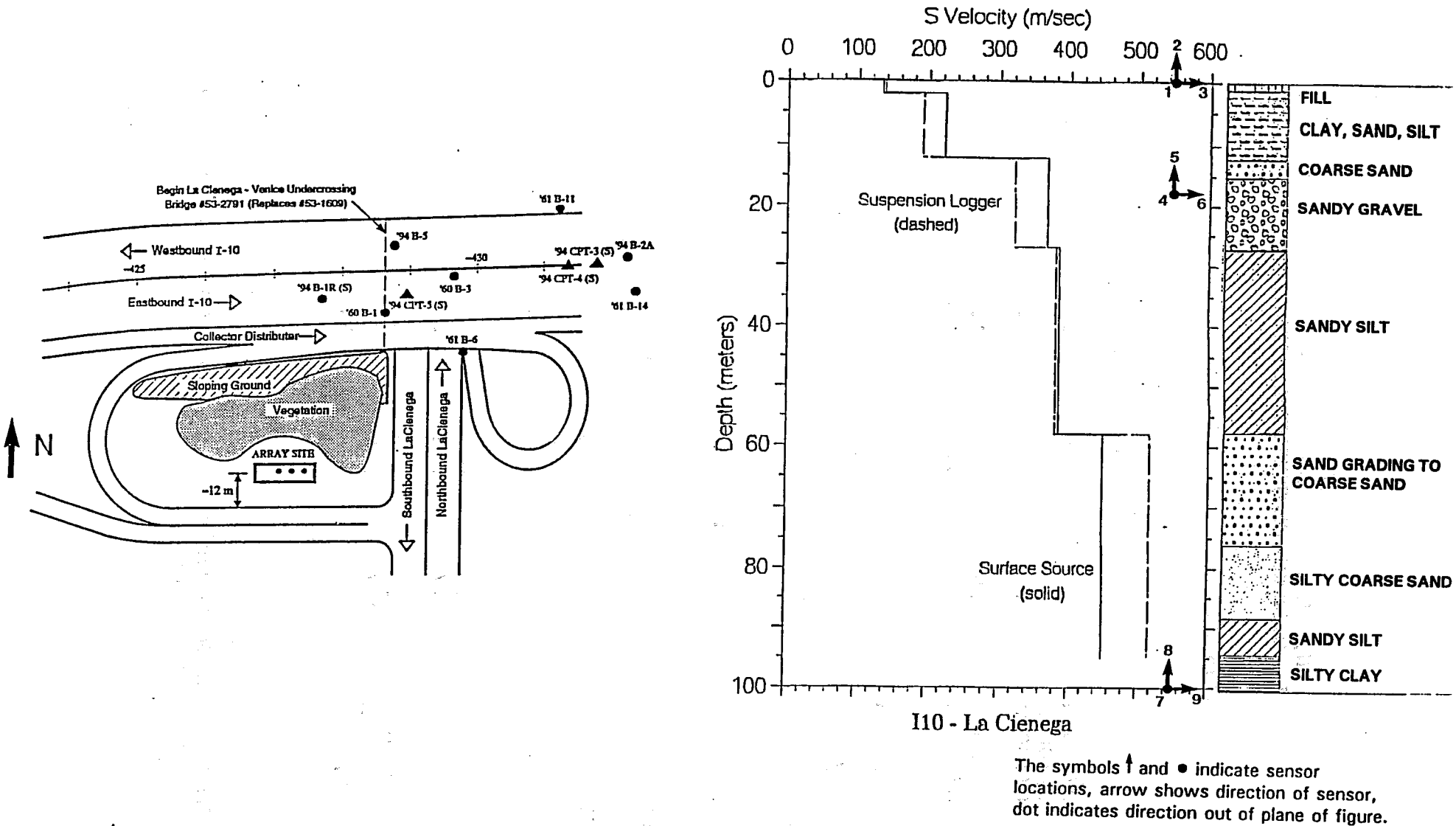


Figure 18. Schematic drawing showing the sensor locations (C. Roblee, written communication), lithology and S-wave velocity (J. Gibbs, written communication) at the cooperative SMIP/Caltrans La Cienega Geotechnical Array in Los Angeles. North-south accelerations are recorded on channels 1, 4 and 7. Vertical motions are recorded on channels 2, 5 and 8. East-west motions are recorded on channels 3, 6, and 9. Surface accelerations are recorded on channels 1, 2 and 3. Accelerations at 18 m depth are recorded on channels 4, 5 and 6. Accelerations at 100 m depth are recorded on channels 7, 8 and 9.

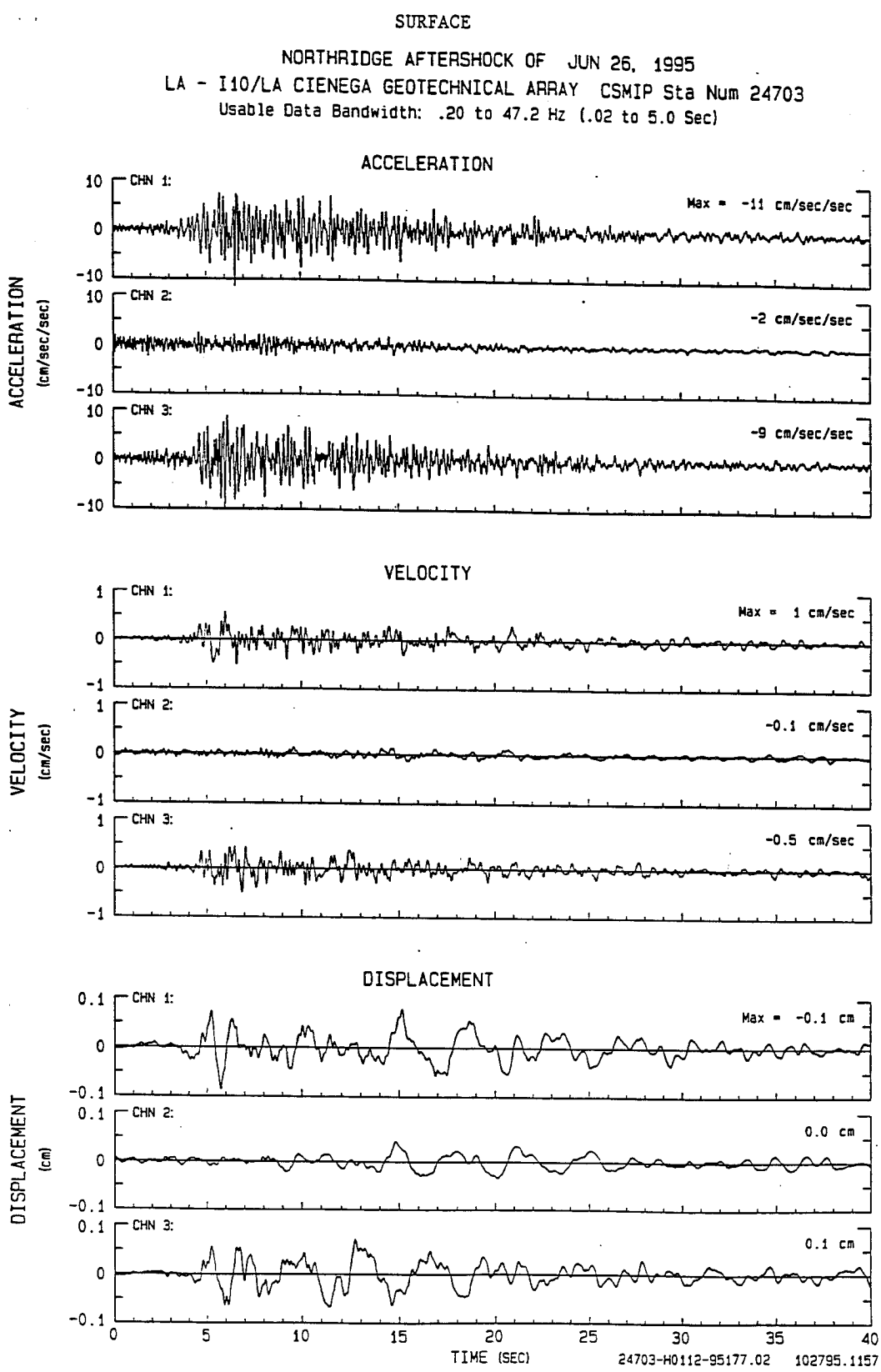


Figure 19. Acceleration, velocity and displacement recorded a the La Cienega Geotechnical Array from the June 26, 1995 earthquake at the surface.

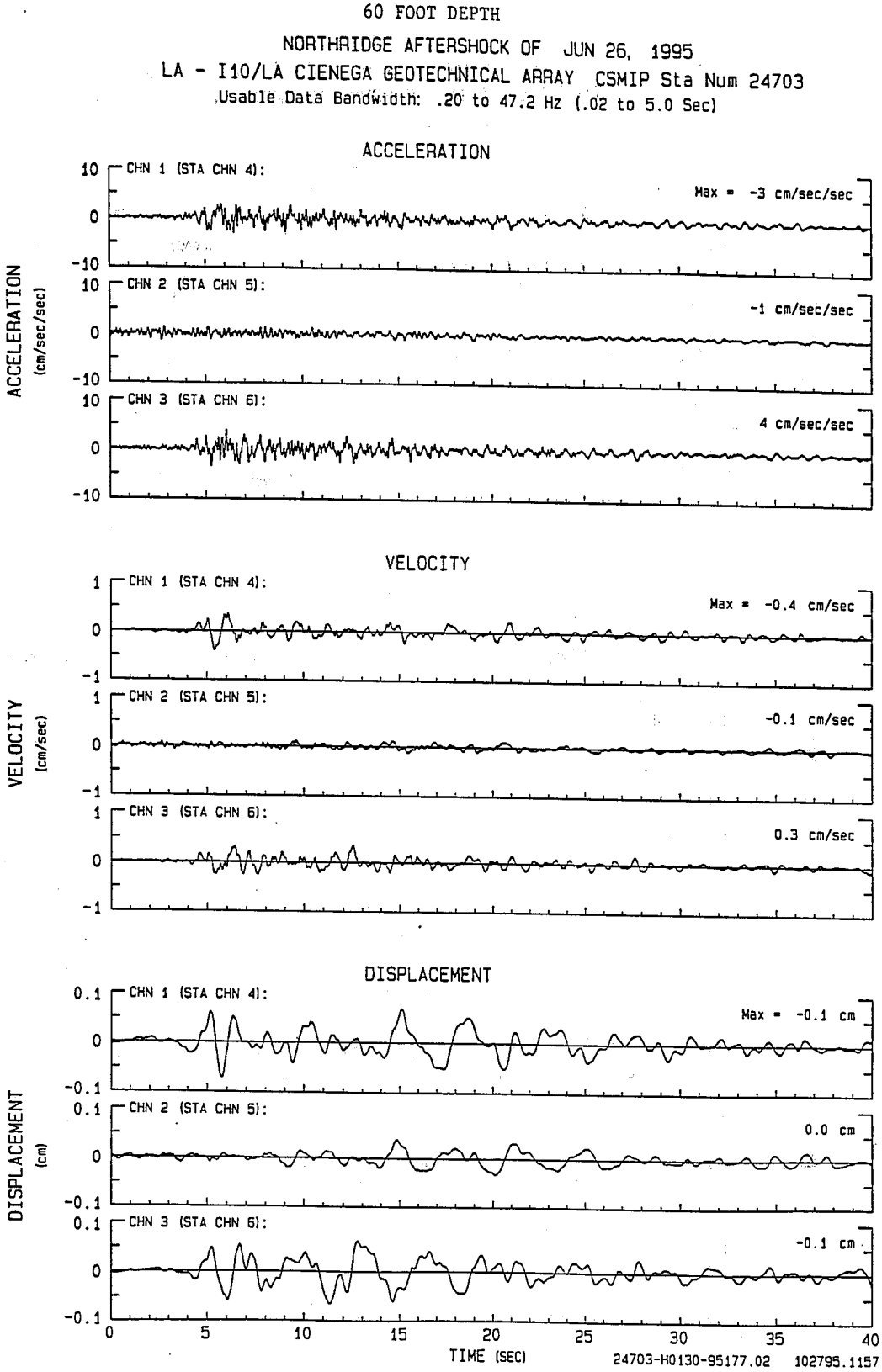


Figure 20. Acceleration, velocity and displacement recorded at the La Cienega Geotechnical Array from the June 26, 1995 earthquake at 18 m (60') depth.

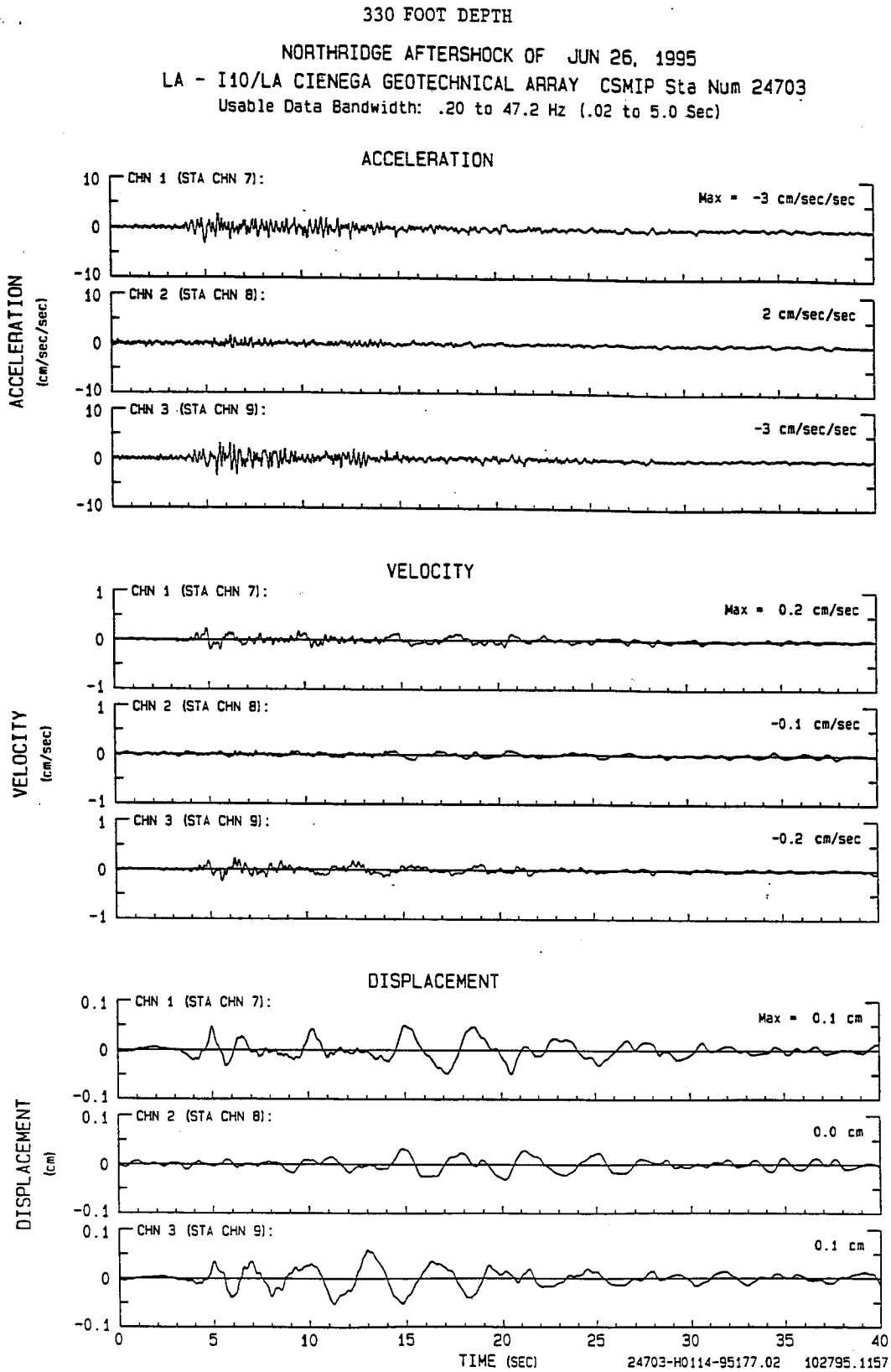


Figure 21. Acceleration, velocity and displacement recorded at the La Cienega Geotechnical Array from the June 26, 1995 earthquake at 100 m (330') depth.

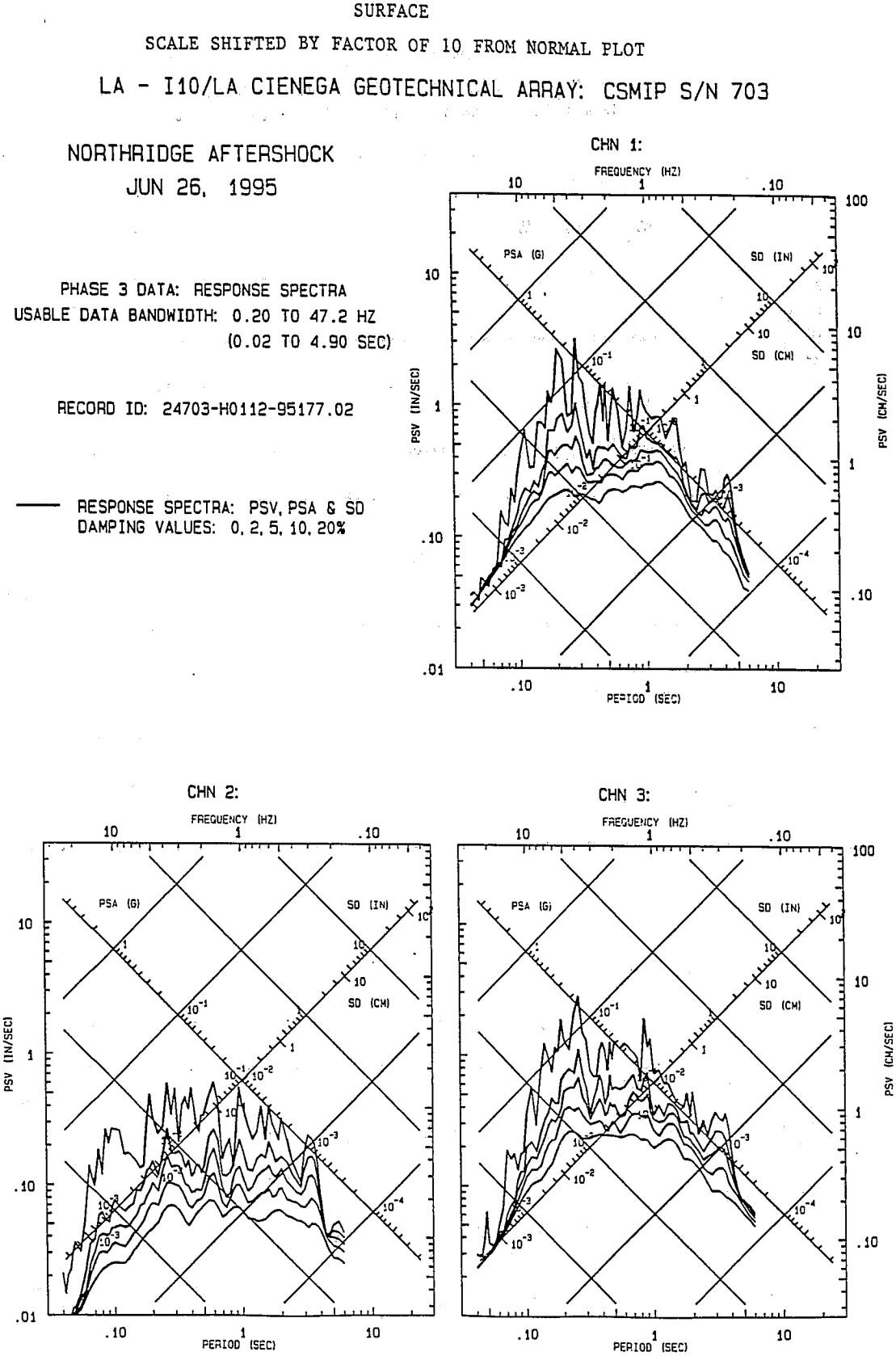


Figure 22. Response spectra (Log S_v) at the surface for the La Cienega Geotechnical Array.

60 FOOT DEPTH
SCALE SHIFTED BY FACTOR OF 10 FROM NORMAL PLOT

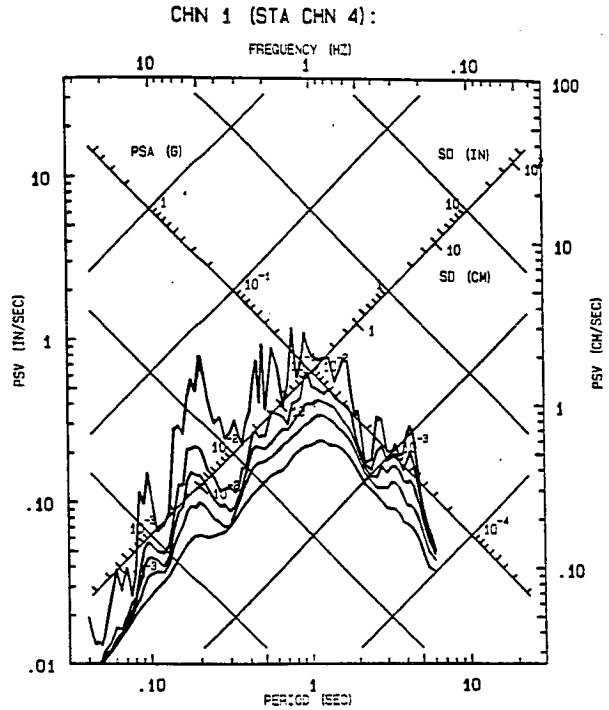
LA - I10/LA CIENEGA GEOTECHNICAL ARRAY: CSMIP S/N 703

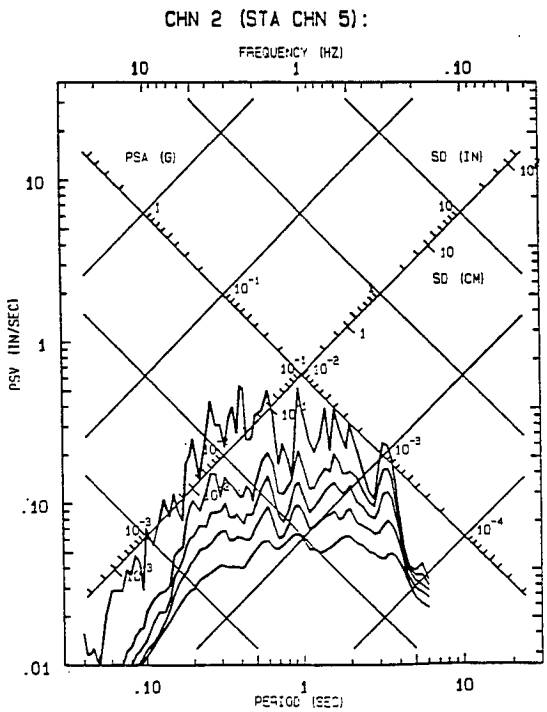
NORTHRIDGE AFTERSHOCK
JUN 26, 1995

PHASE 3 DATA: RESPONSE SPECTRA
USABLE DATA BANDWIDTH: 0.20 TO 47.2 HZ
(0.02 TO 4.90 SEC)

RECORD ID: 24703-H0130-95177.02

RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%





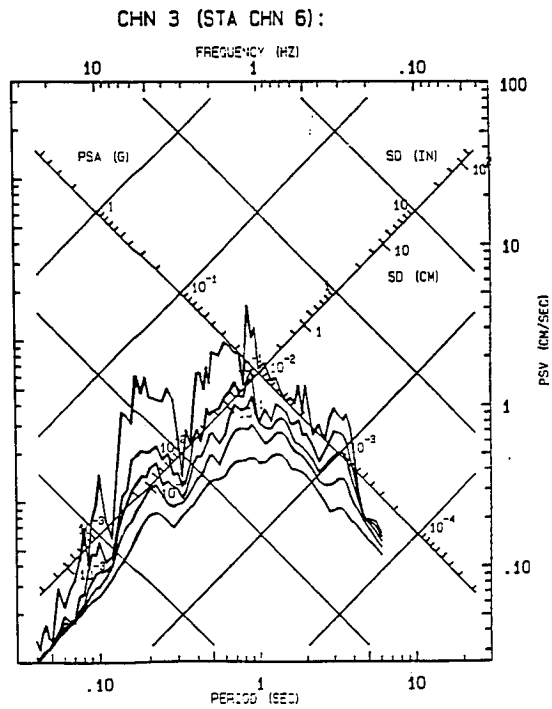


Figure 23. Response spectra (Log S_v) at 18 m (60') depth for th
La Cienega Geotechnical Array.

330 FOOT DEPTH
SCALE SHIFTED BY FACTOR OF 10 FROM NORMAL PLOT

LA - I10/LA CIENEGA GEOTECHNICAL ARRAY: CSMIP S/N 703

NORTHRIDGE AFTERSHOCK
JUN 26, 1995

PHASE 3 DATA: RESPONSE SPECTRA
USABLE DATA BANDWIDTH: 0.20 TO 47.2 HZ
(0.02 TO 4.90 SEC)

RECORD ID: 24703-H0114-95177.02

—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

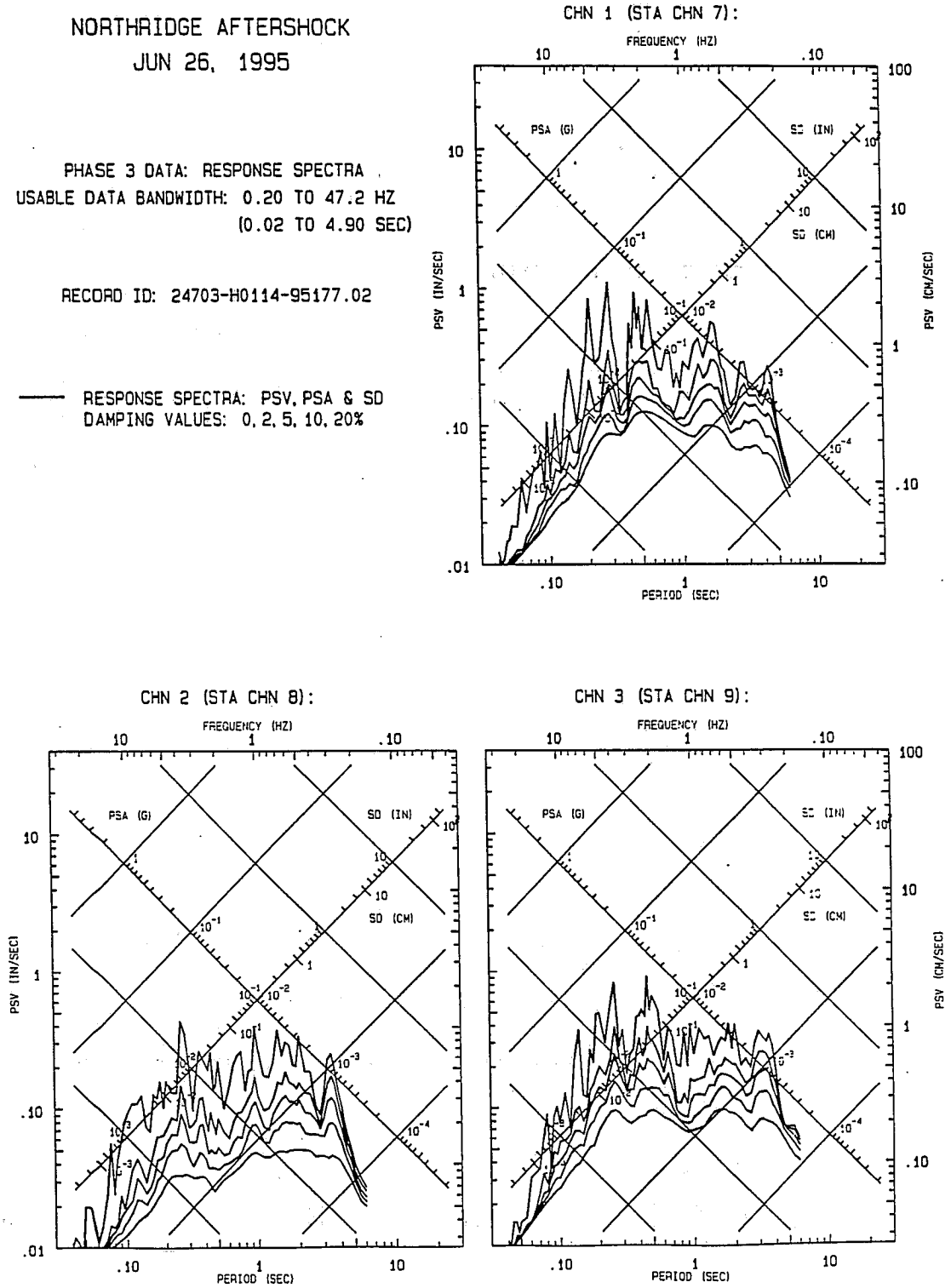


Figure 24. Response spectra (Log S_v) at 100 m (330') depth for the La Cienega Geotechnical Array.

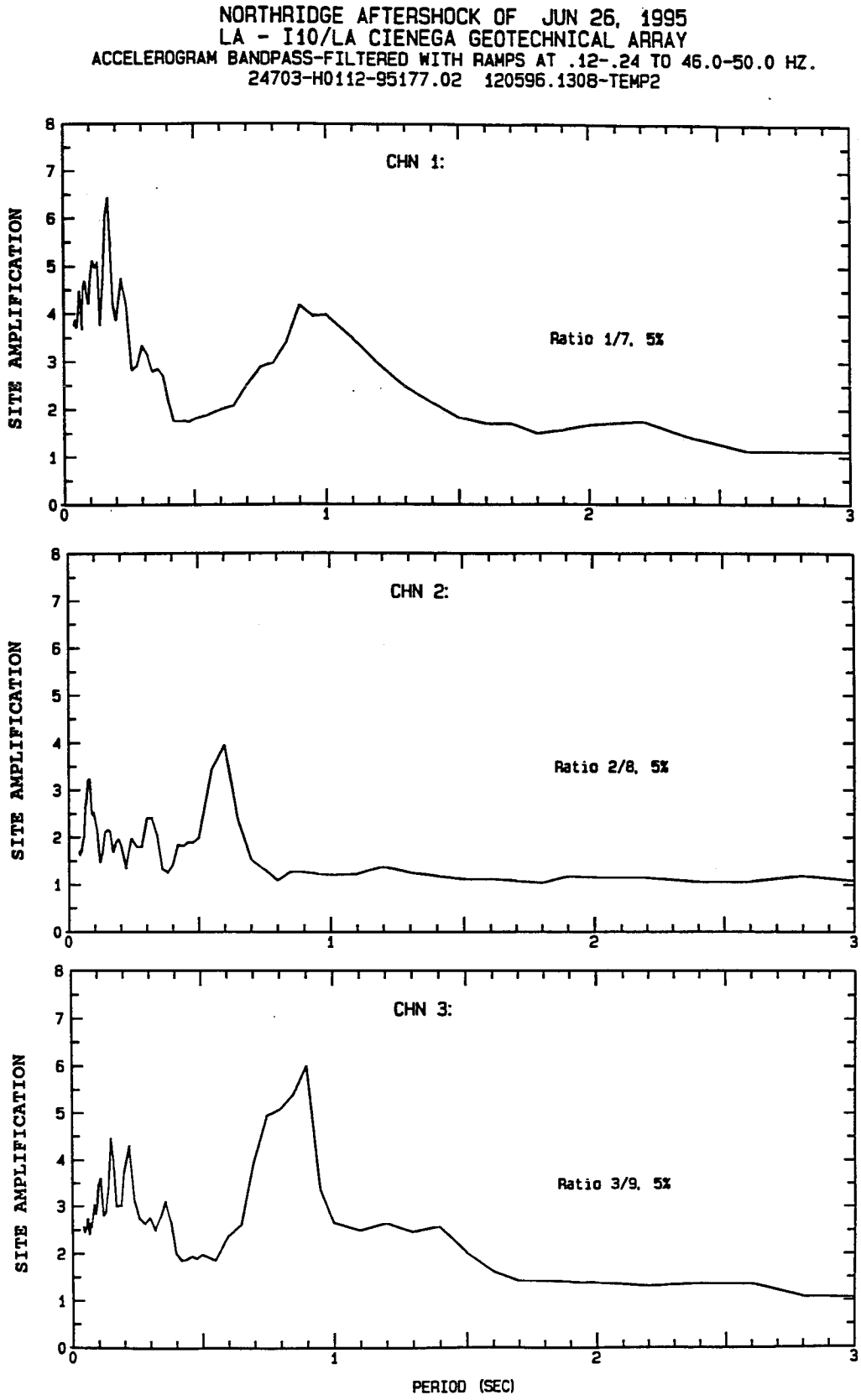


Figure 25. 5% damped response spectral ratios (Surface/100 m). All three components are shown (east-west (top), vertical (middle) and north-south (bottom)).

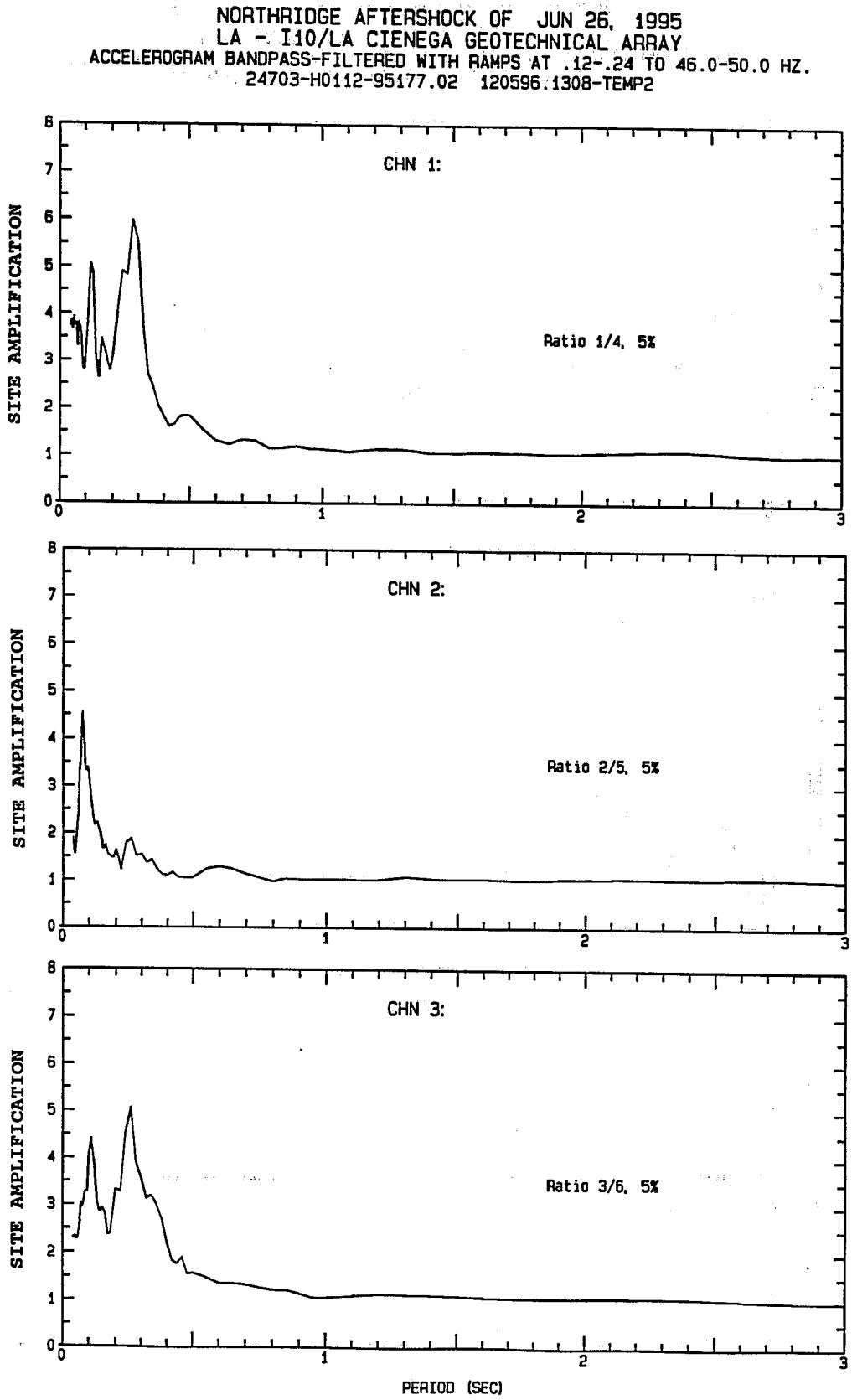


Figure 26. 5% damped response spectral ratios (Surface/18 m). All three components are shown (east-west (top), vertical (middle) and north-south (bottom)).

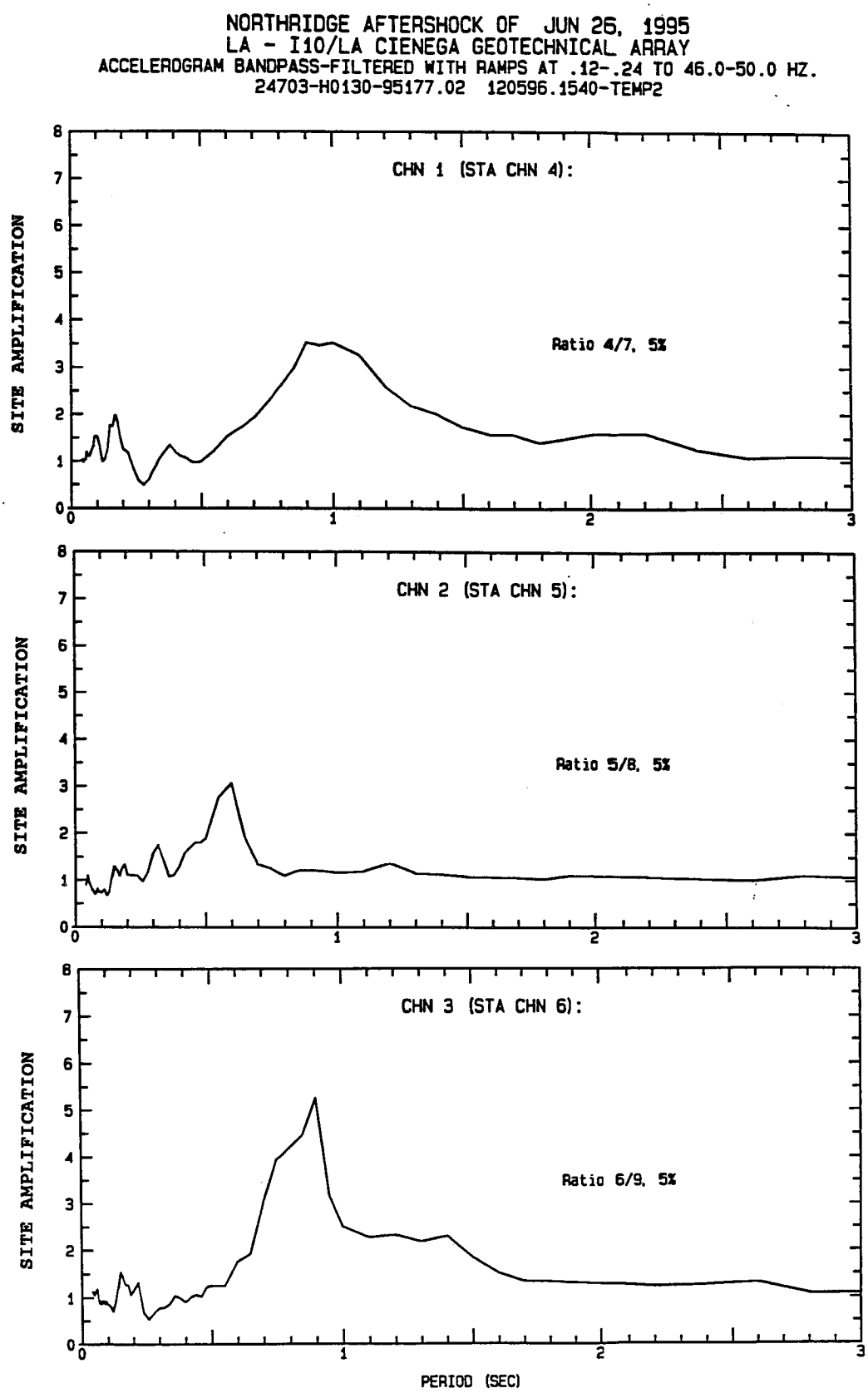


Figure 27. 5% damped response spectral ratios (18 m/100 m). All three components are shown (east-west (top), vertical (middle) and north-south (bottom)).

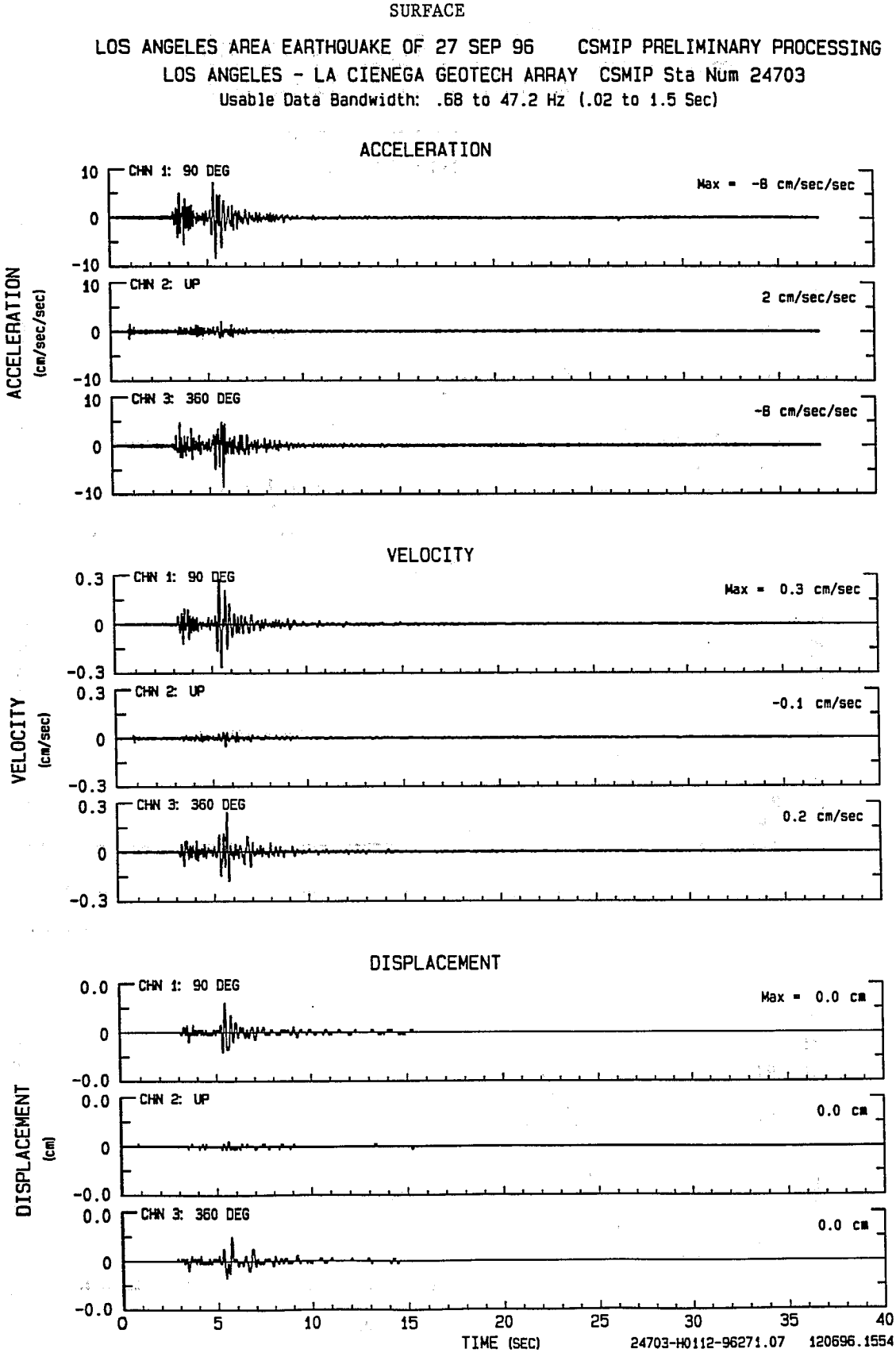


Figure 28. Acceleration, velocity and displacement recorded at the cooperative SMIP/Caltrans La Cienega Geotechnical Array from the September 27, 1996 earthquake at the surface.

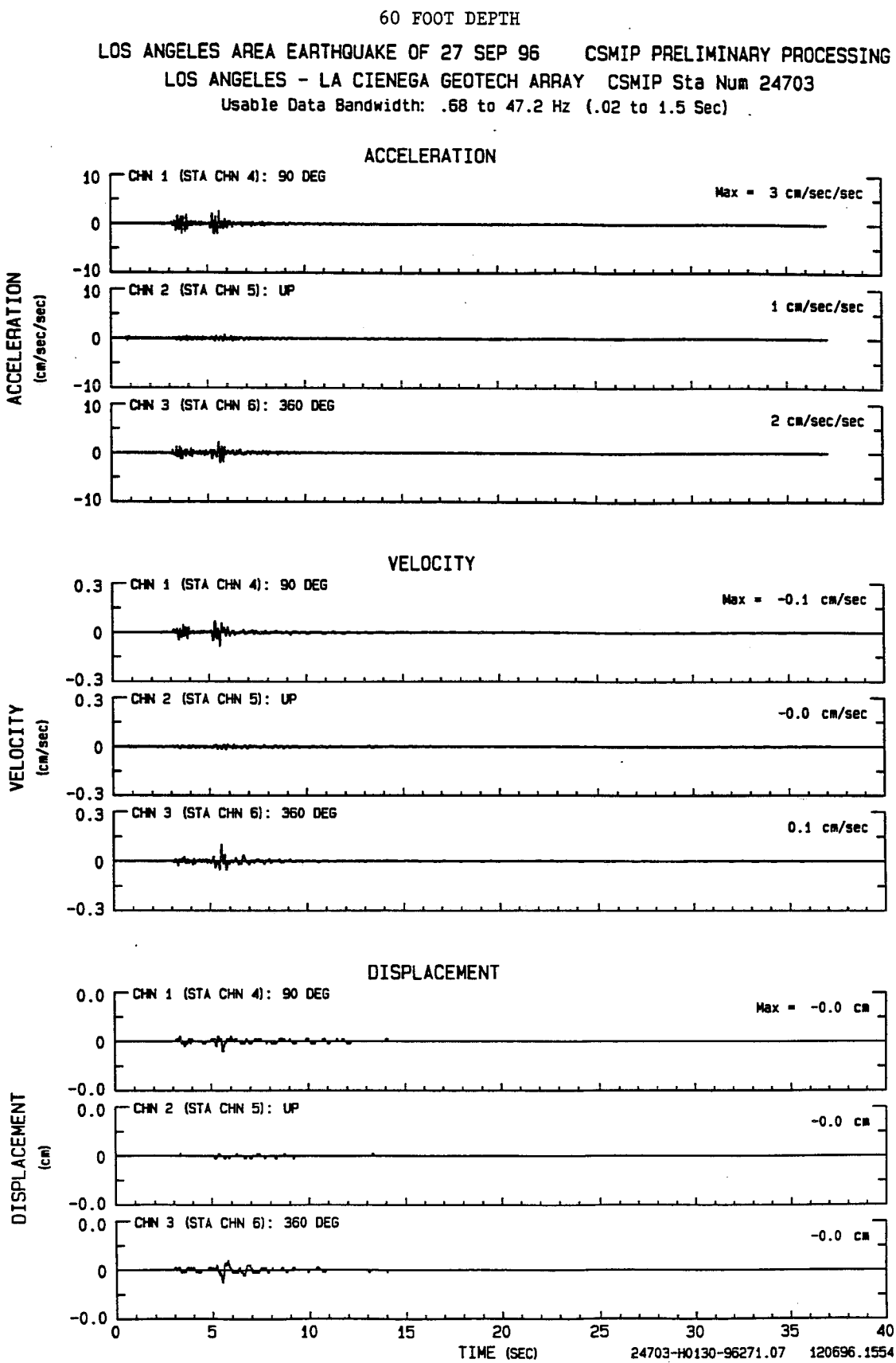


Figure 29. Acceleration, velocity and displacement recorded at the La Cienega Geotechnical Array from the September 27, 1996 earthquake at 18 m (60') depth.

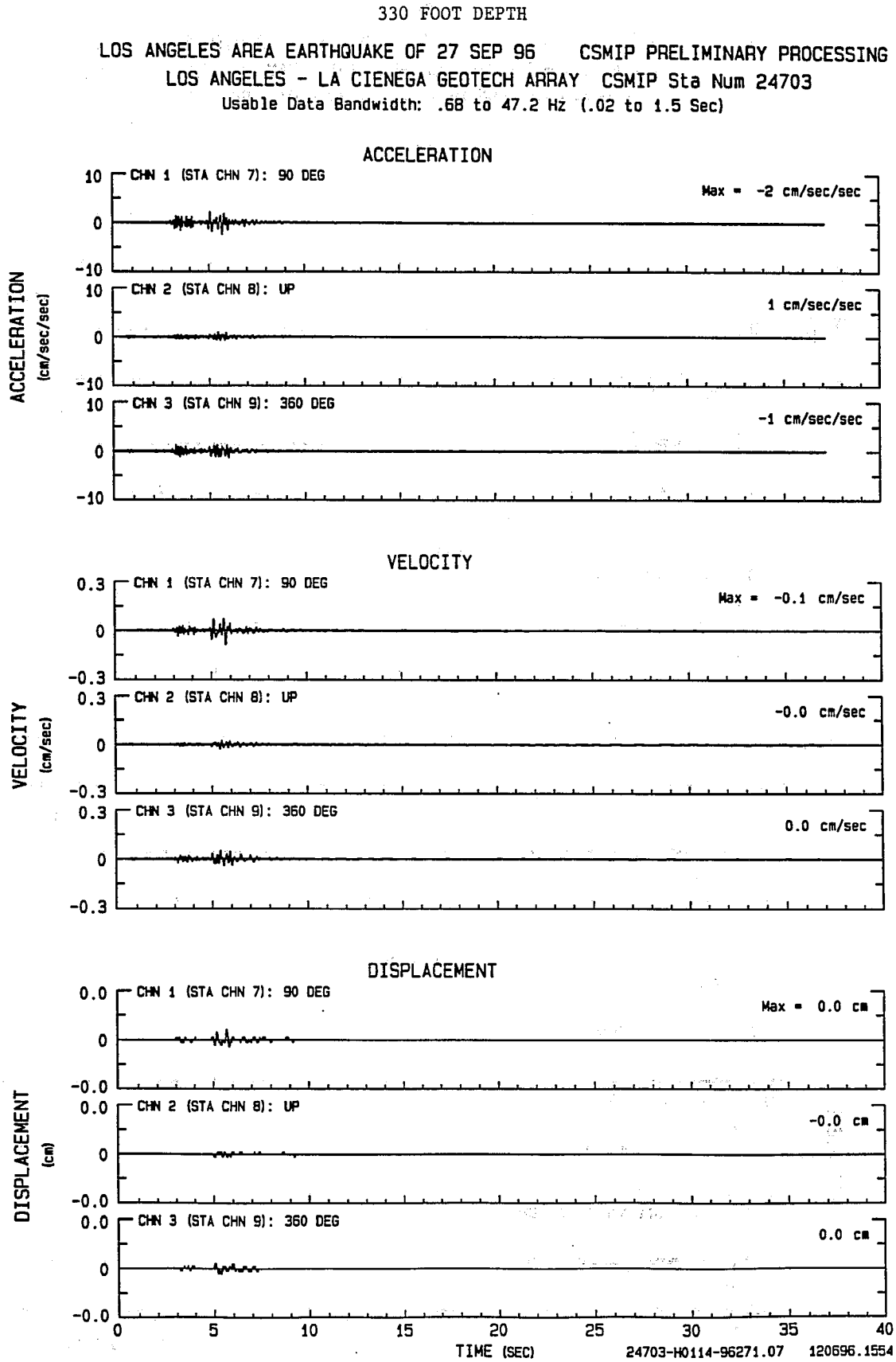


Figure 30. Acceleration, velocity and displacement recorded at the La Cienega Geotechnical Array from the September 27, 1996 earthquake at 100 m (330') depth.

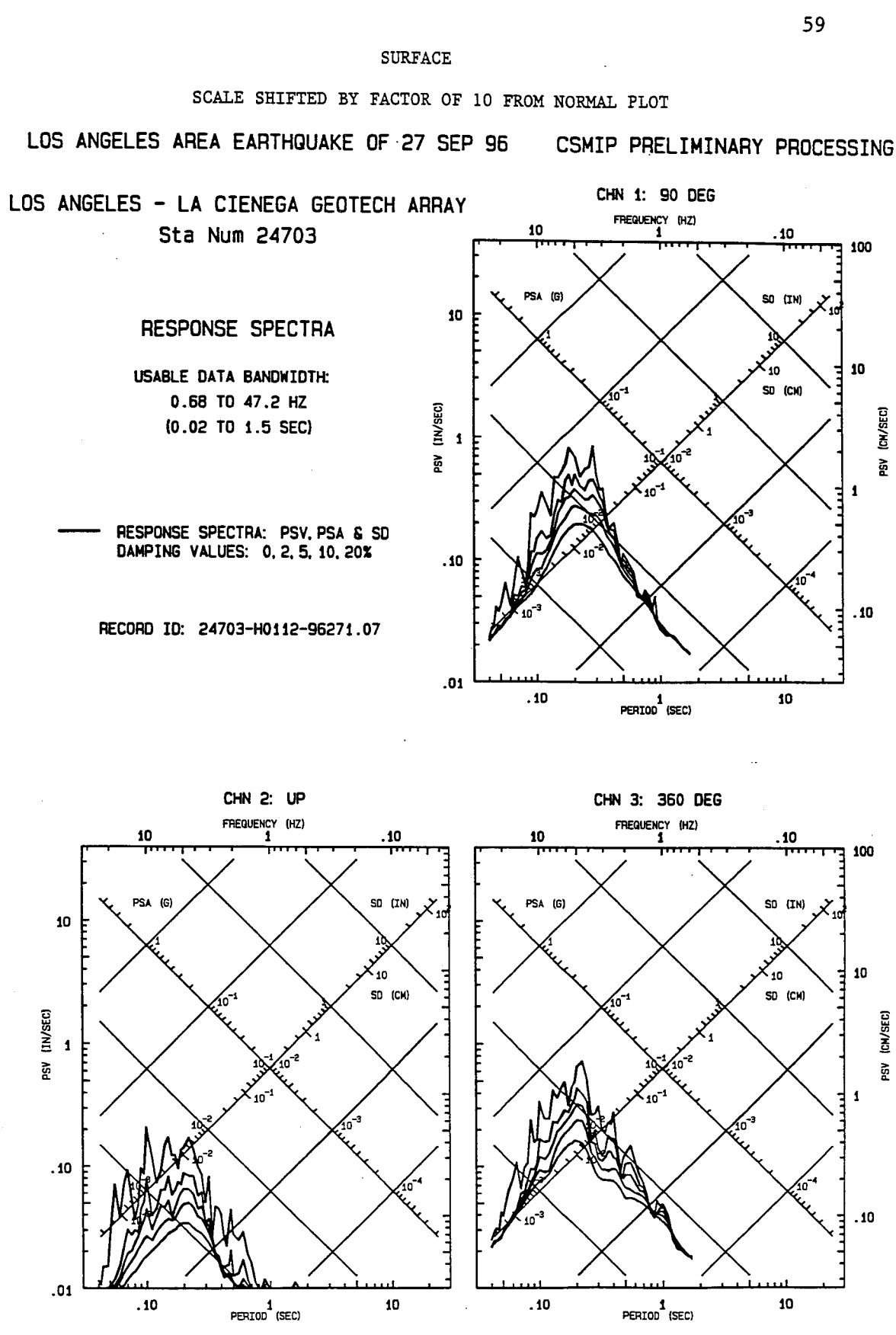


Figure 31. Response spectra (Log S_v) at the surface for the La Cienega Geotechnical Array.

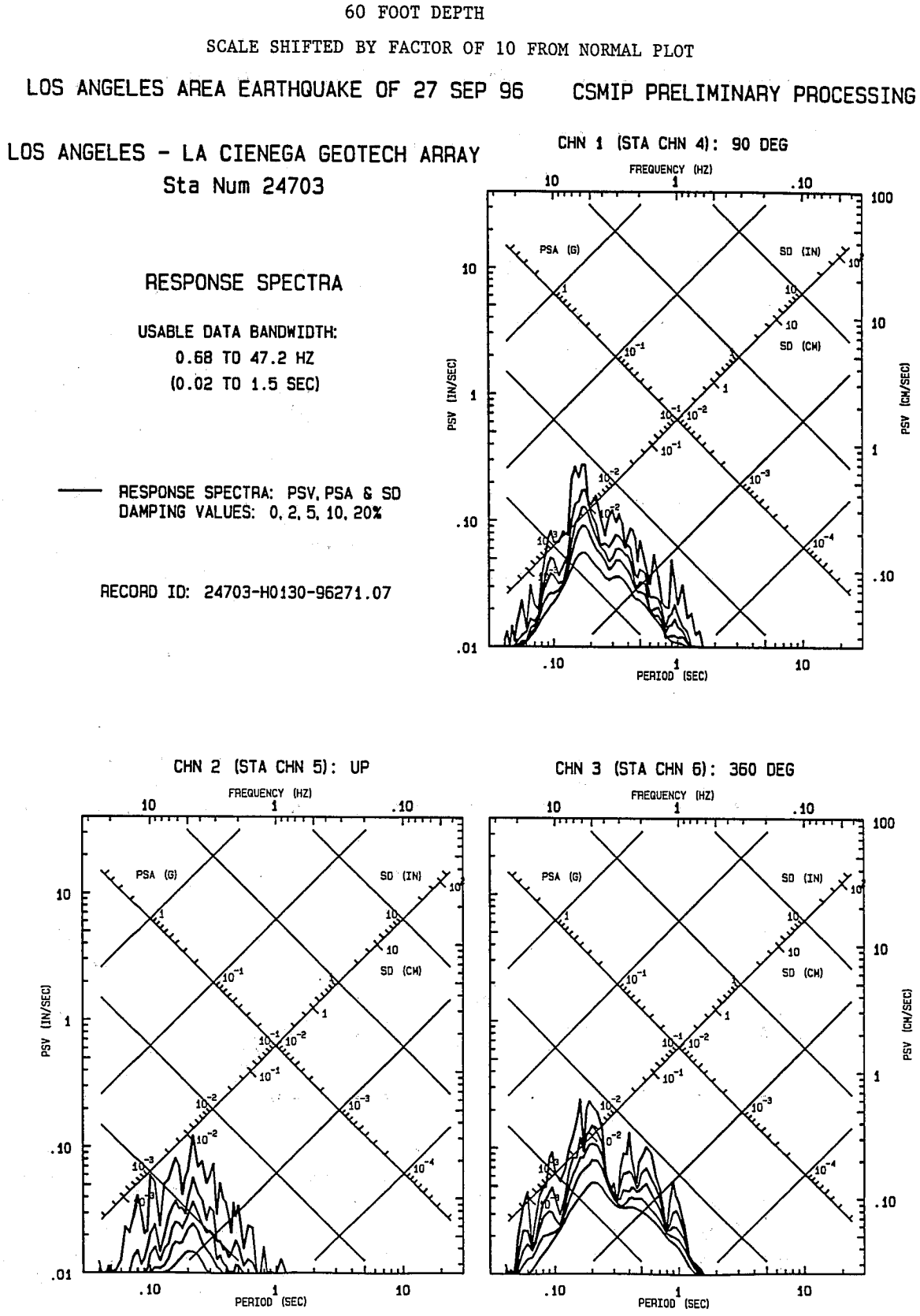


Figure 32. Response spectra (Log S_v) at 18 m (60') for the La Cienega Geotechnical Array.

330 FOOT DEPTH

SCALE SHIFTED BY FACTOR OF 10 FROM NORMAL PLOT

LOS ANGELES AREA EARTHQUAKE OF 27 SEP 96 CSMIP PRELIMINARY PROCESSING

LOS ANGELES - LA CIENEGA GEOTECH ARRAY
Sta Num 24703

RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.68 TO 47.2 HZ
(0.02 TO 1.5 SEC)

RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 24703-H0114-96271.07

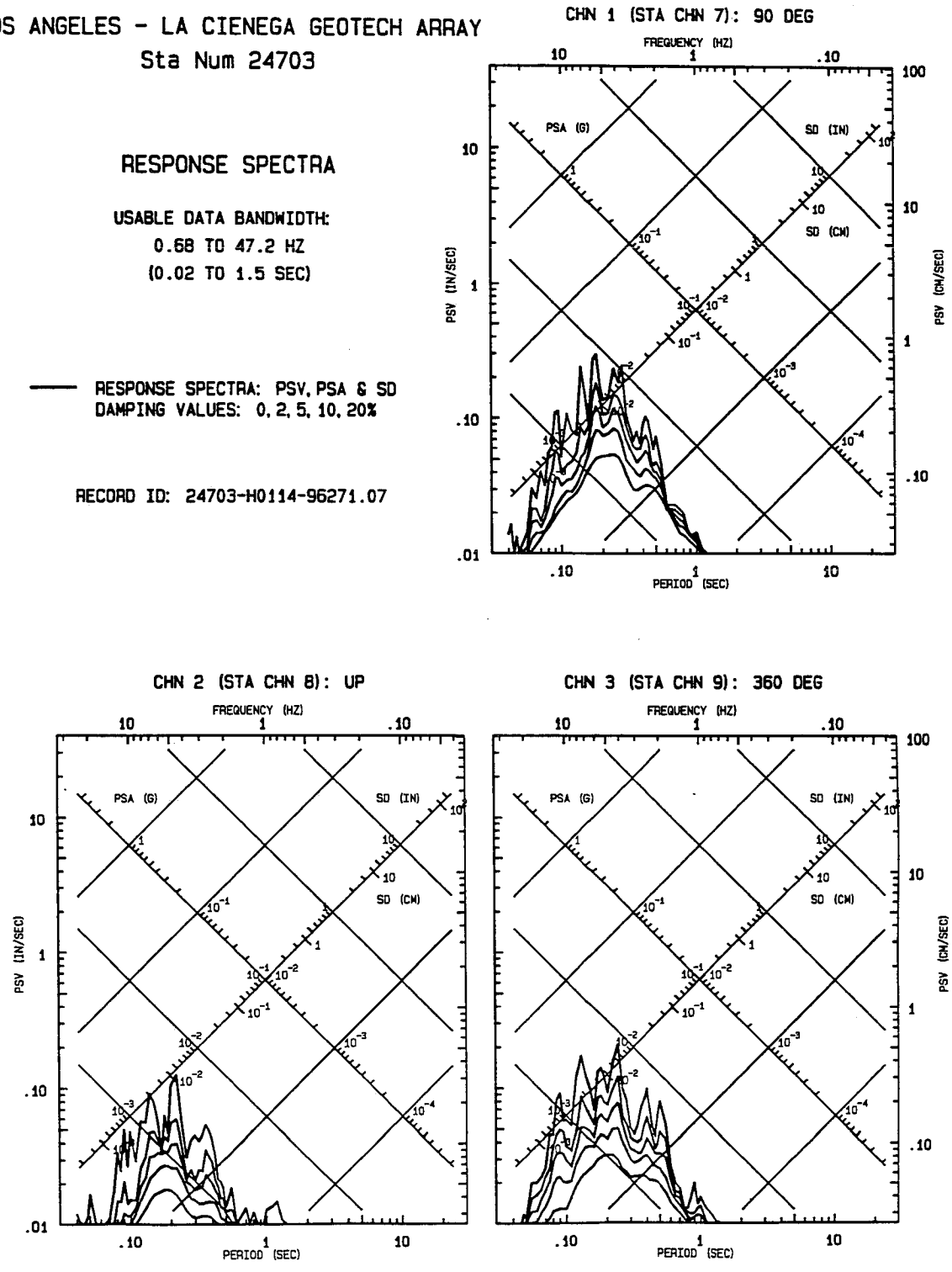


Figure 33. Response spectra (Log S_v) at the 100 m (330') depth for the La Cienega Geotechnical Array.

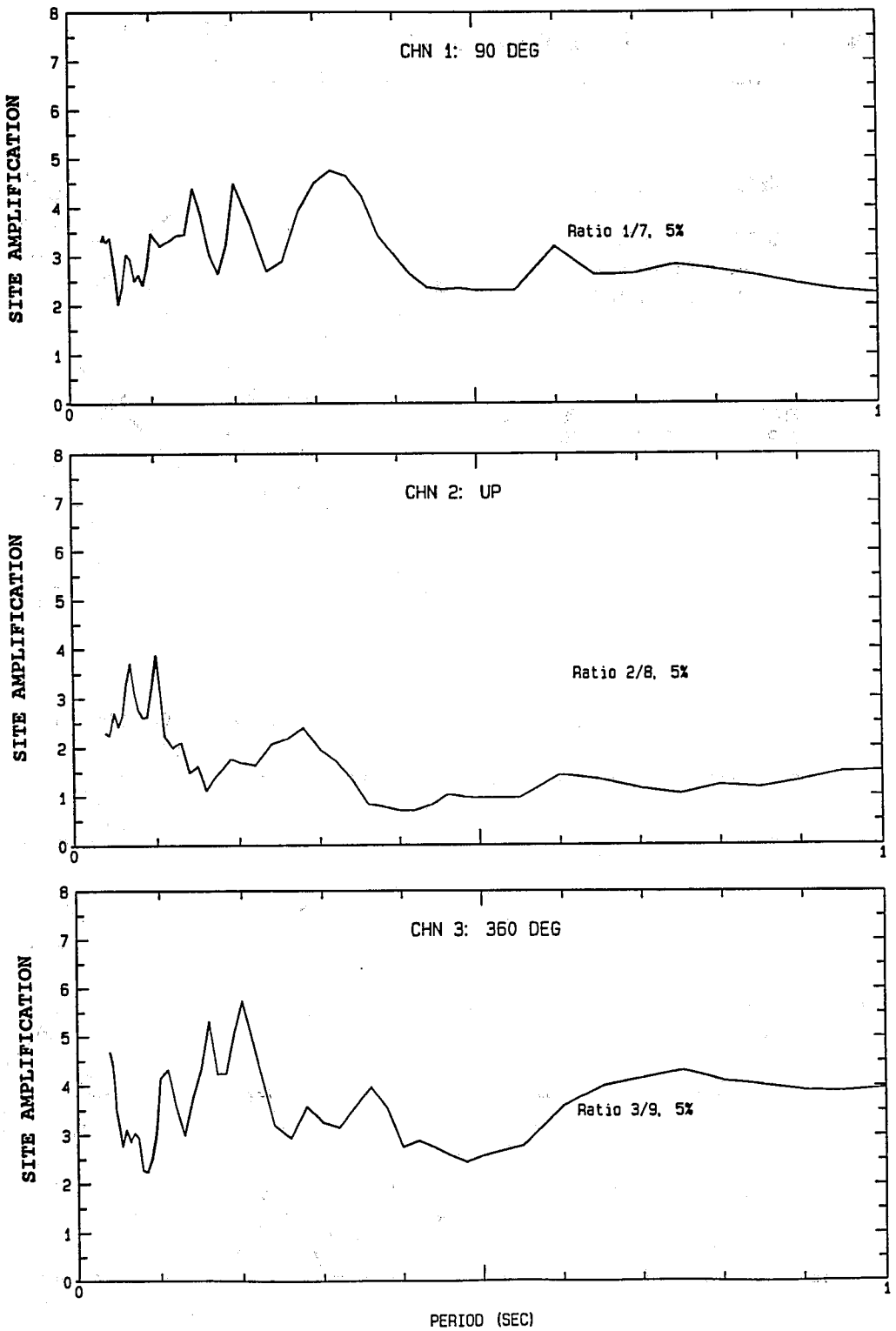


Figure 34. 5% damped response spectral ratios (Surface/100 m). All three components are shown (east-west (top), vertical (middle) and north-south (bottom)).

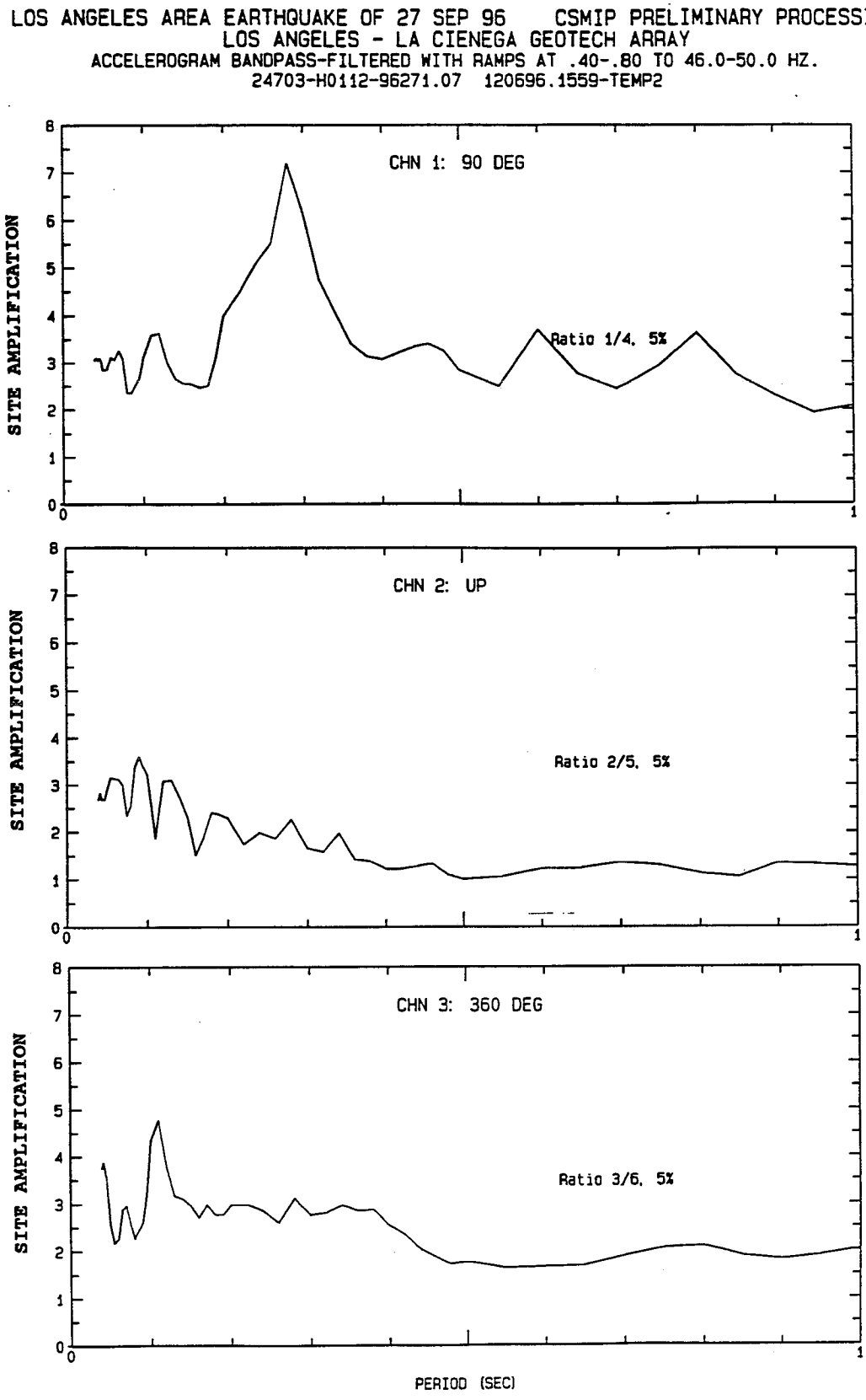


Figure 35. 5% damped response spectral ratios (Surface/18 m). All three components are shown (east-west (top), vertical (middle) and north-south (bottom)).

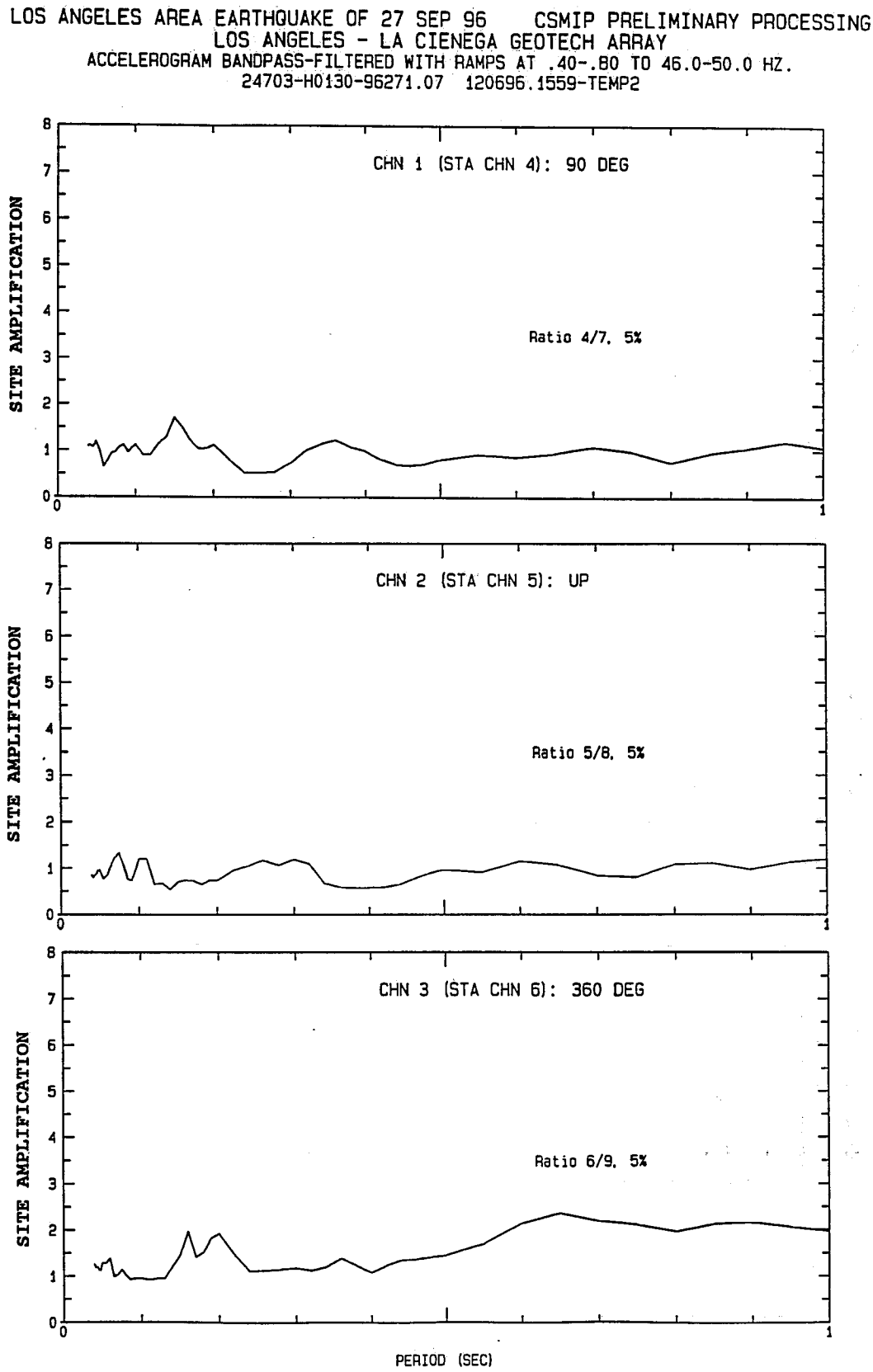


Figure 36. 5% damped response spectral ratios (18 m/100 m). All three components are shown (east-west (top), vertical (middle) and north-south (bottom)).

Acknowledgements

The California Strong Motion Instrumentation Program extends its appreciation to Ralph Herman Sr. for his long-term cooperation with strong-motion instrumentation at Tarzana. Instrumentation and site characterization of the La Cienega Geotechnical Array was supported by Caltrans. The efforts of Jim Gates, Pat Hipley and Cliff Roblee at Caltrans are acknowledged.

The records presented in this report were made possible through the efforts of SMIP technicians who installed and maintained these stations. Special thanks to Robert Sydnor who provided information and many discussions concerning the site geology and he performed the geotechnical logging of the 100 m borehole at the La Cienega Geotechnical Array. We also thank David Wald for providing the digital accelerogram from Encino Reservoir. Numerous beneficial comments and suggestions from Roger Sherburne are acknowledged.

Rob Stellar and Bob Nigbor of Agbabian Associates performed the drilling, sampling, logging and velocity measurements at Tarzana under a contract with SMIP. Their efforts are greatly appreciated. The downhole samples are stored at the Geotechnical Laboratory of Mladen Vucetic at University of California at Los Angeles until testing under the NSF-funded Resolution of Site Response Issues from the Northridge Earthquake project (ROSRINE). We thank Mladen Vucetic and the ROSRINE Technical Committee for their cooperation.

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APPENDIX A

Preliminary Processed Data for Tarzana Cedar Hill Nursery A from the Northridge Earthquake of 17 January 1994, SMIP OSMS Report No. 94-12B

STATE OF CALIFORNIA - THE RESOURCES AGENCY PETE WILSON, *Governor*

DEPARTMENT OF CONSERVATION
DIVISION OF MINES AND GEOLOGY
STRONG MOTION INSTRUMENTATION PROGRAM
801 K Street, MS 13-35
Sacramento, CA 95814-3531
Phone (916) 322-3105
Fax (916) 323-7778

Preliminary Processed Data for

Tarzana - Cedar Hill Nursery A

from the Northridge Earthquake

of 17 January 1994

by

R. Darragh, T. Cao, M. Huang and A. Shakal

REPORT OSMS 94-12B
California Strong Motion Instrumentation Program (CSMIP)

The processed data plots are presented in the following order:

1. Phase 1 (Vol. 1) data: uncorrected accelerations. Acceleration for the first 22 seconds are plotted with a common scaling factor for all channels; three channels are plotted on one page. This plot is followed by another plot of the full processed length (60 seconds) with each channel individually scaled.

2. Phase 2 (Vol. 2) data: instrument, tilt and baseline-corrected acceleration, velocity and displacement. The data for the full processed length are plotted with equal scaling for all channels. The filter frequencies used in the processing (0.05-0.10 to 23.0-25.0 Hz) are indicated on the plots (see Definition of Usable Data Bandwidth).

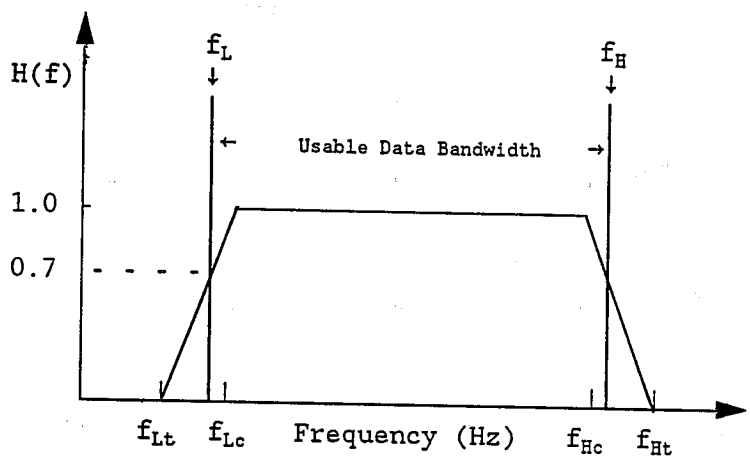
3. Phase 3 (Vol. 3) data: response spectra. The pseudo-velocity spectra (PSV), the pseudo-acceleration spectra (PSA), the displacement spectra (SD), and the Fourier amplitude spectra (FS) are presented on a tripartite logarithmic plot for each channel. The spectra are plotted for periods within the filter bandwidth used in the Vol. 2 processing. In addition, the absolute acceleration spectra (SA) for 0%, 2%, 5%, 10%, and 20% dampings are plotted against period for periods from 0 to 4 seconds with linear-linear scaling.

Note: A release of <u>preliminary</u> processed data is being made because the maximum acceleration of some components were not recorded on the film. Due to the importance of this record, CSMIP staff are carefully estimating the motion from this accelerogram. In the meantime, the preliminary data are being released so that users will not be delayed from analyzing the data.

9/9/94

DEFINITION OF USABLE DATA BANDWIDTH

The filter bands for each record are indicated on the plots for the Phase 2 and Phase 3 data. In standard processing, the digitized data are processed and filtered using Ormsby filters. The data are first low-pass filtered using a high-frequency filter with a corner frequency of 23 Hz and a roll-off termination frequency of 25 Hz. Then the data are high-pass filtered using a low-frequency filter with a corner frequency of 0.07 Hz and a roll-off termination of 0.05 Hz. Therefore, the Phase 2 data is the result of the digitized data being filtered by the bandpass filter H(f) with ramps as shown in the figure:

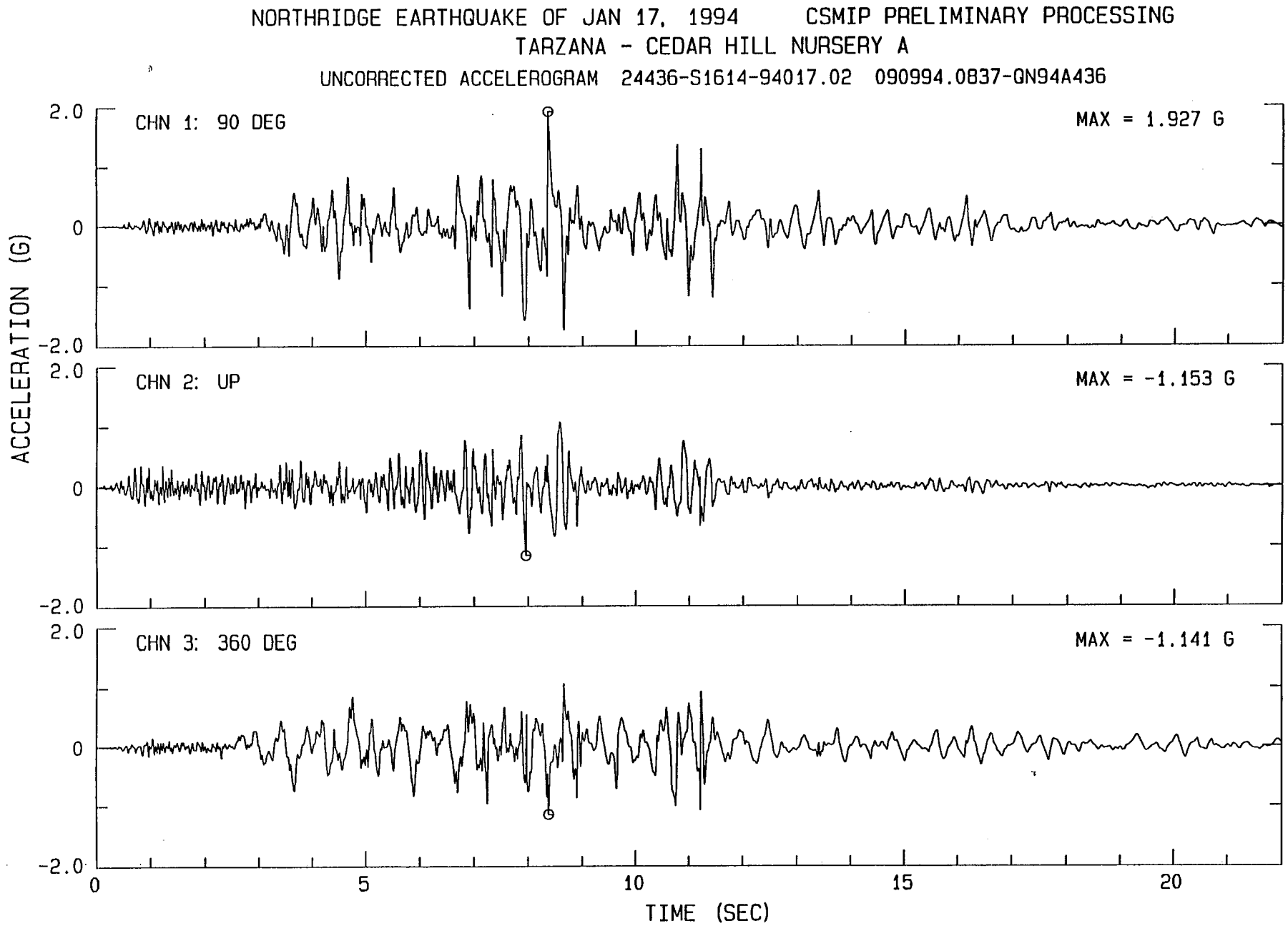


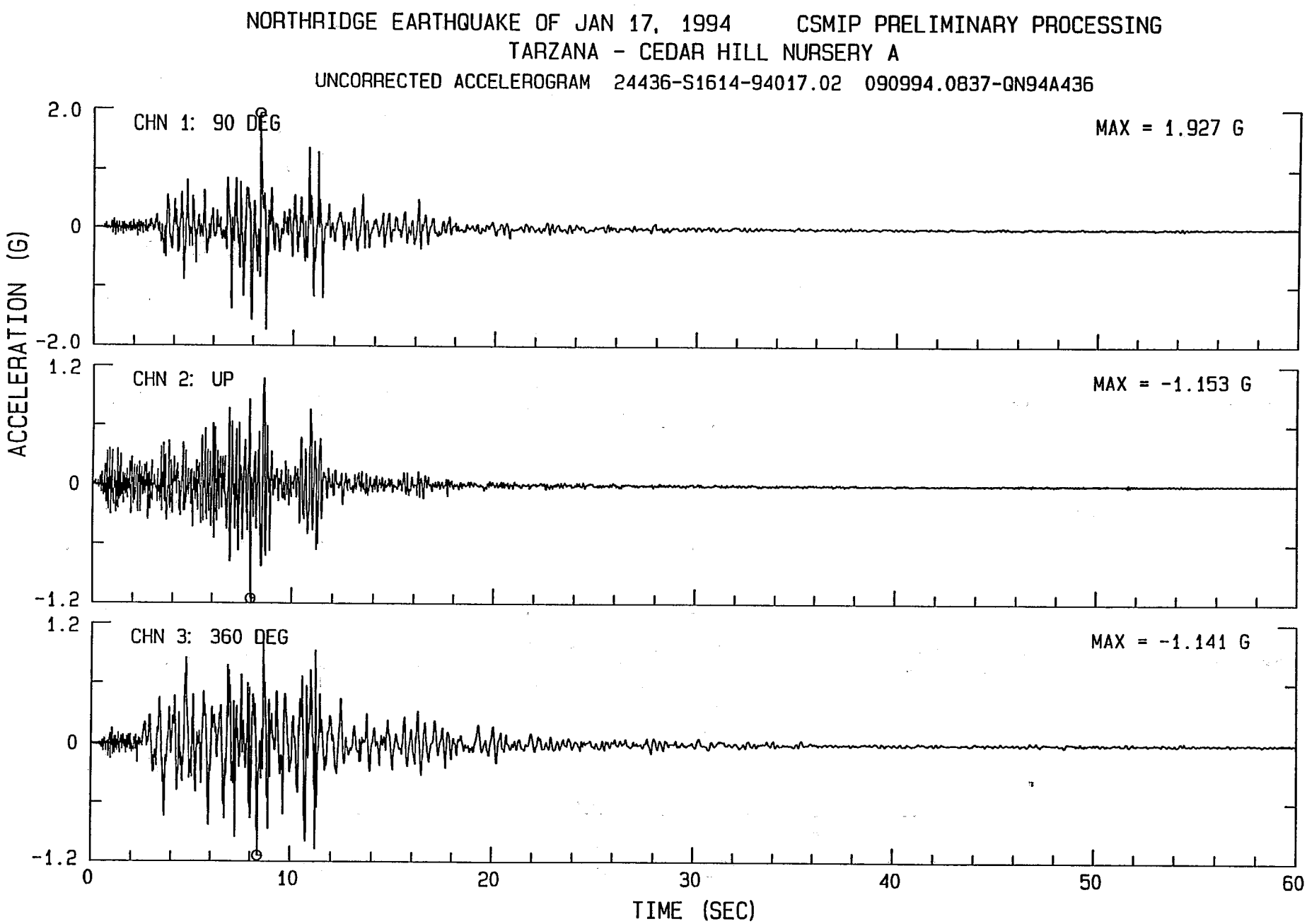
The Usable Data Bandwidth is defined as the band between frequencies f_H and f_L, where f_H and f_L are the -3 dB points on the high-frequency and low-frequency ramps, respectively. The value of H(f) is approximately equal to 0.7 for -3 dB (see Notes). The user should only use these data for analyses within this bandwidth.

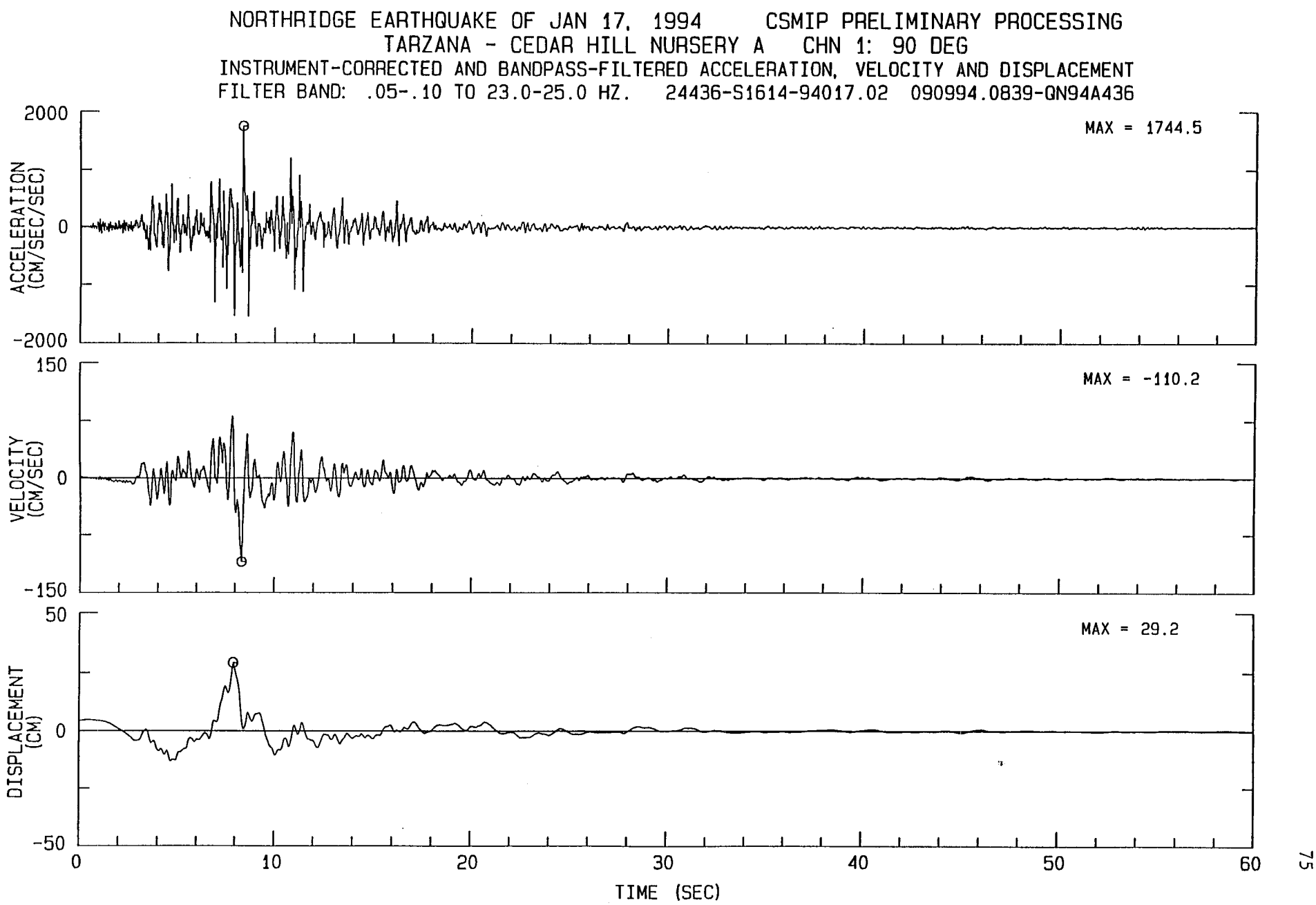
Notes:

1) The values of f_H and f_L can be calculated from the corner frequencies (f_{Hc}, f_{Lc}) and the roll-off termination frequencies (f_{Ht}, f_{Lt}) used in the processing by using the formulas $f_H = f_{Hc} + 0.3 * (f_{Ht} - f_{Hc})$ and $f_L = f_{Lc} - 0.3 * (f_{Lc} - f_{Lt})$. For example, the Usable Data Bandwidth for data bandpass-filtered with ramps at 0.30 to 0.60 Hz and 23.0 to 25.0 Hz is 0.51 Hz to 23.6 Hz (0.042 to 2.0 seconds period).

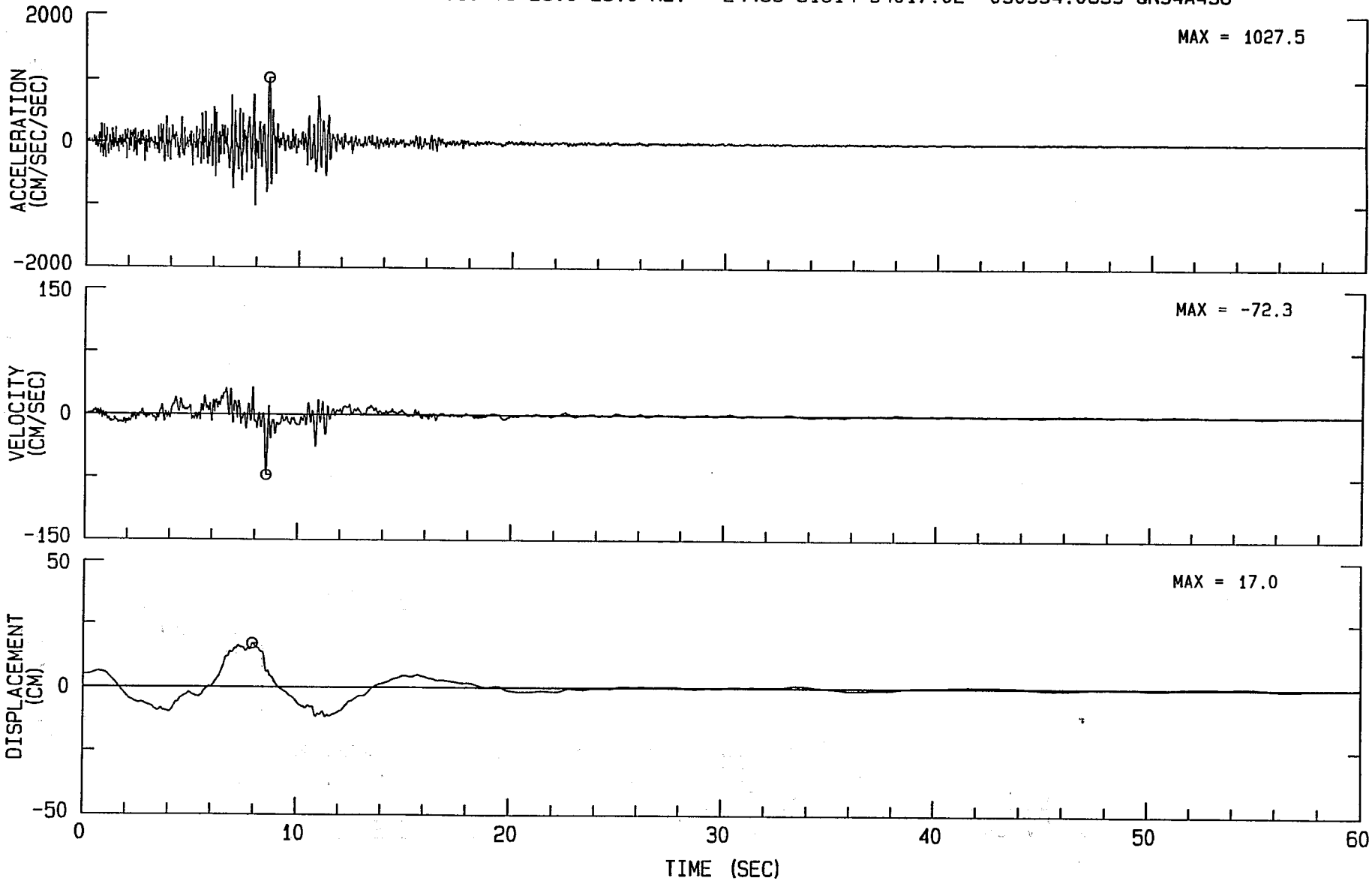
2) It is common in signal processing to plot 20 $\log_{10}[H(f)]$ versus frequency, and express the ordinate value in decibels (abbreviated dB). Accordingly, 0 dB corresponds to a value of H(f) equal to 1; 20 dB is equivalent to H(f) = 10, and -20 dB corresponds to H(f) = 0.1. Thus, at the -3 dB frequency point, the amplitude of the transfer function, H(f) is reduced to 0.7, while the power transmitted by the filter, $H^2(f)$, is reduced to 0.5.


NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
UNCORRECTED ACCELEROGRAM 24436-S1614-94017.02 090994.0837-GN94A436
CHN 1: 90 DEG
MAX = 1.927 G
CHN 2: UP
MAX = -1.153 G
CHN 3: 360 DEG
MAX = -1.141 G
ACCELERATION (G)
2.0
0
-2.0
0
5
10
15
20
TIME (SEC)

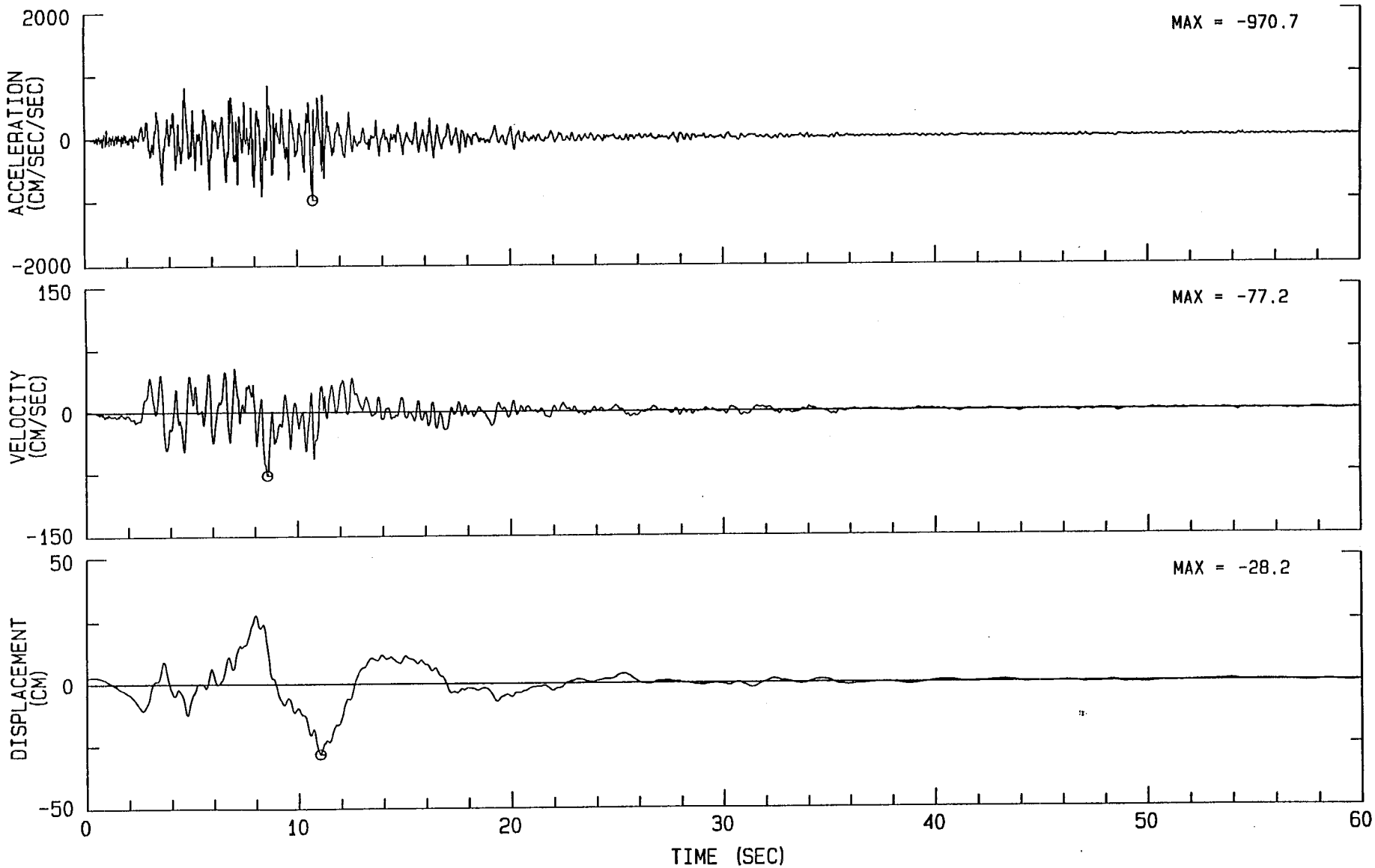

NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
UNCORRECTED ACCELEROGRAM 24436-S1614-94017.02 090994.0837-QN94A436
CHN 1: 90 DEG
MAX = 1.927 G
CHN 2: UP
MAX = -1.153 G
CHN 3: 360 DEG
MAX = -1.141 G
ACCELERATION (G)
2.0
0
-2.0
1.2
0
-1.2
1.2
0
-1.2
0
10
20
30
40
50
60
TIME (SEC)


NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A CHN 1: 90 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .05-.10 TO 23.0-25.0 HZ. 24436-S1614-94017.02 090994.0839-QN94A436
ACCELERATION (CM/SEC/SEC)
2000
0
-2000
MAX = 1744.5
VELOCITY (CM/SEC)
150
0
-150
MAX = -110.2
DISPLACEMENT (CM)
50
0
-50
MAX = 29.2
0
10
20
30
40
50
60
TIME (SEC)

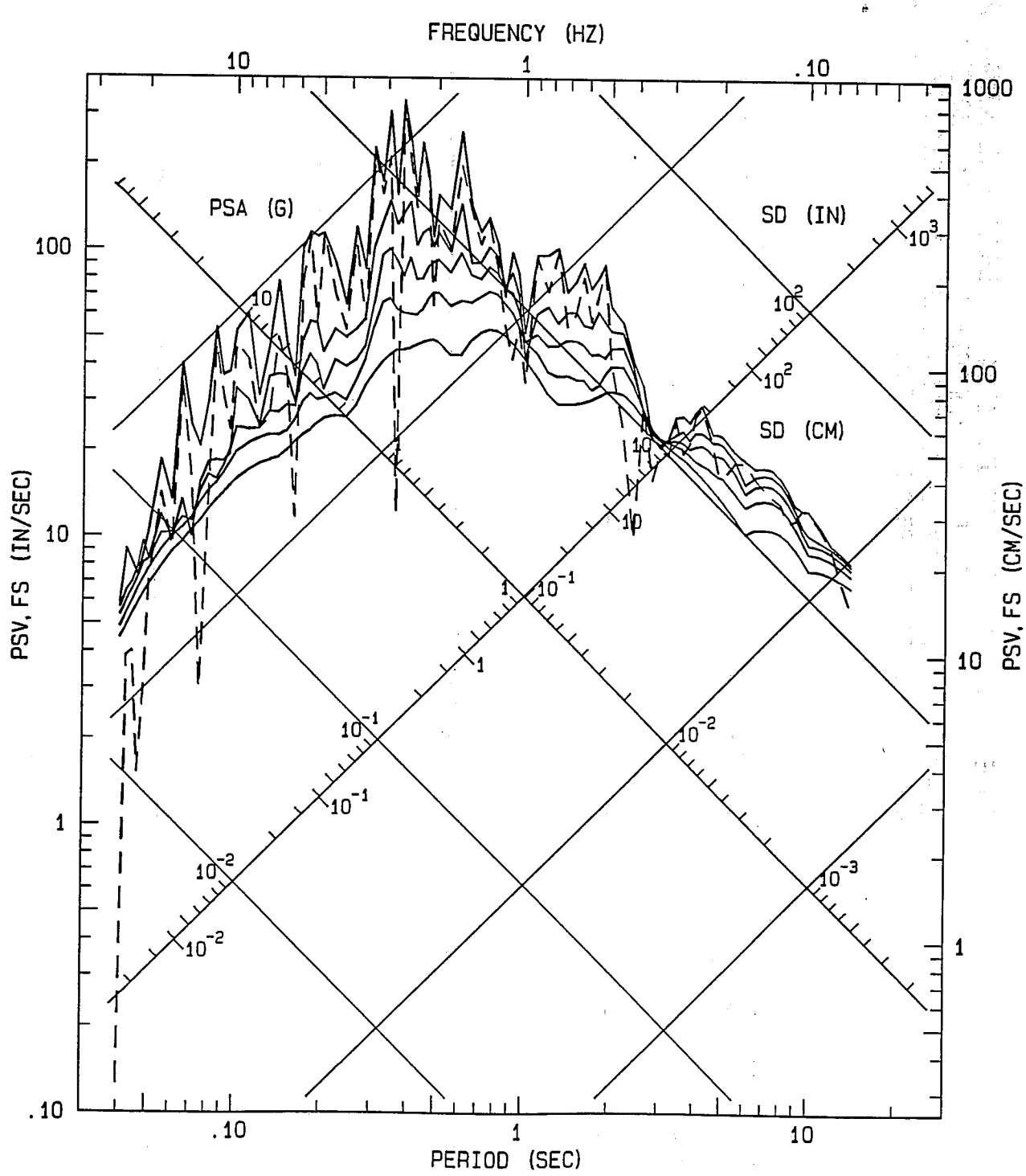
NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A CHN 2: UP
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .05-.10 TO 23.0-25.0 HZ. 24436-S1614-94017.02 090994.0839-QN94A436



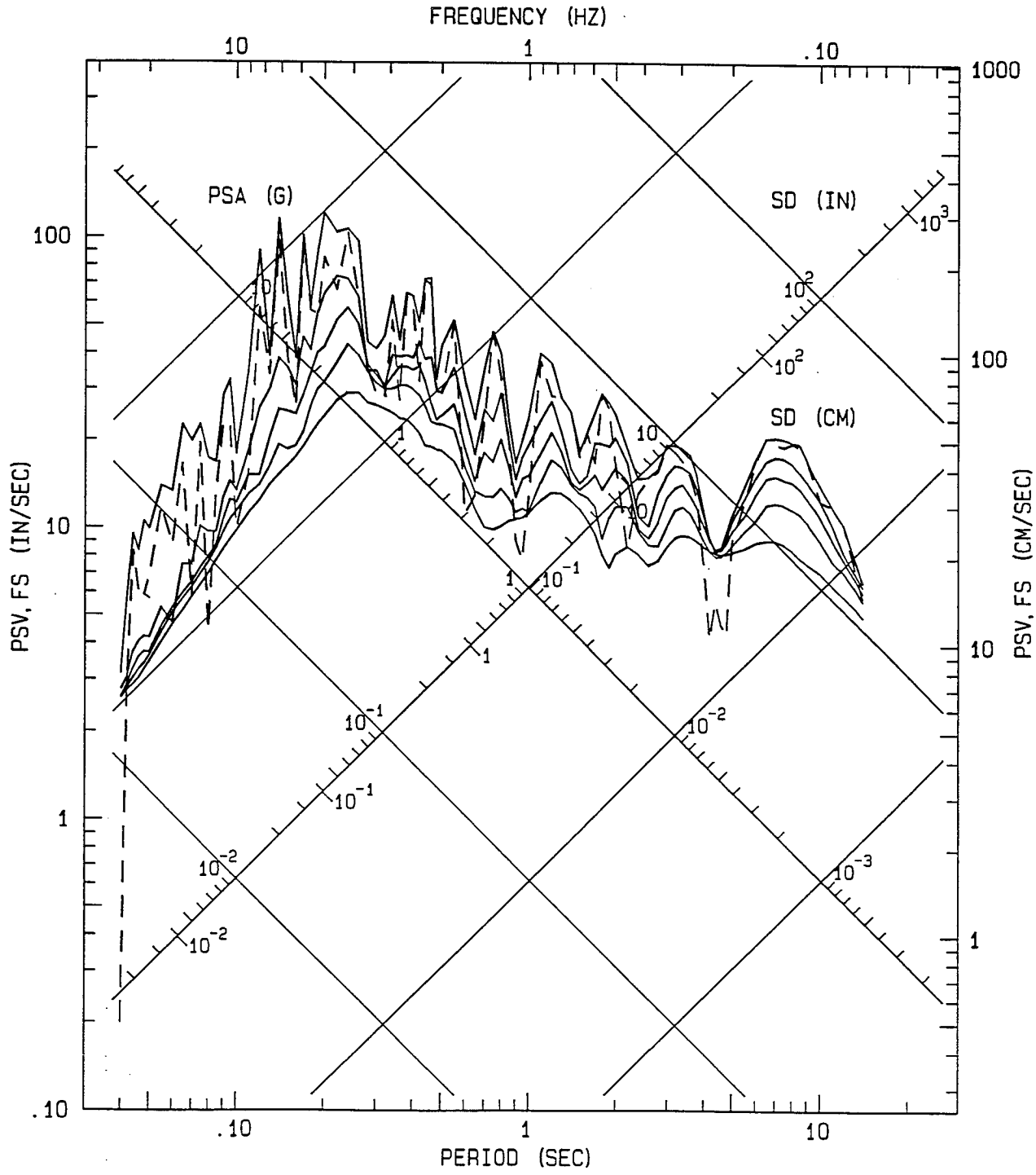
NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A CHN 3: 360 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .05-.10 TO 23.0-25.0 HZ. 24436-S1614-94017.02 090994.0839-QN94A436



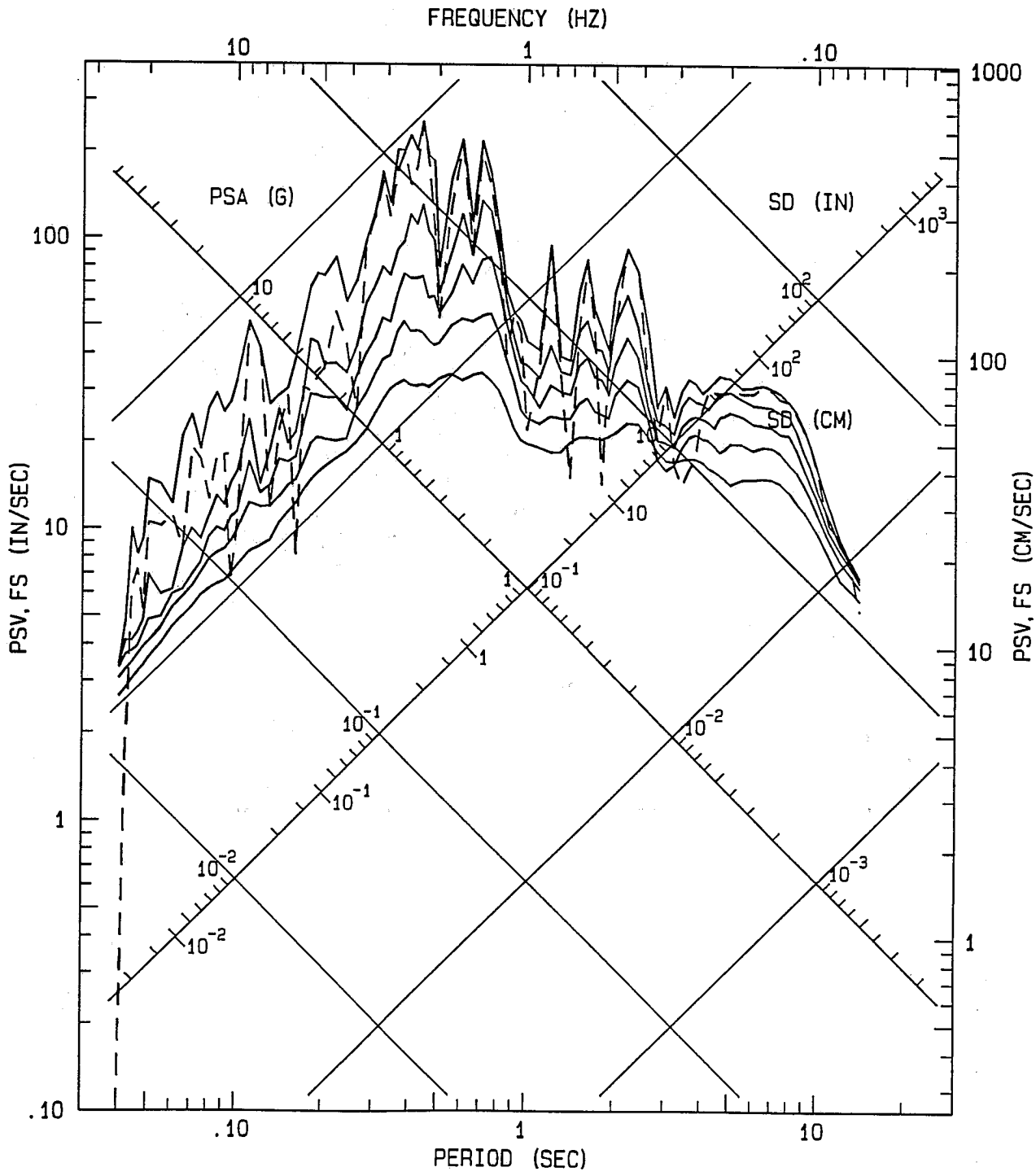
NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
CHN 1: 90 DEG
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .05-.10 TO 23.0-25.0 HZ.
24436-S1614-94017.02 090994.0841-QN94A436



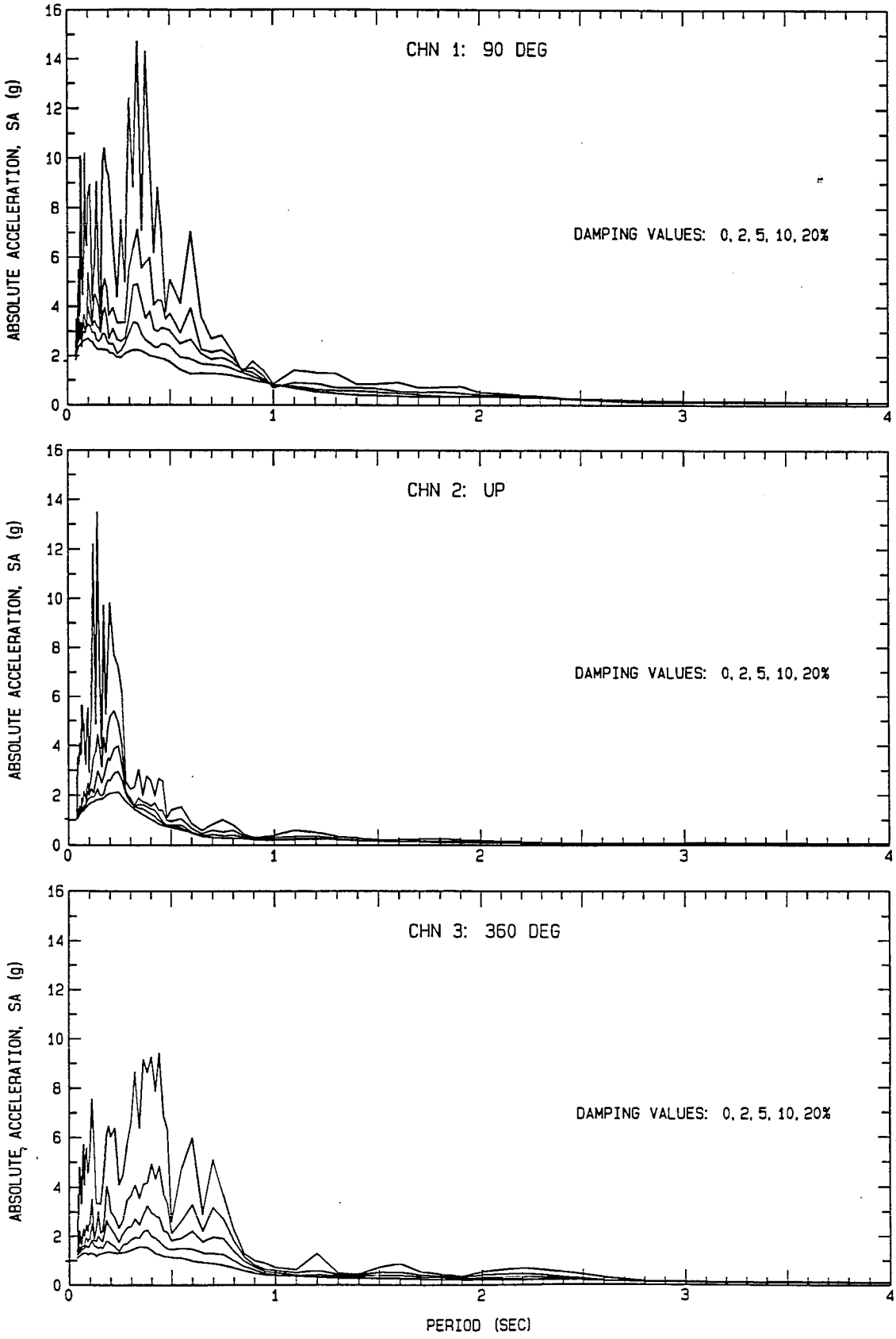
NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
CHN 2: UP
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .05-.10 TO 23.0-25.0 HZ.
24436-S1614-94017.02 090994.0841-QN94A436



NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
CHN 3: 360 DEG
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .05-.10 TO 23.0-25.0 HZ.
24436-S1614-94017.02 090994.0841-QN94A436



NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .05-.10 TO 23.0-25.0 HZ.
24436-S1614-94017.02 090994.0841-QN94A436



APPENDIX B

Processed Data for Tarzana - Ventura Blvd #10 from the Northridge Earthquake of 17 January 1994, SMIP OSMS Report No. 94-14FF

STATE OF CALIFORNIA - THE RESOURCES AGENCY PETE WILSON, *Governor*

DEPARTMENT OF CONSERVATION
DIVISION OF MINES AND GEOLOGY
STRONG MOTION INSTRUMENTATION PROGRAM
801 K Street, MS 13-35
Sacramento, CA 95814-3531
Phone (916) 322-3105
Fax (916) 323-7778

Processed Data for

Tarzana - Ventura Blvd. #10

from the Northridge Earthquake

of 17 January 1994

REPORT OSMS 94-14FF
California Strong Motion Instrumentation Program (CSMIP)

There are three recorders in this building at the ground, 5th floor and roof.

The processed data plots are presented in the following order:

1. Phase 2 (Vol. 2) data: instrument and baseline-corrected acceleration, velocity and displacement. The data for the first 40 seconds are plotted with equal scaling for all channels. Three channels are plotted per page. The Usable Data Bandwidth of the Phase 2 data, as determined during processing, is indicated on the plots (see Definition of Usable Data Bandwidth).

2. Phase 3 (Vol. 3) data: response spectra. The pseudo-velocity spectra (PSV), the pseudo-acceleration spectra (PSA), and the displacement spectra (SD) for 0%, 2%, 5%, 10%, and 20% dampings are presented on a tripartite logarithmic plot for each channel. The spectra are plotted for periods within the Usable Data bandwidth used in the Phase 2 processing.

3. Phase 3 (Vol. 3) data: response spectra. The absolute acceleration spectra (SA) for 0%, 2%, 5%, and 10% dampings are plotted against period for periods from 0 to 6 seconds with linear-linear scaling.

4. Phase 1 (Vol. 1) data: uncorrected accelerations. Acceleration for the full processed length (48 seconds) with each channel scaled individually: three channels are plotted on one page. This plot is followed by another plot of the acceleration for the first 22 seconds plotted with a common scaling factor for all channels; three channels are plotted on one page.

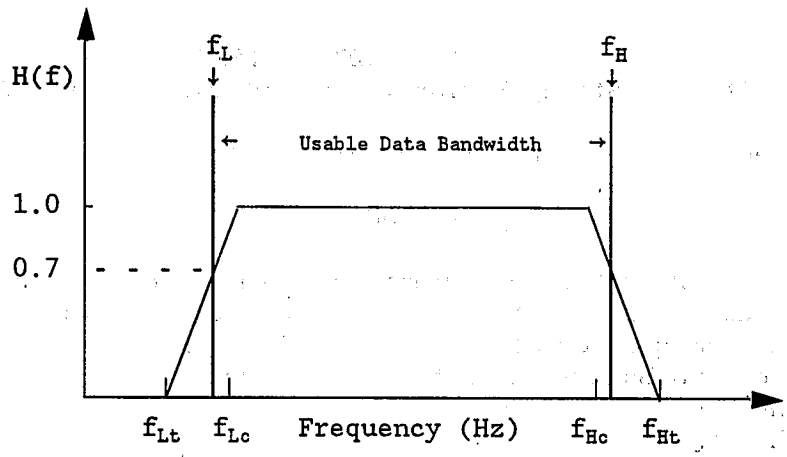
5. Phase 2 (Vol. 2) data: instrument and baseline-corrected acceleration, velocity and displacement. The data for the full processed length are plotted with equal scaling for all channels. The filter frequencies used in the processing (0.10-0.20 to 23.0-25.0 Hz) are indicated on the plots.

Note: The three recorders in this structure did not trigger at the same time. The recorders are all oriented in the same direction however.

10/24/94

DEFINITION OF USABLE DATA BANDWIDTH

The filter bands for each record are indicated on the plots for the Phase 2 and Phase 3 data. In standard processing, the digitized data are processed and filtered using Ormsby filters. The data are first low-pass filtered using a high-frequency filter with a corner frequency of 23 Hz and a roll-off termination frequency of 25 Hz. Then the data are high-pass filtered using a low-frequency filter with a corner frequency of 0.07 Hz and a roll-off termination of 0.05 Hz. Therefore, the Phase 2 data is the result of the digitized data being filtered by the bandpass filter H(f) with ramps as shown in the figure:



The Usable Data Bandwidth is defined as the band between frequencies f_H and f_L, where f_H and f_L are the -3 dB points on the high-frequency and low-frequency ramps, respectively. The value of H(f) is approximately equal to 0.7 for -3 dB (see Notes). The user should only use these data for analyses within this bandwidth. For these Code records, the Usable Data Bandwidth is 0.17 Hz to 23.6 Hz (or 0.042 to 5.9 seconds period).

Notes:

1) The values of f_H and f_L can be calculated from the corner frequencies (f_{Hc}, f_{Lc}) and the roll-off termination frequencies (f_{Ht}, f_{Lt}) used in the processing by using the formulas $f_H = f_{Hc} + 0.3 * (f_{Ht} - f_{Hc})$ and $f_L = f_{Lc} - 0.3 * (f_{Lc} - f_{Lt})$. The Usable Data Bandwidth for Code building data bandpass-filtered with ramps at 0.10 to 0.20 Hz and 23.0 to 25.0 Hz is 0.17 Hz to 23.6 Hz (0.042 to 5.9 seconds period).

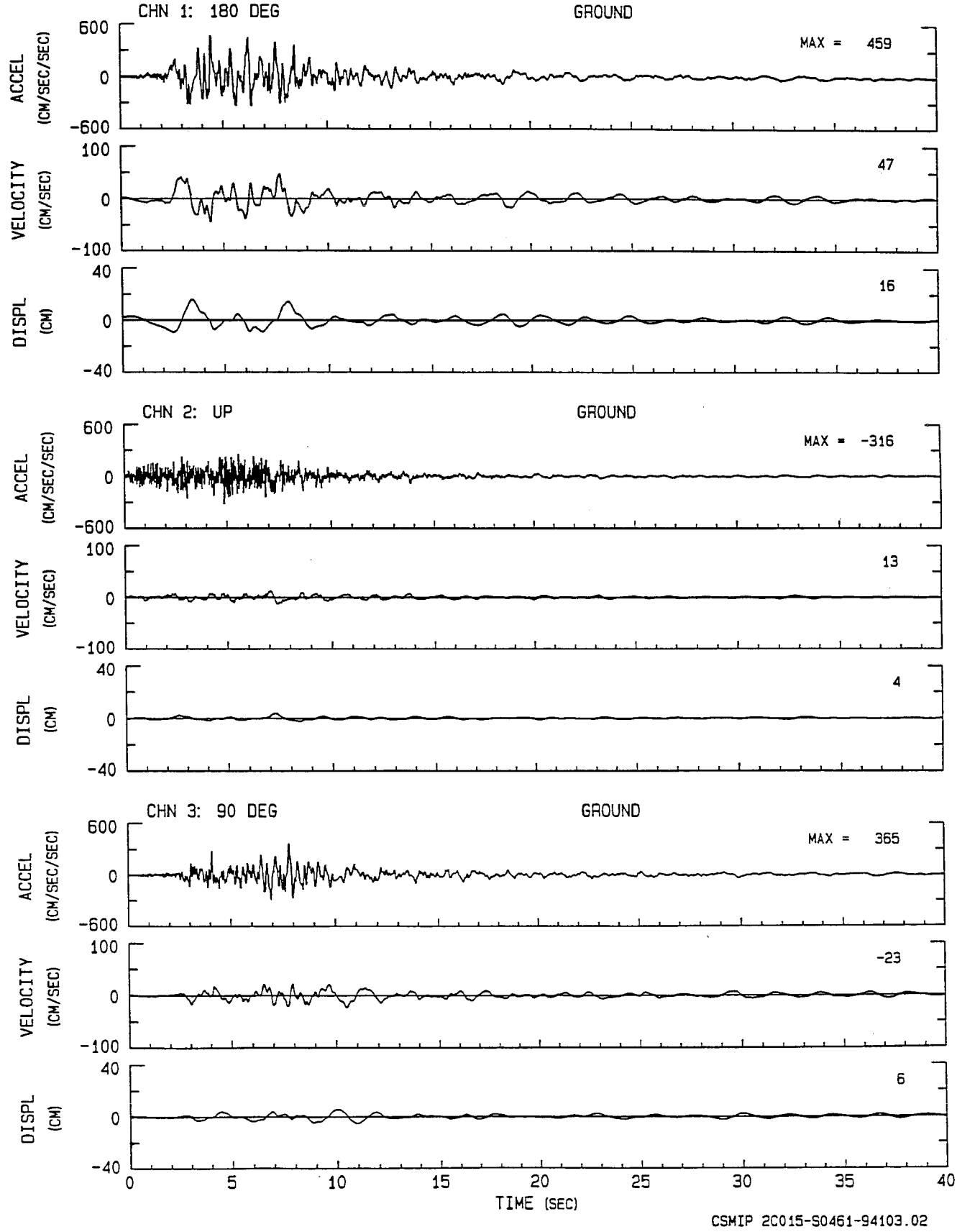
2) It is common in signal processing to plot 20 $\log_{10}[H(f)]$ versus frequency, and express the ordinate value in decibels (abbreviated dB). Accordingly, 0 dB corresponds to a value of H(f) equal to 1; 20 dB is equivalent to H(f) = 10, and -20 dB corresponds to H(f) = 0.1. Thus, at the -3 dB frequency point, the amplitude of the transfer function, H(f) is reduced to 0.7, while the power transmitted by the filter, $H^2(f)$, is reduced to 0.5.

NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - VENTURA BLVD #10 Sta Num 2C015

Acceleration, Velocity and Displacement (Phase 2)

Usable Data Bandwidth: .17 to 23.6 Hz (.04 to 6.0 Sec)



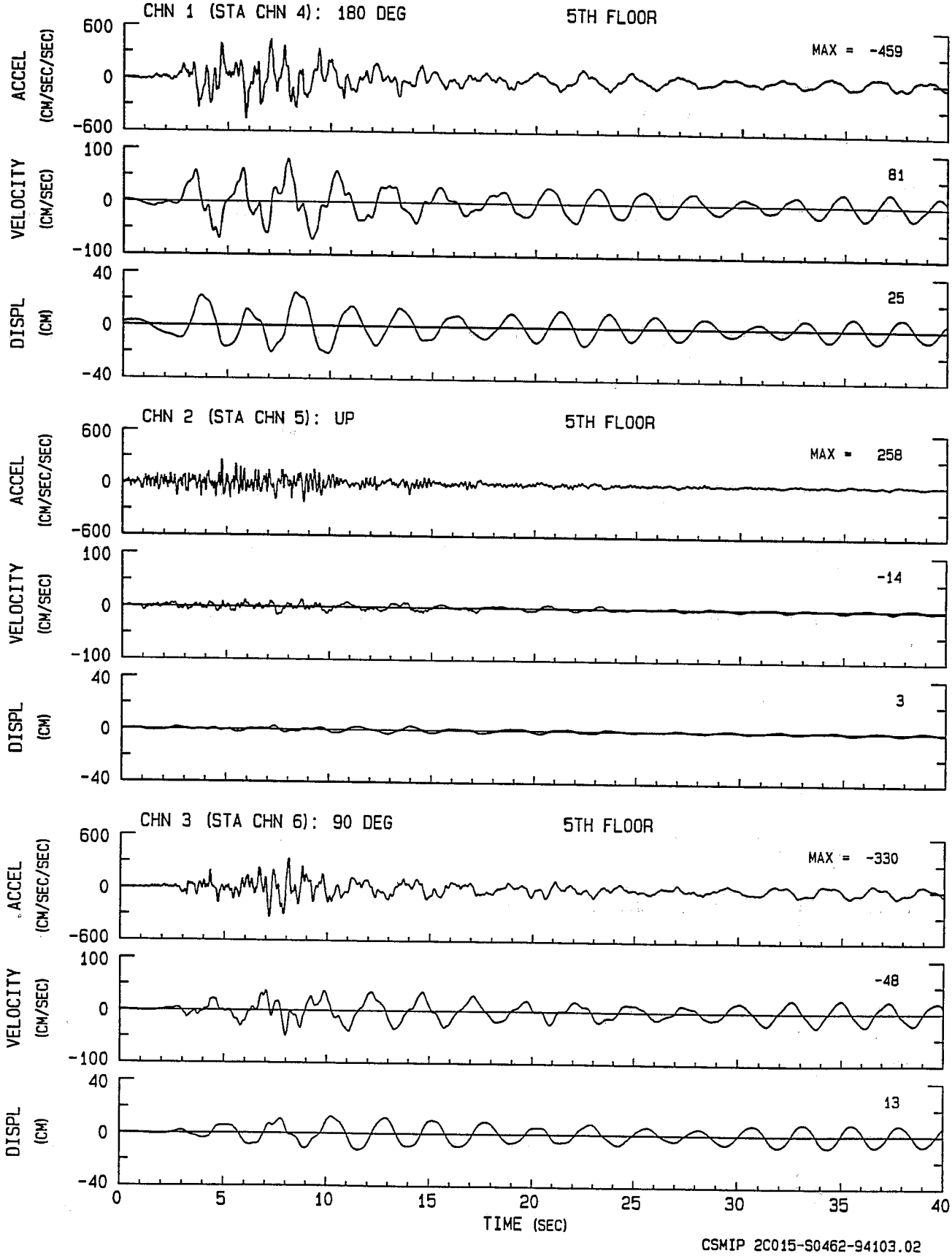
CSMIP 2C015-S0461-94103.02

NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - VENTURA BLVD #10 Sta Num 2C015

Acceleration, Velocity and Displacement (Phase 2)

Usable Data Bandwidth: .17 to 23.6 Hz (.04 to 6.0 Sec)



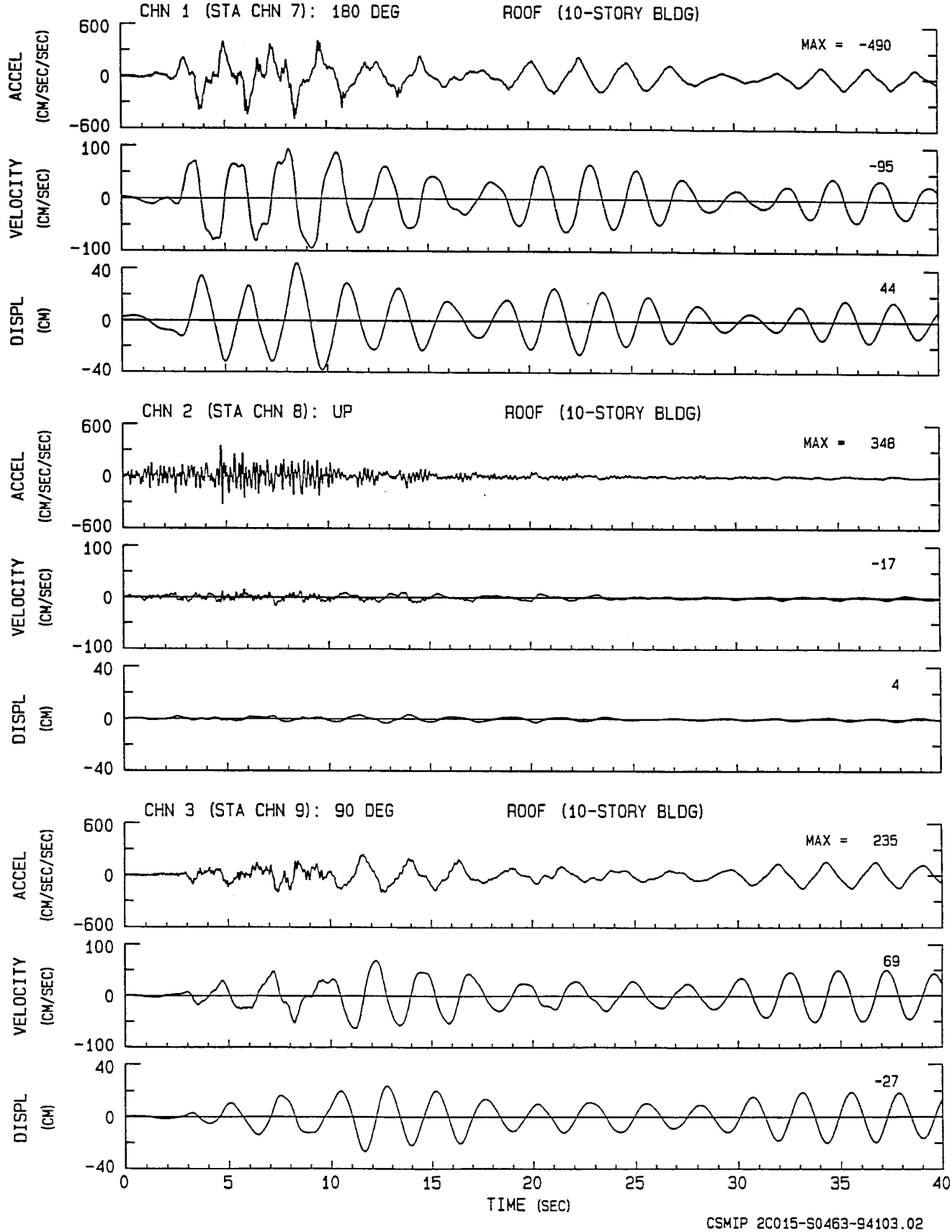
CSMIP 2C015-S0462-94103.02

NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - VENTURA BLVD #10 Sta Num 2C015

Acceleration, Velocity and Displacement (Phase 2)

Usable Data Bandwidth: .17 to 23.6 Hz (.04 to 6.0 Sec)



CSMIP 2C015-S0463-94103.02

NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - VENTURA BLVD #10
Sta Num 2C015

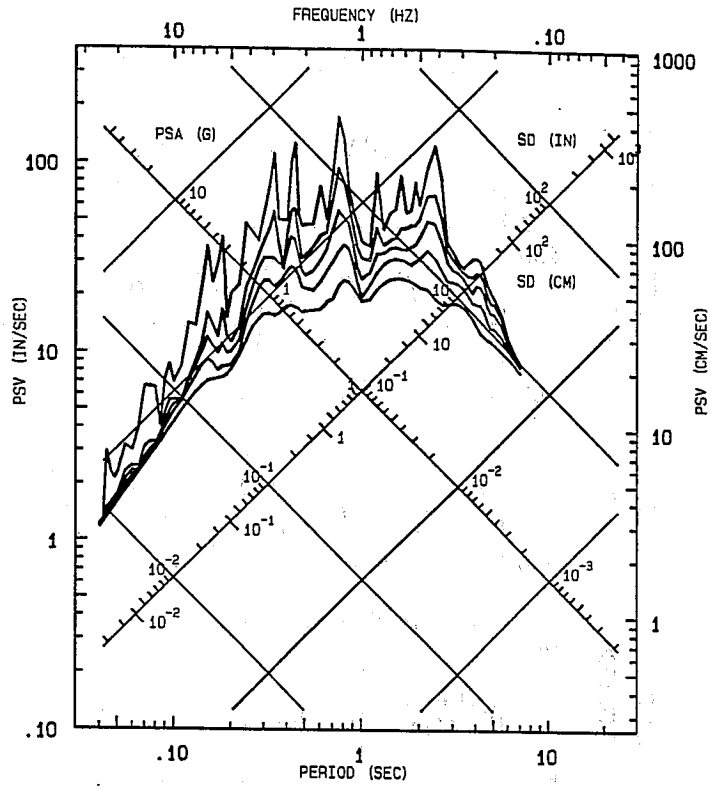
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.17 TO 23.6 HZ
(0.04 TO 6.0 SEC)

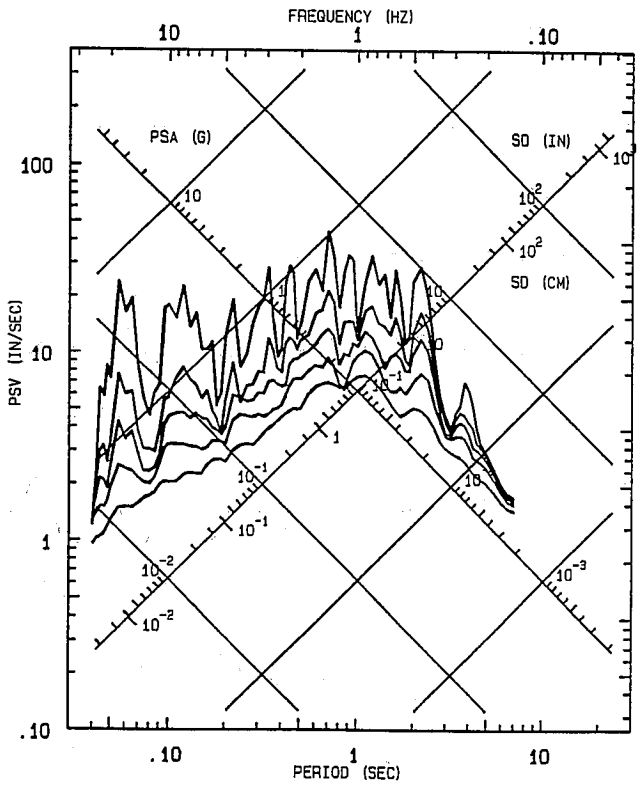
RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 2C015-S0461-94103.02

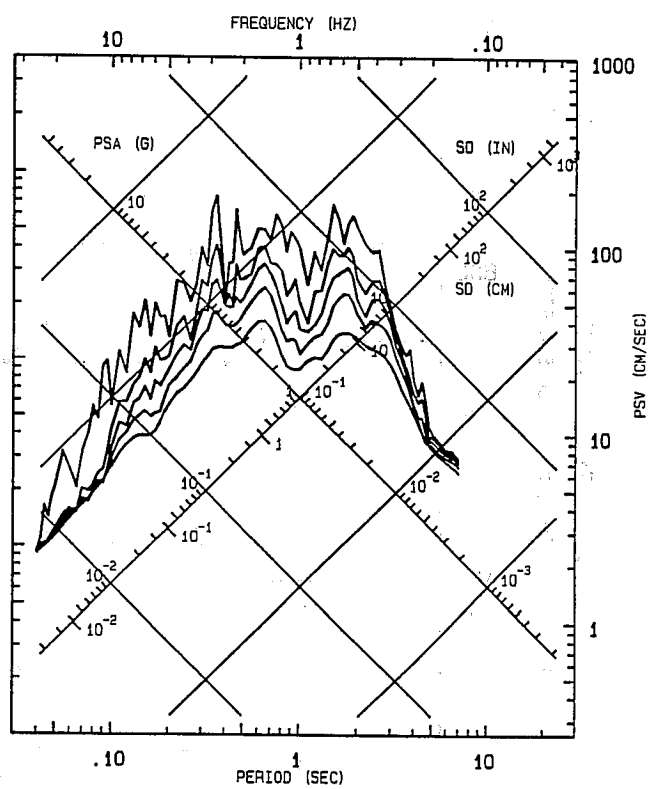
CHN 1: 180 DEG
GROUND



CHN 2: UP
GROUND



CHN 3: 90 DEG
GROUND



NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - VENTURA BLVD #10
Sta Num 2C015

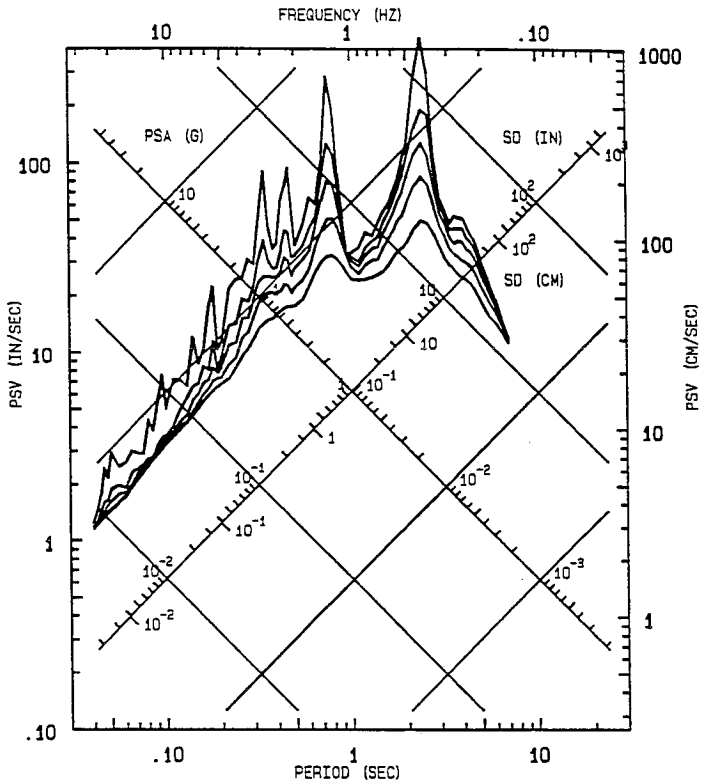
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.17 TO 23.6 HZ
(0.04 TO 6.0 SEC)

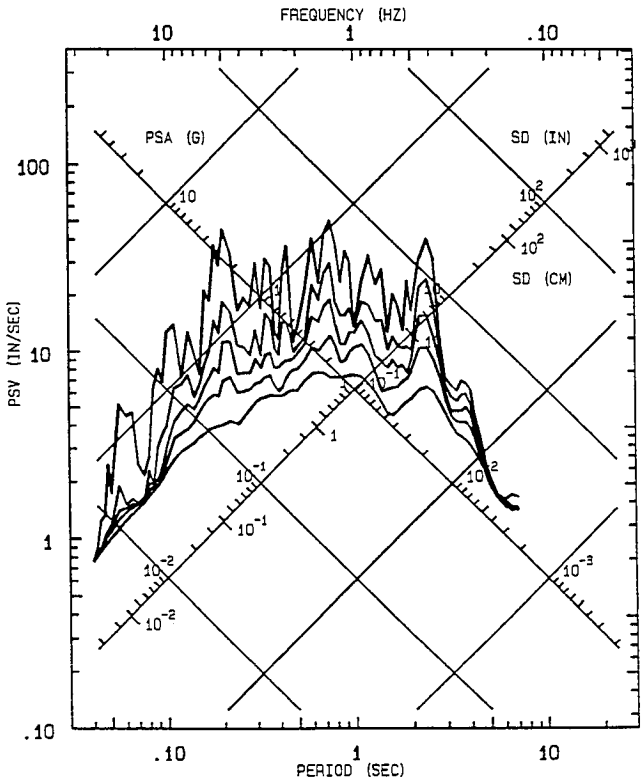
—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 2C015-S0462-94103.02

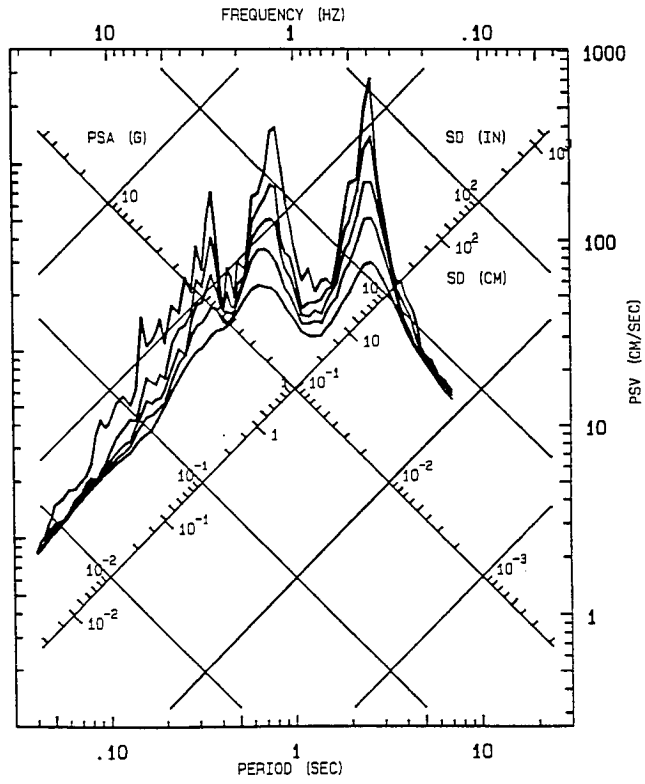
CHN 1 (STA CHN 4): 180 DEG
5TH FLOOR



CHN 2 (STA CHN 5): UP
5TH FLOOR



CHN 3 (STA CHN 6): 90 DEG
5TH FLOOR



NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - VENTURA BLVD #10
Sta Num 2C015

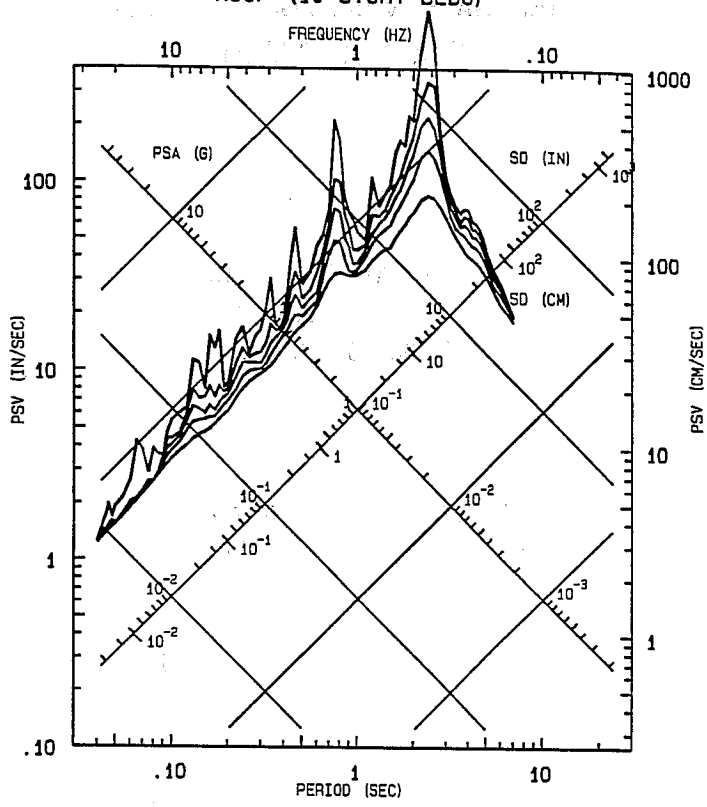
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.17 TO 23.6 HZ
(0.04 TO 6.0 SEC)

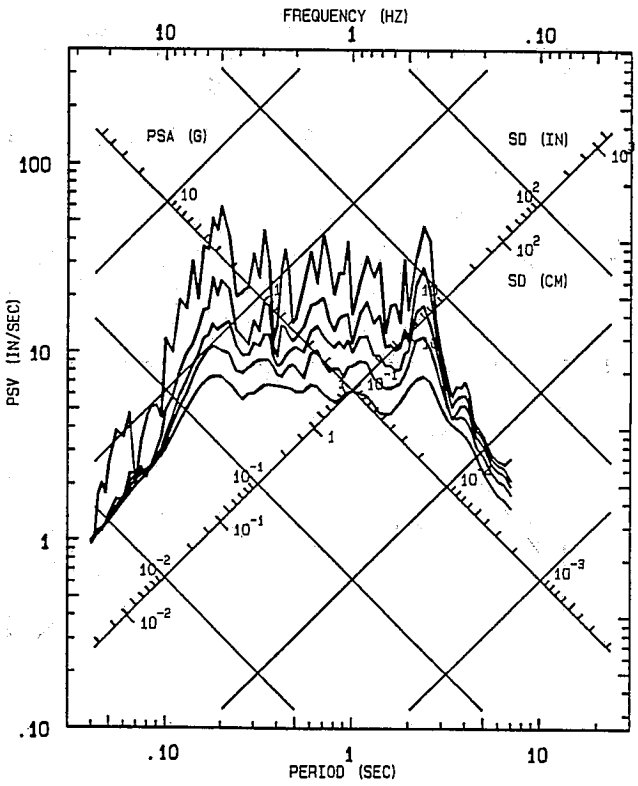
RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 2C015-S0463-94103.02

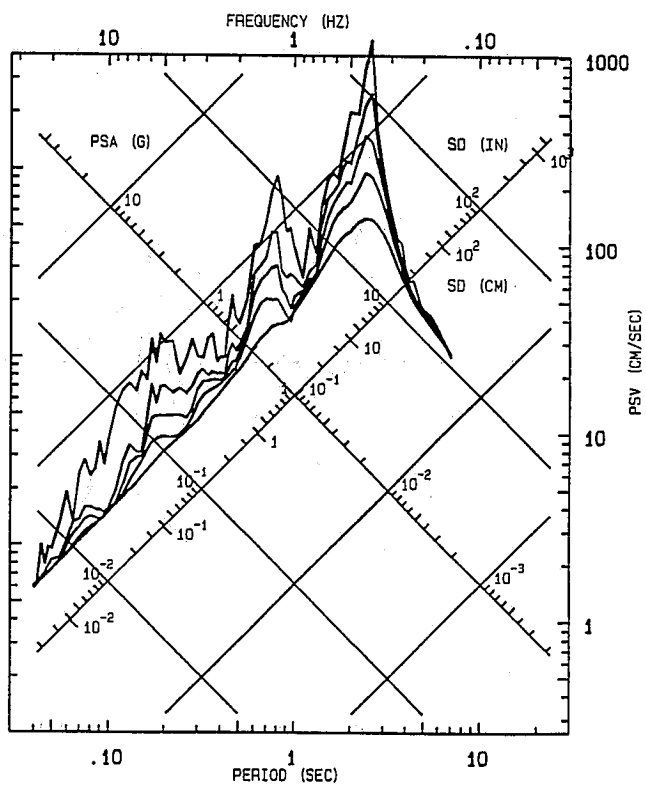
CHN 1 (STA CHN 7): 180 DEG
ROOF (10-STORY BLDG)



CHN 2 (STA CHN 8): UP
ROOF (10-STORY BLDG)



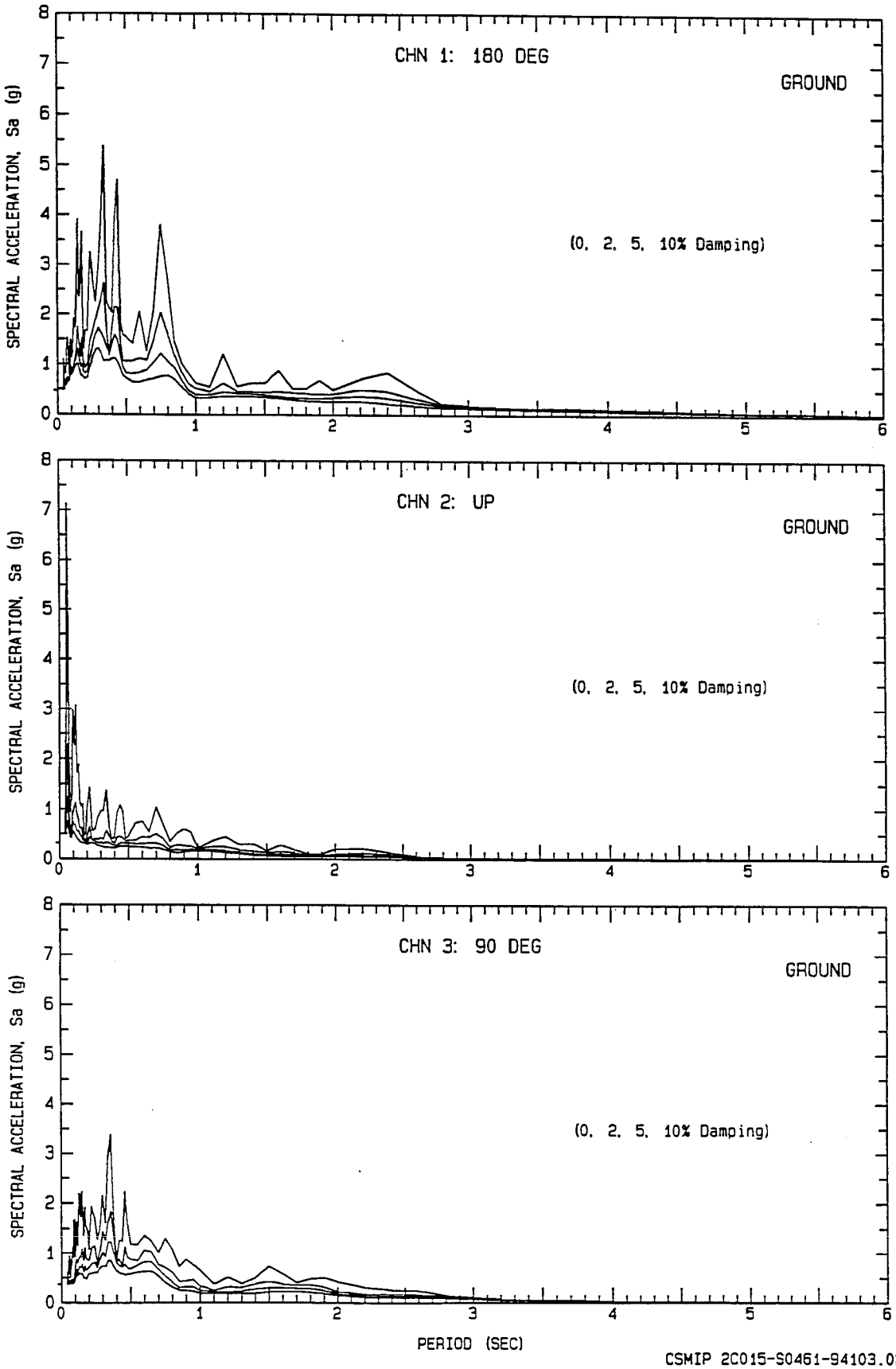
CHN 3 (STA CHN 9): 90 DEG
ROOF (10-STORY BLDG)



NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - VENTURA BLVD #10 Sta Num 2C015

USABLE DATA BANDWIDTH: .17 TO 23.6 HZ (.04 TO 6.0 SEC)

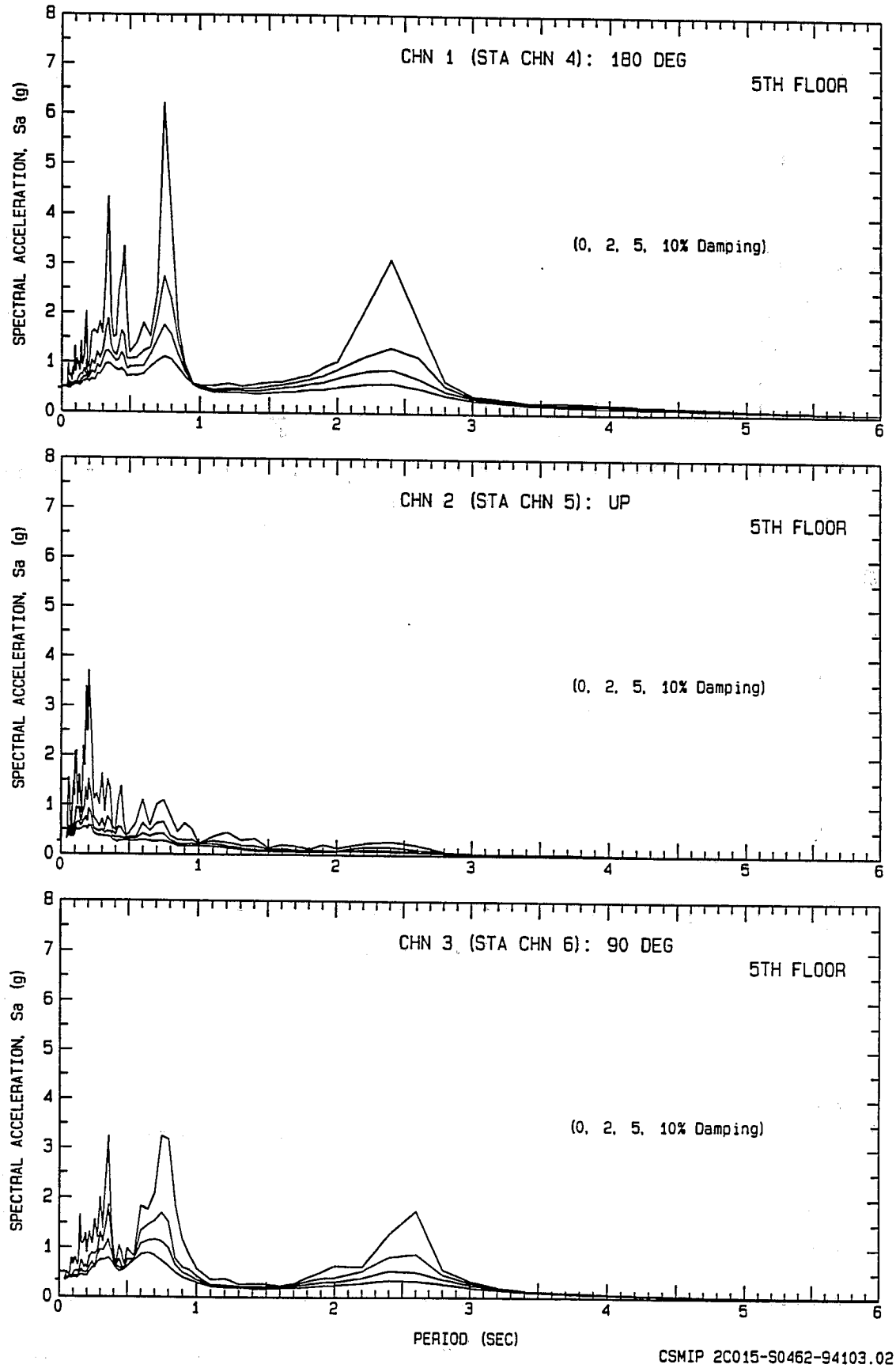


CSMIP 2C015-S0461-94103.02

NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - VENTURA BLVD #10 Sta Num 2C015

USABLE DATA BANDWIDTH: .17 TO 23.6 HZ (.04 TO 6.0 SEC)

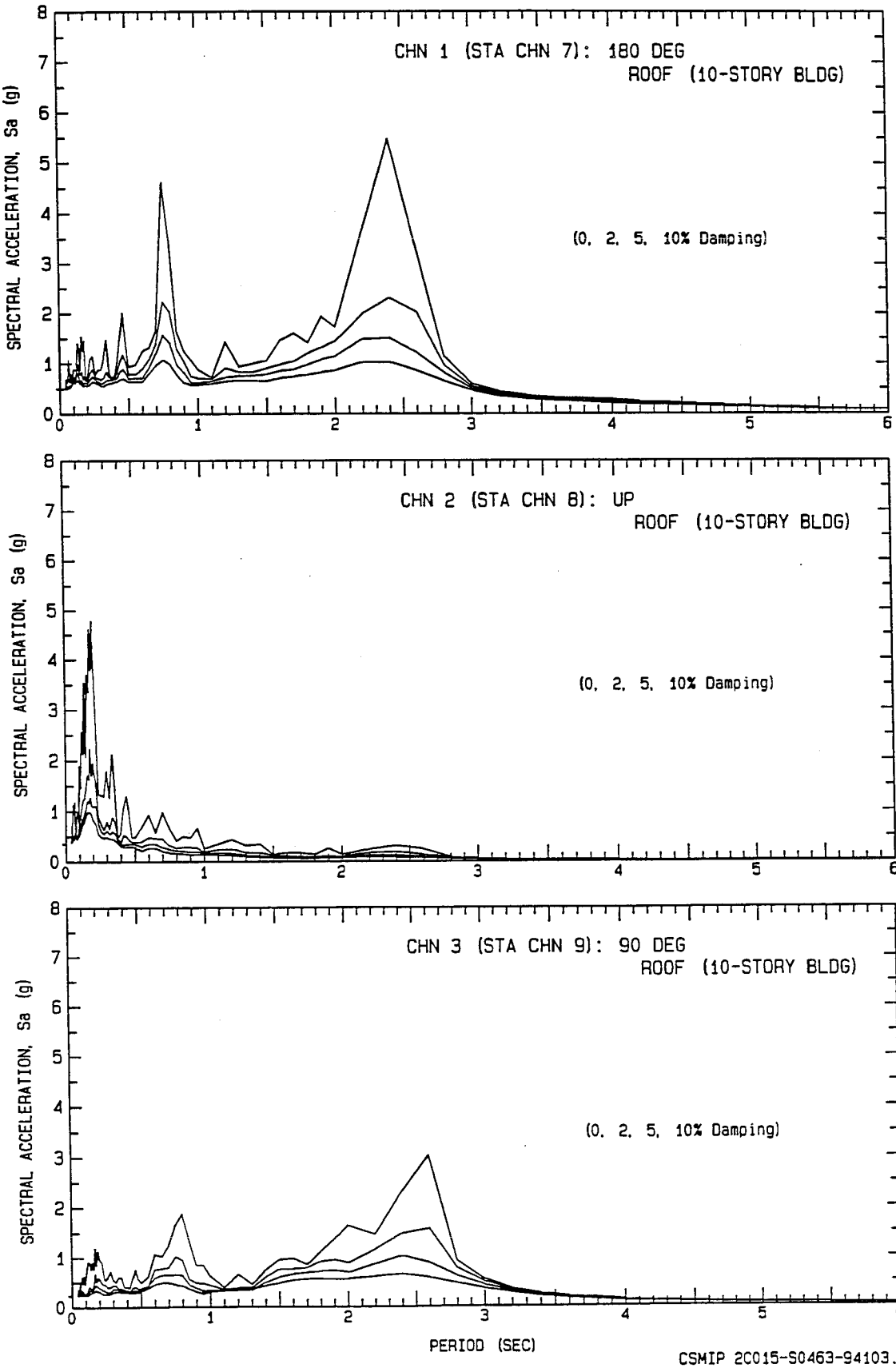


CSMIP 2C015-S0462-94103.02

NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - VENTURA BLVD #10 Sta Num 2C015

USABLE DATA BANDWIDTH: .17 TO 23.6 HZ (.04 TO 6.0 SEC)

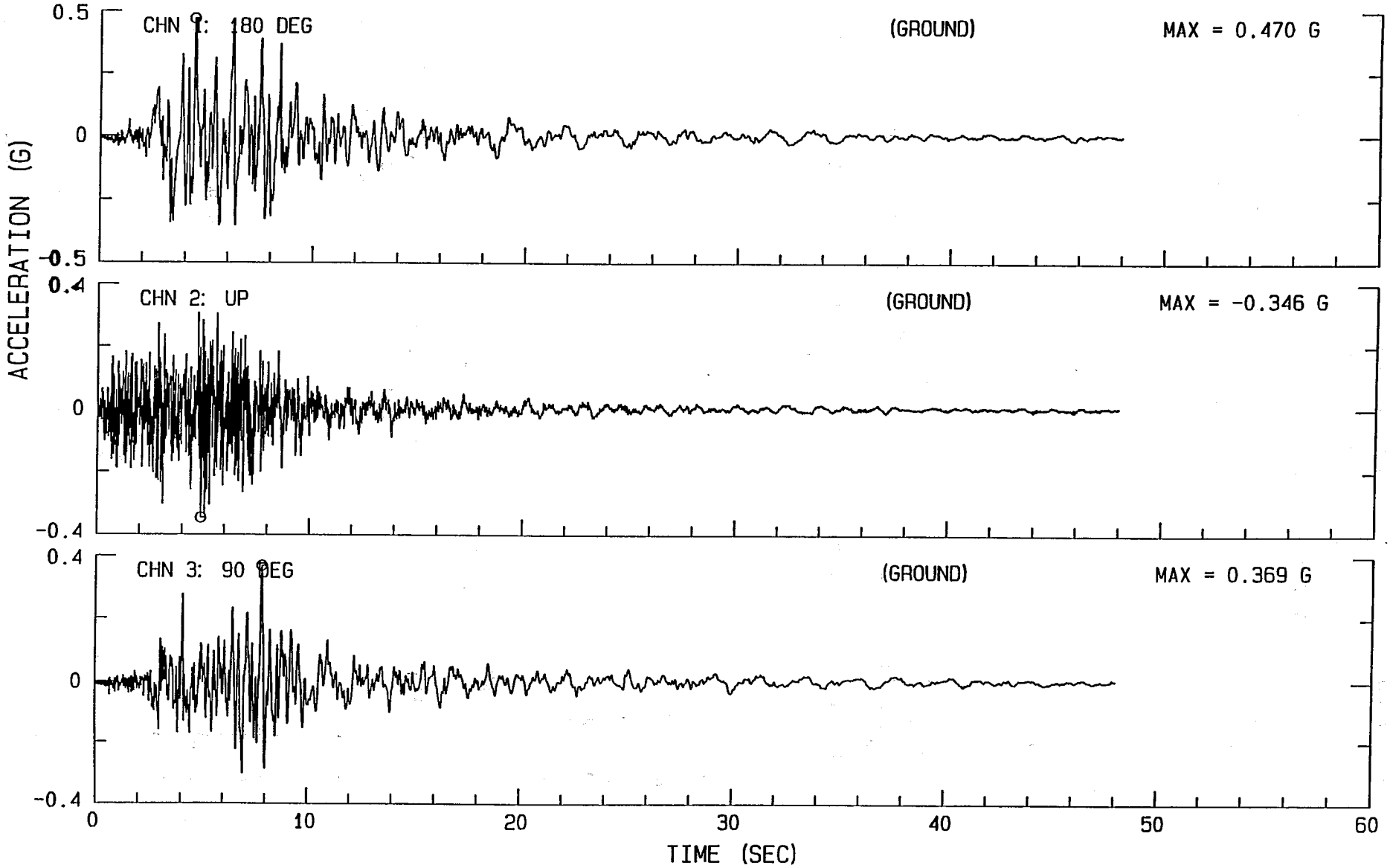


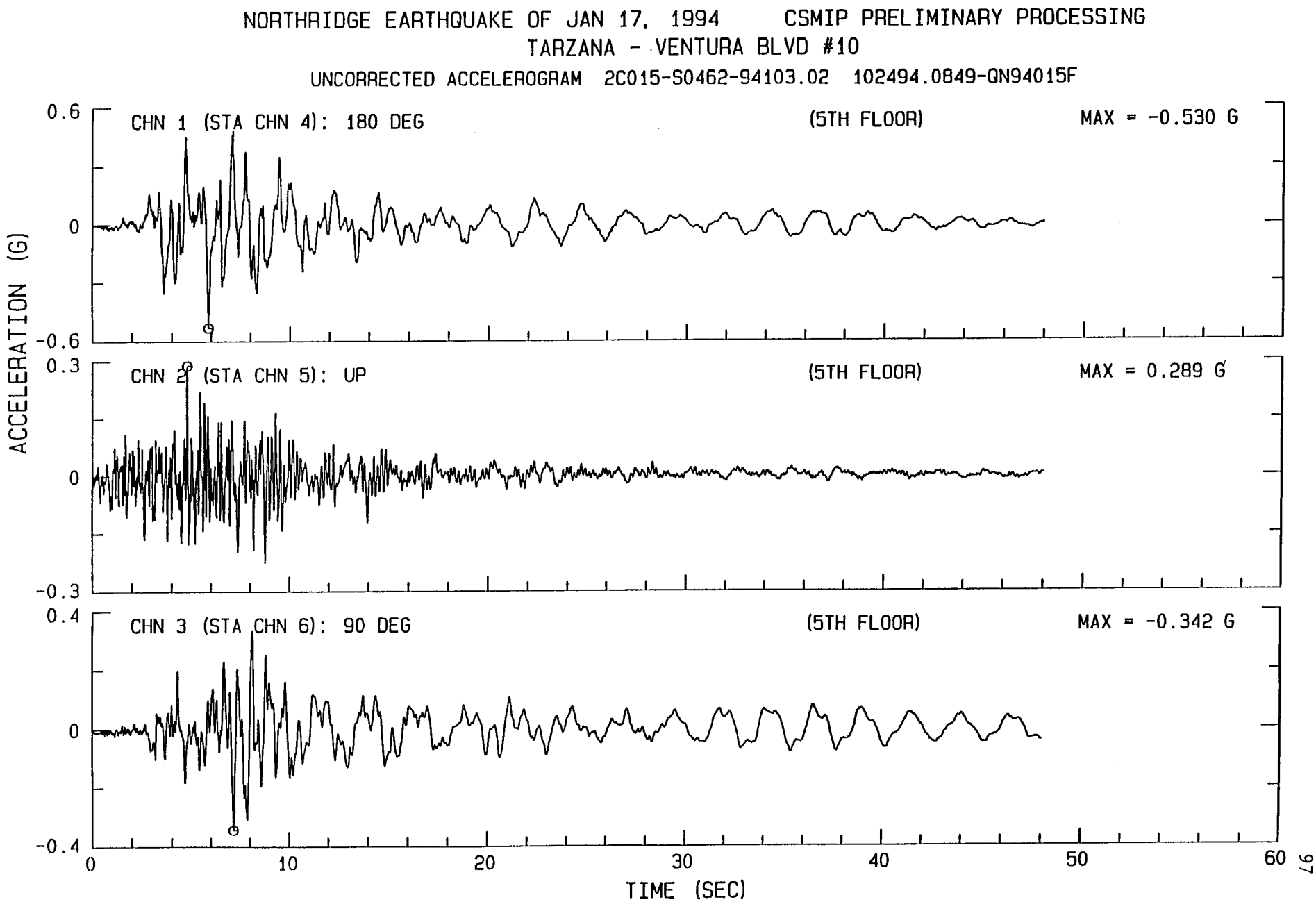
CSMIP 2C015-S0463-94103.02

NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING

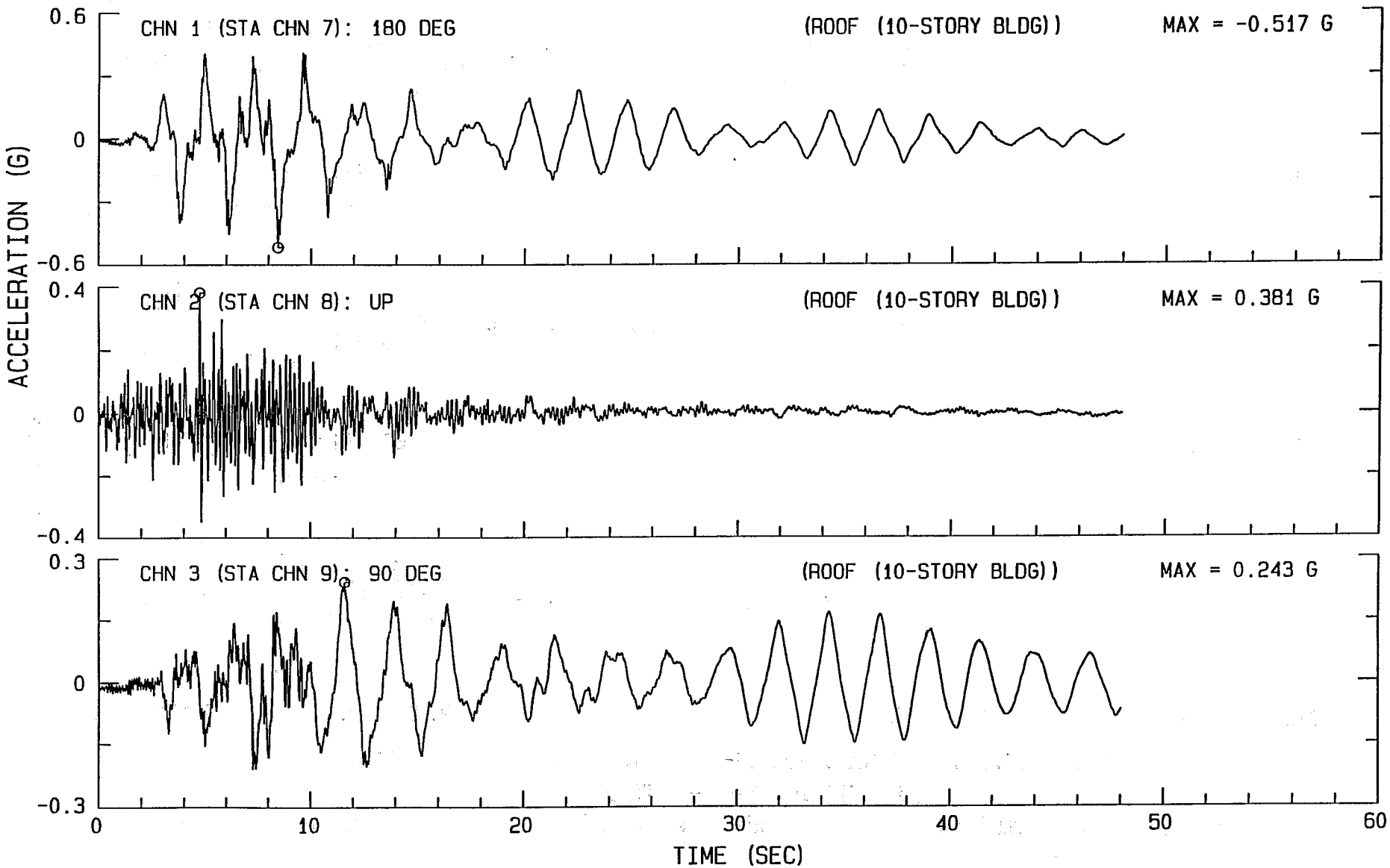
TARZANA - VENTURA BLVD #10

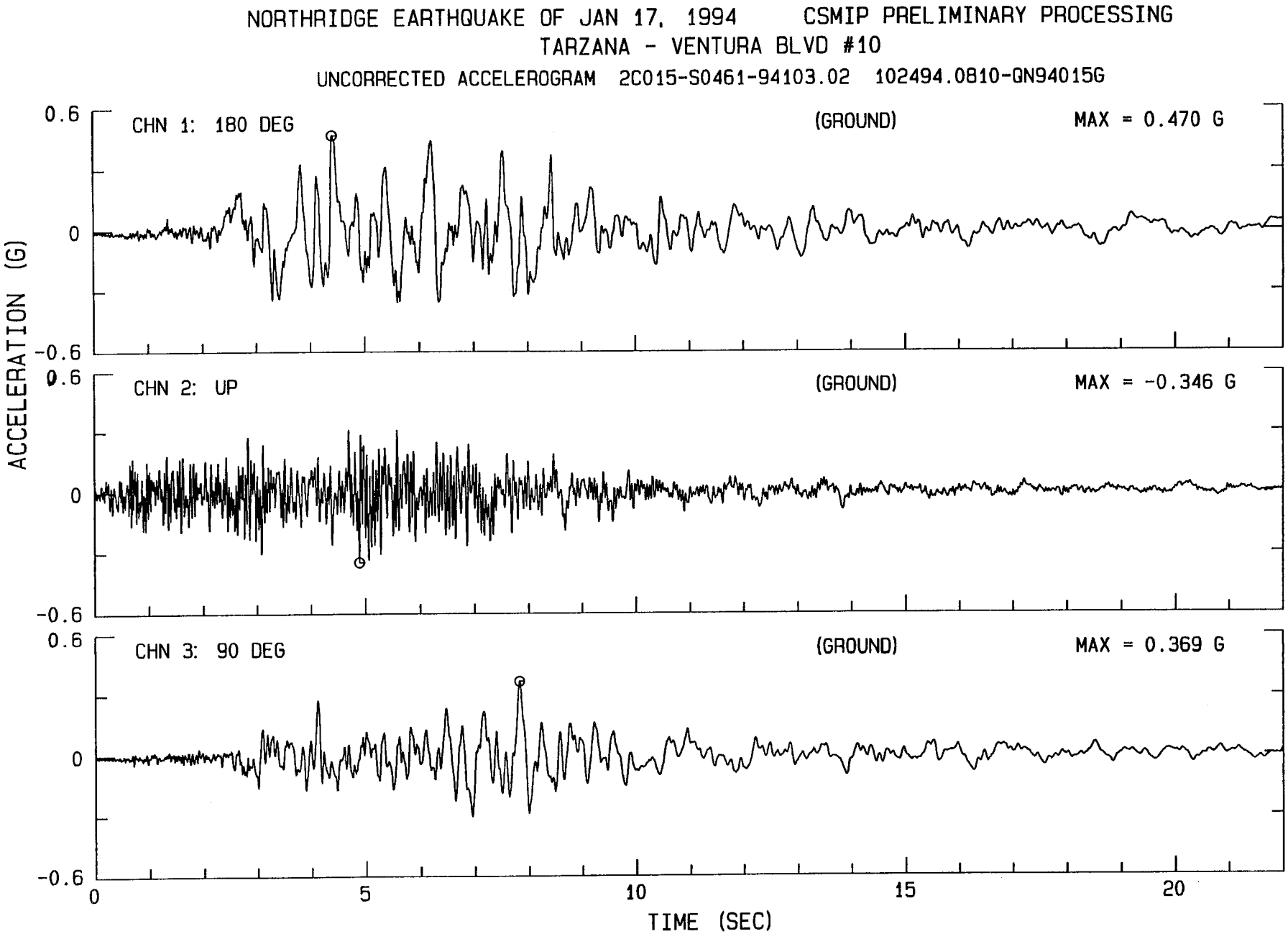
UNCORRECTED ACCELEROGRAM 2C015-S0461-94103.02 102494.0810-GN94015G



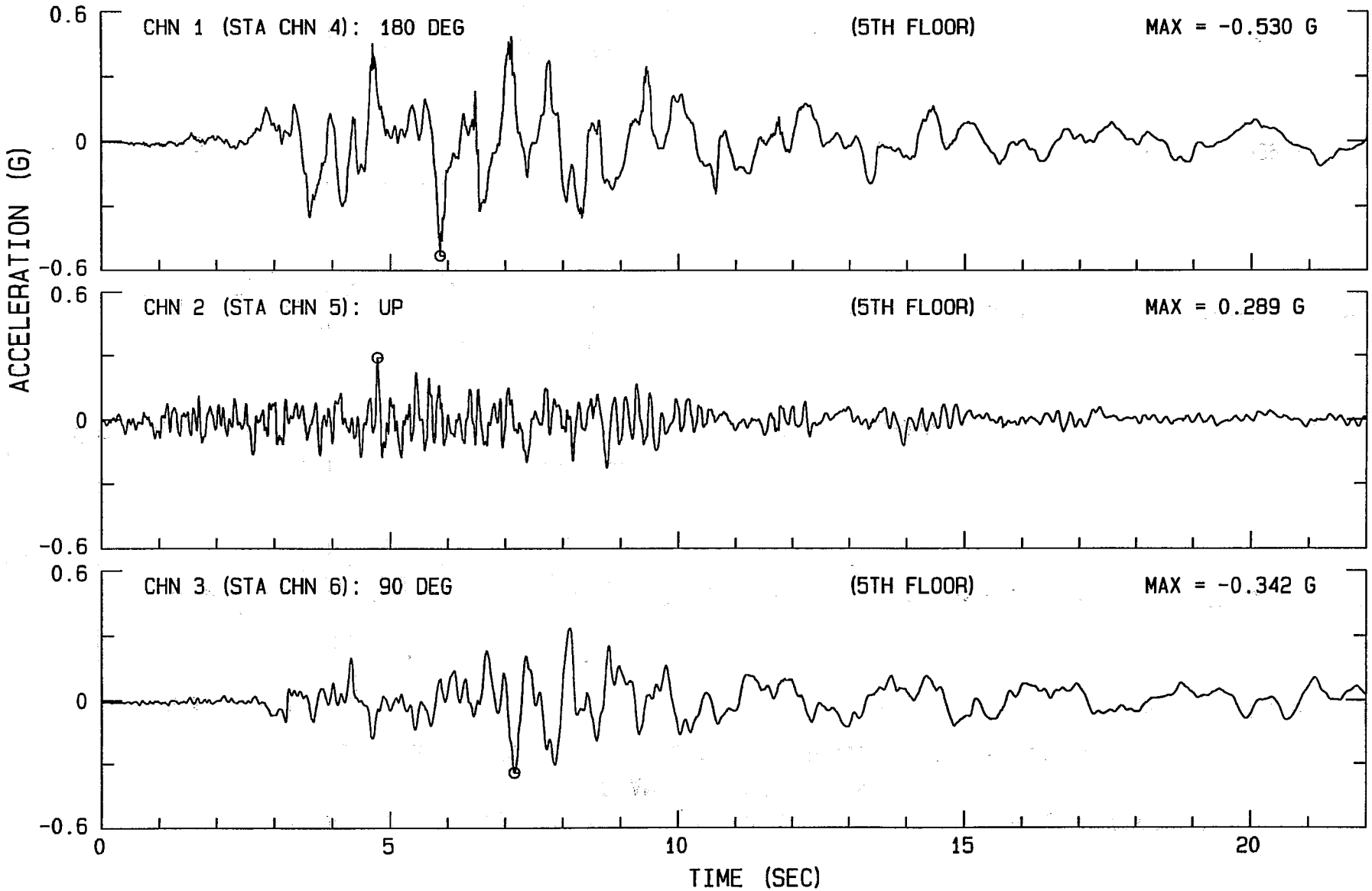

NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - VENTURA BLVD #10
UNCORRECTED ACCELEROGRAM 2C015-S0462-94103.02 102494.0849-QN94015F
CHN 1 (STA CHN 4): 180 DEG
(5TH FLOOR)
MAX = -0.530 G
CHN 2 (STA CHN 5): UP
(5TH FLOOR)
MAX = 0.289 G
CHN 3 (STA CHN 6): 90 DEG
(5TH FLOOR)
MAX = -0.342 G
ACCELERATION (G)
0.6
0
-0.6
0.3
0
-0.3
0.4
0
-0.4
0
10
20
30
40
50
60
TIME (SEC)

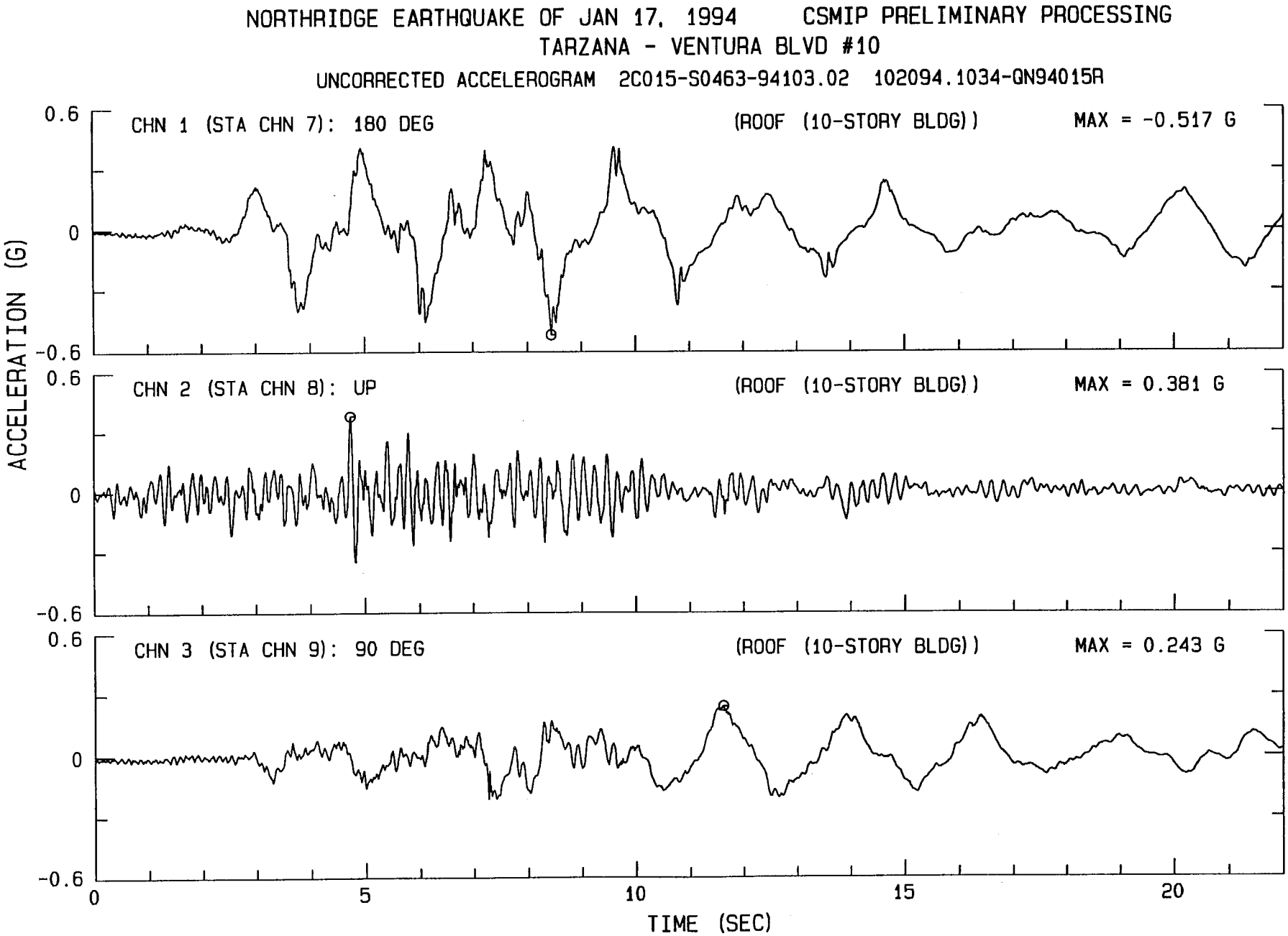
NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - VENTURA BLVD #10
UNCORRECTED ACCELEROGRAM 2C015-S0463-94103.02 102094.1050-QN94015R



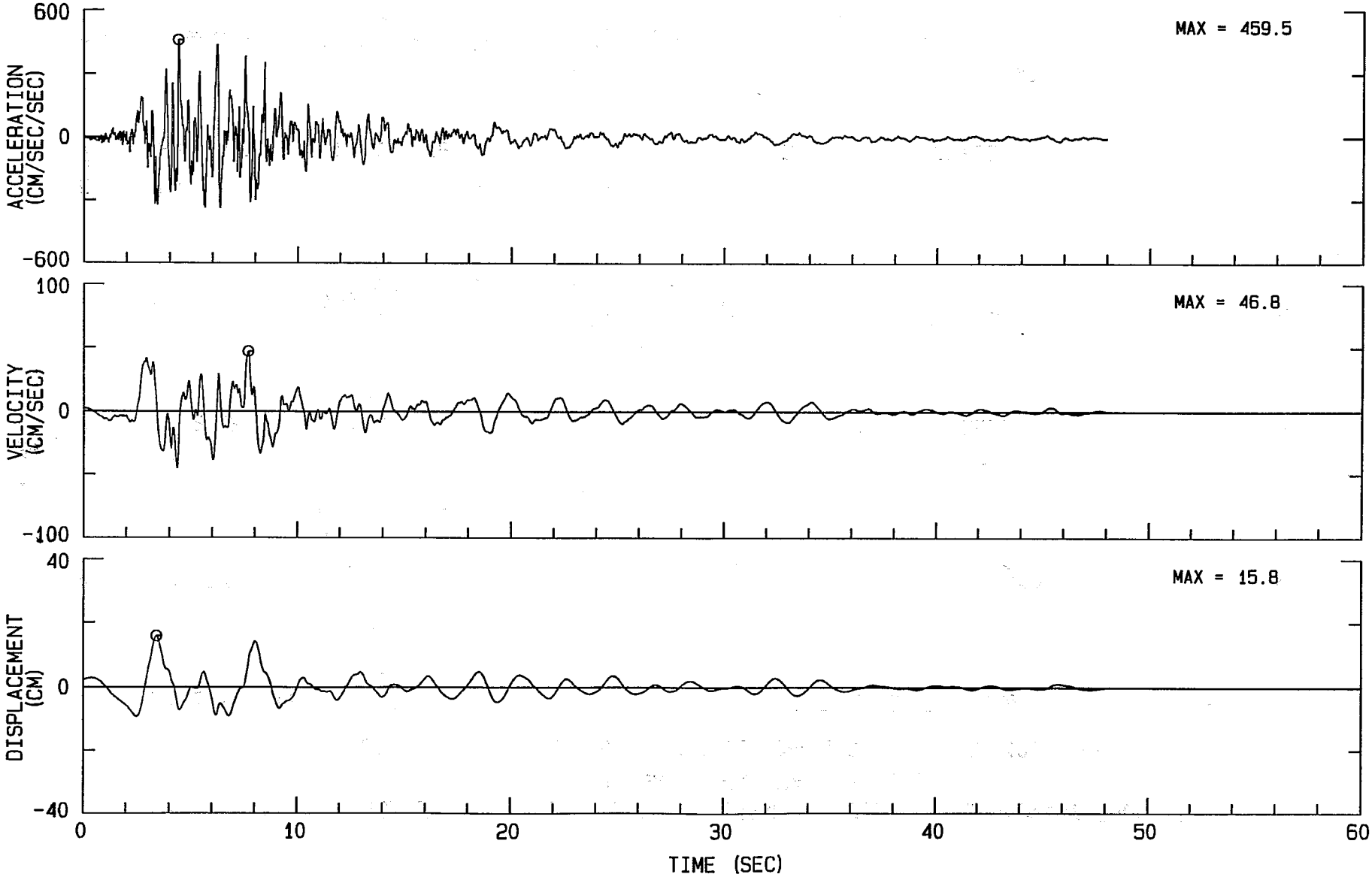

NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - VENTURA BLVD #10
UNCORRECTED ACCELEROGRAM 2C015-S0461-94103.02 102494.0810-GN94015G
CHN 1: 180 DEG
(GROUND)
MAX = 0.470 G
CHN 2: UP
(GROUND)
MAX = -0.346 G
CHN 3: 90 DEG
(GROUND)
MAX = 0.369 G
ACCELERATION (G)
0.6
0
-0.6
0
5
10
15
20
TIME (SEC)

NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - VENTURA BLVD #10
UNCORRECTED ACCELEROGRAM 2C015-S0462-94103.02 102494.0849-GN94015F

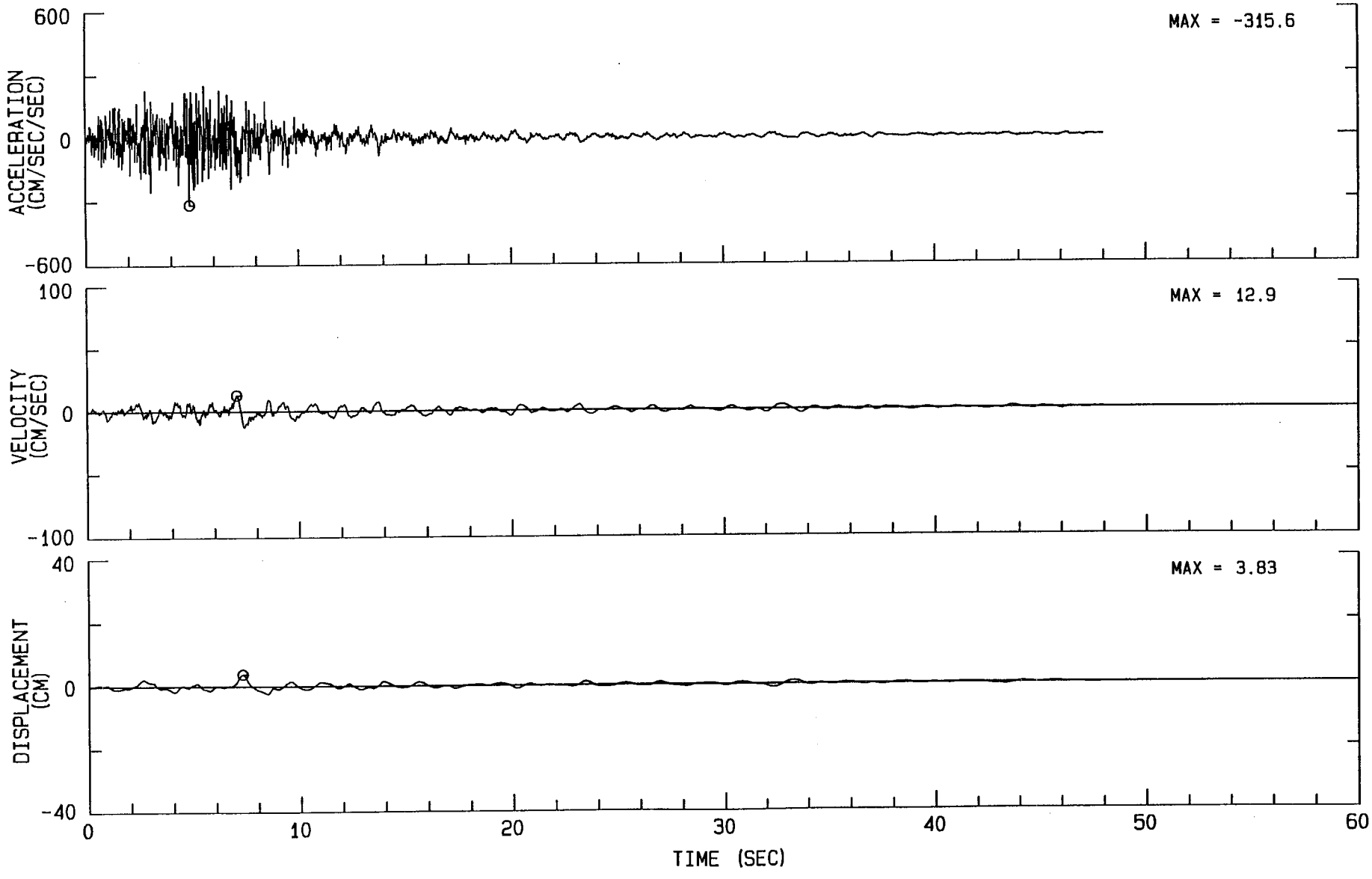



NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - VENTURA BLVD #10
UNCORRECTED ACCELEROGRAM 2C015-S0463-94103.02 102094.1034-GN94015R
CHN 1 (STA CHN 7): 180 DEG
(ROOF (10-STORY BLDG))
MAX = -0.517 G
CHN 2 (STA CHN 8): UP
(ROOF (10-STORY BLDG))
MAX = 0.381 G
CHN 3 (STA CHN 9): 90 DEG
(ROOF (10-STORY BLDG))
MAX = 0.243 G
ACCELERATION (G)
0.6
0
-0.6
0
5
10
15
20
TIME (SEC)

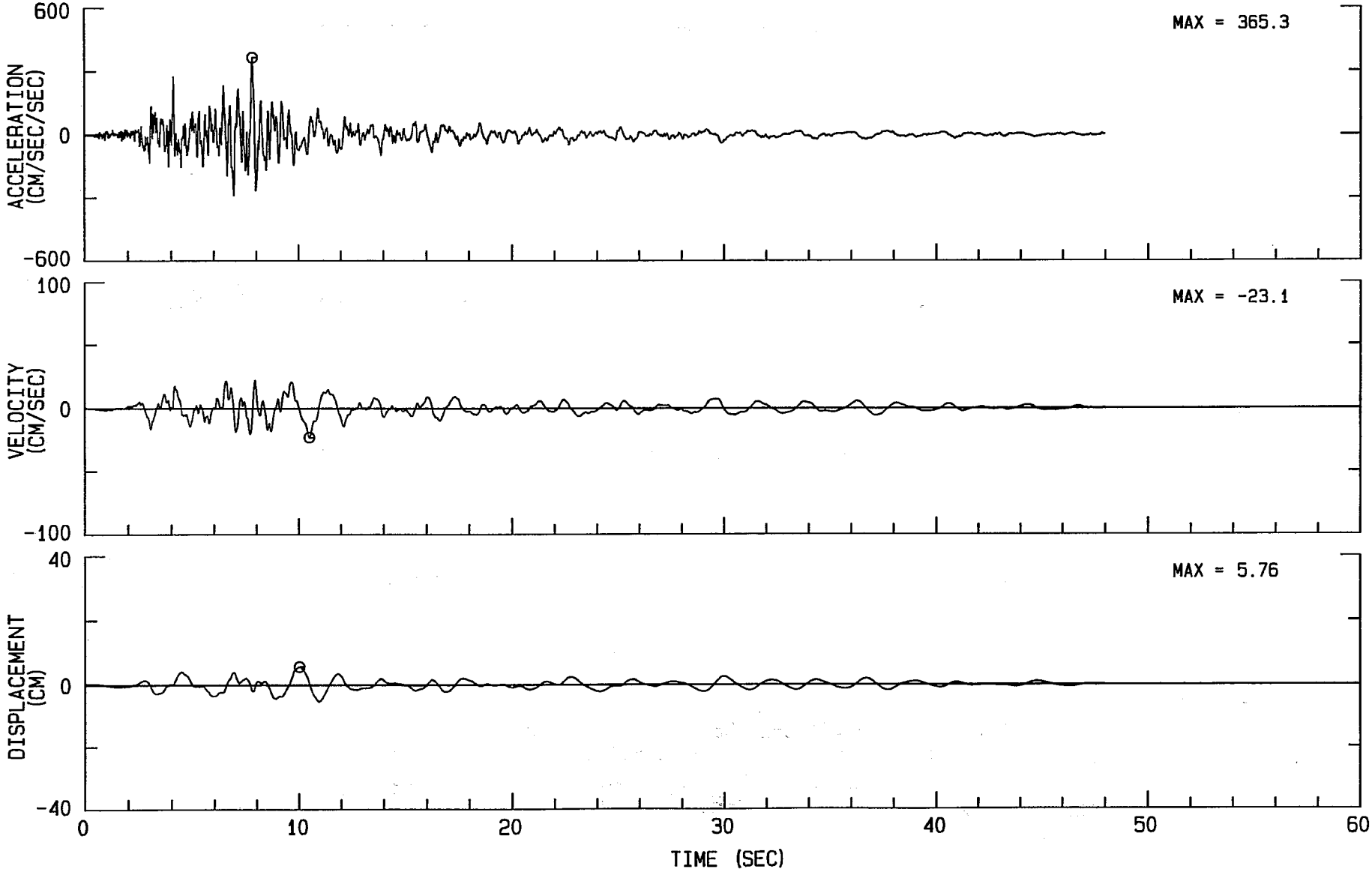
NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - VENTURA BLVD #10 CHN 1: 180 DEG (GROUND)
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 2C015-S0461-94103.02 102494.0811-QN94015G



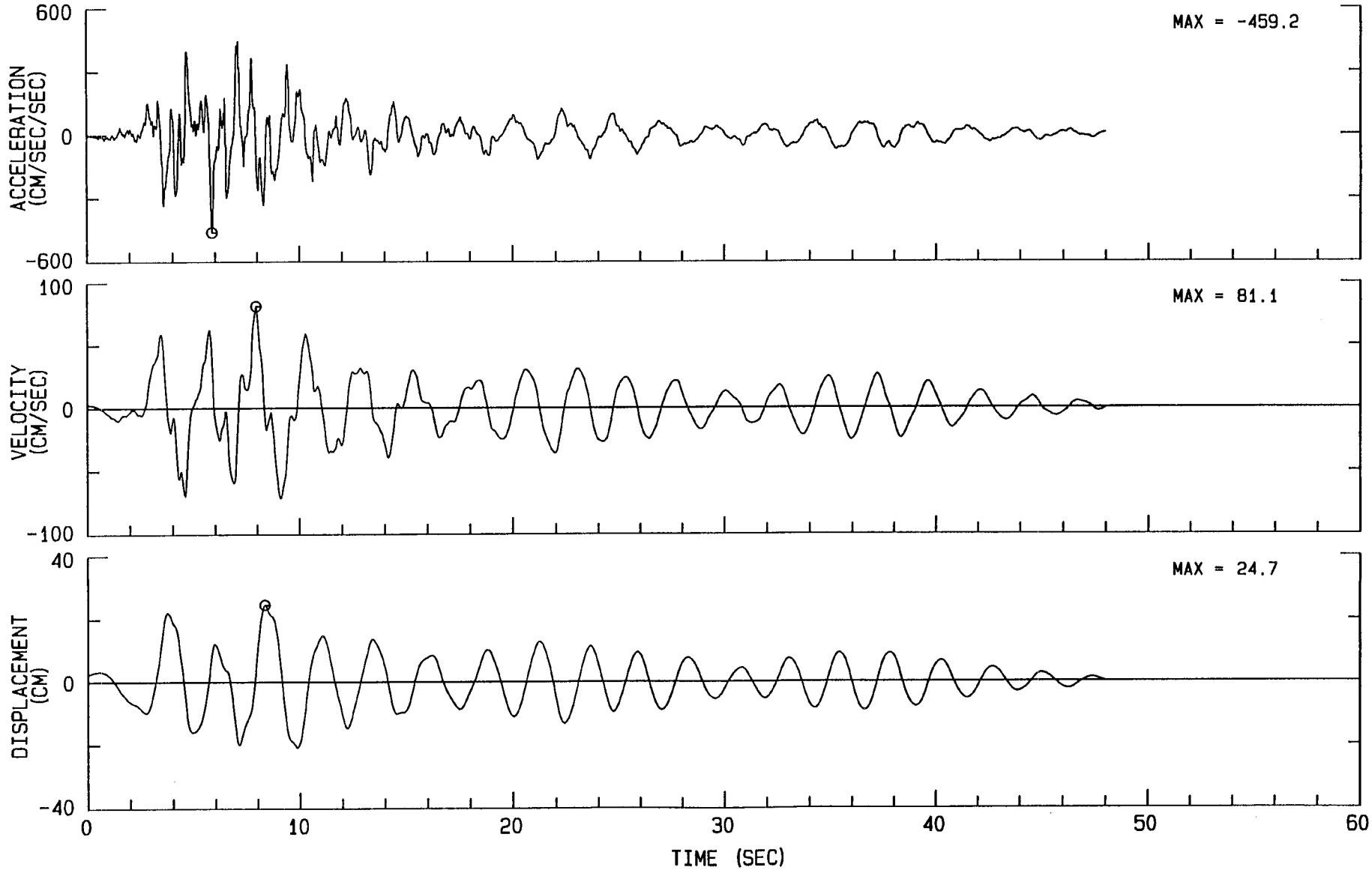
NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - VENTURA BLVD #10 CHN 2: UP (GROUND)
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 2C015-S0461-94103.02 102494.0811-QN94015G



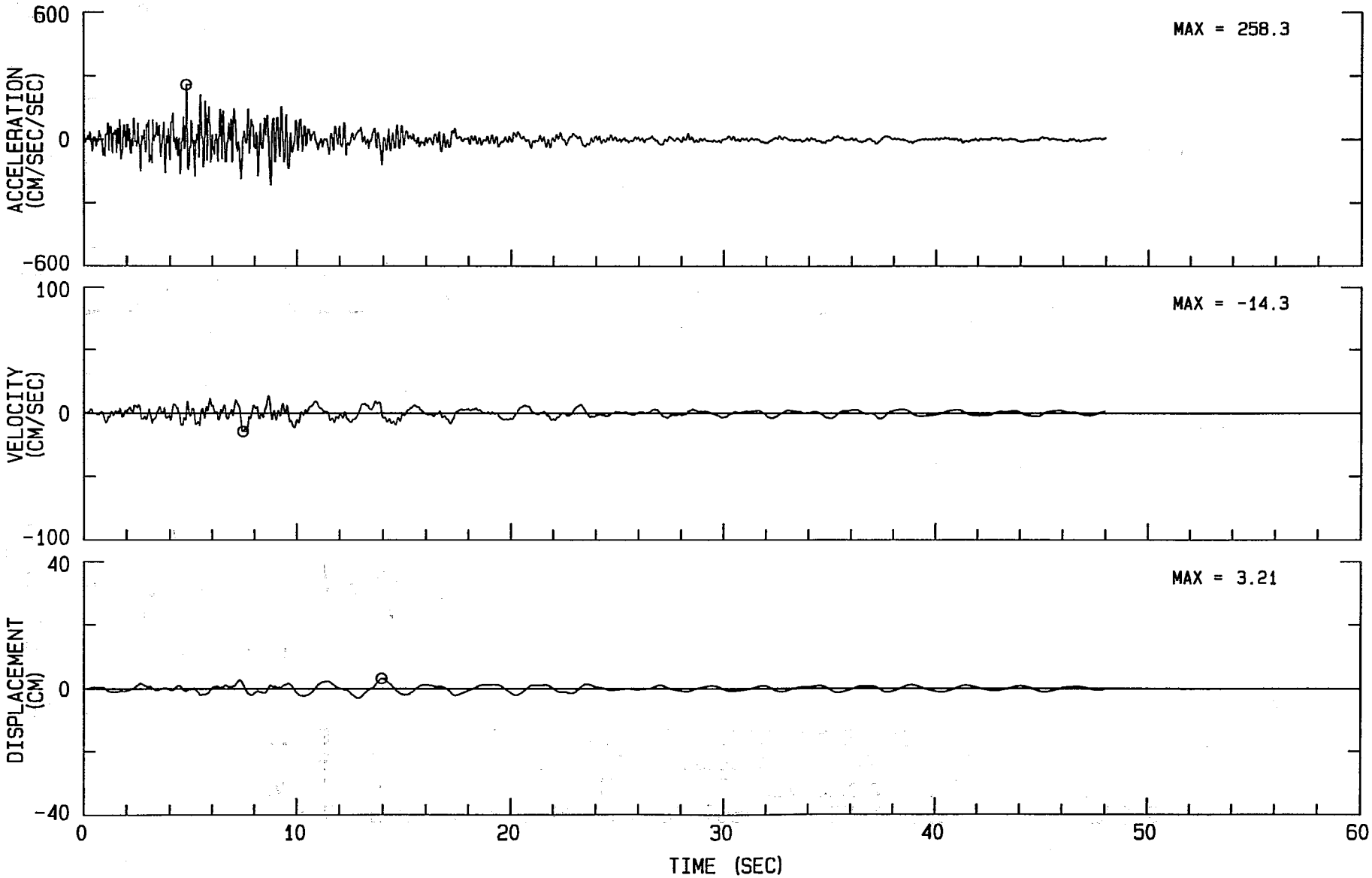
NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - VENTURA BLVD #10 CHN 3: 90 DEG (GROUND)
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 2C015-S0461-94103.02 102494.0811-QN94015G



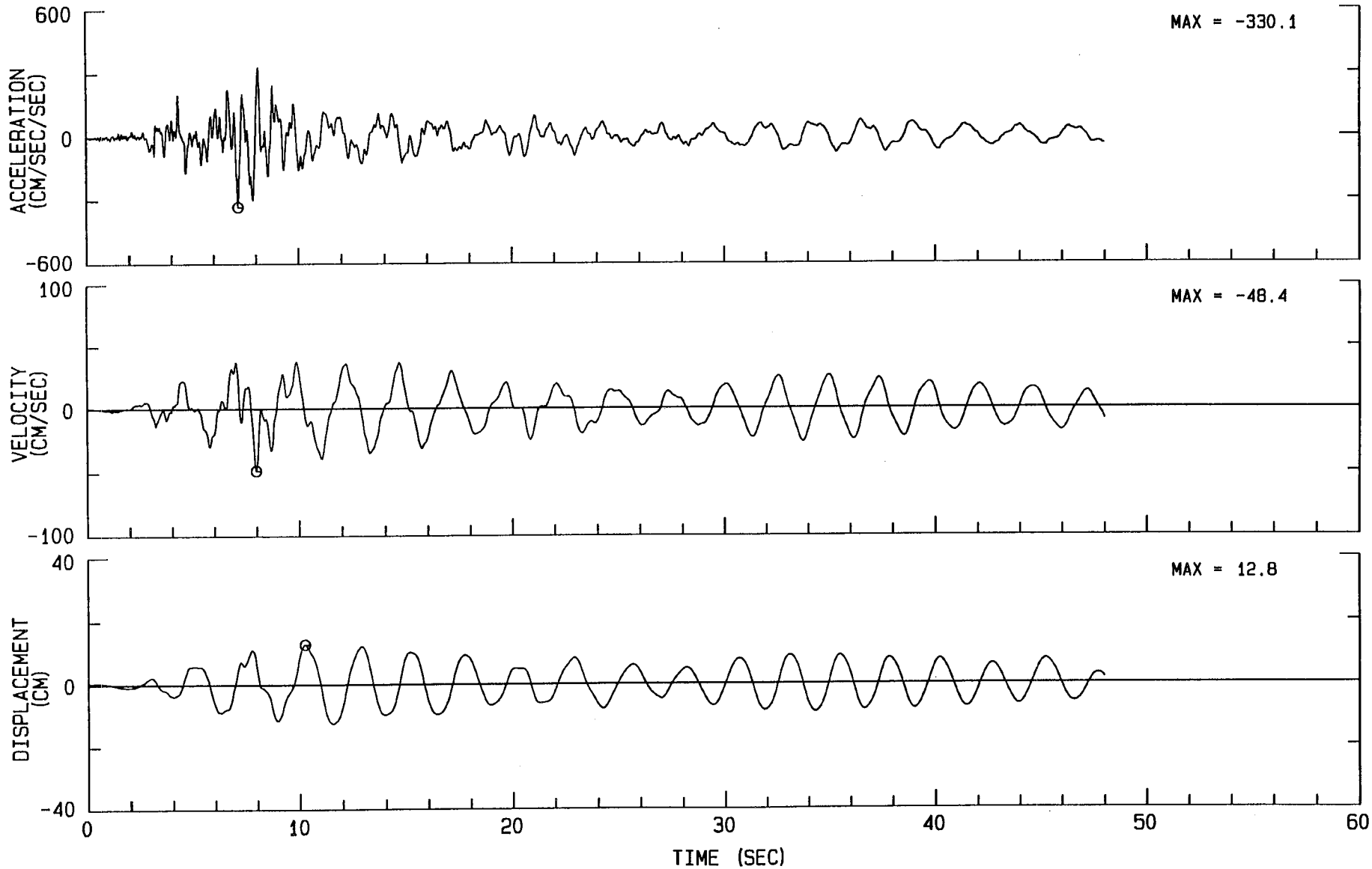
NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - VENTURA BLVD #10 CHN 1 (STA CHN 4): 180 DEG (5TH FLOOR)
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 2C015-S0462-94103.02 102494.0850-QN94015F



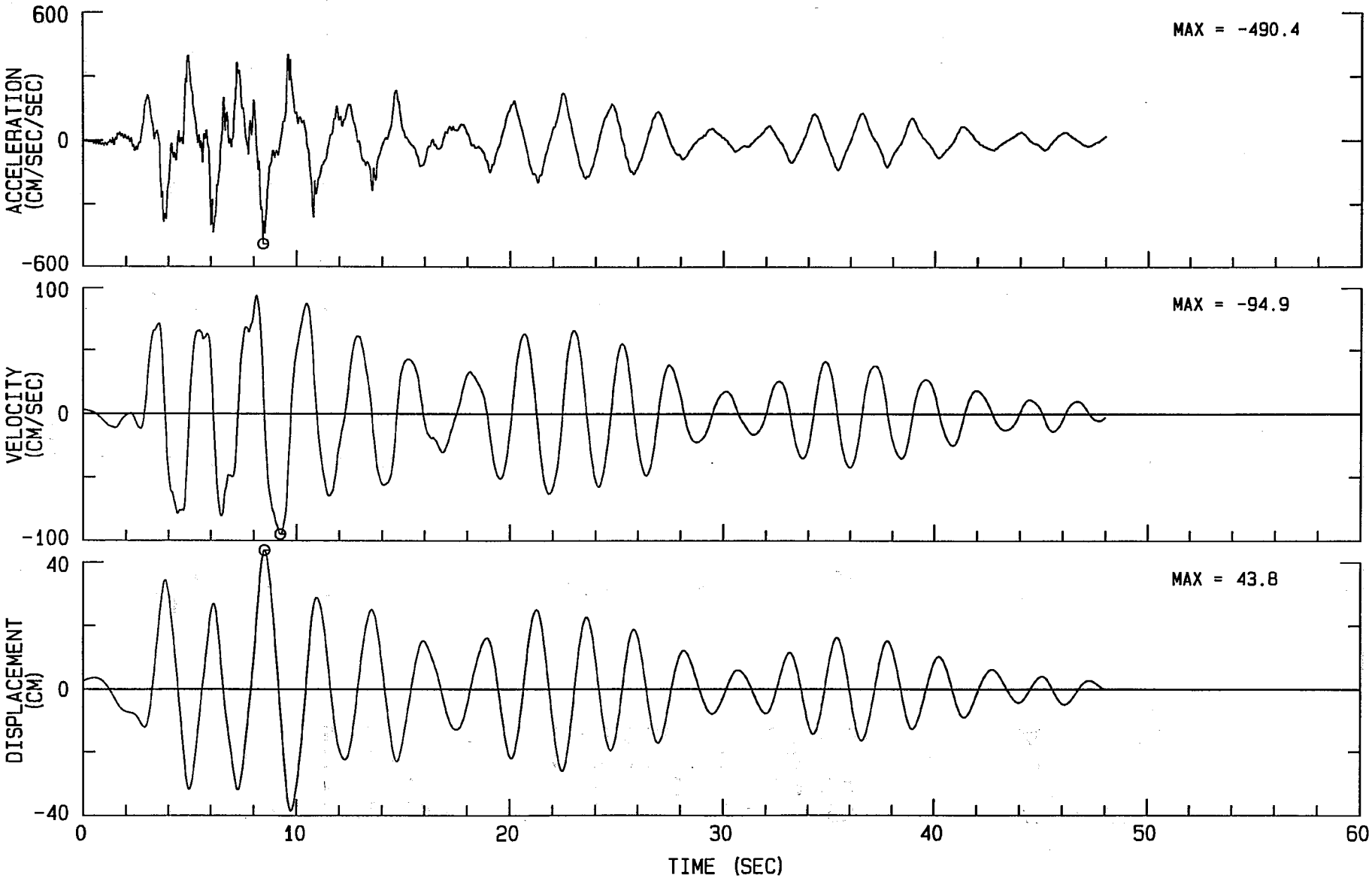
NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - VENTURA BLVD #10 CHN 2 (STA CHN 5): UP (5TH FLOOR)
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 2C015-S0462-94103.02 102494.0850-QN94015F



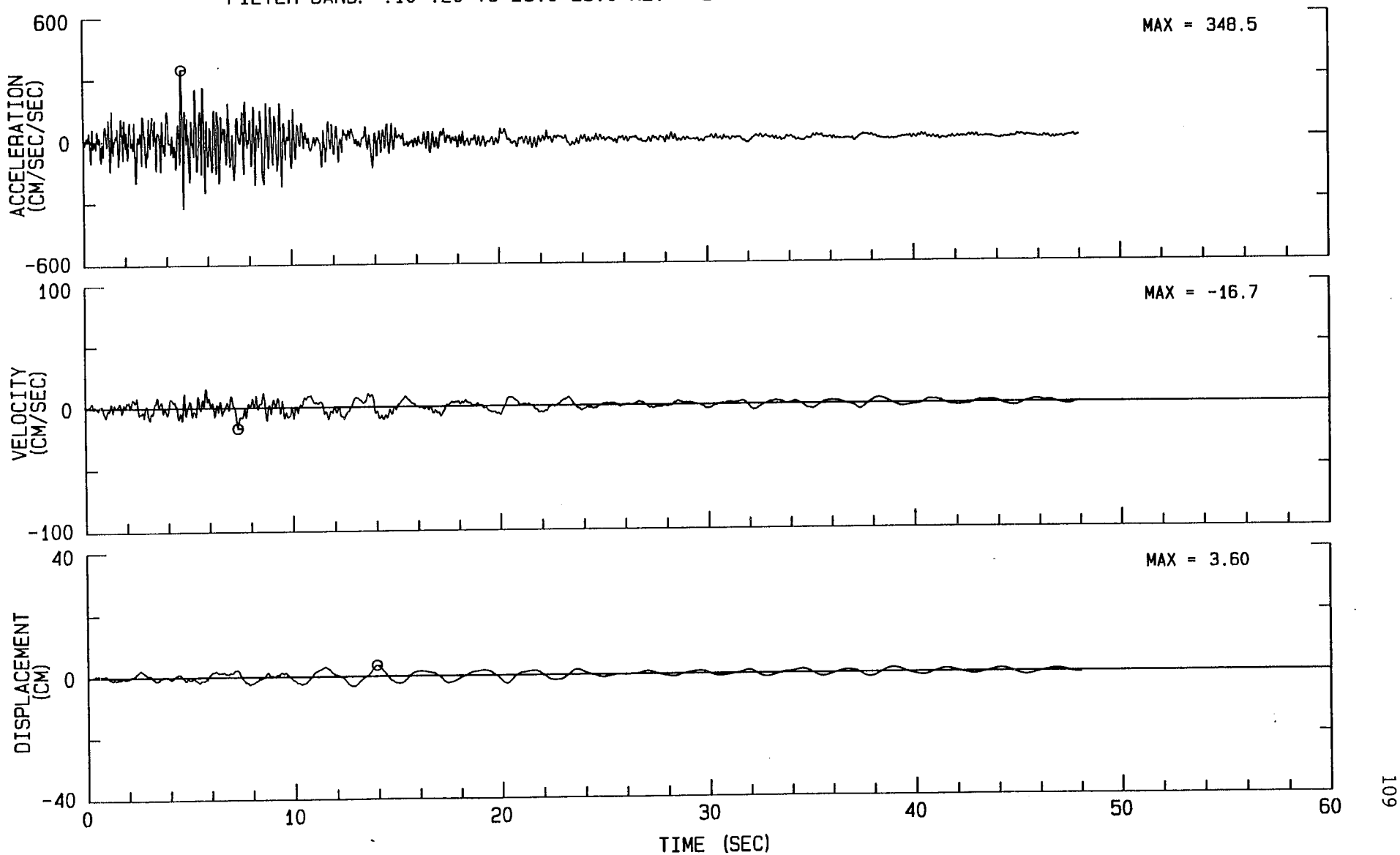
NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - VENTURA BLVD #10 CHN 3 (STA CHN 6): 90 DEG (5TH FLOOR)
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 2C015-S0462-94103.02 102494.0850-QN94015F



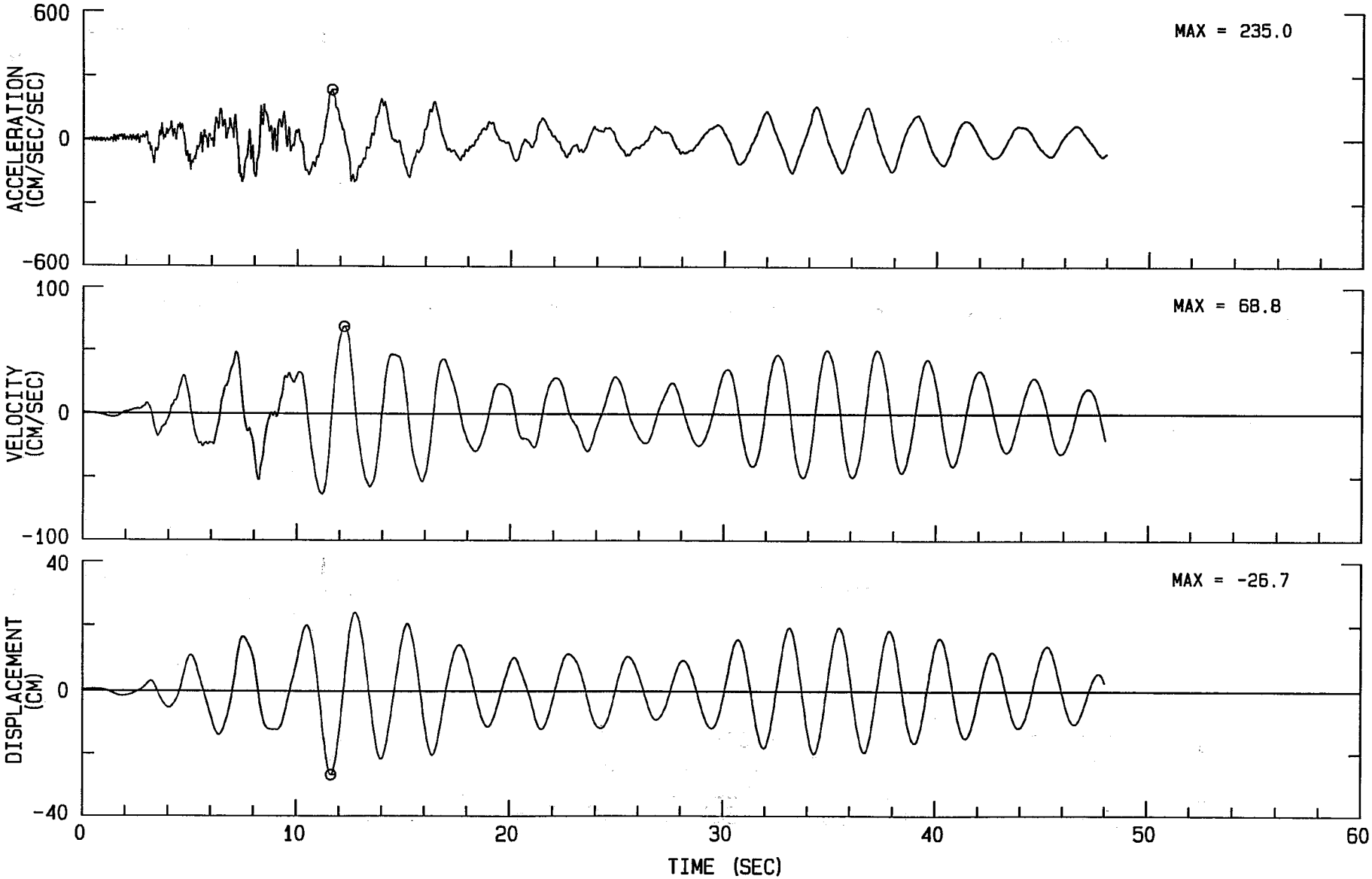
NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - VENTURA BLVD #10 CHN 1 (STA CHN 7): 180 DEG (ROOF (10-STORY BLDG))
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 2C015-S0463-94103.02 102094.1051-QN94015R



NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - VENTURA BLVD #10 CHN 2 (STA CHN 8): UP (ROOF (10-STORY BLDG))
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 2C015-S0463-94103.02 102094.1051-QN94015R



NORTHRIDGE EARTHQUAKE OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - VENTURA BLVD #10 CHN 3 (STA CHN 9): 90 DEG (ROOF (10-STORY BLDG))
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 2C015-S0463-94103.02 102094.1051-GN94015R



APPENDIX C

SMIP Processed Strong-Motion Data Tarzana, California Recorded during Northridge Aftershocks, SMIP OSMS Report No. 96-06

CSMIP PROCESSED STRONG-MOTION DATA AT TARZANA, CALIFORNIA RECORDED DURING NORTHRIDGE AFTERSHOCKS

R. Darragh

V. Graizer

A. Shakal

Report No. OSMS 96-06

California Strong Motion Instrumentation Program

California Department of Conservation

Division of Mines and Geology

Office of Strong Motion Studies

801 K Street, MS 13-35, Sacramento, California 95814-3531

December 20, 1996

CONTENTS

INTRODUCTION

The CSMIP analog accelerograph located at Tarzana - Cedar Hill Nursery recorded extremely high accelerations during the Northridge earthquake of January 17, 1994 (Shakal et al., 1994, 1996). All three components had peak accelerations over 1.0 g. In addition, a peak velocity over 100 cm/sec was measured (Darragh et al., 1994a). Other instruments located within several kilometers of Tarzana recorded significantly smaller peak accelerations of about 0.5 g, with peak velocities lower than 60 cm/sec from the mainshock (Darragh et al., 1994b, 1995). Relatively high seismic response at this station was also identified during the 1987 Whittier Narrows earthquake, though not in the largest Whittier aftershock (Shakal et al., 1988).

The Tarzana station is located near the crest of a low (20 m) natural hill on the south side of the San Fernando Valley. The site is underlain by a variable thickness of colluvial soil (silty clay) or artificial fill generated by fill grading of the bedrock and slopewash estimated to be about 0.5 to 1.5 m in thickness (Geosoils, 1992). The soil is derived by in-place weathering of a soft claystone and siltstone of the Upper Modelo Formation, which underlies the soil.

To help study the ground motion effects, CSMIP installed a reference station near Tarzana - Cedar Hills Nursery after the Northridge earthquake on January 25, 1994 (Figure 1). In addition, a digital accelerograph was collocated with the analog accelerograph in the t-hut at Tarzana - Cedar Hills Nursery. Numerous aftershocks have been recorded at both stations, some with peak accelerations as high as 0.37 g. The reference site, Tarzana - Clubhouse, is located about 150 m from the Tarzana - Cedar Hills Nursery station, off the gentle hill. The site is located on Quaternary alluvium. At a test pit site about 35 m from the station the top of the Modelo formation was located at 3 m depth (Geosoils, 1992).

PROCESSED RECORDS FROM NORTHRIDGE AFTERSHOCKS

This report presents processed data (instrument and baseline-corrected acceleration, velocity, displacement and response spectra) from 21 accelerograms recorded at the two CSMIP Tarzana stations. The accelerograms were obtained during eleven Northridge aftershocks with local magnitudes ranging from 3.2 to 5.9. Nineteen of the 21 accelerograms were recorded on digital instruments (12-bit, 0.25 g maximum acceleration recorder) installed several days after the Northridge mainshock.

Two accelerograms recorded on the analog instrument at Tarzana - Cedar Hills Nursery are also included. The processed data from the accelerogram of the magnitude 5.9 aftershock that occurred about one minute after the mainshock are presented. This record

is from the largest Northridge aftershock. Also, included are the processed data from the analog record of the March 20, 1994 aftershock. During this earthquake the peak motions were clipped on the digital recorder when peak accelerations exceeded 0.25 g. The peak acceleration from the analog recorder is 0.37 g.

The following table lists the location, origin time and magnitude for these eleven aftershocks as determined by the California Institute of Technology. The table also lists the page number on which the processed data are reproduced.

TABLE 1 - SUMMARY OF NORTHRIDGE AFTERSHOCK INFORMATION

Page No.	Date	Origin Time	Epicenter Coordinates	Depth	Magnitude
11	Jan 17, 1994	12:31:57.8	34.279N 118.474W	0	5.9 ML
15	Jan 27, 1994	17:19:58.8	34.274N 118.563W	15	4.6 ML
23	Mar 20, 1994	21:20:12.2	34.231N 118.475W	13	5.3 ML
31	May 3, 1994	00:30:46.3	34.181N 118.566W	7	3.2 ML
39	May 16, 1994	08:40:46.7	34.330N 118.619W	14	3.8 ML
47	May 25, 1994	12:56:57.0	34.312N 118.393W	7	4.4 ML
55	May 28, 1994	17:15:12.3	34.355N 118.682W	12	3.6 ML
63	Jun 2, 1994	03:27:14.4	34.277N 118.457W	11	3.8 ML
71	Jun 15, 1994	05:59:48.6	34.311N 118.398W	7	4.2 ML
79	Jul 11, 1994	06:50:49.6	34.260N 118.692W	16	3.7 ML
87	Jun 26, 1995	08:40:28.9	34.394N 118.669W	13	5.0 ML

For each record, four processed-data plots are presented in the following order:

1st Page Phase 2 (Vol. 2) data: Instrument and baseline-corrected acceleration, velocity and displacement. The data for the full processed length (either 40 or 25 seconds) are plotted with equal scaling for all channels. The Usable Data Bandwidth used in the processing is indicated on the plots. In general, the Usable Data Bandwidth (UDB) of the Phase 2 data is from 0.51 to 47.2 Hz (0.02 to 2.0 sec period) which is indicated on the plots (see Definition of Usable Data Bandwidth). Two exception are the records from the January 17, 1994 and the March 20, 1994 aftershocks, recorded by an analog accelerograph (SMA-1) at Tarzana - Cedar Hills Nursery, for which the UDB is from 0.51 to 23.6 Hz (0.04 to 2.0 sec). Three channels of acceleration, velocity and displacement are plotted on a single page.

2nd Page Phase 1 (Vol. 1) data: Uncorrected accelerations. Acceleration for the full processed record length is plotted with each channel individually scaled so record details can be observed; three channels are plotted on a single page. In general, the full processed length for these records is 40 seconds (25 seconds in several cases).

3rd Page Phase 3 (Vol. 3) data: Response spectra - Linear Sa. The absolute acceleration spectra (Sa) for 0%, 2%, 5%, and 10% dampings are plotted against period with linear-linear scaling from 0 to 1 seconds. The spectra are plotted for periods within the Usable Data Bandwidth. Three channels are plotted on a single page.

4th Page Phase 3 (Vol. 3) data: Response spectra - Log Sv. The pseudo-velocity spectra (PSV), the pseudo-acceleration spectra (PSA), and the displacement spectra (SD) are presented on a tripartite logarithmic plot for each channel for 0%, 2%, 5%, 10%, and 20% dampings. The spectra are plotted for periods within the Usable Data Bandwidth. Three channels are plotted on a single page. Note that the amplitude scale has been shifted up by a factor of 10 from the normal spectral plot presentation.

ORGANIZATION OF THE REPORT

The locations of the two Tarzana strong-motion stations and the aftershock epicenters are shown in Figure 2. A three-digit station code is shown on the map adjacent to each station symbol. The station code, the CSMIP station number and the station name are cross-referenced in Table 2. Table 2 provides listing of stations, information on site conditions and station coordinates. Detailed information about each record, including peak acceleration, velocity and displacement, instrument orientation, and usable data bandwidth, are presented in Table 2. For 9 aftershocks the processed data from both the digital accelerograph at Tarzana - Cedar Hill Nursery and Tarzana - Clubhouse are presented. In addition, the data from the analog accelerogram of the aftershock that occurred about one minute after the mainshock on January 17, 1994 are presented.

Only the processed data from the analog accelerograph record of the March 20, 1994 at the Tarzana - Cedar Hill Nursery are included in this report. Both horizontal components of the digital record clipped when the motions exceeded the maximum level of 0.25 g set for this recorder. One horizontal component of the record from the March 20, 1994 event recorded by digital instrument at the Clubhouse was also clipped. The peak motions were clipped on only two adjacent peaks occurring between 8.0 to 8.1 sec into the record. We estimated the peak motion from this accelerogram by a careful extrapolation of the acceleration traces based on an assumption that the gradient was similar as recorded on nearby peaks. Using this method, the peak acceleration of this component is probably between 0.28 and 0.29 g. Small differences (less than 1%) are obtained between the processed velocities, displacements and response spectra calculated from the clipped or the extrapolated accelerograms. The processed data from the original accelerogram are included in this report.

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ACKNOWLEDGEMENTS

The California Strong Motion Instrumentation Program extends its appreciation to Ralph Herman Sr. for his long-term cooperation with strong motion instrumentation at Tarzana. The records presented in this report were made possible through the efforts of CSMIP technicians who installed and maintained these stations for many years. Robert Sydnor of CSMIP provided information about the geology of the sites.

This material is based upon work supported by CSMIP and the National Science Foundation under Grant No. CMS-9416424. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

TABLE 2 - SUMMARY OF PROCESSED GROUND-RESPONSE RECORDS FROM

Station No.	Station Name	Station Coordinates N Lat.	W Long.	Site Geology	Instrument Housing *	Epicentral Dist. ** (km)
24436	Tarzana Cedar Hill Nursery A	34.160	118.534	Thin alluvium over silstone	Instr. shltr. H	14.3
24436	Tarzana Cedar Hill Nursery A	34.160	118.534	Thin alluvium over silstone	Instr. shltr. H	12.9
24T03	Tarzana Clubhouse	34.160	118.532	Alluvium	Instr. shltr. F	13.0
24436	Tarzana Cedar Hill Nursery A	34.160	118.534	Thin alluvium over silstone	Instr. shltr. H	9.6
24T03	Tarzana Clubhouse	34.160	118.532	Alluvium	Instr. shltr. F	9.5
24436	Tarzana Cedar Hill Nursery A	34.160	118.534	Thin alluvium over silstone	Instr. shltr. H	3.8
24T03	Tarzana Clubhouse	34.160	118.532	Alluvium	Instr. shltr. F	3.9
24436	Tarzana Cedar Hill Nursery A	34.160	118.534	Thin alluvium over silstone	Instr. shltr. H	20.4
24T03	Tarzana Clubhouse	34.160	118.532	Alluvium	Instr. shltr. F	20.5
24436	Tarzana Cedar Hill Nursery A	34.160	118.534	Thin alluvium over silstone	Instr. shltr. H	21.3
24T03	Tarzana Clubhouse	34.160	118.532	Alluvium	Instr. shltr. F	21.2

AFTERSHOCKS OF THE NORTHRIDGE EARTHQUAKE OF JANUARY 17, 1994

Station No.	Earthq. Date	Component Azimuth (deg.)	Peak Accel. (g) #	Peak Velocity (cm/sec)	Peak Displ. (cm)	Usable Data Bandwidth
24436 SMA	1/17/94	90	0.345	14.6	1.30	0.51-23.6 Hz
		UP	0.152	3.5	0.35	(0.04-1.96 sec)
		360	0.232	11.4	0.86	
24436	1/27/94	90	0.096	5.4	0.29	0.51-47.2 Hz
		UP	0.069	1.2	0.04	(0.02-1.96 sec)
		180	0.117	5.3	0.27	
24T03	1/27/94	90	0.039	1.8	0.15	0.51-47.2 Hz
		UP	0.062	0.9	0.03	(0.02-1.96 sec)
		180	0.021	0.7	0.05	
24436 SMA	3/20/94	90	0.374	11.8	0.78	0.51-23.6 Hz
		UP	0.144	3.7	0.25	(0.04-1.96 sec)
		360	0.312	12.8	0.99	
24T03	3/20/94	90	0.171	5.9	0.42	0.51-47.2 Hz
		UP	0.105	3.1	0.22	(0.02-1.96 sec)
		180	0.250##	7.2	0.62	
24436	5/03/94	90	0.028	0.68	0.02	0.51-47.2 Hz
		UP	0.041	0.68	0.02	(0.02-1.96 sec)
		180	0.035	0.82	0.04	
24T03	5/03/94	90	0.019	0.40	0.01	0.51-47.2 Hz
		UP	0.042	0.58	0.01	(0.02-1.96 sec)
		180	0.013	0.27	0.02	
24436	5/16/94	90	0.031	0.81	0.03	0.51-47.2 Hz
		UP	0.022	0.48	0.01	(0.02-1.96 sec)
		180	0.028	0.86	0.03	
24T03	5/16/94	90	0.017	0.43	0.01	0.51-47.2 Hz
		UP	0.011	0.18	0.01	(0.02-1.96 sec)
		180	0.013	0.31	0.02	
24436	5/25/94	90	0.027	0.73	0.06	0.51-47.2 Hz
		UP	0.016	0.41	0.02	(0.02-1.96 sec)
		180	0.035	0.87	0.05	
24T03	5/25/94	90	0.017	0.46	0.04	0.51-47.2 Hz
		UP	0.014	0.26	0.02	(0.02-1.96 sec)
		180	0.013	0.56	0.04	

TABLE 2 - SUMMARY OF PROCESSED GROUND-RESPONSE RECORDS FROM

Station No.	Station Name	Station Coordinates N Lat.	Station Coordinates W Long.	Site Geology	Instrument Housing *	Epicentral Dist. ** (km)
24436	Tarzana Cedar Hill Nursery A	34.160	118.534	Thin alluvium over silstone	Instr. shltr. H	25.6
24T03	Tarzana Clubhouse	34.160	118.532	Alluvium	Instr. shltr. F	25.7
24436	Tarzana Cedar Hill Nursery A	34.160	118.534	Thin alluvium over silstone	Instr. shltr. H	14.8
24T03	Tarzana Clubhouse	34.160	118.532	Alluvium	Instr. shltr. F	14.7
24436	Tarzana Cedar Hill Nursery A	34.160	118.534	Thin alluvium over silstone	Instr. shltr. H	20.9
24T03	Tarzana Clubhouse	34.160	118.532	Alluvium	Instr. shltr. F	20.8
24436	Tarzana Cedar Hill Nursery A	34.160	118.534	Thin alluvium over silstone	Instr. shltr. H	18.3
24T03	Tarzana Clubhouse	34.160	118.532	Alluvium	Instr. shltr. F	18.5
24436	Tarzana Cedar Hill Nursery A	34.160	118.534	Thin alluvium over silstone	Instr. shltr. H	28.8
24T03	Tarzana Clubhouse	34.160	118.532	Alluvium	Instr. shltr. F	28.9

* - Instrument shelter types:
Instr. shltr H - small fiberglass shelter
Instr. shltr F - small, 1-story building
** - Distance given relative to the aftershock epicenter.

AFTERSHOCKS OF THE NORTHRIDGE EARTHQUAKE OF JANUARY 17, 1994 (continued)

Station No.	Earthq. Date	Component Azimuth (deg.)	Peak Accel. (g) #	Peak Velocity (cm/sec)	Peak Displ. (cm)	Usable Data Bandwidth
24436	5/28/94	90	0.013	0.47	0.02	0.51-47.2 Hz
		UP	0.005	0.14	0.01	(0.02-1.96 sec)
		180	0.016	0.59	0.03	
24T03	5/28/94	90	0.005	0.23	0.01	0.51-47.2 Hz
		UP	0.004	0.09	0.01	(0.02-1.96 sec)
		180	0.004	0.15	0.01	
24436	6/02/94	90	0.016	0.45	0.03	0.51-47.2 Hz
		UP	0.010	0.21	0.01	(0.02-1.96 sec)
		180	0.015	0.63	0.04	
24T03	6/02/94	90	0.010	0.25	0.02	0.51-47.2 Hz
		UP	0.010	0.13	0.01	(0.02-1.96 sec)
		180	0.011	0.32	0.02	
24436	6/15/94	90	0.028	0.98	0.07	0.51-47.2 Hz
		UP	0.019	0.38	0.01	(0.02-1.96 sec)
		180	0.019	0.52	0.03	
24T03	6/15/94	90	0.022	0.63	0.05	0.51-47.2 Hz
		UP	0.022	0.30	0.01	(0.02-1.96 sec)
		180	0.018	0.46	0.02	
24436	7/11/94	90	0.026	0.64	0.02	0.51-47.2 Hz
		UP	0.022	0.35	0.01	(0.02-1.96 sec)
		180	0.021	0.50	0.03	
24T03	7/11/94	90	0.010	0.27	0.01	0.51-47.2 Hz
		UP	0.010	0.25	0.01	(0.02-1.96 sec)
		180	0.015	0.38	0.02	
24436	6/26/95	90	0.073	3.0	0.19	0.51-47.2 Hz
		UP	0.028	1.1	0.07	(0.02-1.96 sec)
		180	0.104	4.4	0.26	
24T03	6/26/95	90	0.037	1.5	0.14	0.51-47.2 Hz
		UP	0.031	0.7	0.06	(0.02-1.96 sec)
		180	0.053	1.8	0.13	

Phase 1 (Volume 1) peak acceleration values.
Component of accelerogram was clipped.

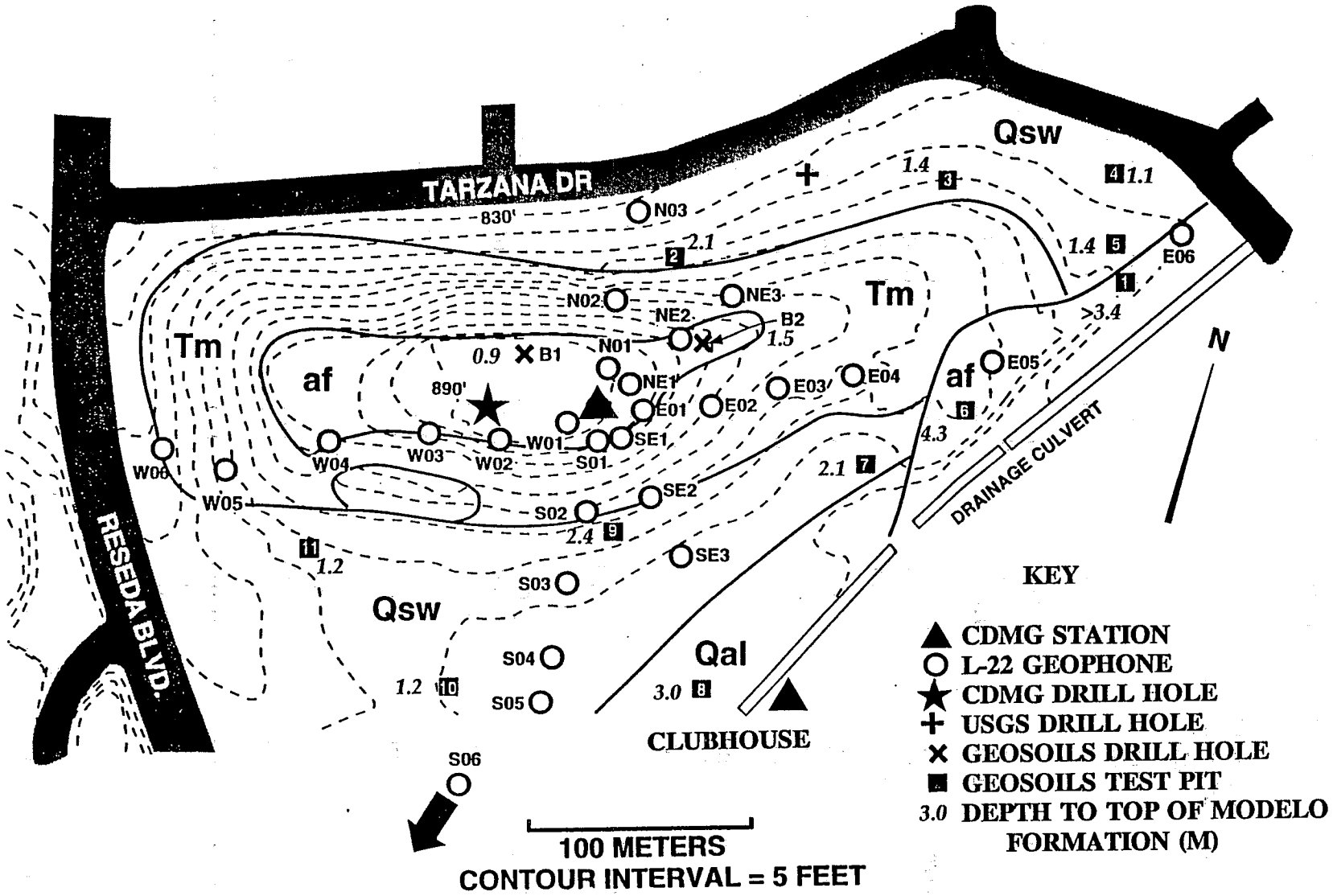


Figure 1. Map showing the locations of Tarzana - Cedar Hill Nursery station and Tarzana - Clubhouse (reference site). The Clubhouse is located about 150 m from the Cedar Hill station. The borehole is located about 49 m (160') from the Cedar Hill station. (The basemap is modified from Spudich et al., 1996).

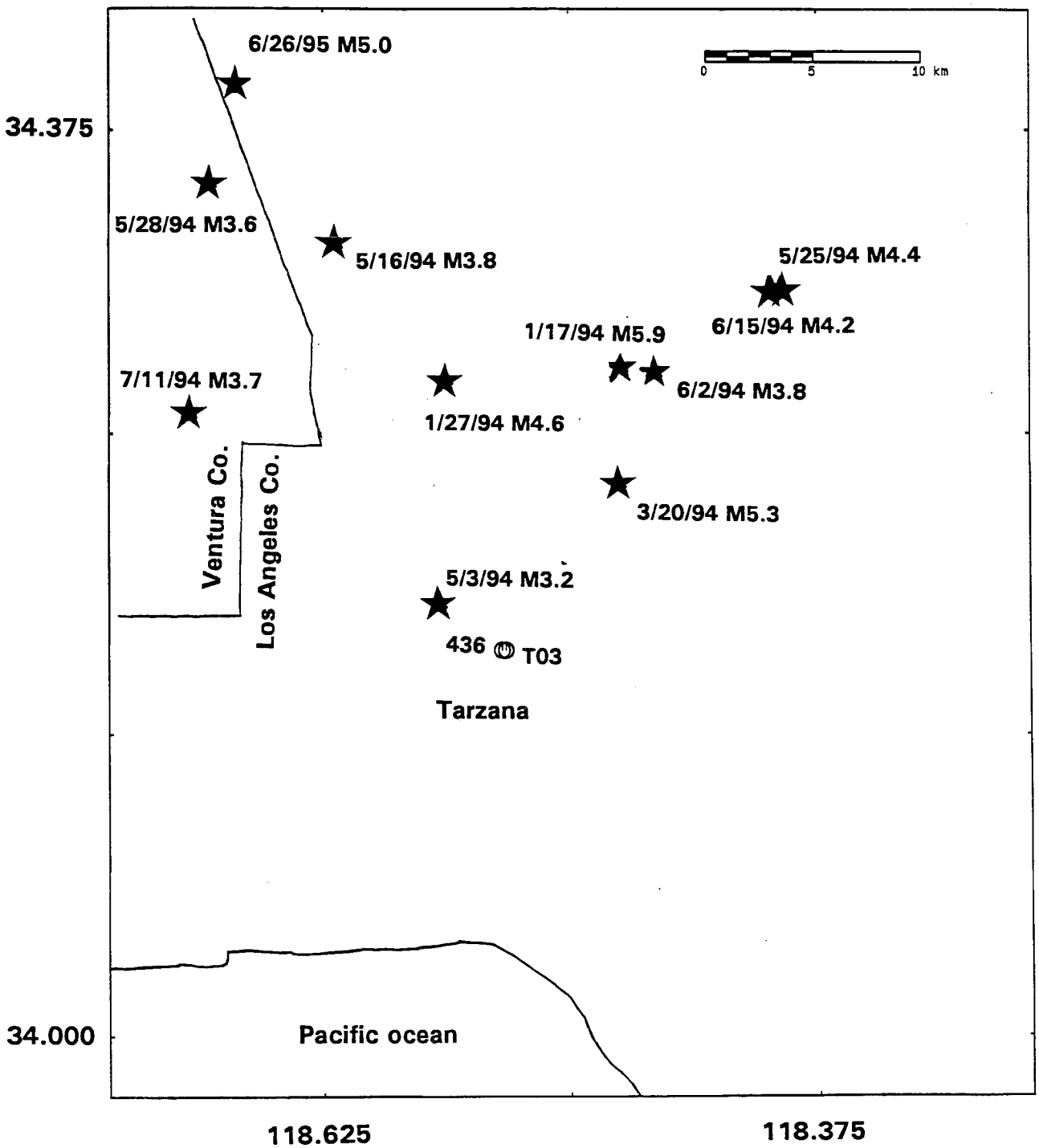
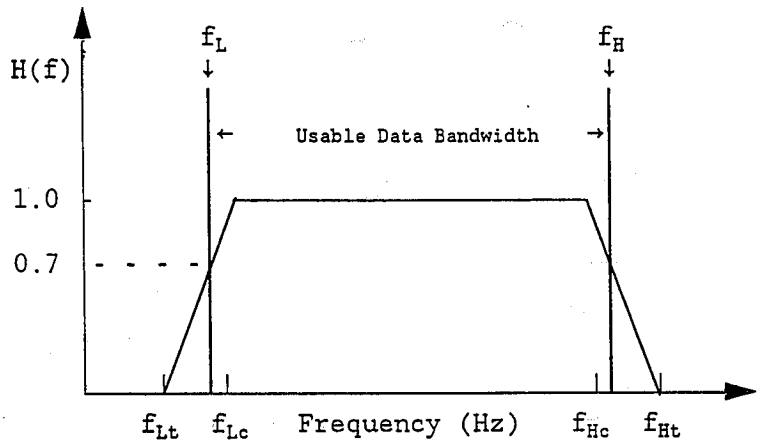


Figure 2. Map showing the locations of Tarzana - Cedar Hill Nursery station (436) and the reference site at Tarzana - Clubhouse (T03). The Clubhouse is located about 150 m from the Cedar Hill station. The location of the eleven Northridge aftershocks are shown as stars.

DEFINITION OF USABLE DATA BANDWIDTH

The filter bands for each record are indicated on the plots for the Phase 2 and Phase 3 data. In standard processing, the digitized data are processed and filtered using Ormsby filters. The data are first low-pass filtered using a high-frequency filter with a corner frequency of 46 Hz and a roll-off termination frequency of 50 Hz. Then the data are high-pass filtered using a low-frequency filter with a corner frequency of 0.07 Hz and a roll-off termination of 0.05 Hz. Therefore, the Phase 2 data is the result of the digitized data being filtered by the bandpass filter H(f) with ramps as shown in the figure:



The Usable Data Bandwidth is defined as the band between frequencies f_H and f_L, where f_H and f_L are the -3 dB points on the high-frequency and low-frequency ramps, respectively. The value of H(f) is approximately equal to 0.7 for -3 dB (see Notes). The user should only use these data for analyses within this bandwidth.

Notes:

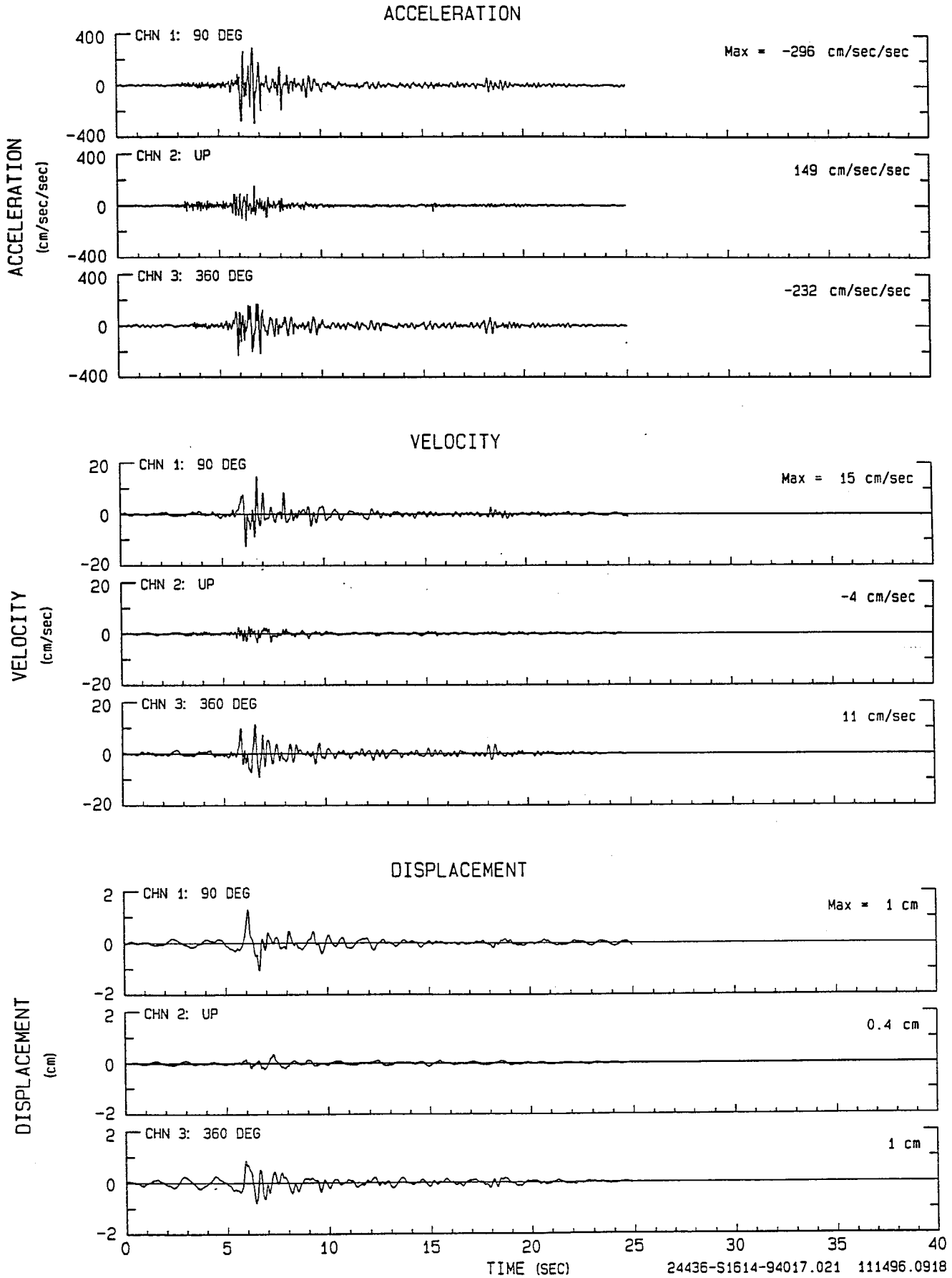
1) The values of f_H and f_L can be calculated from the corner frequencies (f_{Hc}, f_{Lc}) and the roll-off termination frequencies (f_{Ht}, f_{Lt}) used in the processing by using the formulas $f_H = f_{Hc} + 0.3 * (f_{Ht} - f_{Hc})$ and $f_L = f_{Lc} - 0.3 * (f_{Lc} - f_{Lt})$. For example, the Usable Data Bandwidth for data bandpass-filtered with ramps at 0.30 to 0.60 Hz and 23.0 to 25.0 Hz is 0.51 Hz to 23.6 Hz (0.042 to 2.0 seconds period).

2) It is common in signal processing to plot 20 $\log_{10}[H(f)]$ versus frequency, and express the ordinate value in decibels (abbreviated dB). Accordingly, 0 dB corresponds to a value of H(f) equal to 1; 20 dB is equivalent to H(f) = 10, and -20 dB corresponds to H(f) = 0.1. Thus, at the -3 dB frequency point, the amplitude of the transfer function, H(f) is reduced to 0.7, while the power transmitted by the filter, $H^2(f)$, is reduced to 0.5.

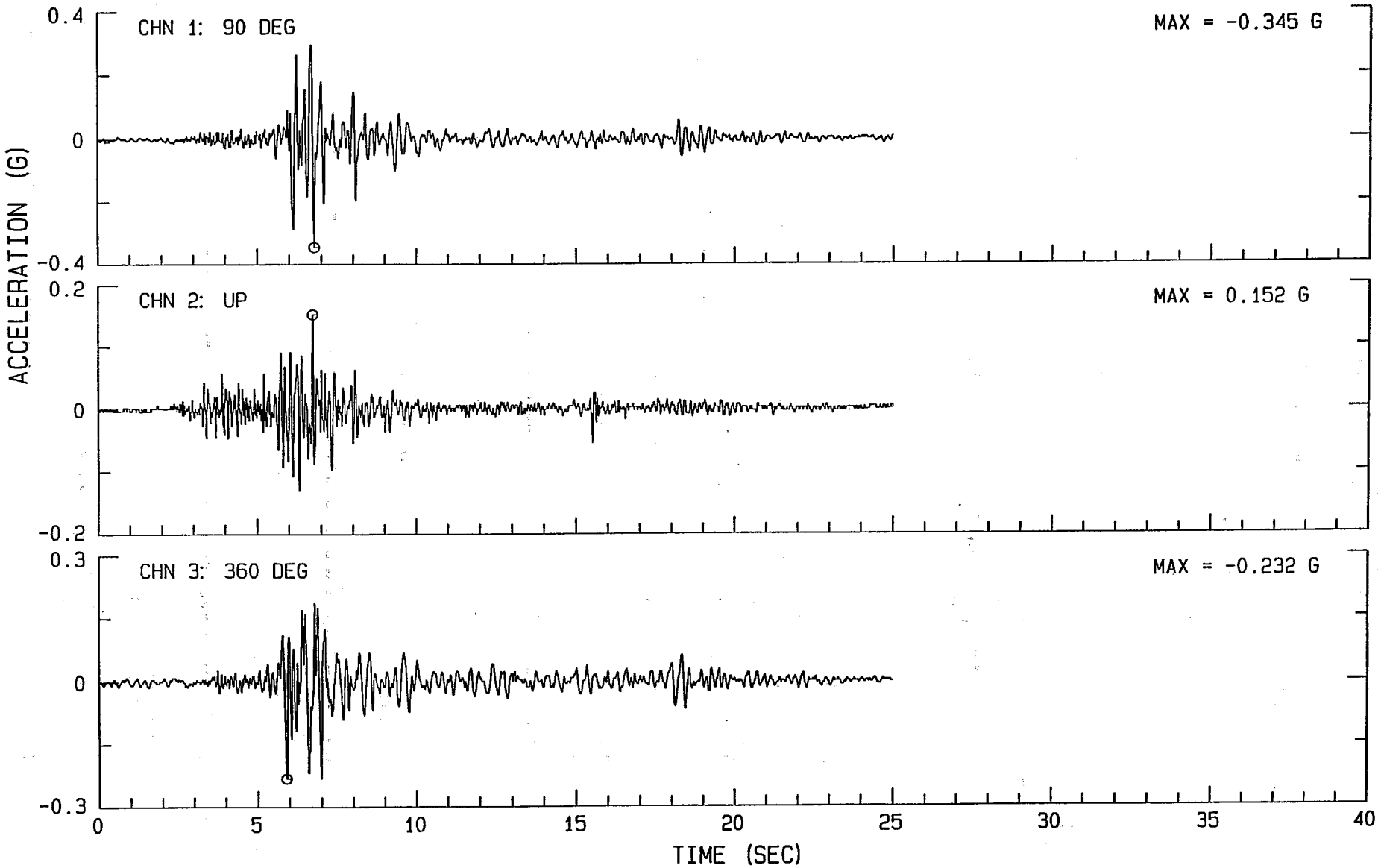
NORTHRIDGE AFTERSHOCK OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CEDAR HILL NURSERY A CSMIP Sta Num 24436

Usable Data Bandwidth: .51 to 23.6 Hz (.04 to 2.0 Sec)



NORTHRIDGE AFTERSHOCK OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
UNCORRECTED ACCELEROGRAM 24436-S1614-94017.021 111496.0917-AFTERSH1



NORTHRIDGE AFTERSHOCK OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CEDAR HILL NURSERY A
Sta Num 24436

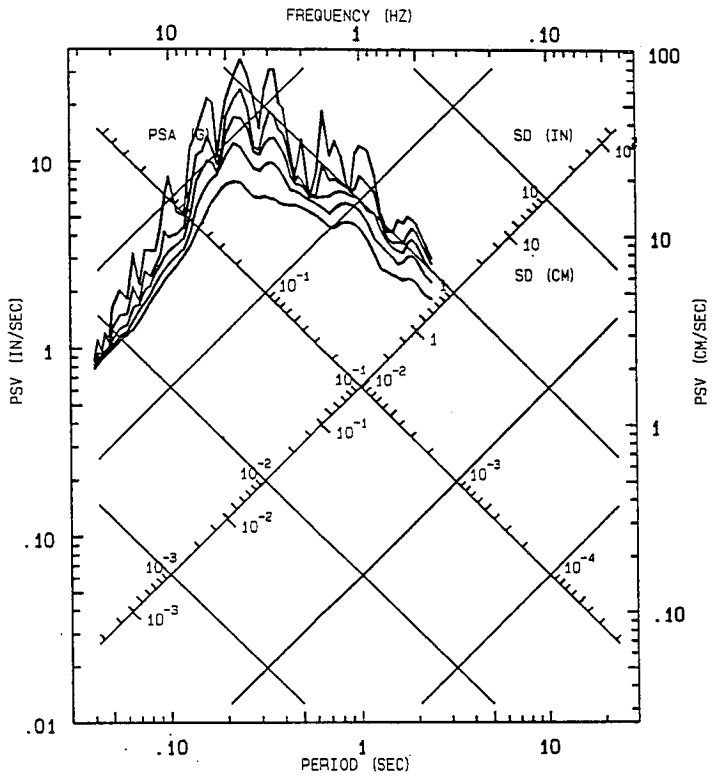
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.51 TO 23.6 HZ
(0.04 TO 2.0 SEC)

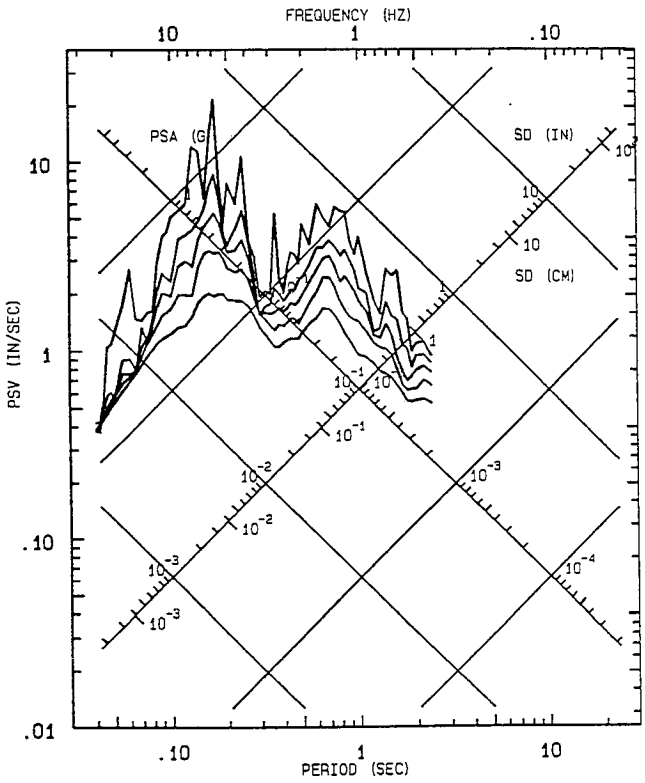
—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 24436-S1614-94017.021

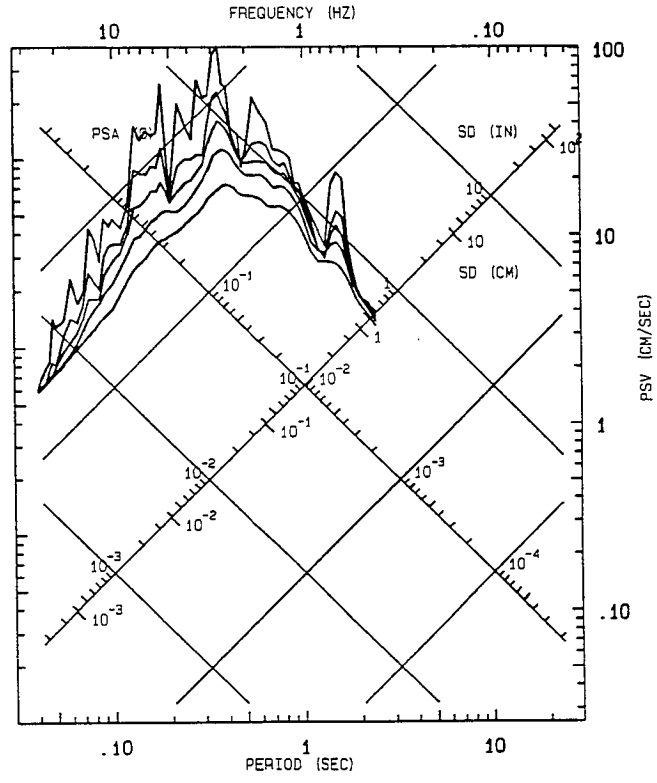
CHN 1: 90 DEG



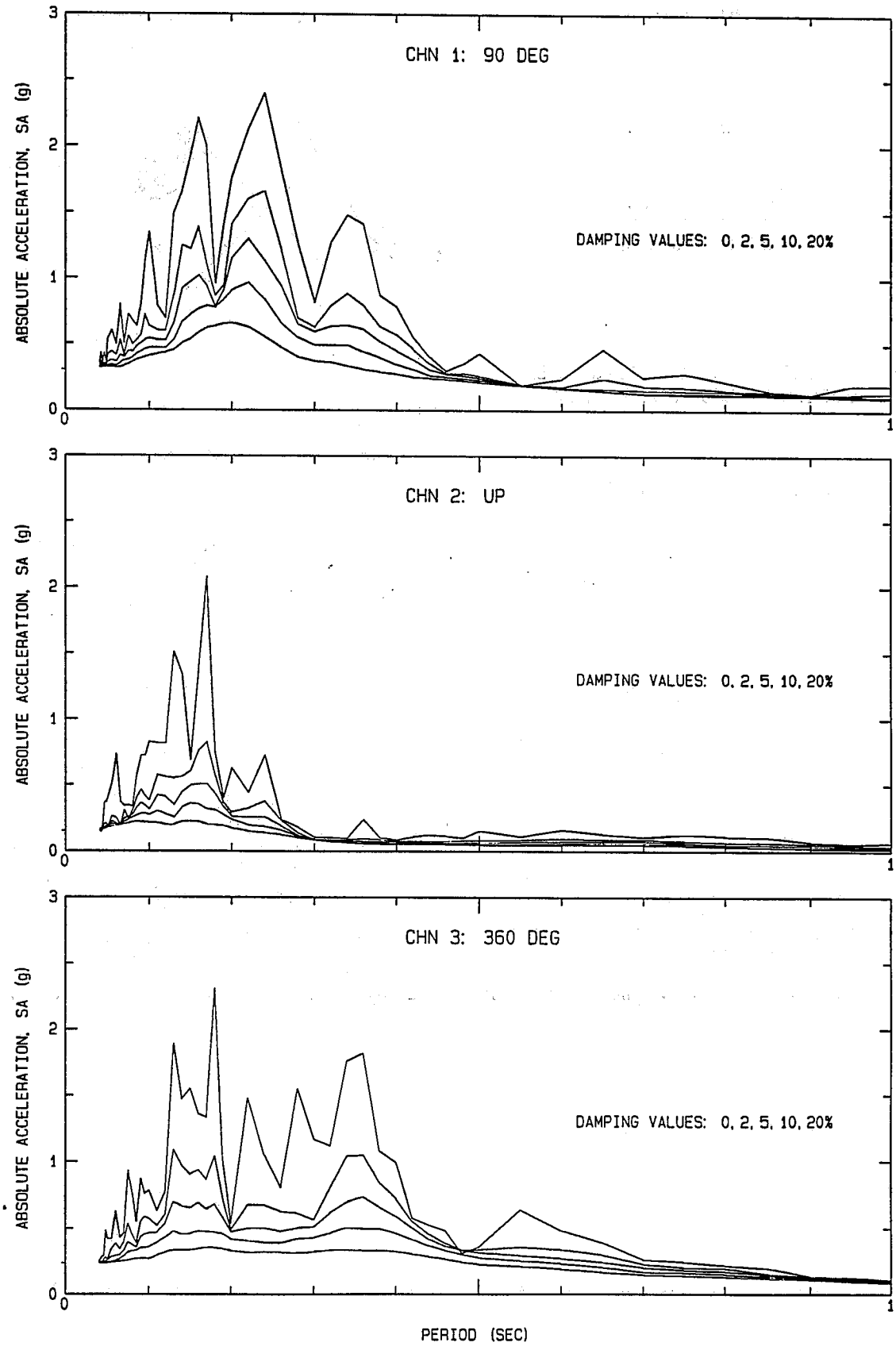
CHN 2: UP



CHN 3: 360 DEG

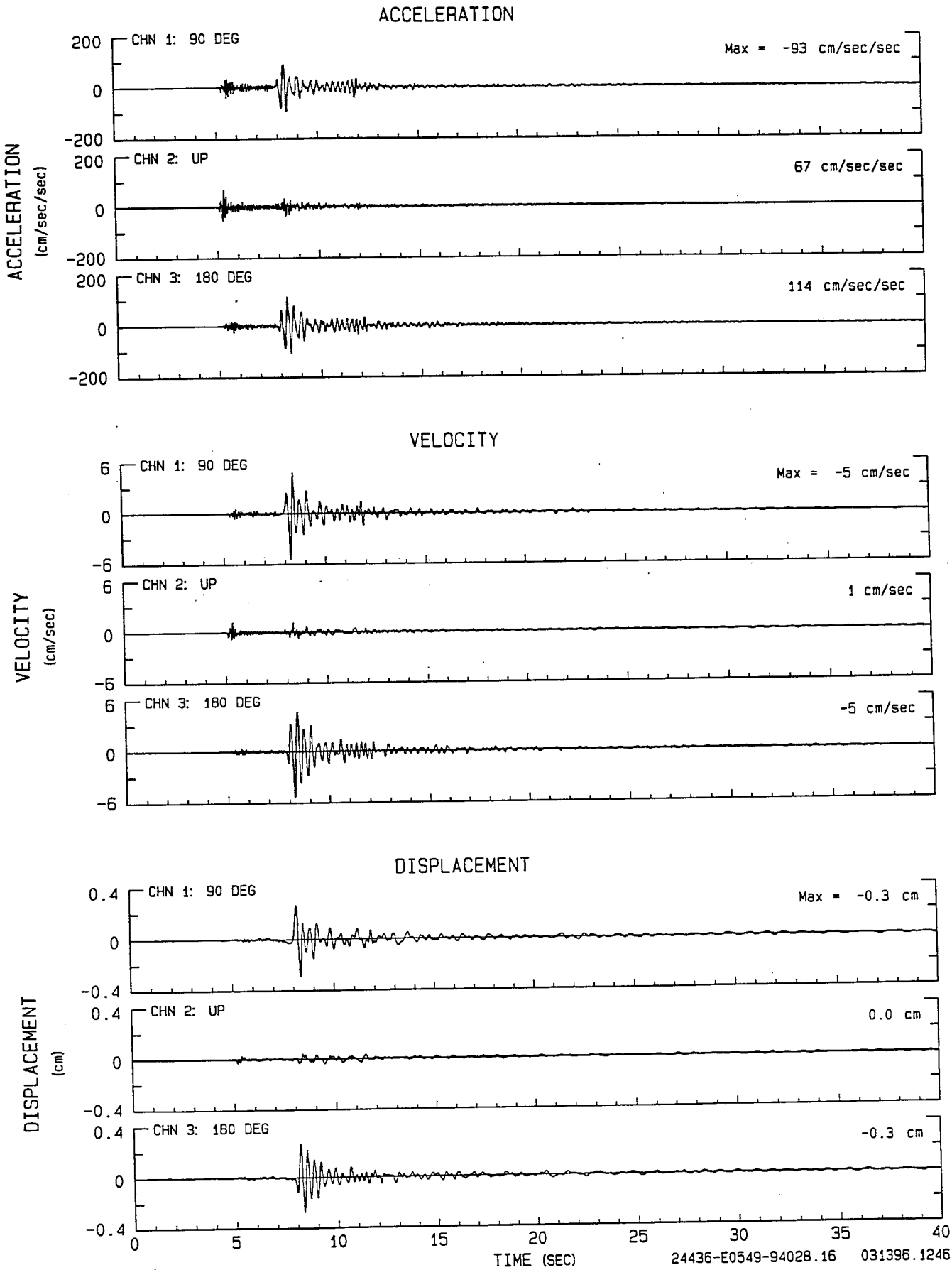


NORTHRIDGE AFTERSHOCK OF JAN 17, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .30-.60 TO 23.0-25.0 HZ.
24436-S1614-94017.021 111496.0918-AFTERSH1

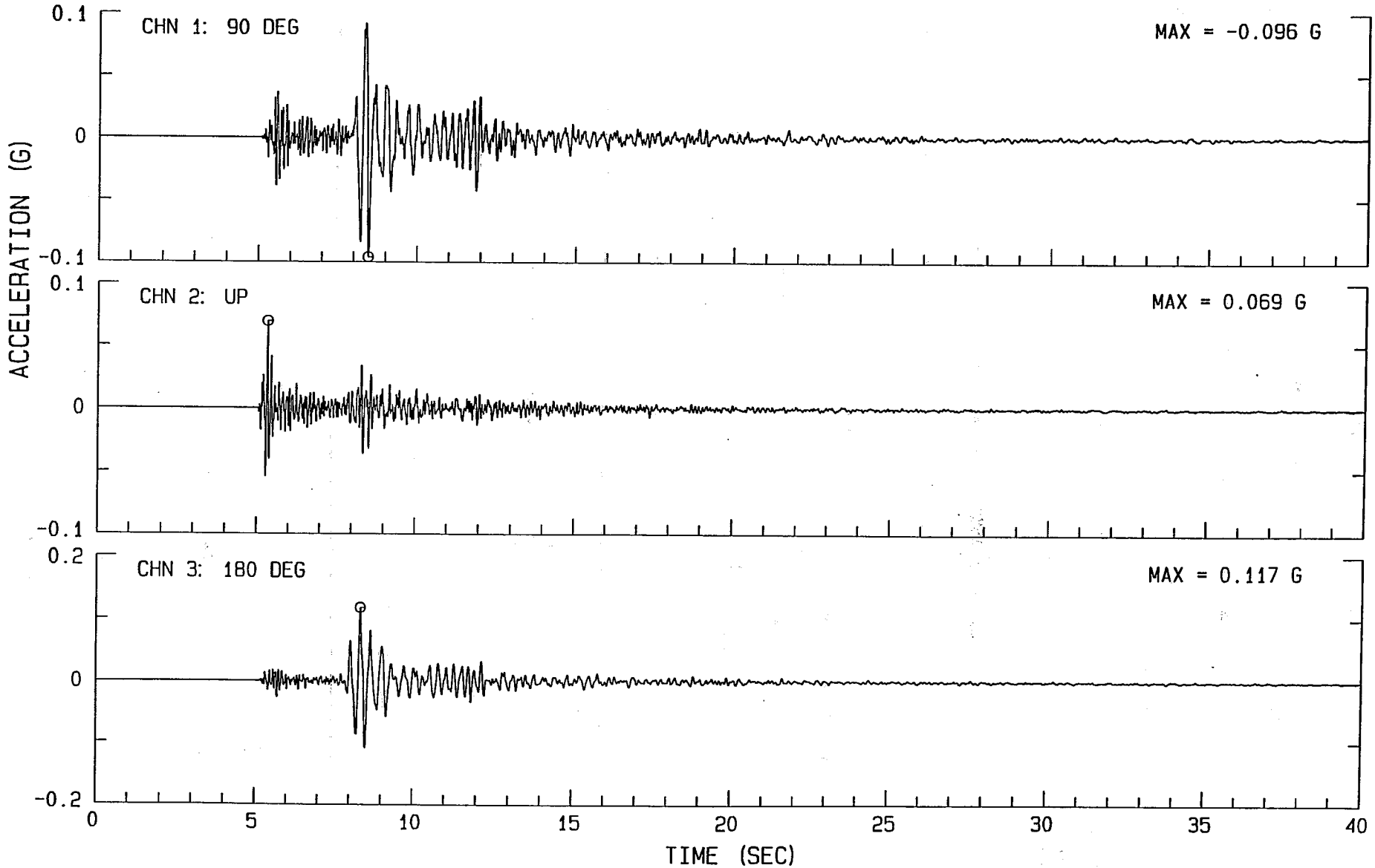


TARZANA - CEDAR HILL NURSERY A CSMIP Sta Num 24436

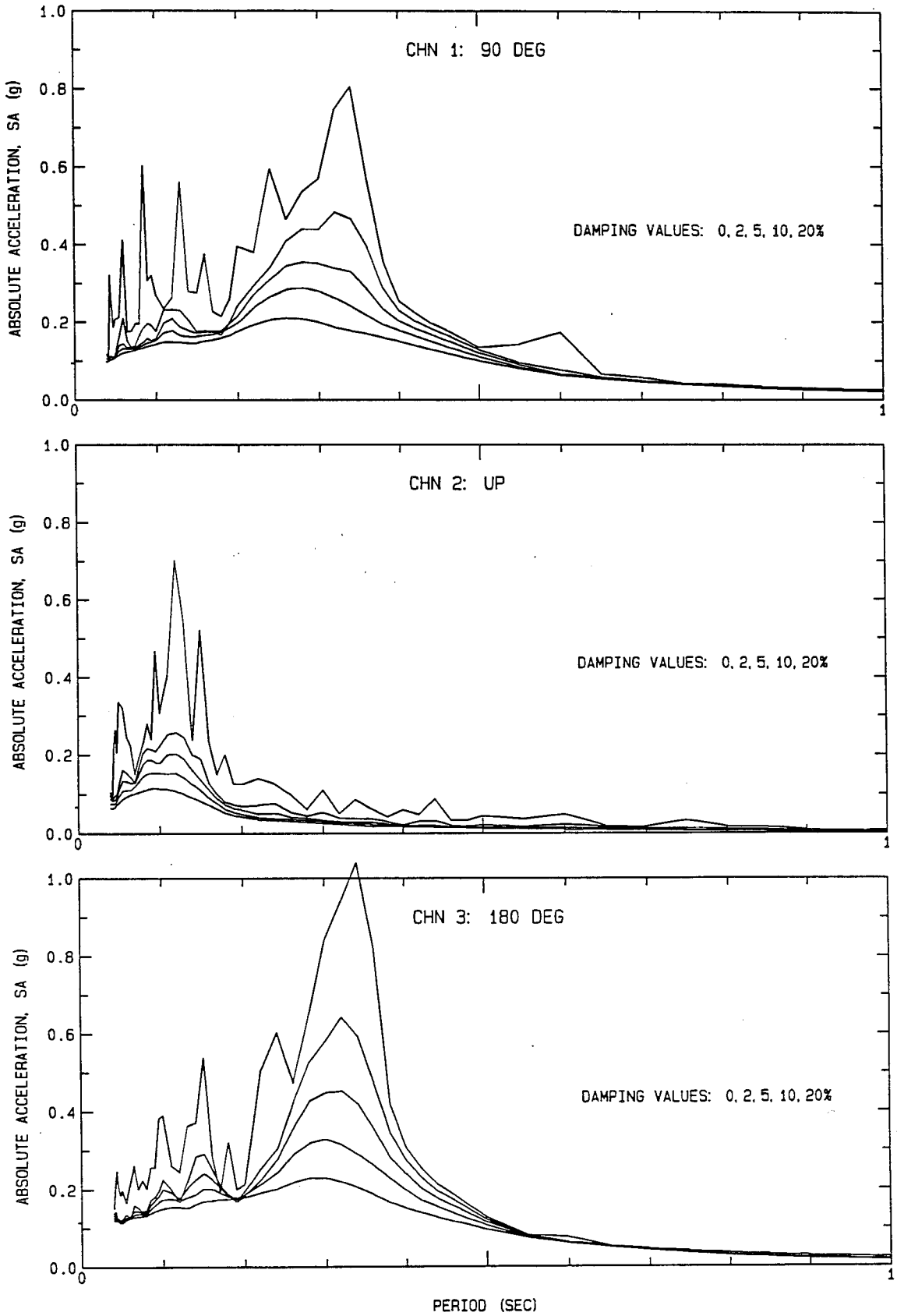
Usable Data Bandwidth: .51 to 47.2 Hz (.02 to 2.0 Sec)



NORTHRIDGE AFTERSHOCK OF JAN 27, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
UNCORRECTED ACCELEROGRAM 24436-E0549-94028.16 031396.1133-QN94B436



NORTHRIDGE AFTERSHOCK OF JAN 27, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .30-.60 TO 46.0-50.0 HZ.
24436-E0549-94028.16 031396.1247-GN94B436



NORTHRIDGE AFTERSHOCK OF JAN 27, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CEDAR HILL NURSERY A
Sta Num 24436

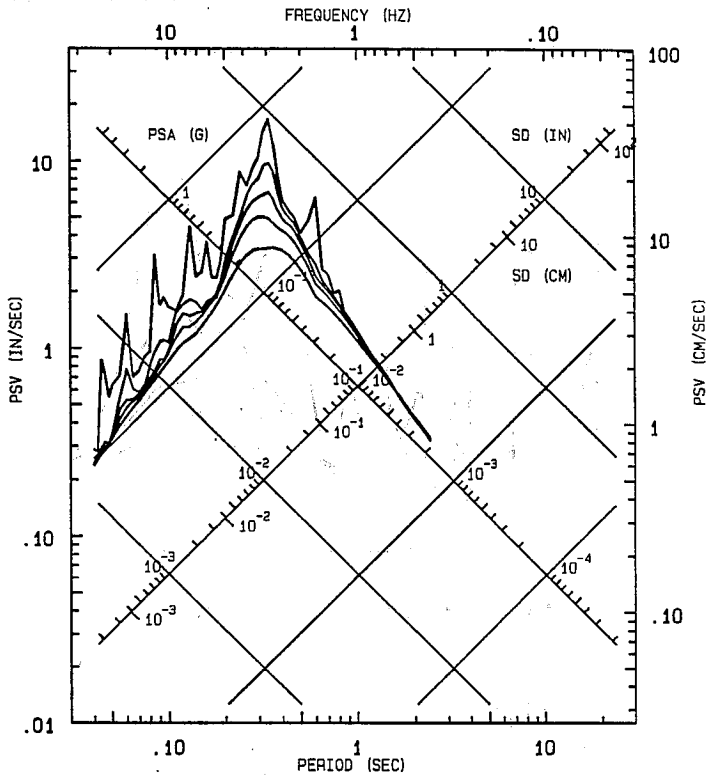
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.51 TO 47.2 HZ
(0.02 TO 2.0 SEC)

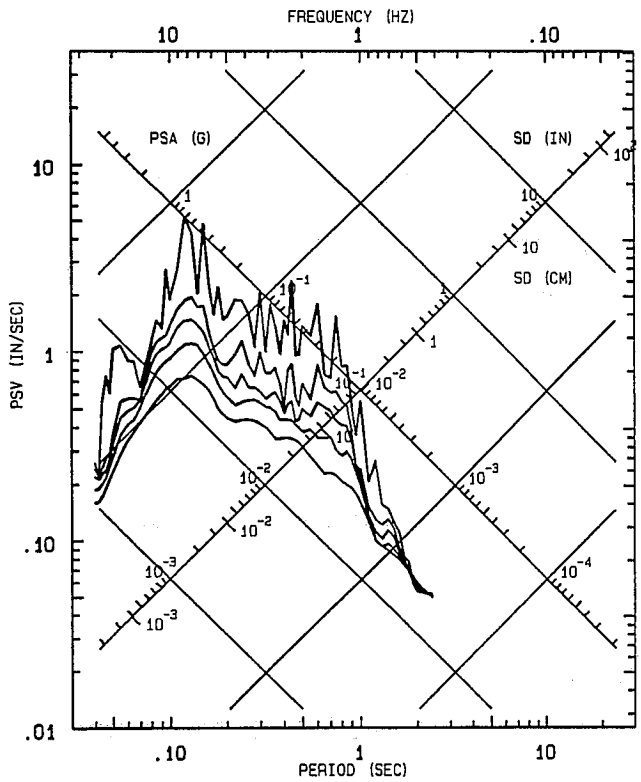
RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 24436-E0549-94028.16

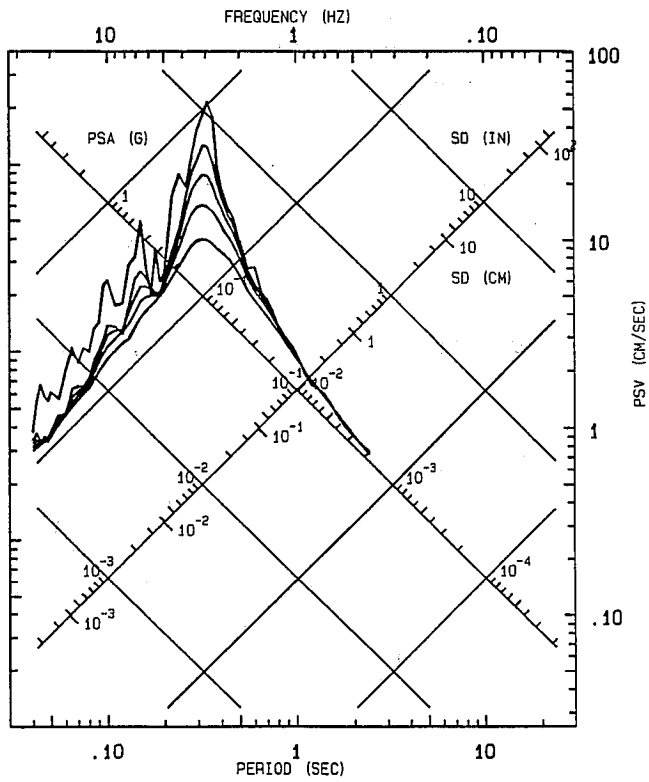
CHN 1: 90 DEG



CHN 2: UP



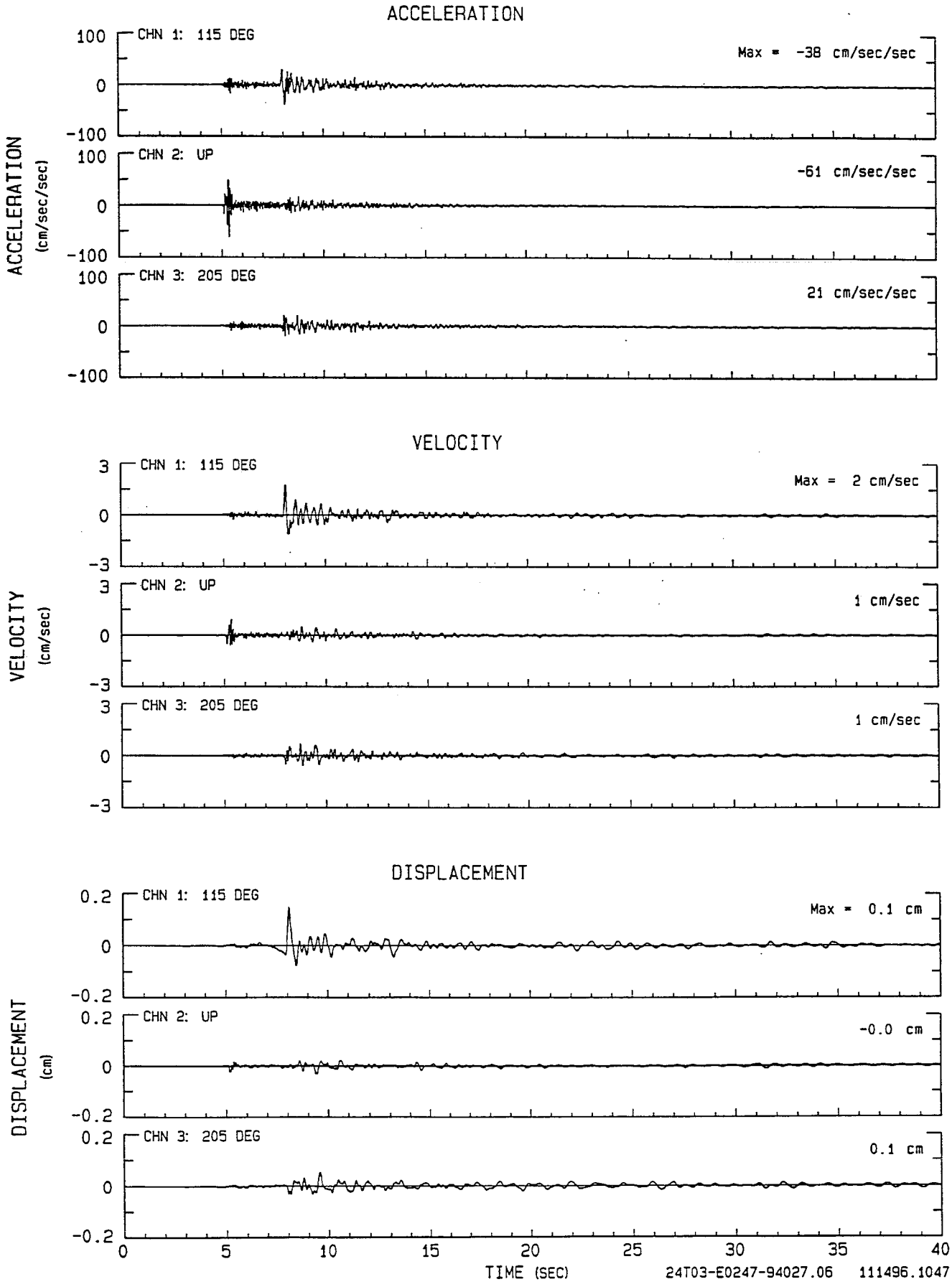
CHN 3: 180 DEG



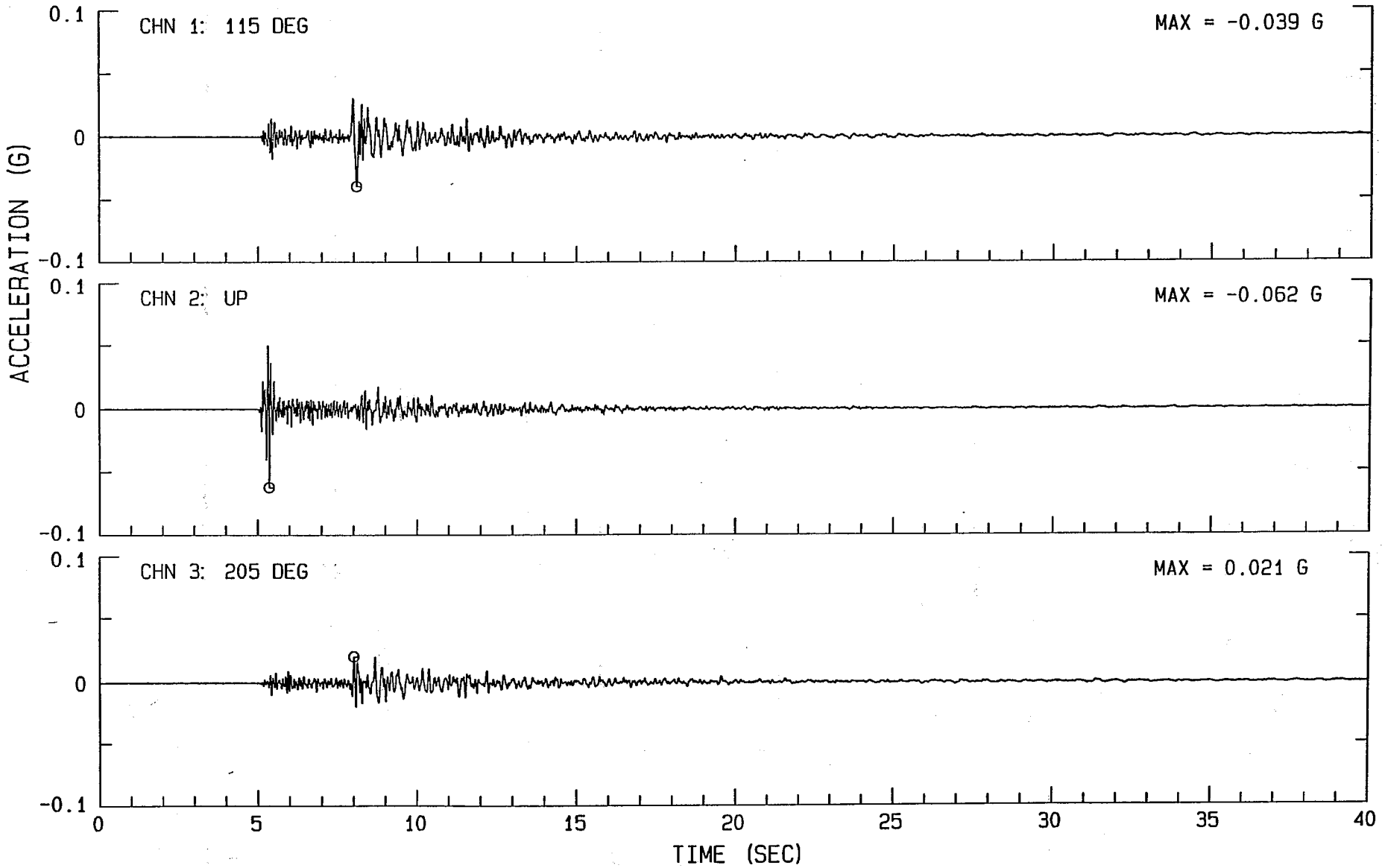
NORTHRIDGE AFTERSHOCK OF JAN 27, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CLUBHOUSE CSMIP Sta Num 24T03

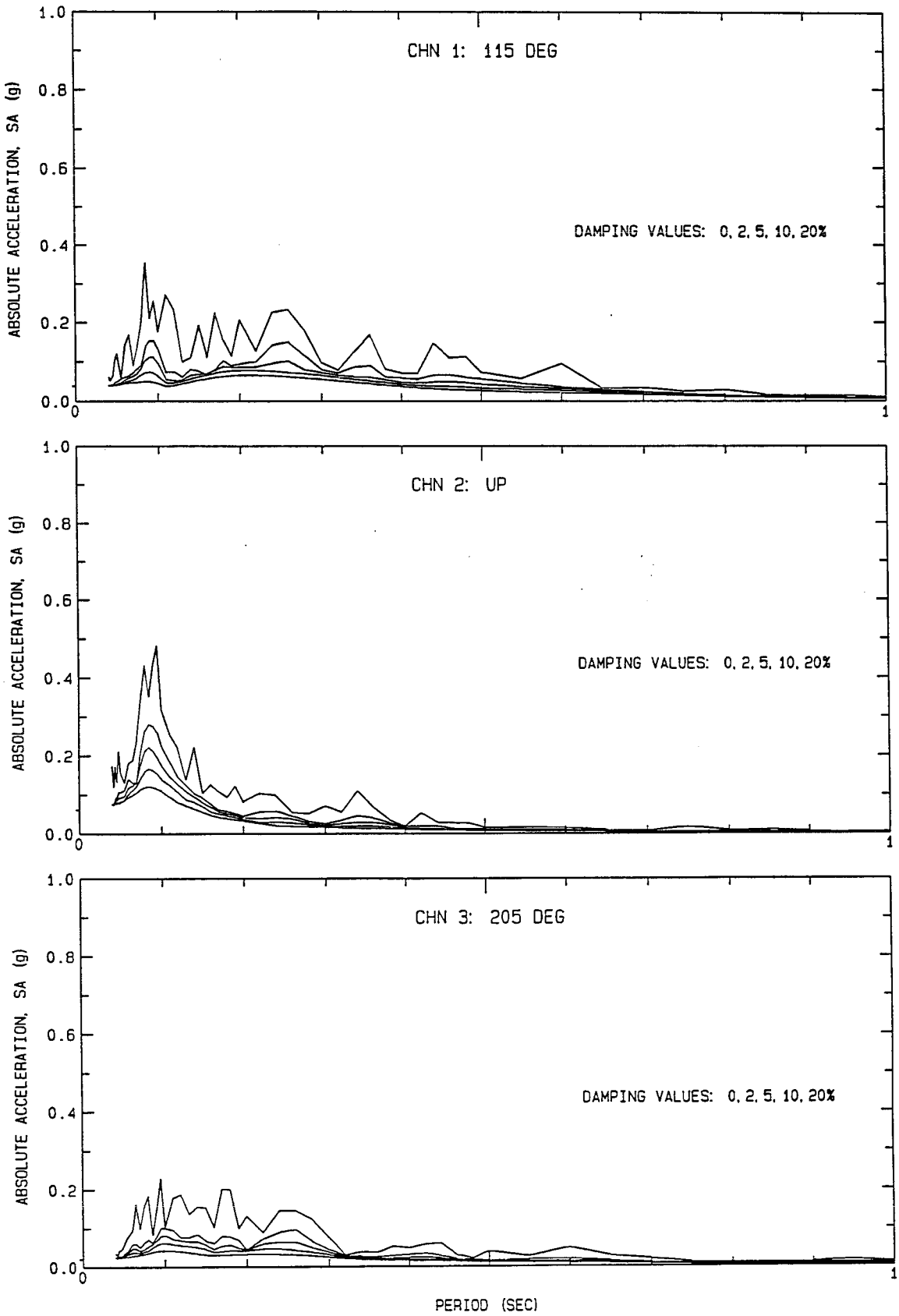
Usable Data Bandwidth: .51 to 47.2 Hz (.02 to 2.0 Sec)



NORTHRIDGE AFTERSHOCK OF JAN 27, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CLUBHOUSE
UNCORRECTED ACCELEROGRAM 24T03-E0247-94027.06 111496.1046-QN94BT03



NORTHRIDGE AFTERSHOCK OF JAN 27, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CLUBHOUSE
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .30-.60 TO 46.0-50.0 HZ.
24T03-E0247-94027.06 111496.1048-QN94BT03



NORTHRIDGE AFTERSHOCK OF JAN 27, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CLUBHOUSE
Sta Num 24T03

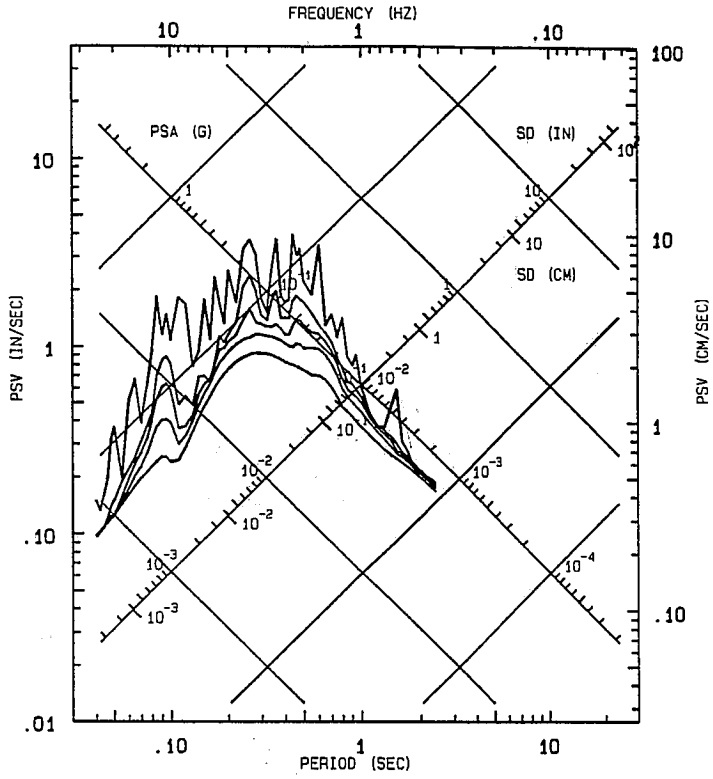
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.51 TO 47.2 HZ
(0.02 TO 2.0 SEC)

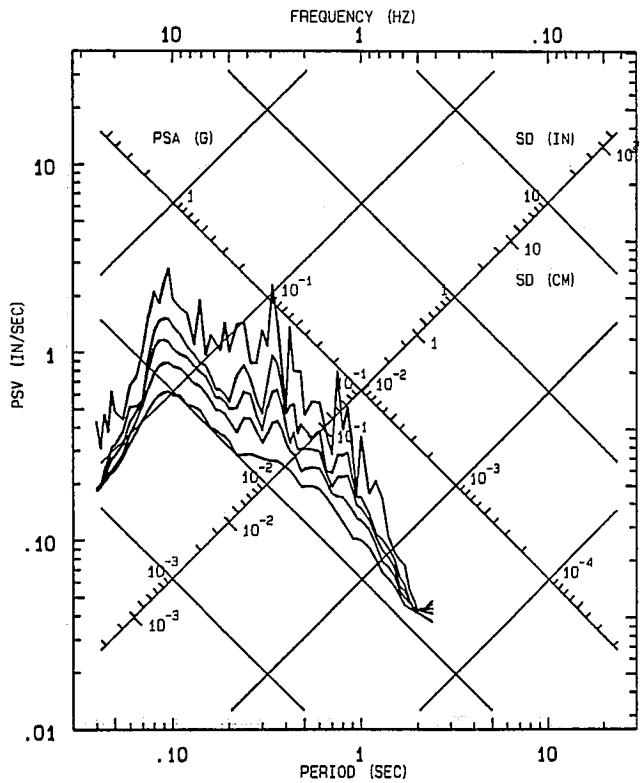
—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 24T03-E0247-94027.06

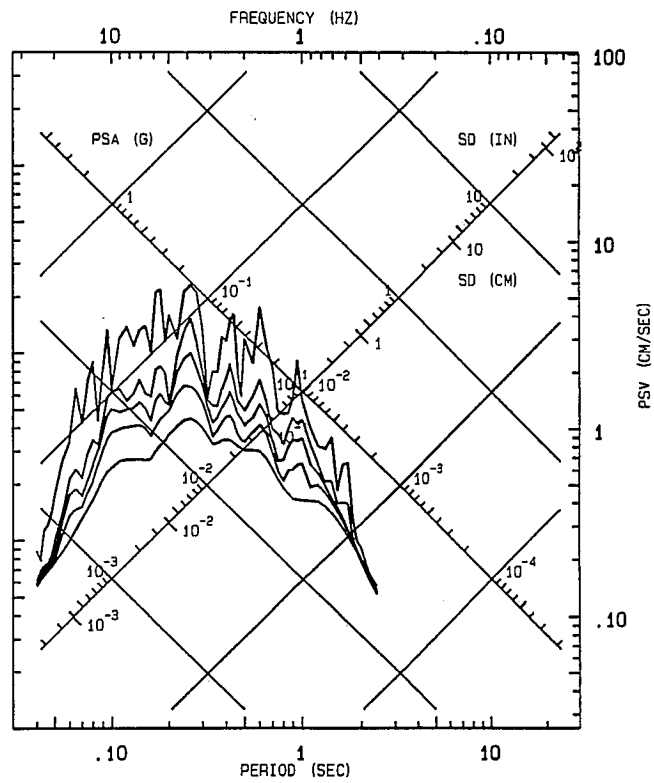
CHN 1: 115 DEG



CHN 2: UP



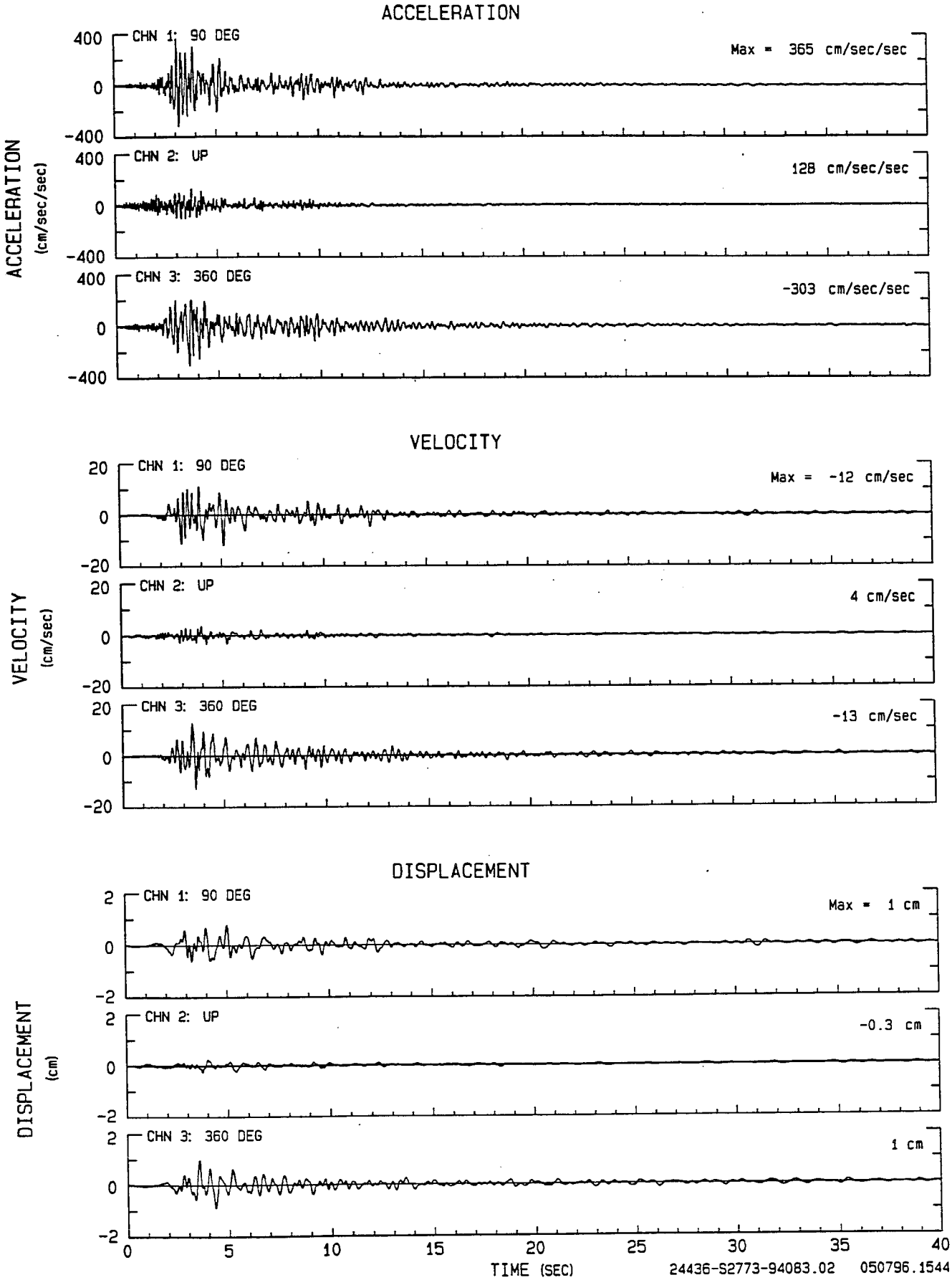
CHN 3: 205 DEG



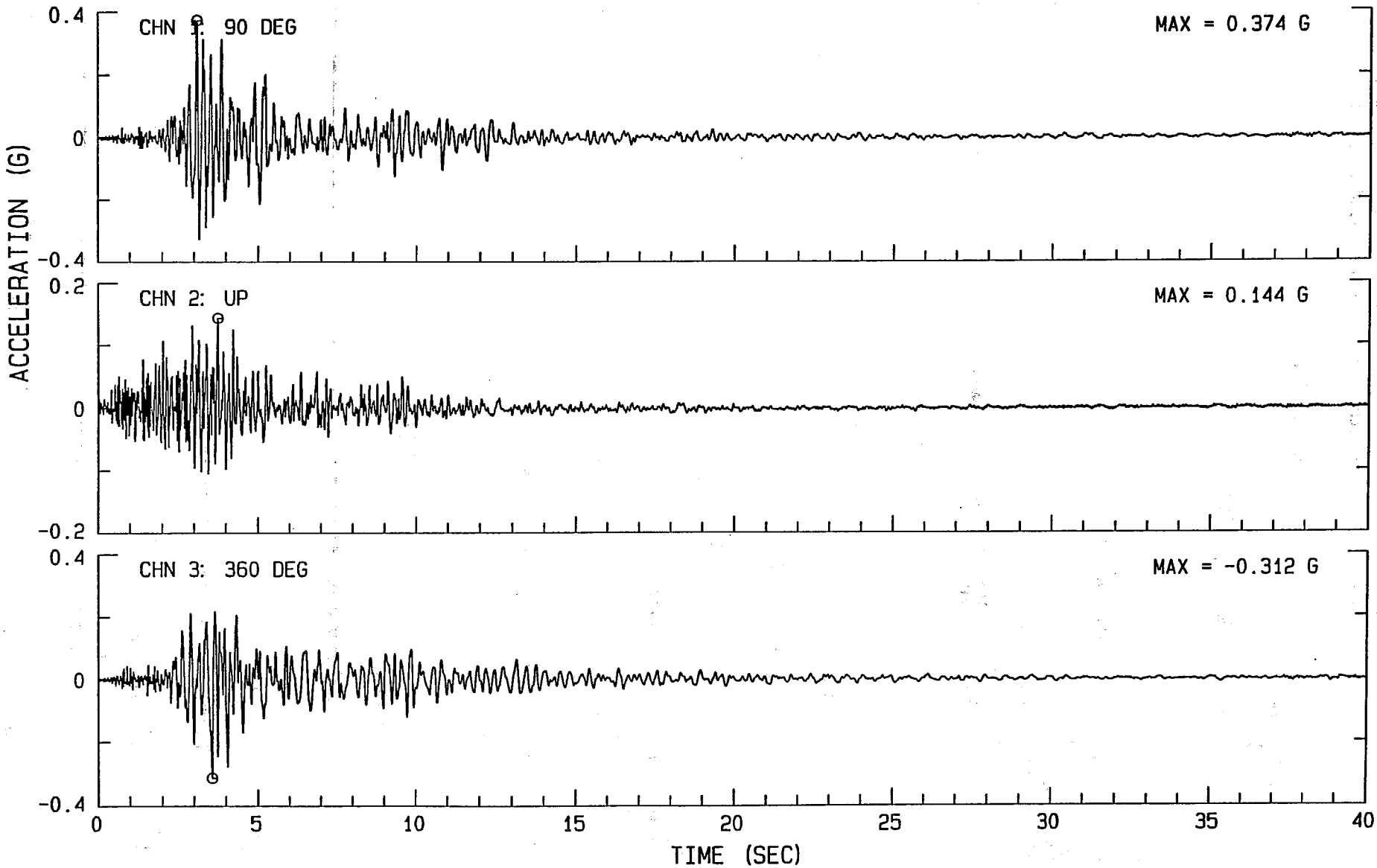
NORTHRIDGE AFTERSHOCK OF MAR 20, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CEDAR HILL NURSERY A CSMIP Sta Num 24436

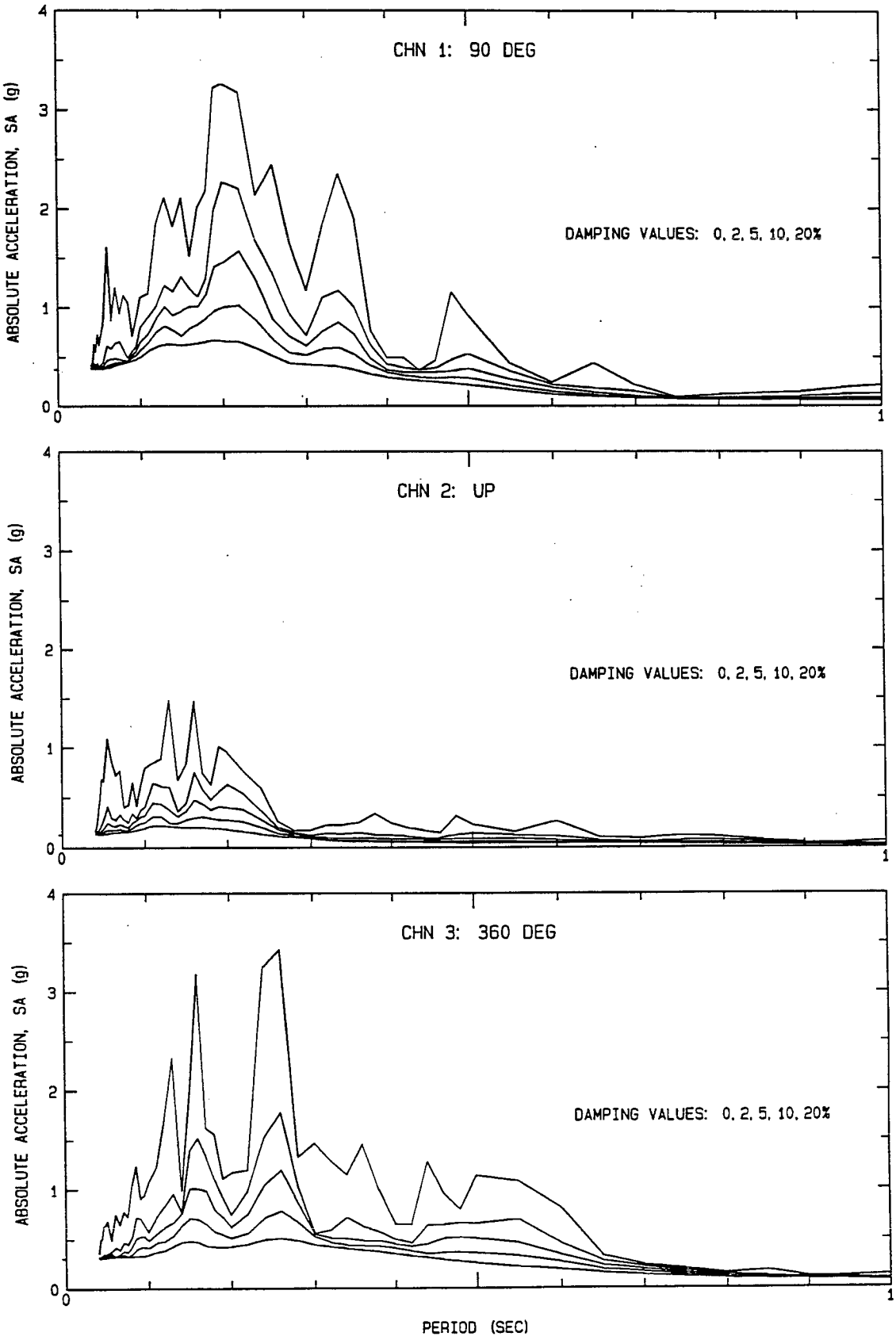
Usable Data Bandwidth: .51 to 23.6 Hz (.04 to 2.0 Sec)



NORTHRIDGE AFTERSHOCK OF MAR 20, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
UNCORRECTED ACCELEROGRAM 24436-S2773-94083.02 050796.1506-AFTERSHK



NORTHRIDGE AFTERSHOCK OF MAR 20, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .30-.60 TO 23.0-25.0 HZ.
24436-S2773-94083.02 050796.1545-AFTERSHK



NORTHRIDGE AFTERSHOCK OF MAR 20, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CEDAR HILL NURSERY A
Sta Num 24436

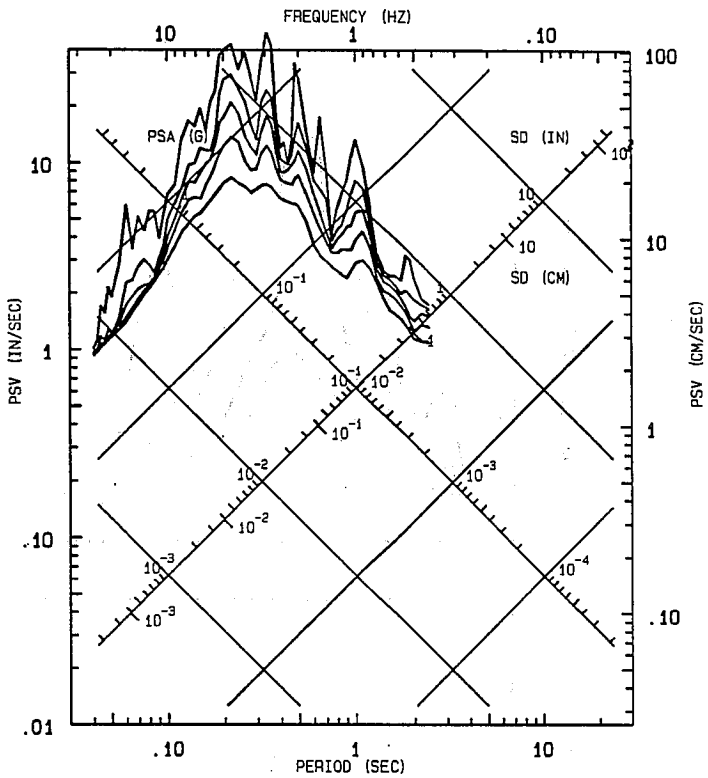
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.51 TO 23.6 HZ
(0.04 TO 2.0 SEC)

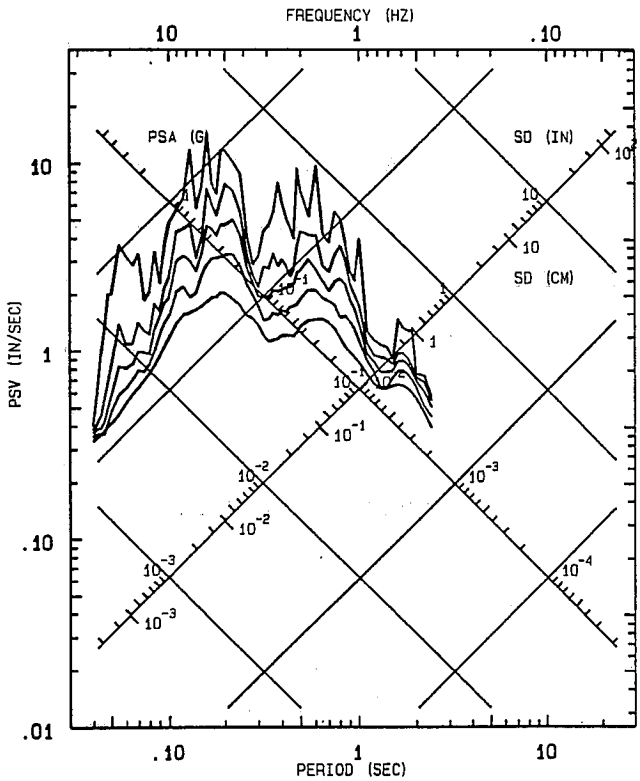
—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 24436-S2773-94083.02

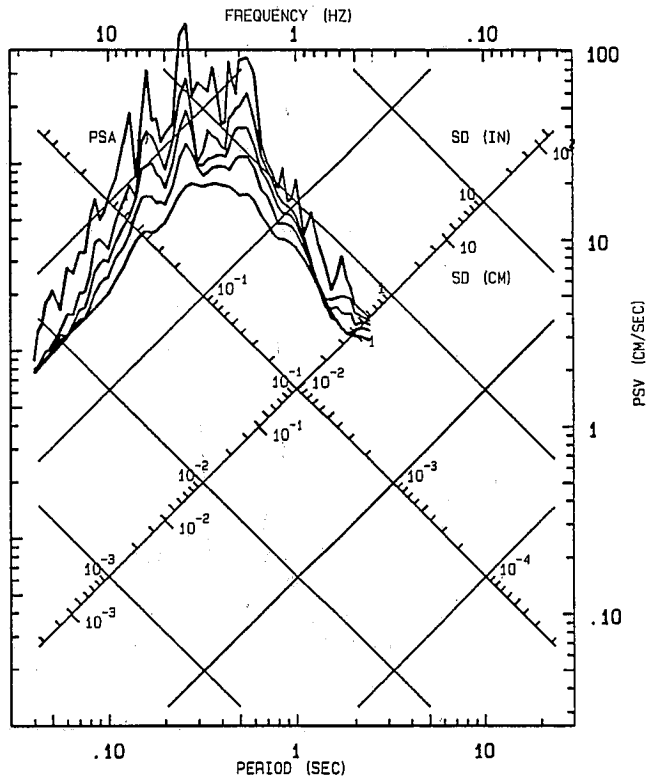
CHN 1: 90 DEG



CHN 2: UP



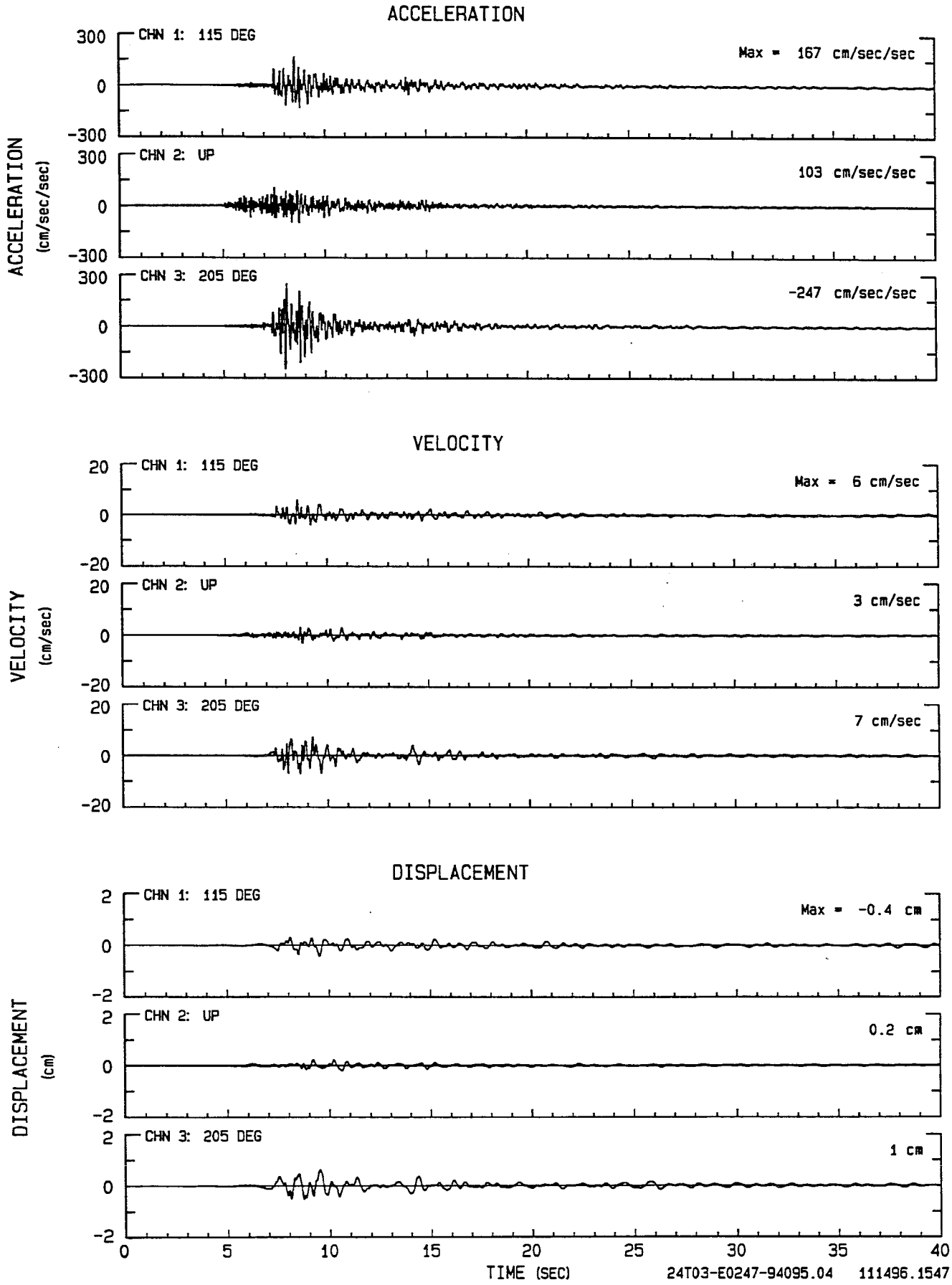
CHN 3: 360 DEG



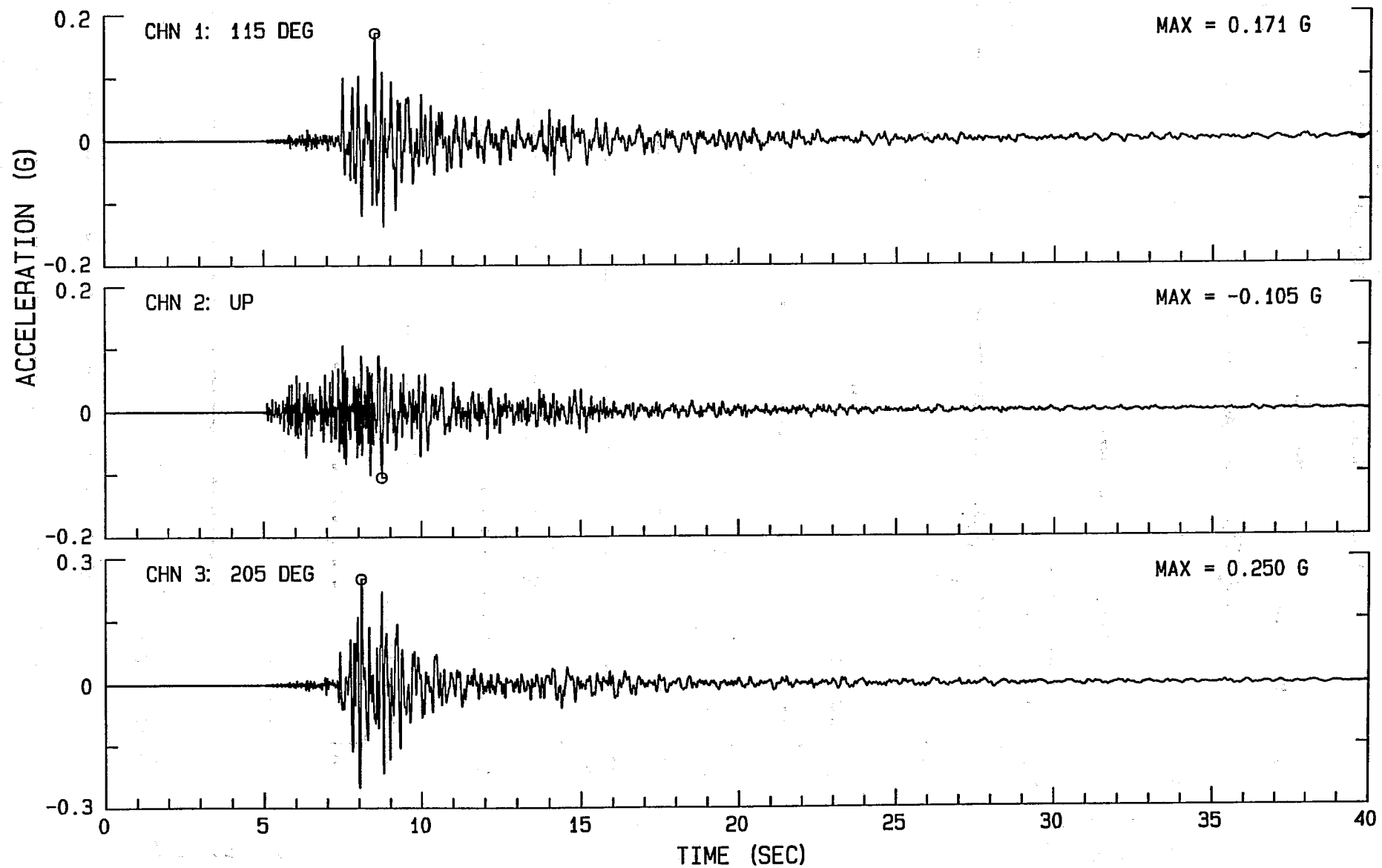
NORTHRIDGE AFTERSHOCK OF MAR 20, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CLUBHOUSE CSMIP Sta Num 24T03

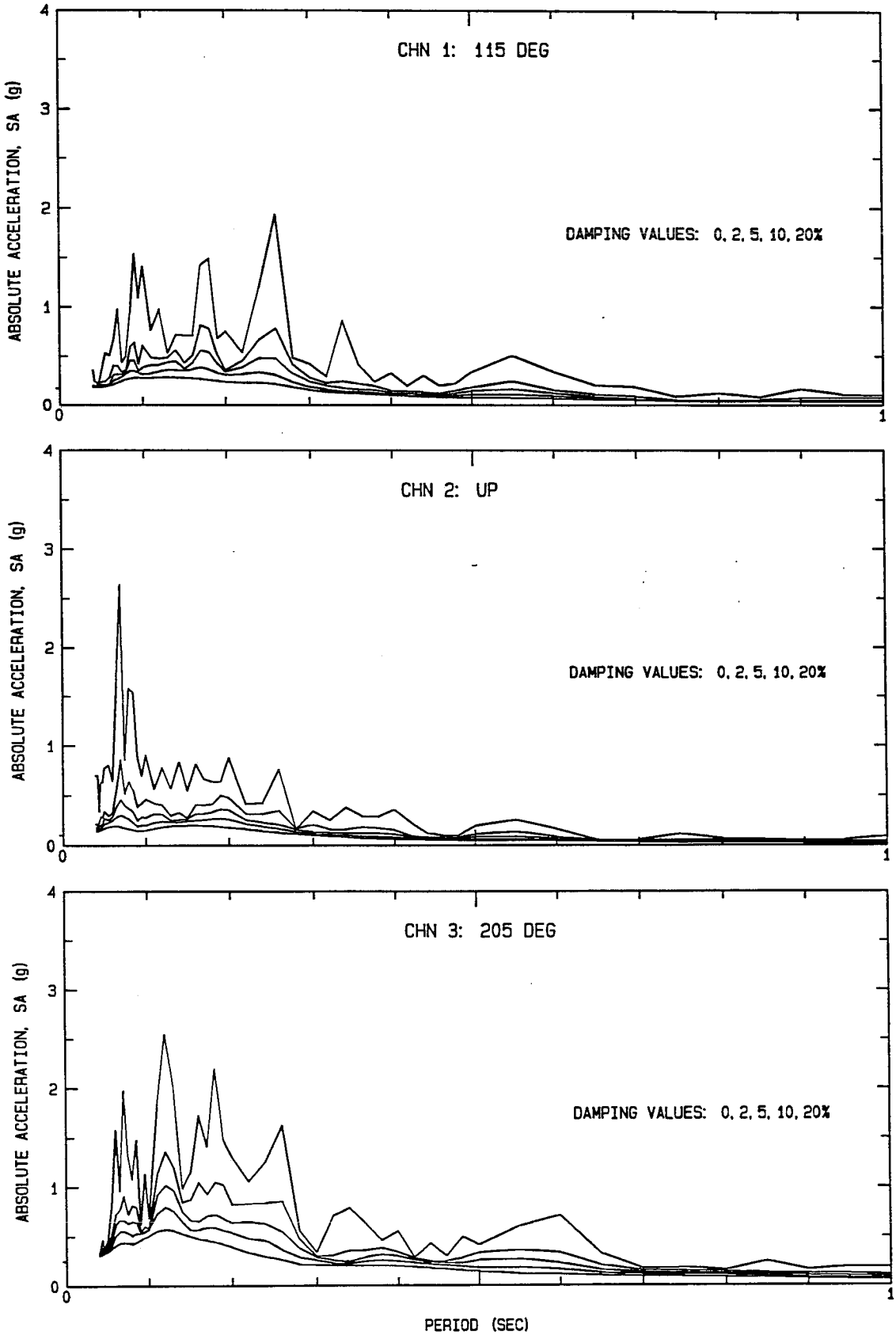
Usable Data Bandwidth: .51 to 47.2 Hz (.02 to 2.0 Sec)



NORTHRIDGE AFTERSHOCK OF MAR 20, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CLUBHOUSE
UNCORRECTED ACCELEROGRAM 24T03-E0247-94095.04 111496.1546-QN94JT03



NORTHRIDGE AFTERSHOCK OF MAR 20, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CLUBHOUSE
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .30-.60 TO 46.0-50.0 HZ.
24T03-E0247-94095.04 111496.1548-QN94JT03



NORTHRIDGE AFTERSHOCK OF MAR 20, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CLUBHOUSE
Sta Num 24T03

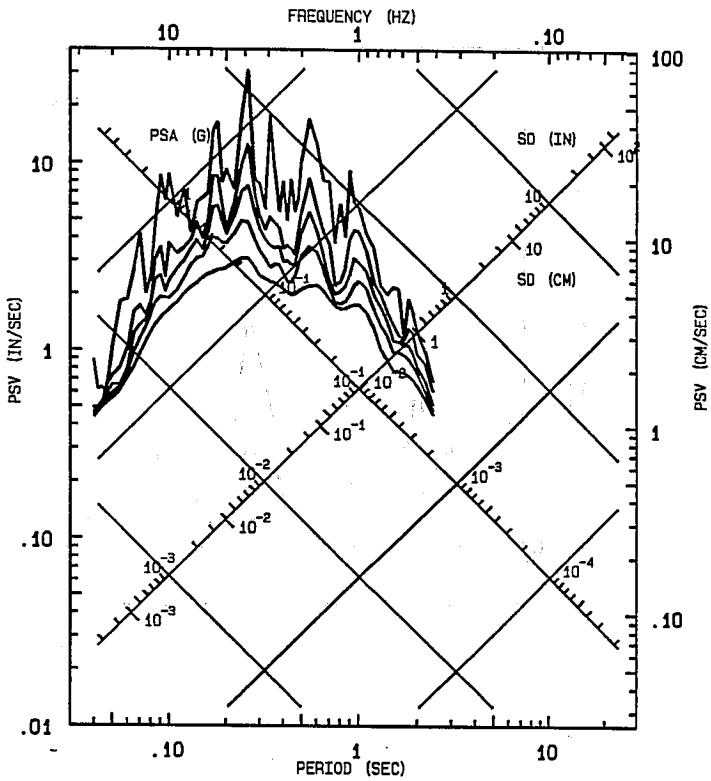
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.51 TO 47.2 HZ
(0.02 TO 2.0 SEC)

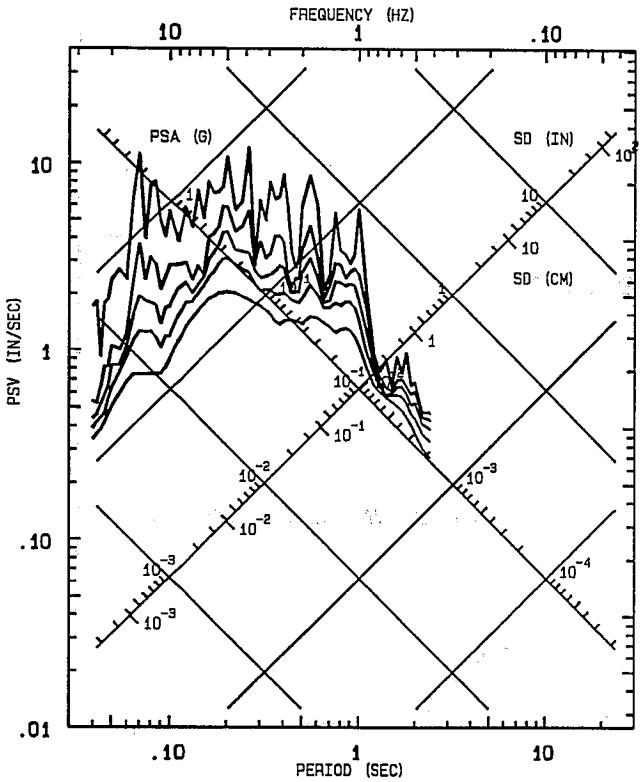
RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 24T03-E0247-94095.04

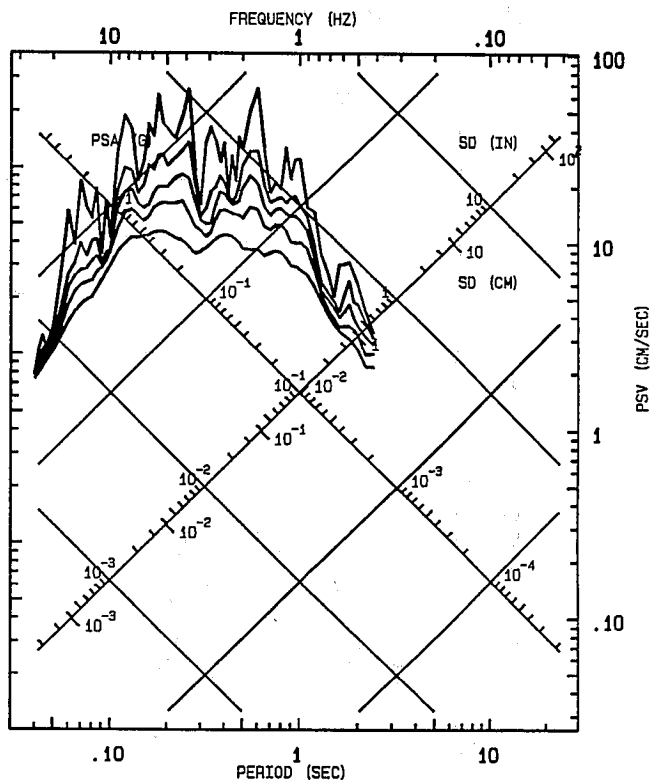
CHN 1: 115 DEG



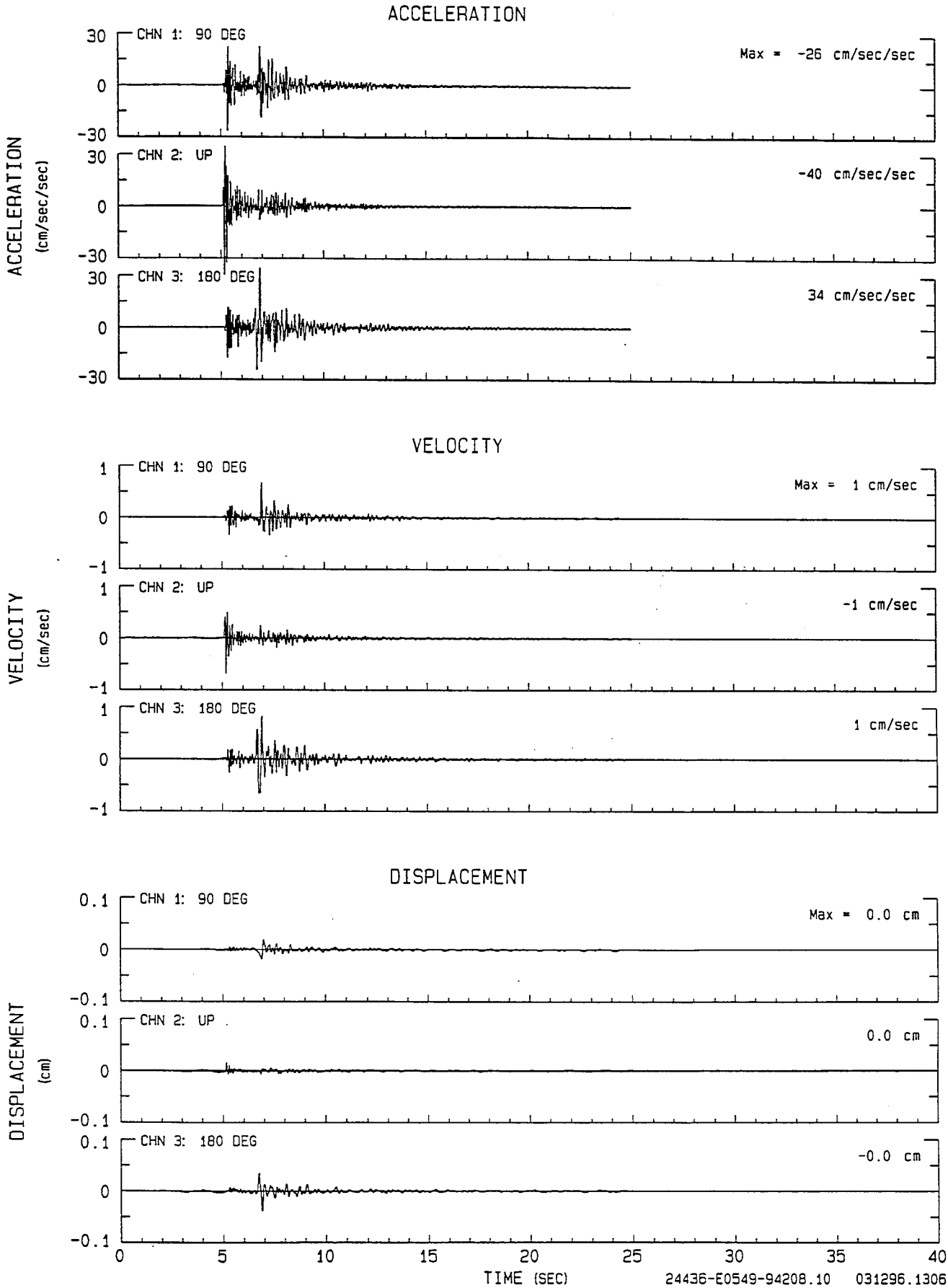
CHN 2: UP



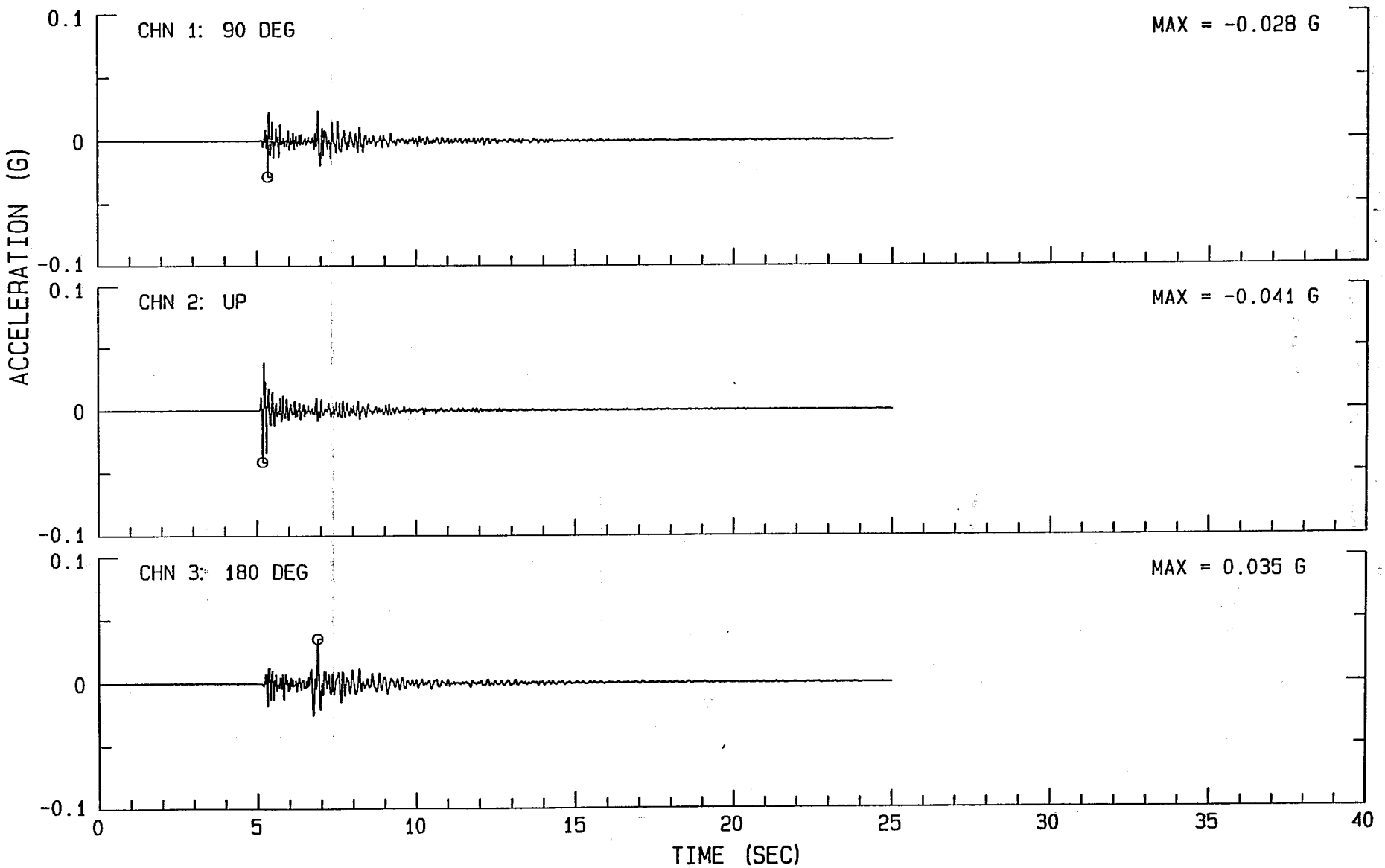
CHN 3: 205 DEG



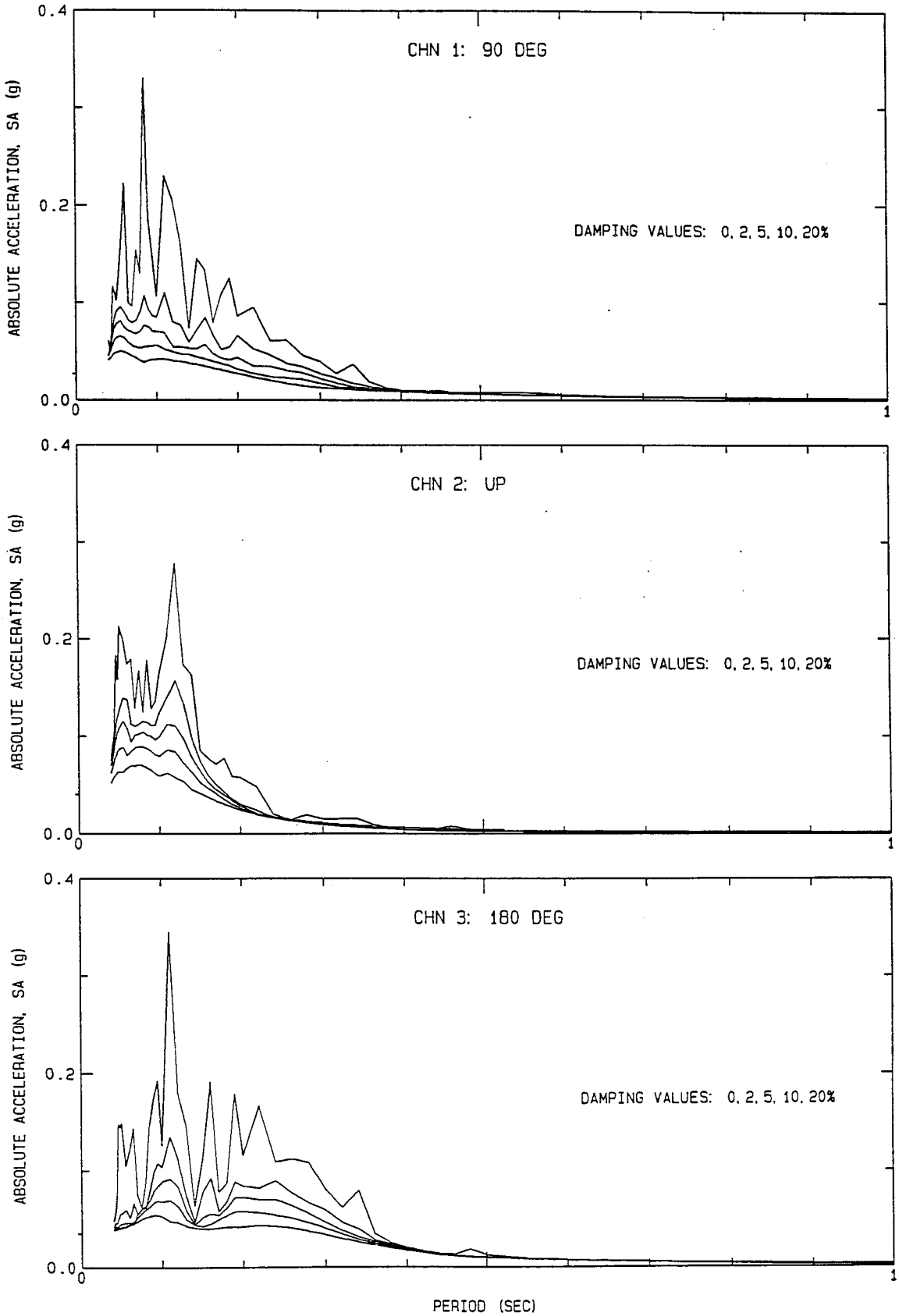
NORTHRIDGE AFTERSHOCK OF MAY 3, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A CSMIP Sta Num 24436 149
Usable Data Bandwidth: .51 to 47.2 Hz (.02 to 2.0 Sec)



NORTHRIDGE AFTERSHOCK OF MAY 3, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
UNCORRECTED ACCELEROGRAM 24436-E0549-94208.10 031296.1140-GN94D436



NORTHRIDGE AFTERSHOCK OF MAY 3, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .30-.60 TO 46.0-50.0 HZ.
24436-E0549-94208.10 031296.1306-QN94D436



NORTHRIDGE AFTERSHOCK OF MAY 3, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CEDAR HILL NURSERY A
Sta Num 24436

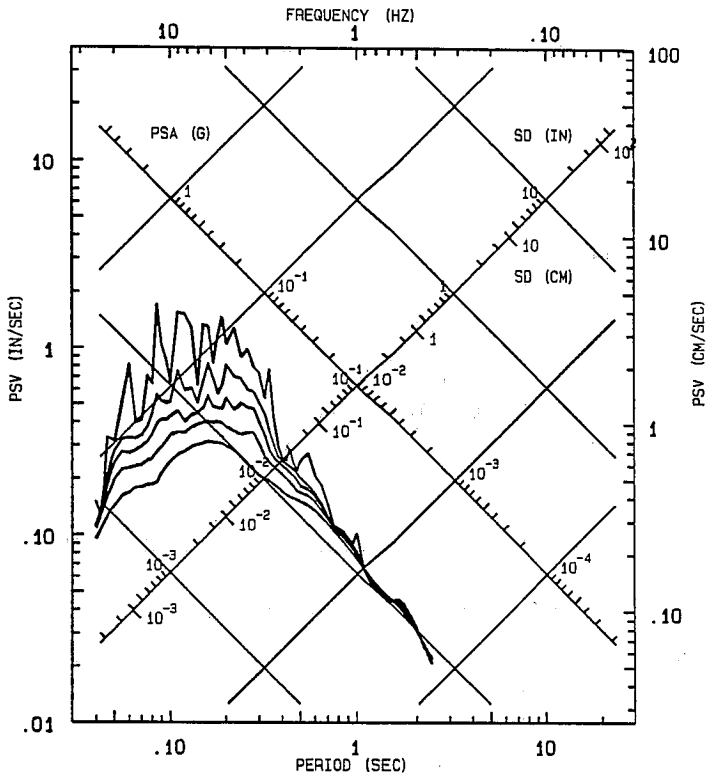
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.51 TO 47.2 HZ
(0.02 TO 2.0 SEC)

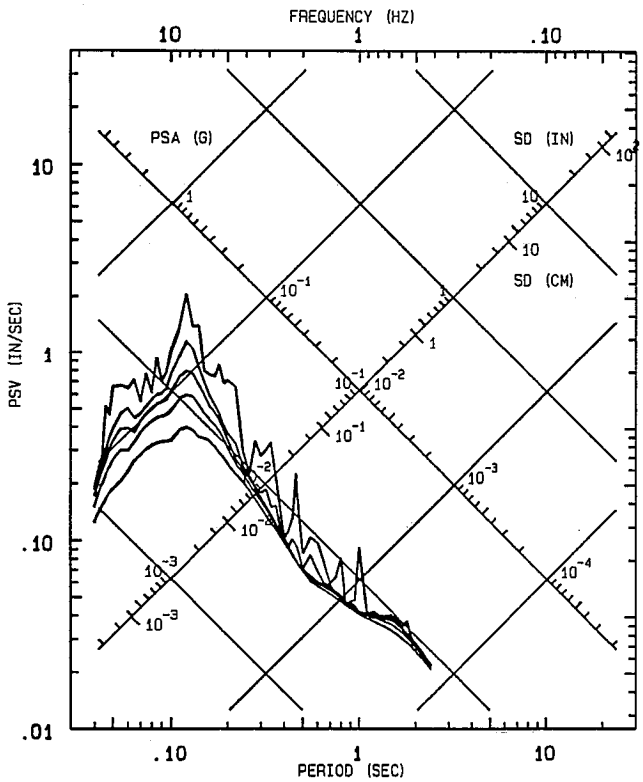
RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 24436-E0549-94208.10

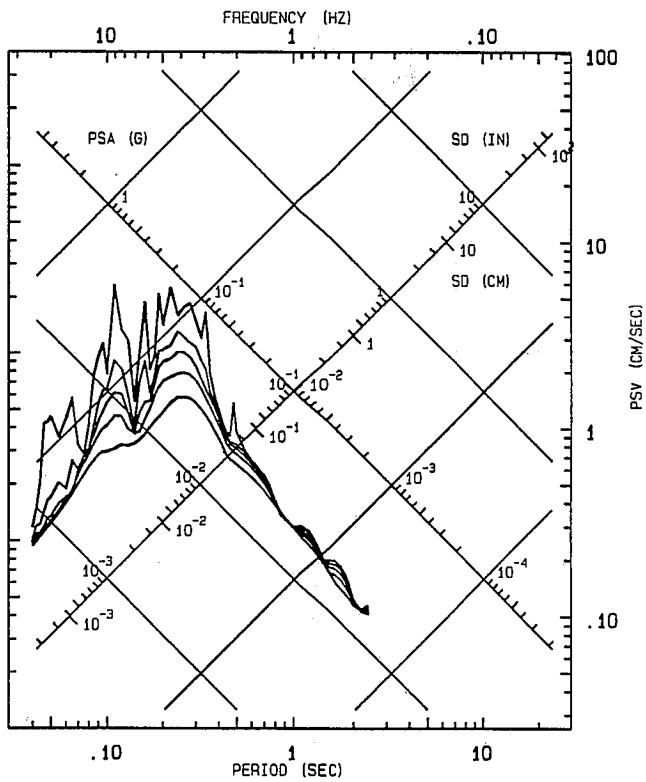
CHN 1: 90 DEG



CHN 2: UP



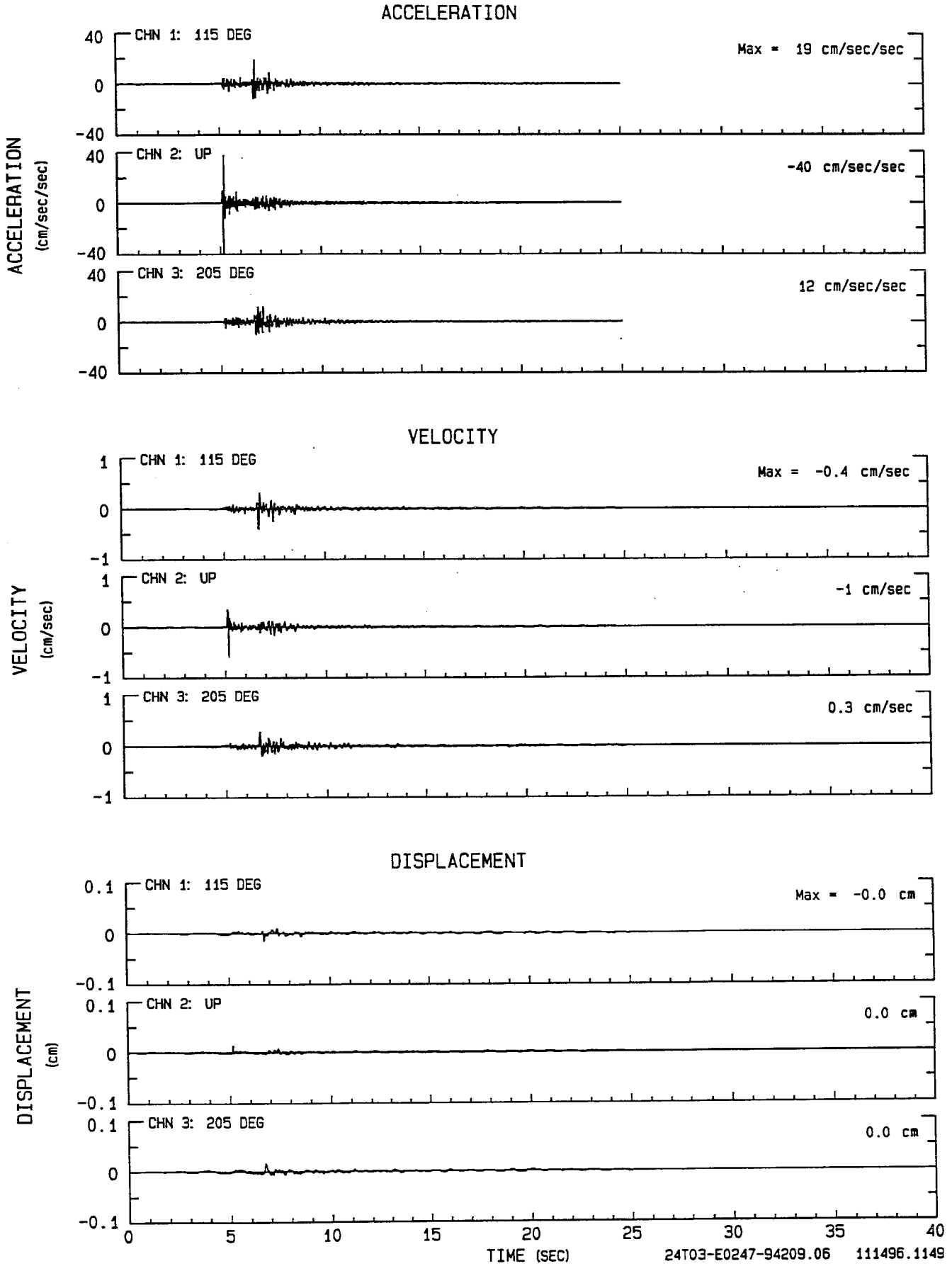
CHN 3: 180 DEG



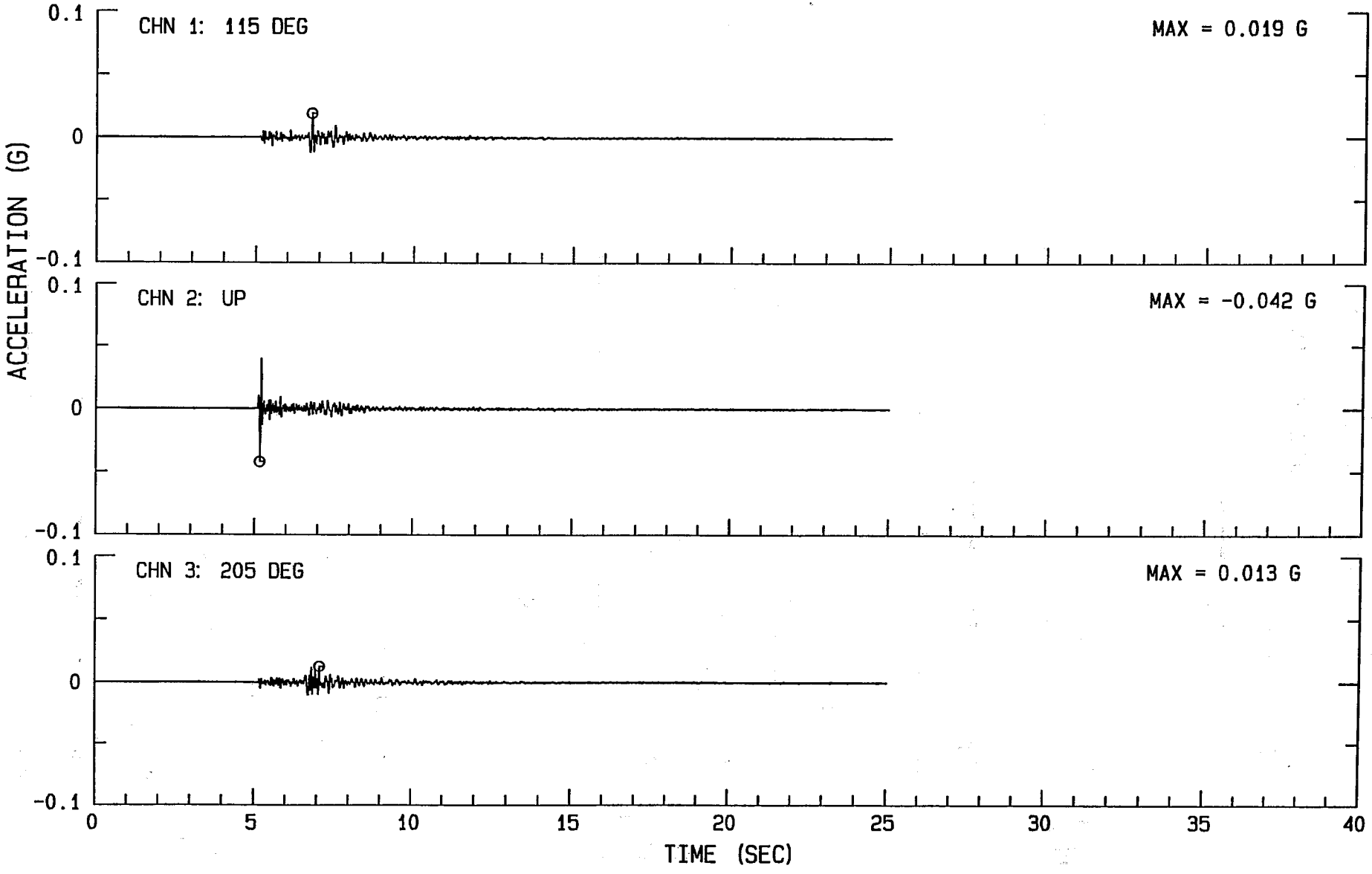
NORTHRIDGE AFTERSHOCK OF MAY 3, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CLUBHOUSE CSMIP Sta Num 24T03

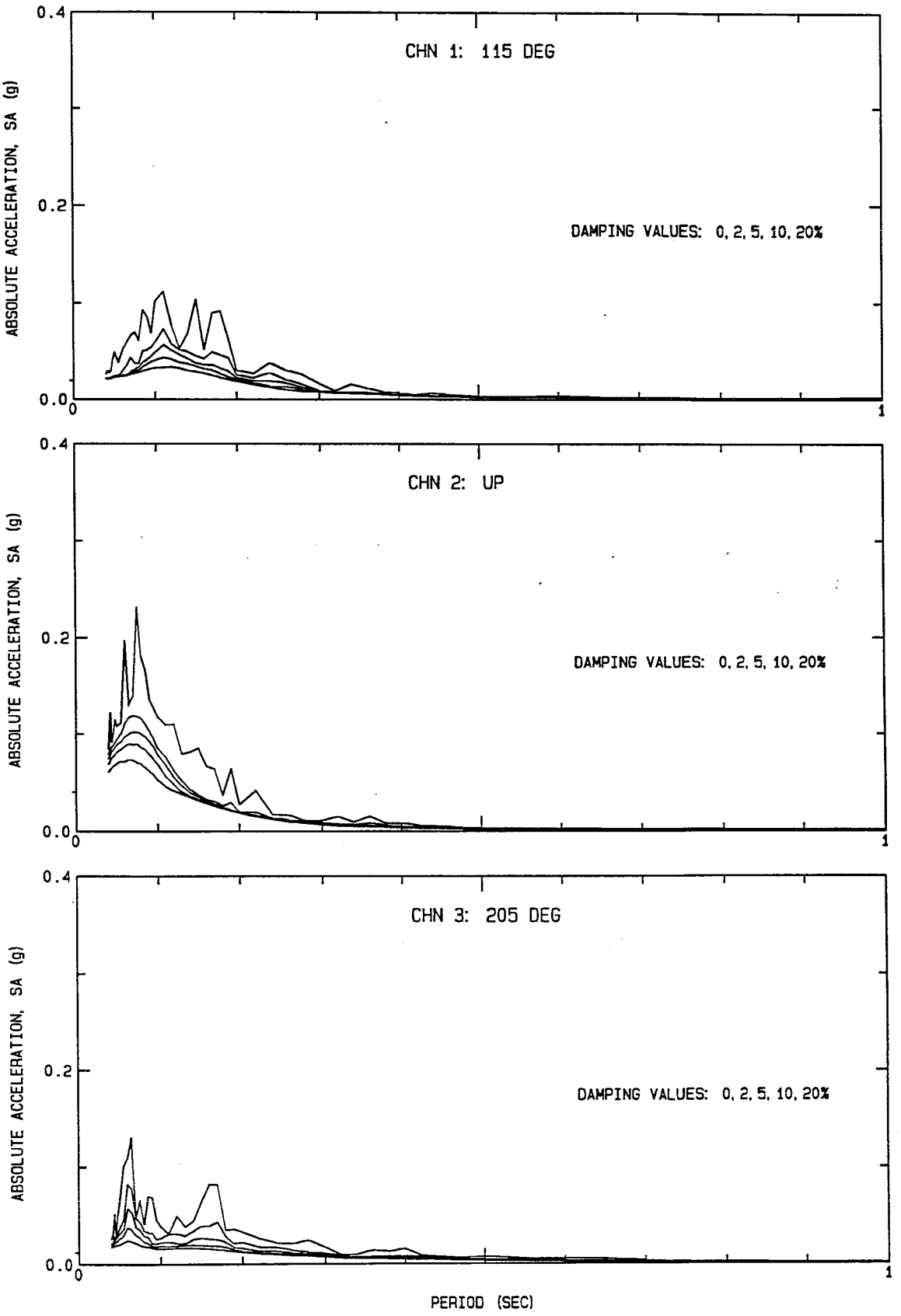
Usable Data Bandwidth: .51 to 47.2 Hz (.02 to 2.0 Sec)



NORTHRIDGE AFTERSHOCK OF MAY 3, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CLUBHOUSE
UNCORRECTED ACCELEROGRAM 24T03-E0247-94209.06 111496.1148-GN94DT03



NORTHRIDGE AFTERSHOCK OF MAY 3, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CLUBHOUSE
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .30-.60 TO 46.0-50.0 HZ.
24T03-E0247-94209.06 111496.1150-GN94DT03



NORTHRIDGE AFTERSHOCK OF MAY 3, 1994 CSMIP PRELIMINARY PROCESSING

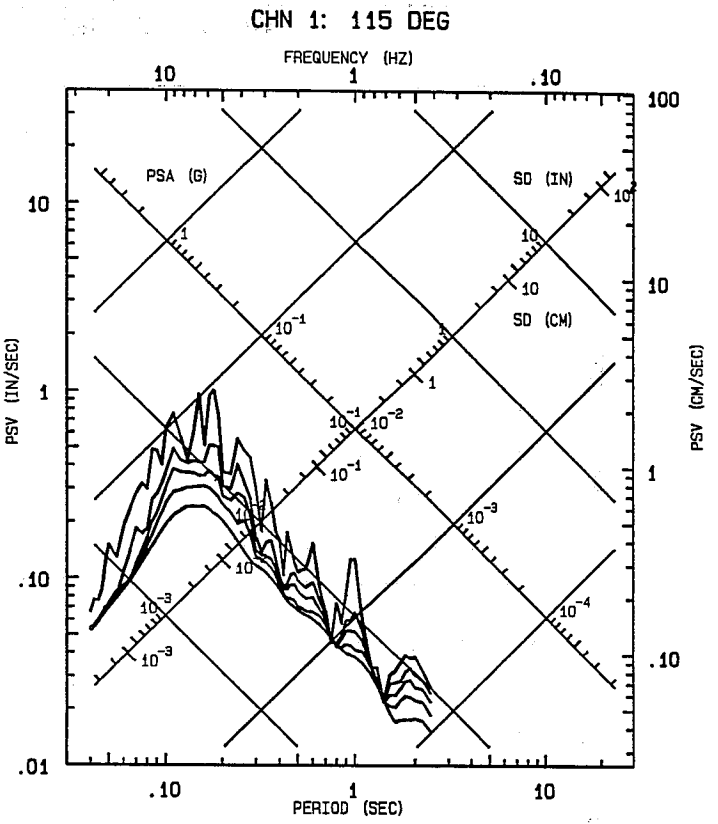
TARZANA - CLUBHOUSE
Sta Num 24T03

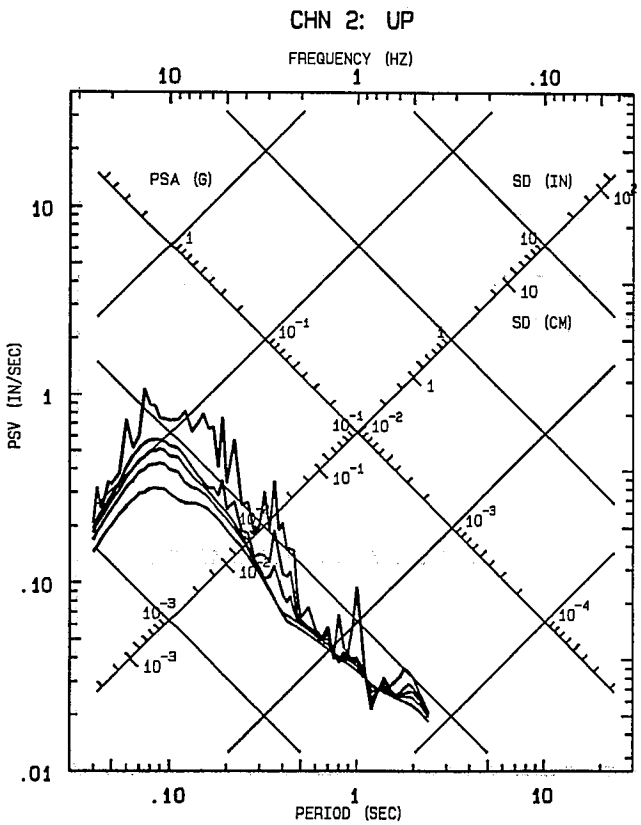
RESPONSE SPECTRA

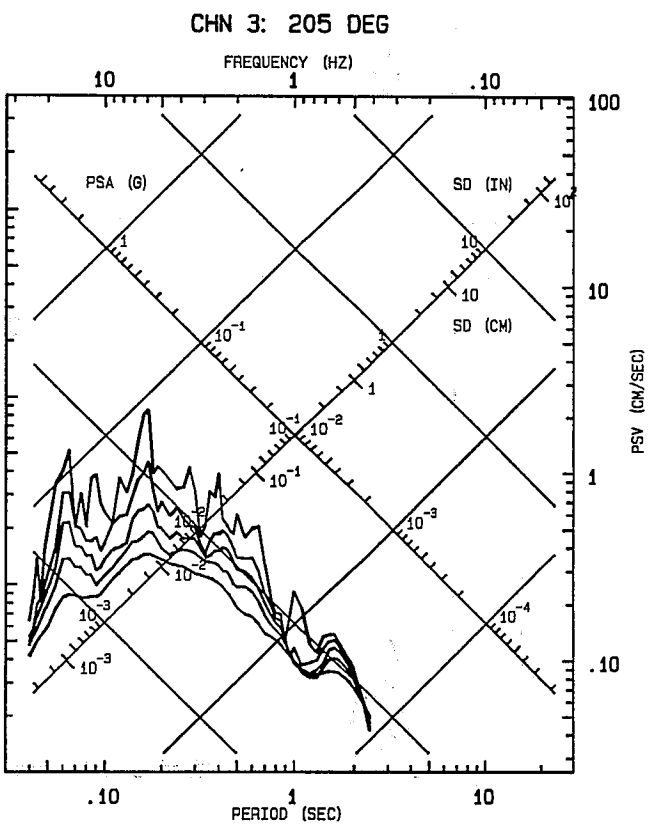
USABLE DATA BANDWIDTH:
0.51 TO 47.2 HZ
(0.02 TO 2.0 SEC)

—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 24T03-E0247-94209.06



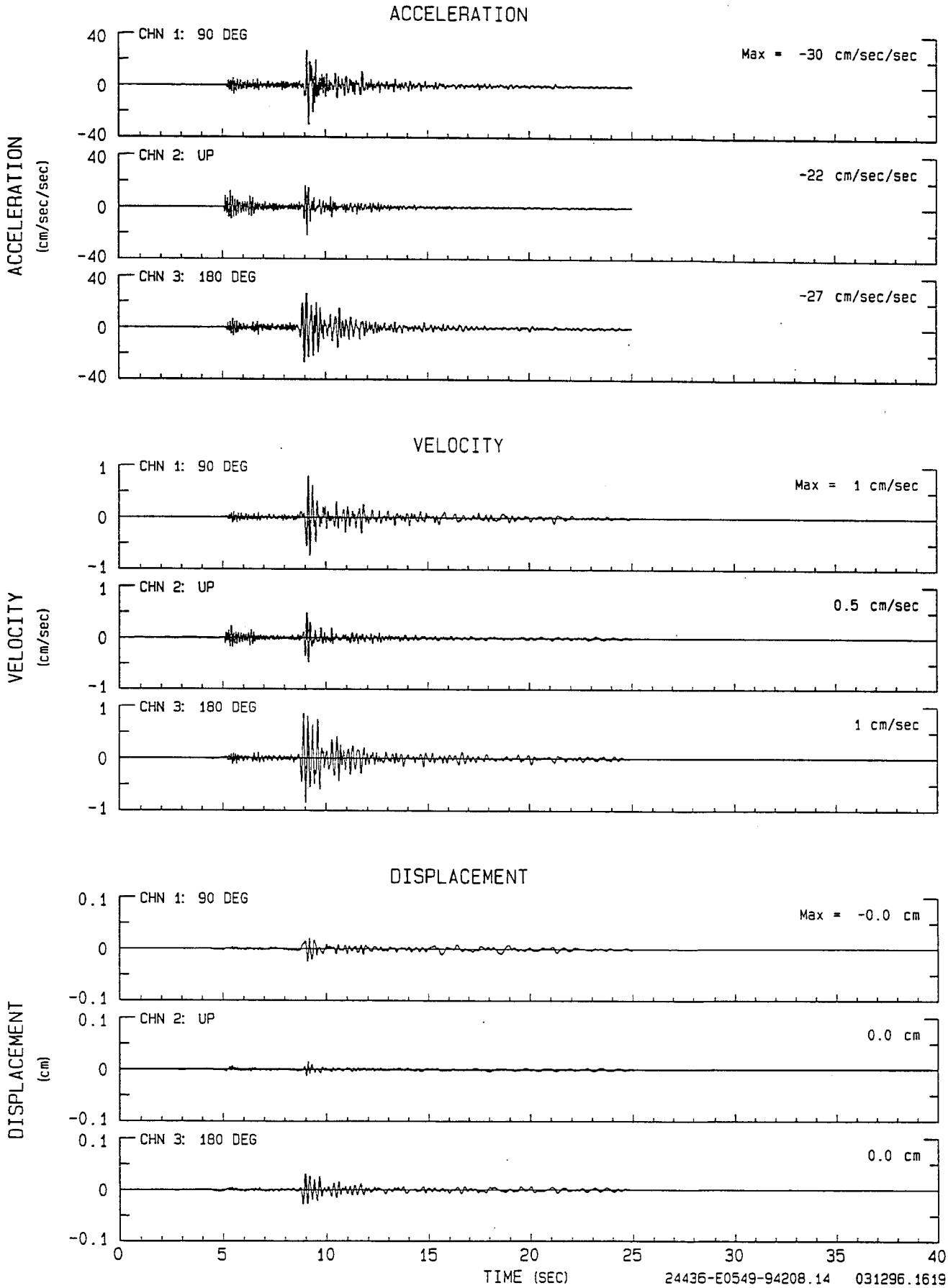




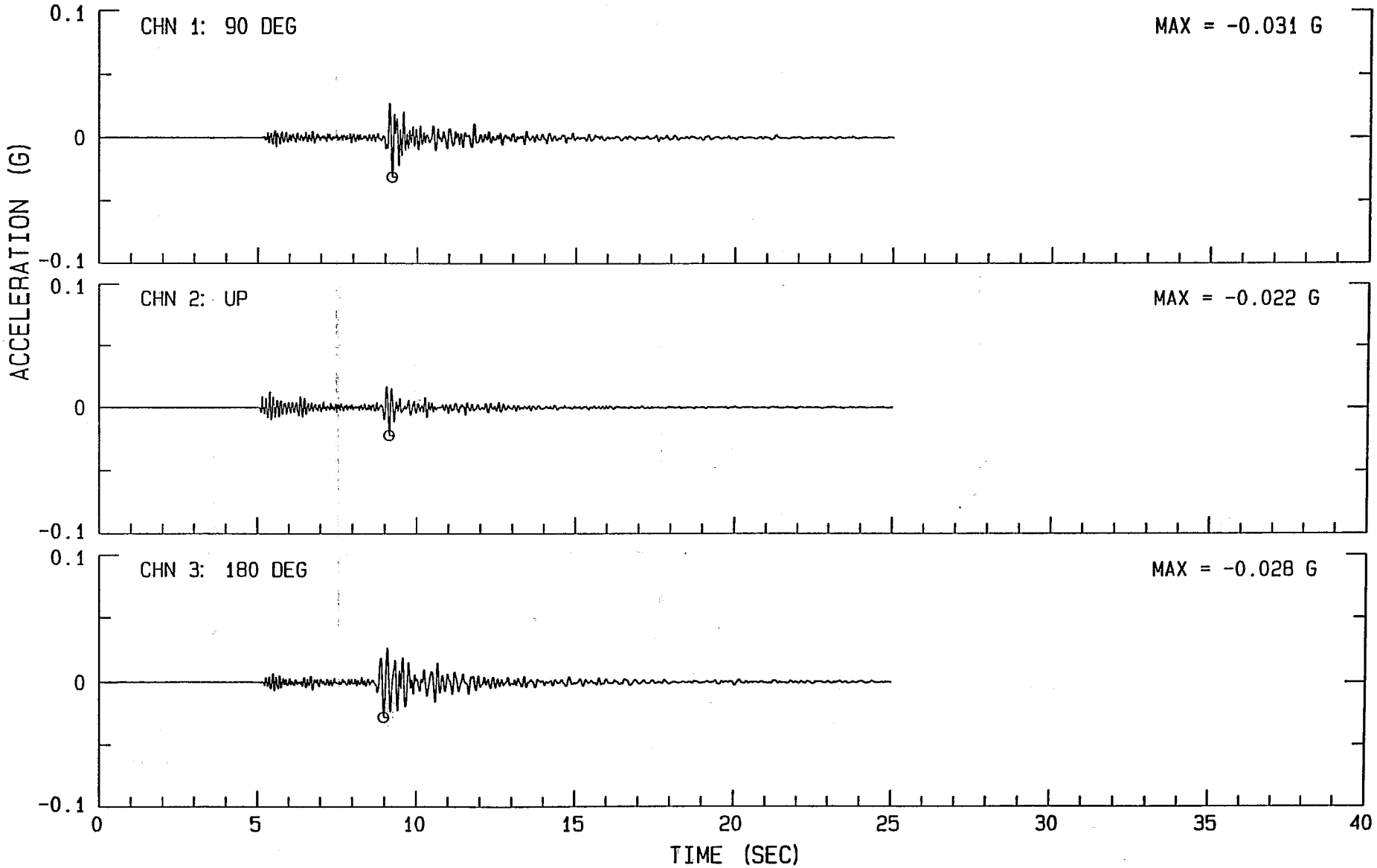
NORTHRIDGE AFTERSHOCK OF MAY 16, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CEDAR HILL NURSERY A CSMIP Sta Num 24436 157

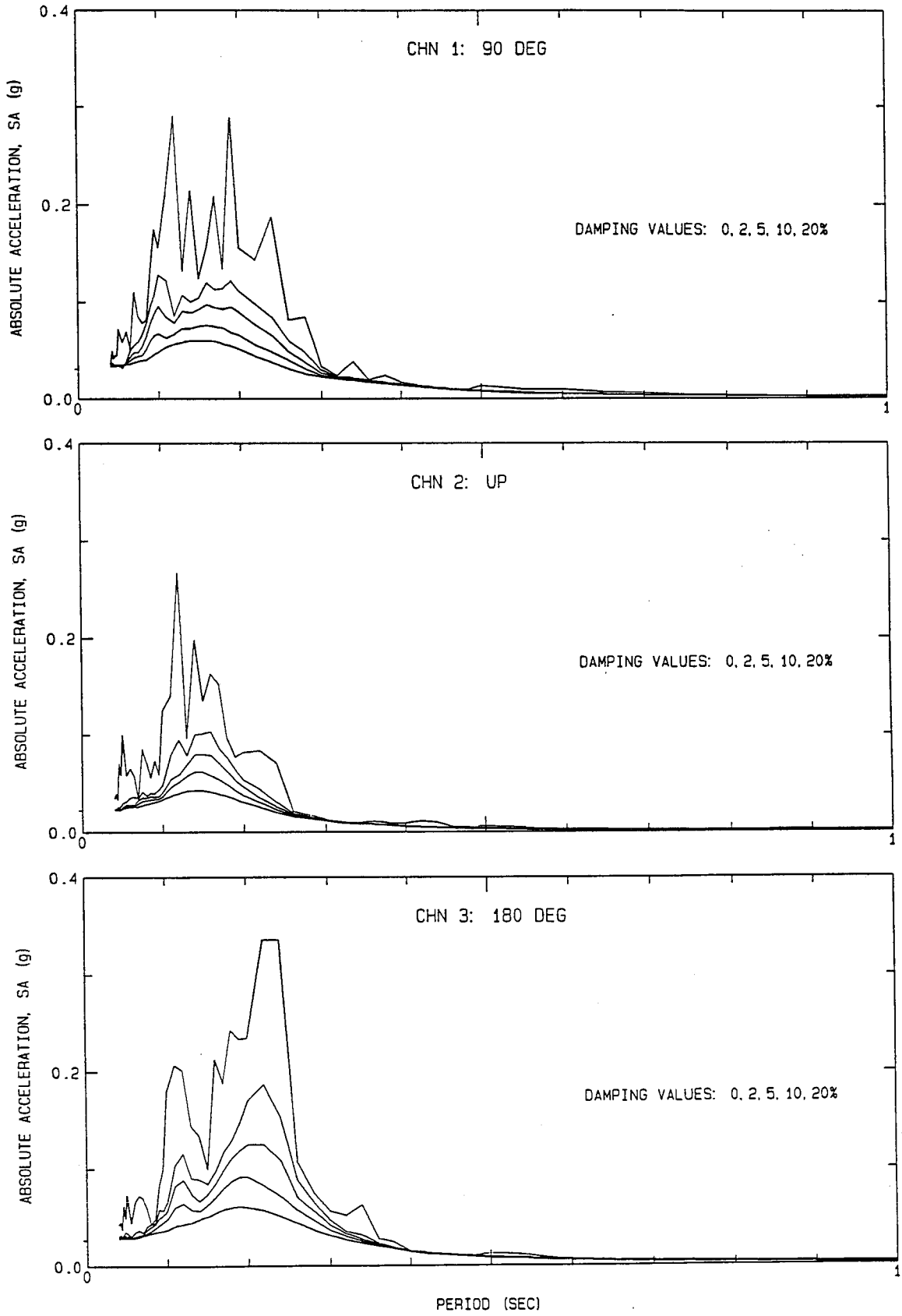
Usable Data Bandwidth: .51 to 47.2 Hz (.02 to 2.0 Sec)



NORTHRIDGE AFTERSHOCK OF MAY 16, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
UNCORRECTED ACCELEROGRAM 24436-E0549-94208.14 031296.1549-QN94F436



NORTHRIDGE AFTERSHOCK OF MAY 16, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .30-.60 TO 46.0-50.0 HZ.
24436-E0549-94208.14 031296.1620-QN94F436



NORTHRIDGE AFTERSHOCK OF MAY 16, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CEDAR HILL NURSERY A
Sta Num 24436

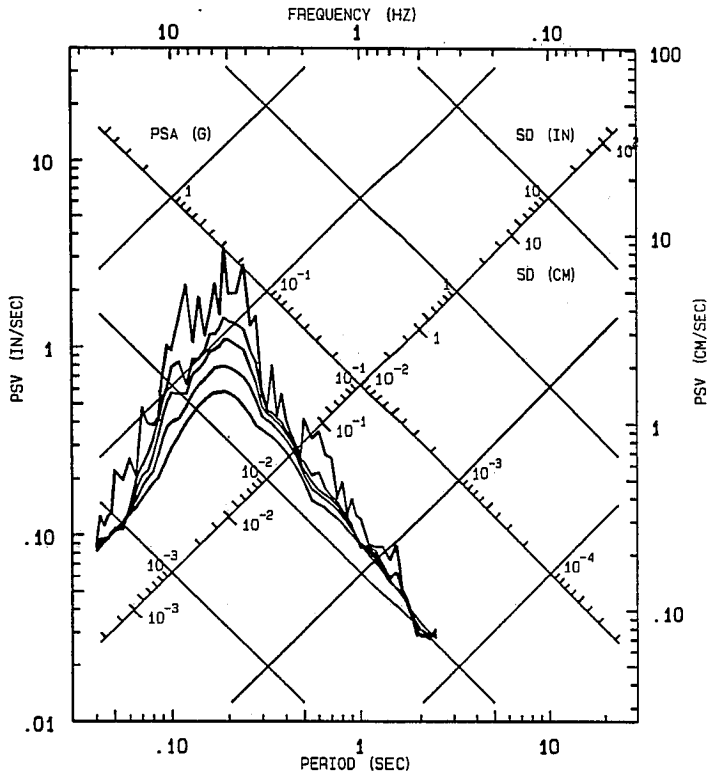
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.51 TO 47.2 HZ
(0.02 TO 2.0 SEC)

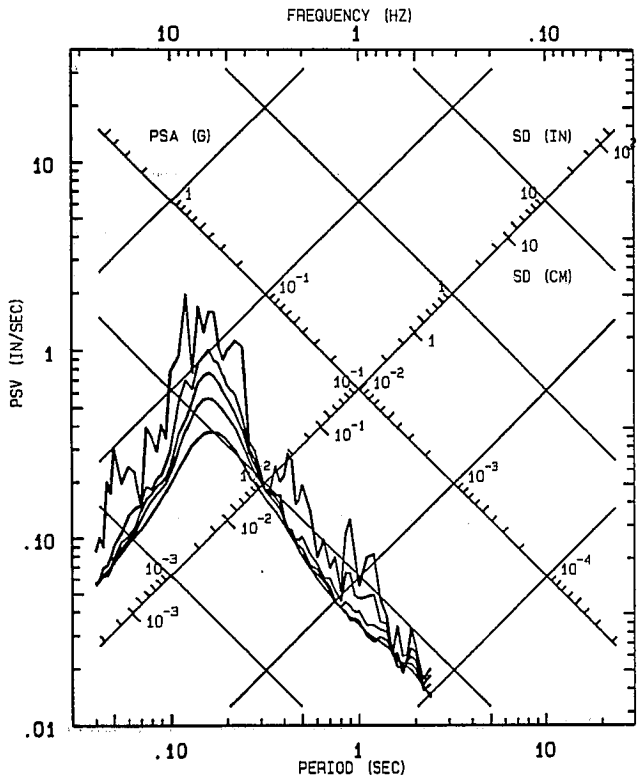
—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 24436-E0549-94208.14

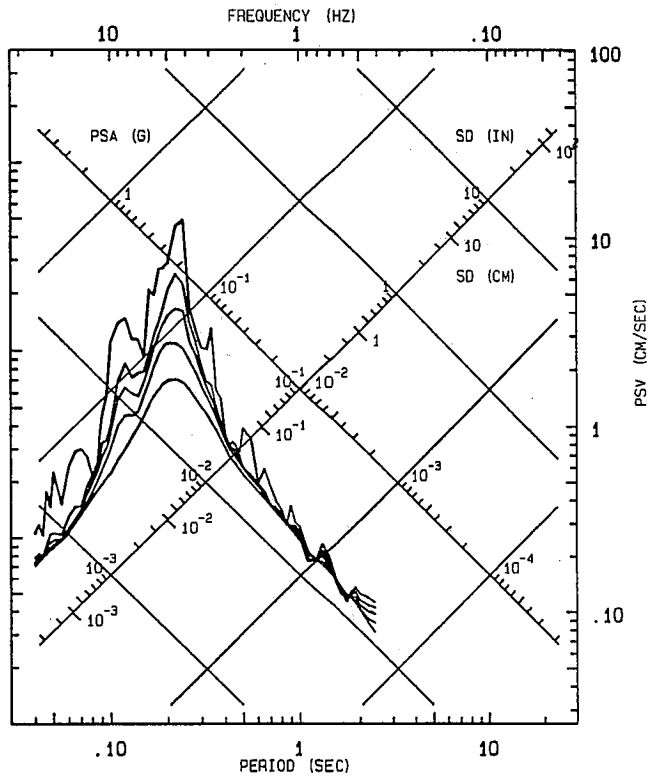
CHN 1: 90 DEG



CHN 2: UP



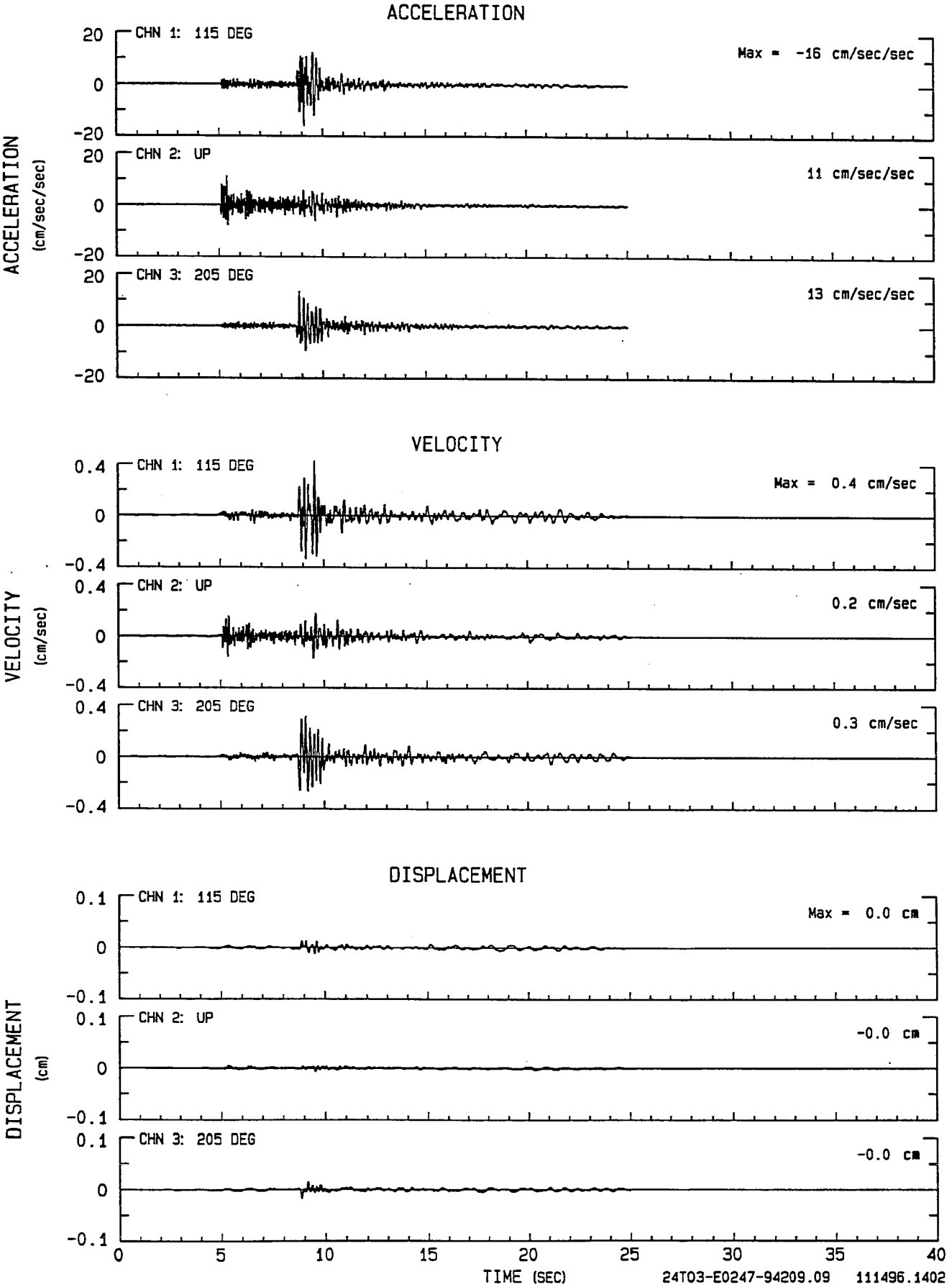
CHN 3: 180 DEG



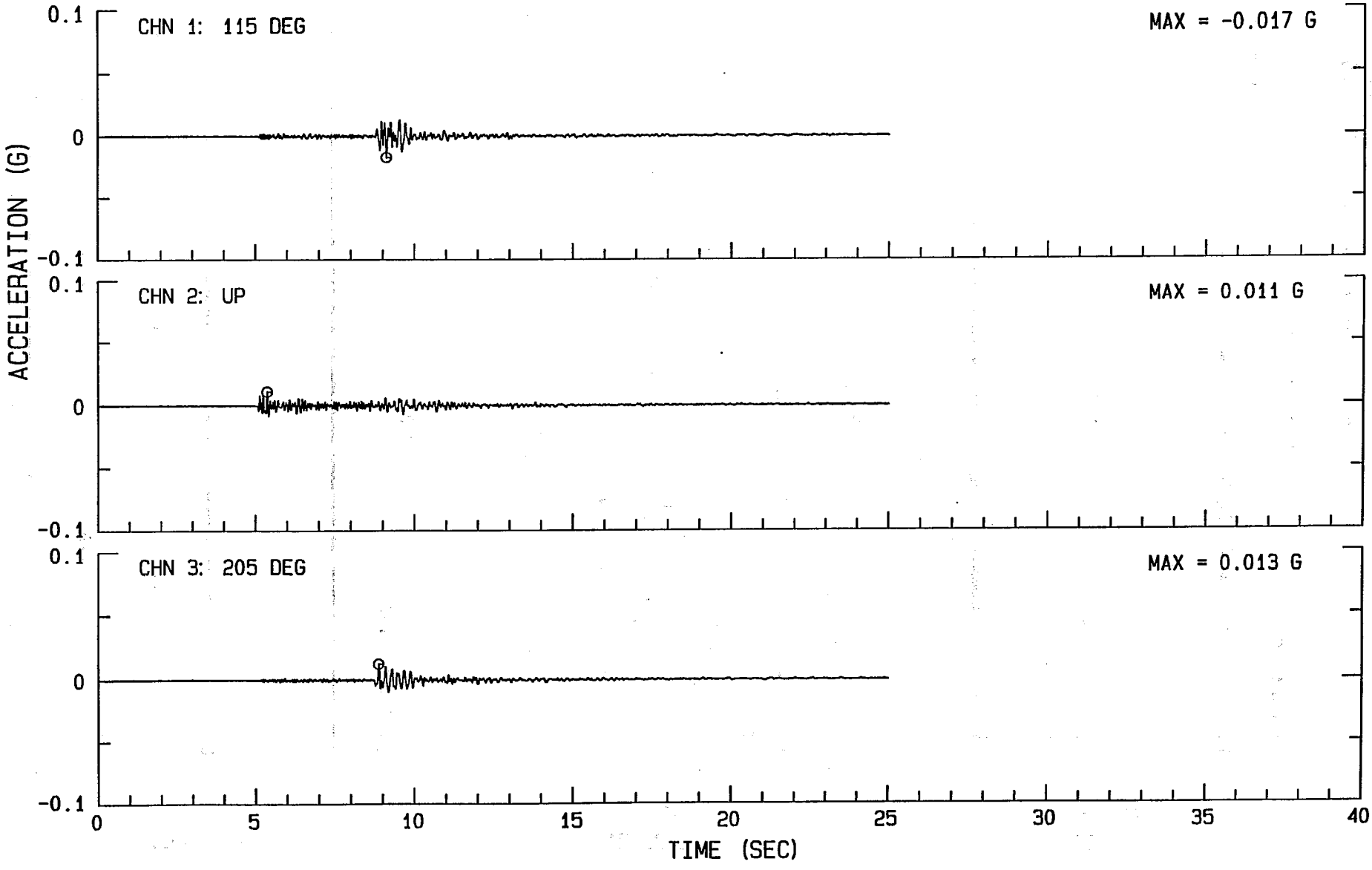
NORTHRIDGE AFTERSHOCK OF MAY 16, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CLUBHOUSE CSMIP Sta Num 24T03 161

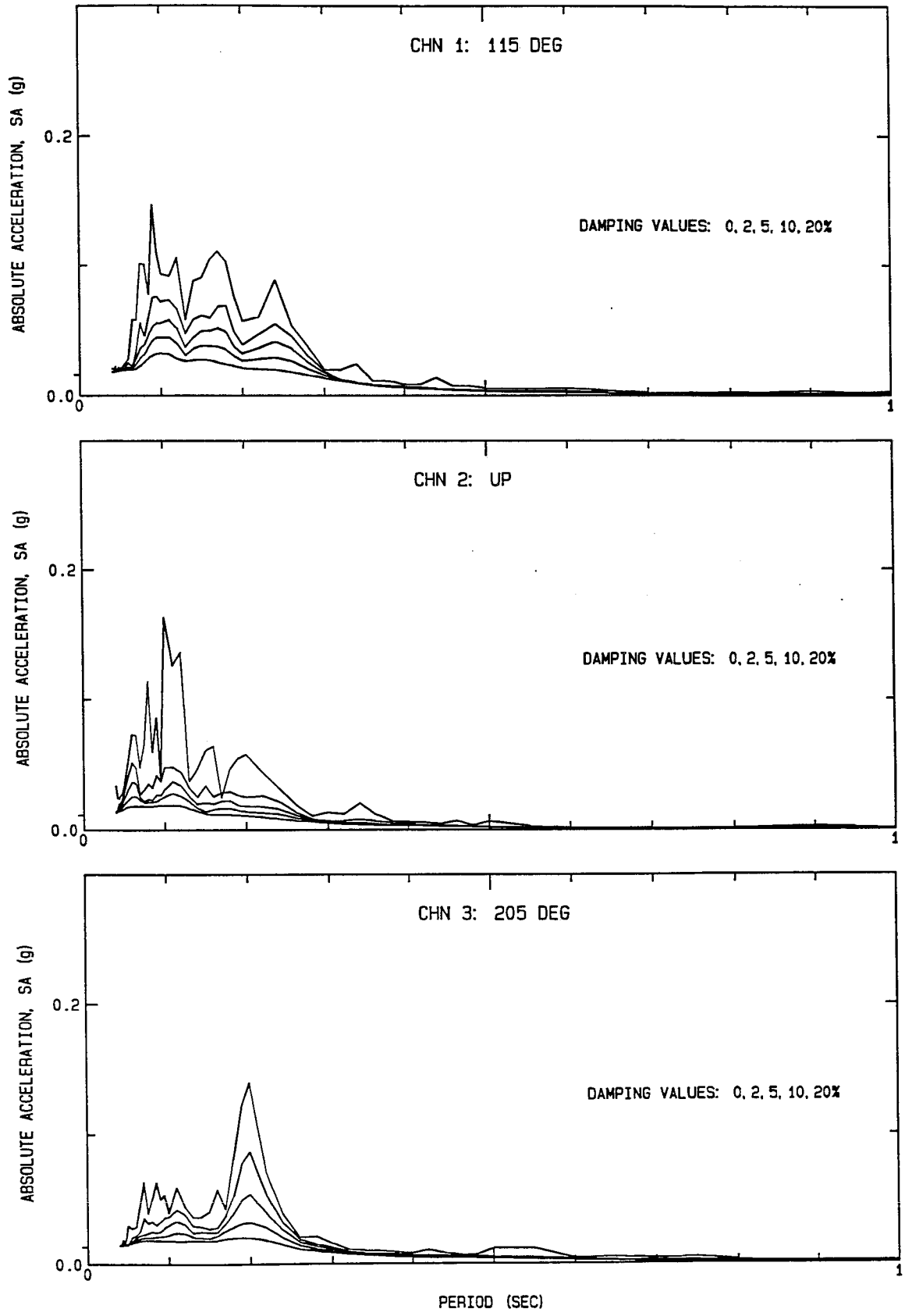
Usable Data Bandwidth: .51 to 47.2 Hz (.02 to 2.0 Sec)



NORTHRIDGE AFTERSHOCK OF MAY 16, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CLUBHOUSE
UNCORRECTED ACCELEROGRAM 24T03-E0247-94209.09 111496.1401-QN94FT03



NORTHRIDGE AFTERSHOCK OF MAY 16, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CLUBHOUSE
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .30-.60 TO 46.0-50.0 HZ.
24T03-E0247-94209.09 111496.1402-GN94FT03



NORTHRIDGE AFTERSHOCK OF MAY 16, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CLUBHOUSE
Sta Num 24T03

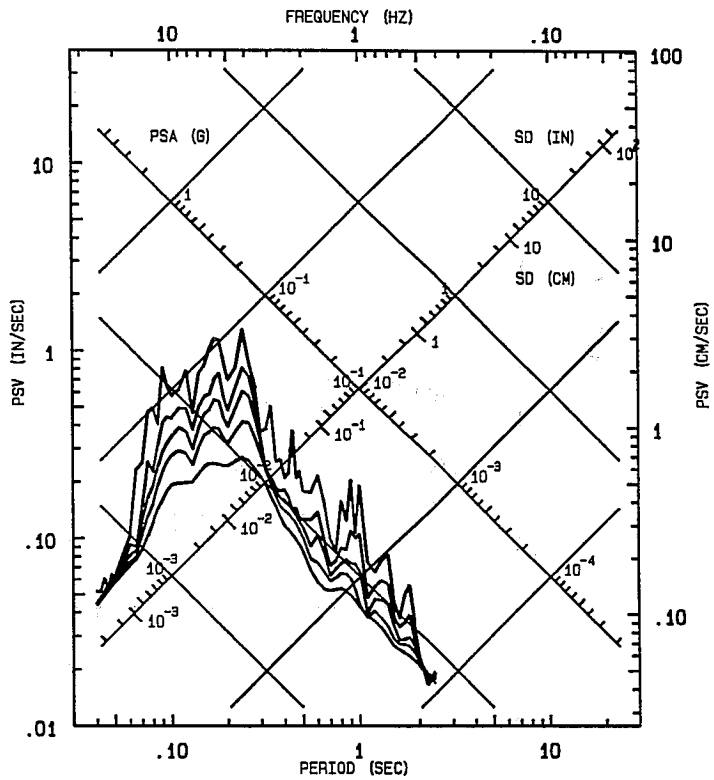
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.51 TO 47.2 HZ
(0.02 TO 2.0 SEC)

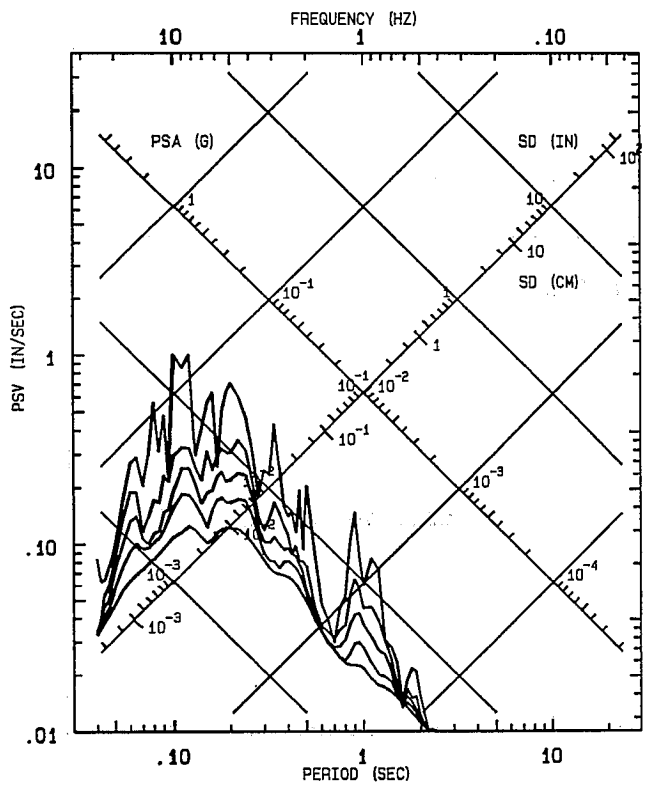
—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 24T03-E0247-94209.09

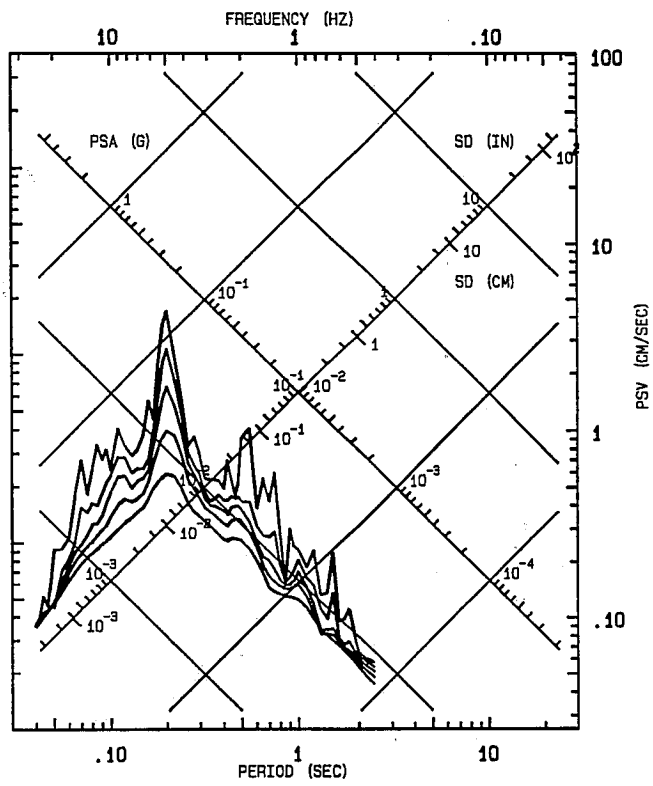
CHN 1: 115 DEG



CHN 2: UP



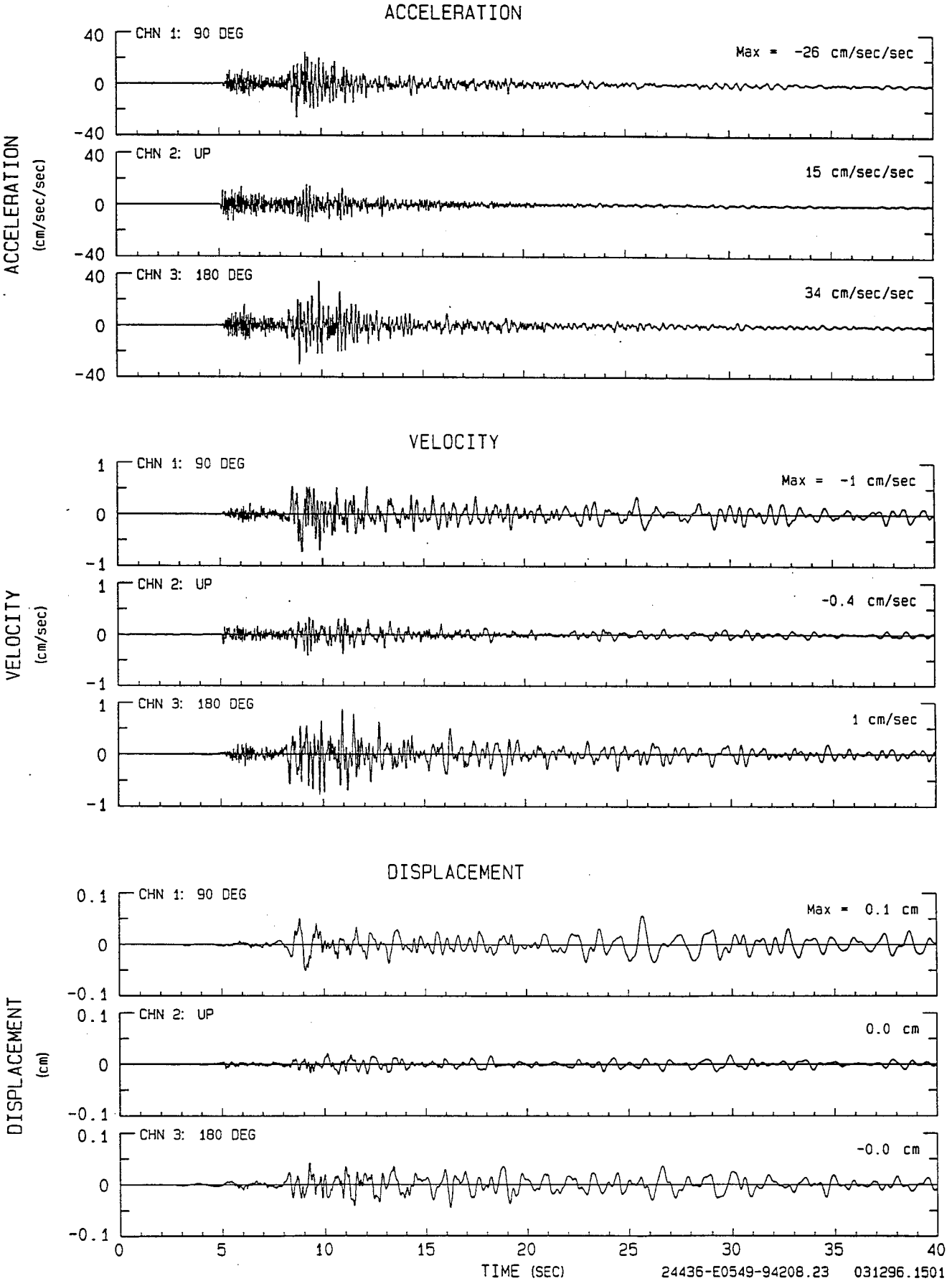
CHN 3: 205 DEG



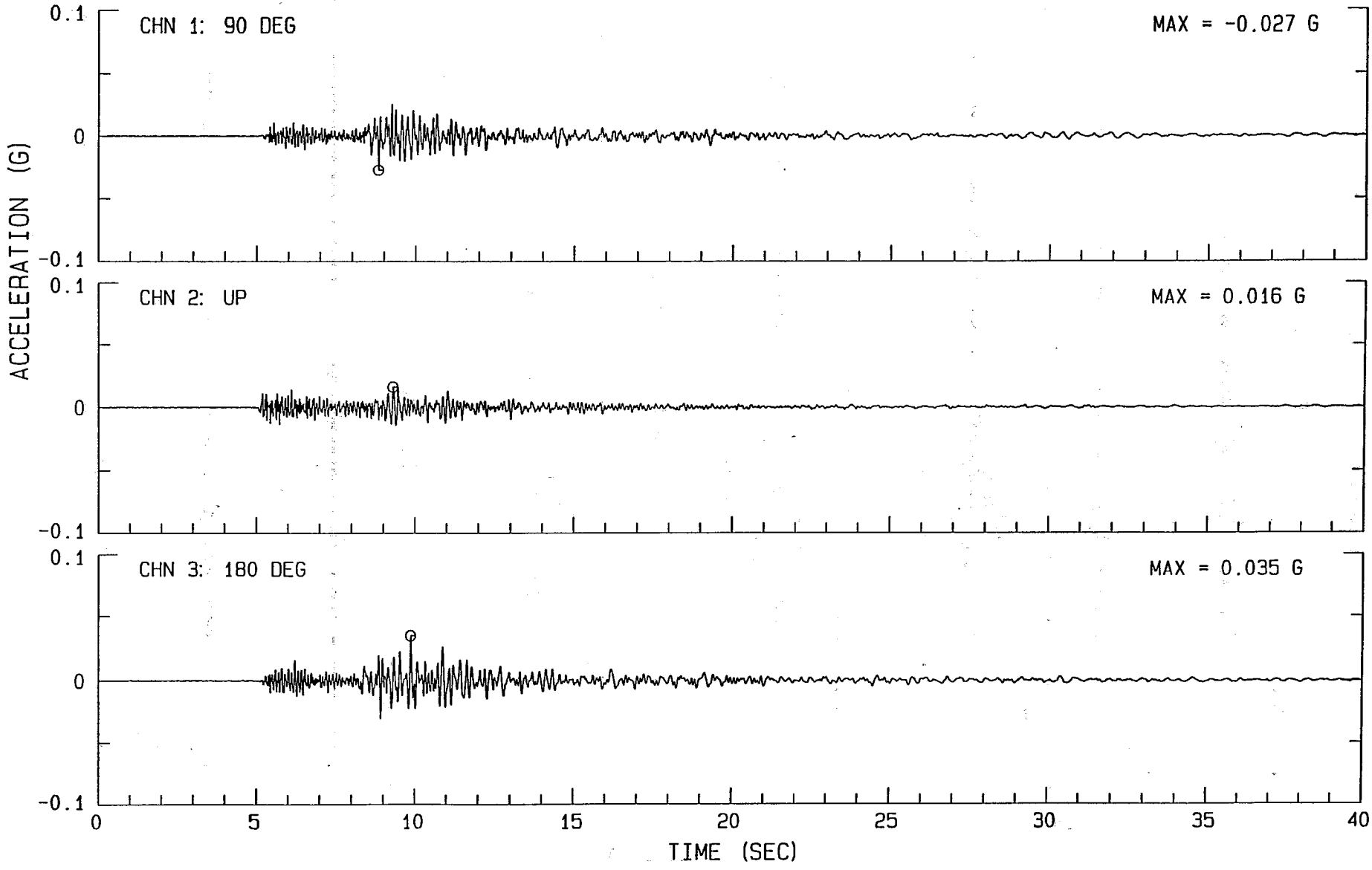
NORTHRIDGE AFTERSHOCK OF MAY 25, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CEDAR HILL NURSERY A CSMIP Sta Num 24436 165

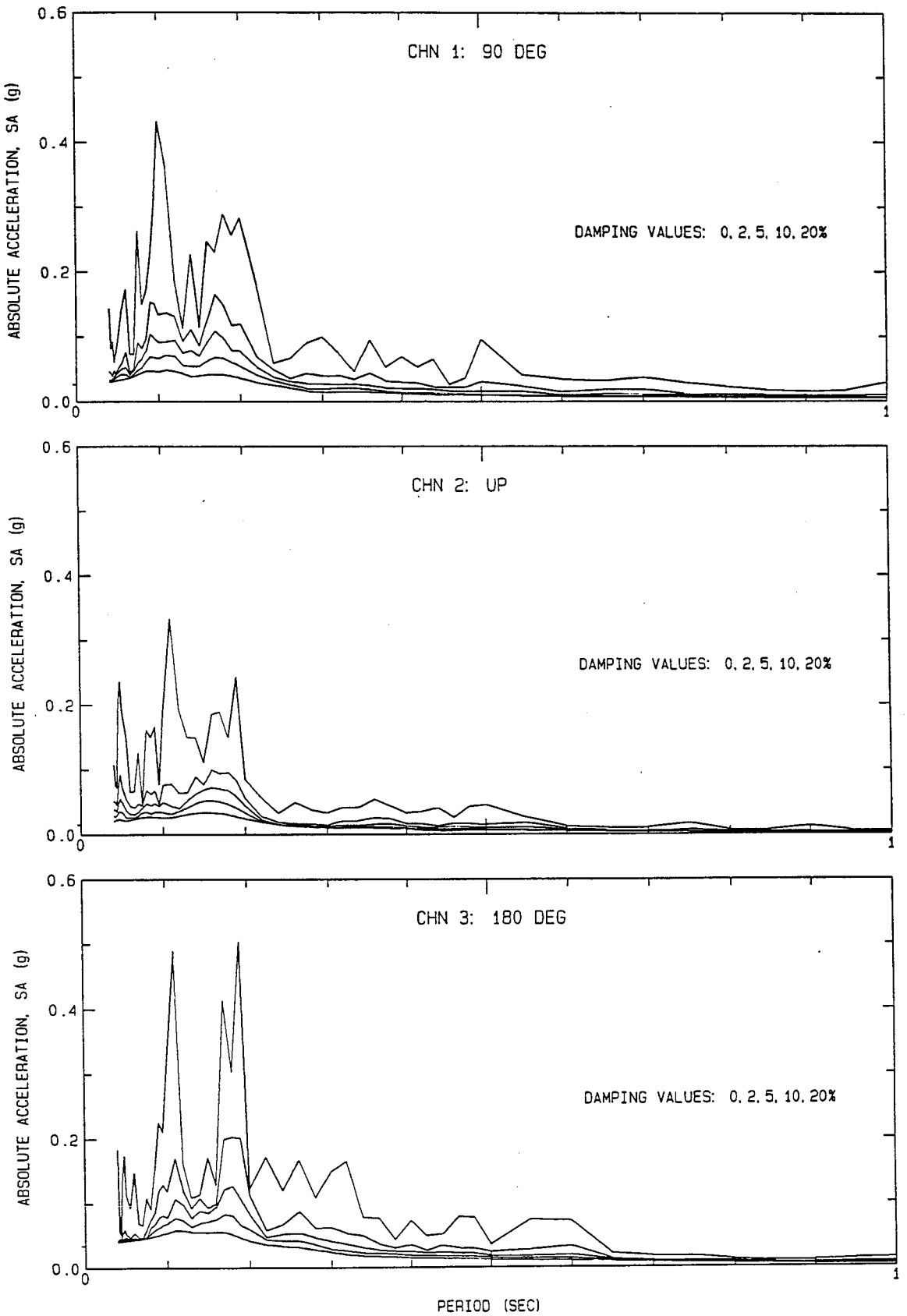
Usable Data Bandwidth: .51 to 47.2 Hz (.02 to 2.0 Sec)



NORTHRIDGE AFTERSHOCK OF MAY 25, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
UNCORRECTED ACCELEROGRAM 24436-E0549-94208.23 031296.1354-QN94E436



NORTHRIDGE AFTERSHOCK OF MAY 25, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .30-.60 TO 46.0-50.0 HZ.
24436-E0549-94208.23 031296.1502-GN94E436



NORTHRIDGE AFTERSHOCK OF MAY 25, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CEDAR HILL NURSERY A
Sta Num 24436

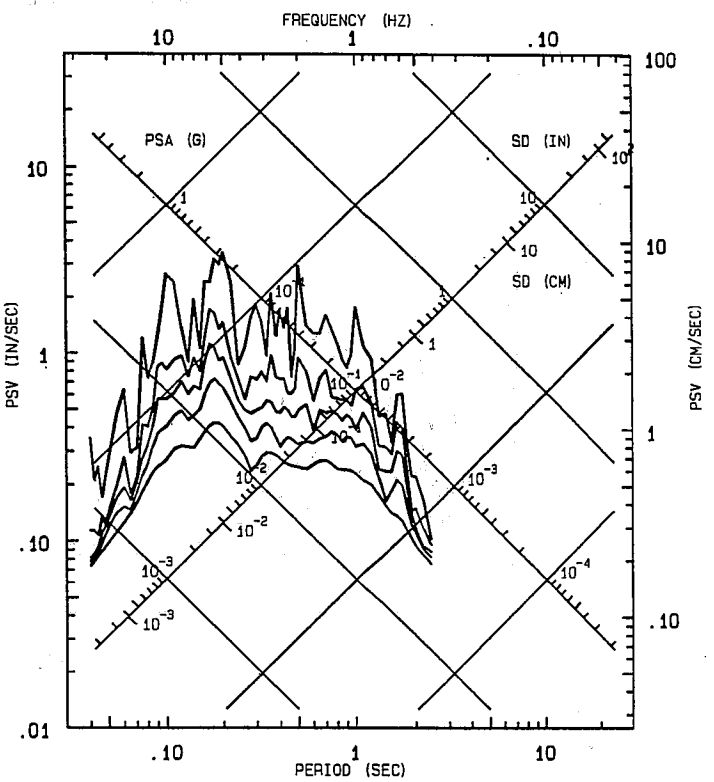
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.51 TO 47.2 HZ
(0.02 TO 2.0 SEC)

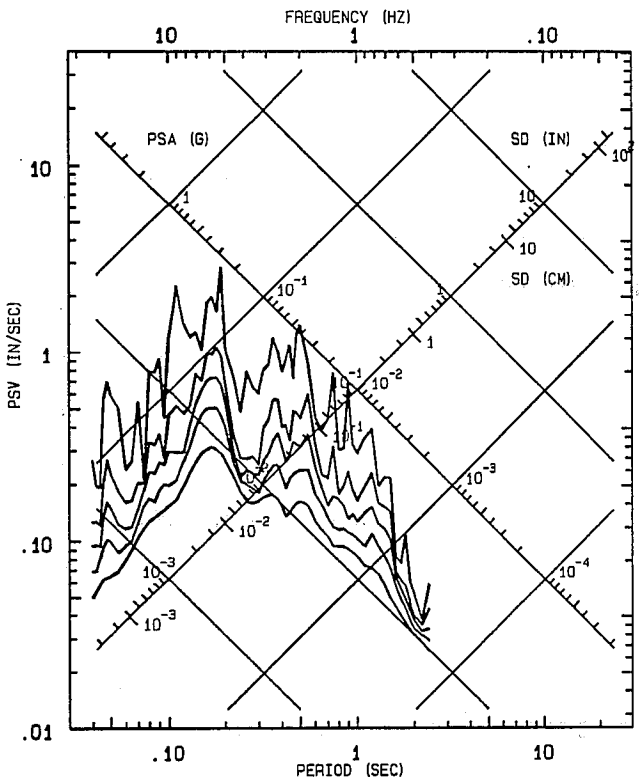
—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 24436-E0549-94208.23

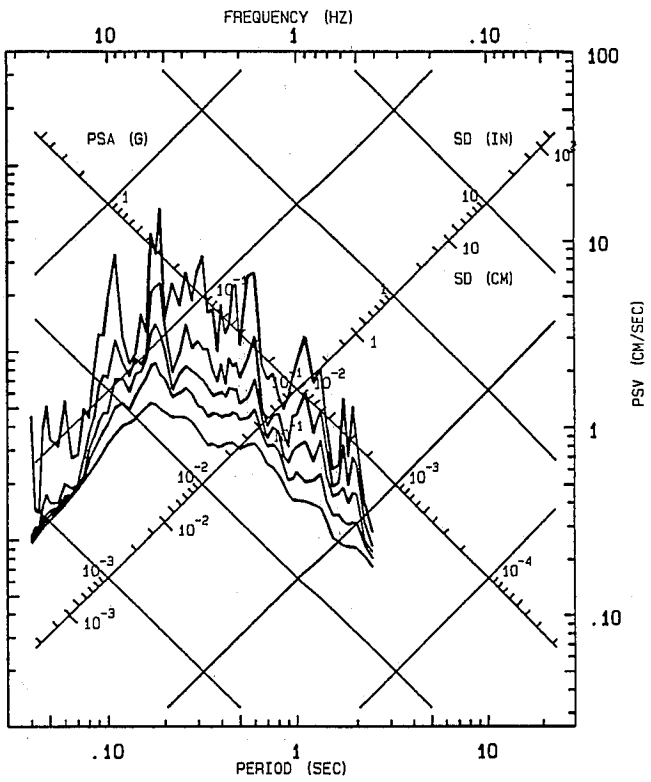
CHN 1: 90 DEG



CHN 2: UP



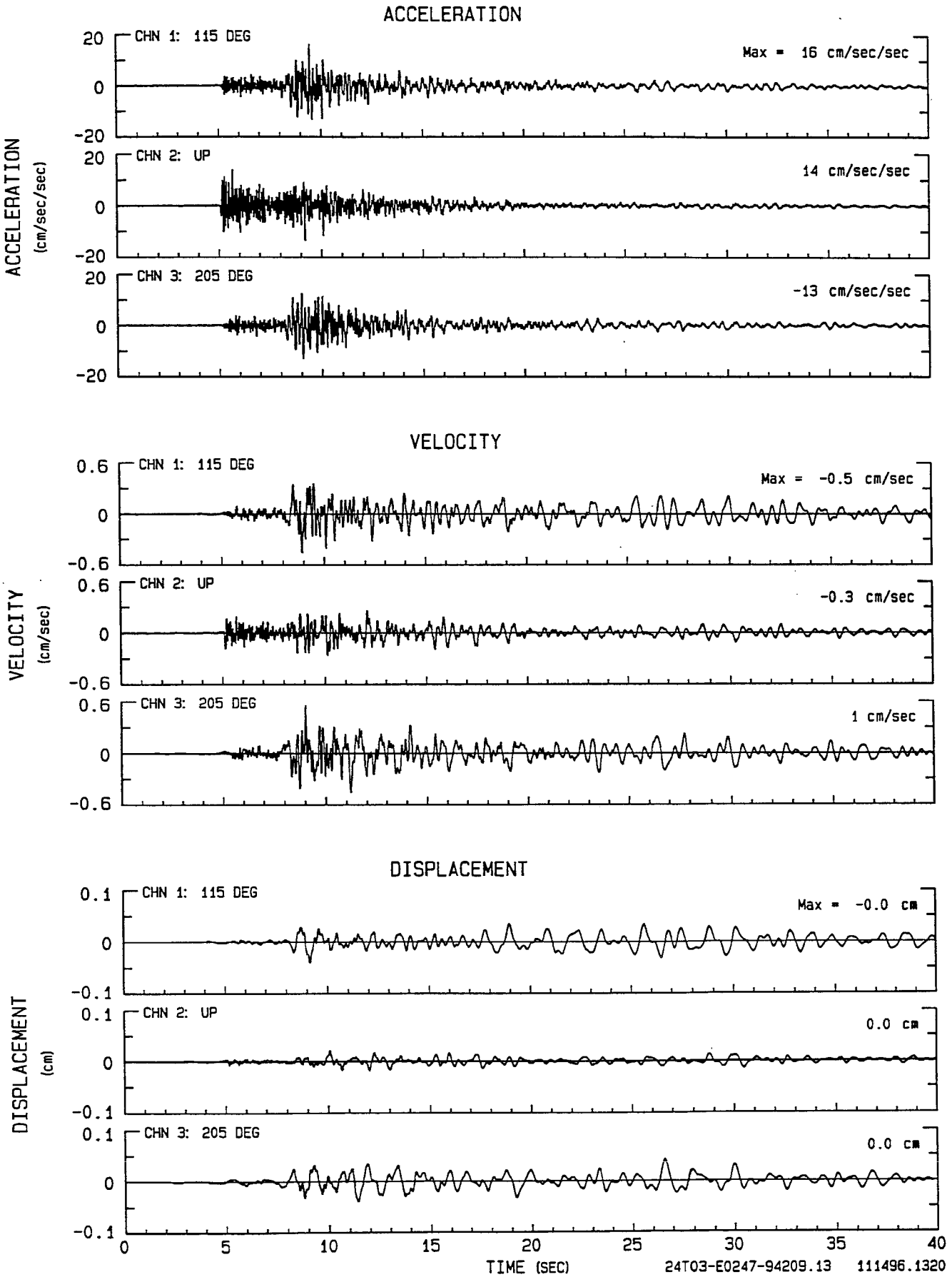
CHN 3: 180 DEG



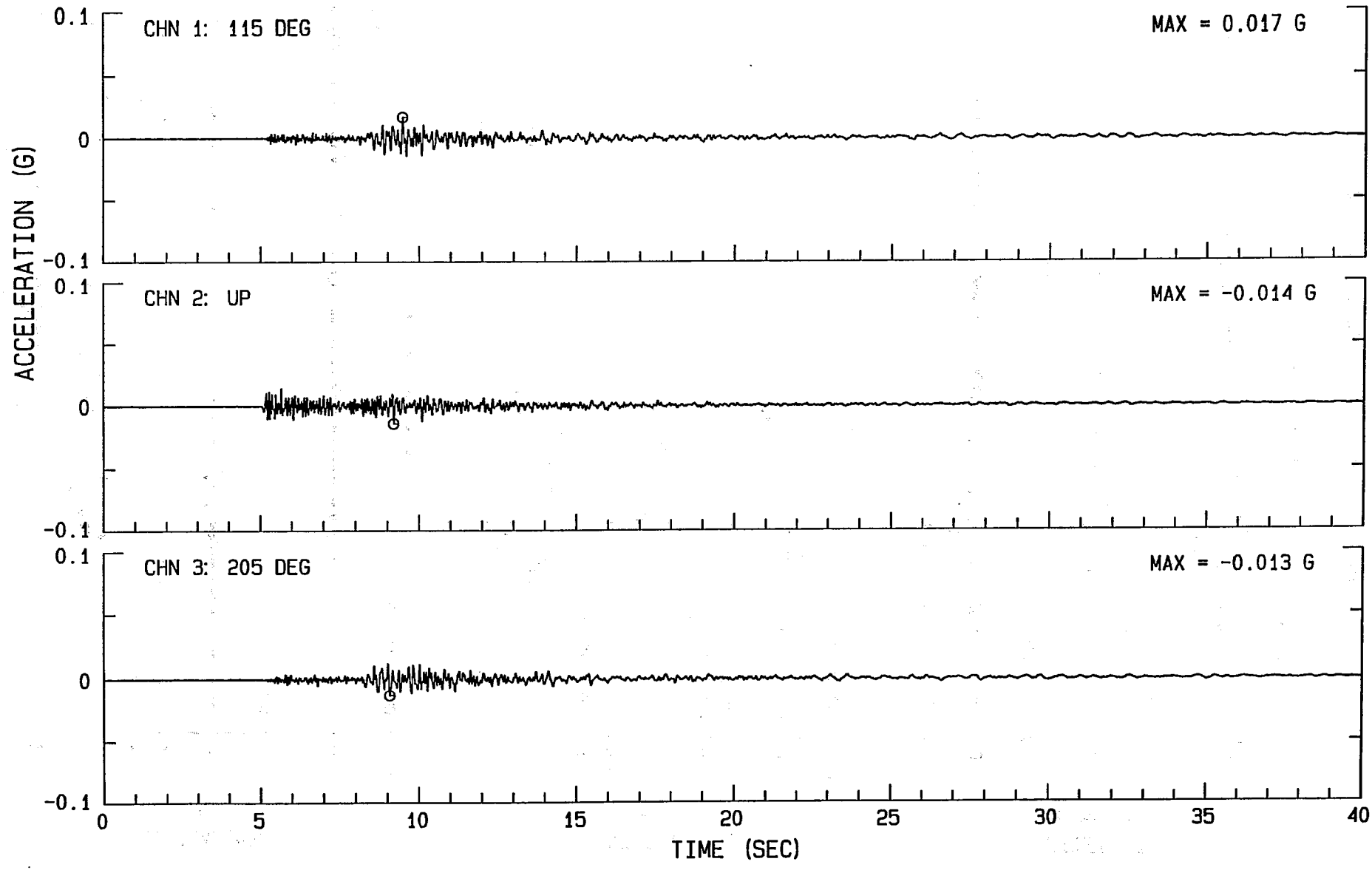
NORTHRIDGE AFTERSHOCK OF MAY 25, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CLUBHOUSE CSMIP Sta Num 24T03

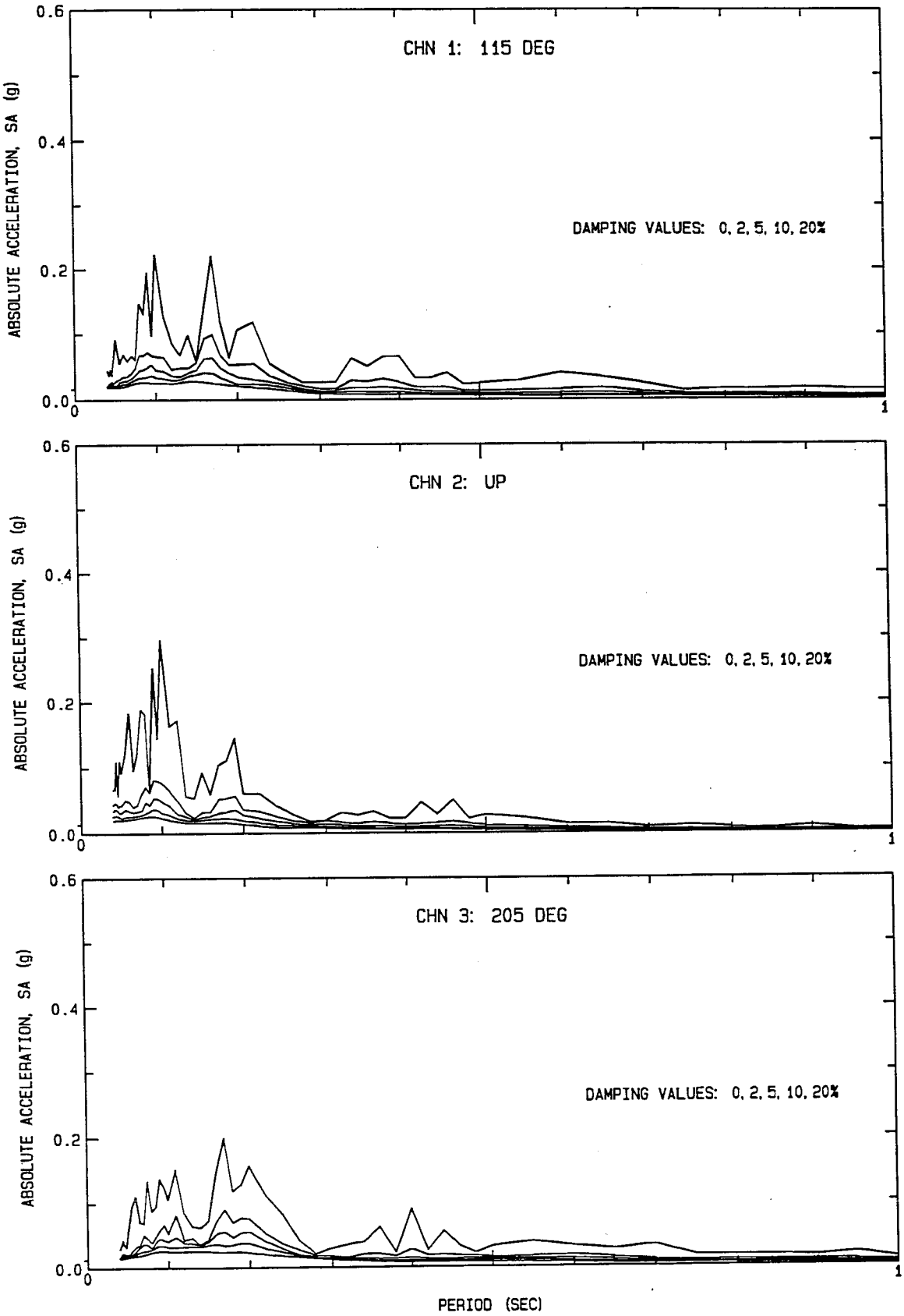
Usable Data Bandwidth: .51 to 47.2 Hz (.02 to 2.0 Sec)



NORTHRIDGE AFTERSHOCK OF MAY 25, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CLUBHOUSE
UNCORRECTED ACCELEROGRAM 24T03-E0247-94209.13 111496.1318-QN94ET03



NORTHRIDGE AFTERSHOCK OF MAY 25, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CLUBHOUSE
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .30-.60 TO 46.0-50.0 HZ.
24T03-E0247-94209.13 111496.1321-GN94ET03



NORTHRIDGE AFTERSHOCK OF MAY 25, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CLUBHOUSE
Sta Num 24T03

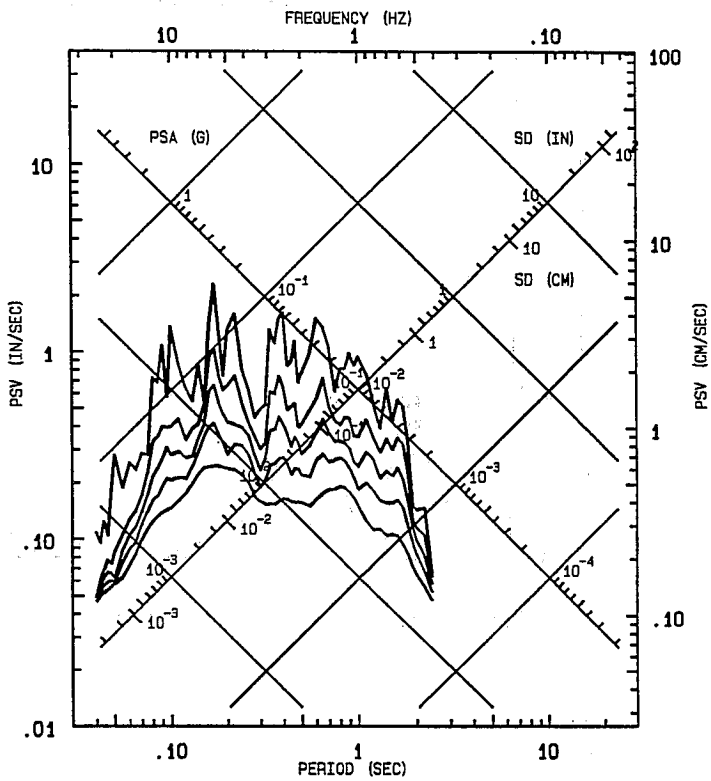
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.51 TO 47.2 HZ
(0.02 TO 2.0 SEC)

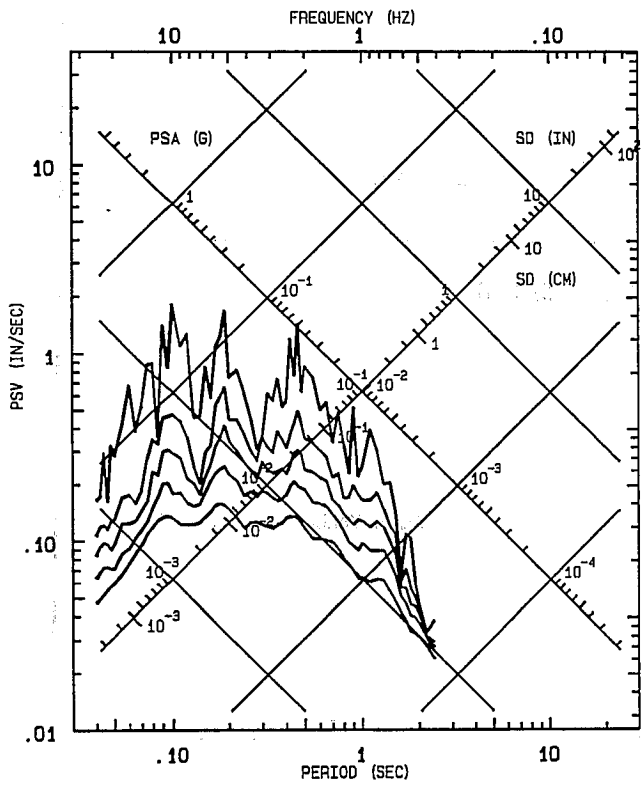
RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 24T03-E0247-94209.13

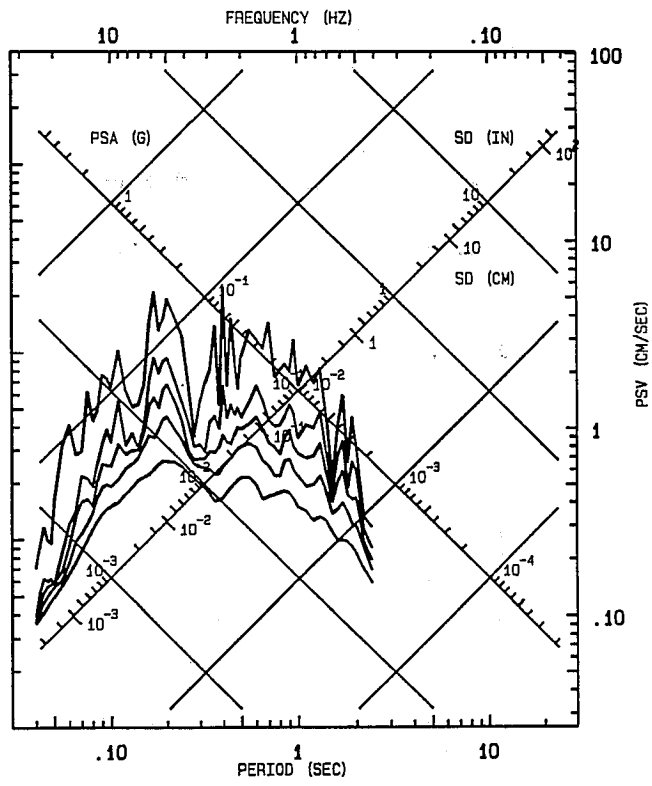
CHN 1: 115 DEG



CHN 2: UP



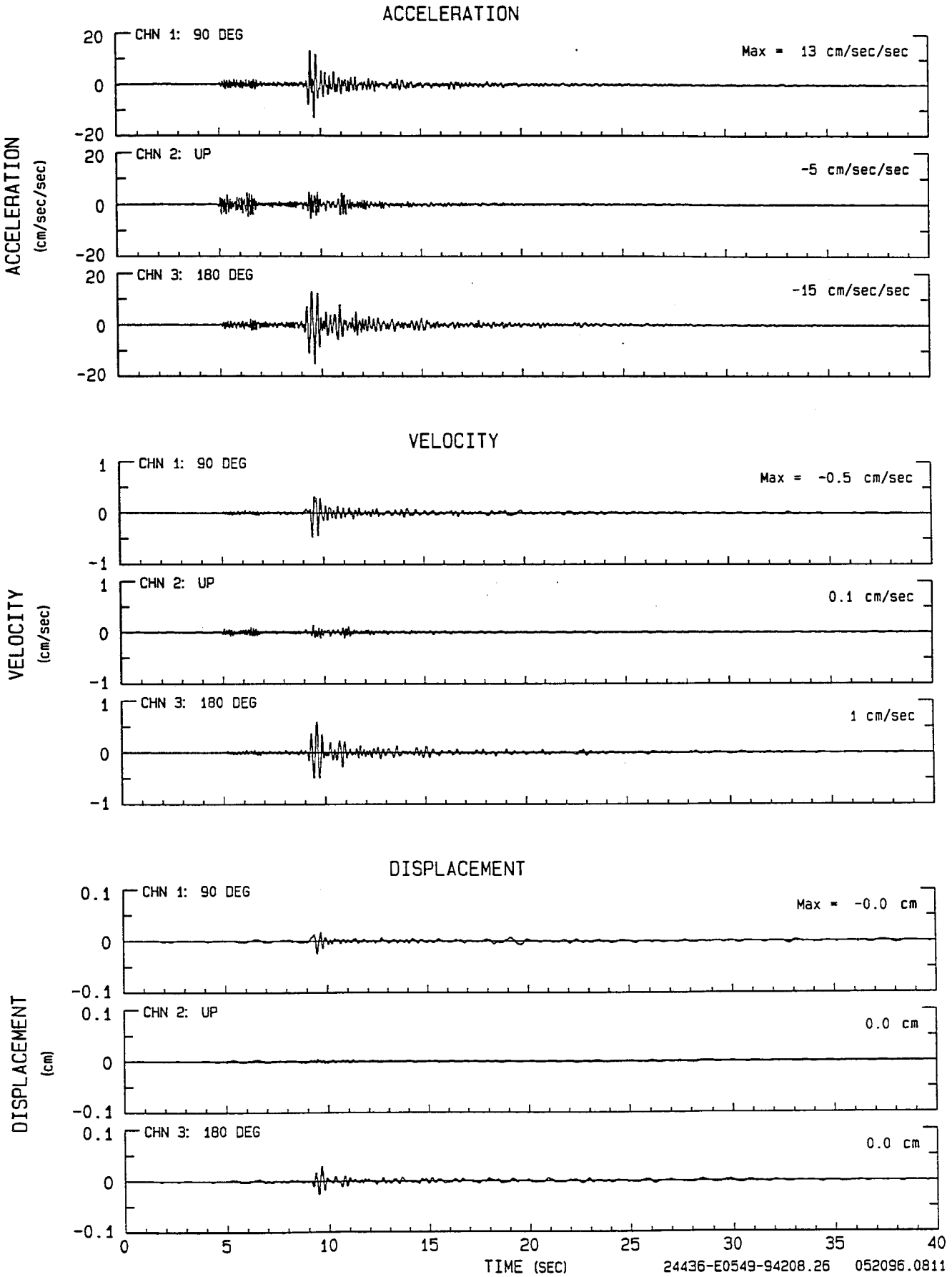
CHN 3: 205 DEG



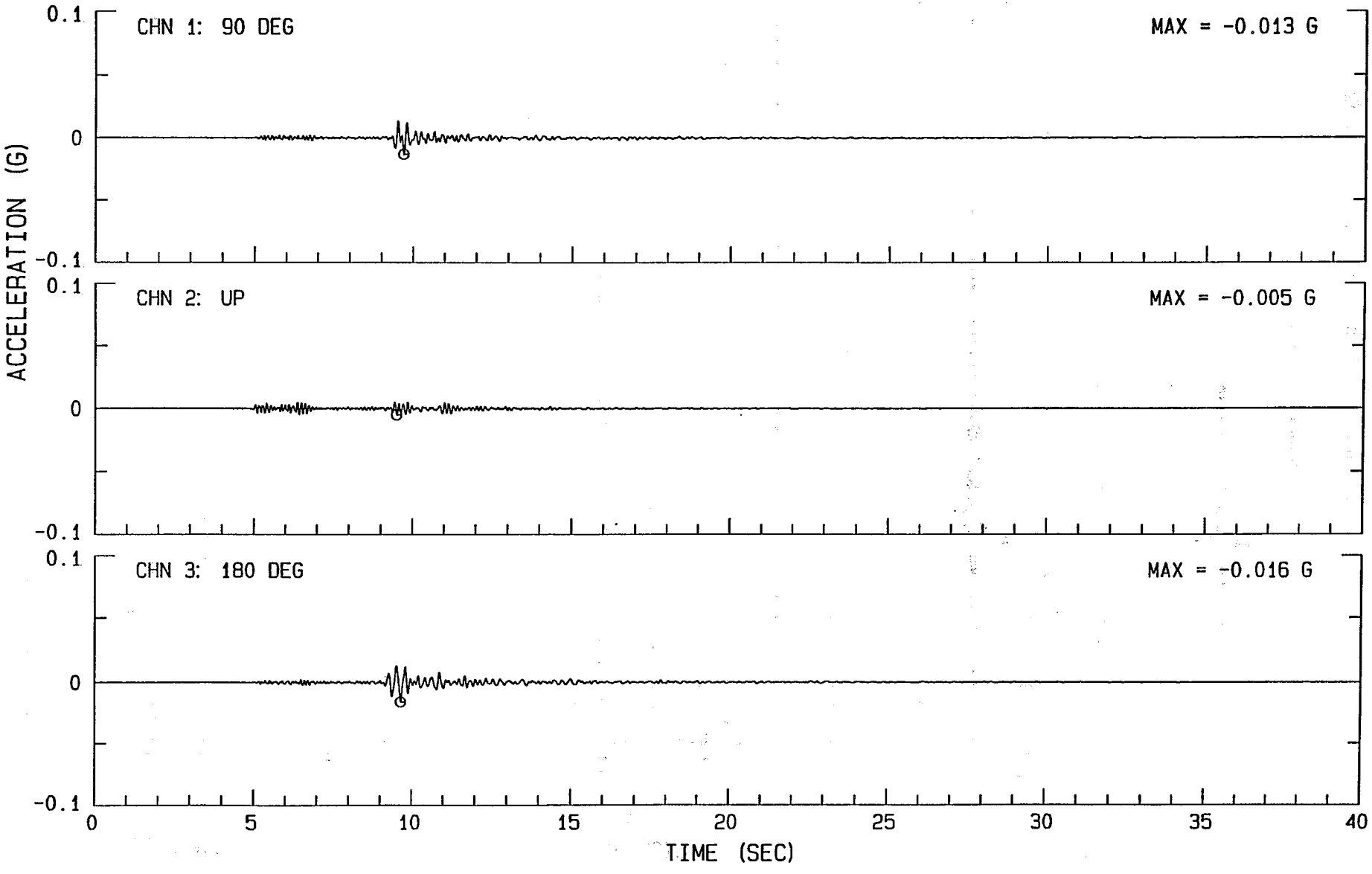
NORTHRIDGE AFTERSHOCK OF MAY 28, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CEDAR HILL NURSERY A CSMIP Sta Num 24436

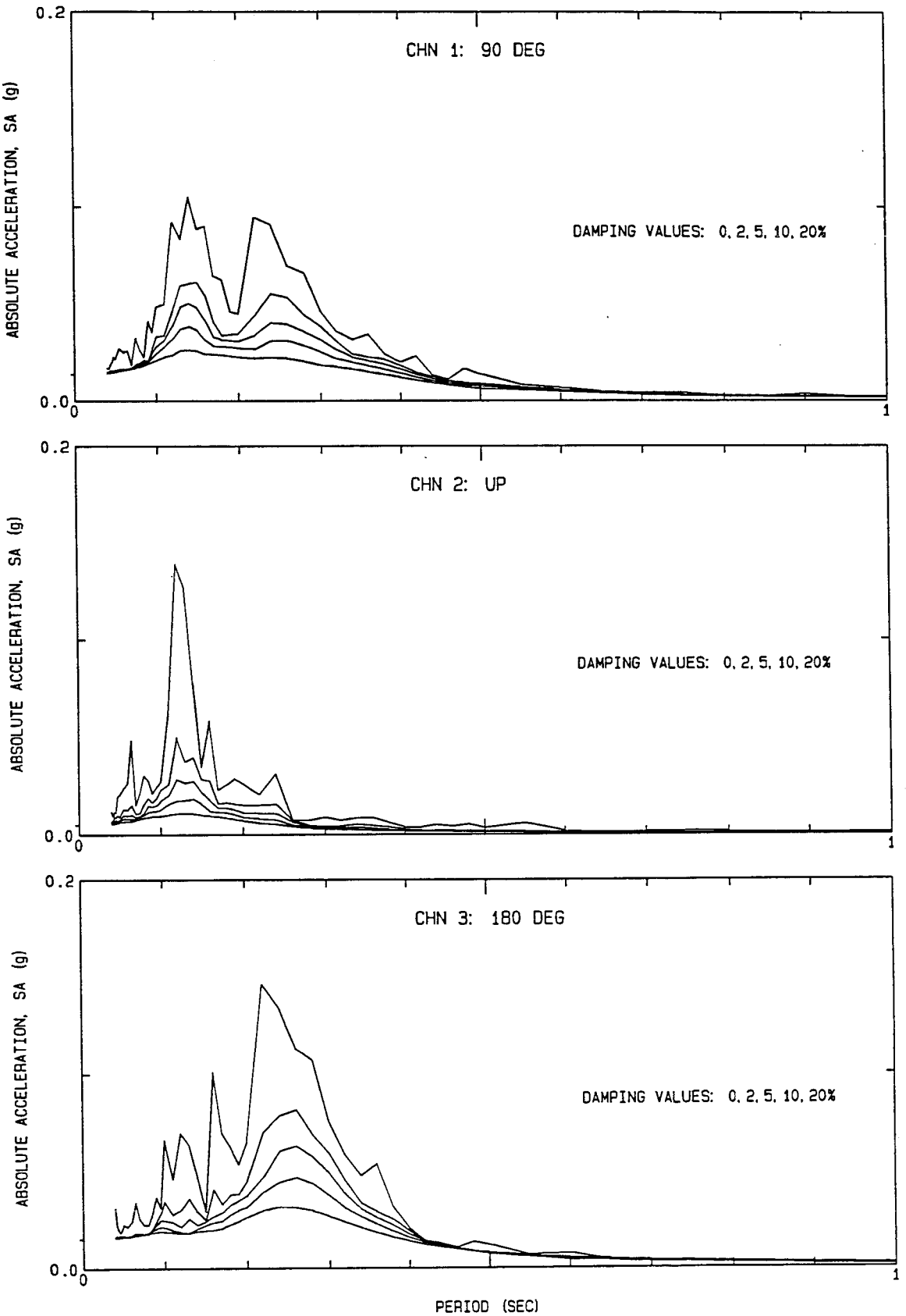
Usable Data Bandwidth: .51 to 47.2 Hz (.02 to 2.0 Sec)



NORTHRIDGE AFTERSHOCK OF MAY 28, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
UNCORRECTED ACCELEROGRAM 24436-E0549-94208.26 031396.0824-QN94H436



NORTHRIDGE AFTERSHOCK OF MAY 28, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .30-.60 TO 46.0-50.0 HZ.
24436-E0549-94208.26 052096.0812-GN94H436



NORTHRIDGE AFTERSHOCK OF MAY 28, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CEDAR HILL NURSERY A
Sta Num 24436

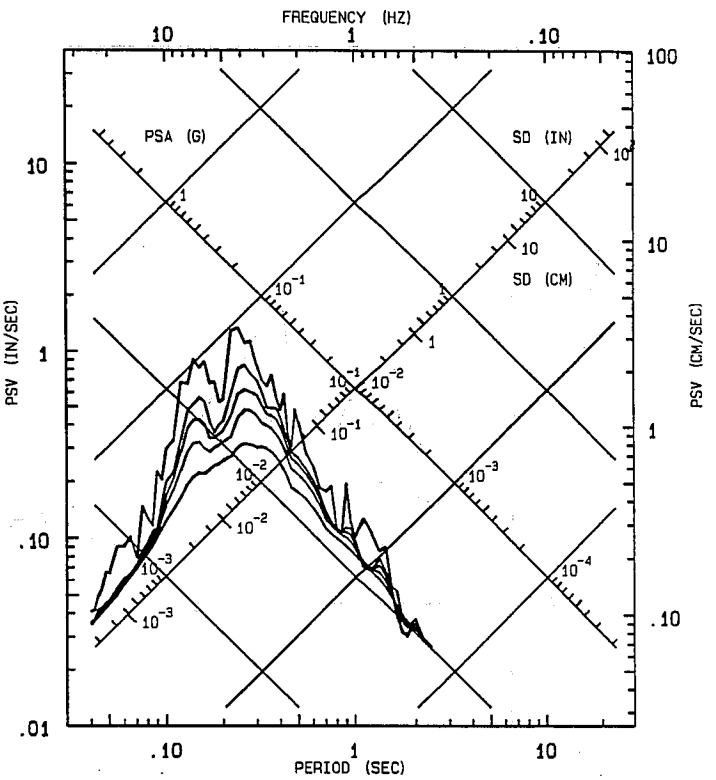
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.51 TO 47.2 HZ
(0.02 TO 2.0 SEC)

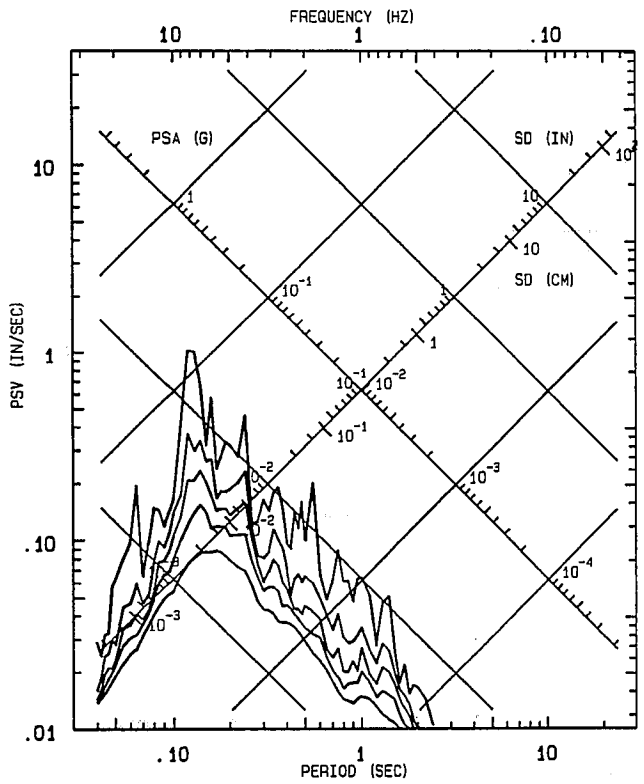
—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 24436-E0549-94208.26

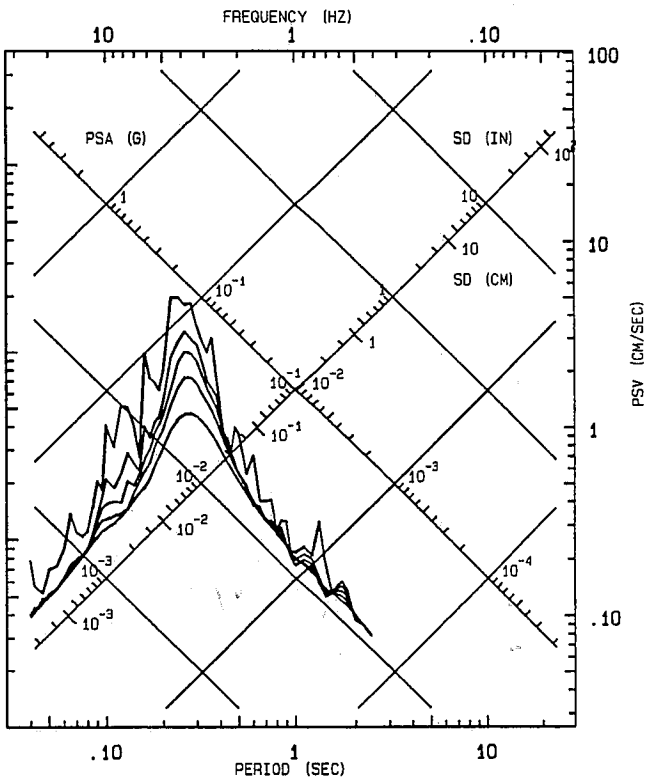
CHN 1: 90 DEG



CHN 2: UP

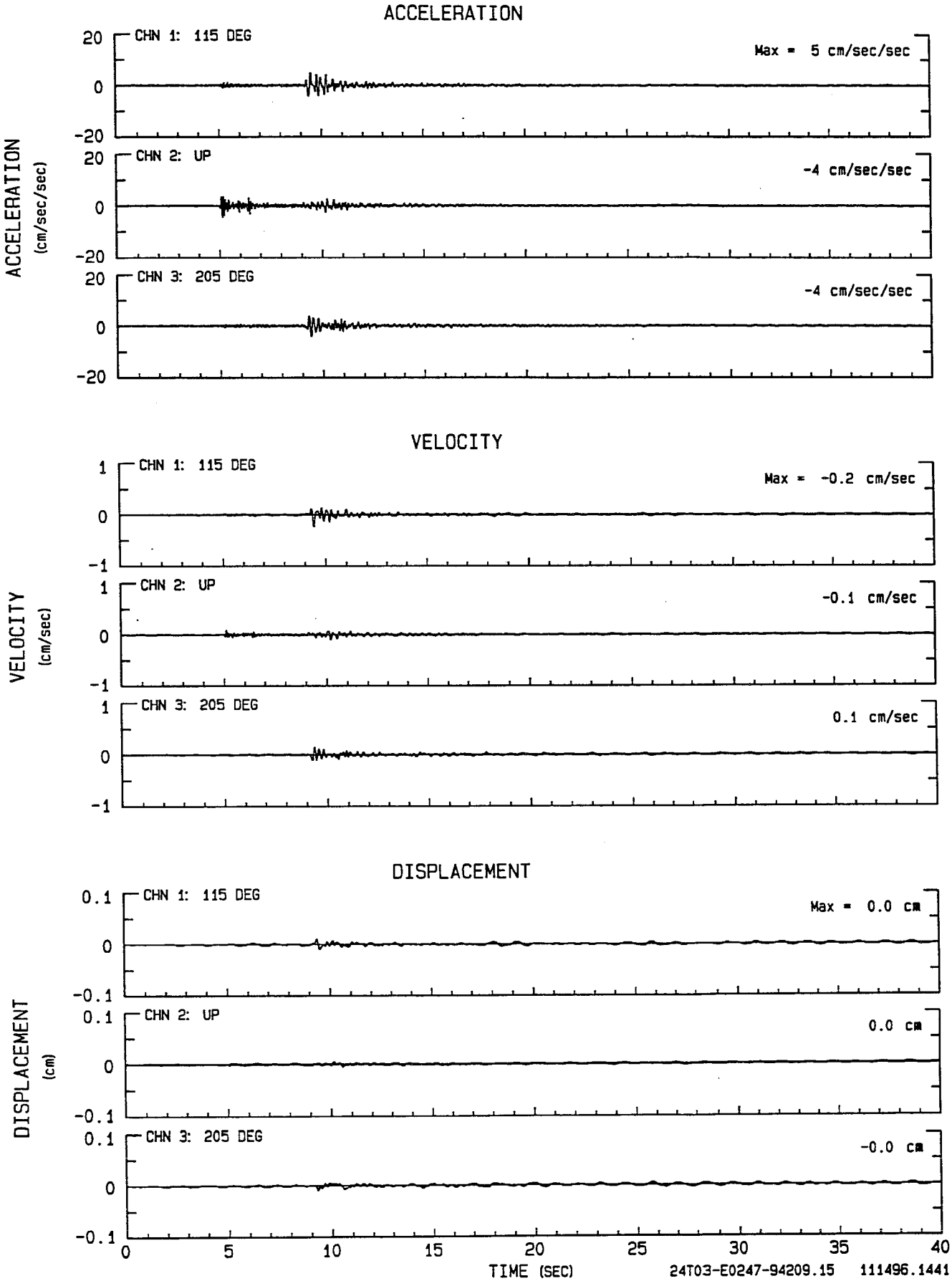


CHN 3: 180 DEG

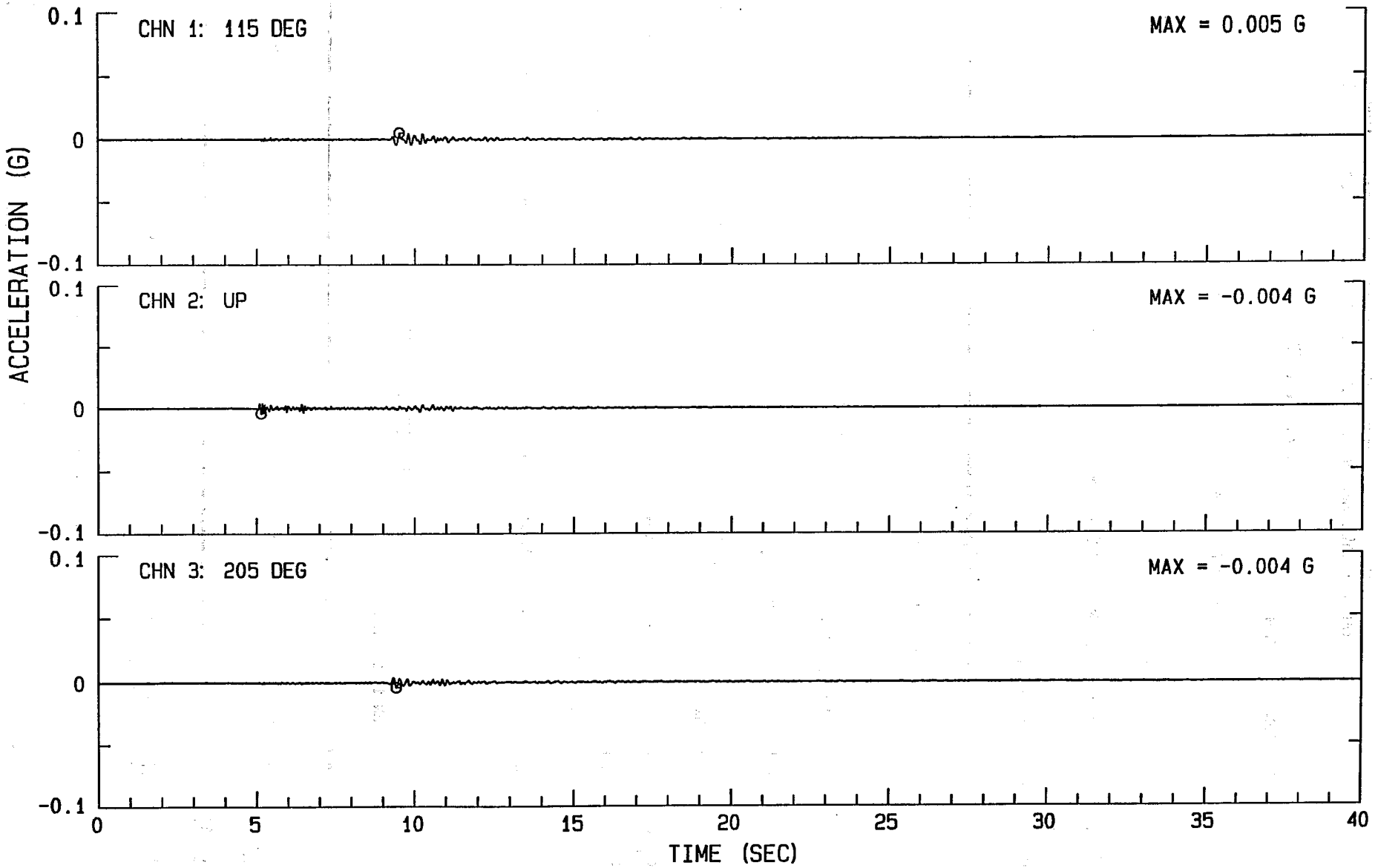


TARZANA - CLUBHOUSE CSMIP Sta Num 24T03

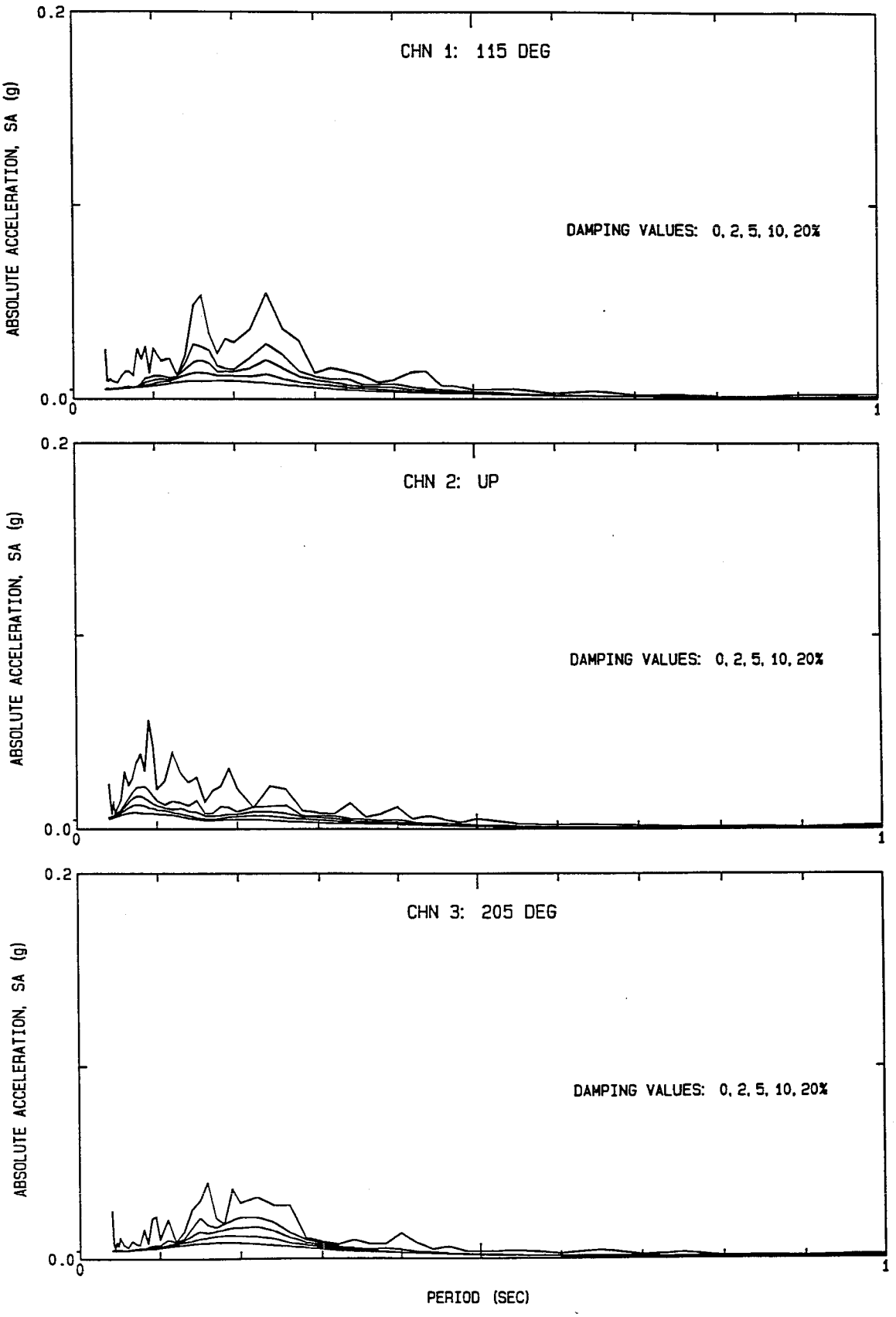
Usable Data Bandwidth: .51 to 47.2 Hz (.02 to 2.0 Sec)



NORTHRIDGE AFTERSHOCK OF MAY 28, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CLUBHOUSE
UNCORRECTED ACCELEROGRAM 24T03-E0247-94209.15 111496.1438-QN94HT03



NORTHRIDGE AFTERSHOCK OF MAY 28, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CLUBHOUSE
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .30-.60 TO 46.0-50.0 HZ.
24T03-E0247-94209.15 111496.1442-GN94HT03



NORTHRIDGE AFTERSHOCK OF MAY 28, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CLUBHOUSE
Sta Num 24T03

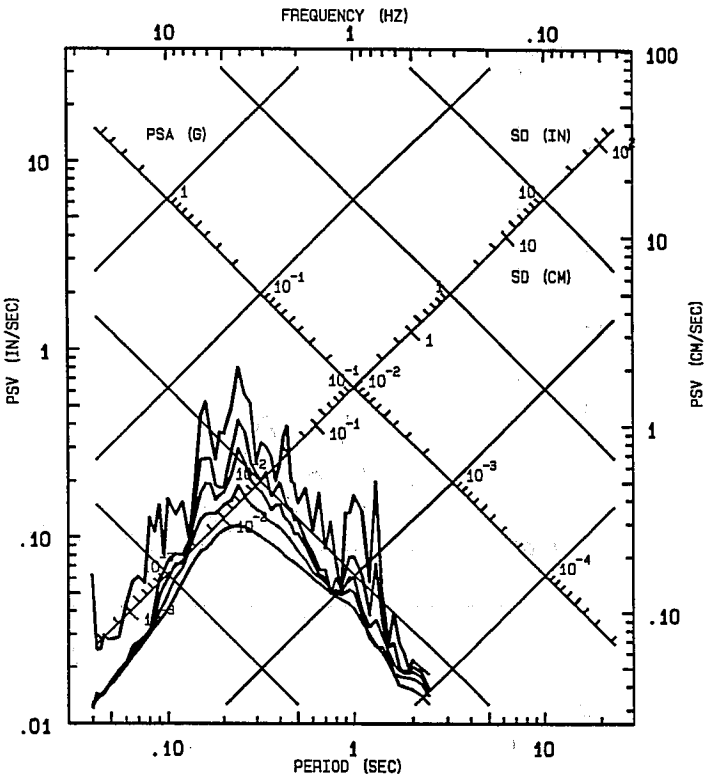
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.51 TO 47.2 HZ
(0.02 TO 2.0 SEC)

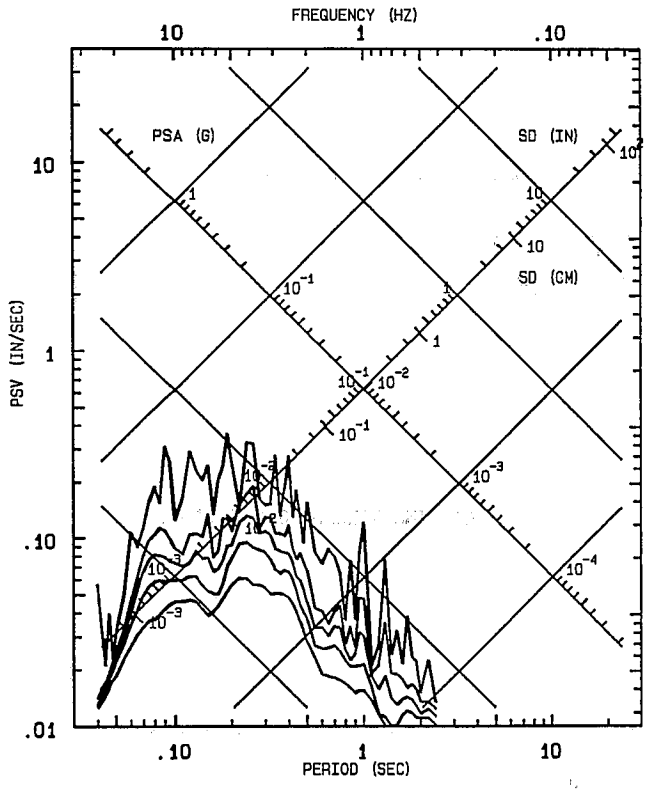
RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 24T03-E0247-94209.15

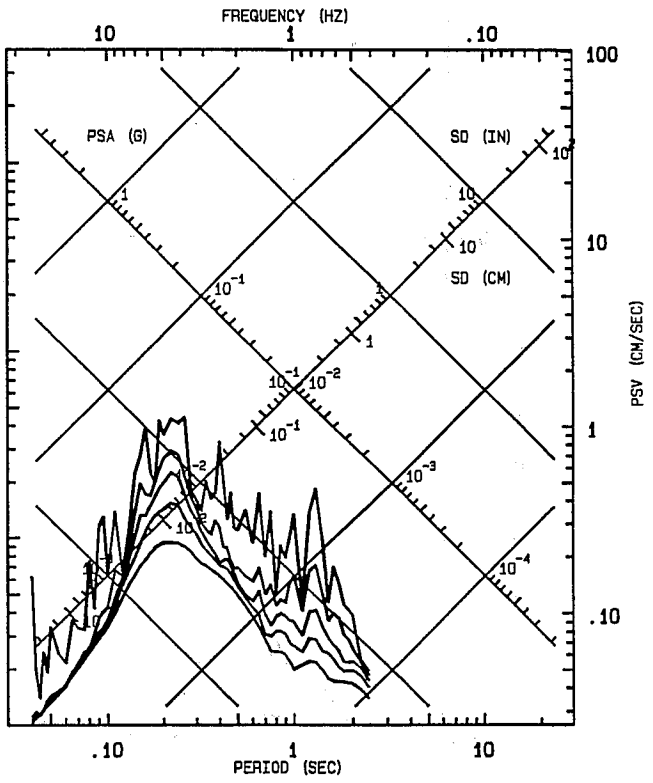
CHN 1: 115 DEG



CHN 2: UP



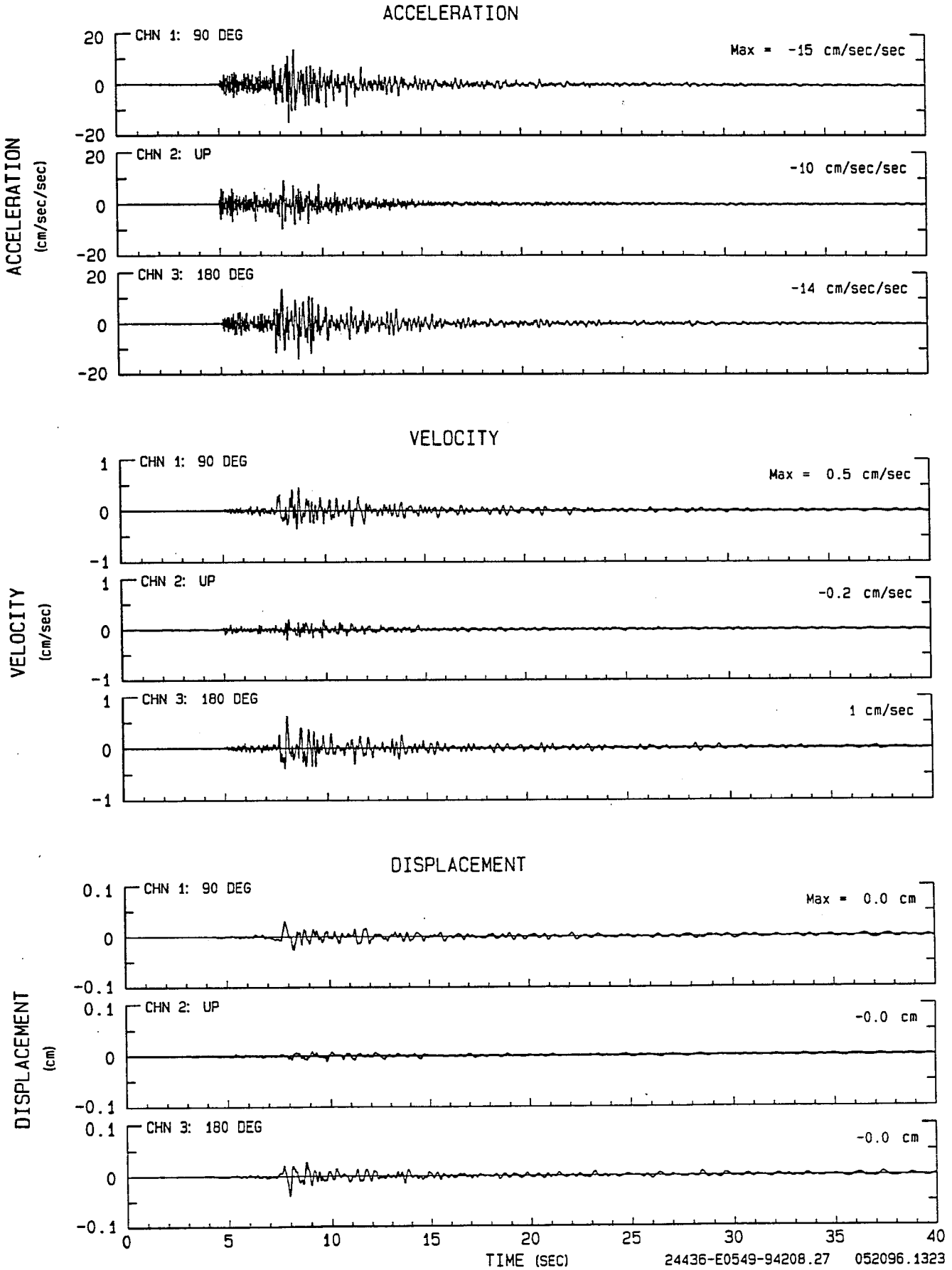
CHN 3: 205 DEG



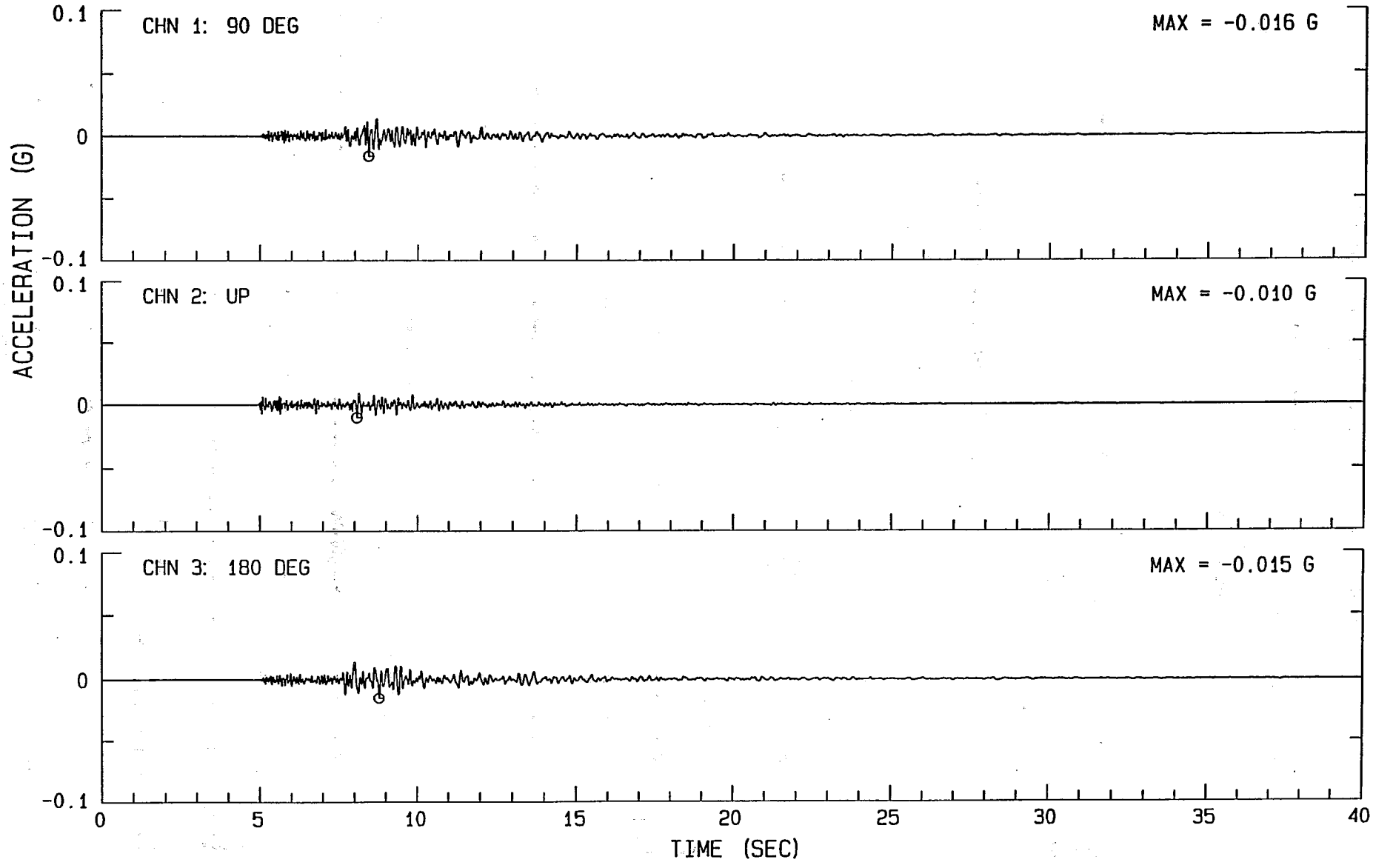
NORTHRIDGE AFTERSHOCK OF JUNE 2, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CEDAR HILL NURSERY A CSMIP Sta Num 24436

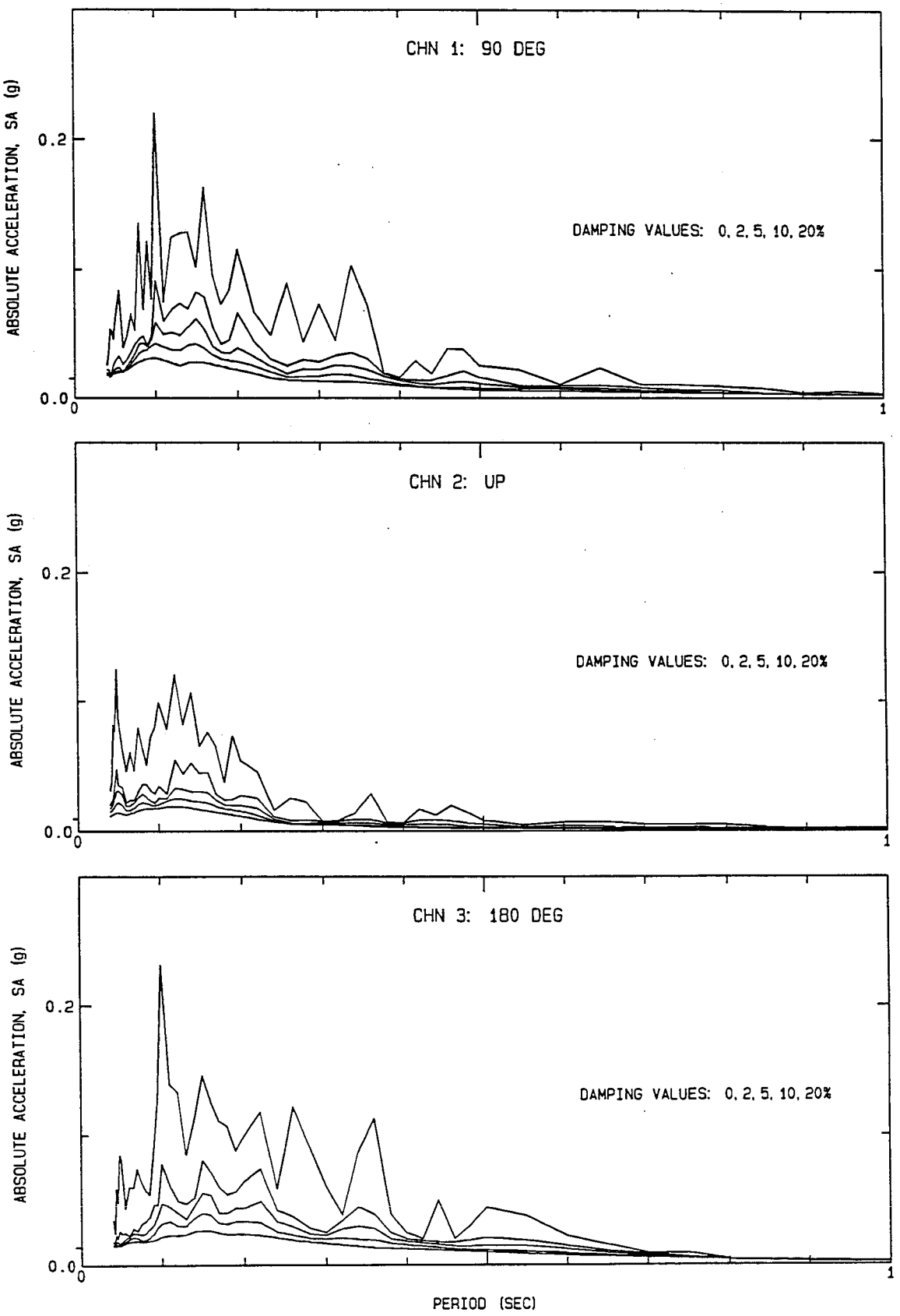
Usable Data Bandwidth: .51 to 47.2 Hz (.02 to 2.0 Sec)



NORTHRIDGE AFTERSHOCK OF JUNE 2, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
UNCORRECTED ACCELEROGRAM 24436-E0549-94208.27 031396.0830-QN94I436



NORTHRIDGE AFTERSHOCK OF JUNE 2, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .30-.60 TO 46.0-50.0 HZ.
24436-E0549-94208.27 052096.1324-QN94I436



NORTHRIDGE AFTERSHOCK OF JUNE 2, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CEDAR HILL NURSERY A
Sta Num 24436

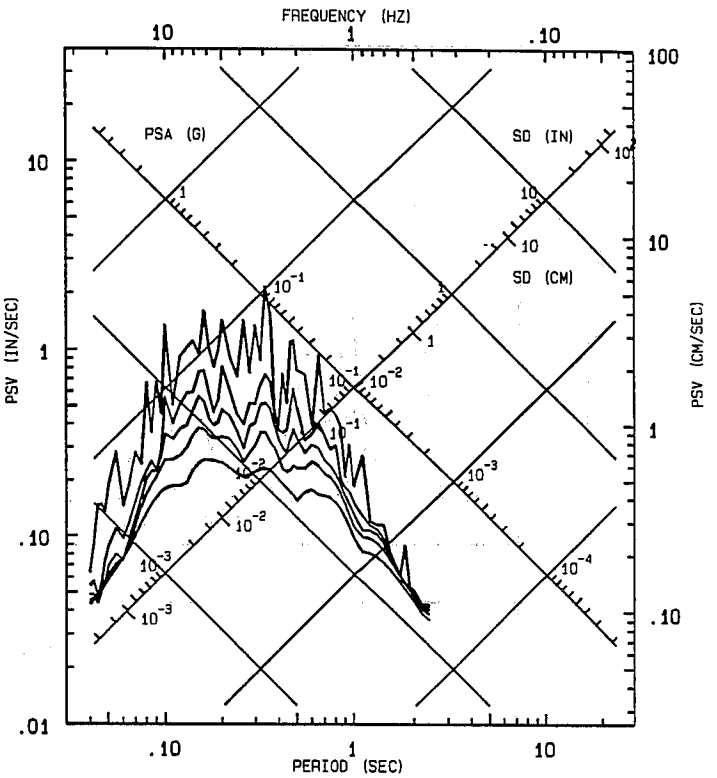
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.51 TO 47.2 HZ
(0.02 TO 2.0 SEC)

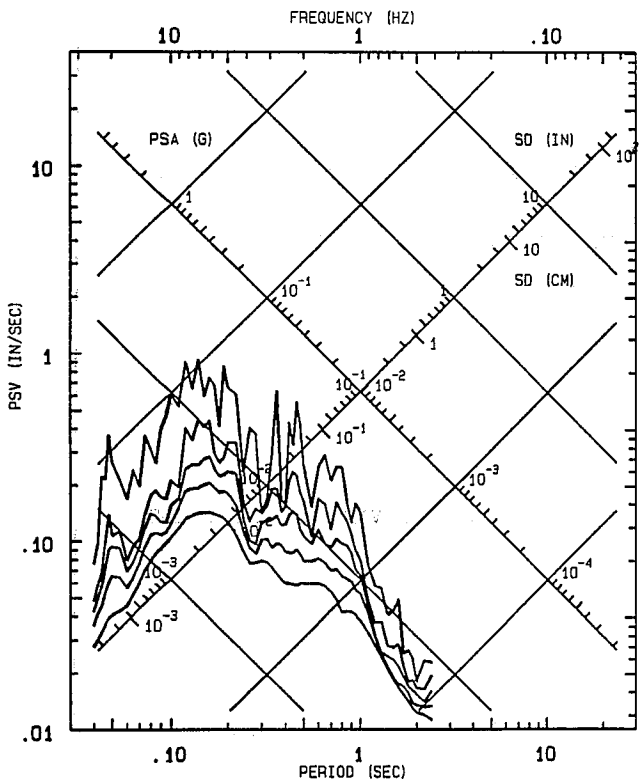
RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 24436-E0549-94208.27

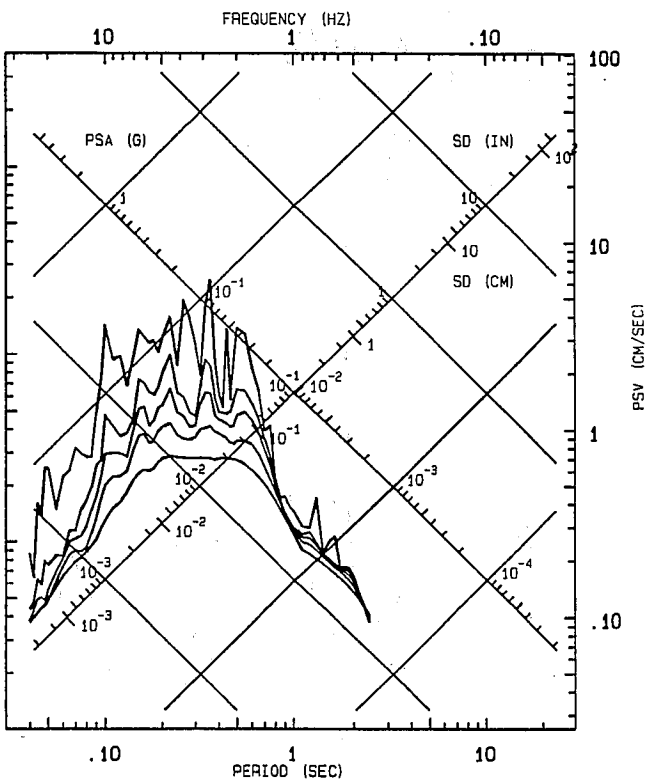
CHN 1: 90 DEG



CHN 2: UP



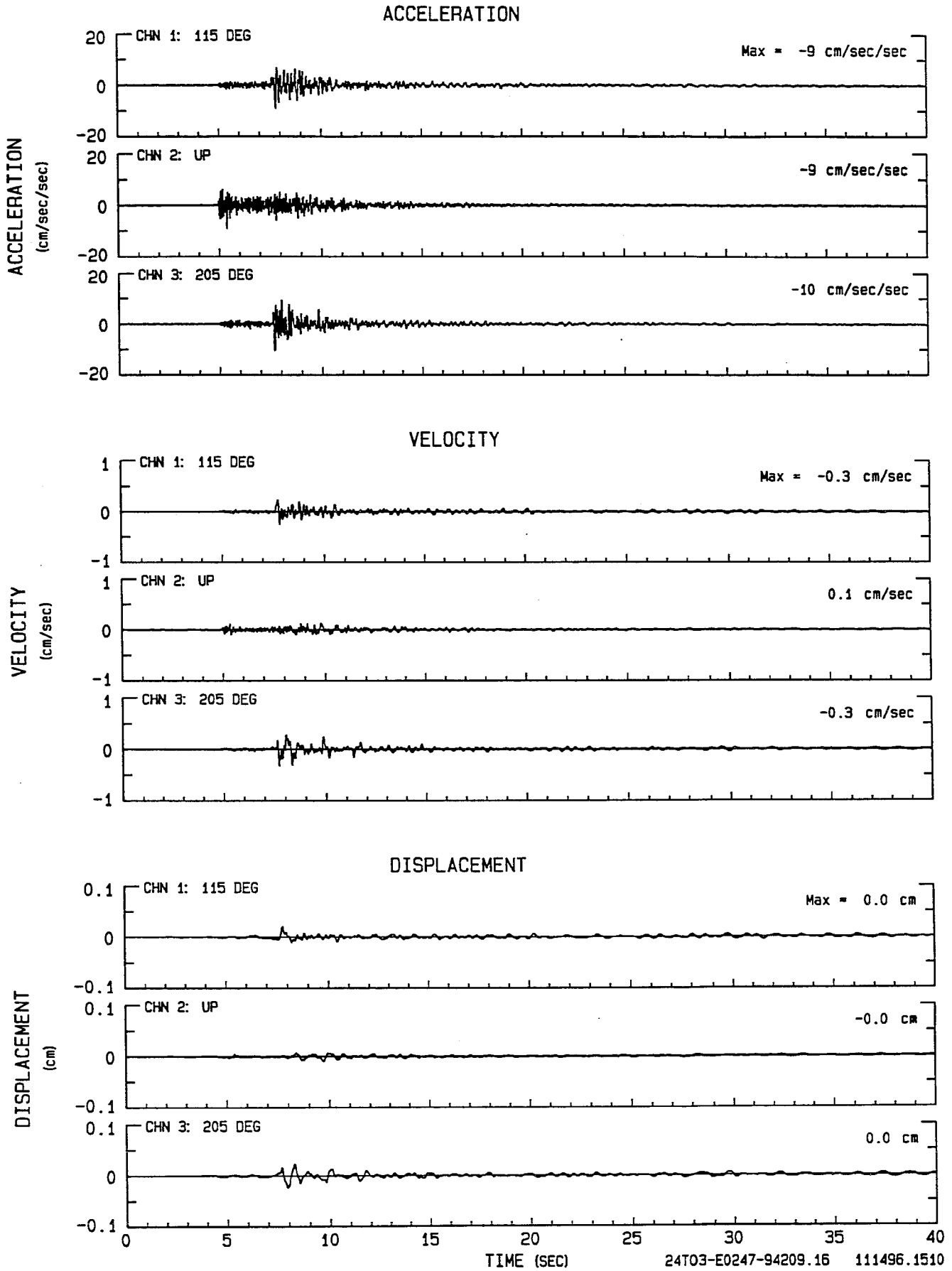
CHN 3: 180 DEG

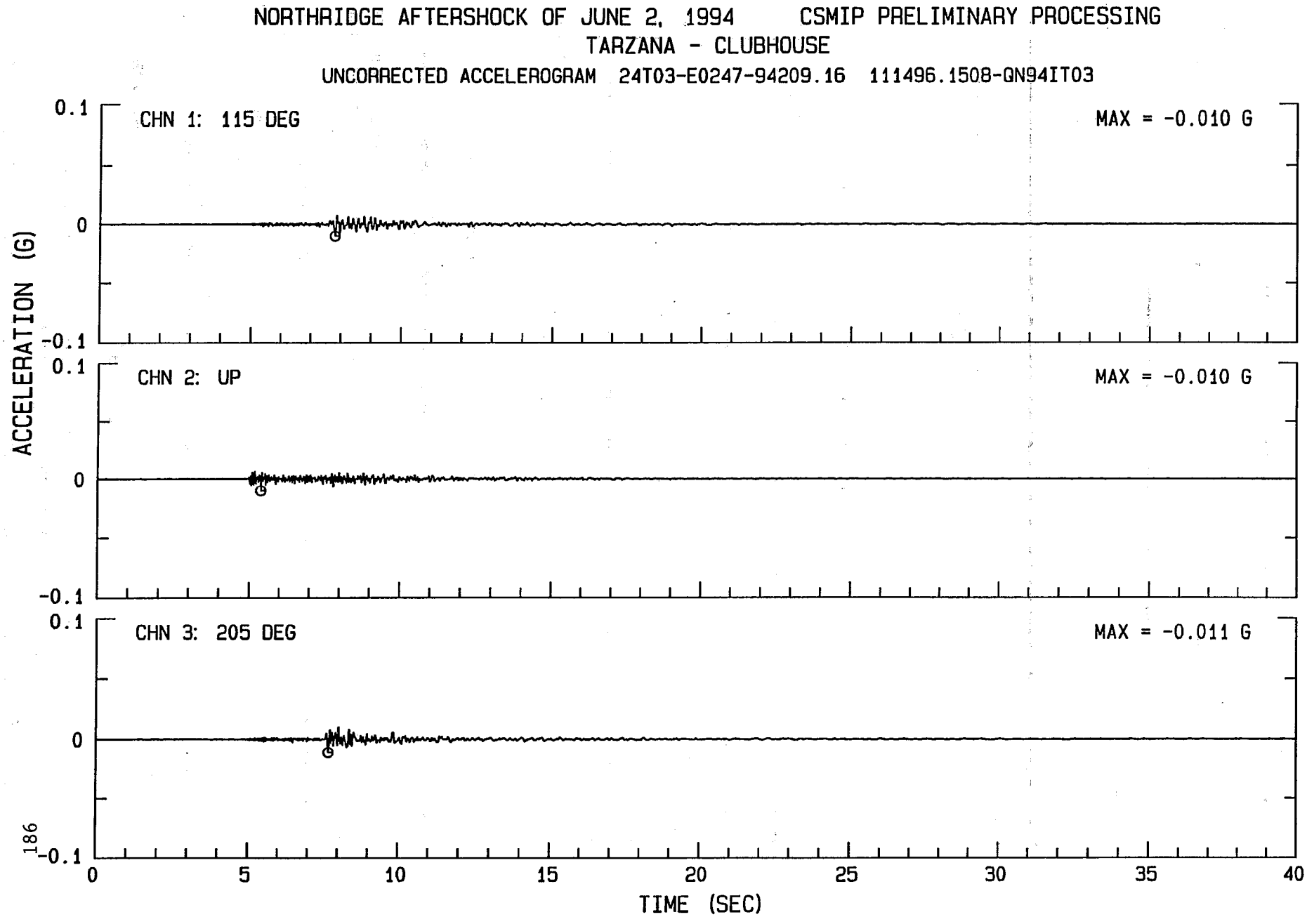


NORTHRIDGE AFTERSHOCK OF JUNE 2, 1994 CSMIP PRELIMINARY PROCESSING

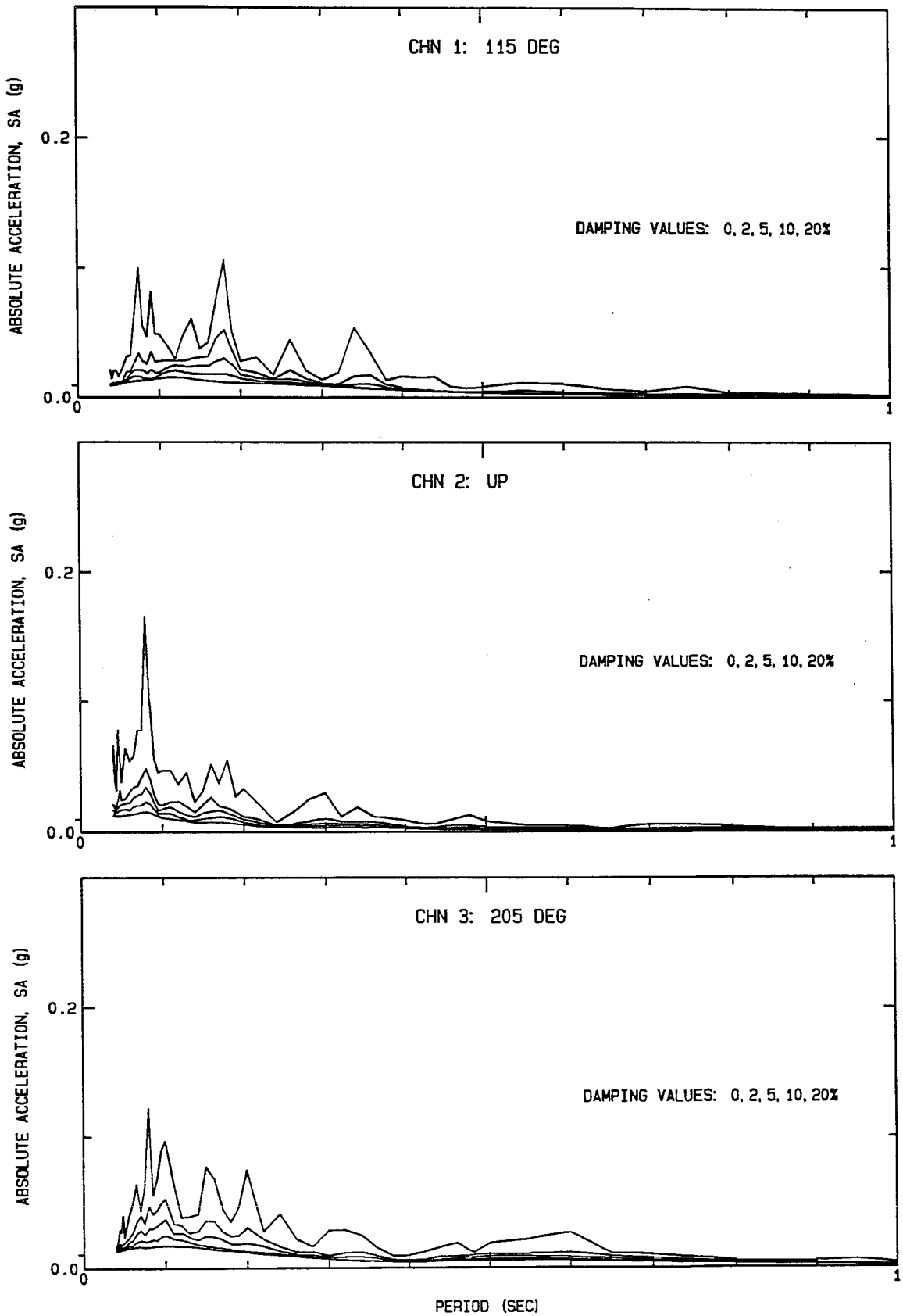
TARZANA - CLUBHOUSE CSMIP Sta Num 24T03

Usable Data Bandwidth: .51 to 47.2 Hz (.02 to 2.0 Sec)




NORTHRIDGE AFTERSHOCK OF JUNE 2, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CLUBHOUSE
UNCORRECTED ACCELEROGRAM 24T03-E0247-94209.16 111496.1508-GN94IT03
CHN 1: 115 DEG
MAX = -0.010 G
CHN 2: UP
MAX = -0.010 G
CHN 3: 205 DEG
MAX = -0.011 G
ACCELERATION (G)
0.1
0
-0.1
0
5
10
15
20
25
30
35
40
TIME (SEC)

NORTHRIDGE AFTERSHOCK OF JUNE 2, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CLUBHOUSE
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .30-.60 TO 46.0-50.0 HZ.
24T03-E0247-94209.16 111496.1511-QN94IT03



NORTHRIDGE AFTERSHOCK OF JUNE 2, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CLUBHOUSE
Sta Num 24T03

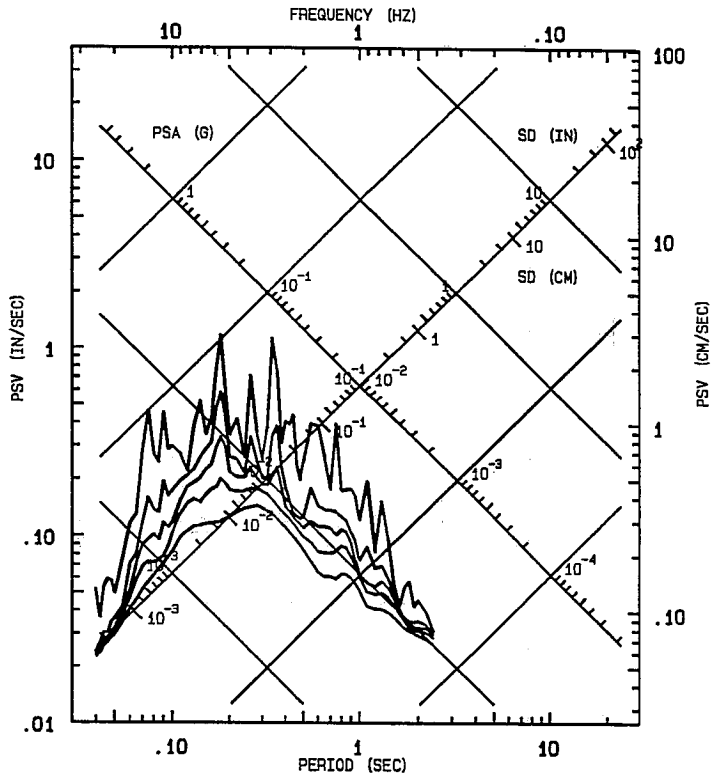
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.51 TO 47.2 HZ
(0.02 TO 2.0 SEC)

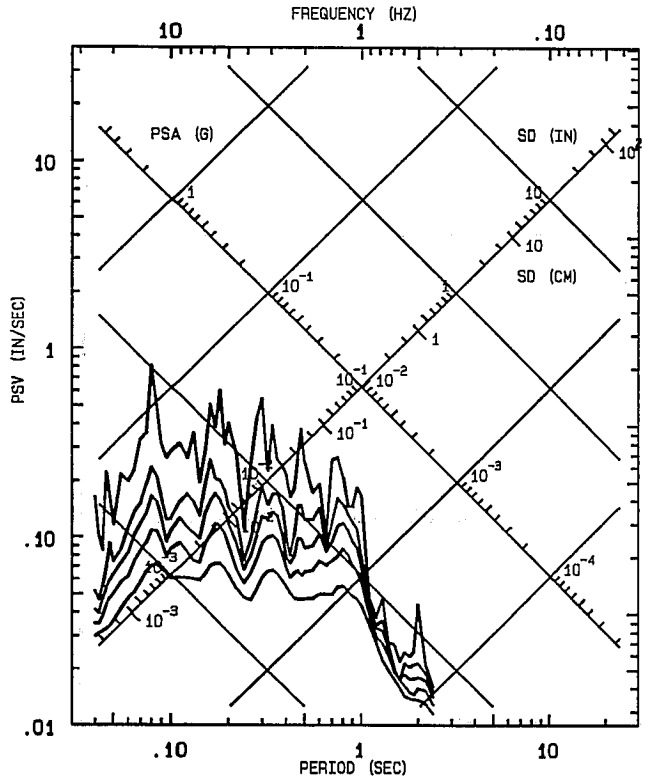
RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 24T03-E0247-94209.16

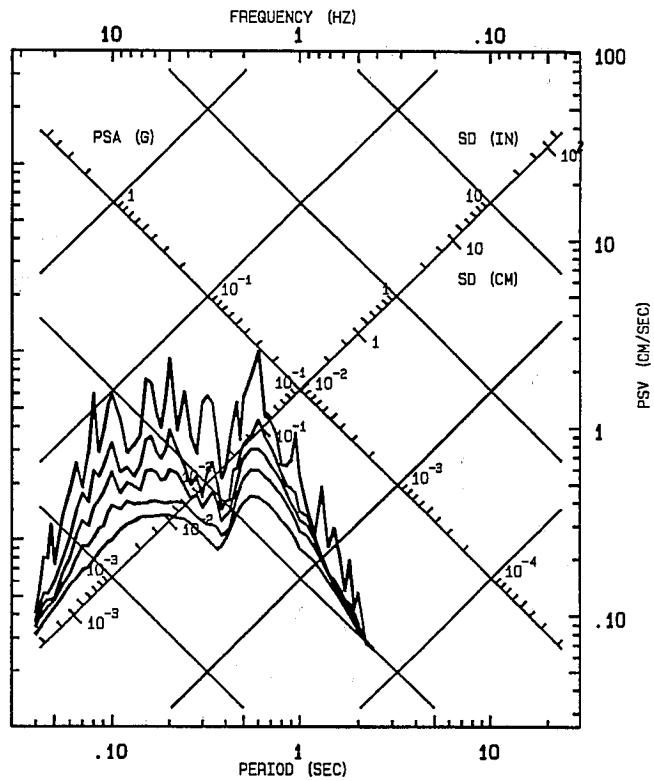
CHN 1: 115 DEG



CHN 2: UP



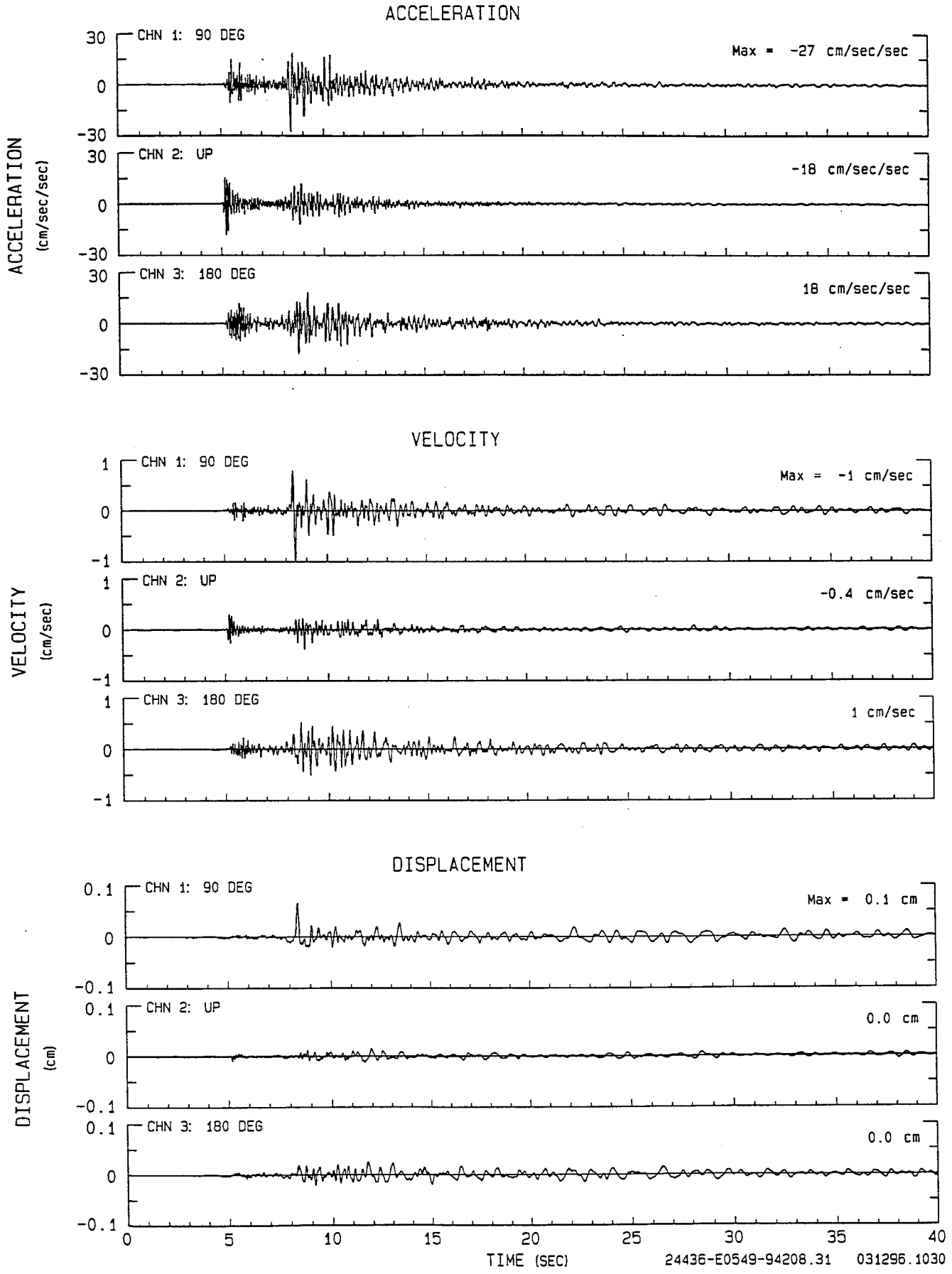
CHN 3: 205 DEG



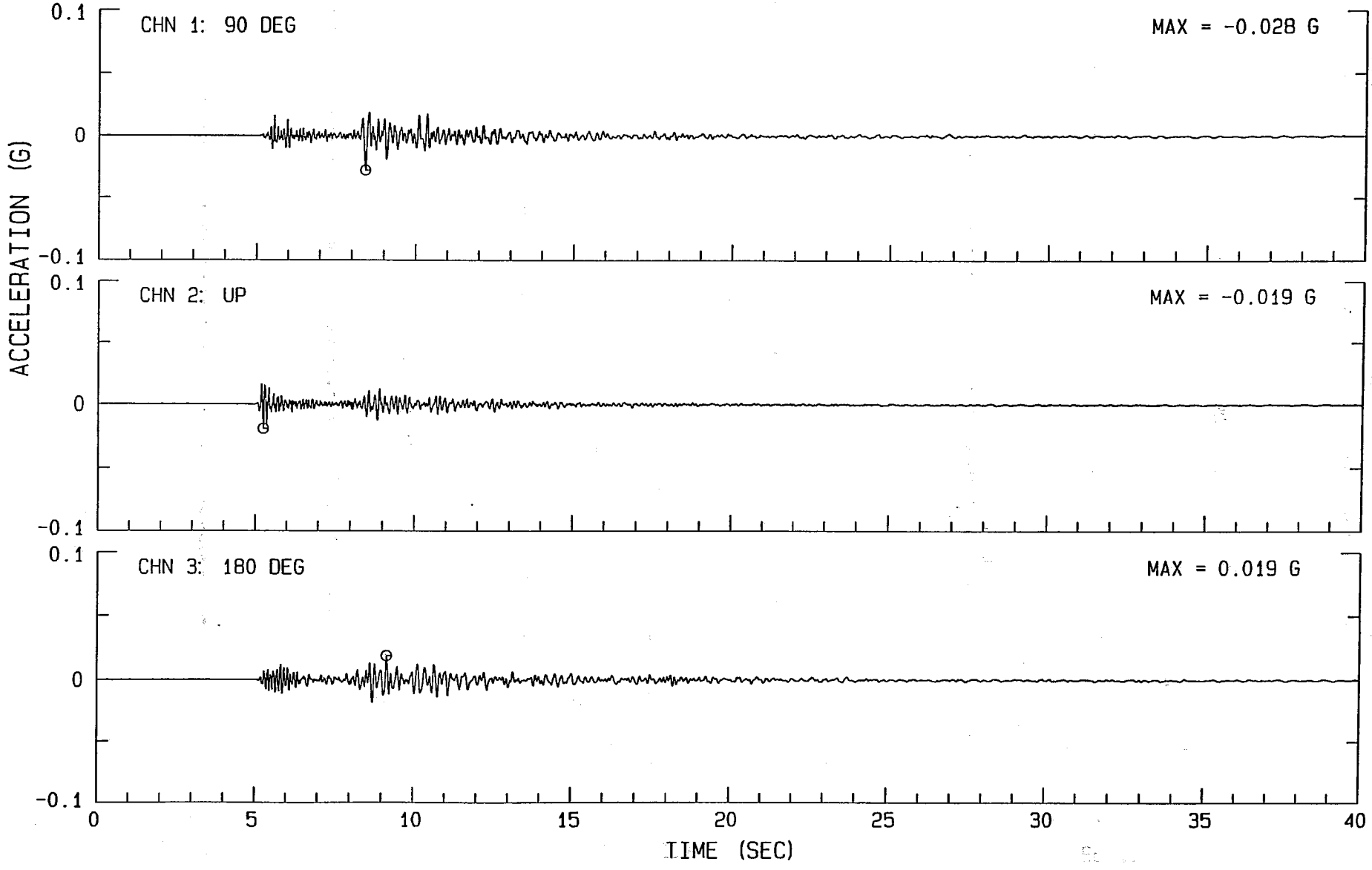
NORTHRIDGE AFTERSHOCK OF JUN 15, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CEDAR HILL NURSERY A CSMIP Sta Num 24436

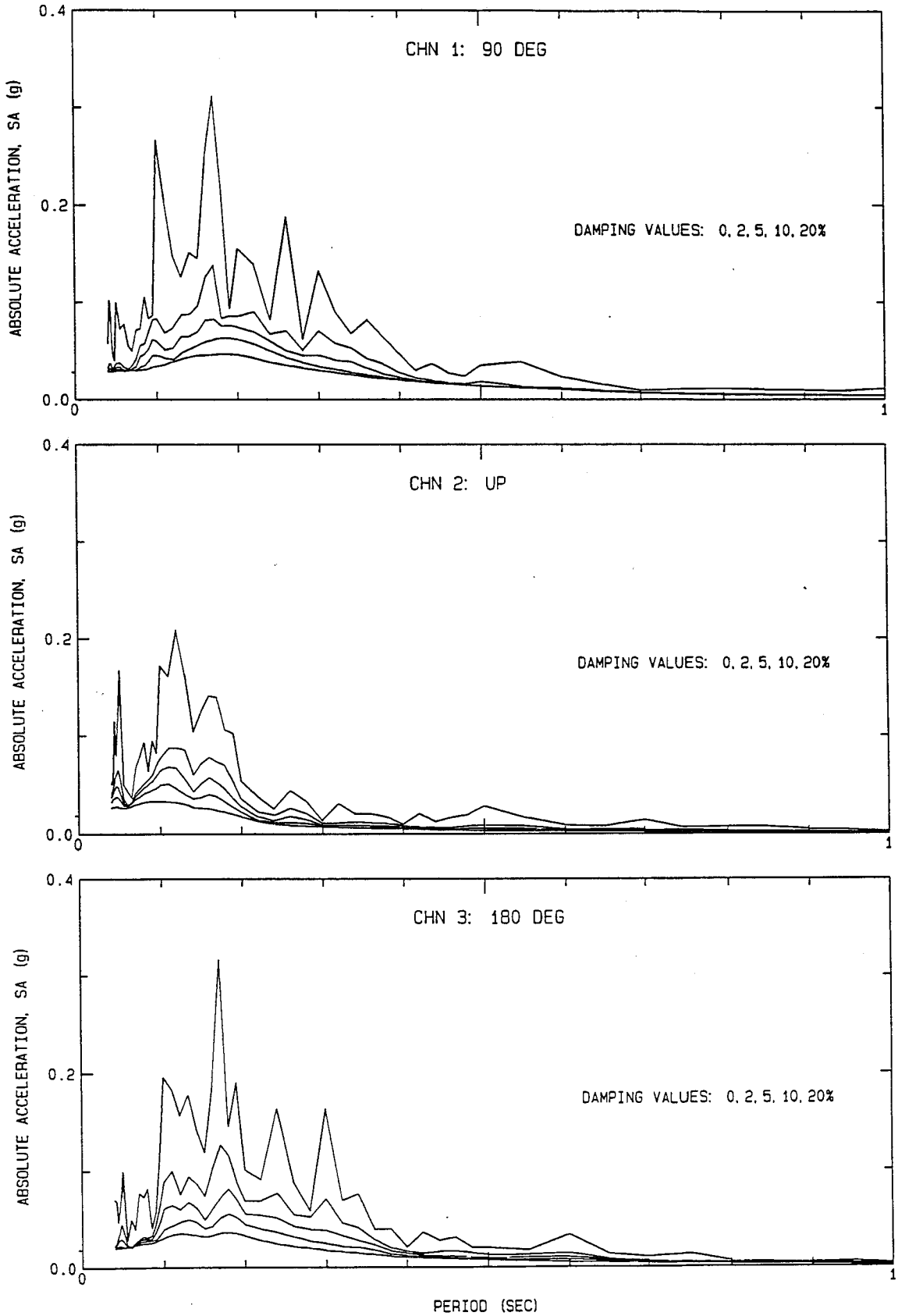
Usable Data Bandwidth: .51 to 47.2 Hz (.02 to 2.0 Sec)



NORTHRIDGE AFTERSHOCK OF JUN 15, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
UNCORRECTED ACCELEROGRAM 24436-E0549-94208.31 031296.1020-GN94C436



NORTHRIDGE AFTERSHOCK OF JUN 15, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .30-.60 TO 46.0-50.0 HZ.
24436-E0549-94208.31 031296.1031-QN94C436



NORTHRIDGE AFTERSHOCK OF JUN 15, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CEDAR HILL NURSERY A
Sta Num 24436

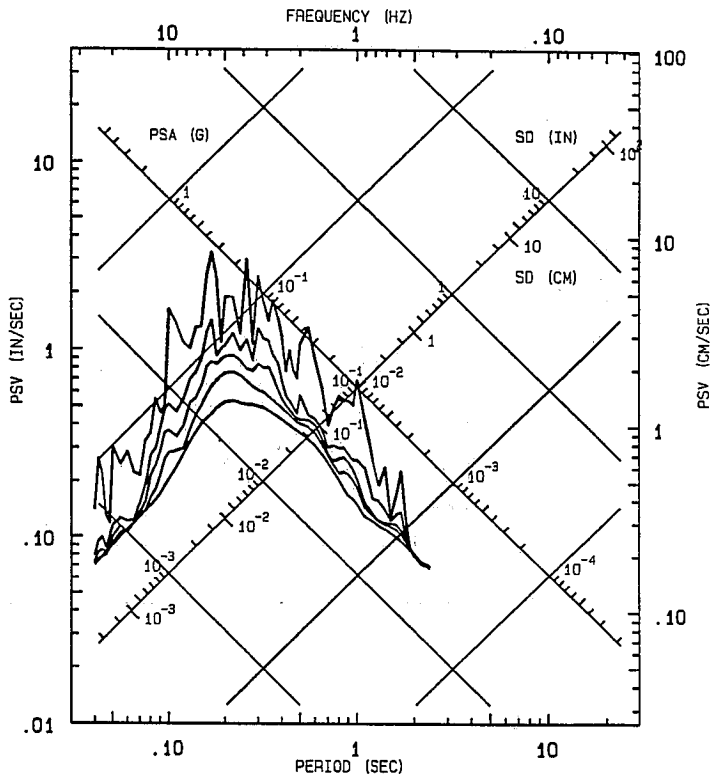
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.51 TO 47.2 HZ
(0.02 TO 2.0 SEC)

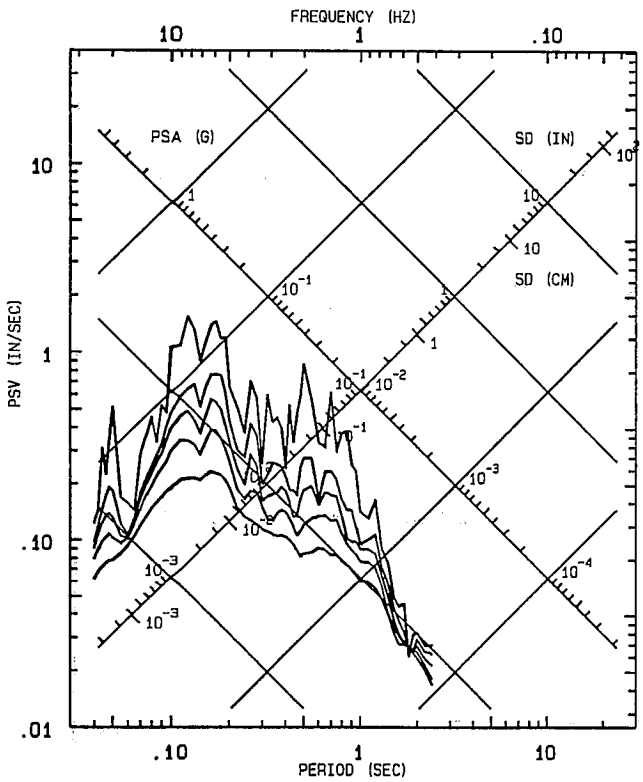
—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 24436-E0549-94208.31

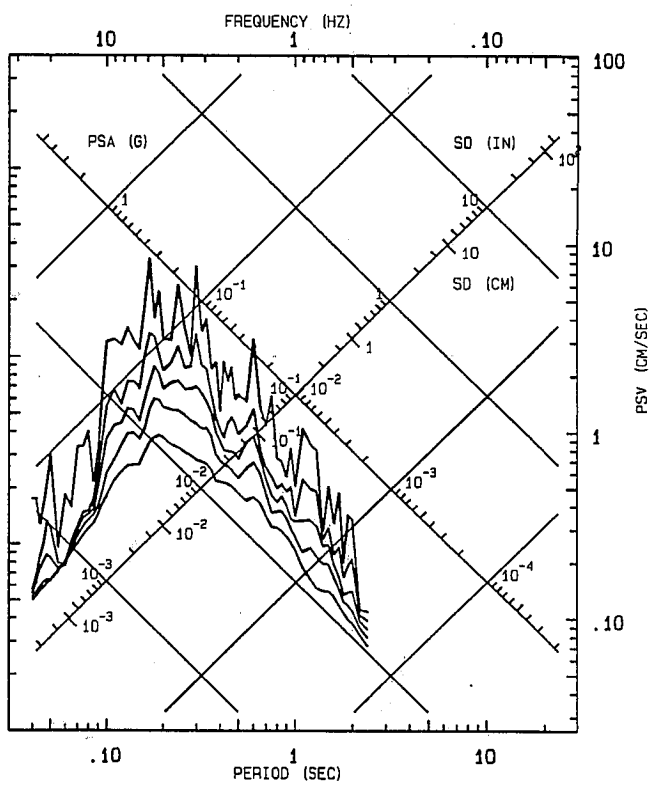
CHN 1: 90 DEG



CHN 2: UP

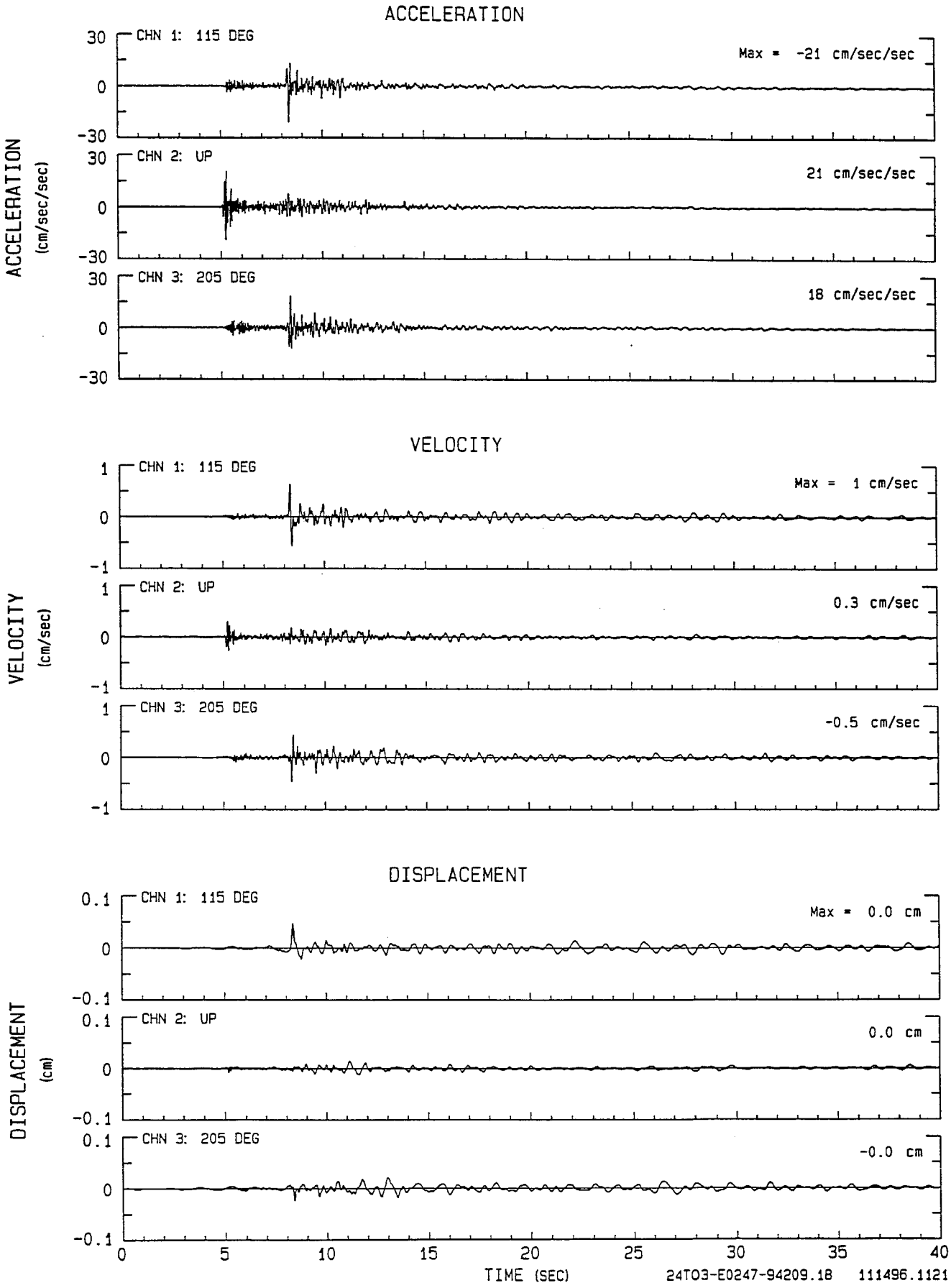


CHN 3: 180 DEG

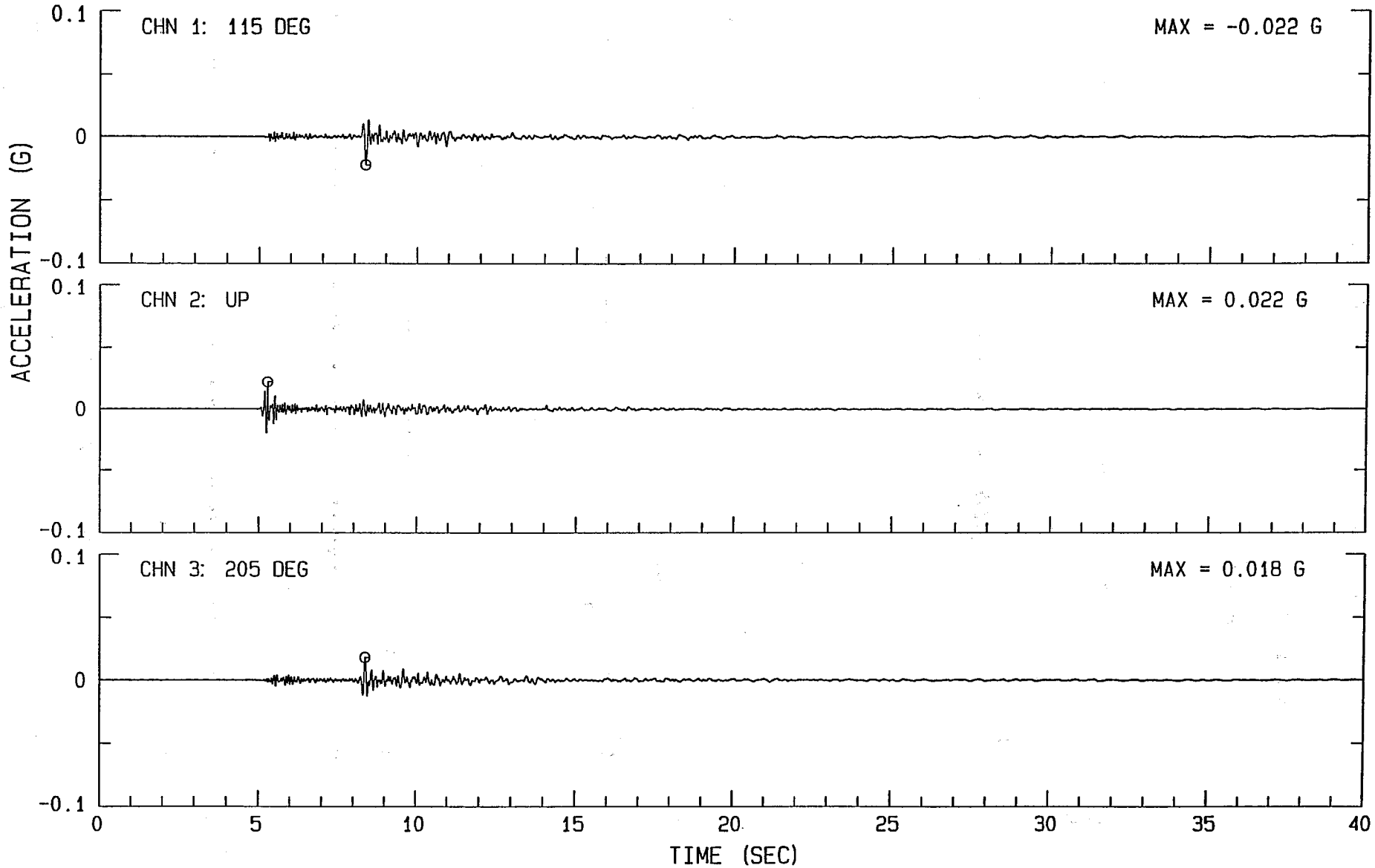


TARZANA - CLUBHOUSE CSMIP Sta Num 24T03

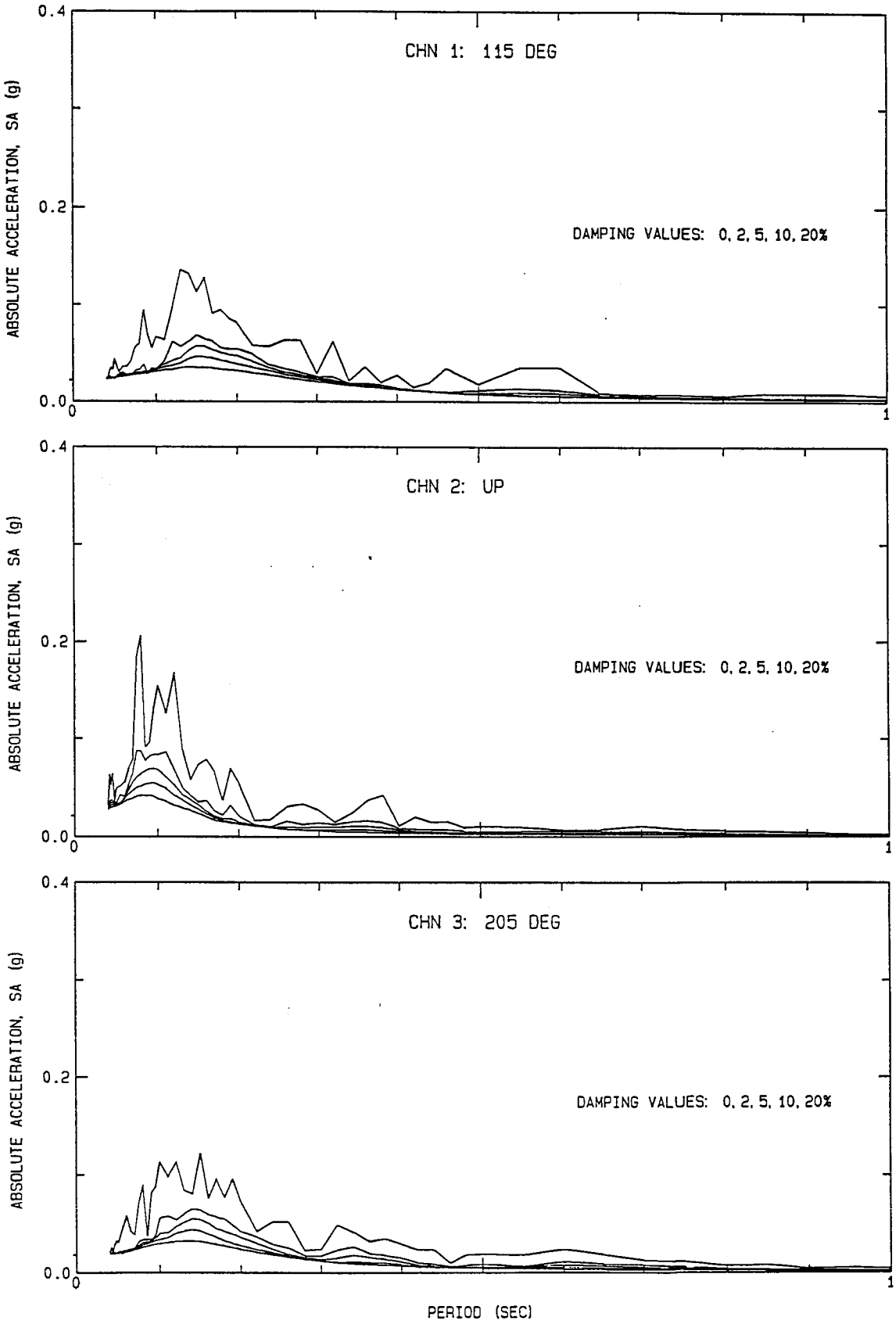
Usable Data Bandwidth: .51 to 47.2 Hz (.02 to 2.0 Sec)



NORTHRIDGE AFTERSHOCK OF JUN 15, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CLUBHOUSE
UNCORRECTED ACCELEROGRAM 24T03-E0247-94209.18 111496.1120-QN94CT03



NORTHRIDGE AFTERSHOCK OF JUN 15, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CLUBHOUSE
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .30-.60 TO 46.0-50.0 HZ.
24T03-E0247-94209.18 111496.1122-GN94CT03



NORTHRIDGE AFTERSHOCK OF JUN 15, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CLUBHOUSE
Sta Num 24T03

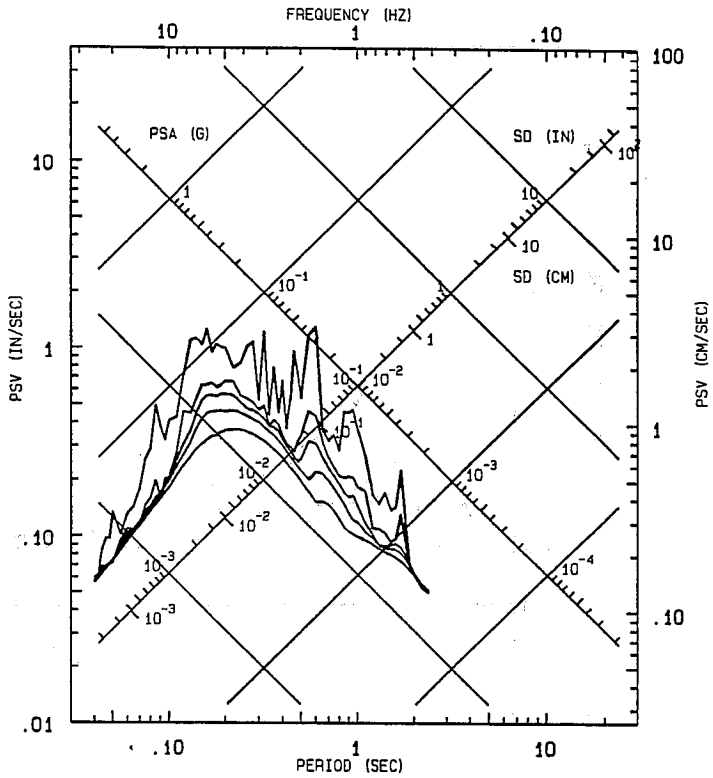
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.51 TO 47.2 HZ
(0.02 TO 2.0 SEC)

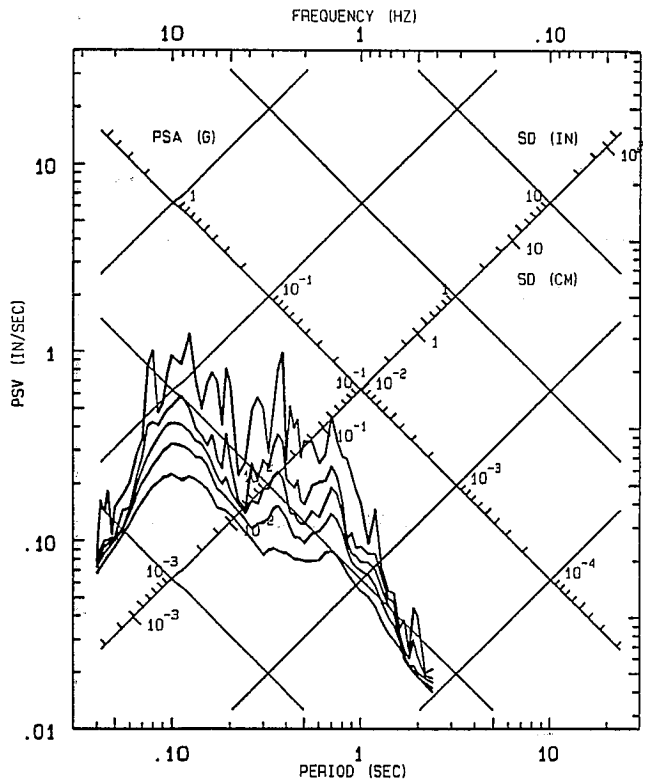
RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 24T03-E0247-94209.18

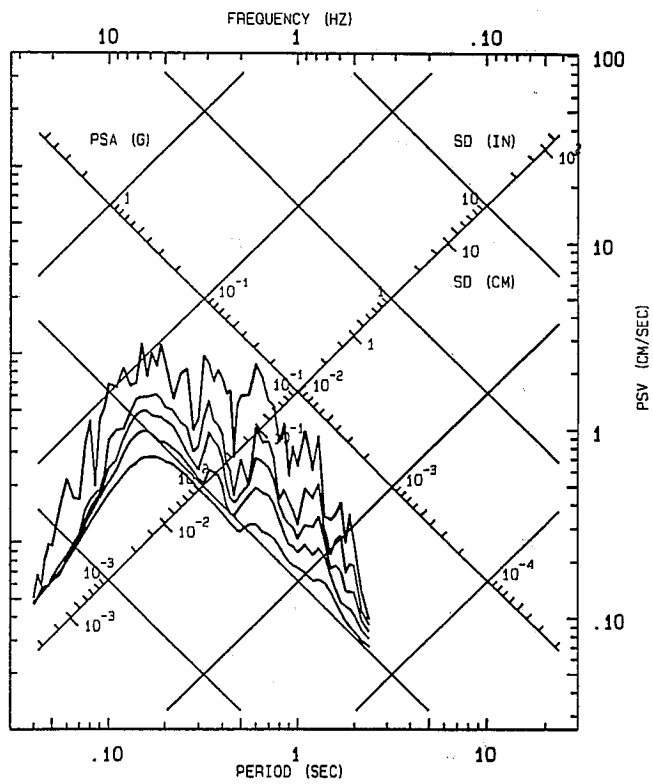
CHN 1: 115 DEG



CHN 2: UP



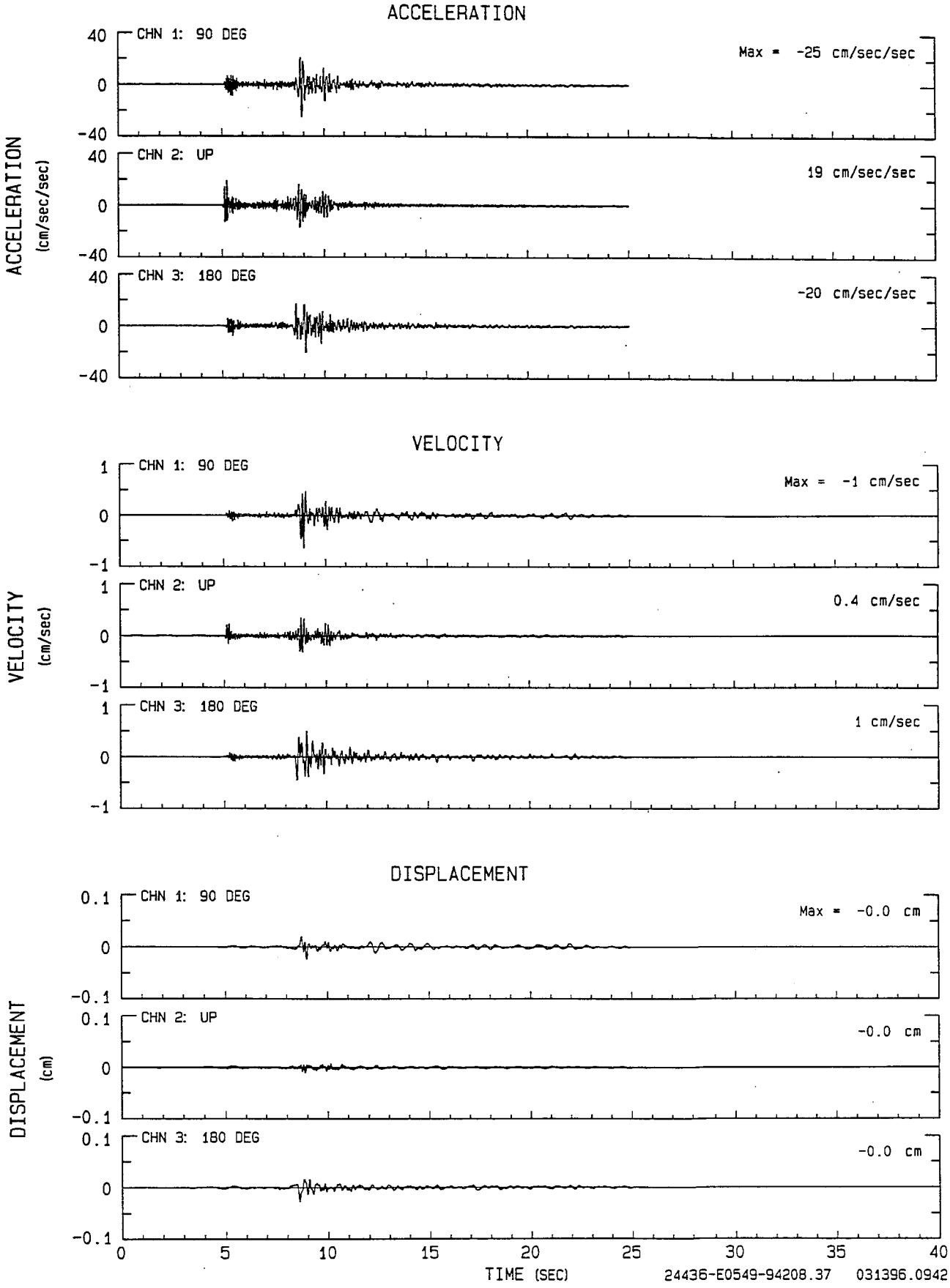
CHN 3: 205 DEG



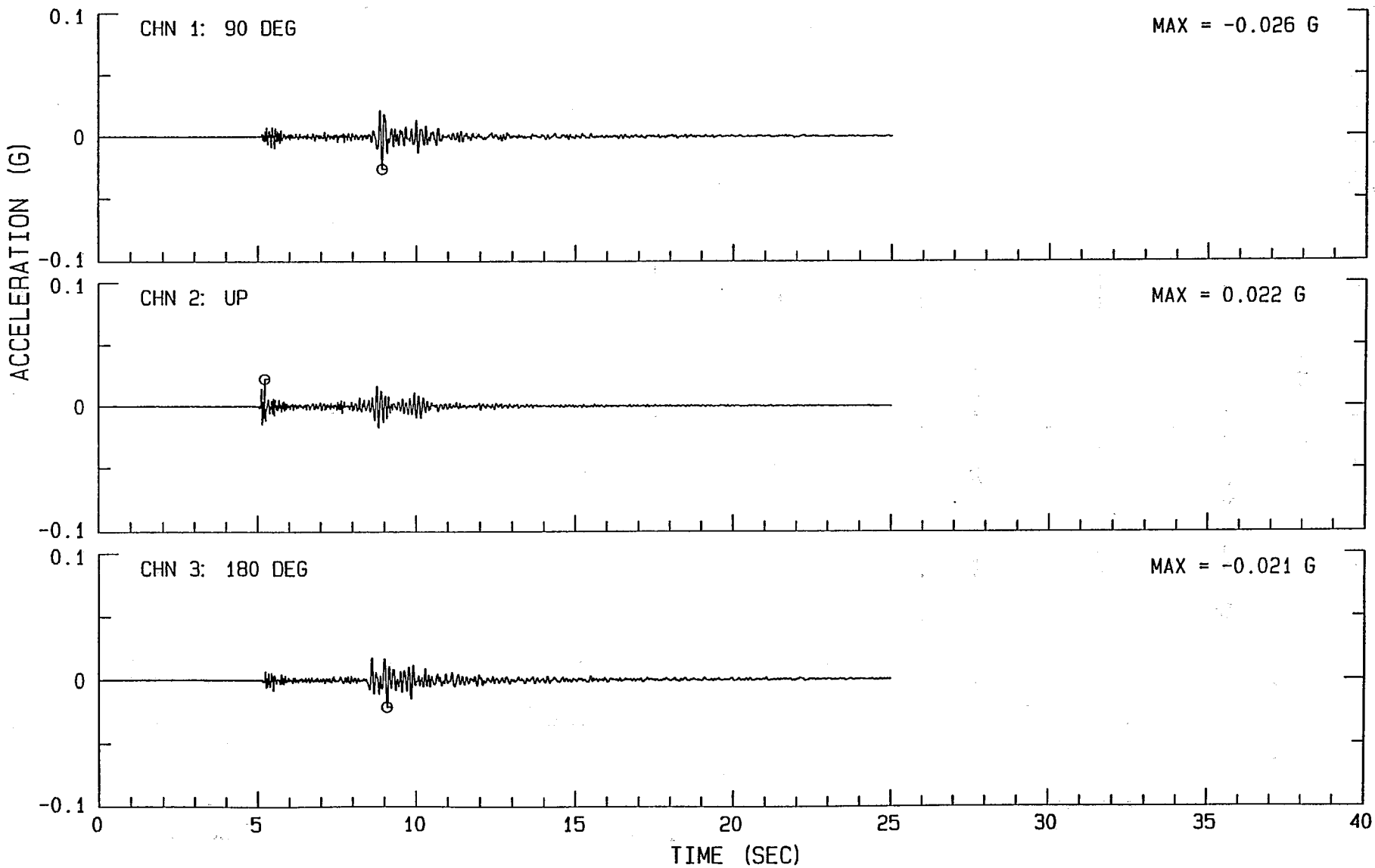
NORTHRIDGE AFTERSHOCK OF JULY 11, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CEDAR HILL NURSERY A CSMIP Sta Num 24436

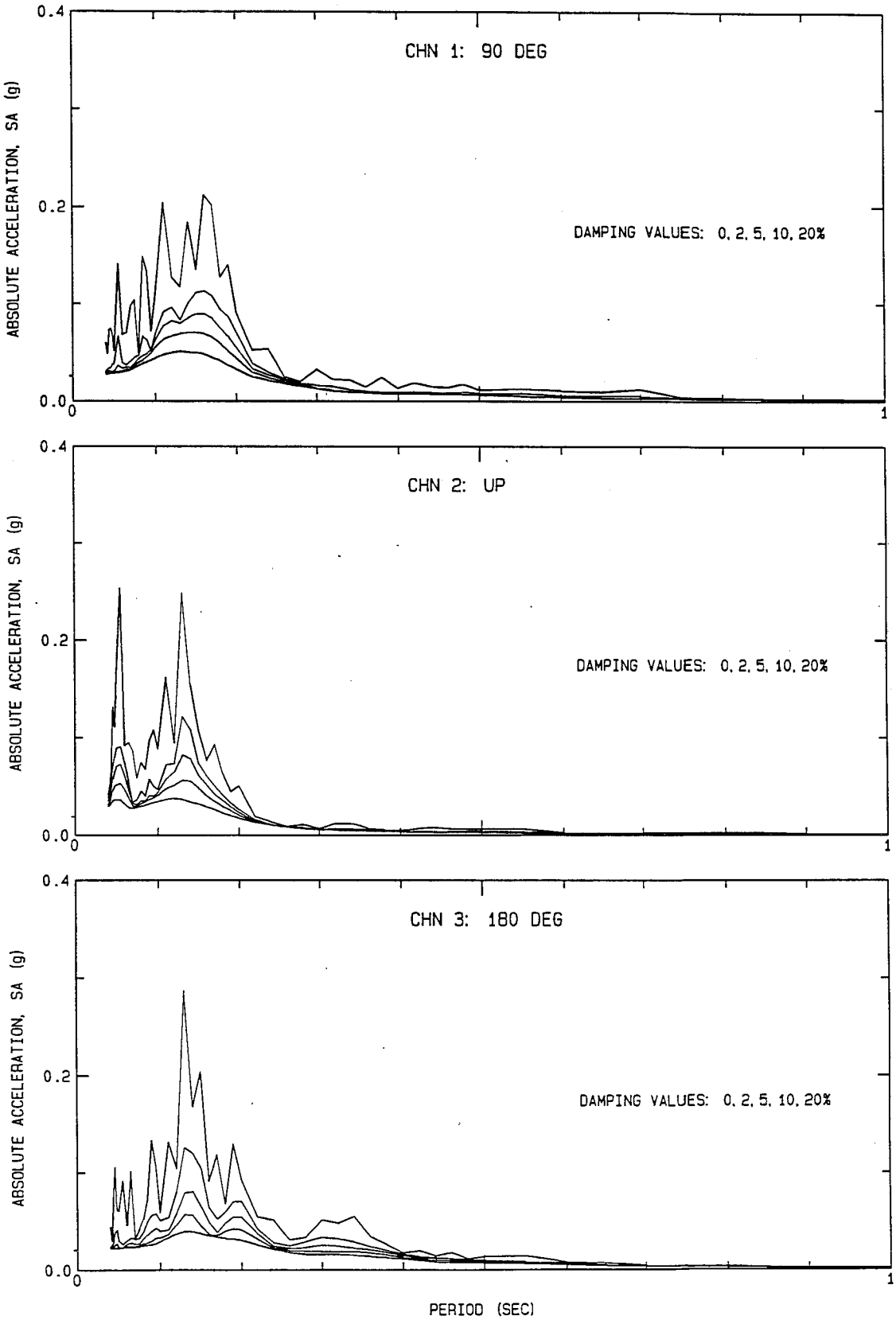
Usable Data Bandwidth: .68 to 47.2 Hz (.02 to 1.5 Sec)



NORTHRIDGE AFTERSHOCK OF JULY 11, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
UNCORRECTED ACCELEROGRAM 24436-E0549-94208.37 031396.0836-QN94G436



NORTHRIDGE AFTERSHOCK OF JULY 11, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .30-.60 TO 46.0-50.0 HZ.
24436-E0549-94208.37 031396.0916-GN94G436



NORTHRIDGE AFTERSHOCK OF JULY 11, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CEDAR HILL NURSERY A
Sta Num 24436

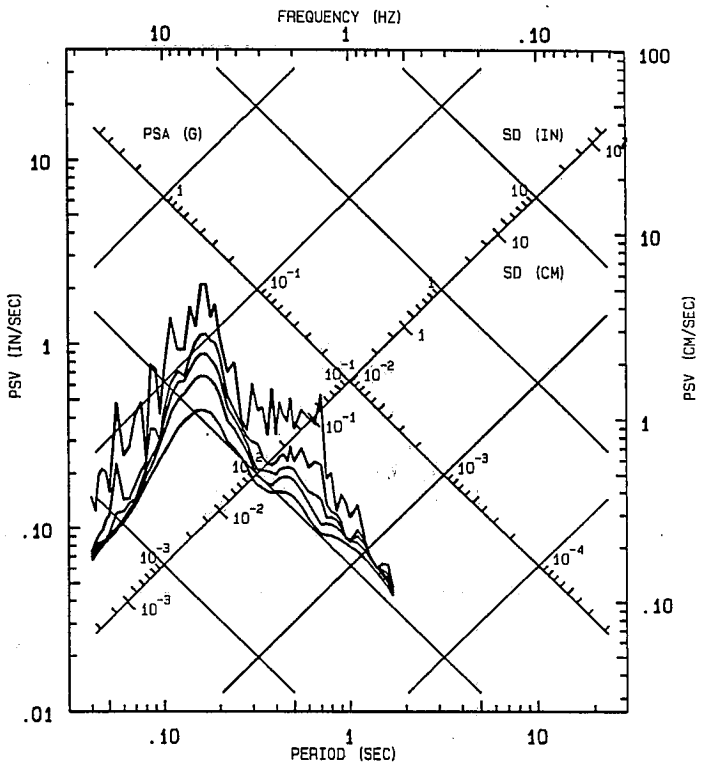
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.68 TO 47.2 HZ
(0.02 TO 1.5 SEC)

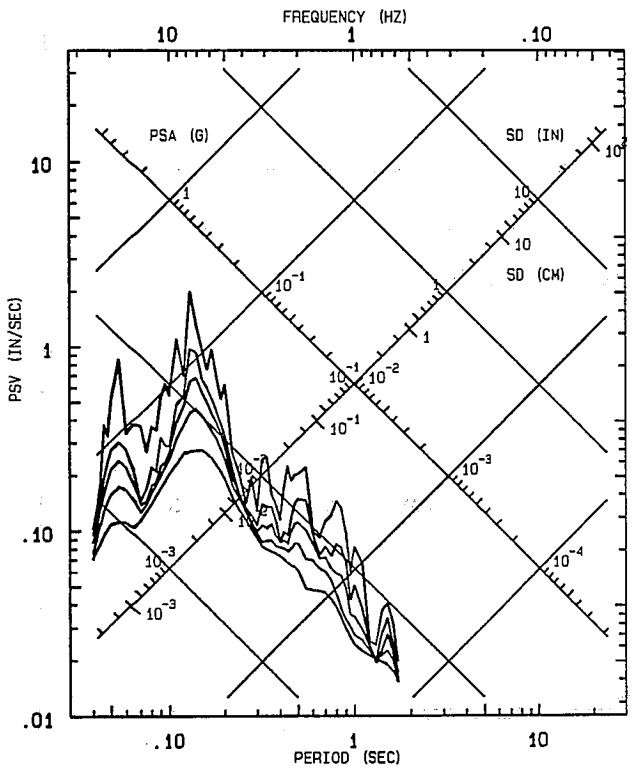
RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 24436-E0549-94208.37

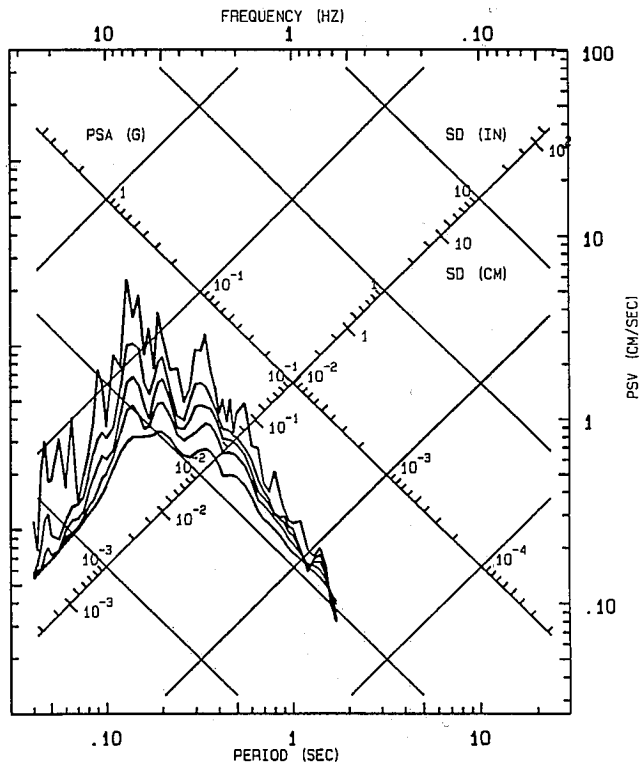
CHN 1: 90 DEG



CHN 2: UP



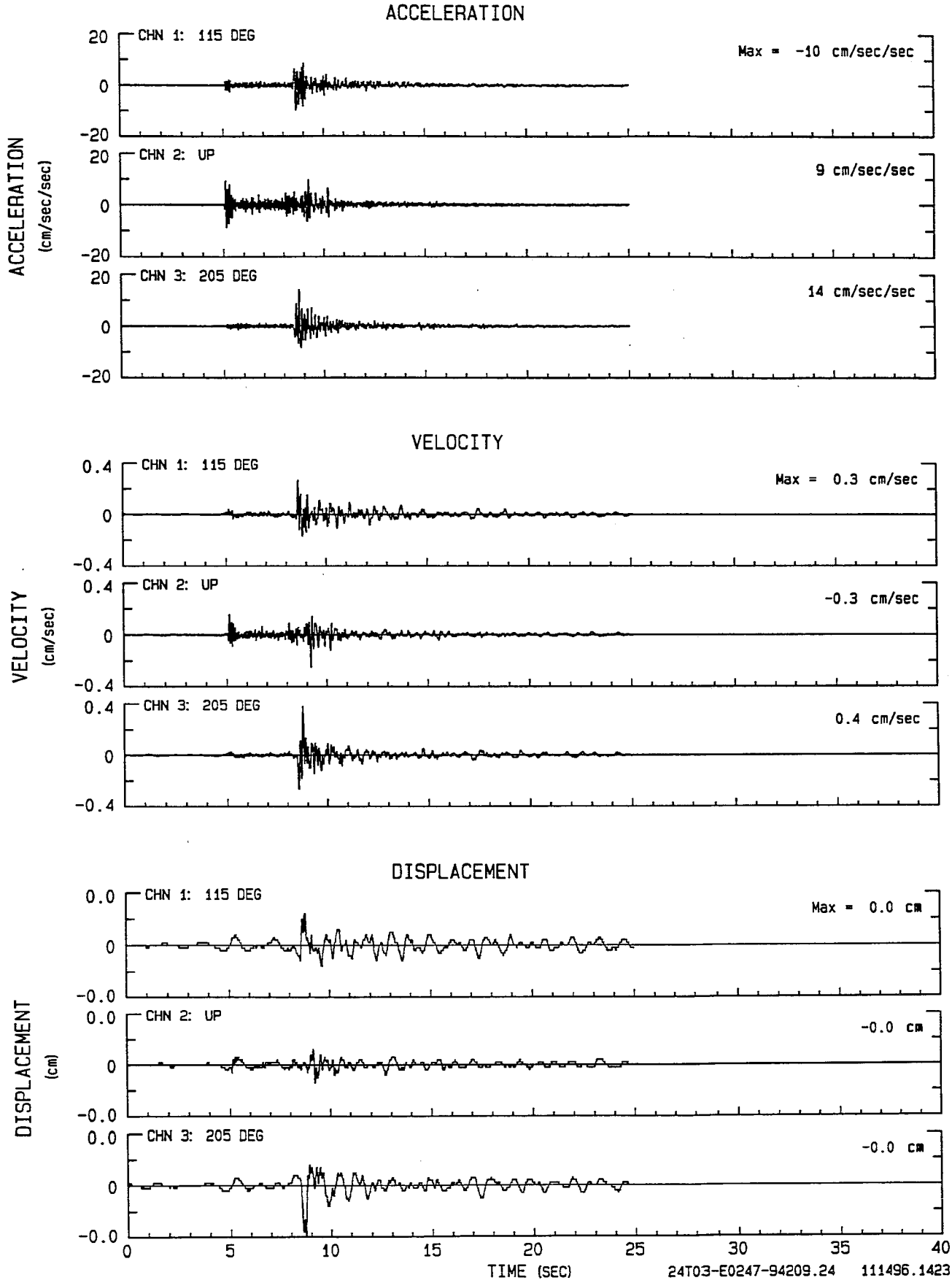
CHN 3: 180 DEG



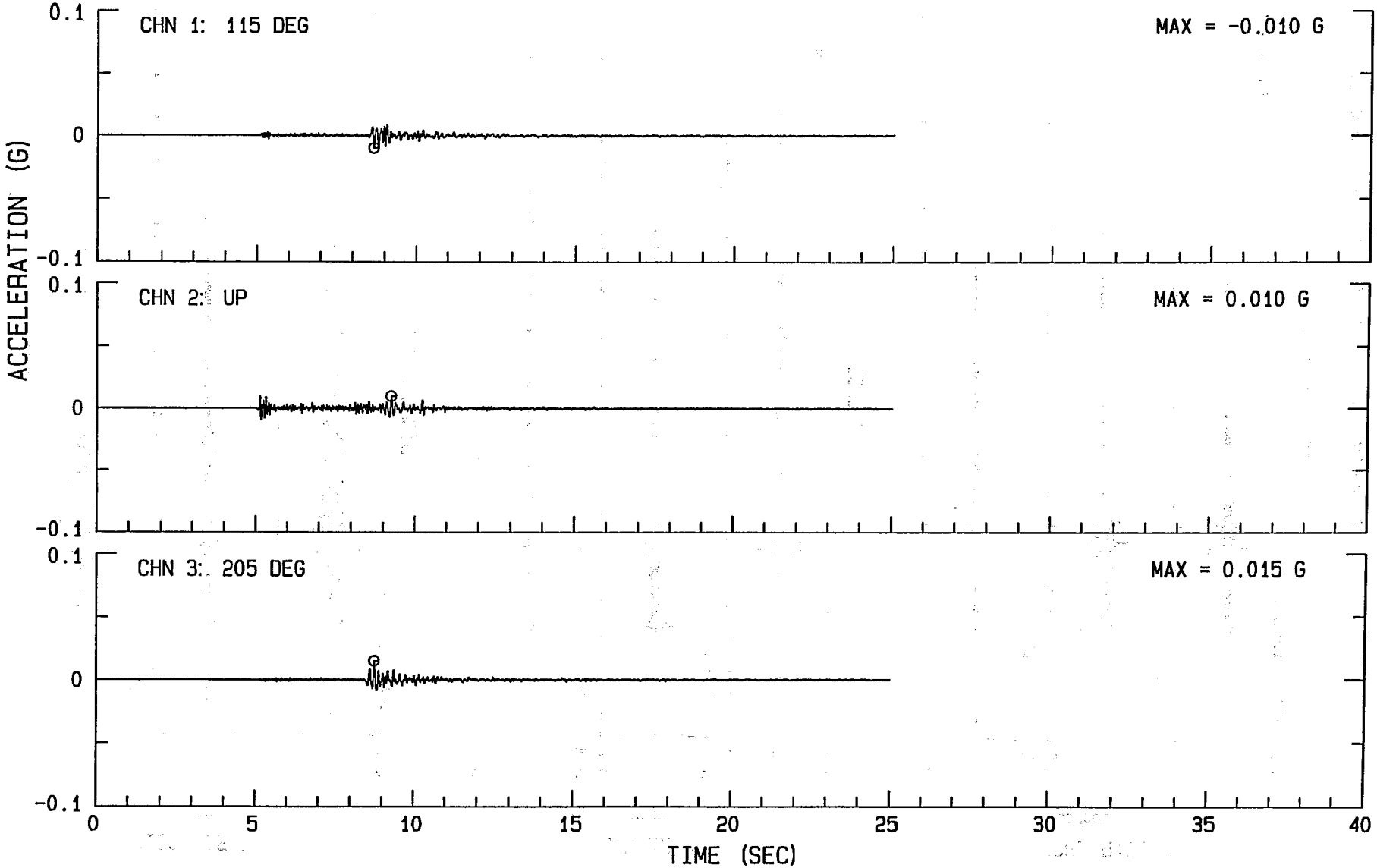
NORTHRIDGE AFTERSHOCK OF JULY 11, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CLUBHOUSE CSMIP Sta Num 24T03

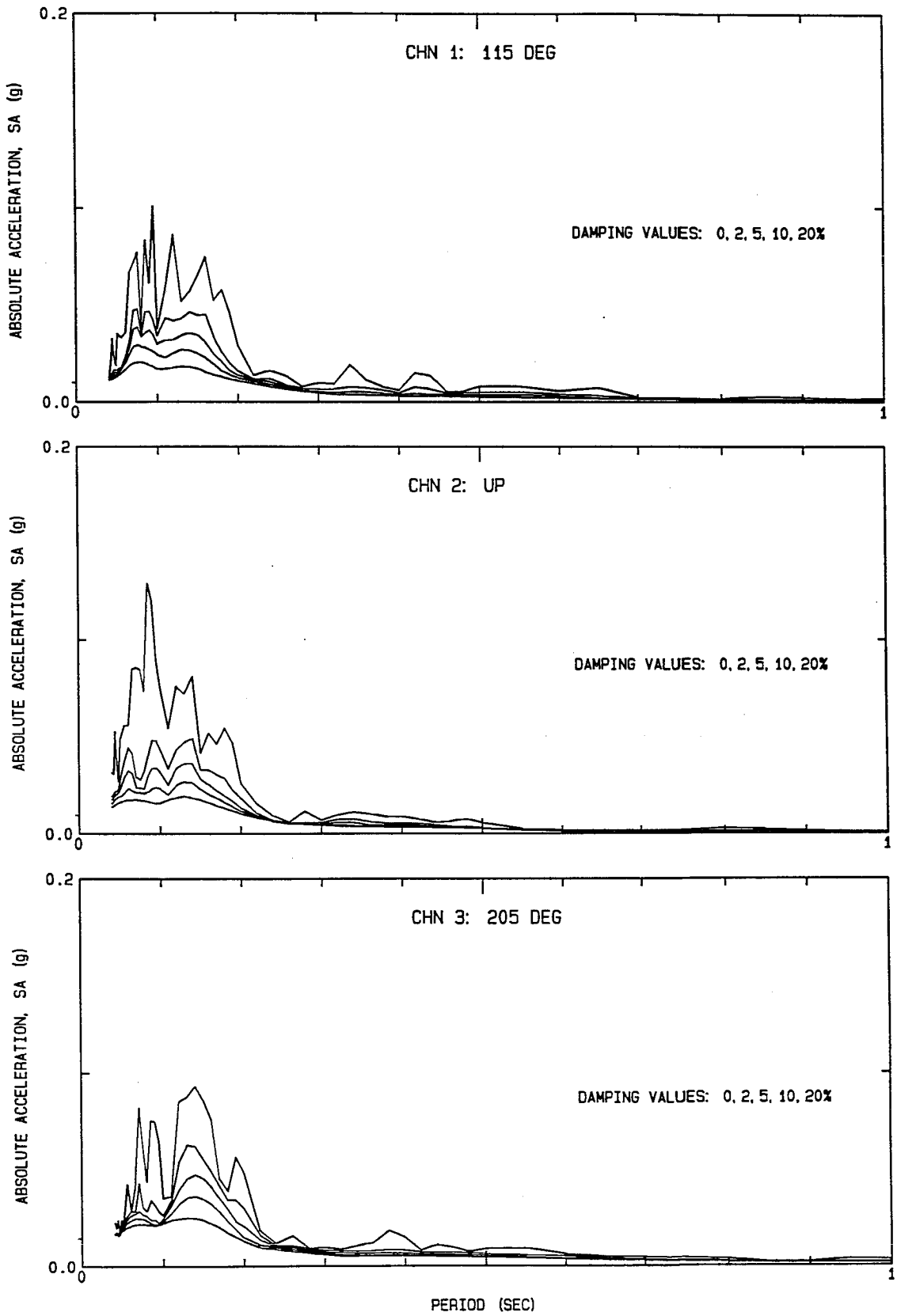
Usable Data Bandwidth: .51 to 47.2 Hz (.02 to 2.0 Sec)



NORTHRIDGE AFTERSHOCK OF JULY 11, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CLUBHOUSE
UNCORRECTED ACCELEROGRAM 24T03-E0247-94209.24 111496.1422-QN94GT03



NORTHRIDGE AFTERSHOCK OF JULY 11, 1994 CSMIP PRELIMINARY PROCESSING
TARZANA - CLUBHOUSE
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .30-.60 TO 46.0-50.0 HZ.
24T03-E0247-94209.24 111496.1424-GN94GT03



NORTHRIDGE AFTERSHOCK OF JULY 11, 1994 CSMIP PRELIMINARY PROCESSING

TARZANA - CLUBHOUSE
Sta Num 24T03

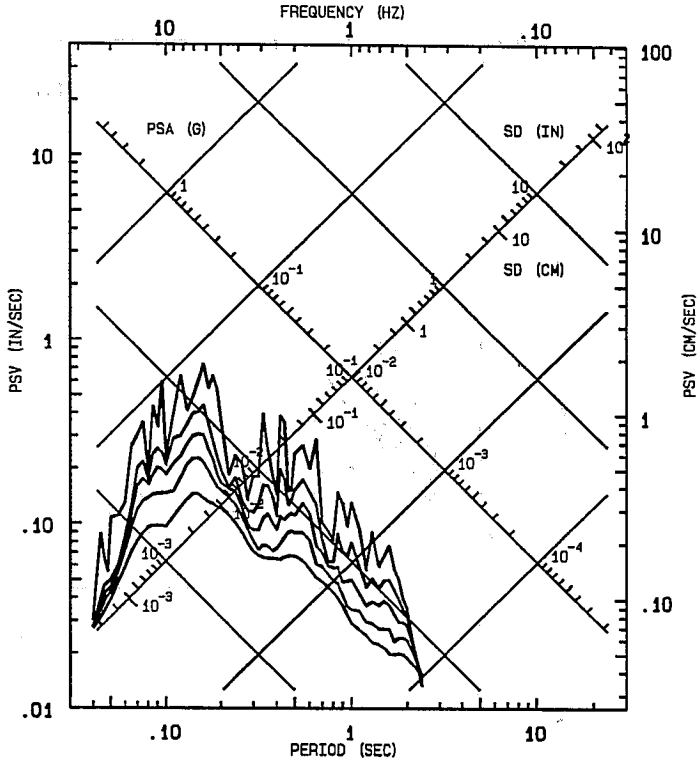
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.51 TO 47.2 HZ
(0.02 TO 2.0 SEC)

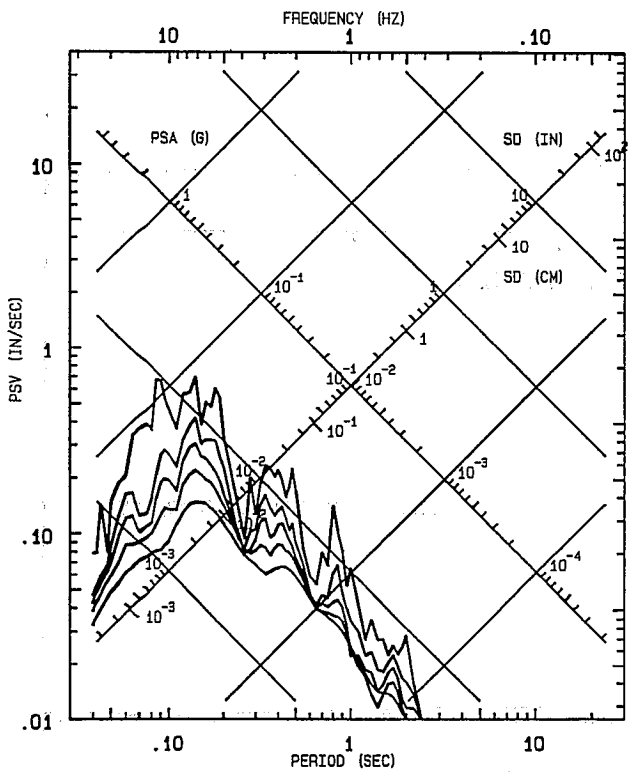
RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 24T03-E0247-94209.24

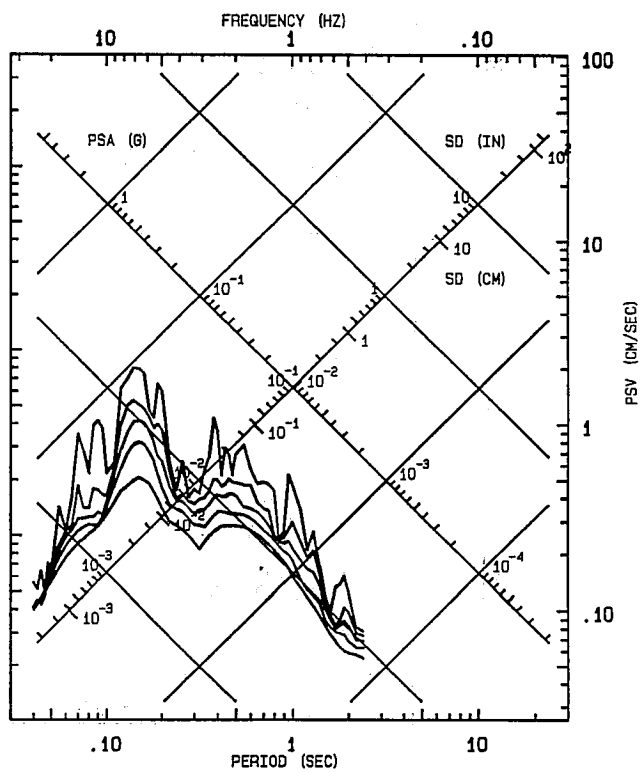
CHN 1: 115 DEG



CHN 2: UP



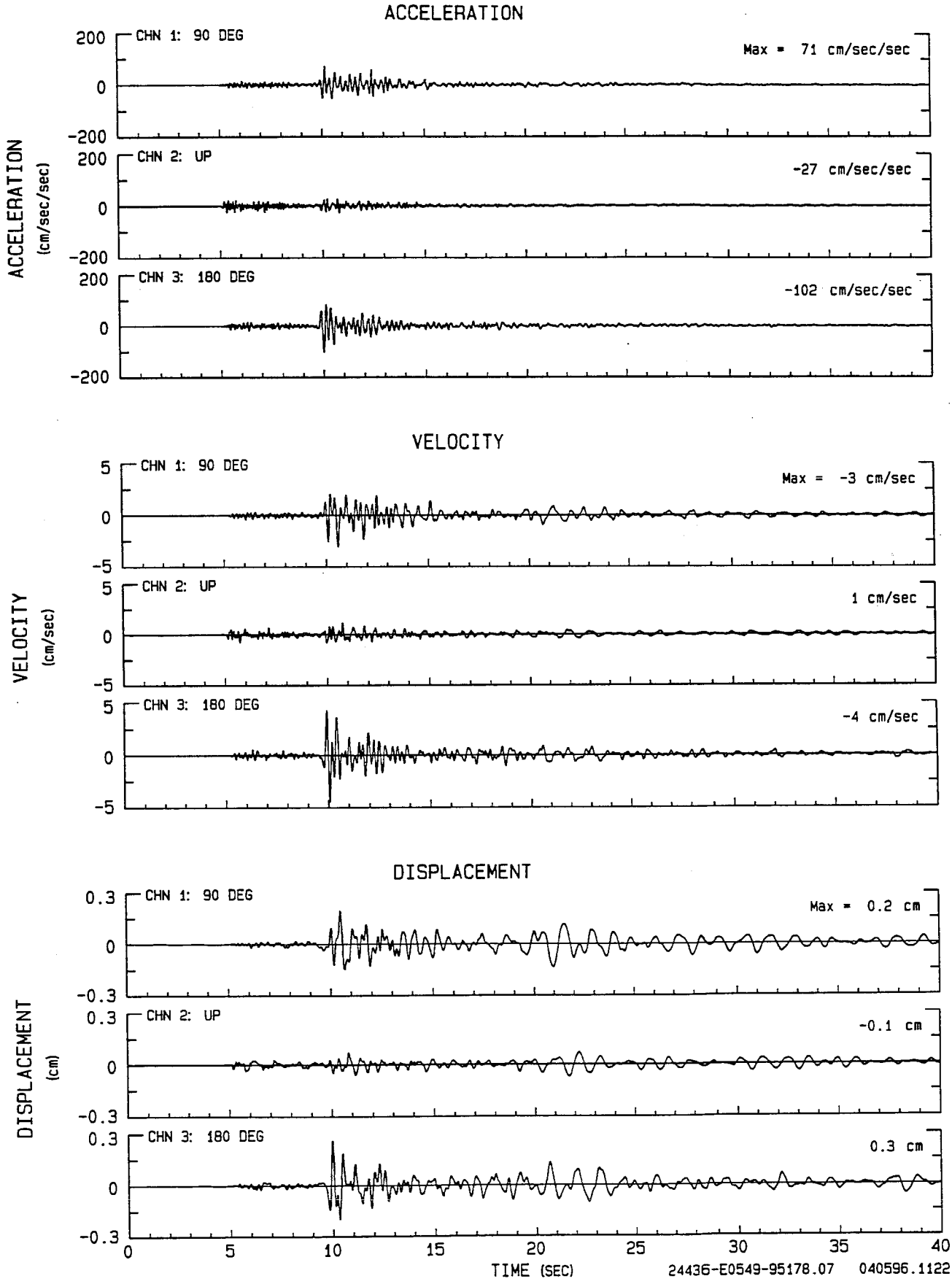
CHN 3: 205 DEG

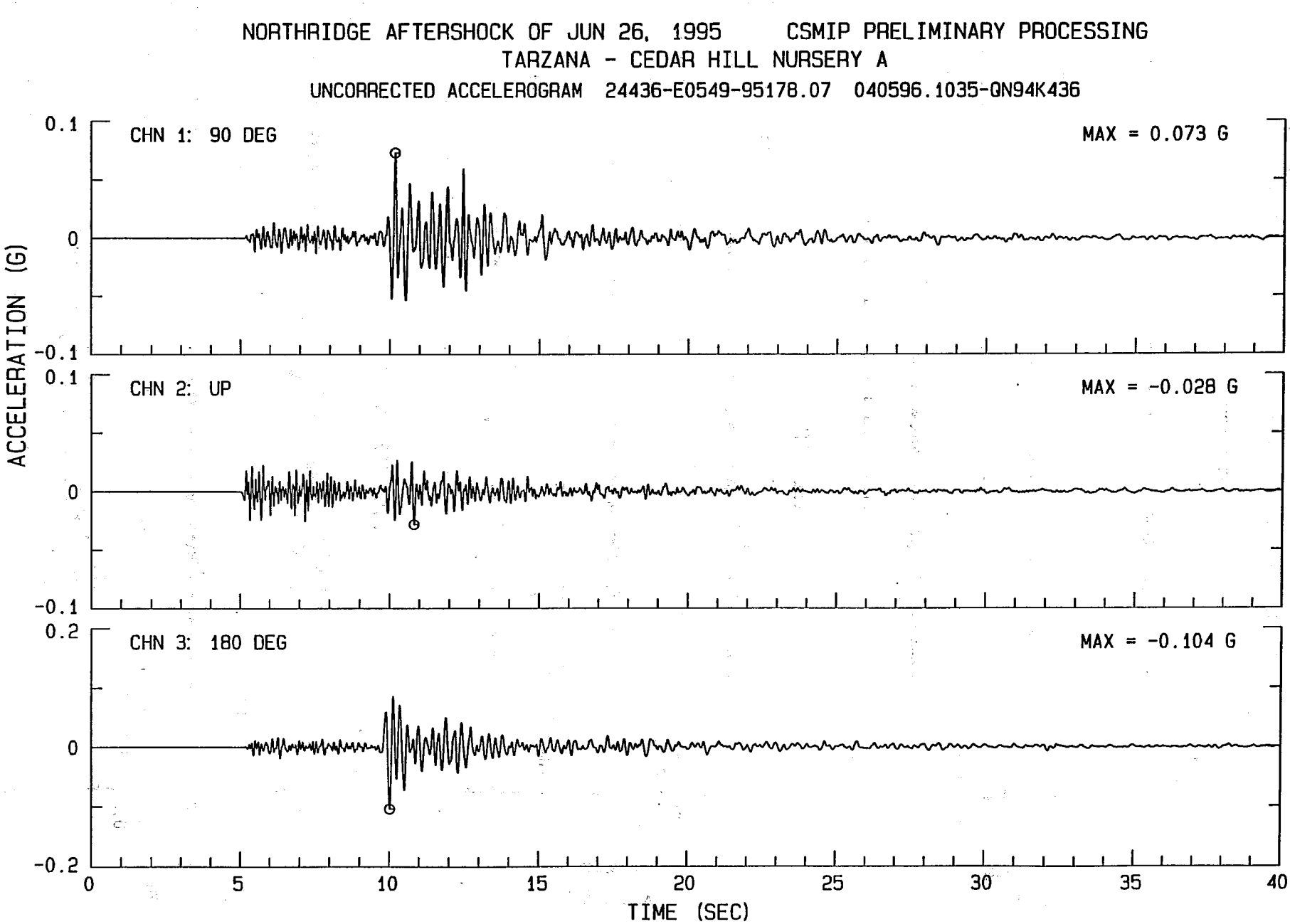


NORTHRIDGE AFTERSHOCK OF JUN 26, 1995 CSMIP PRELIMINARY PROCESSING

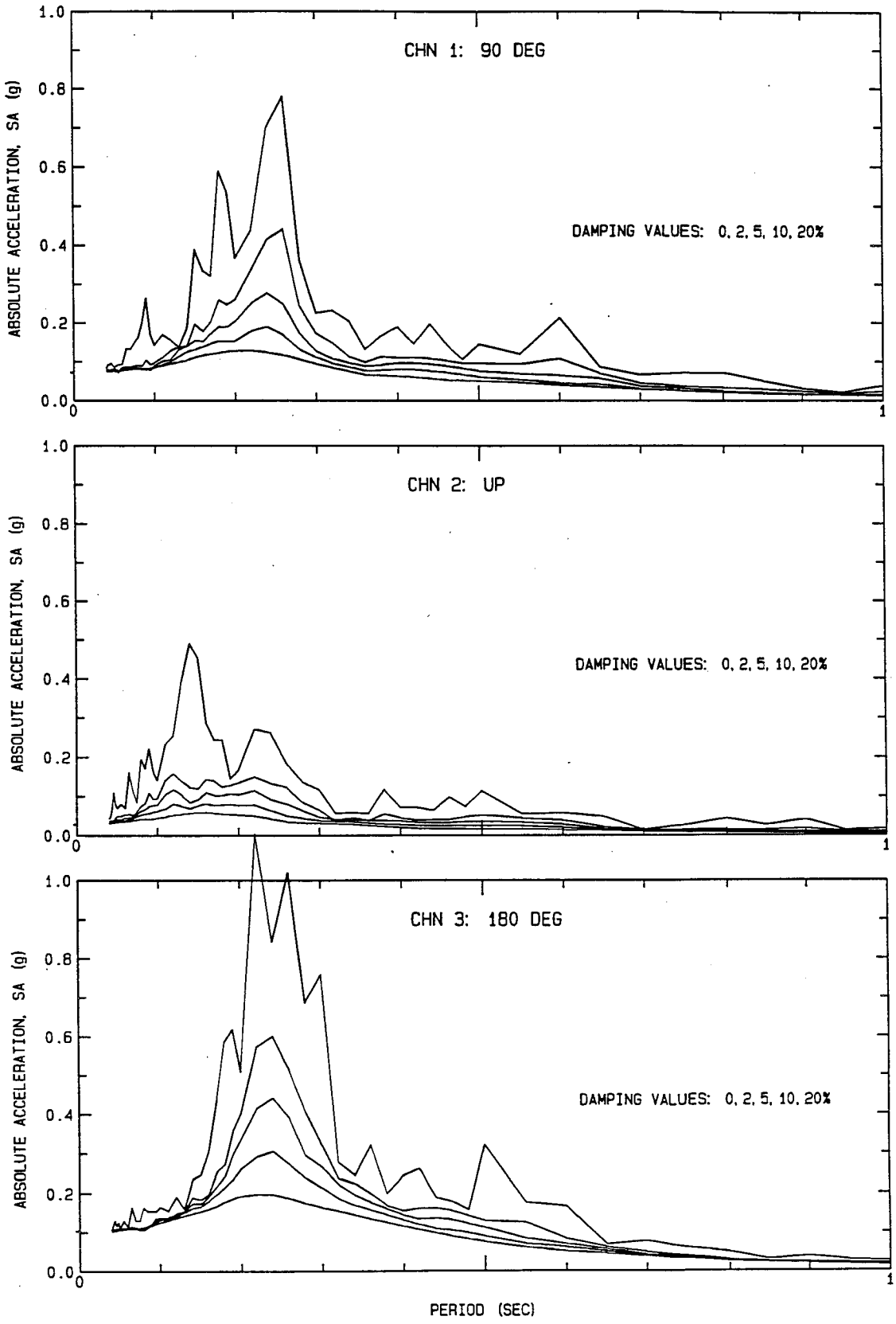
TARZANA - CEDAR HILL NURSERY A CSMIP Sta Num 24436

Usable Data Bandwidth: .51 to 47.2 Hz (.02 to 2.0 Sec)




NORTHRIDGE AFTERSHOCK OF JUN 26, 1995 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
UNCORRECTED ACCELEROGRAM 24436-E0549-95178.07 040596.1035-QN94K436
CHN 1: 90 DEG
MAX = 0.073 G
CHN 2: UP
MAX = -0.028 G
CHN 3: 180 DEG
MAX = -0.104 G
ACCELERATION (G)
0.1
0
-0.1
0.2
-0.2
0
5
10
15
20
25
30
35
40
TIME (SEC)

NORTHRIDGE AFTERSHOCK OF JUN 26, 1995 CSMIP PRELIMINARY PROCESSING
TARZANA - CEDAR HILL NURSERY A
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .30-.60 TO 46.0-50.0 HZ.
24436-E0549-95178.07 040596.1123-QN94K436



NORTHRIDGE AFTERSHOCK OF JUN 26, 1995 CSMIP PRELIMINARY PROCESSING

TARZANA - CEDAR HILL NURSERY A
Sta Num 24436

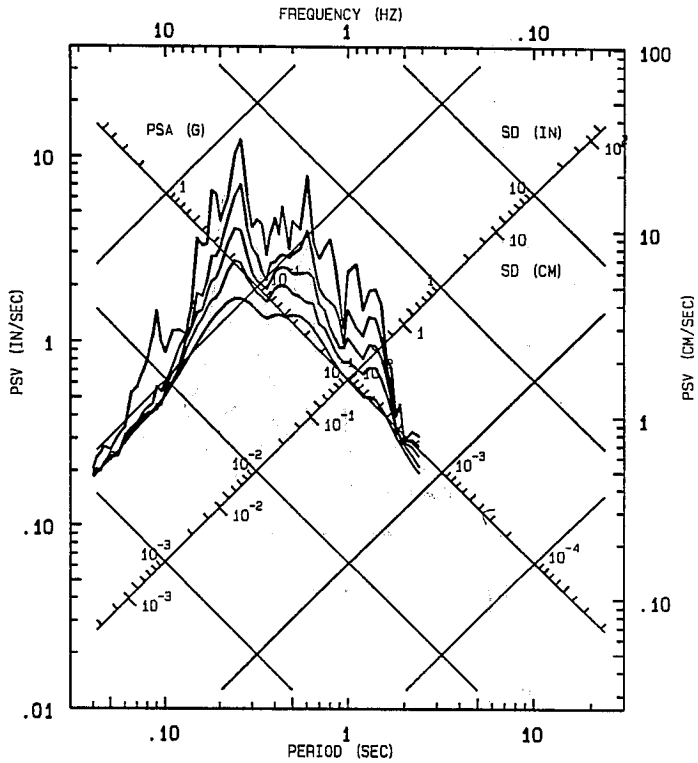
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.51 TO 47.2 HZ
(0.02 TO 2.0 SEC)

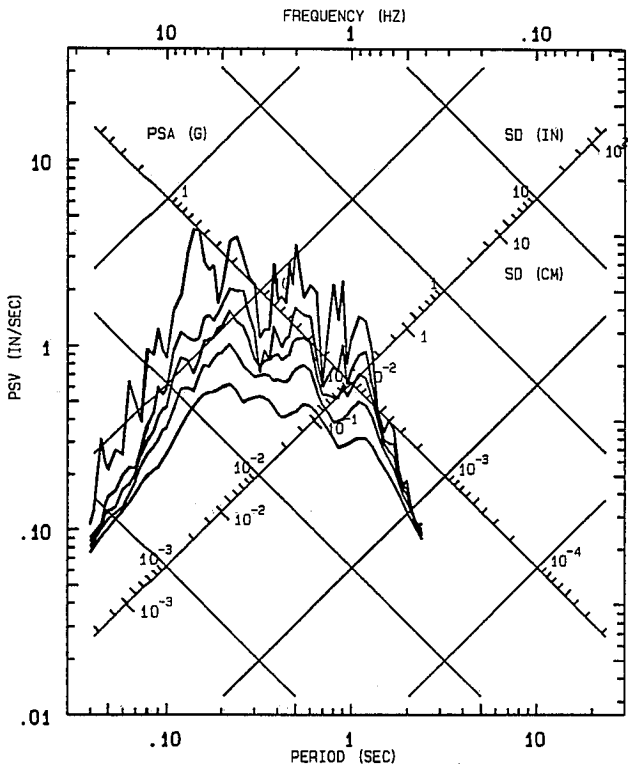
RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 24436-E0549-95178.07

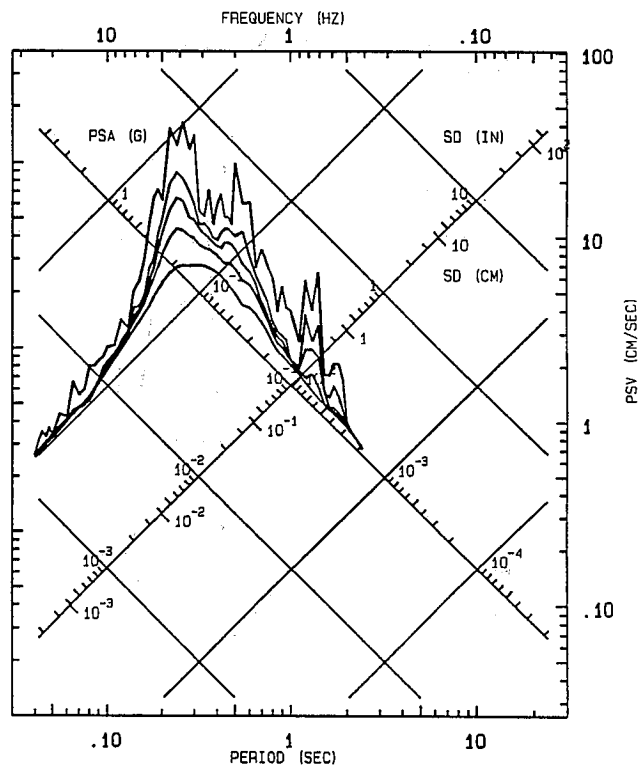
CHN 1: 90 DEG



CHN 2: UP

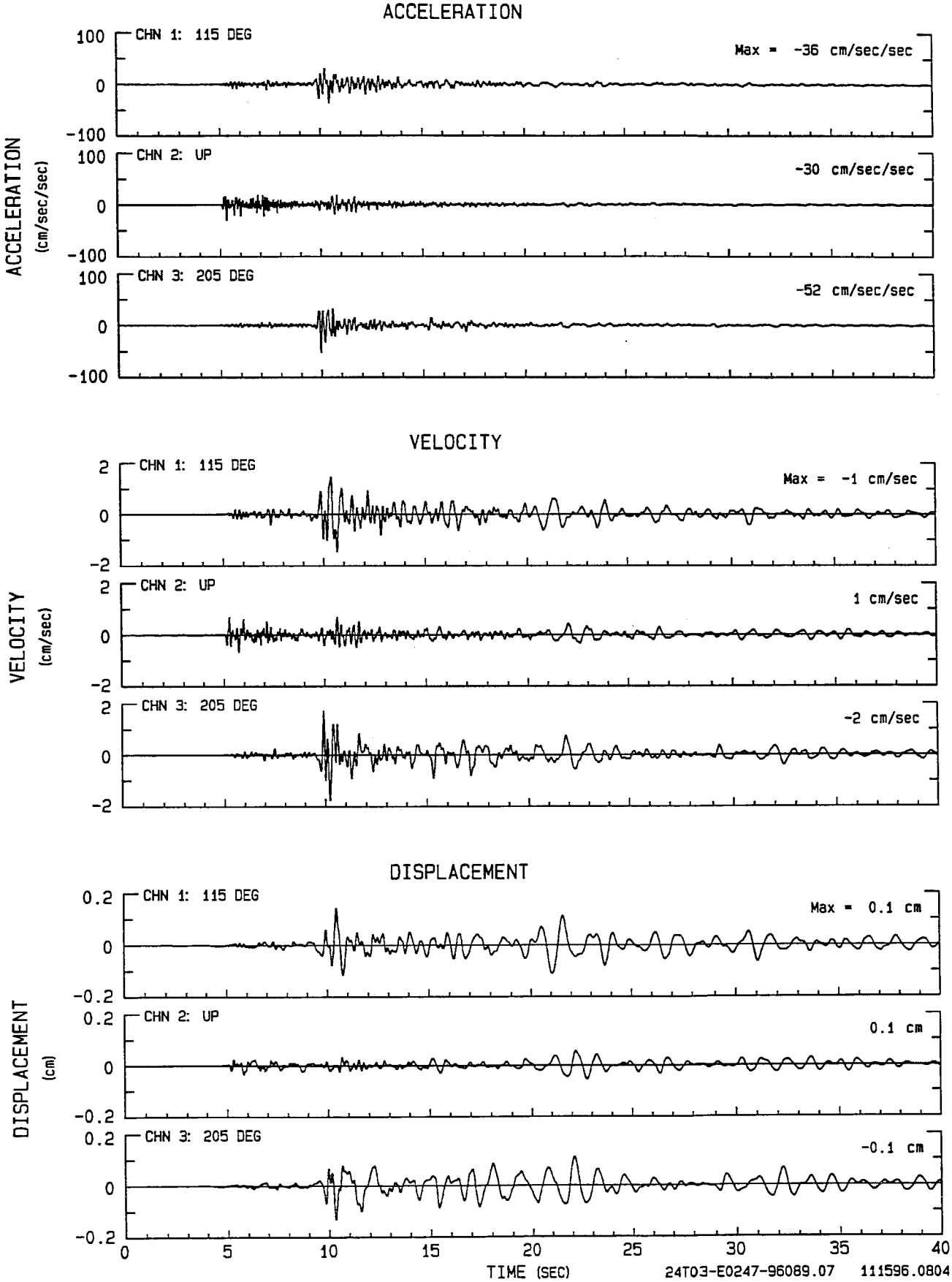


CHN 3: 180 DEG

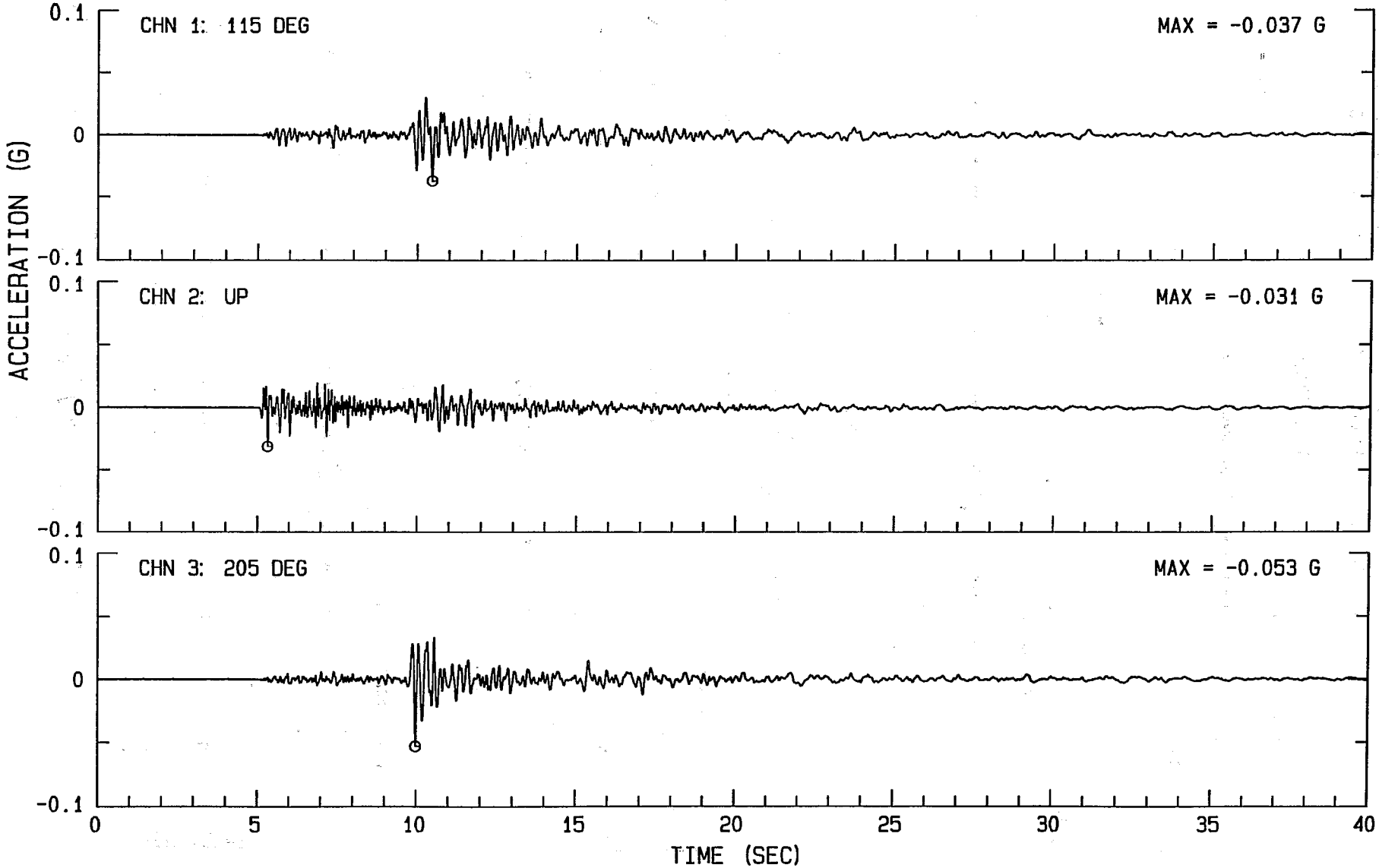


TARZANA - CLUBHOUSE CSMIP Sta Num 24T03

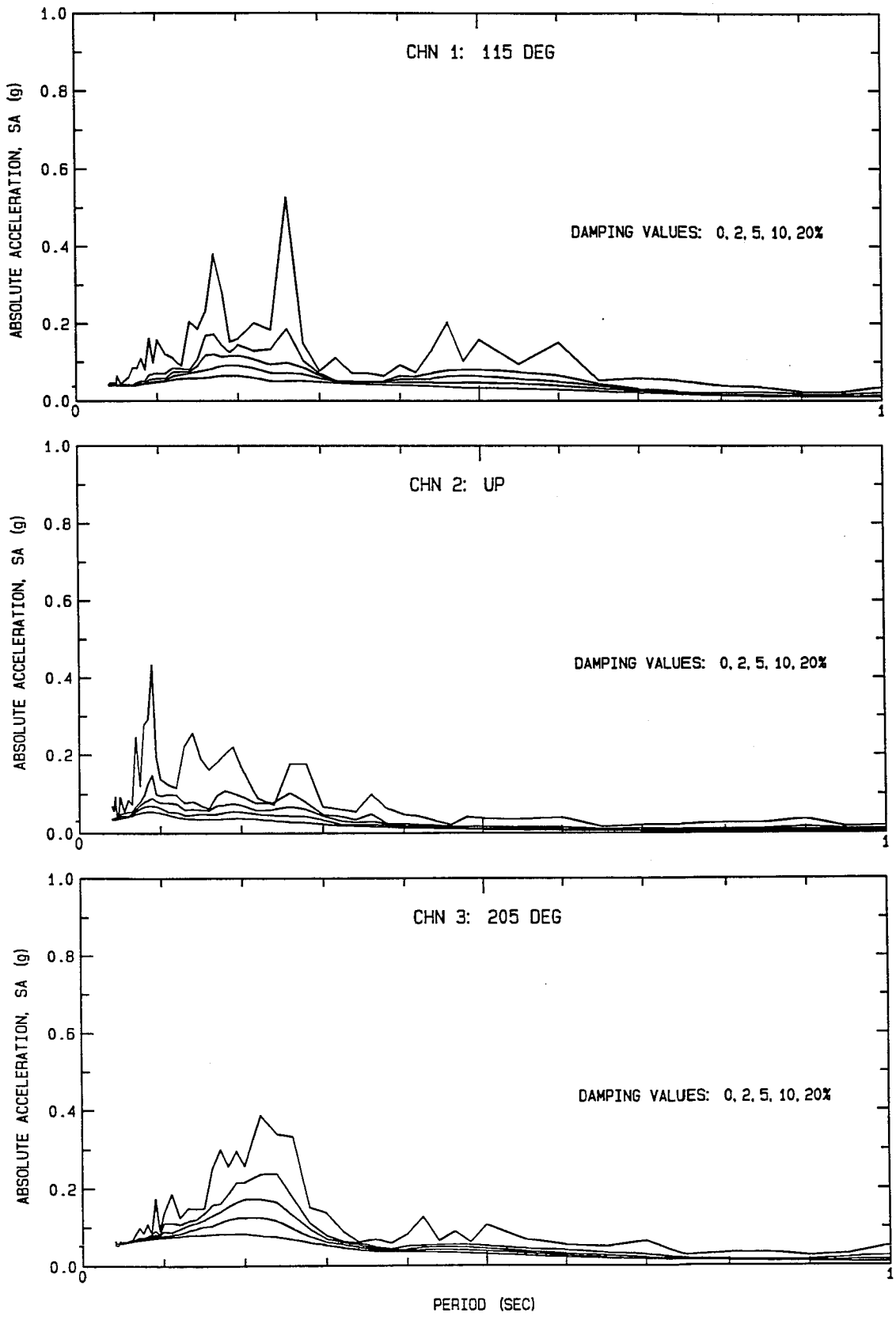
Usable Data Bandwidth: .51 to 47.2 Hz (.02 to 2.0 Sec)



NORTHRIDGE AFTERSHOCK OF JUN 26, 1995 CSMIP PRELIMINARY PROCESSING
TARZANA - CLUBHOUSE
UNCORRECTED ACCELEROGRAM 24T03-E0247-96089.07 111596.0802-QN94KT03



NORTHRIDGE AFTERSHOCK OF JUN 26, 1995 CSMIP PRELIMINARY PROCESSING
TARZANA - CLUBHOUSE
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .30-.60 TO 46.0-50.0 HZ.
24T03-E0247-96089.07 111596.0805-QN94KT03



NORTHRIDGE AFTERSHOCK OF JUN 26, 1995 CSMIP PRELIMINARY PROCESSING

TARZANA - CLUBHOUSE
Sta Num 24T03

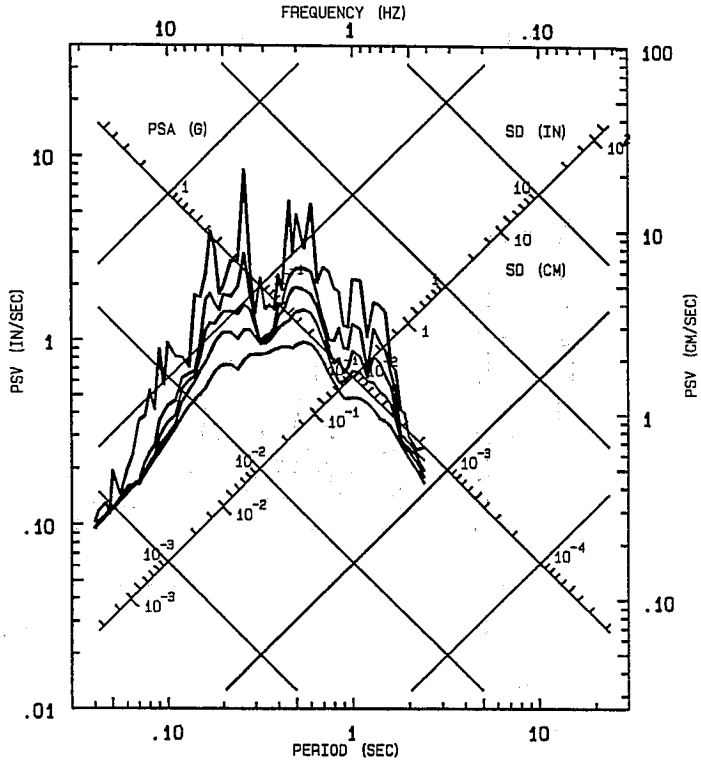
RESPONSE SPECTRA

USABLE DATA BANDWIDTH:
0.51 TO 47.2 HZ
(0.02 TO 2.0 SEC)

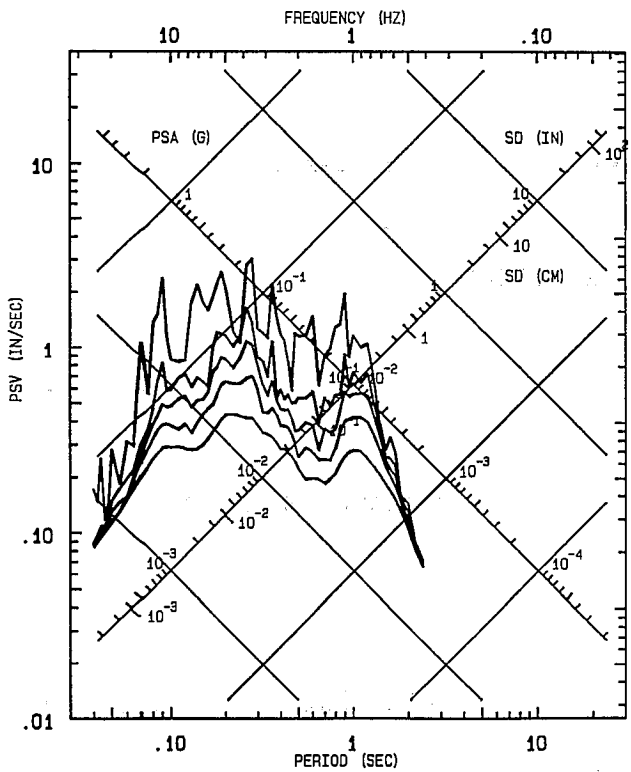
RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

RECORD ID: 24T03-E0247-96089.07

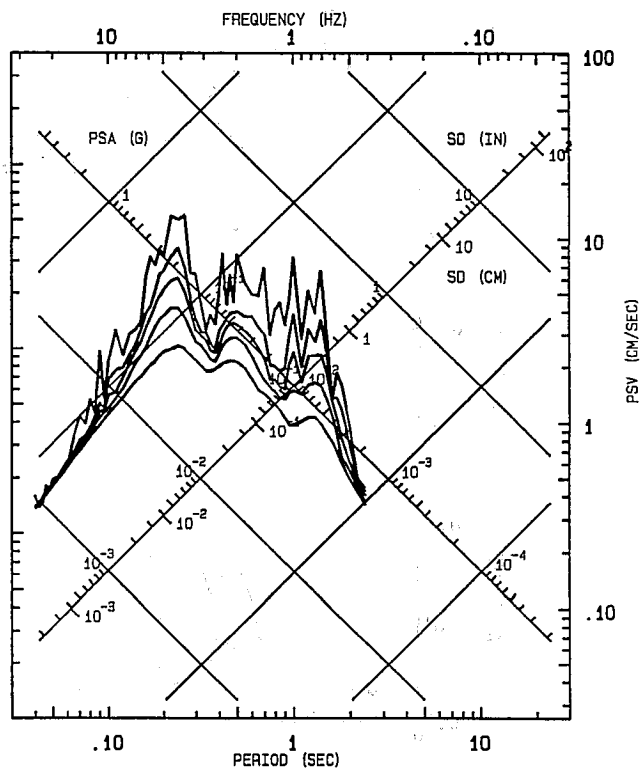
CHN 1: 115 DEG



CHN 2: UP



CHN 3: 205 DEG

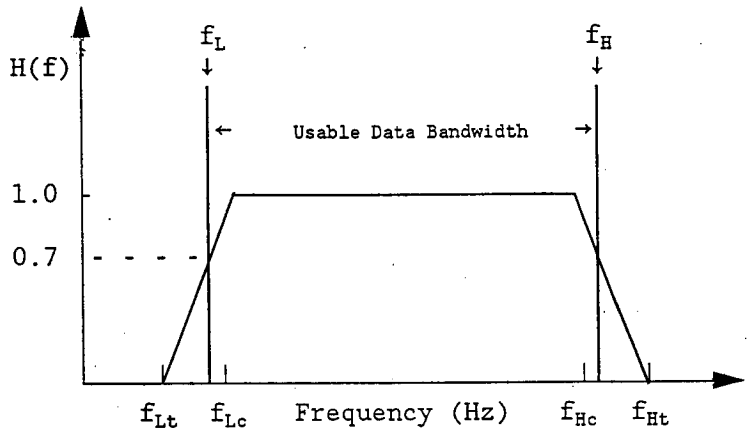


APPENDIX D

Definition of Usable Data Bandwidth

DEFINITION OF USABLE DATA BANDWIDTH

The filter bands for each record are indicated on the plots for the Phase 2 and Phase 3 data. In standard processing, the digitized data are processed and filtered using Ormsby filters. The data are first low-pass filtered using a high-frequency filter with a corner frequency of 46 Hz and a roll-off termination frequency of 50 Hz. Then the data are high-pass filtered using a low-frequency filter with a corner frequency of 0.07 Hz and a roll-off termination of 0.05 Hz. Therefore, the Phase 2 data is the result of the digitized data being filtered by the bandpass filter H(f) with ramps as shown in the figure:



The Usable Data Bandwidth is defined as the band between frequencies f_H and f_L, where f_H and f_L are the -3 dB points on the high-frequency and low-frequency ramps, respectively. The value of H(f) is approximately equal to 0.7 for -3 dB (see Notes). The user should only use these data for analyses within this bandwidth.

Notes:

1) The values of f_H and f_L can be calculated from the corner frequencies (f_{Hc}, f_{Lc}) and the roll-off termination frequencies (f_{Ht}, f_{Lt}) used in the processing by using the formulas $f_H = f_{Hc} + 0.3 * (f_{Ht} - f_{Hc})$ and $f_L = f_{Lc} - 0.3 * (f_{Lc} - f_{Lt})$. For example, the Usable Data Bandwidth for data bandpass-filtered with ramps at 0.30 to 0.60 Hz and 23.0 to 25.0 Hz is 0.51 Hz to 23.6 Hz (0.042 to 2.0 seconds period).

2) It is common in signal processing to plot 20 $\log_{10}[H(f)]$ versus frequency, and express the ordinate value in decibels (abbreviated dB). Accordingly, 0 dB corresponds to a value of H(f) equal to 1; 20 dB is equivalent to H(f) = 10, and -20 dB corresponds to H(f) = 0.1. Thus, at the -3 dB frequency point, the amplitude of the transfer function, H(f) is reduced to 0.7, while the power transmitted by the filter, $H^2(f)$, is reduced to 0.5.

APPENDIX E

Agbabian Associates (Subcontractor) report to SMIP on the drilling at Tarzana

DRILLING AND LOGGING OF THE CSMIP TARZANA SITE BOREHOLE

for

DIVISION OF MINES AND GEOLOGY
Department of Conservation
State of California
Contract #1096-020

by

AGBABIAN ASSOCIATES, INC.
1111 S. Arroyo Parkway #470
Pasadena, CA 91105
Job #9705

December 31, 1996
Report 9705-6624

TABLE OF CONTENTS

1.0 INTRODUCTION

A new cased borehole was installed at the Tarzana Station of the Department of Conservation's Strong Motion Instrumentation Program (SMIP) by Agbabian Associates, Inc. under Contract #1096-020. Planning was done in November, 1996 and the field work was done during December 2-7. The borehole was drilled and logged to a depth of 90 meters (297 feet) and then cased and grouted according to SMIP specifications to a depth of 61 meters (200 feet).

This report documents the field work, results, and planned future work.

2.0 FIELD WORK

Planning, permitting, and preparation for the field work at the Tarzana Station was done throughout the month of November. This work included:

- Selection of drilling subcontractor
- Coordination with drilling subcontractor
- Selection of disposal subcontractor
- Coordination with disposal subcontractor
- Coordination with SMIP regarding technical requirements
- Site visit and coordination with landowner (Manhattan Holding Company and Ralph Herman)
- Mobilization of supplies and equipment for lithology and geophysical logging

The borehole location was specified by SMIP (Bob Darragh) in a November 7, 1996 facsimile. The borehole location is 23' from the empty pool behind the house on top of the hill (in the nursery), 160' west of the existing SMIP T-hut.

A well permit was required by Los Angeles County for this permanent "test well." Figure 1 is this well permit.

Layne-Christensen, a Fontana, California drilling contractor, was selected to perform the drilling work. They are one of two firms currently under contract to Agbabian Associates for the ROSRINE (Resolution of Site Response Issues for the Northridge Earthquake) project; they were selected by competitive bid.

United Pumping was selected to perform the tailings disposal for this project. They are also the competitively-selected disposal firm for the ROSRINE project.

Field work was done during the week of December 2-7. Appendix A contains the original Daily Field Logs describing the activities of each field day. Details of drilling, sampling, lithology logging, and geophysical logging are described below.

2.1 Drilling

Drilling was done using a rotary mud rig with a 9-7/8" diameter tricone bit to 200' and an 8-3/4" tricone bit from 200-300'. The drill rig was moved to the site on Monday, December 2, and a 6' length of steel conductor casing (17" diameter) was driven into the soil to seal the loose soil at the top of the borehole.

Drilling began on Tuesday, December 3. Progress is documented in the Daily Field Logs (Appendix A) and in the Boring Logs (Appendix B). Throughout the drilling process there were significant problems with loss of fluid. These are documented in the logs. Otherwise, the drilling went well and was completed on Friday, December 6.

After the geophysical logging, casing was installed and the hole grouted in the afternoon and evening of Dec. 6. Casing was 4" Schedule 80 screw-joint PVC, with a custom SMIP "bishop's cap" bottom cap. This bottom cap was provided by SMIP, and its installation was supervised by Richard Payne of SMIP. Grouting was done by bottom feed tremie using a neat cement grout mix per SMIP specifications.

The conductor casing was removed on the morning of Saturday, December 7 and the grout was topped up. The equipment was then removed and the site cleaned up in the afternoon of Dec. 7. This included pumping and disposal of the tailings by United Pumping.

2.2 Sampling

Six undisturbed Pitcher samples (3"x30") were collected at depths of 10, 20, 30, 40, 100, and 196'. These were denoted P-1 through P-6. In addition, 26 cutting samples (stored in plastic "ziploc" bags and denoted B-1 through B-26) were collected to assist in the lithology logging.

These samples were taken to the Geotechnical Laboratory at UCLA (run by Prof. M. Vucetic) for appropriate storage in a "moist room." Appendix C contains the sample Delivery Record.

2.3 Lithology Logging

The site geologist for this borehole was Robert Steller of Agbabian Associates. He supervised the drilling and logged the soil/rock formations. Appendix B contains his field Boring Logs for this borehole.

The material encountered at this site was mostly shale with varying degrees of weathering. The top 13.5' is soft, silty clay. From 13.5-40' the material is still clayey but is clearly decomposed shale. Below 40' the material is highly to slightly weathered shale.

2.4 Geophysical Logging

P- and S-wave velocities were measured in the open, 297' borehole using the OYO suspension logging method. Measurements were taken at 1-meter intervals.

Figure 2 shows the P- and S-wave velocity profiles for this site. Figure 3 shows only S-wave velocity with an expanded scale.

FIGURE 1: WELL PERMIT

APPLICATION FOR WELL PERMIT
ENVIRONMENTAL HEALTH 2525 Corporate Place Monterey Park, Ca 91754
COUNTY OF LOS ANGELES DEPARTMENT OF HEALTH SERVICES

DATE 11/26/96

DESCRIPTION

TYPE OF PERMIT (CHECK)
- ☑ NEW WELL CONSTRUCTION
- ☐ RECONSTRUCTION OR RENOVATION
- ☐ DESTRUCTION

TYPE OF WELL
- ☐ PRIVATE DOMESTIC
- ☐ PUBLIC DOMESTIC
- ☐ IRRIGATION
- ☐ OBSERVATION/MONITORING
- ☐ CATHODIC
- ☐ INDUSTRIAL
- ☐ GRAVEL PACK
- ☑ TEST

TYPE OF CASING: 4" SCH. 80 PVC FLUSH JOINT - NO PERFS. MAX DEPTH 300'

METHOD OF SEALING OF CASING: CEMENT - BENTONITE GROUT - BOTTOM FEED TREMIE BOTTOM TO TOP.

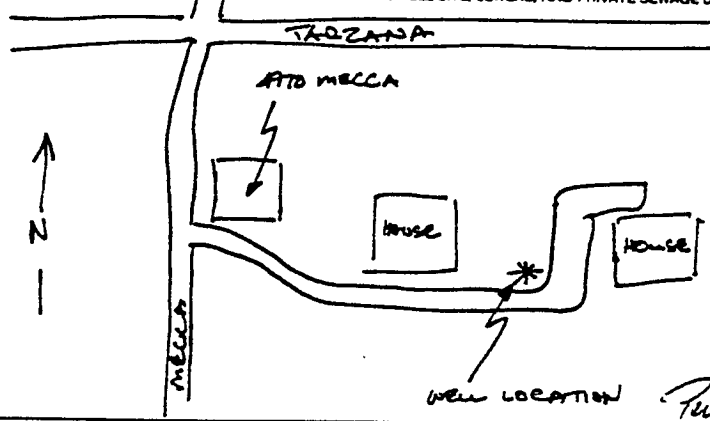
METHOD OF DESTRUCTION:

LOCATION

ADDRESS (NUMBER, STREET, AND NEAREST INTERSECTION): 4970 MECCA AVE, E MECCA & TARZANA.

CITY: TARZANA

DIAGRAM (SHOW PROPERTY LINES, STREET, ADDRESS, WELL SITE, SEWERS, AND PRIVATE SEWAGE DISPOSAL SYSTEMS ALONG WITH LABELS AND DIMENSIONS)



Permit for Monitoring Well

APPLICANT

NAME OF WELL DRILLER (PRINT)

TRADE NAME: LANCE CHRISTENSEN

BUSINESS ADDRESS: FONTANA CITY:

NAME OF WELL OWNER (PRINT): CALIF. DIVISION OF MINES & GEOLOGY

MAILING ADDRESS: 801 K ST. MS 12-30

CITY: SACRAMENTO, CA 95814

I hereby agree to comply in every respect with all regulations of the County Preventive/Public Health Services and with all ordinances and laws of the County of Los Angeles and of the State of California pertaining to well construction, reconstruction and destruction. Upon completion of well and within ten days thereafter, I will furnish the County Preventive/Public Health Services with a complete log of the well, giving date drilled, depth of well, all perforations in casing, and any other data deemed necessary by such County Preventive/Public Health Services.

Applicant's Signature

DISPOSITION OF APPLICATION: (For Sanitarians Use Only)
- ☒ APPROVED
- ☐ DENIED
- ☐ APPROVED WITH CONDITIONS

If denied or approved with conditions, report reason or conditions here:

DATE

SANITARIAN

DATE 11/26/96

SECTION CHIEF Albert P. Cheng

76A658
H-13 (Rev. 3/91) 5/96

When signed by Section Chief, this application is a permit.
APPLICANT COPY
Please Return All Copies

FIGURE 2: P- AND S-WAVE VELOCITY LOG

TARZANA SUSPENSION LOG

P - AND S-WAVE VELOCITIES, DATA COLLECTED 12/5/96 & 12/6/96

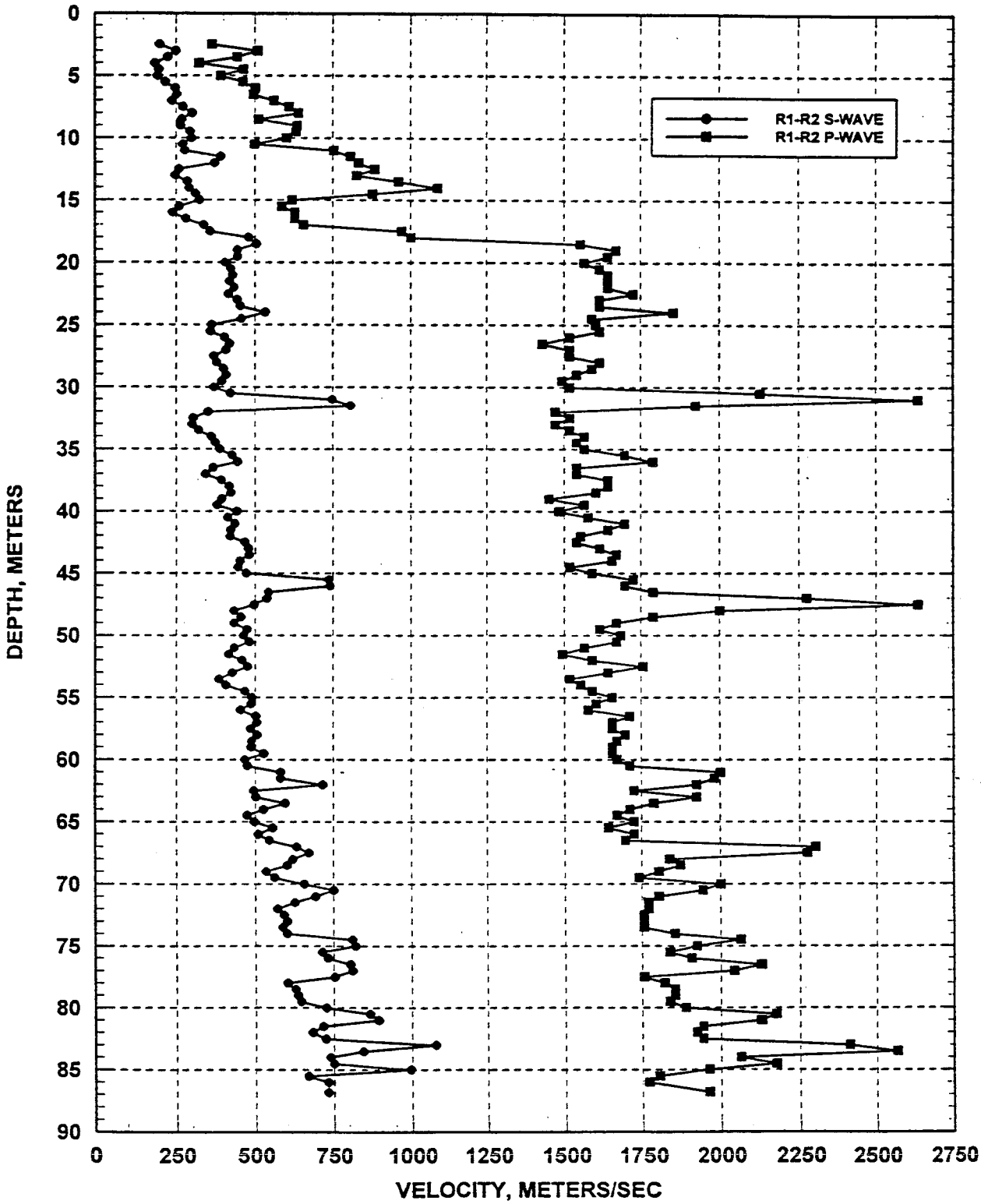
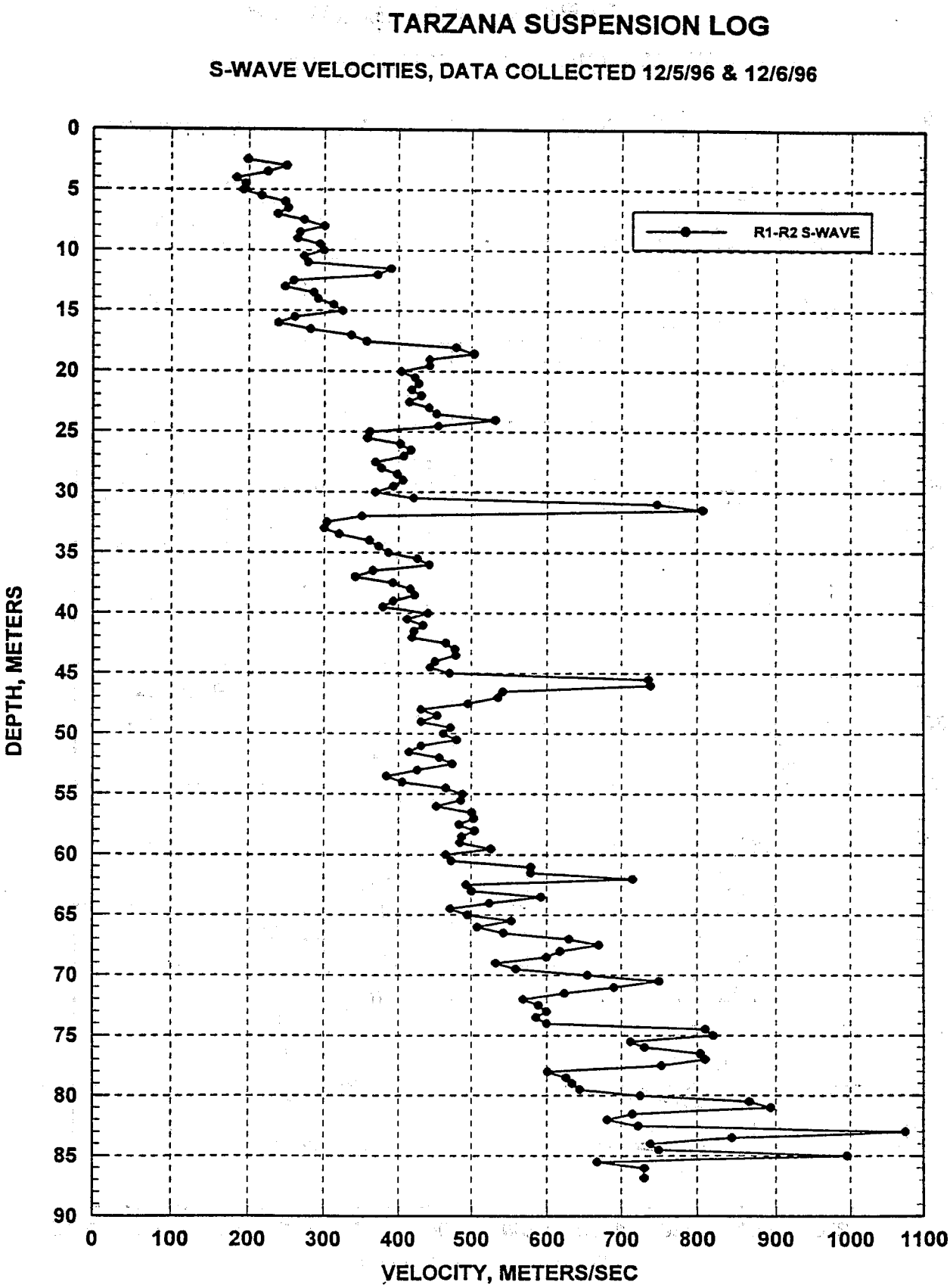


FIGURE 3: S-WAVE VELOCITY LOG



3.0 FUTURE WORK

The work described in the previous section completes Agbabian Associates' contractual requirements for this project. However, this work was done in conjunction with the SMIP new instrumentation program and with the ROSRINE project. Planned future work using the soil samples and the cased borehole is described below.

3.1 Laboratory Testing of Samples

As part of the ROSRINE project, selected samples from the 6 Pitcher tubes and the 26 bag samples will undergo further laboratory testing at either UCLA (by M. Vucetic) or at University of Texas, Austin (by K. Stokoe). This testing will consist of "index property" testing to determine density, soil type, grain size distribution, etc., and "dynamic" testing, to measure the nonlinear behavior of the material.

Testing details will be determined by the ROSRINE Technical Committee. Tests will be performed during 1997, and results made available to SMIP as soon as possible.

3.2 Installation of Downhole Accelerometer

SMIP will install a downhole accelerometer in the cased borehole along with a new or relocated surface sensor and accelerograph. The schedule for this work is to be determined.

4.0 SUMMARY

Under contract to and with the cooperation of the California Strong Motion Instrumentation Program, Agbabian Associates has successfully installed a 61 meter (200 foot) deep cased borehole at the Tarzana strong-motion accelerograph station operated by SMIP.

Along with the borehole drilling, lithology and seismic velocity logs have been produced to a depth of 90 meters and soil samples obtained for future laboratory studies. These data will assist in the understanding of the unusual site response observed at the Tarzana station during several recent earthquakes.

APPENDIX A

DAILY FIELD LOGS

Agbabian Associates

DAILY FIELD LOG

Project Name ~~TARZANA~~	Date 12/3/96
Description	Project No. 9618
	Sheet 1 of 1

06:45 ON SITE, POSITION RIG ETC.

09:00 BIN ARRIVES, — TO HIGH

≈ 5' TO TABLE

≈ 2' FOR BIT & SUB

≈ 6'6" FOR PITCHER & SUB

11:15 START MIXING MUD

11:30 START DRILLING ≥ CAL 415 - 329 - 4928

11:55 START P-1 @ 10'

12:55 START P-2 @ 20'

13:55 START P-3 @ 30'

15:00 LOST CIRCULATION @ ≈ 34' - COBBLES LIKE BITE @ 6'?

15:30 ~~REGAIN~~ RE-ESTABLISH CIRC.

16:30 TRIP OUT, END SHIFT

Weather CLEAR	Notes/Comments/Changes to Work Plan
Visitors On-Site	
Agbabian Associates Personnel on Site R. STENGEL	Signed RS

Agbabian Associates

DAILY FIELD LOG

Project Name ROSRINE TARTANA	Date 12/4/96
Description	Project No. 9618
	Sheet 1 of 1

06:30 ON SITE SET 10" PVC COND. CASE TO 8'

08:00 AT BOTTOM @ 35' DRILLING AHEAD - LOST CIRC. AGAIN DRIVE PVC CASE TO 10', STILL NO CIRC., MUD LEVEL @ ≈ 5'

8:40 FILLED W/ BENT CHIPS TO 30', REFILL W/ MUD STILL POOR CIRC.

10:00 PULL STEEL FLOW CASE, ATTEMPT TO PULL 10" PVC & OVERDRILL TO SET NEW CASE W/ BETTER SEAL. - CHECKED SEPTIC TANK - NO FLUID, ALL DRY.

11:00 PVC WON'T PULL. SEEMS TO BE TIGHT NOW, RE-INSTALL FLOW CASE. CIRC OK.

11:50 REACH 40'

12:20 FINISH CUTTING P-#4. 40 - 42.5'

13:40 REACH 52'

14:30 REACH 57', LOOSE CIRC., SHUT DOWN TO WAIT FOR CEMO-FLAKE.

17:00 CEMO-FLAKE ARRIVES, ADD 5 SACKS CHIPS & 3 SACKS CEMO, END SHIFT.

Weather CLEAR	Notes/Comments/Changes to Work Plan
Visitors On-Site	
Agbabian Associates Personnel on Site R. STEINER	Signed

DAILY FIELD LOG

Agbabian Associates

Project Name ROSPINE TARZANA	Date 12/5/96
Description	Project No. 9618
	Sheet 1 of 1

06:15 START MIXING MUD W/ CELLOFLAKE ~~5~~ 10 SACKS CELLOFLAKE

07:30 BACK TO 37', SEEMS TO HOLD MUD.

07:40 TO 51' - HARD DRILLING

07:48 TO 56'

09:10 START DRILLING @ 77'

09:38 REACH 100', LOOSE CIRC. - ADD MORE BENTONITE & CELLOFLAKE - START ON P-5

10:40 FINISH P-5 & TRIP OUT.

11:20 TRIPPED BACK TO 100'

12:05 GROUT & CASE ARRIVE, STOP DRILLING & CIRCULATE

16:23 STOP DRILLING @ 196' SET UP FOR P-6

18:00 FINISH P-6 & TRIPPING OUT. - END SHIFT.

18:30 START SUSPENSION LOG

20:30 FINISH SUSPENSION LOG

21:30 OFF SITE

Weather RAIN	Notes/Comments/Changes to Work Plan
Visitors On-Site	
Agbabian Associates Personnel on Site R. STEWART	Signed

Agbabian Associates

DAILY FIELD LOG

Project Name ROSEVINE TARZANA	Date 12/6/96
Description	Project No. 9618
	Sheet 1 of 2

07:40 START DRILLING @ 197' w/ 8" BIT

11:46 REACH T.D. @ 298', CIRC TO CLEAN

12:20 FINISH CIRCULATION, START TO TRIP OUT

12:40 RODS OUT, START P.S. LOG OF 200' - 300'

14:10 FINISH P.S. LOG

14:25 INSTALL TREMIE (21' x 14 - 5' = 289') & CASE TO 200'

16:40 PUMP 3 LOADS (~50 GAL) w 2 SACKS CEMENT & SACK BENT/40 GAL. TOO THICK, CLOG TREMIE. PULL OUT 4 JOINTS TO 205' CLEAR TREMIE & GO TO 3 SACKS CEMENT & 1½ SACK BENT/40 GAL. PUMP LOADS 4-6 @ 205' - PUMP PROBLEMS.

18:00 PULL 2 TREMIE TO 163', PUMP LOADS 6-8

18:16 PULL 2 TREMIE TO 121' PUMP LOADS 9-12

18:33 PULL 2 TREMIE TO 79' PUMP LOADS 13-14
PUMP FAILS.

18:49 PULL 2 TREMIE TO 37' PUMP LOAD 15 - GROUT RETURNS STARTING TO SHOW @ COLLAR.

Weather CLOUDY	Notes/Comments/Changes to Work Plan
Visitors On-Site RICHARD PAYNE - CDMG	
Agbabian Associates Personnel on Site D. STELLER	Signed

Agbabian Associates

DAILY FIELD LOG

Project Name ROSLYNE TARZANA	Date 12/16/96
Description	Project No. 9618
	Sheet 2 of 2

9:00 LADLE GROUT/MUD LEVEL DOWN TO ≈ 5' TO CLEAR FLOW CASE. - CLEAN ALL EQ.

21:00 FINISH CLEANING - OFF SITE

TOTAL GROUT PUMPED ≈ 750 GAL. CALC. VOLUME OF HOLE ≈ 900 GAL. — BOTTOM MAY NOT BE FULLY GROUTED. - FROM 200' ↑ PROB. OK. CEMENT GOOD @ 200' FOR INST.

Weather CLOUDY	Notes/Comments/Changes to Work Plan
Visitors On-Site RICHARD PAYNE - CDMG	
Agbabian Associates Personnel on Site R STELLER	Signed

APPENDIX B

FIELD BORING LOGS

Agbabian Associates

DAILY FIELD LOG

Project Name ROSRINE – TARZANA	Date 12/7/90
Description	Project No. 9618
	Sheet 1 of 1

06:30 – ON SITE, FILL FLOW CASE, LOWER RIG.
ADD ≈ 30-40 GAL GROUT AT TOP.

08:00 – MOVE RIG & LOAD RODS ONTO SUPPORT TRUCK

09:00 – MOVE RIG TO BACK FOR CLEANUP.
BEGIN CLEANING SITE. – CHECK BIN PH. – NO SPOT > 9.1 – PUMP BIN & REMOVE.

14:00 – ALL CLEAN, HOSES COILED, RIGS DEPART.
PARK FORK TRUCK AT BOTTOM OF HILL.
DEPART.

Weather CLEAR – COLD.	Notes/Comments/Changes to Work Plan
Visitors On-Site RICHARD RAYNE – CDMG	
Agbabian Associates Personnel on Site R. STEVER	Signed

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AGBABIAN ASSOCIATES

FIELD LOG OF BORING

PROJECT NUMBER: 9618	PROJECT NAME: ROSRINE TARZANA	SHEET 1 OF 15
ENGINEER/GEOLOGIST: R. STELLER	COORDINATES:	
DEPTH: 0 DATE/TIME: 12/3/96 11:30	DATE STARTED: 12/3/96	
DEPTH: 20 DATE/TIME: 12/3/96 12:50	DATE COMPLETED:	

DEPTH, FT.	RECOVERY	SAMPLE TYPE AND NO.	USCS	BLOWS PER 6"	Consistency/Color/Major Material/Minor Material/Moisture/Additional Description
5		B-1	SILTY CLAY		
10	30	B-2, B-3, B-5, P-1, B-4, B-6			SILTY CLAY 2.5Y 5/2 GRAYISH BROWN DRY, FRIABLE (B-3 FROM BAT @ 10')
	30				P-1 SILTY CLAY POCKET PENETROMETER = 4.5 TSF 2.5Y 4/2 DARK GRAYISH BROWN, DRY, FRIABLE NO REACTION TO HCL. - YELLOW STREAKS LOW DRY STRENGTH
15			DECOMPOSED SHALE		CHANGE TO HARDER MATERIAL - SHAKER SHOWS SHALE-LIKE FRAGMENTS - THINLY LAMINATED PLATES TAN COLORED, SOME RED-BROWN FRAGMENTS & FINE SAND.
20					

AGBABIAN ASSOCIATES

FIELD LOG OF BORING

15

PROJECT NUMBER: 9618	PROJECT NAME: ROSELINE TARZANA	SHEET 2 OF 2
ENGINEER/GEOLOGIST: R. STELLER	COORDINATES:	
DEPTH: 20 DATE/TIME: 12/3/96 12:50		DATE STARTED:
DEPTH: 40 DATE/TIME: 12/4/96 11:50		DATE COMPLETED:

DEPTH, FT.	RECOVERY	SAMPLE TYPE AND NO.	USCS	BLOWS PER 6"	Consistency/Color/Major Material/Minor Material/Moisture/Additional Description
20	22 / 8 / 30	P-2 B-7	DECOMPOSED SHALE SILTY CLAY		SAME AS P-1 WITH WHITE CRYSTALLINE INCLUSIONS ≤ 3% BY VOLUME, COLUMNAR - GYPSUM? NO REACTION TO HCL. MORE THAN 4.5 TSF
25		B-8			SAME AS ABOVE - MORE CRYSTALLINE INCLUSIONS?
30	24 / 30	P-3 B-9			SAME AS P-2 - SOFTER 2.25 TSF, THIN LAYERS OF YELLOW & RUST, WHITE CRYSTALS VERY SMALL.
					LOST CIRCULATION. END OF DAY 12/3/96
35		B-10		B-10	FROM BIT - FINELY BEDDED, VERY LOW DENSITY SHALE? BRT COLOR = 2.5Y 8/1 WHITE ⇒ LIGHT GRAY ALMOST CHALK LIKE. RESULT SCRAPED BY FINGERNAIL NO REACTION TO HCL
40					

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AGBABIAN ASSOCIATES

FIELD LOG OF BORING

15
13

PROJECT NUMBER: 9618	PROJECT NAME: ROSELAWN TARZANA	SHEET 3 OF 12
ENGINEER/GEOLOGIST: R STELLER	COORDINATES:	
DEPTH: 40 DATE/TIME: 12/4/96 11:55		DATE STARTED:
DEPTH: 60 DATE/TIME: 12/5 08:09		DATE COMPLETED:

DEPTH, FT.	RECOVERY	SAMPLE TYPE AND NO.	USCS	BLOWS PER 6"	Consistency/Color/Major Material/Minor Material/Moisture/Additional Description
40	26/30	P-4 B-11	SHALE		SHALE SLIGHTLY DECOMPOSED, FINELY BEDDED W/ GYPSUM VEIN @ 1/8" THICK ~~FRT~~ VERT. ORIENTED. 10YR 3/3 DARK BROWN P.P. > 4.5 TSF
			WEATHERED SHALE		DRILLING FASTER - PIT NOT BALLING UP - LESS CLAY LIKE, MORE SILT LIKE
45					
					MUD STARTS TO LEAK OUTSIDE OF CASING AT 6± INCHES - GOPHER HOLE & FRACTURES? NO OTHER VISIBLE PATH. - ADD FIBERS TO MUD
50			SLIGHTLY WEATHERED SHALE.		DRILLING BECOMES HARDER - AND RETURN CUT. HARD LAYER
55					7:48 HARD LAYER @ 200 PSI
			SHALE		7:53 @ 200 PSI ⊖ MUD PUMP
					8:04 @ 200 PSI
					8:08
60					8:11 FRACTURED ROCK

AGBABIAN ASSOCIATES

FIELD LOG OF BORING

15 X3

PROJECT NUMBER: 9618	PROJECT NAME: 9618 ROSRINE	SHEET 4 OF 12
ENGINEER/GEOLOGIST: R. STEVENS	COORDINATES:	
DEPTH: 60 DATE/TIME: 12/5/96 08:09		DATE STARTED:
DEPTH: 80 DATE/TIME: 12/5/96 09:17		DATE COMPLETED:

DEPTH, FT.	RECOVERY	SAMPLE TYPE AND NO.	USCS	BLOWS PER 6"	Consistency/Color/Major Material/Minor Material/Moisture/Additional Description
60					08:09 FRACTURED ROCK — RUN DUMPED.
				SHALE	08:10' 50"
					SMOOTH OUT - SOFT
				WEATHERED SHALE	08:11' 30"
					08:12 @ 0 PSI
					08:13 @ 0PSI
					08:14 @ 0PSI
65					08:14'30" @ 0PSI
			8:15		08:15 MUD GOES DARK BROWN
			8:16'30"		SMOOTH DRILLING
			8:17'20"		
70		B-12	8:		
			8:21		
75			8:22'30"		
		B-13	8:24		
			8:25		
					NEW RUN, CLEAN MUD PIPE
80			9:15		

AGBABIAN ASSOCIATES

FIELD LOG OF BORING

PROJECT NUMBER: 9616		PROJECT NAME: BOREHOLE - TADZANIA		SHEET: 5 OF 15	
ENGINEER/GEOLOGIST: R. STELLFOX			COORDINATES:		
DEPTH: 80	DATE/TIME: 12/5/96	09:17	DATE STARTED:		
DEPTH: 100	DATE/TIME: 12/5/96	09:38	DATE COMPLETED:		

DEPTH, FT.	RECOVERY	SAMPLE TYPE AND NO.	USCS	BLOWS PER 6"	Consistency/Color/Major Material/Minor Material/Moisture/Additional Description
80			9:15		
			9:20	SHALE	HARD LAYERED EASY.
			9:21		
			9:22	20	
85			9:22'45"		
			9:23'15"		
			9:24		
			9:24'40	20	
			9:25'15		
90			9:26		
			9:26:20		
			9:27:00		
		B-14	9:27:40		
			9:28:20		
95			9:29		
			9:29:47		
			9:30:30		NEW ROD.
			9:36:30		
			9:37.00		
100			9:39:40		

AGBABIAN ASSOCIATES

FIELD LOG OF BORING

PROJECT NUMBER: 9618	PROJECT NAME: ROSRINE - TARZANA	SHEET 6 OF 5 1/2
ENGINEER/GEOLOGIST: R STELLER	COORDINATES:	
DEPTH: 100 DATE/TIME: 12/5/96 09:38		DATE STARTED:
DEPTH: 120 DATE/TIME: 12/5/96 11:50		DATE COMPLETED:

DEPTH, FT.	RECOVERY	SAMPLE TYPE AND NO.	USCS	BLOWS PER 6"	Consistency/Color/Major Material/Minor Material/Moisture/Additional Description
100	18/18	P-5	SHALE		SHALE, FINELY BEDDED, SOME GYPSUM? PLANES GROOVE WITH FINGERNAIL, 5Y 3/1 DARK GREY - HINT OF OLIVE. MOIST POCKET PEN > 4.5 TSF
		B-15			
		B-10	11:25:00		FRACTURED ROCK, RIG JUMPS
					HARD WHITE ROCK CHIPS.
			11:33		SMOOTHS OUT.
105			11:34		
			11:35		WEATHERED SHALE
			11:36		
			11:36		
110			11:37:15		
			11:38		
			11:39		
			11:40:10		
			11:41:10		
115			11:42:15		
			11:43		
			11:44:45		
		B-17			
			11:48	NEW ROD	HARD CHIPS OF FINELY BEDDED SHALE, HARD TO SCRATCH W/ FINGERNAIL
			11:49		
120			11:50		

AGBABIAN ASSOCIATES

FIELD LOG OF BORING

15 X3

PROJECT NUMBER: 9618	PROJECT NAME: ROSRINE TANZANIA	SHEET 7 OF 12
ENGINEER/GEOLOGIST: R STEVENS	COORDINATES:	
DEPTH: 120 DATE/TIME: 12/5/96 11:50		DATE STARTED:
DEPTH: 140 DATE/TIME: 12/5/96 12:29		DATE COMPLETED:

DEPTH, FT.	RECOVERY	SAMPLE TYPE AND NO.	USCS	BLOWS PER 6"	Consistency/Color/Major Material/Minor Material/Moisture/Additional Description
120					
					WEATHERED SHALE
				11:50: 30	@ ϕ
				11:51	
				11:51:40	
				11:52:15	
125				11:53:15	
				11:54:15	
				11:55:20	@ ϕ
				11:56:15	
				11:57	
130				11:57:40	
				11:58:30	
135					
				12:02:45	
		B-18		12:03:30	NEW RUN SAME AS B-17
				12:27	
				12:28	
140				12:29	

AGBABIAN ASSOCIATES

FIELD LOG OF BORING

15 13

PROJECT NUMBER: 9618	PROJECT NAME: ROSELINE TRAILS	SHEET 8 OF ~~12~~
ENGINEER/GEOLOGIST: R. STELLER	COORDINATES:	
DEPTH: 140 DATE/TIME: 12/5/96 12:30		DATE STARTED:
DEPTH: 160 DATE/TIME: 12/5/96 13:01		DATE COMPLETED:

DEPTH, FT.	RECOVERY	SAMPLE TYPE AND NO.	USCS	BLOWS PER 6"	Consistency/Color/Major Material/Minor Material/Moisture/Additional Description
~~140~~				12:30 @ 0 PSI	
				12:30:30	
				12:31:30	
				12:32:35	
145				12:33:30	
				12:34:00	ROUGH
				12:34:40	SHANK ROUGH
				12:35:25	
				12:36:10	SLOWER DRILLING / SMOOTH
150				12:37:25	
				12:39:00	@ 0 PSI
				12:40:00	ROUGH
				12:40:40	ROUGH
				12:41:40	
155				12:42:25	ROUGH (WEAK) HARD.
				12:45:25	
				12:47:50	SLOWER WITH END SHANK
		B-19		NEW RUN.	SAME AS B-18, ADDITION OF SMALL HARD WHITE CHIPS.
				12:58:20	
				12:59:40	
160				13:00:40	

250

AGBABIAN ASSOCIATES

FIELD LOG OF BORING

15 ~~13~~

PROJECT NUMBER: 9618	PROJECT NAME: ROSRINE — TARZANA	SHEET 9 OF ~~15~~
ENGINEER/GEOLOGIST: R STELLER	COORDINATES:	
DEPTH: 160 DATE/TIME: 12/5/96 13:00	DATE STARTED:	
DEPTH: 180 DATE/TIME: 12/5/96 15:06	DATE COMPLETED:	

DEPTH, FT.	RECOVERY	SAMPLE TYPE AND NO.	USCS	BLOWS PER 6"	Consistency/Color/Major Material/Minor Material/Moisture/Additional Description
160			13:01:30		WEATHERED SAME — ROUGH
			13:02:20		
			13:03:40		
			13:03:55		
165			13:04:55		
			13:06:05 @ 0 psi		
			13:09 @ 0 psi		— CLAY — BIT BALLING UP?
			13:15:15		
			13:16:00		
170			13:16:55		
			13:17:45		
			13:18:50		← CLAY — BIT BALLING UP?
			13:28:30		
			13:31:30		
175		B-20			SAME AS B-18
					NEW ROD
			15:08		
180					

AGBABIAN ASSOCIATES

FIELD LOG OF BORING

15
13

PROJECT NUMBER: 968	PROJECT NAME: BORING - TARZANA	SHEET 10 OF 12
ENGINEER/GEOLOGIST: L STELLER	COORDINATES:	
DEPTH: ~~12/5/96~~ 180 DATE/TIME: 15:00:00 12/5/96	DATE STARTED:	
DEPTH: 300 DATE/TIME: 12/6/96 07:45	DATE COMPLETED:	

DEPTH, FT.	RECOVERY	SAMPLE TYPE AND NO.	USCS	BLOWS PER 6"	Consistency/Color/Major Material/Minor Material/Moisture/Additional Description
180				15:06:00	SLIGHTLY WEATHERED SHALE
				15:07:30	
				15:08:30	
				15:	
				15:	
				15:11:	
185				15:12:15	
				15:13:15	
				15:15:30	CLAY?
				15:22:30	
				15:34:30	
				15:36	
				15:37	
				15:37:45	
				15:45:15	
				15:58:30	
195				16:19:25	
	25/30	P-6			SAME AS P-5 : BIT HARDER.
		~~B-21~~			
				~7:45	
200					

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AGBABIAN ASSOCIATES

FIELD LOG OF BORING

PROJECT NUMBER: 9618	PROJECT NAME: TARZANA	SHEET 11 OF 15
ENGINEER/GEOLOGIST: R. STELLER	COORDINATES:	
DEPTH: 200 DATE/TIME: 12/6/96 7:40		DATE STARTED:
DEPTH: 220 DATE/TIME: 12/6/96 8:35		DATE COMPLETED:

DEPTH, FT.	RECOVERY	SAMPLE TYPE AND NO.	USCS	BLOWS PER 6"	Consistency/Color/Major Material/Minor Material/Moisture/Additional Description
200			SHALE		BIT CHATTERING
205					SMOOTHER DRILLING.
			SLIGHTLY WEATHERED SHALE		
210		B-22			SAME AS B-21
				B:02:20	
25					
				B:20:00/B:32:00	NEW ROD.
220					

AGBABIAN ASSOCIATES

FIELD LOG OF BORING

15

PROJECT NUMBER: 9618	PROJECT NAME: TARZANA	SHEET 12 OF ~~15~~
ENGINEER/GEOLOGIST: R. STELLER	COORDINATES:	
DEPTH: 220 DATE/TIME: 12/6/96 - 8:35		DATE STARTED:
DEPTH: 240 DATE/TIME: 12/6/96 - 9:35		DATE COMPLETED:

DEPTH, FT.	RECOVERY	SAMPLE TYPE AND NO.	USCS	BLOWS PER 6"	Consistency/Color/Major Material/Minor Material/Moisture/Additional Description
220				8:35	SMOOTH DRILLING - TAILING ~~SAME AS ABOVE~~
			SLIGHTLY WEATHERED SHALE		
225					
230				8:56	
235					CLAY? - BIT BALLING UP.
		B-23		9:18 - 9:31	NEW ROD. SMOOTH DRILLING SAME AS B-22
240					

AGBABIAN ASSOCIATES

FIELD LOG OF BORING

PROJECT NUMBER: 9618	PROJECT NAME: TARZANA	SHEET 15 OF 15
ENGINEER/GEOLOGIST: R. STELLER	COORDINATES:	
DEPTH: 240 DATE/TIME: 12/6/95 - 9:35		DATE STARTED:
DEPTH: 260 DATE/TIME: 12/6/95 - 10:~~15~~55		DATE COMPLETED:

DEPTH, FT.	RECOVERY	SAMPLE TYPE AND NO.	USCS	BLOWS PER 6"	Consistency/Color/Major Material/Minor Material/Moisture/Additional Description
240					SLIGHTLY WEATHERED SHALE
245					SMOOTH DRILLING. TAILING SAME AS ABOVE.
					9:46
250					
					9:48
255					STOP DRILLING TO CIRCULATE.
					10:42
260					

AGBABIAN ASSOCIATES

FIELD LOG OF BORING

PROJECT NUMBER: 9618	PROJECT NAME: TARZANA	SHEET 10 OF 15
ENGINEER/GEOLOGIST: R. STELLER	COORDINATES:	
DEPTH: 260 DATE/TIME: 12/6/95 - 10:55	DATE STARTED:	
DEPTH: 280 DATE/TIME: 12/6/95 - ≈ 11:27	DATE COMPLETED:	

DEPTH, FT.	RECOVERY	SAMPLE TYPE AND NO.	USCS	BLOWS PER 6"	Consistency/Color/Major Material/Minor Material/Moisture/Additional Description
260					
					SLIGHTLY WEATHERED SHALE — SMOOTH DRILLING
265					10:59 SHALE — RIG JUMPING
					SLIGHTLY WEATHERED SHALE
		B-24			11:04 — SAME AS B-23
270					
					11:07 SHALE — RIG JUMPING HARD MATERIAL
275					11:14 — DRILL SMOOTH & FAST
					SLIGHTLY WEATHERED SHALE
					11:15 — CHATTER
		B-25			11:16/11:25 — NEW ROD. SAME AS B-24
280					

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AGBABIAN ASSOCIATES

FIELD LOG OF BORING

PROJECT NUMBER: 9618	PROJECT NAME: TARZANA	SHEET 15 OF 15
ENGINEER/GEOLOGIST: R. STELLER	COORDINATES:	
DEPTH: 280 DATE/TIME: 12/6/95 ~~10:05~~ 11:27	DATE STARTED:	
DEPTH: 300 DATE/TIME: 12/6/95 - 11:46	DATE COMPLETED:	

DEPTH, FT.	RECOVERY	SAMPLE TYPE AND NO.	USCS	BLOWS PER 6"	Consistency/Color/Major Material/Minor Material/Moisture/Additional Description
280					
					VERY SLIGHTLY WEATHERED SHALE
				11:29:30	SMOOTH & FAST
				11:31:00	
285					
				11:34:30	CHATTER SMOOTH & FAST
290					
295		B-26		11:46	T.D @ 11:46. SAME AS B-25
300					

APPENDIX C

SAMPLE DELIVERY RECORD

DELIVERY RECORD

PROJECT NAME/NUMBER ROSRINE 9618 - [redacted] TARZANA

LAB DESTINATION UCLA

Sample Number	Sample Location and Description	Date and Time Collected	Sample Type	Container Type
P-1	10.0' - 12.5'	12/3/96	PITCHER	STEEL TUBE
P-2	20.0 - 22.0'	12/3/96	"	"
P-3	30.0' - 32.0'	12/3/96 - 14:55	"	"
P-4	40.0' - 42.0'	12/4/96 - 11:50	"	"
P-5	100.0' - 101.5'	12/5/96 - 11:00	"	"
P-6	196.0 - 198.0'	12/5/96 - 16:19	"	"
B-1	TAILINGS 4'-6'	12/3/96 - 11:30	BAG.	ZIPLOC BAG
B-2	TAILINGS 9'-10'	12/3/96 - 11:40		
B-3	FROM BIT @ 10'	12/3/96 - 11:50		
B-4	BOTTOM OF P-1 @ 12.5'	12/3/96 - 12:10		
B-5	TOP OF P-1 @ 10'	12/3/96 - 12:10		
B-6	TAILINGS 13' - 14'	12/3/96 - 12:30		
B-7	TIP OF P-2 @ 22.0'	12/3/96 - 13:10		
B-8	TAILINGS 25' - 28'	12/3/96 - 13:30		
B-9	TIP OF P-3 @ 32.0'	12/3/96 - 14:55		
B-10	FROM BIT @ 35'	12/4/96 - 8:40		
B-11	TIP OF P-4 @ 42.0'	12/4/96 - 13:00		

Special Instructions: _____

Possible Sample Hazards: _____

SIGNATURES:

Delivered By: [signature] Received By: Harold Kasper

Date & Time: 12/11/96 14:00

DELIVERY RECORD

PROJECT NAME/NUMBER ROSPINE 9618 - TARZANA LAB DESTINATION UCLA

Sample Number	Sample Location and Description	Date and Time Collected	Sample Type	Container Type
B-12	TAILINGS 70'-71'	12/5/96 - 8:18	BAG	ZIPLOC BAG
B-13	TAILINGS 76'-77'	12/5/96 - 8:26		
B-14	TAILINGS 92'-93'	12/5/96 - 9:27		
B-15	TIP OF P-5 @ 101.5' - SHALE	12/5/96 - 11:00		
B-16	TAILINGS 103'-104'	12/5/96 - 11:25		
B-17	TAILINGS 117' - 118'	12/5/96 - 11:45		
B-18	TAILINGS 137' - 138'	12/5/96 - 12:15		
B-19	TAILINGS 157' - 158'	12/5/96 - 12:58		
B-20	TAILINGS 175' - 176'	12/5/96 - 14:00		
B-21	TIP OF P-6 @ 198' - SHALE	12/5/96 - 17:00		
B-22	TAILINGS 209' - 211'	12/6/96 - 8:00		
B-23	TAILINGS 238' - 239'	12/6/96 - 9:30		
B-24	TAILINGS 266' - 268'	12/6/96 - 11:00		
B-25	TAILINGS 276' - 278'	12/6/96 - 11:20		
B-26	TAILINGS 296' - 298'	12/6/96 - 11:50		

Special Instructions: _____

Possible Sample Hazards: _____

SIGNATURES:

Delivered By: _____ Received By: HAROLD KAESER

Date & Time: 12/6/96 14:00