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April 10, 2001

UPDATE OF DETERMINISTIC GROUND MOTION ASSESSMENTS
DOCKET NO. 72-22 / TAC NO. L22462
PRIVATE FUEL STORAGE FACILITY
PRIVATE FUEL STORAGE L.L.C.

Reference: PFS letter Donnell to Delligatti, "Submittal of Commitment Resolution #3 Information", dated April 8, 1999

The report listed below has been revised by Geomatrix Consultants, Inc. for the Private Fuel Storage Facility (PFSF) and is enclosed for your use.

- Update of Deterministic Ground Motion Assessments, Revision 1, April 2001

This report was originally generated at the request of the NRC and submitted with the above referenced letter. The report was revised to update the PFSF design ground motion as discussed in License Amendment #22. If you have any questions regarding this submittal, please contact me at 303-741-7009.

Sincerely,

John L. Donnell

John L. Donnell
Project Director
Private Fuel Storage L.L.C.

Enclosure

NMSS01 Public

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GEOMATRIX

UPDATE OF DETERMINISTIC GROUND MOTION ASSESSMENTS, REVISION 1

Private Fuel Storage Facility

Skull Valley, Utah

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April 2001

Project No. 4790.002.0

GEOMATRIX

UPDATE OF DETERMINISTIC GROUND MOTION ASSESSMENTS

Revision 1 – April 6, 2001
Private Fuel Storage Facility
Skull Valley, Utah

1.0 INTRODUCTION

This report presents updated deterministic ground motion assessments for the Private Fuel Storage Facility site located in Skull Valley, Utah. These assessments are based on the seismic source and ground motion characterization presented in Geomatrix Consultants, Inc. (2001a and 2001b).

2.0 APPROACH

The approach used to assess deterministic ground motions for the Skull Valley site follows the methodology described in Geomatrix (1997). The standard approach used for deterministic ground motion assessments for nuclear facilities is to use the 84th percentile of the empirical distribution of peak motions predicted for the maximum earthquake on each seismic source occurring at the minimum source-to-site distance. We have extended this approach to include the uncertainty in maximum magnitude, minimum source-to-site distance, and selecting appropriate attenuation relationships in the estimation of the 84th percentile ground motion levels. The formulation used is given by the relationship:

$$P(Z > z) = \sum_{m} p(m_i) \cdot \sum_{r} p(r_j | m_i) \cdot \sum_{A} p(A_k) \cdot P(Z > z \; | m_i, r_j, A_k) \qquad (1)$$

where $p(m_i)$ is the discrete probability density function for maximum magnitude, $p(r_j)$ is the discrete probability density function for minimum distance given a maximum magnitude, $p(A_k)$ is the discrete probability density (weight) assigned to a particular attenuation relationship and $P(Z>z | m_i, r_j, A_k)$ is the probability that ground motion parameter Z exceeds level z given maximum magnitude m_i, minimum distance r_j, and attenuation relationship A_k. Assuming that ground motions are log normally distributed about the median attenuation relationship A_k, $P(Z>z | m_i, r_j, A_k)$ is given by the standard log-normal distribution using the standard error specified for A_k. Equation **(1)** is solved iteratively for the value of z that results in $P(Z>z)$ equal to 0.8416.

3.0 SEISMIC SOURCES AND MAXIMUM MAGNITUDES

Deterministic ground motion assessments were made for the four nearby faults, the Stansbury, East, West, and East Cedar Mountains faults. The characteristics of these sources are described in Geomatrix Consultants, Inc. (2001a). Distributions for maximum magnitude are developed for each source and are shown on Figure 6-6 of Geomatrix Consultants, Inc. (2001a). The mean maximum magnitudes are **M** 7.0, 6.5, 6.4, and 6.5 for the Stansbury, East, West, and East Cedar Mountains faults, respectively. The Canister Transfer Building lies 9, 0.9, 2.0, and 9 km from the surface traces of the Stansbury, East, West, and East Cedar Mountains faults, respectively. The distance to the rupture depends upon the assigned dip. Following the assessment used for the probabilistic seismic hazard analysis (PSHA), dips of 45°, 55°, and 65° were used, with equal weight assigned to each dip angle. An assessment was also made for the occurrence of a random earthquake in the site vicinity using the methodology discussed by Kimball (1983). The magnitude of the random event was assumed to be the maximum magnitude for the areal source zone in which the site lies (uniform distribution from **M** 5.5 to 6.5) and the event is assumed to occur at a random location within 25 km of the site.

4.0 GROUND MOTION MODELS

The ground motion models used in this assessment are the set of 20 horizontal and 11 vertical attenuation relationships used in the PSHA (Geomatrix Consultants, Inc., 2001a, Appendix F). These relationships are empirical ground motion models that have been adjusted for source, path and site effects. The site effects adjustment consists of two sets of factors, one based on site response analyses and one based on empirical data, with weights of 0.67 and 0.33, respectively. In addition, the attenuation relationships were adjusted for near-source effects using the empirical model developed by Somerville and others (1997). Two effects are represented, one resulting from directivity of rupture (a Doppler effect) and one representing a systematic difference between fault-normal and fault-parallel motions (the horizontal response spectral attenuation relationships used in the PSHA represent the geometric mean of the two horizontal components). The effects first become significant at a spectral frequency of 1.67 (0.6-second period) and increase with decreasing spectral frequency (increasing period).

The magnitude of these effects is related to the size of the earthquake and to the geometric relationship between the site, the length of the rupture, and the location of the point of rupture initiation. For dip-slip faults, these are parameterized by the term $y\cos(\phi)$, where ϕ is the angle between the rupture surface and a line drawn from the point of rupture initiation and the site and y is the distance from the point of rupture initiation to the site measured along the fault divided by the length of rupture measured in the direction of slip (for dip slip faults, the rupture width). Because most large normal faulting earthquakes appear to initiate near the base of the seismogenic crust, sites located on the fault trace will have $\phi = 0$ and y near 1.0, and will thus experience the maximum effect of both directivity and systematic fault-normal-to-fault-parallel differences in ground motion. The values of ϕ and y were computed for each fault geometry assuming that the maximum earthquake initiates at the base of the seismogenic crust. It was assumed that the effect of rupture directivity affects vertical motions by the same amount as horizontal motions.

5.0 RESULTS

Figure 1 compares the 84th-percentile response spectra for the five seismic sources for the fault-normal component of motion. The ground motions from the East fault generally envelop those for the other sources. The 84th-percentile peak horizontal acceleration for this source is 1.15 g and the corresponding 84th-percentile peak vertical acceleration is 1.17 g. Figures 2, 3, and 4 compare the 84th-percentile response spectra for the East fault with equal-hazard response spectra for return periods ranging from 1,000 to 10,000 years. The equal-hazard spectra have been adjusted for near-source ground motion effects as described in Geomatrix Consultants, Inc. (2001b). The controlling deterministic spectra generally lie between the 5,000-yr and 10,000-yr return period equal-hazard response spectra.

6.0 REFERENCES

Geomatrix Consultants, Inc., 1997, Deterministic earthquake ground motions analysis, Private Fuel Storage Facility, Skull Valley, Utah: report prepared for Stone & Webster Engineering Corporation, P.O. No. CS-028233, J.O. No. 05996.01.

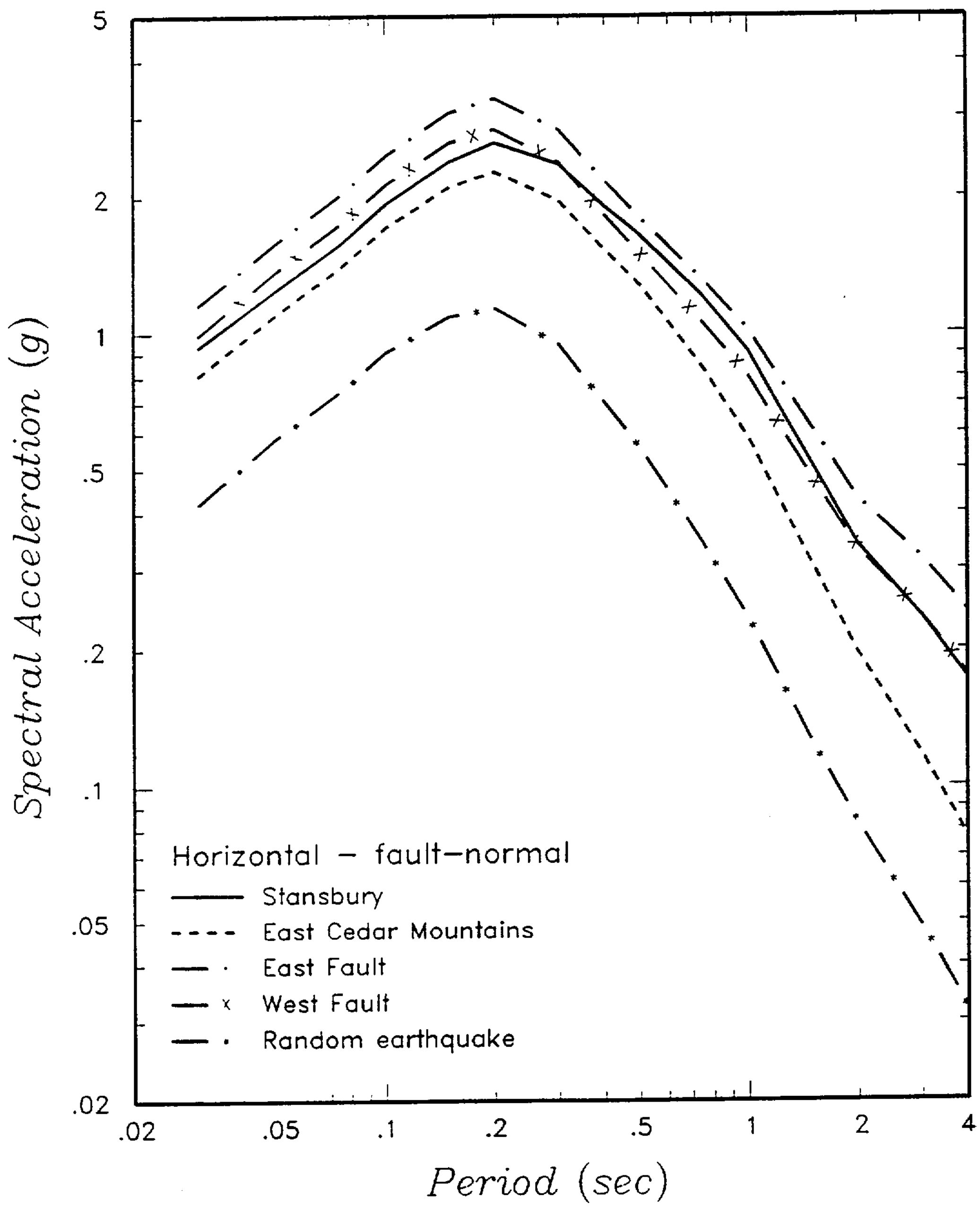
Geomatrix Consultants, Inc., 2001a, Fault evaluation study and seismic hazard assessment, Private Fuel Storage Facility, Skull Valley, Utah, Rev 1: report prepared for Stone & Webster Engineering Corporation, February, 3 vols.

Geomatrix Consultants, Inc., 2001b, Development of design ground motions for the private fuel storage facility, Skull Valley, Utah, Rev 1: report prepared for Stone & Webster Engineering Corporation, March, 6 p.

Kimball, J.K., 1983, The use of site dependent spectra: Proceedings of the U.S. Geological Survey Workshop on Site Specific Effects of Soil and Rock on Ground Motions and the Implications for Earthquake-Resistant Design: U.S. Geological Survey Open File Report 83-845, p. 401-422.

Somerville, P.G., Smith, N.F., Graves, R.W., and Abrahamson, N.A., 1997, Modification of empirical strong ground motion attenuation relations to include the amplitude and duration effects of rupture directivity: Seismological Research Letters, v. 68, p. 199-222.

Non-GDS



GEOMATRIX

COMPARISON OF 84TH-PERCENTILE DETERMINISTIC HORIZONTAL RESPONSE SPECTRA (5% DAMPING) FOR THE FIVE NEARBY SEISMIC SOURCES. THE RESPONSE SPECTRA HAVE BEEN ADJUSTED FOR DIRECTIVITY AND REPRESENT THE FAULT-NORMAL COMPONENT.

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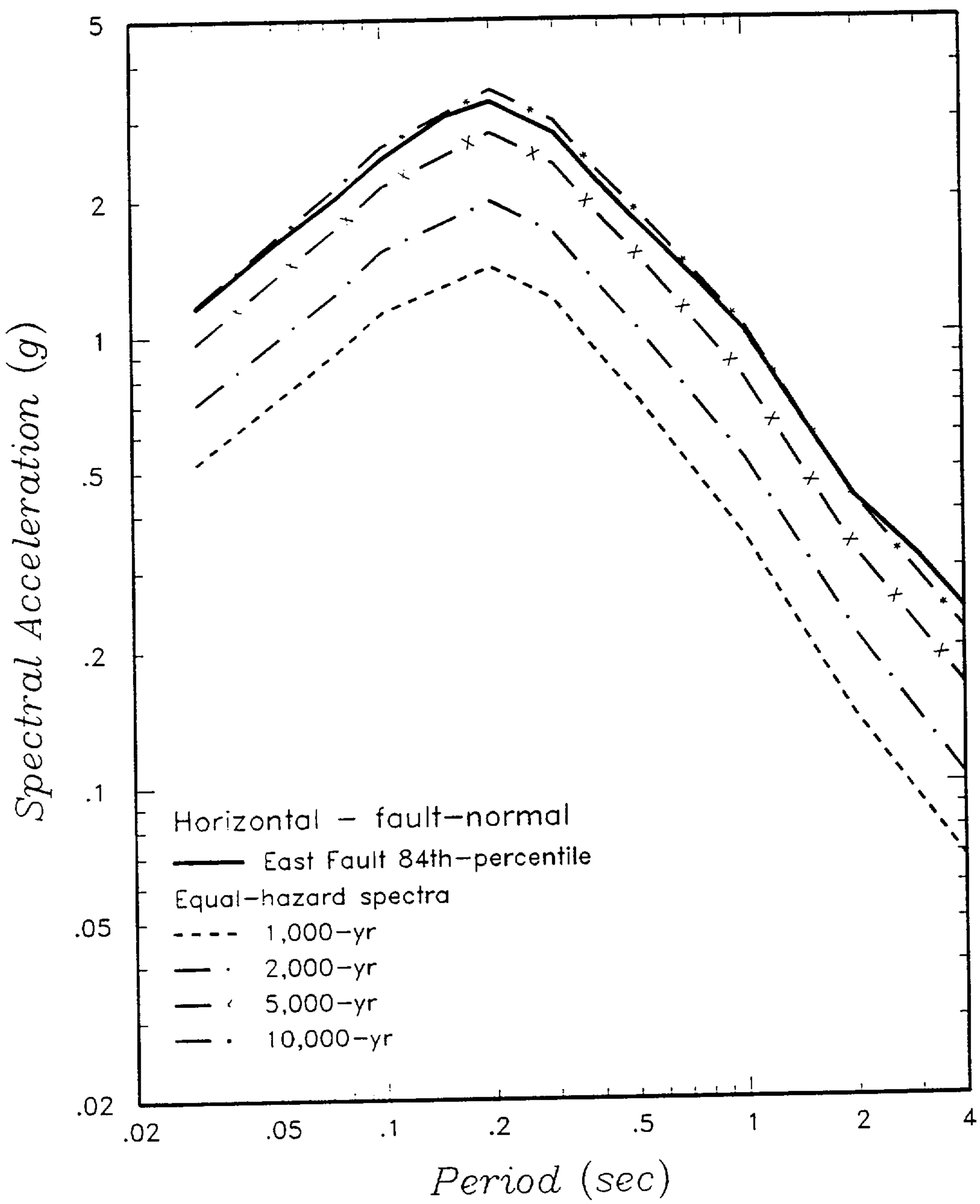
Figure 1

Non-GDS



GEOMATRIX

COMPARISON OF THE 84TH-PERCENTILE DETERMINISTIC HORIZONTAL RESPONSE SPECTRUM (5% DAMPING) FOR THE EAST FAULT WITH EQUAL HAZARD RESPONSE SPECTRA FROM GEOMATRIX (20001A). THE RESPONSE SPECTRA HAVE BEEN ADJUSTED FOR DIRECTIVITY AND REPRESENT THE FAULT-NORMAL COMPONENT.

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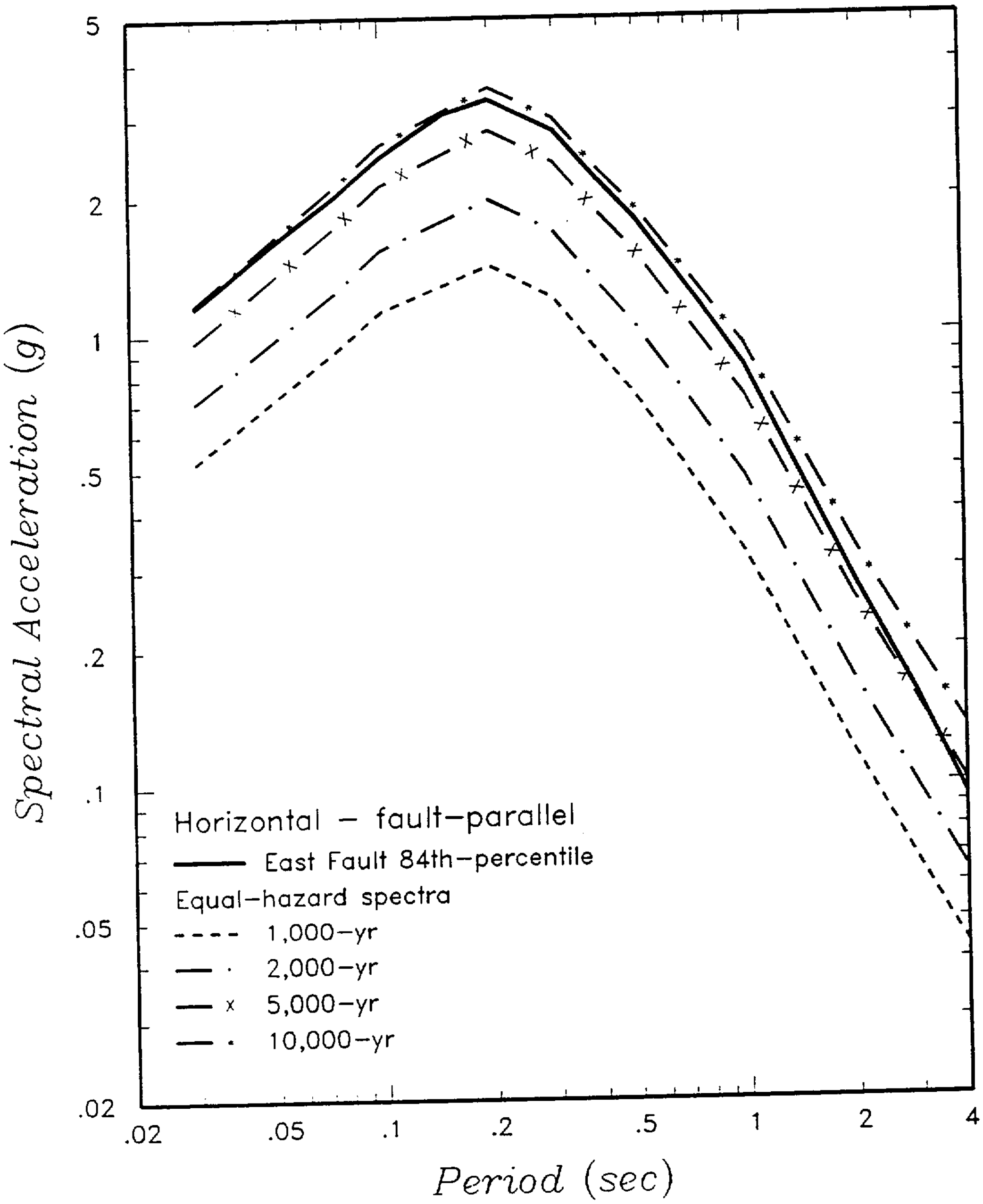
Figure 2

Non-GDS



GEOMATRIX

COMPARISON OF THE 84TH-PERCENTILE DETERMINISTIC HORIZONTAL RESPONSE SPECTRUM (5% DAMPING) FOR THE EAST FAULT WITH EQUAL HAZARD RESPONSE SPECTRA FROM GEOMATRIX (20001A). THE RESPONSE SPECTRA HAVE BEEN ADJUSTED FOR DIRECTIVITY AND REPRESENT THE FAULT-PARALLEL COMPONENT.

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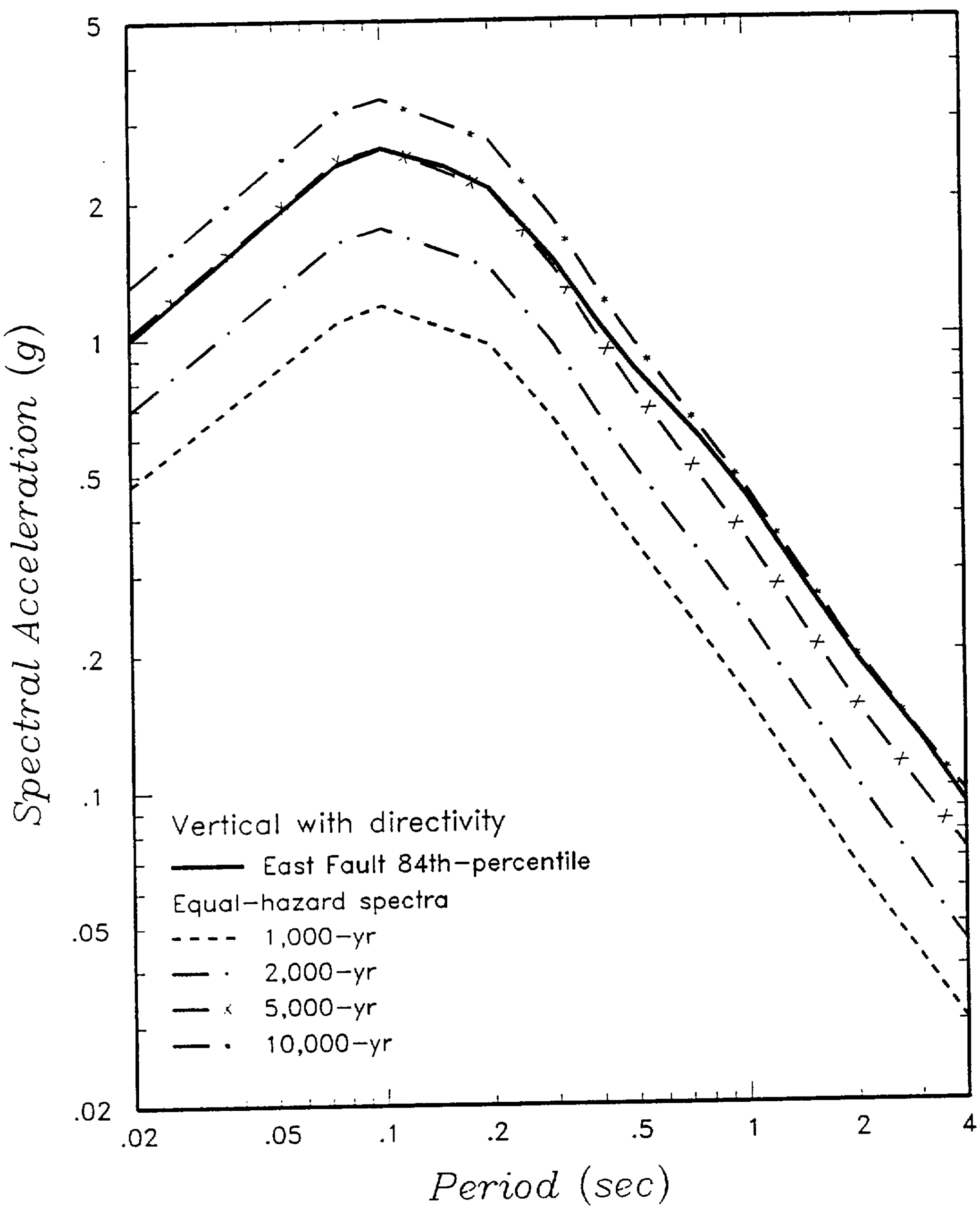
Figure 3

Non-GDS



GEOMATRIX

COMPARISON OF THE 84TH-PERCENTILE DETERMINISTIC VERTICAL RESPONSE SPECTRUM (5% DAMPING) FOR THE EAST FAULT WITH EQUAL HAZARD RESPONSE SPECTRA FROM GEOMATRIX (20001A). THE RESPONSE SPECTRA HAVE BEEN ADJUSTED FOR DIRECTIVITY.

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Figure	4