TABLE F4-5
A. McGARR: HORIZONTAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 0.50 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.09408	0.78921	0.35494	0.08239
2	5.00	1	0.12759	0.77760	0.40561	0.07818
3	5.00	5	0.03808	0.78688	0.33888	0.08116
4	5.00	5	0.05581	0.77991	0.32861	0.07863
5	5.80	10	0.09734	0.73214	0.18824	0.09231
6	5.80	20	0.08215	0.73295	0.21058	0.09277
7	6.50	1	0.49629	0.70629	0.23021	0.09949
8	6.50	1	0.53565	0.70663	0.32029	0.10017
9	6.50	1	0.44392	0.70995	0.23537	0.10176
10	6.50	5	0.45438	0.70738	0.30880	0.10006
11	6.50	5	0.28673	0.70640	0.19241	0.09954
12	6.50	50	0.04446	0.70948	0.24497	0.10147
13	6.50	50	0.04821	0.70496	0.25579	0.09899
14	7.00	10	0.33018	0.68942	0.26958	0.11298
15	7.50	50	0.10581	0.69089	0.22371	0.12148
16	7.50	50	0.12022	0.68679	0.25248	0.11918
17	5.00	1	0.03887	0.78921	0.58915	0.08239
18	5.80	5	0.15795	0.73360	0.18515	0.09309
19	5.80	5	0.08856	0.73374	0.24305	0.09325
20	5.00	10	0.04359	0.77760	0.19409	0.07818
21	5.00	10	0.05966	0.77298	0.26170	0.07790
22	5.00	50	0.00674	0.77529	0.26470	0.07794
23	5.00	50	0.00769	0.77760	0.22716	0.07818
24	5.00	160	0.00155	0.77068	0.41756	0.07807
25	5.80	1	0.26897	0.73044	0.28280	0.09134
26	5.80	5	0.24327	0.73129	0.31881	0.09176
27	5.80	5	0.13833	0.72709	0.21590	0.09044
28	5.80	10	0.11971	0.73307	0.22512	0.09282
29	5.80	10	0.17139	0.73077	0.29279	0.09171
30	5.80	10	0.08471	0.73030	0.26780	0.09157
31	5.80	50	0.01728	0.73081	0.47267	0.09154
32	5.80	50	0.01802	0.73239	0.56708	0.09285
33	6.50	5	0.36574	0.70542	0.26328	0.09914
34	6.50	10	0.24055	0.70747	0.26598	0.10021
35	6.50	10	0.37022	0.70704	0.33527	0.10001
36	6.50	10	0.18834	0.70535	0.21757	0.09912
37	6.50	20	0.12470	0.70642	0.21653	0.09955
38	6.50	20	0.17731	0.70980	0.29052	0.10167
39	6.50	20	0.10509	0.70571	0.17444	0.09925
40	6.50	100	0.02213	0.70631	0.29387	0.09950
41	6.50	160	0.01144	0.70845	0.40268	0.10121
42	7.00	1	0.62292	0.69025	0.22411	0.11339
43	7.00	10	0.51173	0.68994	0.30369	0.11320
44	7.00	10	0.26018	0.68938	0.17538	0.11296
45	7.00	50	0.07252	0.68813	0.21359	0.11223
46	7.00	50	0.08304	0.69105	0.27230	0.11386
47	7.50	1	0.75940	0.69782	0.28949	0.12824
48	5.00	10	0.42137	0.69464	0.29154	0.12506
49	5.00	10	0.61968	0.69063	0.40666	0.12131
50	8.00	50	0.13952	0.70611	0.25434	0.11343
51	8.00	160	0.04306	0.70202	0.36680	0.11172

TABLE F4-6
A. McGARR: HORIZONTAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 1.00 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.04141	0.82412	0.30516	0.07128
2	5.00	1	0.05545	0.82182	0.39650	0.07107
3	5.00	5	0.01665	0.81952	0.36408	0.07110
4	5.00	5	0.02459	0.81952	0.43752	0.07110
5	5.80	10	0.05043	0.78845	0.20197	0.08301
6	5.80	20	0.04207	0.78654	0.21934	0.08614
7	6.50	1	0.29217	0.76628	0.21096	0.09875
8	6.50	1	0.30525	0.76701	0.31509	0.10181
9	6.50	1	0.25518	0.76217	0.23163	0.09985
10	6.50	5	0.26587	0.76567	0.31860	0.10119
11	6.50	5	0.16142	0.76262	0.25448	0.09977
12	6.50	50	0.02959	0.76286	0.28559	0.09762
13	6.50	50	0.02986	0.76291	0.34876	0.09986
14	7.00	10	0.20101	0.74890	0.25864	0.11597
15	7.50	50	0.07470	0.75033	0.25503	0.12649
16	7.50	50	0.08269	0.74842	0.29251	0.12758
17	5.00	1	0.01676	0.81722	0.72014	0.07134
18	5.80	5	0.08104	0.79407	0.36904	0.09110
19	5.80	5	0.04537	0.79209	0.34173	0.08900
20	5.00	10	0.01813	0.81722	0.14918	0.07134
21	5.00	10	0.02417	0.81722	0.21981	0.07134
22	5.00	50	0.00293	0.81493	0.41534	0.07180
23	5.00	50	0.00320	0.82182	0.37162	0.07107
24	5.00	160	0.00090	0.81952	0.41360	0.07110
25	5.80	1	0.13781	0.79135	0.30971	0.08489
26	5.80	5	0.12383	0.78401	0.34350	0.08432
27	5.80	5	0.06911	0.78985	0.31612	0.08716
28	5.80	10	0.06058	0.78968	0.22683	0.08392
29	5.80	10	0.08685	0.78479	0.29479	0.08466
30	5.80	10	0.04437	0.79050	0.29278	0.08874
31	5.80	50	0.01007	0.78400	0.48317	0.08137
32	5.80	50	0.01065	0.78646	0.53086	0.08526
33	6.50	5	0.20543	0.76853	0.26516	0.09979
34	6.50	10	0.14143	0.76614	0.26065	0.09874
35	6.50	10	0.21626	0.76409	0.32505	0.10033
36	6.50	10	0.10926	0.76232	0.24306	0.09968
37	6.50	20	0.07419	0.76271	0.24685	0.09751
38	6.50	20	0.10122	0.76615	0.33036	0.10150
39	6.50	20	0.06206	0.76340	0.24613	0.10003
40	6.50	100	0.01580	0.76339	0.28697	0.09772
41	6.50	160	0.00878	0.76388	0.43595	0.09797
42	7.00	1	0.36811	0.74990	0.32675	0.11649
43	7.00	10	0.31315	0.75058	0.35191	0.11855
44	7.00	10	0.16192	0.74645	0.23605	0.11695
45	7.00	50	0.04928	0.74880	0.29796	0.11595
46	7.00	50	0.05339	0.74706	0.36957	0.11711
47	7.50	1	0.48414	0.75679	0.41763	0.12961
48	5.00	10	0.27547	0.75406	0.31417	0.12864
49	5.00	10	0.40973	0.75064	0.49681	0.12841
50	8.00	50	0.10475	0.75795	0.25976	0.12604
51	8.00	160	0.03921	0.76188	0.33445	0.12695

TABLE F4-7
A. McGARR: HORIZONTAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 2.00 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.01170	0.91687	0.44990	0.07130
2	5.00	1	0.01556	0.91228	0.37888	0.07193
3	5.00	5	0.00542	0.90544	0.54983	0.07446
4	5.00	5	0.00738	0.90544	0.51380	0.07446
5	5.80	10	0.02039	0.88529	0.31735	0.10388
6	5.80	20	0.01603	0.88198	0.34426	0.11280
7	6.50	1	0.13624	0.86561	0.26294	0.12915
8	6.50	1	0.13756	0.86033	0.32083	0.13460
9	6.50	1	0.11574	0.86217	0.21271	0.13531
10	6.50	5	0.11617	0.86312	0.40839	0.13601
11	6.50	5	0.07994	0.86301	0.25717	0.13577
12	6.50	50	0.01503	0.86272	0.43598	0.12849
13	6.50	50	0.01473	0.86013	0.50787	0.13438
14	7.00	10	0.10475	0.85316	0.35852	0.15056
15	7.50	50	0.04270	0.85226	0.50795	0.16212
16	7.50	50	0.04513	0.84361	0.57992	0.16507
17	5.00	1	0.00486	0.91000	0.89805	0.07257
18	5.80	5	0.03228	0.87676	0.33589	0.11027
19	5.80	5	0.01972	0.87801	0.35255	0.11071
20	5.00	10	0.00636	0.90544	0.25571	0.07446
21	5.00	10	0.00778	0.90771	0.31558	0.07341
22	5.00	50	0.00117	0.90544	0.46521	0.07446
23	5.00	50	0.00112	0.90544	0.55630	0.07446
24	5.00	160	0.00047	0.90544	0.48000	0.07446
25	5.80	1	0.05435	0.89000	0.24463	0.10599
26	5.80	5	0.04744	0.87569	0.33961	0.10984
27	5.80	5	0.03023	0.87722	0.27912	0.11036
28	5.80	10	0.02407	0.88939	0.29054	0.10784
29	5.80	10	0.03153	0.88555	0.35098	0.11678
30	5.80	10	0.01896	0.87611	0.35654	0.11000
31	5.80	50	0.00458	0.88163	0.64329	0.10248
32	5.80	50	0.00459	0.88026	0.66741	0.11234
33	6.50	5	0.10013	0.86505	0.27767	0.12876
34	6.50	10	0.06675	0.86542	0.28345	0.12887
35	6.50	10	0.09241	0.86336	0.39798	0.13647
36	6.50	10	0.05269	0.86061	0.31857	0.13459
37	6.50	20	0.03809	0.86773	0.28966	0.12992
38	6.50	20	0.04730	0.85792	0.34860	0.13363
39	6.50	20	0.03039	0.85997	0.37785	0.13437
40	6.50	100	0.00874	0.86403	0.36371	0.12863
41	6.50	160	0.00511	0.86858	0.59103	0.13045
42	7.00	1	0.19363	0.85316	0.30861	0.15056
43	7.00	10	0.14430	0.84904	0.46045	0.15547
44	7.00	10	0.08445	0.85029	0.36053	0.15645
45	7.00	50	0.02789	0.85108	0.39784	0.14990
46	7.00	50	0.02908	0.84582	0.47628	0.15417
47	7.50	1	0.24850	0.85676	0.45266	0.16441
48	5.00	10	0.14675	0.85170	0.49999	0.16193
49	5.00	10	0.19363	0.84570	0.64907	0.16566
50	8.00	50	0.06564	0.86234	0.30079	0.16399
51	8.00	160	0.02777	0.86352	0.41672	0.16411

TABLE F4-8
A. McGARR: HORIZONTAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 3.33 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.00407	0.95631	0.55928	0.07796
2	5.00	1	0.00493	0.94932	0.53335	0.07431
3	5.00	5	0.00170	0.94932	0.48334	0.07431
4	5.00	5	0.00215	0.94932	0.50607	0.07431
5	5.80	10	0.00940	0.89777	0.34842	0.11603
6	5.80	20	0.00646	0.89363	0.34813	0.12481
7	6.50	1	0.07791	0.87968	0.24975	0.15548
8	6.50	1	0.07449	0.86199	0.26963	0.14763
9	6.50	1	0.06375	0.86630	0.24394	0.15104
10	6.50	5	0.06215	0.86799	0.34984	0.15240
11	6.50	5	0.04552	0.87061	0.29508	0.15501
12	6.50	50	0.00885	0.87424	0.53610	0.14787
13	6.50	50	0.00787	0.86615	0.59643	0.15083
14	7.00	10	0.06460	0.85716	0.36724	0.17276
15	7.50	50	0.03205	0.85189	0.43624	0.18038
16	7.50	50	0.02976	0.84587	0.57781	0.18362
17	5.00	1	0.00151	0.95165	0.73524	0.07532
18	5.80	5	0.01297	0.89723	0.33121	0.12813
19	5.80	5	0.00809	0.89644	0.37226	0.12728
20	5.00	10	0.00220	0.94468	0.39526	0.07290
21	5.00	10	0.00241	0.94700	0.35118	0.07349
22	5.00	50	0.00046	0.94237	0.34346	0.07252
23	5.00	50	0.00042	0.94237	0.30143	0.07252
24	5.00	160	0.00015	0.94237	0.33319	0.07252
25	5.80	1	0.02572	0.89960	0.30701	0.11755
26	5.80	5	0.02062	0.89663	0.33583	0.12785
27	5.80	5	0.01392	0.89325	0.33091	0.12448
28	5.80	10	0.01153	0.89923	0.33671	0.11707
29	5.80	10	0.01252	0.89141	0.36938	0.12303
30	5.80	10	0.00808	0.89481	0.47855	0.12568
31	5.80	50	0.00216	0.89940	0.63111	0.11716
32	5.80	50	0.00196	0.89456	0.68478	0.12568
33	6.50	5	0.05887	0.87914	0.24520	0.15359
34	6.50	10	0.03783	0.87673	0.29971	0.15063
35	6.50	10	0.04436	0.86747	0.38968	0.15216
36	6.50	10	0.02779	0.86963	0.41675	0.15418
37	6.50	20	0.02094	0.87233	0.35747	0.14617
38	6.50	20	0.02253	0.87122	0.41900	0.15569
39	6.50	20	0.01613	0.86394	0.47096	0.14906
40	6.50	100	0.00476	0.86915	0.51889	0.14370
41	6.50	160	0.00329	0.87857	0.58656	0.15219
42	7.00	1	0.12487	0.85491	0.28151	0.17065
43	7.00	10	0.07585	0.84840	0.46087	0.17388
44	7.00	10	0.04878	0.84914	0.43370	0.17437
45	7.00	50	0.01845	0.85394	0.44843	0.16989
46	7.00	50	0.01743	0.84947	0.52519	0.17476
47	7.50	1	0.17502	0.85792	0.38368	0.18555
48	5.00	10	0.09741	0.85630	0.51116	0.18411
49	5.00	10	0.11032	0.84693	0.64831	0.18444
50	8.00	50	0.05303	0.87160	0.25135	0.18110
51	8.00	160	0.02409	0.87208	0.31114	0.18150

TABLE F4-9
A. McGARR: HORIZONTAL POINT ESTIMATES
PEAK GROUND VELOCITY

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	5.76892	0.77513	0.42153	0.07727
2	5.00	1	8.96000	0.77513	0.37607	0.07727
3	5.00	5	2.01906	0.77513	0.30275	0.07727
4	5.00	5	3.34081	0.76900	0.38084	0.07375
5	5.80	10	5.59918	0.74832	0.18514	0.09661
6	5.80	20	4.59678	0.74679	0.18488	0.09881
7	6.50	1	33.93066	0.75161	0.18533	0.11509
8	6.50	1	37.32352	0.74897	0.31358	0.11705
9	6.50	1	28.89401	0.74897	0.21364	0.11705
10	6.50	5	33.16038	0.74696	0.30885	0.11576
11	6.50	5	18.36356	0.74540	0.18142	0.11522
12	6.50	50	2.47847	0.74552	0.33705	0.11290
13	6.50	50	2.55408	0.74445	0.37580	0.11482
14	7.00	10	23.59593	0.74789	0.24704	0.12606
15	7.50	50	7.44233	0.74841	0.38578	0.13626
16	7.50	50	8.47371	0.74335	0.45892	0.13663
17	5.00	1	1.84080	0.76900	0.71942	0.07375
18	5.80	5	9.73234	0.74761	0.34306	0.09896
19	5.80	5	5.20978	0.74667	0.31641	0.09860
20	5.00	10	2.42389	0.76594	0.12511	0.07232
21	5.00	10	3.50263	0.76900	0.10771	0.07375
22	5.00	50	0.27286	0.76289	0.20093	0.07113
23	5.00	50	0.30460	0.76594	0.19567	0.07232
24	5.00	160	0.05448	0.75681	0.24571	0.06949
25	5.80	1	17.18606	0.74999	0.31394	0.09721
26	5.80	5	16.38807	0.74456	0.31007	0.09789
27	5.80	5	8.45280	0.74601	0.22597	0.09840
28	5.80	10	6.95378	0.75164	0.22147	0.09773
29	5.80	10	10.82250	0.74683	0.21336	0.09882
30	5.80	10	4.81959	0.74561	0.29965	0.09829
31	5.80	50	0.80705	0.74895	0.52645	0.09675
32	5.80	50	0.86779	0.74884	0.56224	0.09952
33	6.50	5	24.09546	0.75074	0.19797	0.11468
34	6.50	10	15.56801	0.74954	0.19304	0.11421
35	6.50	10	24.93648	0.74728	0.31349	0.11589
36	6.50	10	11.51401	0.74482	0.21603	0.11506
37	6.50	20	7.54828	0.74832	0.23254	0.11375
38	6.50	20	10.65791	0.74782	0.27492	0.11613
39	6.50	20	5.98332	0.74287	0.25458	0.11431
40	6.50	100	1.20417	0.74701	0.35479	0.11354
41	6.50	160	0.53600	0.75174	0.58288	0.11601
42	7.00	1	45.19347	0.74891	0.29994	0.12675
43	7.00	10	37.40738	0.74592	0.41376	0.12772
44	7.00	10	17.71020	0.74322	0.30764	0.12672
45	7.00	50	4.61680	0.74404	0.32868	0.12495
46	7.00	50	5.17090	0.74223	0.40715	0.12641
47	7.50	1	60.57650	0.75566	0.50900	0.14015
48	5.00	10	33.02724	0.75068	0.42410	0.13735
49	5.00	10	48.64212	0.74540	0.67888	0.13727
50	8.00	50	12.06421	0.75608	0.36087	0.13408
51	8.00	160	3.71883	0.76042	0.45514	0.13457

TABLE F4-10
A. McGARR: VERTICAL POINT ESTIMATES
PEAK GROUND ACCELERATION

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.08773	0.65788	0.61424	0.07873
2	5.00	1	0.10244	0.66188	0.31600	0.07940
3	5.00	5	0.02608	0.65788	0.40156	0.07873
4	5.00	5	0.03042	0.66063	0.22121	0.07912
5	5.80	10	0.05001	0.60510	0.26502	0.09930
6	5.80	20	0.04325	0.59898	0.36240	0.09243
7	6.50	1	0.29021	0.56190	0.28457	0.11353
8	6.50	1	0.32237	0.56528	0.24609	0.11759
9	6.50	1	0.26248	0.56140	0.21735	0.11298
10	6.50	5	0.27964	0.56003	0.31306	0.11152
11	6.50	5	0.16792	0.56140	0.24414	0.11298
12	6.50	50	0.01241	0.56040	0.29642	0.11191
13	6.50	50	0.01493	0.55953	0.28418	0.11102
14	7.00	10	0.15156	0.53819	0.19367	0.14253
15	7.50	50	0.02606	0.53671	0.26060	0.15077
16	7.50	50	0.03198	0.53646	0.36468	0.15046
17	5.00	1	0.02872	0.65338	0.46575	0.07871
18	5.80	5	0.07677	0.59810	0.37503	0.09164
19	5.80	5	0.04600	0.60160	0.36352	0.09510
20	5.00	10	0.03355	0.66463	0.28174	0.08020
21	5.00	10	0.05823	0.65013	0.29962	0.07917
22	5.00	50	0.00275	0.65563	0.16842	0.07862
23	5.00	50	0.00281	0.64913	0.15459	0.07940
24	5.00	160	0.00030	0.65688	0.24926	0.07866
25	5.80	1	0.17892	0.59998	0.46725	0.09339
26	5.80	5	0.17016	0.59810	0.38014	0.09164
27	5.80	5	0.09041	0.59998	0.26397	0.09339
28	5.80	10	0.06710	0.60210	0.29646	0.09565
29	5.80	10	0.10974	0.59948	0.33714	0.09290
30	5.80	10	0.05089	0.60048	0.26298	0.09390
31	5.80	50	0.00514	0.59898	0.55375	0.09243
32	5.80	50	0.00604	0.60098	0.50851	0.09442
33	6.50	5	0.21342	0.55953	0.20921	0.11102
34	6.50	10	0.12410	0.56240	0.17870	0.11410
35	6.50	10	0.22048	0.56403	0.32217	0.11602
36	6.50	10	0.09872	0.56040	0.23381	0.11191
37	6.50	20	0.05555	0.56140	0.17455	0.11298
38	6.50	20	0.09089	0.56465	0.31443	0.11680
39	6.50	20	0.04323	0.55953	0.25315	0.11102
40	6.50	100	0.00468	0.56290	0.35610	0.11468
41	6.50	160	0.00169	0.56040	0.46202	0.11191
42	7.00	1	0.32060	0.54069	0.22876	0.14549
43	7.00	10	0.25173	0.54107	0.32693	0.14596
44	7.00	10	0.11848	0.53957	0.20036	0.14413
45	7.00	50	0.01822	0.53932	0.21504	0.14383
46	7.00	50	0.02303	0.53932	0.38217	0.14383
47	7.50	1	0.42540	0.54283	0.34844	0.15906
48	5.00	10	0.18229	0.53671	0.24519	0.15077
49	5.00	10	0.29286	0.53958	0.39797	0.15451
50	8.00	50	0.03734	0.54292	0.29347	0.14981
51	8.00	160	0.00781	0.54392	0.34952	0.15101

TABLE F4-11
A. McGARR: VERTICAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 0.05 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.19611	0.66776	0.74679	0.07405
2	5.00	1	0.22714	0.66776	0.40246	0.07405
3	5.00	5	0.05487	0.66651	0.58540	0.07425
4	5.00	5	0.06538	0.67226	0.34465	0.07387
5	5.80	10	0.09962	0.61616	0.40006	0.09436
6	5.80	20	0.08278	0.61191	0.32080	0.08956
7	6.50	1	0.59513	0.57615	0.41567	0.11001
8	6.50	1	0.65188	0.57777	0.37186	0.11213
9	6.50	1	0.49860	0.57515	0.31546	0.10876
10	6.50	5	0.57174	0.57515	0.40572	0.10876
11	6.50	5	0.30783	0.57415	0.36895	0.10756
12	6.50	50	0.01997	0.57565	0.36803	0.10938
13	6.50	50	0.02442	0.57615	0.31693	0.11001
14	7.00	10	0.28825	0.55289	0.30716	0.13788
15	7.50	50	0.04088	0.55102	0.27650	0.14468
16	7.50	50	0.05064	0.55127	0.35364	0.14502
17	5.00	1	0.06152	0.66876	0.62732	0.07394
18	5.80	5	0.15471	0.61453	0.50509	0.09239
19	5.80	5	0.08652	0.61741	0.46528	0.09598
20	5.00	10	0.07164	0.68151	0.45203	0.07604
21	5.00	10	0.12523	0.66776	0.22462	0.07405
22	5.00	50	0.00513	0.66651	0.23809	0.07425
23	5.00	50	0.00560	0.67226	0.21339	0.07387
24	5.00	160	0.00039	0.66876	0.37943	0.07394
25	5.80	1	0.37618	0.61741	0.61769	0.09598
26	5.80	5	0.34437	0.61391	0.51263	0.09168
27	5.80	5	0.17400	0.61391	0.39888	0.09168
28	5.80	10	0.13601	0.61803	0.44266	0.09682
29	5.80	10	0.21540	0.61341	0.46138	0.09112
30	5.80	10	0.09348	0.61291	0.42610	0.09059
31	5.80	50	0.00893	0.61291	0.62613	0.09059
32	5.80	50	0.01039	0.61678	0.63282	0.09516
33	6.50	5	0.42971	0.57565	0.32267	0.10938
34	6.50	10	0.24185	0.57952	0.29392	0.11456
35	6.50	10	0.43085	0.57727	0.40965	0.11147
36	6.50	10	0.17916	0.57665	0.34712	0.11065
37	6.50	20	0.10371	0.57665	0.24709	0.11065
38	6.50	20	0.17143	0.57952	0.32035	0.11456
39	6.50	20	0.07476	0.57465	0.34334	0.10815
40	6.50	100	0.00624	0.57665	0.42745	0.11065
41	6.50	160	0.00213	0.57377	0.49972	0.10713
42	7.00	1	0.65060	0.55626	0.31494	0.14236
43	7.00	10	0.48672	0.55751	0.40088	0.14412
44	7.00	10	0.21085	0.55464	0.27340	0.14015
45	7.00	50	0.02975	0.55389	0.26624	0.13916
46	7.00	50	0.03755	0.55351	0.37479	0.13867
47	7.50	1	0.85022	0.55902	0.34831	0.15653
48	5.00	10	0.34681	0.55077	0.33709	0.14435
49	5.00	10	0.56548	0.55427	0.46742	0.14925
50	8.00	50	0.05744	0.56270	0.29045	0.14875
51	8.00	160	0.00856	0.56070	0.42310	0.14628

TABLE F4-12
A. McGARR: VERTICAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 0.10 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.17932	0.70108	0.54242	0.08433
2	5.00	1	0.21198	0.70608	0.24608	0.08744
3	5.00	5	0.05854	0.70608	0.33249	0.08744
4	5.00	5	0.06892	0.71158	0.15364	0.09168
5	5.80	10	0.10659	0.63343	0.23175	0.11105
6	5.80	20	0.09024	0.62955	0.41739	0.10506
7	6.50	1	0.58532	0.58992	0.29588	0.11368
8	6.50	1	0.64442	0.59192	0.30262	0.11687
9	6.50	1	0.51292	0.59192	0.28156	0.11687
10	6.50	5	0.53488	0.58992	0.39294	0.11368
11	6.50	5	0.32512	0.59092	0.24212	0.11525
12	6.50	50	0.02516	0.58992	0.35971	0.11368
13	6.50	50	0.02998	0.59042	0.33795	0.11446
14	7.00	10	0.29998	0.56768	0.27498	0.14037
15	7.50	50	0.05144	0.56669	0.32701	0.14950
16	7.50	50	0.06150	0.56519	0.39521	0.14697
17	5.00	1	0.06380	0.70108	0.39876	0.08433
18	5.80	5	0.16259	0.63005	0.30390	0.10580
19	5.80	5	0.09609	0.63005	0.33024	0.10580
20	5.00	10	0.07437	0.71008	0.22507	0.09045
21	5.00	10	0.12434	0.69758	0.35532	0.08262
22	5.00	50	0.00624	0.70883	0.22066	0.08946
23	5.00	50	0.00649	0.69983	0.21479	0.08367
24	5.00	160	0.00054	0.70358	0.39052	0.08579
25	5.80	1	0.36638	0.62855	0.37523	0.10363
26	5.80	5	0.33337	0.63005	0.39968	0.10580
27	5.80	5	0.17546	0.62805	0.23318	0.10293
28	5.80	10	0.13695	0.63218	0.31612	0.10905
29	5.80	10	0.22037	0.63218	0.41889	0.10905
30	5.80	10	0.10064	0.62855	0.24779	0.10363
31	5.80	50	0.01126	0.63280	0.52392	0.11004
32	5.80	50	0.01231	0.63218	0.59821	0.10905
33	6.50	5	0.42559	0.59092	0.23559	0.11525
34	6.50	10	0.25479	0.59142	0.22340	0.11606
35	6.50	10	0.42767	0.59142	0.41362	0.11606
36	6.50	10	0.19632	0.59042	0.23794	0.11446
37	6.50	20	0.11288	0.59042	0.23139	0.11446
38	6.50	20	0.18205	0.59354	0.39339	0.11957
39	6.50	20	0.08684	0.58904	0.22634	0.11233
40	6.50	100	0.00838	0.58792	0.44726	0.11064
41	6.50	160	0.00287	0.58954	0.48917	0.11309
42	7.00	1	0.64614	0.56968	0.26616	0.14368
43	7.00	10	0.48712	0.57281	0.41971	0.14909
44	7.00	10	0.22972	0.56768	0.19058	0.14037
45	7.00	50	0.03653	0.56681	0.29672	0.13895
46	7.00	50	0.04542	0.56793	0.39735	0.14077
47	7.50	1	0.84681	0.57044	0.43931	0.15609
48	5.00	10	0.36351	0.56582	0.34873	0.14802
49	5.00	10	0.57576	0.56844	0.48598	0.15253
50	8.00	50	0.07132	0.58777	0.35881	0.15898
51	8.00	160	0.01038	0.58827	0.44070	0.15966

TABLE F4-13
A. McGARR: VERTICAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 0.20 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.11264	0.69996	0.43327	0.08494
2	5.00	1	0.12451	0.70996	0.27520	0.08623
3	5.00	5	0.04017	0.70846	0.16527	0.08581
4	5.00	5	0.04299	0.70596	0.17344	0.08529
5	5.80	10	0.07777	0.63319	0.17111	0.11102
6	5.80	20	0.06835	0.63107	0.50257	0.10845
7	6.50	1	0.44086	0.59667	0.20892	0.11293
8	6.50	1	0.45906	0.59554	0.25431	0.11116
9	6.50	1	0.38845	0.59504	0.24801	0.11039
10	6.50	5	0.41591	0.59392	0.34828	0.10870
11	6.50	5	0.25808	0.59292	0.25631	0.10724
12	6.50	50	0.02274	0.59067	0.38503	0.10413
13	6.50	50	0.02725	0.59392	0.41687	0.10870
14	7.00	10	0.24849	0.57241	0.27143	0.12883
15	7.50	50	0.05116	0.56905	0.36987	0.13407
16	7.50	50	0.06091	0.57017	0.42926	0.13592
17	5.00	1	0.04230	0.70846	0.24675	0.08581
18	5.80	5	0.11510	0.62944	0.30366	0.10665
19	5.80	5	0.07245	0.63157	0.34337	0.10904
20	5.00	10	0.04468	0.71121	0.23177	0.08663
21	5.00	10	0.08317	0.70596	0.52475	0.08529
22	5.00	50	0.00520	0.70996	0.36602	0.08623
23	5.00	50	0.00505	0.69496	0.24330	0.08561
24	5.00	160	0.00059	0.70471	0.33462	0.08511
25	5.80	1	0.25224	0.62994	0.32370	0.10719
26	5.80	5	0.23759	0.63382	0.37464	0.11181
27	5.80	5	0.13329	0.63157	0.20669	0.10904
28	5.80	10	0.10175	0.63632	0.20110	0.11518
29	5.80	10	0.16022	0.63507	0.44697	0.11346
30	5.80	10	0.07741	0.62994	0.22574	0.10719
31	5.80	50	0.00957	0.63319	0.49152	0.11102
32	5.80	50	0.01146	0.63319	0.50075	0.11102
33	6.50	5	0.32166	0.59292	0.21526	0.10724
34	6.50	10	0.19259	0.59067	0.20637	0.10413
35	6.50	10	0.32625	0.59504	0.40591	0.11039
36	6.50	10	0.16182	0.59292	0.24749	0.10724
37	6.50	20	0.09331	0.59392	0.27914	0.10870
38	6.50	20	0.14895	0.59904	0.47863	0.11683
39	6.50	20	0.07684	0.59342	0.30506	0.10796
40	6.50	100	0.00916	0.59604	0.50193	0.11194
41	6.50	160	0.00362	0.59442	0.48893	0.10944
42	7.00	1	0.49837	0.57241	0.24831	0.12883
43	7.00	10	0.39984	0.57666	0.42799	0.13597
44	7.00	10	0.20125	0.57316	0.27225	0.13004
45	7.00	50	0.03542	0.57103	0.33009	0.12664
46	7.00	50	0.04434	0.57141	0.46095	0.12723
47	7.50	1	0.65472	0.57405	0.44585	0.14258
48	5.00	10	0.31265	0.57155	0.33984	0.13823
49	5.00	10	0.47565	0.57280	0.46870	0.14038
50	8.00	50	0.07163	0.59740	0.38540	0.14792
51	8.00	160	0.01378	0.59240	0.49521	0.14131

TABLE F4-14
A. MCGARR: VERTICAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 0.50 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.04395	0.73405	0.53915	0.08267
2	5.00	1	0.05306	0.73530	0.28672	0.08279
3	5.00	5	0.01460	0.74155	0.42222	0.08422
4	5.00	5	0.01800	0.73405	0.21245	0.08267
5	5.80	10	0.04496	0.65847	0.15653	0.11556
6	5.80	20	0.04200	0.65959	0.52128	0.11676
7	6.50	1	0.25877	0.62705	0.18034	0.11553
8	6.50	1	0.29198	0.62593	0.18759	0.11393
9	6.50	1	0.25345	0.62643	0.18413	0.11463
10	6.50	5	0.25351	0.62343	0.27599	0.11058
11	6.50	5	0.17452	0.62493	0.19850	0.11255
12	6.50	50	0.01834	0.62255	0.30791	0.10948
13	6.50	50	0.02291	0.62218	0.33268	0.10902
14	7.00	10	0.17743	0.60420	0.27592	0.12911
15	7.50	50	0.04542	0.60433	0.36211	0.13916
16	7.50	50	0.05128	0.60283	0.32687	0.13694
17	5.00	1	0.01682	0.75405	0.37923	0.09095
18	5.80	5	0.06376	0.66122	0.26159	0.11859
19	5.80	5	0.04010	0.65659	0.23231	0.11371
20	5.00	10	0.01965	0.73180	0.22403	0.08260
21	5.00	10	0.03358	0.72980	0.44269	0.08269
22	5.00	50	0.00253	0.74155	0.20988	0.08422
23	5.00	50	0.00280	0.73180	0.22509	0.08260
24	5.00	160	0.00043	0.73655	0.35657	0.08296
25	5.80	1	0.12219	0.65897	0.46511	0.11608
26	5.80	5	0.12624	0.66609	0.35400	0.12484
27	5.80	5	0.07854	0.65797	0.16988	0.11505
28	5.80	10	0.05937	0.66234	0.17839	0.11994
29	5.80	10	0.09163	0.66347	0.40558	0.12135
30	5.80	10	0.04646	0.66409	0.19000	0.12215
31	5.80	50	0.00621	0.65797	0.59425	0.11505
32	5.80	50	0.00777	0.66059	0.52415	0.11787
33	6.50	5	0.20274	0.62868	0.17454	0.11793
34	6.50	10	0.13198	0.62755	0.26996	0.11625
35	6.50	10	0.22523	0.62705	0.38873	0.11553
36	6.50	10	0.11414	0.62493	0.27476	0.11255
37	6.50	20	0.06598	0.62705	0.30271	0.11553
38	6.50	20	0.10799	0.62930	0.48456	0.11888
39	6.50	20	0.05427	0.62493	0.22832	0.11255
40	6.50	100	0.00861	0.62543	0.41112	0.11323
41	6.50	160	0.00400	0.62493	0.42565	0.11255
42	7.00	1	0.33300	0.60995	0.18651	0.13831
43	7.00	10	0.28411	0.60795	0.40194	0.13498
44	7.00	10	0.14843	0.60533	0.25427	0.13082
45	7.00	50	0.02866	0.60420	0.25382	0.12911
46	7.00	50	0.03688	0.60458	0.41774	0.12967
47	7.50	1	0.41407	0.60883	0.30230	0.14627
48	5.00	10	0.22150	0.60370	0.27594	0.13822
49	5.00	10	0.33432	0.60533	0.37385	0.14068
50	8.00	50	0.06706	0.63650	0.41892	0.14094
51	8.00	160	0.01758	0.63825	0.46570	0.14290

TABLE F4-15
A. McGARR: VERTICAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 1.00 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.01926	0.75468	0.47268	0.07644
2	5.00	1	0.02190	0.76593	0.25586	0.07572
3	5.00	5	0.00632	0.75893	0.43968	0.07558
4	5.00	5	0.00756	0.75293	0.19447	0.07699
5	5.80	10	0.02214	0.69853	0.26455	0.09747
6	5.80	20	0.01985	0.69573	0.32964	0.10305
7	6.50	1	0.14190	0.67160	0.35861	0.10753
8	6.50	1	0.15766	0.66745	0.24439	0.10972
9	6.50	1	0.13288	0.66632	0.22151	0.10836
10	6.50	.5	0.13989	0.66695	0.34171	0.10910
11	6.50	5	0.09722	0.66345	0.10304	0.10519
12	6.50	50	0.01084	0.66985	0.43326	0.10539
13	6.50	50	0.01416	0.66257	0.37913	0.10432
14	7.00	10	0.10003	0.65427	0.22631	0.13014
15	7.50	50	0.02989	0.65060	0.23696	0.13700
16	7.50	50	0.03523	0.64751	0.40349	0.13880
17	5.00	1	0.00654	0.75368	0.56634	0.07674
18	5.80	5	0.03187	0.69673	0.34070	0.10398
19	5.80	5	0.02193	0.69836	0.30981	0.10562
20	5.00	10	0.00713	0.74943	0.45917	0.07844
21	5.00	10	0.01160	0.75293	0.25261	0.07699
22	5.00	50	0.00101	0.75368	0.32419	0.07674
23	5.00	50	0.00130	0.75468	0.15191	0.07644
24	5.00	160	0.00023	0.75693	0.52079	0.07589
25	5.80	1	0.06369	0.70778	0.49307	0.10816
26	5.80	5	0.06223	0.69948	0.42074	0.10685
27	5.80	5	0.04029	0.69523	0.17231	0.10260
28	5.80	10	0.02950	0.70053	0.20974	0.09936
29	5.80	10	0.04451	0.69436	0.33898	0.10186
30	5.80	10	0.02707	0.69886	0.21488	0.10616
31	5.80	50	0.00355	0.70391	0.69121	0.10311
32	5.80	50	0.00467	0.69523	0.47841	0.10260
33	6.50	5	0.10896	0.67097	0.24016	0.10675
34	6.50	10	0.07436	0.67047	0.17102	0.10614
35	6.50	10	0.10899	0.66170	0.29556	0.10349
36	6.50	10	0.06783	0.66382	0.17906	0.10558
37	6.50	20	0.03546	0.67097	0.27290	0.10675
38	6.50	20	0.05674	0.66257	0.28752	0.10432
39	6.50	20	0.03495	0.66170	0.22112	0.10349
40	6.50	100	0.00572	0.66697	0.35020	0.10223
41	6.50	160	0.00285	0.67047	0.58308	0.10614
42	7.00	1	0.17745	0.65740	0.38601	0.13460
43	7.00	10	0.15936	0.64906	0.34746	0.12935
44	7.00	10	0.09235	0.64906	0.17421	0.12935
45	7.00	50	0.01881	0.65027	0.31589	0.12501
46	7.00	50	0.02359	0.64618	0.43099	0.12572
47	7.50	1	0.24116	0.66735	0.37247	0.16095
48	5.00	10	0.13286	0.65122	0.27302	0.13771
49	5.00	10	0.19815	0.64813	0.41587	0.13954
50	8.00	50	0.04350	0.67995	0.15722	0.14612
51	8.00	160	0.01488	0.67545	0.40442	0.14211

TABLE F4-16
A. McGARR: VERTICAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 2.00 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.00590	0.82151	0.39748	0.07480
2	5.00	1	0.00668	0.81651	0.35261	0.07724
3	5.00	5	0.00185	0.82001	0.47369	0.07544
4	5.00	5	0.00215	0.81701	0.22194	0.07695
5	5.80	10	0.00852	0.76922	0.31030	0.12524
6	5.80	20	0.00685	0.76425	0.34775	0.14192
7	6.50	1	0.07216	0.74340	0.22998	0.14956
8	6.50	1	0.07920	0.73013	0.30401	0.15463
9	6.50	1	0.06482	0.72875	0.15843	0.15347
10	6.50	5	0.06912	0.73163	0.44399	0.15599
11	6.50	5	0.04605	0.72875	0.21209	0.15347
12	6.50	50	0.00548	0.73903	0.35622	0.14537
13	6.50	50	0.00721	0.72963	0.73295	0.15420
14	7.00	10	0.04717	0.72099	0.38391	0.16836
15	7.50	50	0.01551	0.72417	0.58840	0.18468
16	7.50	50	0.02011	0.71422	0.86965	0.18993
17	5.00	1	0.00173	0.81876	0.76101	0.07603
18	5.80	5	0.01311	0.75725	0.32002	0.13617
19	5.80	5	0.00769	0.75925	0.41478	0.13758
20	5.00	10	0.00199	0.81651	0.55549	0.07724
21	5.00	10	0.00369	0.81501	0.36171	0.07814
22	5.00	50	0.00029	0.81751	0.56535	0.07668
23	5.00	50	0.00053	0.81501	0.55390	0.07814
24	5.00	160	0.00006	0.82751	1.13750	0.07314
25	5.80	1	0.02792	0.77885	0.27050	0.13547
26	5.80	5	0.02615	0.76212	0.46622	0.13994
27	5.80	5	0.01649	0.76425	0.33324	0.14192
28	5.80	10	0.01064	0.76872	0.32389	0.12483
29	5.80	10	0.01499	0.76587	0.49498	0.14356
30	5.80	10	0.01031	0.76262	0.47282	0.14039
31	5.80	50	0.00140	0.76510	0.65362	0.12223
32	5.80	50	0.00206	0.76362	0.74810	0.14132
33	6.50	5	0.05061	0.74115	0.23864	0.14731
34	6.50	10	0.03409	0.74215	0.16407	0.14829
35	6.50	10	0.04842	0.73563	0.48882	0.16002
36	6.50	10	0.03144	0.73500	0.37211	0.15935
37	6.50	20	0.01702	0.74115	0.23276	0.14731
38	6.50	20	0.02454	0.73225	0.54022	0.15658
39	6.50	20	0.01593	0.72963	0.48470	0.15420
40	6.50	100	0.00267	0.74053	0.51410	0.14672
41	6.50	160	0.00166	0.74215	0.63519	0.14829
42	7.00	1	0.09153	0.72286	0.40551	0.17014
43	7.00	10	0.07365	0.71591	0.52759	0.17886
44	7.00	10	0.04352	0.71541	0.39336	0.17833
45	7.00	50	0.00962	0.72074	0.49261	0.16814
46	7.00	50	0.01348	0.71179	0.75641	0.17471
47	7.50	1	0.11313	0.73129	0.49443	0.19224
48	5.00	10	0.06513	0.72967	0.51407	0.19037
49	5.00	10	0.10136	0.72484	0.66017	0.20165
50	8.00	50	0.02830	0.76211	0.29458	0.19185
51	8.00	160	0.01195	0.76436	0.52852	0.19349

TABLE F4-17
A. McGARR: VERTICAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 3.33 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.00199	0.86897	0.58471	0.08812
2	5.00	1	0.00239	0.86347	0.56624	0.08745
3	5.00	5	0.00066	0.86547	0.58288	0.08758
4	5.00	5	0.00091	0.86197	0.51706	0.08744
5	5.80	10	0.00404	0.80443	0.29218	0.15407
6	5.80	20	0.00323	0.79421	0.45921	0.16547
7	6.50	1	0.03715	0.78276	0.21028	0.18037
8	6.50	1	0.04356	0.76849	0.39428	0.18396
9	6.50	1	0.03677	0.76686	0.34242	0.18232
10	6.50	5	0.04027	0.76886	0.57489	0.18435
11	6.50	5	0.02405	0.76611	0.29248	0.18159
12	6.50	50	0.00283	0.78164	0.34175	0.17903
13	6.50	50	0.00363	0.77386	0.72255	0.18998
14	7.00	10	0.02839	0.77047	0.25707	0.20706
15	7.50	50	0.00981	0.76746	0.50584	0.21467
16	7.50	50	0.01194	0.75538	0.78796	0.21833
17	5.00	1	0.00061	0.86822	0.83448	0.08797
18	5.80	5	0.00672	0.79458	0.54608	0.16581
19	5.80	5	0.00393	0.79321	0.46905	0.16459
20	5.00	10	0.00068	0.86722	0.67584	0.08780
21	5.00	10	0.00141	0.86197	0.60323	0.08744
22	5.00	50	0.00010	0.86822	0.63733	0.08797
23	5.00	50	0.00022	0.86222	0.93270	0.08744
24	5.00	160	0.00003	0.87847	0.70783	0.09164
25	5.80	1	0.01230	0.80593	0.30922	0.15559
26	5.80	5	0.01303	0.79546	0.60522	0.16663
27	5.80	5	0.00723	0.79346	0.44067	0.16481
28	5.80	10	0.00480	0.80318	0.31641	0.15287
29	5.80	10	0.00663	0.79583	0.56525	0.16698
30	5.80	10	0.00465	0.79783	0.57046	0.16897
31	5.80	50	0.00064	0.80281	0.57289	0.15252
32	5.80	50	0.00095	0.79858	0.79828	0.16976
33	6.50	5	0.02960	0.77914	0.20062	0.17617
34	6.50	10	0.01720	0.77464	0.15228	0.17157
35	6.50	10	0.02369	0.77224	0.47767	0.18807
36	6.50	10	0.01545	0.76936	0.41252	0.18488
37	6.50	20	0.00889	0.78389	0.19476	0.18176
38	6.50	20	0.01136	0.76974	0.46478	0.18528
39	6.50	20	0.00882	0.77174	0.65561	0.18749
40	6.50	100	0.00131	0.77914	0.56415	0.17617
41	6.50	160	0.00090	0.77914	0.56231	0.17617
42	7.00	1	0.05357	0.76534	0.39249	0.20056
43	7.00	10	0.03962	0.75927	0.55596	0.21178
44	7.00	10	0.02477	0.75577	0.52185	0.20744
45	7.00	50	0.00571	0.76797	0.51771	0.20381
46	7.00	50	0.00745	0.75927	0.79249	0.21178
47	7.50	1	0.07725	0.77471	0.29861	0.22386
48	5.00	10	0.03848	0.76633	0.53179	0.21336
49	5.00	10	0.05754	0.76201	0.72542	0.22623
50	8.00	50	0.02032	0.81560	0.50803	0.21526
51	8.00	160	0.00826	0.81735	0.51294	0.21677

TABLE F4-18
A. McGARR: VERTICAL POINT ESTIMATES
PEAK GROUND VELOCITY

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	3.51791	0.65369	0.63598	0.08446
2	5.00	1	4.54194	0.65469	0.28625	0.08515
3	5.00	5	0.84525	0.65469	0.45857	0.08515
4	5.00	5	1.16534	0.65369	0.16207	0.08446
5	5.80	10	2.54933	0.62518	0.18207	0.13171
6	5.80	20	2.38133	0.61594	0.41413	0.12905
7	6.50	1	15.68956	0.61778	0.22500	0.15041
8	6.50	1	20.80833	0.61258	0.24880	0.15108
9	6.50	1	8.58214	0.61375	0.89385	0.15224
10	6.50	5	19.51708	0.60975	0.30496	0.14840
11	6.50	5	5.92469	0.61191	0.85398	0.15043
12	6.50	50	0.82693	0.61245	0.37987	0.14562
13	6.50	50	1.26487	0.61075	0.56537	0.14932
14	7.00	10	10.58788	0.61933	0.21741	0.17205
15	7.50	50	2.62447	0.61442	0.40242	0.18642
16	7.50	50	3.69140	0.61114	0.68314	0.18811
17	5.00	1	0.92577	0.65369	0.52421	0.08446
18	5.80	5	4.20172	0.61511	0.30767	0.12820
19	5.80	5	2.53698	0.61711	0.42130	0.13029
20	5.00	10	1.09262	0.65869	0.34852	0.08812
21	5.00	10	2.40898	0.65003	0.21098	0.08205
22	5.00	50	0.11739	0.65603	0.06887	0.08611
23	5.00	50	0.15247	0.63869	0.17117	0.07638
24	5.00	160	0.01701	0.66469	0.49392	0.09305
25	5.80	1	8.53003	0.62268	0.44687	0.12888
26	5.80	5	9.66733	0.61594	0.34810	0.12905
27	5.80	5	2.65836	0.61378	0.91903	0.12688
28	5.80	10	3.42054	0.62384	0.21454	0.13018
29	5.80	10	5.95535	0.61661	0.34049	0.12975
30	5.80	10	2.92209	0.61711	0.29270	0.13029
31	5.80	50	0.27576	0.62318	0.66480	0.12943
32	5.80	50	0.42276	0.61711	0.60964	0.13029
33	6.50	5	12.42783	0.61845	0.17451	0.15106
34	6.50	10	7.69370	0.61445	0.15610	0.14732
35	6.50	10	12.85128	0.61441	0.37841	0.15292
36	6.50	10	4.06735	0.60825	0.81126	0.14708
37	6.50	20	3.44543	0.61211	0.19834	0.14535
38	6.50	20	5.72157	0.61075	0.39690	0.14932
39	6.50	20	3.28365	0.60975	0.39781	0.14840
40	6.50	100	0.37168	0.61661	0.31329	0.14929
41	6.50	160	0.14707	0.61345	0.55159	0.14646
42	7.00	1	19.08100	0.62033	0.28288	0.17304
43	7.00	10	17.78589	0.61588	0.43819	0.17382
44	7.00	10	5.71387	0.61355	0.77096	0.17145
45	7.00	50	1.56797	0.61683	0.35194	0.16967
46	7.00	50	2.38716	0.61355	0.66397	0.17145
47	7.50	1	26.74642	0.62525	0.37924	0.19758
48	5.00	10	14.02704	0.61575	0.32293	0.18766
49	5.00	10	22.31861	0.61530	0.58960	0.19236
50	8.00	50	4.99881	0.64678	0.30704	0.19667
51	8.00	160	1.34581	0.66178	0.53584	0.20831

APPENDIX F5

ESTIMATION OF STRONG GROUND MOTIONS AT YUCCA MOUNTAIN

Walter Silva

APPENDIX F5
TABLE OF CONTENTS

APPENDIX F5

ESTIMATION OF STRONG GROUND MOTIONS AT YUCCA MOUNTAIN

Walter Silva

Pacific Engineering and Analysis

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F5-1 INTRODUCTION

The process used to develop appropriate site-specific attenuation relations for both probabilistic and deterministic applications to Yucca Mountain is by the use of multiple expects. A total of seven strong ground motion experts were given the task of developing a suite of scaling rules and weights to apply to an expert selected suite of strong ground motion empirical and/or numerical models. Fifty-one specific cases of magnitude, source mechanism, source depth, and site distance (Table 3-3) were specified for which 4 ground motion parameters were requested: median (μ), aleatory uncertainty (σ), standard error of the median estimate (σ_μ), and uncertainty of the aleatory uncertainty (σ_σ). These estimates were requested for both horizontal (random component) and vertical components at seven frequencies: 0.33, 0.50, 1.00, 2.00, 5.00, 10.00 and 20.00 Hz as well as peak ground acceleration (PGA) and peak ground velocity (PGV). The 3,672 point estimates were then used to develop smoothed models over magnitude, source mechanism, and site location (distance and hanging wall/foot wall) for each expert. The suite of expert models then represent the expected epistemic uncertainty for strong ground motion estimation on a site specific-basis at Yucca Mountain.

The magnitude range is **M** 5.0 to 8.0 with a horizontal distance range of 1 to 160 km (Yucca Mountain Data Package, Volume 1, Table 3-3). The specific cases selected by the facilitation team were based on sources expected to be major contributors to the seismic hazard at Yucca Mountain. Both strike-slip and normal-slip mechanisms are considered with normal faults representing 25 of 51 cases in Table 3-3. In addition to the 51 cases, two additional cases or scenarios were specified: 1) nearly simultaneous (triggered) multiple ruptures on parallel or possibly sub-parallel faults; and 2) a low angle normal fault.

The evaluation, specification, and defense of appropriate empirical and numerical point estimates and their associated uncertainties for all of these cases is a formidable task, particularly in view of the relatively "new" parameters requested: $\sigma\mu$ and $\sigma\sigma$. The consideration and use of these parameters does not reflect state-of-the-practice and considerable uncertainty exists regarding appropriate methods to estimate their values. As a result they should be regarded in the context of development rather than mature and stable practice. In addition, there are several issues, site

specific and general, which were controlling factors in the selection of empirical and numerical models and their associated weights. These issues are discussed below.

F5-2 SITE-SPECIFIC ISSUES

The site-specific issues at Yucca Mountain requiring special consideration are: 1) the definition of the free-surface; 2) crustal, kappa, and Q(f) differences between California and the Yucca Mountain region of the Basin and Range province; and 3) the large contribution of normal fault sources to the seismic hazard.

F5-2.1 Free Surface At -300m

The free surface at which the ground motions are defined for Yucca Mountain was at a depth of -300m, the average depth (or horizon) of the repository. The shear-wave velocity at this depth is about 6,000 ft/sec (1.9 km/sec), much greater than shear-wave velocities of about 1,000 ft/sec which are typical of soft rock sites near the surface. Since empirical attenuation relations for rock are dominated by soft California rock, a significant ($\geq$ 20%) site-specific adjustment factor is necessary. At rock sites, over the frequency range of 0.33 to 20.00 Hz, horizontal motions are dominated by vertically propagating shear-waves (W. J. Silva *et al.*, Pacific Engineering and Analysis, written communication, 1997) and vertical motions are comprised of inclined compression- and shear-waves (EPRI, 1993; W. J. Silva *et al.*, Pacific Engineering and Analysis, written communication, 1997). As a result, separate adjustment factors are warranted for horizontal and vertical motions.

F5-2.2 Yucca Mountain Regional Crustal Structure

The differences between the regional crustal structure containing the site and those representative of the empirical strong motion database (largely California) are large and represent differences in shear-wave velocity, deep crustal damping (Q(f)), and shallow crustal damping (as expressed by kappa in the top 1 to 2 km). These parameters have large and predictable effects on strong ground motions (EPRI, 1993; Silva and Darragh, 1995; Silva, 1992; W. J. Silva *et al.*, Pacific Engineering and Analysis, written communication, 1997) and substantial ($\pm$ 20%) differences in these parameters should be accommodated in scale factors for the empirical (largely California based) attenuations relations. Both the definition of -300m outcropping as the reference point of free field motions as well as the differences in regional crustal models is accommodated in a single set of frequency-dependent scale factors for horizontal motions. For numerical simulations, use of the site and regional-specific parameters precludes the use of these adjustment factors.

F5-2.3 Normal Faulting Sources

It has long been recognized that normal faulting sources produce strong ground motions that are generally lower than those expected for reverse fault sources. More recently, evidence suggests that strong ground motions from normal fault ruptures in extensional regimes are also lower than those from comparable strike-slip ruptures in compressional regimes, suggesting that this observation should be incorporated into the Yucca Mountain ground motion point estimates.

Because of sparse normal faulting strong motion data available for WUS sources, currently available empirical attenuation relations do not distinguish between strike-slip and normal-slip mechanisms. As a result, the USGS recently acquired world-wide strong motion data from normal faulting earthquakes, added these to existing data for extensional regime strike-slip earthquakes, and developed an attenuation relation appropriate for extensional regime sources (Spudich *et al.*, 1997). They also made the data available to the Yucca Mountain project and normal fault adjustment factors to the predominately compressional strike-slip attenuation relation of Abrahamson and Silva (1997) were developed by N. Abrahamson. Because the combination of both strike-slip and normal-slip data into the relation of Spudich *et al.* (1997) makes applying their relation somewhat ambiguous, the normal-slip adjustment factors of Abrahamson for horizontal and vertical motions are applied to each empirical relation selected. As a result, each selected relation is implemented for strike-slip mechanism and the normal-slip factors applied as appropriate (see Table F5-1). Because the adjustment factors of Abrahamson are large, particularly at low frequencies, only 50% of the factors are implemented. This is a judgmental assessment since there are still too few data to unambiguously constrain the adjustment factors. Both more earthquakes and a larger number of sites, particularly at close distances ($D \leq 20$ km) are needed.

F5-3 GENERAL ISSUES

The general issues are those which are faced for most seismic hazard assessments: the magnitude and distance ranges exceed those used in developing empirical attenuation relations and exceed the magnitudes and distances used in validating the numerical models as well. To address the ranges in magnitudes and distances appropriate for implementing the empirical relations, only the ranges specified by the authors are used. The relations receive a substantially lower weight outside their respective **M** and D ranges (Table F5-1).

For the numerical simulations, a wide range in degree of validation exists between the four proponent models. The Anderson finite-fault model currently has had only limited validations ($\mathbf{M} > 5.0$) in the form of comparisons to recorded data. Formal validations resulting in statistically significant estimates of model variability are not available. The Silva point- and finite-source models have recently been validated for horizontal motions for 15 earthquakes for the finite-source (**M** 5.7 to 7.4) and 18 earthquakes for the point-source (**M** 4.2 to 7.4) at about 500 sites (W. J. Silva *et al.*, Pacific Engineering and Analysis, written communication, 1997) over the fault distance range of 1 to 218 km (460 km for the Saguenay earthquake). For vertical motions, which are only computed for the point-source model, validations to-date consist of five earthquakes (**M** 6.4 to 7.2) at about 200 sites. As a result, the modeling variability is well constrained for horizontal motions and reasonably well constrained for the vertical component.

For the Somerville finite-fault model, reasonably extensive validations have also been performed Approximately four earthquakes have model variability estimates: Loma Prieta, Nahanni, Saguenay, and Northridge but with few sites exceeding source-to-site distances of about 30 km

(EPRI, 1993; P. G. Somerville *et al.*, WCFS, written communication, 1995). As a result, the model variability estimates are most appropriate for close-in conditions. For WUS crustal conditions, model variability increases sharply for distances exceeding about 50 km (Silva *et al.*, 1997) suggesting that close-in model variability estimates may result in values which are too low for applications to larger distances.

For vertical motions, neither the Anderson nor Somerville models have validation results which produced model variability estimates. As a result, the point-source vertical component model variability estimates were applied to both the Anderson and Somerville point estimates. For the horizontal components, because the Somerville validations covered a limited distance range and the values given by Somerville appeared low compared to published results (EPRI, 1993; P. G. Somerville *et al.*, WCFS, written communication, 1995) and since no estimates were available for the Anderson model, the finite-source model uncertainty estimates of Silva were used for their simulations.

F5-4 PROPONENT GROUND MOTION MODELS AND WEIGHTING SCHEME

The proponent models were selected from two general classes: empirical and numerical.

F5-4.1 Empirical Models

The empirical models chosen were those considered to generally reflect the most recent analyses of data, represent different functional forms, be appropriate for crustal earthquakes, and use a consistent data set for soft rock site conditions. To represent empirical attenuation relations the following models were selected: Abrahamson and Silva (1997), Boore *et al.* (1997), Campbell (1997), and Sadigh *et al.* (1997). Because few of the relations specify peak ground velocity, Joyner and Boore (1988) was added for PGV only since it has the same functional form as Boore *et al.* (1997). The selected empirical relations, ground motion parameters, and magnitude and distance ranges specified by the authors are listed in Table F5-1. The class weight for the empirical is 0.4 and the within class (proponent model) weights are generally equal at 1.0 (Table F5-1). Exceptions to the weights of 1.0 are cases outside the specified ranges (weight of 0.25) and the case-specific weights which are listed in Table F5-2. These case-specific weights reflect a judgmental assessment that the ground motion point estimates were unrealistic. For the empirical relations (BJF97, CP97, and SD97), this may be an artifact of smoothing of coefficients or simply cases outside the range of applicability which are poorly constrained by little or no data.

F5-4.1.1 Scale Factors for the Empirical Models. For the empirical models up to four scale factors are used depending upon which parameters are available. The first scale factor adjusts the empirical rock (soft rock for CP97) horizontal motion estimates to Yucca Mountain crustal conditions and to a depth of 300m outcropping. This scale factor is termed "crust" in Table F5-1 and is the factor developed by Campbell. This factor is distance dependent due to the difference in Q(f) models between California and the Yucca Mountain region of the Basin and Range province. This factor is preferred to the distance independent crustal factor of Silva.

The second scale factor is the normal faulting factors of Abrahamson for horizontal and vertical motions. This is applied to normal slip (NS in Table F5-1) sources and, as previously stated, only 50% of the factor is implemented. The third scale factor is the PGV/PGA (VOA) point-source scale factor of Silva for horizontal and vertical components. The fourth factor is related to the third and is the vertical-to-horizontal (VOH) point-source scale factor of Silva. These last two factors are site-specific. Because a crustal adjustment factor is not available for vertical components, appropriate vertical component motions are estimated by applying the VOH scale factor to the horizontal motions adjusted to a 300m depth at Yucca Mountain. This approach is considered preferable to directly using the empirical vertical component estimates combined with the horizontal component crustal factor.

F5-4.2 Numerical Models

The numerical models available were the finite-fault models of Anderson, Silva, and Somerville and the point-source model of Silva. This suite of models generally reflects the range in currently viable approaches to kinematic (specification of slip) numerical simulations. The finite-source models share common features in that they sum small earthquakes to construct a large earthquake. The Silva and Somerville models use asperity slip distributions and an empirical constant rise time model which determines the number of events to sum for each subfault. Both approaches use $\mathbf{M} \approx 5$ subevents to model crustal earthquakes. The models differ in their wave propagation algorithms as well as subevent source spectra (W. J. Silva *et al.*, Pacific Engineering and Analysis, written communication, 1997; P. G. Somerville *et al.*, WCFS, written communication, 1995). The Anderson model uses a distinctly different subevent source description (Zeng *et al.*, 1994) with a wave propagation algorithm similar to that of Somerville.

The inclusion of the point-source model, which has been demonstrated over the years to reliably predict strong ground motions (Boore, 1983; 1986; Schneider *et al.*, 1993; Silva and Darragh, 1995; W. J. Silva *et al.*, Pacific Engineering and Analysis, written communication, 1997) completes the suite of numerical models. The point-source model is an important adjunct to the suite of numerical models as it has been implemented on numerous seismic hazard evaluations and is the model which forms the basis for evaluating strong ground motions in the CEUS. As a result, the point-source model provides base-case site-specific predictions.

For the numerical models, the class weight is 0.6 as compared to the class weight of 0.4 for the empirical models (Table F5-1). The higher weight for the numerical models reflects the preference in their fundamentally site-specific nature as well as the degree of validation, particularly for the Silva and Somerville models. In adjusting the empirical (i.e. California) models for Yucca Mountain, essentially doubling the parametric assumptions and model computations are necessary compared to direct site-specific simulations.

Table F5-1 also lists the **M** and D ranges of applicability for which simulations were available as well as the proponent model's weights. For the Anderson model, although simulations were available, the **M** 5.0 simulations were not used as validations were not available for $\mathbf{M} \leq 5.7$

(1992 Little Skull Mountain earthquake). Also, for this model, because model variability estimates were not available, it was given a weight of 0.7 compared to the equal weights of 1.0 assigned to the other numerical models. This lower weight is not intended to reflect the expectation that it will perform less well than the other finite-fault models in statistically significant validations over a large range in **M** and D, but simply indicates less confidence in its predictions at this time.

As with the empirical model estimates, case-specific weights are listed in Table F5-2. The **M** 5.0 exclusion of the Anderson model was addressed earlier. The case and frequency exclusions of the Somerville model reflect unreasonable values possibly due to computational errors (i.e. deterministic radiation pattern nodes).

F5-4.2.1 Scale Factors for the Numerical Models. As with the empirical models, scale factors were applied to the numerical models (Table F5-1). Because the simulations were site specific, the crustal factor is not necessary resulting in direct use of the horizontal and vertical components for strike-slip earthquakes. This also applies to the point-source model. For the latter, a constant stress drop of 60 bars was used, the appropriate average value for strike-slip earthquakes (W. J. Silva *et al.*, Pacific Engineering and Analysis, written communication, 1997). The remaining scale factors; the Abrahamson normal slip factor for vertical and horizontal components, the VOA, and the VOH factors were all applied in a manner analogous to the empirical estimates (Table F5-1).

F5-5 ESTIMATES OF UNCERTAINTY

The estimates of uncertainty provided for each median ground motion estimate include: 1) the uncertainty about the median estimate (aleatory, σ), uncertainty of the median estimate (epistemic, σ_μ), and the uncertainty of the aleatory uncertainty σ (epistemic, σ_σ). Table F5-3 summarizes the partition of uncertainty for both the empirical and numerical model.

F5-5.1 Aleatory Uncertainty

The aleatory uncertainties (σ_j) for the empirical models are given by each proponent for an average horizontal component and vertical component (if available). If the vertical component median estimate is computed using the average horizontal component estimate, the average horizontal component aleatory is increased by the σ_{VOH} factor in Table F5-3. A similar approach is applied to peak ground velocity (PGA). These increases in aleatory uncertainty were computed based on the increase in aleatory uncertainty for the vertical component over the average horizontal component for σ_{VOH} and the increase of 1 sec aleatory uncertainty for response spectral acceleration over peak ground acceleration for the σ_{VOA} (Table F5-3). For the numerical point-source aleatory uncertainty, an uncertainty in stress drop ($\sigma_{\Delta\sigma}$) of 0.5 was specified. This value is considered appropriate for the expected variability in stress drop for large (**M** $\geq$ 5) earthquakes located within a tectonic province.

The total aleatory uncertainty (σ_j^T) for the jth proponent model is computed as the vector sum of the various contributions. The σ_{MECH} is included for the potential case of higher aleatory uncertainty for normal-slip earthquakes over strike-slip earthquakes. Since not enough data are available to constrain the normal-slip aleatory uncertainty, this increase is set to zero. The σ_{CRUST} is the increase in aleatory uncertainty due to a possible larger variability in crustal structure in the Yucca Mountain region (within about 200 km of the site) than exists in California. The potential increased variability in crustal structure, evidenced by a suite of measured shear-wave velocities at Yucca Mountain, would result in a larger contribution of ground motion variations due to path and site variations than exists in California. As a result, the modeling uncertainty, based almost entirely on California data (W. J. Silva *et al.*, Pacific Engineering and Analysis, written communication, 1997) would not reflect this potentially higher uncertainty. The value of 0.2 is based on judgment from parametric analyses on the effects of variations in crustal and site parameters on estimated ground motions (C. J. Roblee *et al.*, Caltrans, written communication, 1997).

The final two aleatory component, σ_{MOD} and σ_{RANDOM}, are the modeling uncertainties estimated for the Silva finite-fault model (W. J. Silva *et al.*, Pacific Engineering and Analysis, written communication, 1997) and the increase in aleatory uncertainty for a random horizontal component (Boore *et al.*, 1997). A previously discussed, because the modeling uncertainty computed for the Silva finite-source covers a large distance and magnitude range, it is applied to both the Anderson and Somerville models. This approach is justified by direct comparisons in limited validation exercises (Northridge and Landers earthquakes at about 20 sites) which showed comparable model uncertainties and bias estimate for all three finite-source models. Interestingly, comparison exercises between the point-source model and the Somerville finite-source model also showed similar uncertainties and bias estimates for frequencies of 1 Hz and greater (EPRI, 1993). At lower frequencies, the point-source model tendency to overpredict (particularly at close distances) is reflected in negative bias estimates (EPRI, 1993; W. J. Silva *et al.*, Pacific Engineering and Analysis, written communication, 1997).

F5-5.2 Epistemic Uncertainty

For the epistemic uncertainties of each proponent model, σ_μ's of 0.1 and 0.2 were assumed for the empirical and numerical finite-source models, respectively. For the point-source model, using the law of propagation of errors combined with the sensitivity of the point-source ground motion estimates to variations in stress drop ($\sigma_{ground\ motion} \approx 0.7\ \sigma_{\Delta\sigma}$, Silva, 1991), estimates of $\sigma_{\sigma\Delta\sigma}$ and $\sigma_{\mu\Delta\mu}$ of 0.2 were obtained. The partition for the j^{th} model's epistemic uncertainties is listed in Table F5-3. These estimates reflect uncertainties in the median scale factors or transfer functions due to parametric uncertainties and are based on judgement. The model component is assumed to be contained in the proponent model epistemic uncertainties on the first page of Table F5-3.

F5-5.3 Median And Uncertainty Estimates

The rules for computing the point estimates are given in Table F5-3. The median estimate (lognormal) is simply the weighted median with the combined class and proponent model weights normalized to sum to unity. The aleatory uncertainty is computed in a similar manner

simply as the mean of weighted variances. For the uncertainty of the median (σ_μ), a double sum is used with the first contribution due to the weighted variance about the median and the second due to a weighted average of the proponent models epistemic uncertainties In a similar manner, the uncertainty of the aleatory uncertainty (σ_σ) is computed as a double sum: a weighted variation about the mean σ in addition to a weighted average of the proponent models total aleatory uncertainties. These relations reflect a consensus opinion at the April 1997 ground motion workshop. More development work is necessary in characterizing appropriate methods to estimate σ_μ and σ_σ and this current relation with both contributions is appealing but certainly not definitive. Tables F5-4 through F5-21 list the point estimates for all 51 cases.

F5-6 MULTIPLE RUPTURE ON PARALLEL FAULTS

Based on the results of the multiple rupture deterministic scenarios of Somerville and the incoherent or SRSS (Square Root Sum Squares) results of Silva, the recommendation is to apply the SRSS approach. The SRSS approach should be applied to the Fourier amplitude spectra and the response spectra subsequently estimated from the SRSS Fourier amplitude spectra. However, in view of all the uncertainties inherent in the multiple rupture scenario, computing the SRSS response spectra directly is a reasonable approach. Because the SRSS is most appropriate at high frequencies, it is recommended to increase the low frequency ($\leq$ 1 Hz SRSS) by 25%. This value is based on the coherent verses incoherent (SRSS) sum results presented by Silva at the April, 1997 ground motion workshop.

F5-7 LOW ANGLE FAULT

Because of the lack of empirical strong motion data from low angle normal faults and no modeling results to provide guidance, it is recommended that this scenario should be treated as a normal fault.

F5-8 REGRESSION MODEL

For the regression model, the distance metric of shortest site-to-rupture surface distance was specified. The regression model for motions was specified to reflect hanging/foot-wall effects while the regression model on aleatory uncertainty was specified to reflect effects of magnitude and period. For the epistemic uncertainties, $\sigma\mu$ and $\sigma\sigma$, the regression model was specified to be magnitude independent and to vary monotomically with distance. All four regression models (μ, σ, σ_μ, σ_σ) reflect appropriate fits to the point estimates and capture stable features of magnitude, distance, and period dependencies.

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TABLE F5-1
PROPONENT MODELS, WEIGHTS, AND SCALE FACTORS

EMPIRICAL RELATIONS

Relation	Parameters	M Range	D Range (km)	WT
AS97	H,V	5 - 8	0 - 200	1.0
BJF97	H	5.5 - 7.5	0 - 80	1.0
CP97	H, V, PGV	5 - 8	3 - 60	1.0
SD97	H, V	4 - 8	0 - 100	1.0
JB88	PGV (only)	5 - 7.5	0 - 100	1.0

Class weights: Empirical 0.4
Numerical 0.6
For cases outside ranges WT = 0.25

TABLE F5-1 CONT.
EMPIRICAL SCALE FACTORS

Parameter	Scale Factor	σ_μ	σ	WT all
H Spectra	Crust	0.15	0.20	1.0
	Normal H (NS)	0.00	0.00	
H PGA	Crust	0.15	0.20	1.0
	Normal H (NS)	0.00	0.00	
H PGV (V available)	Crust	0.15	0.20	1.0
	Normal H (NS)	0.00	0.00	
H PGV (V not available use PGA)	Crust	0.15	0.20	0.5
	Normal H (NS)	0.00	0.00	
	VOA H	0.15	0.30	
V Spectra (use horizontal)	Crust	0.15	0.20	1.0
	Normal V (NS)	0.00	0.00	
	VOH	0.20	0.20	
V PGA (use horizontal)	Crust	0.15	0.20	1.0
	Normal V (NS)	0.00	0.00	
	VOH	0.20	0.20	
V PGV (use horizontal PGA)	Crust	0.15	0.00	0.5
	Normal V (NS)	0.00	0.00	
	VOA V	0.15	0.30	
	VOH	0.20	0.20	

TABLE F5-1 CONT.
NUMERICAL RELATIONS

Relation	Parameters	M Range	D Range(km)	WT
AND	H, V, PGV	5.8 - 8.0	ALL	0.7
POINT	H, VOH, VOA	ALL	ALL	1.0
SIL	H, PGV	ALL	ALL	1.0
SOM	H, V, PGV	ALL	ALL	1.0

TABLE F5-1 CONT.
NUMERICAL SCALE FACTORS

Parameter	Scale Factor	σ_μ	σ	WT all
H Spectra	Normal H (NS)	0.00	0.00	1.0
H PGA	Normal H (NS)	0.00	0.00	1.0
H PGV (V available)	Normal H (NS)	0.00	0.00	1.0
H PGV (V not available use PGA)	Normal H (NS)	0.00	0.00	0.5
	VOA H	0.15	0.30	
V Spectra (available)	Normal V (NS)	0.00	0.00	1.0
	VOH*, 0.00	0.20	0.20	
V Spectra (not available use H)	Normal V (NS)	0.00	0.00	1.0
	VOH	0.20	0.20	
V PGA (available)	Normal V (NS)	0.00	0.00	1.0
	VOH*, 0.00	0.20	0.20	
V PGA (not available use H)	Normal V (NS)	0.00	0.00	1.0
	VOH	0.20	0.20	
V PGV (available)	Normal V (NS)	0.00	0.00	1.0
	VOH*, 0.00	0.20	0.20	
V PGV (not available use H)	VOH	0.20	0.20	0.5
	VOA V	0.15	0.30	

*Use scale factor of 0.0 and σln of 0.20 to increase variability for vertical components

N.B. Normal Faulting Scale Factor: Use 0.5 of scale factor for horizontal and vertical components.

TABLE F5-2
CASE SPECIFIC WEIGHTS

Relation	Component	F (Hz)	Case
Anderson	H, V	ALL	ALL **M** 5.0
Somerville	H, V	0.3, 0.5	5, 6
	H, V	0.3, 0.5, 1.0	12, 13, 14, 15, 16, 38, 39, 40, 41
	H, V	ALL	31, 32
	H, V	1.0	42
	H, V	0.3, 0.5, 1.0	44, 45, 46, 47, 48, 49
Silva PT	H, V	ALL	51
BJF97	H	0.5	ALL
	H	ALL	24, 42, 47, 48
CMP 97	H	ALL	40, 41
SAD 97	H	ALL	40, 41

TABLE F5-3
APPROACH TO COMPUTING POINT ESTIMATES

Given μ_j, σ_j, $\sigma_{\mu j}$, WT_j for j^{th} relation

Empirical σ_j = aleatory for average component
$\sigma_\mu = 0.1$

Numerical (Point) σ_j = aleatory modeling plus parametric for average component
$\sigma_\mu = 0.2$

Numerical (Finite) σ_j = aleatory parametric for average component
$\sigma_\mu j = 0.2$

Compute Total Aleatory

$$\sigma_j^{T2} = \sigma_j^2 + \sigma_{MECH}^2 + \sigma_{CRUST}^2 + \sigma_{VOA}^2 + \sigma_{VOH}^2 + \sigma_{MOD}^2 + \sigma_{RANDOM}^2$$

Where σ_{MECH} = increase in aleatory due to mechanism
= 0

σ_{CRUST} = increase in aleatory due to YM crust at -300m
= 0.2

σ_{VOA} = increase in aleatory for larger PGV than PGA aleatory
= 0.3

σ_{VOH} = increase in aleatory for larger vertical than horizontal aleatory
= 0.2

σ_{MOD} = modeling aleatory
= $\sigma_{MOD}(f)$

σ_{RANDOM} = increase in aleatory for random component (JBF 97)

Compute Total Epistemic

$$\sigma_{\mu j}^{T2} = \sigma_{\mu j}^2 + \sigma_{\mu\, CRUST}^2 + \sigma_{\mu\, VOA}^2 + \sigma_{\mu\, VOH}^2$$

Where $\sigma_{\mu\, CRUST}$ = epistemic uncertainty in median crustal transfer function
= 0.15

$\sigma_{\mu\, VOA}$ = epistemic uncertainty in median peak velocity/peak acceleration transfer function
= 0.15

$\sigma_{\mu\, VOH}^2$ = epistemic uncertainty in median vertical/horizontal transfer function
= 0.2

Then

$$\mu' = \sum \mu_j WT_j$$

$$\sigma = \sqrt{\sum \sigma_j^{T2}\ WT_j}$$

$$\sigma_\mu^2 = \sum WT_j (\mu'_j - \bar{\mu})^2 - \sum WT_j \sigma_{\mu j}^2$$

$$\sigma_\sigma^2 = \sum WT_j (\sigma'_j - \bar{\sigma})^2 - \sum WT_j \sigma_{\sigma j}^2$$

TABLE F5-4
W. J. SILVA: HORIZONTAL POINT ESTIMATES
PEAK GROUND ACCELERATION

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.18154	0.69272	0.33829	0.09780
2	5.00	1	0.16407	0.69790	0.35660	0.09664
3	5.00	5	0.05301	0.69142	0.30515	0.09733
4	5.00	5	0.05273	0.69404	0.32525	0.09694
5	5.80	10	0.09850	0.64265	0.28714	0.12739
6	5.80	20	0.07220	0.64150	0.30682	0.12754
7	6.50	1	0.44361	0.63259	0.35821	0.13041
8	6.50	1	0.44822	0.63454	0.47015	0.13169
9	6.50	1	0.40568	0.63572	0.42342	0.13101
10	6.50	5	0.38053	0.62620	0.39716	0.13056
11	6.50	5	0.25263	0.63550	0.37082	0.13102
12	6.50	50	0.03212	0.62533	0.28341	0.13052
13	6.50	50	0.02886	0.62489	0.30835	0.13051
14	7.00	10	0.25534	0.61246	0.29294	0.13619
15	7.50	50	0.06446	0.61457	0.26442	0.14042
16	7.50	50	0.06725	0.61118	0.30051	0.13935
17	5.00	1	0.05988	0.69272	0.31289	0.09780
18	5.80	5	0.14463	0.64362	0.36724	0.12730
19	5.80	5	0.08764	0.64587	0.37996	0.12697
20	5.00	10	0.06253	0.69142	0.27819	0.09733
21	5.00	10	0.08381	0.68884	0.31447	0.09788
22	5.00	50	0.00627	0.68884	0.30815	0.09788
23	5.00	50	0.00647	0.68629	0.32103	0.09860
24	5.00	160	0.00082	0.68479	0.31645	0.10058
25	5.80	1	0.28355	0.64688	0.39176	0.12727
26	5.80	5	0.23086	0.64201	0.38387	0.12747
27	5.80	5	0.13760	0.64521	0.36858	0.12706
28	5.80	10	0.12277	0.64761	0.29022	0.12838
29	5.80	10	0.16273	0.64233	0.33084	0.12742
30	5.80	10	0.07790	0.64636	0.40005	0.12735
31	5.80	50	0.01366	0.63860	0.36519	0.12722
32	5.80	50	0.01308	0.64289	0.43421	0.12736
33	6.50	5	0.32732	0.62743	0.32643	0.13068
34	6.50	10	0.20988	0.62944	0.30294	0.13110
35	6.50	10	0.28650	0.62878	0.37365	0.13102
36	6.50	10	0.15940	0.62928	0.34808	0.12992
37	6.50	20	0.10365	0.62543	0.27592	0.13052
38	6.50	20	0.13123	0.63010	0.34906	0.13119
39	6.50	20	0.07799	0.62631	0.32867	0.12961
40	6.50	100	0.01536	0.62875	0.32606	0.13088
41	6.50	160	0.00692	0.63373	0.47604	0.13417
42	7.00	1	0.50973	0.62110	0.30018	0.13682
43	7.00	10	0.34653	0.61999	0.36376	0.13793
44	7.00	10	0.19675	0.61444	0.35980	0.13565
45	7.00	50	0.04820	0.61044	0.28756	0.13590
46	7.00	50	0.05004	0.61234	0.29839	0.13617
47	7.50	1	0.53874	0.63507	0.40136	0.14863
48	5.00	10	0.31386	0.62399	0.33627	0.14593
49	5.00	10	0.37202	0.61523	0.50832	0.14039
50	8.00	50	0.08215	0.62024	0.30312	0.12008
51	8.00	160	0.02067	0.62010	0.35827	0.11416

TABLE F5-5
W. J. SILVA: HORIZONTAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 0.05 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.38075	0.69545	0.33018	0.09939
2	5.00	1	0.34394	0.69805	0.34951	0.09873
3	5.00	5	0.10251	0.69548	0.29638	0.09736
4	5.00	5	0.10245	0.69812	0.30720	0.09693
5	5.80	10	0.16409	0.63976	0.30585	0.12667
6	5.80	20	0.11575	0.63497	0.31270	0.12610
7	6.50	1	0.75712	0.62015	0.35657	0.12836
8	6.50	1	0.76219	0.62146	0.43611	0.12976
9	6.50	1	0.68812	0.61987	0.43093	0.12822
10	6.50	5	0.66534	0.61581	0.42085	0.12742
11	6.50	5	0.43674	0.61751	0.43627	0.12761
12	6.50	50	0.04384	0.61474	0.31454	0.12693
13	6.50	50	0.03978	0.61417	0.36969	0.12690
14	7.00	10	0.41711	0.59704	0.31474	0.13136
15	7.50	50	0.08330	0.59945	0.31441	0.13590
16	7.50	50	0.08779	0.59570	0.36204	0.13439
17	5.00	1	0.11669	0.69545	0.29720	0.09939
18	5.80	5	0.23822	0.63580	0.38003	0.12552
19	5.80	5	0.14207	0.63612	0.41122	0.12621
20	5.00	10	0.12277	0.70626	0.29028	0.09669
21	5.00	10	0.16854	0.69548	0.33278	0.09736
22	5.00	50	0.01000	0.69028	0.30905	0.09874
23	5.00	50	0.01042	0.69028	0.32072	0.09874
24	5.00	160	0.00099	0.68274	0.40870	0.10417
25	5.80	1	0.49887	0.63682	0.42044	0.12612
26	5.80	5	0.40840	0.64025	0.41323	0.12735
27	5.80	5	0.23339	0.63927	0.46608	0.12701
28	5.80	10	0.20516	0.64232	0.33043	0.12788
29	5.80	10	0.27113	0.63597	0.36271	0.12594
30	5.80	10	0.13033	0.63472	0.49343	0.12591
31	5.80	50	0.01944	0.63522	0.40813	0.12605
32	5.80	50	0.01836	0.63740	0.50336	0.12632
33	6.50	5	0.55790	0.61308	0.32780	0.12628
34	6.50	10	0.35724	0.62170	0.30464	0.12893
35	6.50	10	0.49397	0.61682	0.40082	0.12716
36	6.50	10	0.26690	0.61819	0.40799	0.12832
37	6.50	20	0.16394	0.61881	0.29092	0.12870
38	6.50	20	0.21231	0.62052	0.36935	0.12833
39	6.50	20	0.12355	0.61327	0.40765	0.12707
40	6.50	100	0.01847	0.61249	0.30872	0.12709
41	6.50	160	0.00845	0.61438	0.33375	0.12670
42	7.00	1	0.87614	0.60436	0.35197	0.13442
43	7.00	10	0.59235	0.60776	0.41121	0.13462
44	7.00	10	0.31968	0.59715	0.43808	0.13237
45	7.00	50	0.06437	0.59479	0.30839	0.13092
46	7.00	50	0.06837	0.59726	0.33628	0.13141
47	7.50	1	0.91498	0.62010	0.47839	0.14962
48	5.00	10	0.49585	0.61084	0.39232	0.14368
49	5.00	10	0.59665	0.60023	0.58079	0.13592
50	8.00	50	0.10607	0.61548	0.37871	0.11540
51	8.00	160	0.02092	0.60722	0.42481	0.10915

TABLE F5-6
W. J. SILVA: HORIZONTAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 0.10 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.39383	0.72685	0.33473	0.10557
2	5.00	1	0.35579	0.72097	0.35847	0.10343
3	5.00	5	0.11568	0.72462	0.26049	0.10507
4	5.00	5	0.11509	0.72165	0.28142	0.10385
5	5.80	10	0.19650	0.65992	0.28205	0.13387
6	5.80	20	0.14256	0.66057	0.33892	0.13396
7	6.50	1	0.90812	0.64863	0.36622	0.13818
8	6.50	1	0.94720	0.64780	0.51587	0.13834
9	6.50	1	0.85388	0.65031	0.45483	0.13872
10	6.50	5	0.77595	0.64005	0.42035	0.13486
11	6.50	5	0.52081	0.64671	0.37779	0.13702
12	6.50	50	0.05912	0.64148	0.34010	0.13524
13	6.50	50	0.05319	0.64058	0.32424	0.13469
14	7.00	10	0.51271	0.62640	0.32021	0.13898
15	7.50	50	0.11119	0.63247	0.33855	0.14576
16	7.50	50	0.11615	0.62514	0.36698	0.14221
17	5.00	1	0.13068	0.71520	0.25901	0.10197
18	5.80	5	0.29465	0.66162	0.38624	0.13415
19	5.80	5	0.17510	0.66122	0.40895	0.13372
20	5.00	10	0.13621	0.72462	0.27916	0.10507
21	5.00	10	0.18229	0.71293	0.35210	0.10121
22	5.00	50	0.01295	0.71872	0.29561	0.10280
23	5.00	50	0.01345	0.71293	0.31691	0.10121
24	5.00	160	0.00126	0.70502	0.44366	0.10370
25	5.80	1	0.57206	0.66483	0.42477	0.13536
26	5.80	5	0.48805	0.66094	0.38818	0.13402
27	5.80	5	0.27315	0.66422	0.40810	0.13591
28	5.80	10	0.23716	0.66235	0.30539	0.13556
29	5.80	10	0.31674	0.66046	0.37521	0.13395
30	5.80	10	0.15342	0.65687	0.40971	0.13262
31	5.80	50	0.02554	0.65979	0.35464	0.13385
32	5.80	50	0.02426	0.66105	0.42436	0.13466
33	6.50	5	0.67664	0.64466	0.34330	0.13634
34	6.50	10	0.42901	0.64384	0.32123	0.13631
35	6.50	10	0.59590	0.64228	0.42454	0.13587
36	6.50	10	0.32047	0.64369	0.34451	0.13621
37	6.50	20	0.20817	0.63857	0.30495	0.13410
38	6.50	20	0.26145	0.64250	0.37121	0.13537
39	6.50	20	0.15332	0.64148	0.33919	0.13520
40	6.50	100	0.02454	0.64086	0.34071	0.13350
41	6.50	160	0.01037	0.63794	0.35233	0.13329
42	7.00	1	1.05138	0.63215	0.34290	0.14156
43	7.00	10	0.69986	0.63435	0.41723	0.14262
44	7.00	10	0.39947	0.62794	0.36645	0.13986
45	7.00	50	0.08577	0.62346	0.35112	0.13785
46	7.00	50	0.09091	0.62737	0.35685	0.13936
47	7.50	1	1.09550	0.64992	0.43579	0.15738
48	5.00	10	0.61825	0.63865	0.37085	0.15098
49	5.00	10	0.74590	0.63125	0.54426	0.14507
50	8.00	50	0.14082	0.64910	0.35904	0.12581
51	8.00	160	0.02399	0.64110	0.45416	0.11630

TABLE F5-7
W. J. SILVA: HORIZONTAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 0.20 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.29847	0.74854	0.33926	0.10165
2	5.00	1	0.27594	0.75429	0.35347	0.10372
3	5.00	5	0.09593	0.74013	0.26000	0.09958
4	5.00	5	0.09702	0.73735	0.27983	0.09905
5	5.80	10	0.18766	0.69017	0.27809	0.13316
6	5.80	20	0.14310	0.68225	0.34102	0.13009
7	6.50	1	0.84001	0.66866	0.35835	0.13145
8	6.50	1	0.87850	0.67736	0.48194	0.13556
9	6.50	1	0.80461	0.68506	0.43649	0.13906
10	6.50	5	0.74158	0.66924	0.40238	0.13282
11	6.50	5	0.51119	0.67238	0.34014	0.13271
12	6.50	50	0.06646	0.66760	0.35420	0.13159
13	6.50	50	0.05943	0.66320	0.30521	0.12992
14	7.00	10	0.50960	0.65322	0.31623	0.13472
15	7.50	50	0.13073	0.65530	0.35163	0.13935
16	7.50	50	0.13931	0.65062	0.34940	0.13712
17	5.00	1	0.10735	0.73740	0.26197	0.09953
18	5.80	5	0.26423	0.68548	0.41272	0.13139
19	5.80	5	0.17504	0.68595	0.34558	0.13095
20	5.00	10	0.11123	0.74013	0.27116	0.09958
21	5.00	10	0.14790	0.73735	0.33823	0.09905
22	5.00	50	0.01282	0.74578	0.29048	0.10114
23	5.00	50	0.01350	0.73188	0.30896	0.09853
24	5.00	160	0.00162	0.73894	0.40344	0.10244
25	5.80	1	0.50229	0.68656	0.39079	0.13152
26	5.80	5	0.43108	0.68415	0.36844	0.13129
27	5.80	5	0.25756	0.68728	0.34025	0.13158
28	5.80	10	0.22041	0.68861	0.31411	0.13235
29	5.80	10	0.29702	0.68292	0.35859	0.13018
30	5.80	10	0.15331	0.69036	0.33123	0.13313
31	5.80	50	0.02768	0.68619	0.31997	0.13148
32	5.80	50	0.02781	0.68572	0.35820	0.13142
33	6.50	5	0.63007	0.66524	0.32814	0.13051
34	6.50	10	0.39870	0.67092	0.29532	0.13289
35	6.50	10	0.54925	0.66848	0.38074	0.13171
36	6.50	10	0.32403	0.66557	0.31994	0.13012
37	6.50	20	0.20155	0.66839	0.29263	0.13214
38	6.50	20	0.26532	0.66606	0.35180	0.13119
39	6.50	20	0.16082	0.66835	0.29726	0.13114
40	6.50	100	0.03067	0.66895	0.34597	0.13063
41	6.50	160	0.01402	0.66932	0.35415	0.13206
42	7.00	1	0.97826	0.65818	0.31707	0.13641
43	7.00	10	0.69059	0.65687	0.39630	0.13634
44	7.00	10	0.40746	0.65219	0.32591	0.13408
45	7.00	50	0.09853	0.65130	0.37144	0.13404
46	7.00	50	0.10531	0.65191	0.35123	0.13424
47	7.50	1	1.08750	0.67163	0.40961	0.14898
48	5.00	10	0.64133	0.66709	0.35800	0.14740
49	5.00	10	0.74593	0.65166	0.49921	0.13756
50	8.00	50	0.16533	0.67096	0.32923	0.11557
51	8.00	160	0.03379	0.66753	0.51995	0.10831

TABLE F5-8
W. J. SILVA: HORIZONTAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 0.50 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.13522	0.81449	0.34956	0.08523
2	5.00	1	0.12851	0.80047	0.38467	0.08003
3	5.00	5	0.04671	0.80668	0.27762	0.08473
4	5.00	5	0.04856	0.79821	0.34027	0.08112
5	5.80	10	0.11628	0.75054	0.29414	0.13229
6	5.80	20	0.09467	0.75207	0.34893	0.13297
7	6.50	1	0.58368	0.73321	0.26841	0.13433
8	6.50	1	0.60411	0.73395	0.38593	0.13521
9	6.50	1	0.55182	0.74010	0.35849	0.13733
10	6.50	5	0.50889	0.73200	0.34874	0.13580
11	6.50	5	0.34953	0.73341	0.34083	0.13440
12	6.50	50	0.05392	0.73599	0.28677	0.13772
13	6.50	50	0.05286	0.72752	0.35419	0.13421
14	7.00	10	0.37911	0.71835	0.27366	0.14163
15	7.50	50	0.12512	0.72211	0.29990	0.14947
16	7.50	50	0.13674	0.71435	0.36390	0.14608
17	5.00	1	0.05212	0.81449	0.29750	0.08523
18	5.80	5	0.17702	0.75327	0.35948	0.13344
19	5.80	5	0.10319	0.75708	0.41754	0.13324
20	5.00	10	0.05319	0.79545	0.27832	0.08032
21	5.00	10	0.07100	0.79000	0.37147	0.07933
22	5.00	50	0.00767	0.79271	0.28738	0.07972
23	5.00	50	0.00820	0.79545	0.32952	0.08032
24	5.00	160	0.00147	0.78732	0.40005	0.08107
25	5.80	1	0.31193	0.75088	0.33225	0.13058
26	5.80	5	0.27107	0.74893	0.39535	0.13150
27	5.80	5	0.15949	0.74482	0.35737	0.12900
28	5.80	10	0.14424	0.75229	0.27727	0.13305
29	5.80	10	0.20182	0.74800	0.36465	0.13134
30	5.80	10	0.09329	0.75069	0.40305	0.13084
31	5.80	50	0.01998	0.74803	0.34683	0.13116
32	5.80	50	0.01998	0.75110	0.45120	0.13298
33	6.50	5	0.44536	0.72836	0.30158	0.13445
34	6.50	10	0.29824	0.73219	0.31326	0.13599
35	6.50	10	0.42055	0.73139	0.39146	0.13570
36	6.50	10	0.22780	0.73149	0.35711	0.13380
37	6.50	20	0.14717	0.73021	0.26420	0.13507
38	6.50	20	0.19826	0.73660	0.36628	0.13799
39	6.50	20	0.12344	0.73213	0.31473	0.13399
40	6.50	100	0.02976	0.73583	0.31874	0.13449
41	6.50	160	0.01669	0.73377	0.33919	0.13607
42	7.00	1	0.71694	0.72297	0.29790	0.14164
43	7.00	10	0.56484	0.71932	0.39154	0.14196
44	7.00	10	0.30914	0.72136	0.34770	0.14104
45	7.00	50	0.08734	0.71590	0.30747	0.14054
46	7.00	50	0.09732	0.72142	0.38978	0.14289
47	7.50	1	0.77911	0.73938	0.35015	0.15766
48	5.00	10	0.47774	0.72965	0.31895	0.15448
49	5.00	10	0.61504	0.72161	0.50614	0.14922
50	8.00	50	0.15956	0.73746	0.29987	0.12457
51	8.00	160	0.04859	0.73704	0.47048	0.11943

TABLE F5-9
W. J. SILVA: HORIZONTAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 1.00 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.05203	0.83787	0.33457	0.06192
2	5.00	1	0.04591	0.83512	0.35431	0.06111
3	5.00	5	0.01892	0.82674	0.27351	0.06286
4	5.00	5	0.01826	0.82674	0.33637	0.06286
5	5.80	10	0.05763	0.79957	0.31238	0.11302
6	5.80	20	0.04397	0.79678	0.32987	0.11642
7	6.50	1	0.32106	0.78624	0.25789	0.11892
8	6.50	1	0.29904	0.78822	0.39454	0.12328
9	6.50	1	0.27001	0.77927	0.38985	0.11987
10	6.50	5	0.26325	0.78181	0.32625	0.12470
11	6.50	5	0.17052	0.78005	0.40892	0.11982
12	6.50	50	0.03584	0.77602	0.26291	0.11923
13	6.50	50	0.03203	0.77663	0.29929	0.12232
14	7.00	10	0.23790	0.76702	0.27533	0.13051
15	7.50	50	0.08908	0.76888	0.25013	0.14030
16	7.50	50	0.09139	0.76585	0.29240	0.14164
17	5.00	1	0.02107	0.82972	0.31377	0.06033
18	5.80	5	0.07935	0.81109	0.50249	0.12427
19	5.80	5	0.04668	0.81133	0.52346	0.11902
20	5.00	10	0.02130	0.82403	0.25282	0.06236
21	5.00	10	0.02592	0.82403	0.31780	0.06236
22	5.00	50	0.00358	0.82135	0.25850	0.06213
23	5.00	50	0.00353	0.82948	0.28079	0.06362
24	5.00	160	0.00088	0.82812	0.34767	0.06361
25	5.80	1	0.14750	0.80923	0.41946	0.11373
26	5.80	5	0.12206	0.79191	0.43336	0.11339
27	5.80	5	0.06975	0.80703	0.46860	0.11635
28	5.80	10	0.06974	0.80192	0.29376	0.11445
29	5.80	10	0.09338	0.79338	0.35029	0.11406
30	5.80	10	0.04458	0.80848	0.41368	0.11847
31	5.80	50	0.01163	0.79135	0.30733	0.10972
32	5.80	50	0.01153	0.79645	0.32481	0.11528
33	6.50	5	0.23284	0.78651	0.28756	0.12327
34	6.50	10	0.16994	0.78207	0.28843	0.12143
35	6.50	10	0.22677	0.77882	0.33715	0.12321
36	6.50	10	0.11742	0.77950	0.37156	0.11965
37	6.50	20	0.08398	0.77574	0.27473	0.11904
38	6.50	20	0.11220	0.78272	0.37362	0.12522
39	6.50	20	0.06715	0.78147	0.34645	0.12031
40	6.50	100	0.02052	0.78236	0.28705	0.11735
41	6.50	160	0.01231	0.77855	0.33980	0.11842
42	7.00	1	0.40718	0.77270	0.29120	0.12910
43	7.00	10	0.30266	0.77069	0.36690	0.13461
44	7.00	10	0.18086	0.76678	0.36592	0.12942
45	7.00	50	0.06159	0.76684	0.26528	0.13046
46	7.00	50	0.06109	0.76410	0.30338	0.13191
47	7.50	1	0.49178	0.78510	0.36727	0.14289
48	5.00	10	0.32253	0.77606	0.32670	0.14407
49	5.00	10	0.39192	0.77000	0.54056	0.14326
50	8.00	50	0.11448	0.77401	0.32558	0.12702
51	8.00	160	0.04251	0.78754	0.40197	0.12370

TABLE F5-10
W. J. SILVA: HORIZONTAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 2.00 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.01406	0.92404	0.42119	0.06278
2	5.00	1	0.01107	0.91864	0.45775	0.06215
3	5.00	5	0.00534	0.90504	0.33300	0.07094
4	5.00	5	0.00452	0.90504	0.38411	0.07094
5	5.80	10	0.02254	0.88033	0.36006	0.12220
6	5.80	20	0.01450	0.87633	0.35129	0.13360
7	6.50	1	0.15787	0.87063	0.28618	0.13191
8	6.50	1	0.13059	0.86266	0.37284	0.13922
9	6.50	1	0.11571	0.86616	0.40327	0.14100
10	6.50	5	0.10370	0.86381	0.43998	0.14671
11	6.50	5	0.07706	0.86779	0.46418	0.14204
12	6.50	50	0.01743	0.86100	0.32579	0.13444
13	6.50	50	0.01411	0.85796	0.43034	0.14294
14	7.00	10	0.12817	0.85880	0.30973	0.15059
15	7.50	50	0.05667	0.85606	0.26936	0.16020
16	7.50	50	0.05058	0.84152	0.36750	0.16231
17	5.00	1	0.00584	0.91597	0.34412	0.06224
18	5.80	5	0.02839	0.86626	0.46777	0.12729
19	5.80	5	0.01749	0.87317	0.53078	0.12467
20	5.00	10	0.00605	0.90504	0.31070	0.07094
21	5.00	10	0.00643	0.90768	0.35738	0.07062
22	5.00	50	0.00114	0.90504	0.25700	0.07094
23	5.00	50	0.00100	0.90504	0.30806	0.07094
24	5.00	160	0.00036	0.90830	0.28989	0.06864
25	5.80	1	0.06006	0.89372	0.36848	0.12242
26	5.80	5	0.04238	0.86420	0.46849	0.12606
27	5.80	5	0.02746	0.87165	0.47769	0.12376
28	5.80	10	0.02488	0.88859	0.41456	0.12971
29	5.80	10	0.02692	0.88372	0.46276	0.14089
30	5.80	10	0.01612	0.86955	0.53698	0.12268
31	5.80	50	0.00509	0.87340	0.43792	0.11835
32	5.80	50	0.00419	0.87310	0.46872	0.13212
33	6.50	5	0.11307	0.86528	0.31075	0.13578
34	6.50	10	0.07464	0.86598	0.33687	0.13610
35	6.50	10	0.08162	0.86436	0.41815	0.14753
36	6.50	10	0.04834	0.86317	0.50868	0.13930
37	6.50	20	0.04150	0.87040	0.35369	0.13861
38	6.50	20	0.04650	0.85374	0.39565	0.14080
39	6.50	20	0.02984	0.86195	0.46623	0.13871
40	6.50	100	0.01212	0.86763	0.31010	0.13130
41	6.50	160	0.00794	0.87394	0.37731	0.13736
42	7.00	1	0.21378	0.86289	0.32864	0.14619
43	7.00	10	0.12100	0.85301	0.46195	0.15766
44	7.00	10	0.08697	0.85968	0.47307	0.15572
45	7.00	50	0.03527	0.85486	0.24972	0.14881
46	7.00	50	0.03042	0.84679	0.36692	0.15434
47	7.50	1	0.25659	0.86919	0.46354	0.16075
48	5.00	10	0.18127	0.85499	0.37731	0.15969
49	5.00	10	0.17889	0.84550	0.57756	0.16411
50	8.00	50	0.07454	0.86928	0.34933	0.15550
51	8.00	160	0.03223	0.87951	0.46998	0.14636

TABLE F5-11
W. J. SILVA: HORIZONTAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 3.33 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.00420	0.97945	0.70348	0.08419
2	5.00	1	0.00331	0.97092	0.70624	0.08009
3	5.00	5	0.00164	0.96419	0.62818	0.09238
4	5.00	5	0.00139	0.96419	0.64245	0.09238
5	5.80	10	0.01035	0.91179	0.41614	0.13882
6	5.80	20	0.00595	0.90654	0.45226	0.15049
7	6.50	1	0.07607	0.92510	0.39247	0.16939
8	6.50	1	0.06318	0.89224	0.40895	0.15739
9	6.50	1	0.05735	0.90074	0.44846	0.16294
10	6.50	5	0.05340	0.89866	0.43180	0.17082
11	6.50	5	0.04196	0.90939	0.50174	0.16919
12	6.50	50	0.00909	0.90816	0.41315	0.16399
13	6.50	50	0.00643	0.89498	0.62048	0.16829
14	7.00	10	0.07079	0.90413	0.34909	0.18306
15	7.50	50	0.03483	0.89336	0.30628	0.18730
16	7.50	50	0.02856	0.88420	0.39667	0.19274
17	5.00	1	0.00178	0.97374	0.64340	0.08126
18	5.80	5	0.01226	0.91376	0.48884	0.15597
19	5.80	5	0.00723	0.91824	0.57367	0.14853
20	5.00	10	0.00184	0.95857	0.59693	0.09042
21	5.00	10	0.00195	0.96137	0.56138	0.09131
22	5.00	50	0.00037	0.95580	0.49356	0.08972
23	5.00	50	0.00032	0.95580	0.51509	0.08972
24	5.00	160	0.00013	0.96222	0.39776	0.08295
25	5.80	1	0.02612	0.92146	0.46384	0.13440
26	5.80	5	0.01879	0.91262	0.49037	0.15547
27	5.80	5	0.01292	0.91193	0.50451	0.14394
28	5.80	10	0.01142	0.91462	0.51200	0.14059
29	5.80	10	0.01059	0.90217	0.55810	0.14740
30	5.80	10	0.00656	0.91498	0.72348	0.14594
31	5.80	50	0.00218	0.91495	0.52901	0.14075
32	5.80	50	0.00170	0.90841	0.61821	0.15194
33	6.50	5	0.05961	0.91832	0.38728	0.17282
34	6.50	10	0.03622	0.91329	0.45475	0.16829
35	6.50	10	0.03636	0.89769	0.48008	0.17043
36	6.50	10	0.02250	0.90745	0.65839	0.16791
37	6.50	20	0.01892	0.90435	0.51072	0.16133
38	6.50	20	0.01976	0.90529	0.48632	0.17602
39	6.50	20	0.01412	0.89605	0.60252	0.15974
40	6.50	100	0.00534	0.90352	0.47216	0.15104
41	6.50	160	0.00411	0.92051	0.44715	0.16635
42	7.00	1	0.12247	0.90447	0.41650	0.17410
43	7.00	10	0.06150	0.88952	0.50200	0.18536
44	7.00	10	0.04636	0.89592	0.55029	0.18100
45	7.00	50	0.02004	0.89763	0.29794	0.17858
46	7.00	50	0.01626	0.89166	0.40332	0.18676
47	7.50	1	0.14939	0.91067	0.51679	0.18968
48	5.00	10	0.10758	0.90229	0.44994	0.19330
49	5.00	10	0.09822	0.88634	0.66807	0.19411
50	8.00	50	0.04955	0.92324	0.37824	0.18569
51	8.00	160	0.02100	0.93330	0.38988	0.17415

TABLE F5-12
W. J. SILVA: HORIZONTAL POINT ESTIMATES
PEAK GROUND VELOCITY

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	6.75385	0.81085	0.37484	0.06924
2	5.00	1	5.99852	0.81085	0.40353	0.06924
3	5.00	5	2.20889	0.79932	0.29676	0.07699
4	5.00	5	2.16783	0.79367	0.36090	0.07371
5	5.80	10	6.41480	0.77058	0.29603	0.12615
6	5.80	20	4.72000	0.76895	0.32184	0.12815
7	6.50	1	36.87325	0.79058	0.31082	0.13466
8	6.50	1	34.80685	0.78758	0.41903	0.13697
9	6.50	1	31.54553	0.78758	0.40525	0.13697
10	6.50	5	29.80575	0.76841	0.35401	0.14279
11	6.50	5	20.57563	0.78262	0.39351	0.13520
12	6.50	50	3.55206	0.76596	0.32155	0.13970
13	6.50	50	3.10300	0.76493	0.42666	0.14154
14	7.00	10	27.12796	0.76862	0.28271	0.15155
15	7.50	50	10.19356	0.76800	0.32316	0.16046
16	7.50	50	10.09783	0.76142	0.39706	0.16018
17	5.00	1	2.49106	0.80528	0.32710	0.06657
18	5.80	5	9.50616	0.77004	0.45049	0.12836
19	5.80	5	5.56210	0.78316	0.45409	0.12334
20	5.00	10	2.50309	0.79089	0.25802	0.07237
21	5.00	10	3.20192	0.79367	0.32364	0.07371
22	5.00	50	0.34513	0.78813	0.30167	0.07124
23	5.00	50	0.34398	0.79089	0.33098	0.07237
24	5.00	160	0.07450	0.78271	0.27826	0.06964
25	5.80	1	17.09039	0.78720	0.40421	0.12170
26	5.80	5	14.08704	0.76587	0.41538	0.12703
27	5.80	5	8.62235	0.78228	0.36726	0.12318
28	5.80	10	7.67284	0.77511	0.29585	0.12750
29	5.80	10	10.12376	0.76901	0.32817	0.12816
30	5.80	10	4.95588	0.78175	0.43091	0.12310
31	5.80	50	1.15414	0.77143	0.39779	0.12634
32	5.80	50	1.07340	0.77176	0.47901	0.12902
33	6.50	5	26.36674	0.77316	0.28155	0.14206
34	6.50	10	17.64168	0.77149	0.27097	0.14146
35	6.50	10	23.35256	0.76886	0.34837	0.14296
36	6.50	10	12.82736	0.78185	0.40468	0.13506
37	6.50	20	8.80323	0.76980	0.30778	0.14087
38	6.50	20	11.50766	0.76962	0.35509	0.14326
39	6.50	20	7.06512	0.77919	0.41324	0.13434
40	6.50	100	1.98055	0.78436	0.48392	0.13330
41	6.50	160	1.04059	0.77473	0.81491	0.14353
42	7.00	1	51.16418	0.78763	0.34450	0.14320
43	7.00	10	34.06840	0.76640	0.41122	0.15307
44	7.00	10	20.53811	0.78031	0.43224	0.14345
45	7.00	50	6.50598	0.76331	0.29957	0.14991
46	7.00	50	6.28715	0.76124	0.37082	0.15121
47	7.50	1	60.22858	0.79663	0.53296	0.15441
48	5.00	10	38.05346	0.77125	0.41266	0.16193
49	5.00	10	45.09637	0.76428	0.64673	0.16116
50	8.00	50	14.52860	0.75883	0.44569	0.15123
51	8.00	160	5.25501	0.78261	0.51865	0.14299

TABLE F5-13
W. J. SILVA: VERTICAL POINT ESTIMATES
PEAK GROUND ACCELERATION

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.14263	0.71377	0.26693	0.09726
2	5.00	1	0.11105	0.71879	0.24455	0.09616
3	5.00	5	0.03515	0.71251	0.22334	0.09680
4	5.00	5	0.03051	0.71505	0.21837	0.09643
5	5.80	10	0.06150	0.66528	0.21279	0.12683
6	5.80	20	0.03778	0.66417	0.20327	0.12698
7	6.50	1	0.31936	0.65557	0.30171	0.12965
8	6.50	1	0.28471	0.65745	0.41510	0.13085
9	6.50	1	0.25684	0.65859	0.36583	0.13020
10	6.50	5	0.24171	0.64940	0.32700	0.12978
11	6.50	5	0.15153	0.65838	0.31198	0.13021
12	6.50	50	0.01385	0.64857	0.20923	0.12974
13	6.50	50	0.01107	0.64814	0.22976	0.12973
14	7.00	10	0.15922	0.63617	0.21993	0.13496
15	7.50	50	0.02709	0.63820	0.18196	0.13884
16	7.50	50	0.02581	0.63494	0.19160	0.13784
17	5.00	1	0.04034	0.71377	0.23381	0.09726
18	5.80	5	0.08192	0.66622	0.29552	0.12675
19	5.80	5	0.04689	0.66839	0.30947	0.12644
20	5.00	10	0.04276	0.71251	0.18479	0.09680
21	5.00	10	0.05266	0.71000	0.17666	0.09733
22	5.00	50	0.00290	0.71000	0.22927	0.09733
23	5.00	50	0.00266	0.70752	0.21046	0.09801
24	5.00	160	0.00035	0.70608	0.37176	0.09988
25	5.80	1	0.21469	0.66937	0.34117	0.12672
26	5.80	5	0.15049	0.66466	0.30822	0.12691
27	5.80	5	0.08290	0.66776	0.30482	0.12652
28	5.80	10	0.08075	0.67007	0.21695	0.12776
29	5.80	10	0.09919	0.66498	0.23584	0.12687
30	5.80	10	0.04324	0.66887	0.34508	0.12680
31	5.80	50	0.00606	0.66137	0.31170	0.12668
32	5.80	50	0.00515	0.66551	0.38120	0.12681
33	6.50	5	0.22548	0.65059	0.26313	0.12988
34	6.50	10	0.13380	0.65253	0.23334	0.13028
35	6.50	10	0.17455	0.65190	0.30783	0.13020
36	6.50	10	0.08781	0.65238	0.28239	0.12918
37	6.50	20	0.05811	0.64866	0.19711	0.12974
38	6.50	20	0.06808	0.65316	0.28287	0.13036
39	6.50	20	0.03766	0.64951	0.25732	0.12890
40	6.50	100	0.00541	0.65186	0.37589	0.13009
41	6.50	160	0.00213	0.65667	0.48793	0.13318
42	7.00	1	0.33592	0.64448	0.27881	0.13555
43	7.00	10	0.20452	0.64341	0.29173	0.13658
44	7.00	10	0.10528	0.63807	0.29202	0.13446
45	7.00	50	0.02045	0.63423	0.21446	0.13468
46	7.00	50	0.01939	0.63605	0.19216	0.13494
47	7.50	1	0.36054	0.65796	0.36353	0.14665
48	5.00	10	0.18868	0.64728	0.29507	0.14406
49	5.00	10	0.21813	0.63883	0.46153	0.13881
50	8.00	50	0.03435	0.64366	0.22474	0.11784
51	8.00	160	0.00753	0.64353	0.29907	0.11230

TABLE F5-14
W. J. SILVA: VERTICAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 0.05 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.32913	0.72253	0.26056	0.09849
2	5.00	1	0.25614	0.72504	0.27708	0.09787
3	5.00	5	0.07623	0.72256	0.21682	0.09661
4	5.00	5	0.06638	0.72511	0.24464	0.09620
5	5.80	10	0.11650	0.66910	0.24507	0.12596
6	5.80	20	0.06895	0.66452	0.26000	0.12544
7	6.50	1	0.62225	0.65037	0.30533	0.12750
8	6.50	1	0.55190	0.65162	0.40169	0.12880
9	6.50	1	0.49672	0.65011	0.40029	0.12737
10	6.50	5	0.48176	0.64624	0.38088	0.12664
11	6.50	5	0.29948	0.64786	0.41146	0.12681
12	6.50	50	0.02167	0.64521	0.26048	0.12619
13	6.50	50	0.01750	0.64467	0.33797	0.12616
14	7.00	10	0.30078	0.62838	0.25551	0.13015
15	7.50	50	0.04026	0.63067	0.25970	0.13424
16	7.50	50	0.03888	0.62710	0.31031	0.13286
17	5.00	1	0.08802	0.72253	0.21783	0.09849
18	5.80	5	0.15295	0.66531	0.34661	0.12491
19	5.80	5	0.08643	0.66562	0.37986	0.12553
20	5.00	10	0.09387	0.73294	0.20810	0.09597
21	5.00	10	0.11758	0.72256	0.25656	0.09661
22	5.00	50	0.00527	0.71756	0.23949	0.09789
23	5.00	50	0.00487	0.71756	0.26193	0.09789
24	5.00	160	0.00042	0.71030	0.37677	0.10294
25	5.80	1	0.42365	0.66628	0.37800	0.12546
26	5.80	5	0.29851	0.66957	0.37427	0.12659
27	5.80	5	0.15870	0.66863	0.44430	0.12627
28	5.80	10	0.15300	0.67154	0.27469	0.12709
29	5.80	10	0.18635	0.66548	0.31770	0.12529
30	5.80	10	0.08210	0.66428	0.47496	0.12526
31	5.80	50	0.00986	0.66476	0.36860	0.12540
32	5.80	50	0.00827	0.66684	0.48261	0.12564
33	6.50	5	0.43965	0.64364	0.27121	0.12559
34	6.50	10	0.26128	0.65185	0.24291	0.12803
35	6.50	10	0.34379	0.64720	0.36684	0.12640
36	6.50	10	0.16864	0.64851	0.38052	0.12747
37	6.50	20	0.10572	0.64909	0.22651	0.12782
38	6.50	20	0.12654	0.65073	0.33767	0.12748
39	6.50	20	0.06861	0.64382	0.38013	0.12632
40	6.50	100	0.00685	0.64307	0.42320	0.12634
41	6.50	160	0.00257	0.64488	0.48597	0.12598
42	7.00	1	0.67555	0.63533	0.31513	0.13294
43	7.00	10	0.40369	0.63857	0.37286	0.13313
44	7.00	10	0.19781	0.62848	0.40817	0.13106
45	7.00	50	0.03137	0.62624	0.25257	0.12976
46	7.00	50	0.03049	0.62858	0.28179	0.13020
47	7.50	1	0.71179	0.65033	0.44942	0.14702
48	5.00	10	0.34660	0.64150	0.36092	0.14149
49	5.00	10	0.40781	0.63141	0.55684	0.13426
50	8.00	50	0.05108	0.64592	0.33134	0.11287
51	8.00	160	0.00762	0.63806	0.38179	0.10712

TABLE F5-15
W. J. SILVA: VERTICAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 0.10 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.27664	0.75810	0.26051	0.10417
2	5.00	1	0.23919	0.75246	0.28073	0.10217
3	5.00	5	0.07494	0.75596	0.15498	0.10372
4	5.00	5	0.07184	0.75312	0.17885	0.10258
5	5.80	10	0.12440	0.69419	0.20526	0.13244
6	5.80	20	0.08505	0.69480	0.26899	0.13253
7	6.50	1	0.63025	0.68346	0.31031	0.13636
8	6.50	1	0.63765	0.68268	0.47277	0.13652
9	6.50	1	0.57386	0.68506	0.40652	0.13686
10	6.50	5	0.52237	0.67533	0.36571	0.13332
11	6.50	5	0.34010	0.68164	0.32059	0.13529
12	6.50	50	0.02888	0.67668	0.28501	0.13367
13	6.50	50	0.02558	0.67583	0.25383	0.13316
14	7.00	10	0.33041	0.66240	0.25490	0.13695
15	7.50	50	0.05352	0.66815	0.28297	0.14306
16	7.50	50	0.05632	0.66121	0.30074	0.13981
17	5.00	1	0.08537	0.74694	0.15233	0.10082
18	5.80	5	0.18414	0.69580	0.32870	0.13269
19	5.80	5	0.10588	0.69542	0.35489	0.13229
20	5.00	10	0.08969	0.75596	0.18428	0.10372
21	5.00	10	0.11857	0.74476	0.27212	0.10013
22	5.00	50	0.00658	0.75030	0.21443	0.10160
23	5.00	50	0.00669	0.74476	0.22890	0.10013
24	5.00	160	0.00058	0.73719	0.42514	0.10240
25	5.80	1	0.40122	0.69885	0.37748	0.13380
26	5.80	5	0.32775	0.69515	0.32843	0.13258
27	5.80	5	0.17644	0.69828	0.35648	0.13432
28	5.80	10	0.15473	0.69650	0.23570	0.13400
29	5.80	10	0.20583	0.69470	0.31347	0.13251
30	5.80	10	0.09478	0.69129	0.35915	0.13128
31	5.80	50	0.01268	0.69407	0.30225	0.13243
32	5.80	50	0.01183	0.69526	0.37432	0.13317
33	6.50	5	0.45851	0.67969	0.28295	0.13467
34	6.50	10	0.27799	0.67892	0.25602	0.13465
35	6.50	10	0.39243	0.67744	0.37250	0.13425
36	6.50	10	0.19935	0.67878	0.28027	0.13455
37	6.50	20	0.12420	0.67393	0.23645	0.13263
38	6.50	20	0.15674	0.67765	0.31224	0.13378
39	6.50	20	0.08766	0.67668	0.27364	0.13363
40	6.50	100	0.00957	0.67609	0.47979	0.13209
41	6.50	160	0.00343	0.67333	0.54178	0.13190
42	7.00	1	0.69735	0.66784	0.31823	0.13929
43	7.00	10	0.45750	0.66992	0.36290	0.14028
44	7.00	10	0.24611	0.66386	0.30452	0.13774
45	7.00	50	0.04151	0.65962	0.29789	0.13591
46	7.00	50	0.04428	0.66332	0.28879	0.13729
47	7.50	1	0.73641	0.68468	0.41024	0.15387
48	5.00	10	0.38802	0.67400	0.34704	0.14792
49	5.00	10	0.49067	0.66699	0.50409	0.14243
50	8.00	50	0.06758	0.68391	0.30118	0.12225
51	8.00	160	0.00973	0.67632	0.42190	0.11351

TABLE F5-16
W. J. SILVA: VERTICAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 0.20 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.16623	0.76178	0.26270	0.10111
2	5.00	1	0.16199	0.76743	0.28750	0.10312
3	5.00	5	0.04871	0.75352	0.14763	0.09910
4	5.00	5	0.05230	0.75079	0.18493	0.09859
5	5.80	10	0.09349	0.70451	0.19398	0.13254
6	5.80	20	0.07421	0.69675	0.27561	0.12957
7	6.50	1	0.45824	0.68345	0.29757	0.13087
8	6.50	1	0.51346	0.69196	0.43561	0.13484
9	6.50	1	0.46945	0.69950	0.38340	0.13823
10	6.50	5	0.43343	0.68402	0.34698	0.13220
11	6.50	5	0.28962	0.68709	0.26637	0.13209
12	6.50	50	0.02649	0.68242	0.29653	0.13101
13	6.50	50	0.02560	0.67811	0.21906	0.12940
14	7.00	10	0.25797	0.66835	0.24582	0.13398
15	7.50	50	0.05175	0.67039	0.29353	0.13841
16	7.50	50	0.06070	0.66581	0.28383	0.13626
17	5.00	1	0.05500	0.75084	0.15097	0.09905
18	5.80	5	0.14346	0.69992	0.35708	0.13082
19	5.80	5	0.09197	0.70038	0.27953	0.13039
20	5.00	10	0.05748	0.75352	0.16619	0.09910
21	5.00	10	0.08345	0.75079	0.27046	0.09859
22	5.00	50	0.00520	0.75907	0.20063	0.10061
23	5.00	50	0.00588	0.74542	0.22589	0.09808
24	5.00	160	0.00068	0.75235	0.38876	0.10187
25	5.80	1	0.27852	0.70098	0.33556	0.13095
26	5.80	5	0.25274	0.69861	0.30785	0.13073
27	5.80	5	0.14472	0.70168	0.26777	0.13101
28	5.80	10	0.11315	0.70298	0.24236	0.13175
29	5.80	10	0.16797	0.69741	0.29676	0.12965
30	5.80	10	0.08228	0.70470	0.25614	0.13250
31	5.80	50	0.01111	0.70061	0.25437	0.13091
32	5.80	50	0.01206	0.70015	0.29026	0.13085
33	6.50	5	0.33549	0.68010	0.26048	0.12996
34	6.50	10	0.20322	0.68567	0.21796	0.13226
35	6.50	10	0.31385	0.68328	0.31830	0.13112
36	6.50	10	0.17502	0.68043	0.24130	0.12960
37	6.50	20	0.09519	0.68319	0.21524	0.13155
38	6.50	20	0.13839	0.68091	0.28174	0.13062
39	6.50	20	0.08034	0.68315	0.21020	0.13058
40	6.50	100	0.01036	0.68374	0.48396	0.13009
41	6.50	160	0.00434	0.68410	0.55763	0.13147
42	7.00	1	0.50485	0.67321	0.29286	0.13561
43	7.00	10	0.39013	0.67192	0.33821	0.13554
44	7.00	10	0.21771	0.66734	0.25092	0.13336
45	7.00	50	0.03909	0.66648	0.31692	0.13333
46	7.00	50	0.04598	0.66707	0.28590	0.13352
47	7.50	1	0.56438	0.68636	0.38940	0.14775
48	5.00	10	0.31461	0.68191	0.33624	0.14621
49	5.00	10	0.42183	0.66682	0.45360	0.13668
50	8.00	50	0.06538	0.68571	0.25757	0.11434
51	8.00	160	0.01310	0.68235	0.48849	0.10734

TABLE F5-17
W. J. SILVA: VERTICAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 0.50 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.06918	0.80988	0.27202	0.08554
2	5.00	1	0.07209	0.79577	0.31859	0.08029
3	5.00	5	0.02158	0.80202	0.17040	0.08503
4	5.00	5	0.02479	0.79350	0.25960	0.08140
5	5.80	10	0.05260	0.74552	0.21185	0.13264
6	5.80	20	0.04638	0.74707	0.27491	0.13332
7	6.50	1	0.29052	0.72808	0.17585	0.13465
8	6.50	1	0.33587	0.72883	0.31340	0.13554
9	6.50	1	0.30622	0.73501	0.27566	0.13769
10	6.50	5	0.28293	0.72686	0.27042	0.13614
11	6.50	5	0.18792	0.72828	0.24892	0.13472
12	6.50	50	0.01939	0.73088	0.20570	0.13808
13	6.50	50	0.02140	0.72235	0.26496	0.13453
14	7.00	10	0.17407	0.71311	0.18499	0.14201
15	7.50	50	0.04474	0.71690	0.22490	0.14991
16	7.50	50	0.05605	0.70908	0.28730	0.14648
17	5.00	1	0.02431	0.80988	0.20112	0.08554
18	5.80	5	0.09107	0.74827	0.28423	0.13380
19	5.80	5	0.05126	0.75211	0.35384	0.13360
20	5.00	10	0.02504	0.79072	0.17138	0.08059
21	5.00	10	0.03811	0.78523	0.30658	0.07959
22	5.00	50	0.00280	0.78796	0.18815	0.07998
23	5.00	50	0.00335	0.79072	0.24234	0.08059
24	5.00	160	0.00056	0.78254	0.37505	0.08134
25	5.80	1	0.15843	0.74587	0.26178	0.13091
26	5.80	5	0.15162	0.74391	0.33178	0.13183
27	5.80	5	0.08515	0.73976	0.27529	0.12931
28	5.80	10	0.06737	0.74729	0.18741	0.13340
29	5.80	10	0.10850	0.74297	0.29807	0.13168
30	5.80	10	0.04740	0.74567	0.33063	0.13117
31	5.80	50	0.00723	0.74300	0.28230	0.13149
32	5.80	50	0.00813	0.74609	0.38602	0.13333
33	6.50	5	0.21599	0.72319	0.22329	0.13477
34	6.50	10	0.13806	0.72705	0.23895	0.13633
35	6.50	10	0.22819	0.72625	0.32066	0.13604
36	6.50	10	0.11640	0.72634	0.27251	0.13412
37	6.50	20	0.06291	0.72506	0.17026	0.13540
38	6.50	20	0.09765	0.73150	0.28313	0.13836
39	6.50	20	0.05813	0.72699	0.21349	0.13430
40	6.50	100	0.00937	0.73072	0.39342	0.13481
41	6.50	160	0.00491	0.72864	0.47901	0.13641
42	7.00	1	0.34965	0.71777	0.21799	0.14201
43	7.00	10	0.30226	0.71408	0.32281	0.14234
44	7.00	10	0.15601	0.71615	0.26259	0.14142
45	7.00	50	0.03128	0.71064	0.23434	0.14091
46	7.00	50	0.03995	0.71620	0.31916	0.14329
47	7.50	1	0.38815	0.73429	0.28690	0.15817
48	5.00	10	0.21752	0.72449	0.25019	0.15497
49	5.00	10	0.32892	0.71640	0.45235	0.14966
50	8.00	50	0.05702	0.73235	0.21460	0.12502
51	8.00	160	0.01737	0.73194	0.42710	0.11980

TABLE F5-18
W. J. SILVA: VERTICAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 1.00 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.02745	0.82591	0.25041	0.06267
2	5.00	1	0.02465	0.82312	0.29666	0.06185
3	5.00	5	0.00898	0.81462	0.16021	0.06363
4	5.00	5	0.00889	0.81462	0.27468	0.06363
5	5.80	10	0.02642	0.78702	0.23362	0.11356
6	5.80	20	0.02020	0.78419	0.27523	0.11706
7	6.50	1	0.16186	0.77348	0.15726	0.11945
8	6.50	1	0.15613	0.77549	0.34897	0.12393
9	6.50	1	0.14069	0.76640	0.34309	0.12043
10	6.50	5	0.13744	0.76898	0.27069	0.12542
11	6.50	5	0.08595	0.76719	0.36428	0.12038
12	6.50	50	0.01262	0.76309	0.16742	0.11979
13	6.50	50	0.01181	0.76371	0.23447	0.12297
14	7.00	10	0.10983	0.75394	0.18632	0.13128
15	7.50	50	0.03101	0.75583	0.15012	0.14122
16	7.50	50	0.03399	0.75275	0.22785	0.14260
17	5.00	1	0.01010	0.81764	0.22202	0.06104
18	5.80	5	0.03841	0.79873	0.46808	0.12509
19	5.80	5	0.02177	0.79898	0.49020	0.11971
20	5.00	10	0.01032	0.81187	0.12140	0.06313
21	5.00	10	0.01330	0.81187	0.25308	0.06313
22	5.00	50	0.00131	0.80915	0.13478	0.06289
23	5.00	50	0.00134	0.81739	0.20213	0.06441
24	5.00	160	0.00033	0.81601	0.31068	0.06439
25	5.80	1	0.07637	0.79684	0.36441	0.11427
26	5.80	5	0.06448	0.77925	0.39343	0.11396
27	5.80	5	0.03511	0.79460	0.43053	0.11697
28	5.80	10	0.03308	0.78941	0.20789	0.11503
29	5.80	10	0.04734	0.78074	0.30039	0.11464
30	5.80	10	0.02130	0.79608	0.37001	0.11914
31	5.80	50	0.00416	0.77868	0.22815	0.11017
32	5.80	50	0.00431	0.78386	0.26680	0.11589
33	6.50	5	0.11422	0.77376	0.20232	0.12394
34	6.50	10	0.07933	0.76924	0.20364	0.12205
35	6.50	10	0.11541	0.76594	0.28383	0.12388
36	6.50	10	0.05606	0.76663	0.32223	0.12021
37	6.50	20	0.03594	0.76281	0.18409	0.11960
38	6.50	20	0.05149	0.76990	0.32520	0.12595
39	6.50	20	0.02933	0.76864	0.29279	0.12089
40	6.50	100	0.00649	0.76953	0.29099	0.11784
41	6.50	160	0.00365	0.76567	0.38606	0.11894
42	7.00	1	0.20248	0.75971	0.21248	0.12981
43	7.00	10	0.15152	0.75767	0.31863	0.13550
44	7.00	10	0.08502	0.75370	0.31658	0.13014
45	7.00	50	0.02152	0.75375	0.17285	0.13123
46	7.00	50	0.02280	0.75097	0.24155	0.13273
47	7.50	1	0.25246	0.77232	0.33480	0.14385
48	5.00	10	0.14744	0.76313	0.25761	0.14509
49	5.00	10	0.19612	0.75697	0.50909	0.14427
50	8.00	50	0.03984	0.76105	0.24821	0.12827
51	8.00	160	0.01464	0.77481	0.34613	0.12482

TABLE F5-19
W. J. SILVA: VERTICAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 2.00 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.00704	0.89820	0.35586	0.06486
2	5.00	1	0.00509	0.89264	0.39207	0.06420
3	5.00	5	0.00239	0.87864	0.32160	0.07331
4	5.00	5	0.00189	0.87864	0.38563	0.07331
5	5.80	10	0.00965	0.85316	0.30034	0.12441
6	5.80	20	0.00572	0.84903	0.30794	0.13642
7	6.50	1	0.07311	0.84314	0.20464	0.13430
8	6.50	1	0.05694	0.83492	0.30551	0.14203
9	6.50	1	0.05042	0.83853	0.34035	0.14390
10	6.50	5	0.04624	0.83610	0.36984	0.14995
11	6.50	5	0.03248	0.84021	0.40580	0.14498
12	6.50	50	0.00549	0.83320	0.25192	0.13705
13	6.50	50	0.00419	0.83006	0.38802	0.14601
14	7.00	10	0.05412	0.83092	0.22875	0.15389
15	7.50	50	0.01735	0.82809	0.17710	0.16376
16	7.50	50	0.01506	0.81306	0.29836	0.16597
17	5.00	1	0.00266	0.88989	0.34623	0.06428
18	5.80	5	0.01192	0.83863	0.42428	0.12985
19	5.80	5	0.00691	0.84577	0.49268	0.12704
20	5.00	10	0.00274	0.87864	0.24988	0.07331
21	5.00	10	0.00282	0.88135	0.29047	0.07300
22	5.00	50	0.00038	0.87864	0.24859	0.07331
23	5.00	50	0.00031	0.87864	0.30003	0.07331
24	5.00	160	0.00012	0.88199	0.30993	0.07092
25	5.80	1	0.02889	0.86697	0.27701	0.12454
26	5.80	5	0.01925	0.83651	0.38926	0.12856
27	5.80	5	0.01166	0.84420	0.41410	0.12609
28	5.80	10	0.01095	0.86168	0.34965	0.13219
29	5.80	10	0.01178	0.85665	0.40160	0.14395
30	5.80	10	0.00647	0.84204	0.49653	0.12496
31	5.80	50	0.00169	0.84600	0.43147	0.12039
32	5.80	50	0.00131	0.84570	0.47628	0.13487
33	6.50	5	0.05096	0.83763	0.22390	0.13847
34	6.50	10	0.03167	0.83834	0.25521	0.13880
35	6.50	10	0.03564	0.83667	0.34676	0.15079
36	6.50	10	0.01906	0.83544	0.45647	0.14212
37	6.50	20	0.01595	0.84291	0.27997	0.14142
38	6.50	20	0.01762	0.82570	0.32829	0.14377
39	6.50	20	0.01061	0.83419	0.41498	0.14150
40	6.50	100	0.00317	0.84004	0.23808	0.13369
41	6.50	160	0.00195	0.84656	0.32968	0.14006
42	7.00	1	0.09830	0.83516	0.25573	0.14916
43	7.00	10	0.05294	0.82494	0.40598	0.16131
44	7.00	10	0.03390	0.83183	0.41487	0.15917
45	7.00	50	0.01090	0.82685	0.13988	0.15202
46	7.00	50	0.00913	0.81851	0.30127	0.15784
47	7.50	1	0.12076	0.84166	0.42006	0.16419
48	5.00	10	0.07745	0.82698	0.31553	0.16322
49	5.00	10	0.07944	0.81717	0.53232	0.16787
50	8.00	50	0.02283	0.84175	0.27730	0.16013
51	8.00	160	0.00975	0.85231	0.41325	0.15042

TABLE F5-20
W. J. SILVA: VERTICAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 3.33 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.00199	0.95511	0.66765	0.08674
2	5.00	1	0.00143	0.94635	0.67180	0.08255
3	5.00	5	0.00067	0.93945	0.58778	0.09531
4	5.00	5	0.00053	0.93945	0.60584	0.09531
5	5.80	10	0.00407	0.88558	0.35777	0.14182
6	5.80	20	0.00210	0.88018	0.39800	0.15406
7	6.50	1	0.03373	0.89929	0.33183	0.17323
8	6.50	1	0.02626	0.86544	0.34640	0.16105
9	6.50	1	0.02377	0.87420	0.39537	0.16679
10	6.50	5	0.02219	0.87207	0.36849	0.17510
11	6.50	5	0.01666	0.88311	0.45333	0.17325
12	6.50	50	0.00256	0.88185	0.35650	0.16792
13	6.50	50	0.00172	0.86827	0.59301	0.17248
14	7.00	10	0.02800	0.87769	0.28168	0.18775
15	7.50	50	0.00966	0.86660	0.22911	0.19211
16	7.50	50	0.00771	0.85716	0.33488	0.19780
17	5.00	1	0.00074	0.94925	0.60402	0.08375
18	5.80	5	0.00463	0.88761	0.43498	0.15971
19	5.80	5	0.00260	0.89223	0.53284	0.15190
20	5.00	10	0.00078	0.93368	0.55425	0.09330
21	5.00	10	0.00080	0.93655	0.51483	0.09421
22	5.00	50	0.00011	0.93083	0.44106	0.09257
23	5.00	50	0.00009	0.93083	0.47153	0.09257
24	5.00	160	0.00004	0.93742	0.33057	0.08557
25	5.80	1	0.01201	0.89554	0.41220	0.13709
26	5.80	5	0.00795	0.88644	0.43409	0.15919
27	5.80	5	0.00513	0.88573	0.45429	0.14717
28	5.80	10	0.00469	0.88850	0.46577	0.14365
29	5.80	10	0.00425	0.87567	0.51365	0.15087
30	5.80	10	0.00244	0.88887	0.69480	0.14923
31	5.80	50	0.00063	0.88884	0.48476	0.14382
32	5.80	50	0.00046	0.88211	0.58969	0.15556
33	6.50	5	0.02551	0.89231	0.32568	0.17700
34	6.50	10	0.01455	0.88713	0.40360	0.17234
35	6.50	10	0.01462	0.87106	0.42702	0.17469
36	6.50	10	0.00833	0.88112	0.62728	0.17193
37	6.50	20	0.00680	0.87793	0.46583	0.16516
38	6.50	20	0.00696	0.87889	0.43904	0.18046
39	6.50	20	0.00467	0.86937	0.56852	0.16349
40	6.50	100	0.00128	0.87707	0.32936	0.15434
41	6.50	160	0.00092	0.89456	0.36242	0.17023
42	7.00	1	0.05271	0.87805	0.36182	0.17832
43	7.00	10	0.02417	0.86263	0.44904	0.19021
44	7.00	10	0.01681	0.86923	0.50555	0.18556
45	7.00	50	0.00558	0.87100	0.21565	0.18312
46	7.00	50	0.00441	0.86485	0.34612	0.19166
47	7.50	1	0.06418	0.88443	0.47484	0.19437
48	5.00	10	0.04243	0.87580	0.40109	0.19831
49	5.00	10	0.03853	0.85936	0.62662	0.19922
50	8.00	50	0.01373	0.89737	0.31251	0.19152
51	8.00	160	0.00575	0.90771	0.32797	0.17932

TABLE F5-21
W. J. SILVA: VERTICAL POINT ESTIMATES
PEAK GROUND VELOCITY

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	4.02063	0.79848	0.30458	0.07021
2	5.00	1	3.63480	0.79848	0.36422	0.07021
3	5.00	5	1.14604	0.78677	0.20089	0.07814
4	5.00	5	1.15680	0.78103	0.31448	0.07480
5	5.80	10	2.95145	0.75756	0.21252	0.12718
6	5.80	20	2.16782	0.75590	0.27688	0.12924
7	6.50	1	18.33007	0.77789	0.23189	0.13585
8	6.50	1	18.03647	0.77484	0.38526	0.13822
9	6.50	1	16.30184	0.77484	0.36980	0.13822
10	6.50	5	15.44497	0.75535	0.31362	0.14426
11	6.50	5	10.16407	0.76980	0.35621	0.13641
12	6.50	50	1.12685	0.75285	0.24686	0.14109
13	6.50	50	1.03599	0.75181	0.39181	0.14298
14	7.00	10	11.70002	0.75556	0.19073	0.15328
15	7.50	50	3.04512	0.75493	0.24510	0.16241
16	7.50	50	3.25418	0.74824	0.36079	0.16211
17	5.00	1	1.30940	0.79282	0.24350	0.06750
18	5.80	5	4.66900	0.75701	0.41940	0.12945
19	5.80	5	2.60342	0.77035	0.42310	0.12426
20	5.00	10	1.33212	0.77820	0.13735	0.07344
21	5.00	10	1.82780	0.78103	0.27279	0.07480
22	5.00	50	0.13110	0.77540	0.20902	0.07228
23	5.00	50	0.13645	0.77820	0.27836	0.07344
24	5.00	160	0.02898	0.76989	0.36336	0.07066
25	5.80	1	9.22932	0.77445	0.34759	0.12257
26	5.80	5	7.76950	0.75277	0.38225	0.12809
27	5.80	5	4.45780	0.76946	0.32784	0.12410
28	5.80	10	3.68903	0.76217	0.21218	0.12857
29	5.80	10	5.28468	0.75596	0.28505	0.12925
30	5.80	10	2.39286	0.76892	0.39736	0.12401
31	5.80	50	0.39300	0.75842	0.34091	0.12738
32	5.80	50	0.38397	0.75876	0.44868	0.13013
33	6.50	5	12.63204	0.76018	0.19084	0.14352
34	6.50	10	7.91494	0.75849	0.17495	0.14290
35	6.50	10	11.68760	0.75581	0.30629	0.14443
36	6.50	10	5.89662	0.76901	0.36829	0.13626
37	6.50	20	3.53467	0.75676	0.22792	0.14229
38	6.50	20	5.02494	0.75658	0.31304	0.14474
39	6.50	20	2.89825	0.76631	0.37765	0.13552
40	6.50	100	0.56912	0.77157	0.39061	0.13445
41	6.50	160	0.27961	0.76178	0.70186	0.14502
42	7.00	1	23.17708	0.77489	0.28343	0.14461
43	7.00	10	16.27792	0.75330	0.37647	0.15483
44	7.00	10	9.02237	0.76745	0.39894	0.14486
45	7.00	50	1.98927	0.75016	0.21559	0.15158
46	7.00	50	2.07269	0.74806	0.33142	0.15292
47	7.50	1	27.14126	0.78404	0.47213	0.15608
48	5.00	10	15.80830	0.75823	0.35217	0.16392
49	5.00	10	21.18422	0.75114	0.62516	0.16312
50	8.00	50	4.29233	0.74560	0.38614	0.15378
51	8.00	160	1.47492	0.76979	0.46899	0.14528

APPENDIX F6

YUCCA MOUNTAIN PROBABILISTIC SEISMIC HAZARD ANALYSIS DOCUMENTATION OF EXPERT MODEL GROUND MOTIONS

Paul G. Somerville
Woodward-Clyde Federal Services

APPENDIX F6
TABLE OF CONTENTS

APPENDIX F6

YUCCA MOUNTAIN PROBABILISTIC SEISMIC HAZARD ANALYSIS DOCUMENTATION OF EXPERT MODEL GROUND MOTIONS

Paul G. Somerville
Woodward-Clyde Federal Services

F6-1 INTRODUCTION

This report documents the decisions that I made in developing a ground motion model for use at Yucca Mountain. The model pertains to a hypothetical rock surface that is produced by excavating the top 300 meters of overburden at the site.

F6-2 WEIGHTING SCHEME

The overall weight, W, for each model is developed by scaling four weights:

$$W = B \times M \times D \times F$$

where

B = base level weight
M = magnitude applicability weight
D = distance applicability weight
F = frequency applicability weight

The base level weights represent my general evaluation of the applicability of the models within each class to the prediction of ground motion at Yucca Mountain. The magnitude, distance, and frequency weights reflect how well the models are expected to predict ground motions at specific magnitudes, distances and frequencies, respectively

F6-2.1 Model Classes

I divided the proponent models into four classes: 1) finite fault numerical simulations, 2) explosion, 3) empirical, and 4) point source stochastic. The model classes and their base level weights are shown in Table F6-1.

The finite fault numerical simulations are generally well validated against recorded data and thus are expected to have the capacity to predict ground motions for Yucca Mountain specific conditions.

The explosion models contain region-specific distance attenuation information, however the distance attenuation has not been adjusted for differences in the source depth of explosions and earthquakes. Since the explosions are at shallower depths than are representative of earthquake source depths, they will contain more surface waves which may significantly affect the distance attenuation.

The empirical models are based on strong motion data that span the relevant ranges of magnitude, distance, and period that are considered in this study. The adjustment factors for the empirical model account for Yucca Mountain specific conditions. The empirical model class is given the largest weight.

The point source stochastic model has been extensively validated against data; however it does not include finite fault effects such as rupture directivity at low frequencies.

F6-2.2 Model Weights - Horizontal Component

Model classes 1, 2, and 3 contain multiple proponent models. The relative weights that I assigned to these models are listed in Table F6-1. The same weights are used for both the median (μ) and the aleatory uncertainty (σ) for all of the models.

F6-2.2.1 Finite Fault Models. All three finite source models have been validated against recorded data. The Silva and Somerville models have been validated against a larger number of earthquakes than the Zeng and Anderson model. The Zeng and Anderson model uses an unconventional source model. The Somerville and Zeng and Anderson models include rupture directivity effects at low frequencies, but these effects are not fully included in the Silva model. Since all three models have been validated against data, I specified equal weight for the three finite source models.

F6-2.2.2 Explosion Models. There are three proponent models based on explosion data. The first model (Blast 1) is based on an explosion source that is not relevant for earthquakes. The third model (Blast 3) is based on the Little Skull Mountain source that is not generally applicable to other earthquakes. Therefore, these two models were given zero weight.

The second model (Blast 2), uses an empirical response spectra shape that is attenuated based on the observed NTS attenuation. This model has a reasonable spectral shape and includes information on the regional attenuation. Of the three proponent explosion models, I consider this to be the only applicable model. Therefore, I assigned it a model weight of 1.0.

F6-2.2.3 Empirical Models. I included the empirical models listed below. I gave higher weight to those models that incorporate magnitude dependent attenuation rates and different attenuation rates for soil and rock sites. Models that were not based on recent data or current regression methods were down weighted. The specific models are discussed below.

Abrahamson and Silva (1997): This model includes recent data and incorporates distance dependent magnitude scaling and different attenuation rates for soil and rock. It includes near fault effects such footwall/hanging wall effects. It includes style-of-faulting factors for normal faulting earthquakes so it does not need scaling for stress drop. Due to the inclusion of near fault effects, I increased the weight on this model to 0.3.

Joyner and Boore (1988): This model is not based on recent data. It uses the same attenuation shape for rock and soil and for different magnitudes which I consider to be unrealistic. Its distance metric (Joyner-Boore distance) makes it unsuitable for use in the near source region of dipping faults. Due to these disadvantages, I down weighted this model to 0.1. This model does include peak velocity which only a few models include.

Campbell (1997), soft rock: This model includes recent data and incorporates distance dependent magnitude scaling and different attenuation rates for soil and rock. I assigned a weight of 0.2 to this model.

Idriss (University of California, Davis, written communication, 1997): This model includes recent data and incorporates distance dependent magnitude scaling and different attenuation

rates for soil and rock. It is not based on current regression methods. Due to the regression methods used in this model, I reduced the weight to 0.1.

Sadigh et al. (1997): This model includes recent data and incorporates distance dependent magnitude scaling and different attenuation rates for soil and rock. I assigned a weight of 0.2 to this model.

Spudich et al. (1997): This model is specific for events in extensional regimes so it does not require scaling for stress drop difference. The use of the same attenuation shape for rock and soil sites and for different magnitudes is unrealistic. Its distance metric (Joyner-Boore distance) makes it unsuitable for use in the near source region of dipping faults. I reduced the weight for this model to 0.1.

The following empirical models were excluded (given zero weight) for the reasons given.

McGarr (1984) : The theoretically based dependence of ground motions on faulting mechanism is not borne out in recorded data.

Sabetta and Pugliese (1996): This model is based on Italian data. The Italian data that are relevant to Yucca Mountain is included in the Spudich *et al.* (1996) model.

Campbell (Dames and Moore, written communication, 1990; Campbell, 1993; Campbell and Bozorgnia, 1994): These Campbell models have been superseded by Campbell (1997).

Boore et al. (1997): The assumption of a constant, distance-independent relation between soil and rock causes this model to underpredict rock motions at close distances.

F6-2.2.4 Point Source Stochastic Model. The point source proponent model was provided with the median and uncertainties in the point source stress drop to be specified by each expert. I specified the following values to be used:

Median stress drop = 60 bars
Standard deviation of stress drop = 0.7 (natural log units)

Standard error of the median stress drop = 0.3

Standard error of the standard deviation of stress drop = 0.3

F6-2.2.5 Magnitude Weights. The magnitude weights reflect how well the models are expected to predict ground motions as a function of magnitude; Table F6-2 summarizes these factors. The weights for the explosion model reflect the decreasing constraint on the explosion attenuation model with increasing magnitude. The weights on the point source stochastic model reflect the decreasing physical realism of the point source model with increasing magnitude.

F6-2.2.6 Distance Weights. The distance weights (Table F6-3) reflect how well the models are expected to predict ground motions as a function of distance. For the Silva models (finite source and point source), the weights are different for two frequency ranges: less than 1 Hz and greater than 1 Hz. The weights for the Silva finite fault reflect the decreasing physical realism of the homogeneous radiation pattern with decreasing distance for frequencies of 1 Hz and less. The weights for the point source stochastic model reflect the decreasing physical realism of the homogeneous radiation pattern with decreasing distance for frequencies of 1 Hz and less and of the point source model with decreasing distance. The need to calibrate the point source stochastic model against empirical models makes it more like an empirically based algorithm. The weights for the explosion model reflect the decreasing appropriateness of the attenuation function with decreasing distance.

F6-2.2.7 Frequency Weights. These weights (Table F6-4) reflect how well the models are expected to predict ground motions as a function of frequency. The weights for the point source stochastic model represent the decreasing physical realism of the point source model with decreasing frequency; it contains no physical representation of source finiteness and rupture directivity effects. The weights for the Silva finite fault stochastic model represents the decreasing physical realism of the homogeneous radiation pattern with decreasing frequency.

F6-2.2.8 Horizontal Component Variability. The proponent models for the horizontal component all predict the average of the two horizontal components. This project is using the random horizontal component, so the component-to-component variability needs to be

added to the aleatory uncertainty. The two available proponent models are Boore et al. (1997) and Spudich *et al.* (1997). These two models are very similar. I selected the horizontal component to component variability from the Boore *et al.* (1997) model.

F6-2.3 Model Weights - Vertical Component

The weighting scheme described for the horizontal component is also used for the vertical component.

F6-3 ADJUSTMENTS TO WEIGHTED POINT ESTIMATES

The weighting scheme described above assumed that predictions were available for each model in a given model class. However, for the class of numerical simulation models, predictions were available for only some of the models for the largest and smallest magnitudes (magnitude 5 and 8). In some instances, the predictions of the one or two available numerical models were quite different from those of the other classes of models and from available recorded data. In these cases, the point estimates were modified to give a lower weight to the class of numerical models.

In particular, for the magnitude 5 case, the Zeng and Anderson model was the only finite fault model that was run. I did not want to give a weight of 0.4 to that single simulation so I modified the point estimates for those cases by hand.

F6-4 EPISTEMIC UNCERTAINTY

Estimates of epistemic uncertainties in the median ground motion values and their aleatory variability were based principally on the variations among the estimates of different models. Most of the proponent models did not provide epistemic uncertainties. The exceptions were the Somerville numerical simulation and the point source stochastic model. The epistemic uncertainties from these proponent models were included in the total epistemic uncertainty. The epistemic uncertainties were computed by the facilitation team.

I made the following modifications to these statistical estimates of the epistemic uncertainty: For the epistemic uncertainty in sigma (σ_σ), I set a minimum value of 0.05 natural log units and a maximum value of 0.2 natural log units.

F6-5 FINAL POINT ESTIMATES

The final point estimates were checked for consistency and found to be mutually consistent. My final point estimates of μ, σ, σ_μ, and σ_σ for the horizontal component for the 51 cases are given in Tables F6-5 to F6-13 for the nine ground motion parameters. The corresponding point estimates for the vertical component are given in Tables F6-14 to F6-22.

F6-6 EVALUATION OF REGRESSION MODELS

The facilitation team developed regression models to parameterize my point estimates in terms of the dependence on magnitude, distance, and style-of-faulting. I reviewed the final regression models given in Volume 10F of the Data Package.

F6-6.1 Mu

The point estimates of the median ground motion are well fit by the regression fits. The point estimates for each magnitude cluster around the regression fits, and point estimates for different magnitudes are generally well separated. Based on review of residual plots (Vol. 10F of the Ground Motion Data Package), the regression fit is judged to be an appropriate representation of my point estimates.

F6-6.2 Sigma

The sigma values are well modeled by a functional form in which sigma decreases with increasing magnitude until it reaches a minimum value at magnitude 7. The sigma values vary from about 0.6 for peak acceleration to about 0.8 for 0.3 Hz spectral acceleration. This degree of variation is not very much larger than that of empirical attenuation relations derived for a specified region, and for this reason is considered to be a realistic representation of the aleatory variation of ground motion at Yucca Mountain.

F6-6.3 Sigma Mu

There are wide variations in the values of sigma mu. They have a systematic variation with distance, tending to have a minimum at a distance of about 20 km. This variation is modeled using a quadratic equation in distance. The values of sigma mu also have a magnitude dependence which is highly variable. This was fit by a linear magnitude dependence, which was allowed to vary from frequency to frequency. This variation is quite large with the magnitude dependence having a minimum at 5 Hz and larger values at both lower and higher frequencies. Based on review of the residual plots (Vol. 10F of the Ground Motion Data Package), these models were judged to be an appropriate representation of my sigma Mu estimates.

F6-6.4 Sigma Sigma

The values of sigma sigma have small variations with magnitude. They also have small variations with distance, except for the lower frequencies and for the vertical component. The regression model is judged to be an appropriate representation of my sigma sigma estimates.

F6-7 SPECIAL CASES

Adjustments for two special fault rupture cases were developed using ground motion simulations. These two scenarios are described below. The simulations used the high frequency part of Woodward-Clyde's simulation procedure (i.e. same method as Somerville simulations) to predict the ground motion for the special cases and for the base cases. The ratios of the predicted ground motions were used to guide the recommendation of adjustment factors to use for the special cases. These simulations are unbiased for frequencies above 1 Hz. At frequencies less than 1 Hz, the simulations tend to underpredict recorded data. However, as described below, the adjustments are based on the ratio of the two simulations and not on their absolute values, so I have also based my estimates on the computed ratios at frequencies less than 1 Hz.

F6-7.1 Multiple Parallel Faults

The response spectral ratios were computed for the case of three parallel faults dipping 60 degrees (separated by 2 and 3 km) rupturing simultaneously compared to a single fault

rupture. The total moment for both cases corresponds to a moment magnitude 6.82 (each of the three parallel faults had moment corresponding to magnitude 6.5). The resulting ratios are given in the Ground Motion Data Package (Vol. 1b). Based on these computed ratios, my estimates of the adjustment factors for simultaneous rupture on parallel faults are given in Table F6-23. These adjustments include additional aleatory and epistemic uncertainty.

F6-7.2 Low Angle Fault

The second case is one of a low angle fault with a dip of about 30 degrees beneath the site, together with a set of three more steeply dipping conjugate faults. The total moment for both cases corresponds to magnitude 6.8. The resulting ratios are given in the Ground Motion Data Package (Vol. 1b). Based on these computed ratios, my estimates of the adjustment factors for simultaneous rupture are given in Table F6-24. These adjustments include additional aleatory and epistemic uncertainty.

F6-8 REFERENCES

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TABLE F6-1
WEIGHTS FOR MODEL CLASSES
(BASE LEVEL WEIGHT B)

MODEL	CLASS	WEIGHT
Finite Fault Numerical	1	0.4
Explosion (NTS)	2	0.05
Empirical	3	0.5
Point Source Stochastic	4	0.05

TABLE F6-2
MAGNITUDE FACTORS M

MODEL	M 5.0	M 5.8	M 6.5	M 7.0	M 7.5
Zeng and Anderson	1	1	1	1	1
Silva Finite Fault	1	1	1	1	1
Somerville	1	1	1	1	1
Explosion	1	1	0.9	0.8	0.7
Empirical	1	1	1	1	1
Point Source Stochastic	1	0.9	0.8	0.7	0.6

TABLE F6-3
DISTANCE FACTORS D (APPLIED TO RUPTURE DISTANCE)

MODEL	1 KM	5 KM	10 KM	20 KM	50 KM
Zeng and Anderson	1	1	1	1	1
Silva Finite Fault	0.5 (f<1 Hz) 1.0 (f >1 Hz)	0.7 (f<1 Hz) 1.0 (f >1 Hz)	0.8 (f<1 Hz) 1.0 (f >1 Hz)	0.9 (f<1 Hz) 1.0 (f >1 Hz)	1.0 (f<1 Hz) 1.0 (f >1 Hz)
Somerville	1	1	1	1	1
Blast 2	0	0	0.75	1	1
Empirical	1	1	1	1	1
Point Source Stochastic	0.2 (f<1 Hz) 0.5 (f >1 Hz)	0.4 (f<1 Hz) 0.7 (f >1 Hz)	0.6 (f<1 Hz) 0.8 (f >1 Hz)	0.8 (f<1 Hz) 0.9 (f >1 Hz)	1.0 (f<1 Hz) 1.0 (f >1 Hz)

TABLE F6-4
FREQUENCY FACTORS F

MODEL	0.3 HZ	0.5 HZ	1.0 HZ, PGV	2-20 HZ	PGA
Zeng and Anderson	1	1	1	1	1
Silva Finite Fault	0.4	0.6	0.8	1	1
Somerville	1	1	1	1	1
Explosion	1	1	1	1	1
Empirical	1	1	1	1	1
Point Source Stochastic	0.25	0.5	0.75	1	1

TABLE F6-5
P. G. SOMERVILLE: HORIZONTAL POINT ESTIMATES
PEAK GROUND ACCELERATION

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.12685	0.66211	0.34401	0.17028
2	5.00	1	0.20004	0.67019	0.46825	0.16916
3	5.00	5	0.04871	0.66711	0.32421	0.16981
4	5.00	5	0.07955	0.67110	0.39932	0.16929
5	5.80	10	0.09769	0.60725	0.22804	0.16059
6	5.80	20	0.07441	0.60700	0.27123	0.16107
7	6.50	1	0.42450	0.57421	0.30895	0.16175
8	6.50	1	0.45352	0.57590	0.44710	0.16307
9	6.50	1	0.40468	0.57327	0.35879	0.15956
10	6.50	5	0.35922	0.57225	0.31859	0.16200
11	6.50	5	0.24893	0.57305	0.23152	0.15953
12	6.50	50	0.02844	0.57185	0.29228	0.16329
13	6.50	50	0.02874	0.57143	0.25031	0.16324
14	7.00	10	0.25219	0.54359	0.27775	0.16772
15	7.50	50	0.05831	0.54086	0.24524	0.17343
16	7.50	50	0.06337	0.53782	0.23715	0.17194
17	5.00	1	0.04215	0.66211	0.61112	0.17028
18	5.80	5	0.15546	0.60692	0.30883	0.16036
19	5.80	5	0.09311	0.60105	0.31775	0.15643
20	5.00	10	0.06646	0.66987	0.21914	0.16989
21	5.00	10	0.08515	0.66605	0.27478	0.17056
22	5.00	50	0.00619	0.66772	0.33520	0.17069
23	5.00	50	0.00623	0.66399	0.38635	0.17150
24	5.00	160	0.00076	0.66028	0.53082	0.17243
25	5.80	1	0.26746	0.60578	0.30810	0.15966
26	5.80	5	0.22324	0.60528	0.27648	0.16047
27	5.80	5	0.13839	0.60036	0.23796	0.15646
28	5.80	10	0.12035	0.61178	0.23646	0.16143
29	5.80	10	0.16267	0.60694	0.28490	0.16062
30	5.80	10	0.07877	0.60147	0.29348	0.15679
31	5.80	50	0.01163	0.60503	0.48840	0.16126
32	5.80	50	0.01200	0.60901	0.50764	0.16137
33	6.50	5	0.30989	0.57347	0.27315	0.16224
34	6.50	10	0.20335	0.57463	0.26236	0.16318
35	6.50	10	0.28016	0.57401	0.32126	0.16304
36	6.50	10	0.15880	0.56687	0.23014	0.15748
37	6.50	20	0.10034	0.57119	0.23849	0.16276
38	6.50	20	0.13590	0.57548	0.30907	0.16380
39	6.50	20	0.07770	0.56387	0.20893	0.15668
40	6.50	100	0.01201	0.57202	0.41962	0.16360
41	6.50	160	0.00473	0.58008	0.48846	0.16752
42	7.00	1	0.46160	0.54927	0.29043	0.16799
43	7.00	10	0.33444	0.55053	0.31262	0.17045
44	7.00	10	0.19492	0.53863	0.20610	0.16217
45	7.00	50	0.04389	0.54249	0.27267	0.16829
46	7.00	50	0.04717	0.54425	0.25900	0.16883
47	7.50	1	0.50761	0.55646	0.34719	0.18185
48	5.00	10	0.28777	0.54833	0.28260	0.17857
49	5.00	10	0.36600	0.54105	0.38566	0.17251
50	8.00	50	0.07351	0.55289	0.25562	0.18382
51	8.00	160	0.01859	0.54634	0.42745	0.18045

TABLE F6-6
P. G. SOMERVILLE: HORIZONTAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 0.05 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.23556	0.67213	0.50631	0.16613
2	5.00	1	0.35471	0.67621	0.26888	0.16530
3	5.00	5	0.08473	0.67707	0.38640	0.16543
4	5.00	5	0.12255	0.68112	0.26846	0.16472
5	5.80	10	0.16379	0.61207	0.27084	0.15854
6	5.80	20	0.11618	0.60838	0.27001	0.15864
7	6.50	1	0.74006	0.57360	0.29435	0.15886
8	6.50	1	0.77949	0.57461	0.35631	0.16011
9	6.50	1	0.69017	0.56929	0.31567	0.15548
10	6.50	5	0.62012	0.57031	0.32786	0.15909
11	6.50	5	0.42881	0.56699	0.31483	0.15471
12	6.50	50	0.03927	0.56955	0.35488	0.16028
13	6.50	50	0.03968	0.56902	0.33133	0.16022
14	7.00	10	0.40569	0.53667	0.26482	0.16408
15	7.50	50	0.07920	0.53438	0.29135	0.17008
16	7.50	50	0.08491	0.53108	0.27838	0.16836
17	5.00	1	0.07255	0.67213	0.66627	0.16613
18	5.80	5	0.25176	0.60754	0.31705	0.15754
19	5.80	5	0.15041	0.60238	0.35176	0.15407
20	5.00	10	0.12032	0.69470	0.24836	0.16328
21	5.00	10	0.15528	0.67917	0.25124	0.16544
22	5.00	50	0.00908	0.67292	0.40172	0.16738
23	5.00	50	0.00891	0.67292	0.44778	0.16738
24	5.00	160	0.00101	0.66165	0.58586	0.17105
25	5.80	1	0.49351	0.60686	0.32597	0.15681
26	5.80	5	0.40211	0.61159	0.27547	0.15891
27	5.80	5	0.24027	0.60546	0.36690	0.15478
28	5.80	10	0.20613	0.61425	0.28229	0.15942
29	5.80	10	0.26987	0.60860	0.27723	0.15810
30	5.80	10	0.13220	0.60100	0.41634	0.15381
31	5.80	50	0.01637	0.60930	0.57855	0.15902
32	5.80	50	0.01654	0.61128	0.59802	0.15913
33	6.50	5	0.53572	0.56783	0.28093	0.15797
34	6.50	10	0.34849	0.57482	0.26659	0.16122
35	6.50	10	0.46808	0.57049	0.34531	0.15949
36	6.50	10	0.26252	0.56752	0.30668	0.15539
37	6.50	20	0.15998	0.57228	0.26549	0.16135
38	6.50	20	0.21731	0.57398	0.33571	0.16119
39	6.50	20	0.12109	0.56271	0.30574	0.15380
40	6.50	100	0.01428	0.56807	0.49650	0.16014
41	6.50	160	0.00585	0.56868	0.58154	0.16019
42	7.00	1	0.80673	0.54469	0.31693	0.16514
43	7.00	10	0.54141	0.54639	0.35894	0.16810
44	7.00	10	0.31455	0.53358	0.28527	0.15887
45	7.00	50	0.06028	0.53540	0.31849	0.16472
46	7.00	50	0.06482	0.53766	0.29889	0.16542
47	7.50	1	0.85600	0.55313	0.39192	0.18094
48	5.00	10	0.46037	0.54323	0.30558	0.17678
49	5.00	10	0.55923	0.53466	0.41191	0.16909
50	8.00	50	0.09699	0.54969	0.32081	0.18063
51	8.00	160	0.02039	0.53952	0.47171	0.17578

TABLE F6-7
P. G. SOMERVILLE: HORIZONTAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 0.10 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.26627	0.72587	0.30872	0.16689
2	5.00	1	0.41922	0.71752	0.56245	0.16623
3	5.00	5	0.10108	0.72620	0.23935	0.16687
4	5.00	5	0.16962	0.72206	0.46122	0.16648
5	5.80	10	0.19342	0.63565	0.24279	0.16280
6	5.80	20	0.14547	0.63668	0.31630	0.16308
7	6.50	1	0.83758	0.60363	0.34411	0.16750
8	6.50	1	0.92271	0.60277	0.52665	0.16759
9	6.50	1	0.81708	0.60185	0.41828	0.16558
10	6.50	5	0.70440	0.59789	0.35826	0.16542
11	6.50	5	0.49557	0.59853	0.23690	0.16381
12	6.50	50	0.05084	0.59820	0.34842	0.16708
13	6.50	50	0.05128	0.59748	0.26587	0.16661
14	7.00	10	0.48458	0.56810	0.31459	0.17257
15	7.50	50	0.09807	0.56838	0.35769	0.18113
16	7.50	50	0.10788	0.56212	0.32674	0.17742
17	5.00	1	0.09171	0.70918	0.44310	0.16611
18	5.80	5	0.31077	0.63703	0.35302	0.16296
19	5.80	5	0.18390	0.63153	0.37054	0.15918
20	5.00	10	0.14000	0.72669	0.29136	0.16665
21	5.00	10	0.18111	0.71089	0.34593	0.16603
22	5.00	50	0.01180	0.71936	0.30093	0.16602
23	5.00	50	0.01172	0.71165	0.34041	0.16601
24	5.00	160	0.00113	0.70011	0.57071	0.16700
25	5.80	1	0.52907	0.63783	0.34188	0.16286
26	5.80	5	0.46096	0.63638	0.28735	0.16289
27	5.80	5	0.27090	0.63412	0.26397	0.16106
28	5.80	10	0.23132	0.63761	0.25615	0.16405
29	5.80	10	0.31414	0.63614	0.32321	0.16284
30	5.80	10	0.15332	0.62729	0.28296	0.15831
31	5.80	50	0.02140	0.63652	0.46335	0.16339
32	5.80	50	0.02147	0.63753	0.51396	0.16396
33	6.50	5	0.61894	0.60216	0.31541	0.16686
34	6.50	10	0.40442	0.59967	0.29965	0.16719
35	6.50	10	0.56217	0.59827	0.39534	0.16676
36	6.50	10	0.31055	0.59561	0.21021	0.16285
37	6.50	20	0.19614	0.59505	0.28443	0.16562
38	6.50	20	0.25581	0.59849	0.32972	0.16680
39	6.50	20	0.14720	0.59356	0.20680	0.16180
40	6.50	100	0.01784	0.59481	0.56710	0.16584
41	6.50	160	0.00640	0.59523	0.68033	0.16595
42	7.00	1	0.92215	0.57375	0.35370	0.17315
43	7.00	10	0.64438	0.57500	0.37483	0.17636
44	7.00	10	0.37921	0.56626	0.20668	0.16845
45	7.00	50	0.07569	0.56589	0.36236	0.17238
46	7.00	50	0.08315	0.56929	0.32682	0.17398
47	7.50	1	0.96213	0.58391	0.38809	0.19009
48	5.00	10	0.54278	0.57316	0.33028	0.18513
49	5.00	10	0.68498	0.56732	0.40738	0.17953
50	8.00	50	0.11749	0.59142	0.37641	0.19357
51	8.00	160	0.01992	0.57948	0.75236	0.18723

TABLE F6-8
P. G. SOMERVILLE: HORIZONTAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 0.20 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.20496	0.74800	0.31892	0.16234
2	5.00	1	0.32023	0.75617	0.55911	0.16285
3	5.00	5	0.07769	0.74023	0.23264	0.16235
4	5.00	5	0.12930	0.73621	0.39891	0.16258
5	5.80	10	0.18434	0.66914	0.24758	0.16336
6	5.80	20	0.14387	0.66279	0.32779	0.16157
7	6.50	1	0.79685	0.62831	0.33769	0.16327
8	6.50	1	0.86816	0.63618	0.49054	0.16704
9	6.50	1	0.78611	0.64023	0.41777	0.16880
10	6.50	5	0.68378	0.63114	0.35506	0.16510
11	6.50	5	0.49115	0.62859	0.23777	0.16257
12	6.50	50	0.05720	0.62913	0.35788	0.16484
13	6.50	50	0.05860	0.62532	0.24486	0.16344
14	7.00	10	0.49293	0.60051	0.31422	0.16971
15	7.50	50	0.12167	0.59775	0.37504	0.17575
16	7.50	50	0.13486	0.59373	0.34083	0.17351
17	5.00	1	0.06626	0.73174	0.52280	0.16294
18	5.80	5	0.27529	0.66444	0.37614	0.16241
19	5.80	5	0.17928	0.65960	0.31658	0.15977
20	5.00	10	0.11052	0.74162	0.27433	0.16224
21	5.00	10	0.14044	0.73777	0.32602	0.16249
22	5.00	50	0.01228	0.74986	0.24322	0.16206
23	5.00	50	0.01083	0.73108	0.32822	0.16335
24	5.00	160	0.00162	0.73857	0.52835	0.16245
25	5.80	1	0.47160	0.66292	0.33285	0.16185
26	5.80	5	0.40567	0.66314	0.29076	0.16241
27	5.80	5	0.25115	0.66083	0.21331	0.16028
28	5.80	10	0.21509	0.66782	0.28684	0.16280
29	5.80	10	0.29150	0.66285	0.33711	0.16146
30	5.80	10	0.15017	0.66366	0.20506	0.16151
31	5.80	50	0.02232	0.66670	0.49040	0.16261
32	5.80	50	0.02484	0.66627	0.40043	0.16260
33	6.50	5	0.59066	0.62763	0.30157	0.16310
34	6.50	10	0.38428	0.63144	0.28040	0.16537
35	6.50	10	0.52735	0.62934	0.35164	0.16437
36	6.50	10	0.31420	0.62215	0.22346	0.15992
37	6.50	20	0.19461	0.62917	0.26755	0.16497
38	6.50	20	0.27263	0.62716	0.34790	0.16416
39	6.50	20	0.15878	0.62480	0.19867	0.16097
40	6.50	100	0.02251	0.62733	0.53137	0.16439
41	6.50	160	0.00902	0.62994	0.65107	0.16573
42	7.00	1	0.88557	0.60483	0.32568	0.17012
43	7.00	10	0.65355	0.60370	0.36173	0.17132
44	7.00	10	0.40028	0.59587	0.22543	0.16537
45	7.00	50	0.09106	0.59920	0.37087	0.16977
46	7.00	50	0.09930	0.59974	0.32289	0.16998
47	7.50	1	1.01131	0.61181	0.41856	0.18346
48	5.00	10	0.59450	0.60735	0.37395	0.18268
49	5.00	10	0.71661	0.59447	0.39673	0.17323
50	8.00	50	0.14508	0.61914	0.36173	0.18322
51	8.00	160	0.02856	0.61121	0.74180	0.17934

TABLE F6-9
P. G. SOMERVILLE: HORIZONTAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 0.50 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.09150	0.81820	0.35807	0.11651
2	5.00	1	0.15592	0.79811	0.54214	0.11576
3	5.00	5	0.03637	0.81384	0.29882	0.11592
4	5.00	5	0.06318	0.80192	0.39047	0.11545
5	5.80	10	0.11233	0.72973	0.26054	0.16404
6	5.80	20	0.09283	0.73164	0.29147	0.16373
7	6.50	1	0.57048	0.69005	0.23564	0.16926
8	6.50	1	0.60408	0.69062	0.35060	0.17001
9	6.50	1	0.54719	0.69347	0.29477	0.17306
10	6.50	5	0.47555	0.69307	0.26573	0.16977
11	6.50	5	0.33672	0.68723	0.22342	0.17011
12	6.50	50	0.04810	0.69664	0.31576	0.17025
13	6.50	50	0.05156	0.68937	0.30935	0.16727
14	7.00	10	0.39010	0.66504	0.30204	0.17609
15	7.50	50	0.11930	0.66328	0.32425	0.18392
16	7.50	50	0.13247	0.65656	0.32840	0.18035
17	5.00	1	0.03323	0.81820	0.55906	0.11651
18	5.80	5	0.17997	0.73100	0.27433	0.16606
19	5.80	5	0.10319	0.72866	0.34550	0.17100
20	5.00	10	0.04654	0.80005	0.22366	0.11571
21	5.00	10	0.06256	0.79249	0.26854	0.11676
22	5.00	50	0.00646	0.79687	0.24879	0.11608
23	5.00	50	0.00758	0.80057	0.24584	0.11563
24	5.00	160	0.00134	0.78950	0.52214	0.11750
25	5.80	1	0.29417	0.72485	0.28678	0.16543
26	5.80	5	0.25563	0.72709	0.31633	0.16471
27	5.80	5	0.15236	0.71695	0.25123	0.16779
28	5.80	10	0.13898	0.73125	0.25558	0.16453
29	5.80	10	0.19236	0.72750	0.32545	0.16345
30	5.80	10	0.08929	0.72259	0.30048	0.16916
31	5.80	50	0.01640	0.72856	0.52114	0.16210
32	5.80	50	0.01655	0.73108	0.61930	0.16330
33	6.50	5	0.42564	0.68972	0.27307	0.16855
34	6.50	10	0.29008	0.69268	0.29561	0.16919
35	6.50	10	0.40129	0.69197	0.34186	0.16893
36	6.50	10	0.22010	0.68538	0.26278	0.16946
37	6.50	20	0.14499	0.69118	0.24339	0.16811
38	6.50	20	0.20260	0.69663	0.31729	0.17059
39	6.50	20	0.12046	0.68600	0.20392	0.16967
40	6.50	100	0.02362	0.69155	0.47442	0.16796
41	6.50	160	0.01099	0.69499	0.62162	0.16987
42	7.00	1	0.70091	0.66658	0.26716	0.17661
43	7.00	10	0.54131	0.66590	0.34128	0.17644
44	7.00	10	0.30141	0.66167	0.21693	0.17500
45	7.00	50	0.08183	0.66354	0.30611	0.17524
46	7.00	50	0.09179	0.66829	0.35469	0.17757
47	7.50	1	0.78365	0.67552	0.28380	0.19197
48	5.00	10	0.46638	0.66913	0.28560	0.18822
49	5.00	10	0.59559	0.66245	0.36648	0.18310
50	8.00	50	0.15150	0.68582	0.35736	0.19604
51	8.00	160	0.04286	0.67904	0.70696	0.19366

TABLE F6-10
P. G. SOMERVILLE: HORIZONTAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 1.00 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.03684	0.83469	0.33193	0.08148
2	5.00	1	0.06206	0.83067	0.60540	0.08165
3	5.00	5	0.01457	0.82650	0.26743	0.08192
4	5.00	5	0.02506	0.82650	0.44080	0.08192
5	5.80	10	0.05252	0.77721	0.23950	0.15479
6	5.80	20	0.04284	0.77375	0.28050	0.15604
7	6.50	1	0.29635	0.74215	0.18465	0.16585
8	6.50	1	0.29795	0.74257	0.33535	0.16913
9	6.50	1	0.26623	0.73288	0.28143	0.16849
10	6.50	5	0.24537	0.74086	0.22083	0.16696
11	6.50	5	0.16304	0.73328	0.23493	0.16839
12	6.50	50	0.02948	0.73676	0.33435	0.16061
13	6.50	50	0.02857	0.73621	0.36707	0.16286
14	7.00	10	0.21064	0.71277	0.19504	0.17229
15	7.50	50	0.07496	0.70823	0.30571	0.17979
16	7.50	50	0.08091	0.70462	0.32346	0.18029
17	5.00	1	0.01255	0.82266	0.61964	0.08275
18	5.80	5	0.08015	0.78508	0.43353	0.16412
19	5.80	5	0.04604	0.78072	0.44976	0.17009
20	5.00	10	0.01740	0.82507	0.21418	0.08270
21	5.00	10	0.02264	0.82507	0.24977	0.08270
22	5.00	50	0.00239	0.82203	0.36740	0.08359
23	5.00	50	0.00264	0.83320	0.30942	0.08132
24	5.00	160	0.00070	0.82947	0.52026	0.08183
25	5.80	1	0.13136	0.78076	0.34181	0.16064
26	5.80	5	0.11392	0.76917	0.34941	0.15745
27	5.80	5	0.06605	0.77734	0.33776	0.16841
28	5.80	10	0.06332	0.77894	0.23340	0.15560
29	5.80	10	0.08897	0.77117	0.34175	0.15610
30	5.80	10	0.04217	0.77745	0.27790	0.16945
31	5.80	50	0.00868	0.77161	0.51785	0.15059
32	5.80	50	0.00905	0.77464	0.57520	0.15439
33	6.50	5	0.21089	0.74657	0.21098	0.16627
34	6.50	10	0.15596	0.74104	0.24869	0.16352
35	6.50	10	0.21720	0.73750	0.32650	0.16479
36	6.50	10	0.11297	0.73283	0.21914	0.16824
37	6.50	20	0.07793	0.73589	0.20854	0.16093
38	6.50	20	0.10511	0.74032	0.35329	0.16554
39	6.50	20	0.06245	0.73445	0.20333	0.16883
40	6.50	100	0.01547	0.73751	0.44519	0.16081
41	6.50	160	0.00758	0.73845	0.59921	0.16123
42	7.00	1	0.34316	0.71578	0.27740	0.17388
43	7.00	10	0.29263	0.71453	0.31788	0.17550
44	7.00	10	0.16508	0.70645	0.19392	0.17339
45	7.00	50	0.04968	0.71282	0.36017	0.17192
46	7.00	50	0.05178	0.70948	0.42042	0.17260
47	7.50	1	0.41974	0.71955	0.29846	0.18445
48	5.00	10	0.27324	0.71321	0.23654	0.18272
49	5.00	10	0.35357	0.70820	0.39652	0.18182
50	8.00	50	0.10447	0.71589	0.32365	0.19499
51	8.00	160	0.03703	0.72344	0.64636	0.19765

TABLE F6-11
P. G. SOMERVILLE: HORIZONTAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 2.00 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.00935	0.89172	0.49082	0.07346
2	5.00	1	0.01588	0.88361	0.57965	0.07156
3	5.00	5	0.00424	0.87199	0.42286	0.07095
4	5.00	5	0.00695	0.87199	0.45999	0.07095
5	5.80	10	0.01734	0.83440	0.34705	0.16632
6	5.80	20	0.01304	0.82725	0.31630	0.17233
7	6.50	1	0.13040	0.79967	0.29657	0.17861
8	6.50	1	0.12585	0.79124	0.31512	0.18592
9	6.50	1	0.11443	0.78346	0.24399	0.18540
10	6.50	5	0.09634	0.79442	0.30664	0.18535
11	6.50	5	0.07563	0.78346	0.22409	0.18540
12	6.50	50	0.01255	0.80184	0.49514	0.17480
13	6.50	50	0.01162	0.79359	0.51534	0.17977
14	7.00	10	0.09182	0.78090	0.31233	0.18956
15	7.50	50	0.03627	0.77257	0.61321	0.19429
16	7.50	50	0.03656	0.75720	0.67174	0.19306
17	5.00	1	0.00321	0.87957	0.81982	0.07103
18	5.80	5	0.02974	0.81767	0.42108	0.17328
19	5.80	5	0.01613	0.81468	0.43387	0.18124
20	5.00	10	0.00564	0.87375	0.32829	0.07002
21	5.00	10	0.00659	0.87757	0.34831	0.06986
22	5.00	50	0.00089	0.87503	0.40978	0.06988
23	5.00	50	0.00080	0.87503	0.43352	0.06988
24	5.00	160	0.00038	0.87503	0.67053	0.06988
25	5.80	1	0.04779	0.83937	0.29572	0.17496
26	5.80	5	0.04019	0.81765	0.38144	0.17326
27	5.80	5	0.02605	0.81267	0.33872	0.17996
28	5.80	10	0.02066	0.83756	0.32523	0.16963
29	5.80	10	0.02601	0.82820	0.35891	0.17768
30	5.80	10	0.01499	0.81065	0.36414	0.17876
31	5.80	50	0.00324	0.83232	0.70135	0.15990
32	5.80	50	0.00316	0.82608	0.68550	0.16912
33	6.50	5	0.09168	0.80289	0.28001	0.17827
34	6.50	10	0.06077	0.80252	0.29024	0.17778
35	6.50	10	0.07721	0.79323	0.32399	0.18391
36	6.50	10	0.04671	0.78145	0.24919	0.18392
37	6.50	20	0.03449	0.80536	0.31726	0.17839
38	6.50	20	0.04115	0.78951	0.36495	0.17917
39	6.50	20	0.02517	0.77944	0.35264	0.18250
40	6.50	100	0.00736	0.80333	0.49687	0.17544
41	6.50	160	0.00375	0.81024	0.71032	0.17996
42	7.00	1	0.17833	0.78134	0.28807	0.18974
43	7.00	10	0.11726	0.76955	0.34867	0.19232
44	7.00	10	0.07280	0.75719	0.31483	0.18813
45	7.00	50	0.02407	0.77831	0.47644	0.18647
46	7.00	50	0.02391	0.76752	0.52341	0.18875
47	7.50	1	0.20165	0.77358	0.25862	0.19437
48	5.00	10	0.12130	0.77014	0.46233	0.19296
49	5.00	10	0.14380	0.75932	0.51746	0.19531
50	8.00	50	0.06298	0.78669	0.41537	0.19320
51	8.00	160	0.02673	0.78818	0.71781	0.19390

TABLE F6-12
P. G. SOMERVILLE: HORIZONTAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 3.33 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.00374	0.92730	0.58312	0.09756
2	5.00	1	0.00590	0.91491	0.50987	0.08801
3	5.00	5	0.00166	0.91521	0.41817	0.08808
4	5.00	5	0.00270	0.91521	0.37529	0.08808
5	5.80	10	0.00818	0.83867	0.40845	0.17568
6	5.80	20	0.00548	0.82797	0.39025	0.18281
7	6.50	1	0.06993	0.80856	0.31632	0.19199
8	6.50	1	0.06577	0.78857	0.27741	0.18916
9	6.50	1	0.06095	0.78495	0.23834	0.19035
10	6.50	5	0.05266	0.79868	0.31813	0.19668
11	6.50	5	0.04578	0.78903	0.28735	0.19460
12	6.50	50	0.00658	0.81892	0.68448	0.19413
13	6.50	50	0.00557	0.80189	0.66287	0.19465
14	7.00	10	0.04984	0.79348	0.44755	0.20000
15	7.50	50	0.02366	0.78296	0.62152	0.20000
16	7.50	50	0.02061	0.76972	0.72085	0.20000
17	5.00	1	0.00128	0.91903	0.80692	0.09107
18	5.80	5	0.01352	0.82829	0.36323	0.18747
19	5.80	5	0.00707	0.81654	0.42916	0.18526
20	5.00	10	0.00231	0.90732	0.31295	0.08259
21	5.00	10	0.00247	0.91141	0.31563	0.08528
22	5.00	50	0.00045	0.90390	0.28857	0.08035
23	5.00	50	0.00042	0.90390	0.23381	0.08035
24	5.00	160	0.00014	0.90390	0.44023	0.08035
25	5.80	1	0.02187	0.84211	0.37290	0.18271
26	5.80	5	0.01919	0.82662	0.39827	0.18624
27	5.80	5	0.01446	0.81451	0.32315	0.18351
28	5.80	10	0.01057	0.84091	0.40847	0.17743
29	5.80	10	0.01075	0.82595	0.40321	0.18302
30	5.80	10	0.00716	0.81654	0.55838	0.18526
31	5.80	50	0.00159	0.84453	0.75672	0.17671
32	5.80	50	0.00134	0.83035	0.80990	0.18290
33	6.50	5	0.05362	0.81462	0.33815	0.19526
34	6.50	10	0.03180	0.81477	0.39268	0.19346
35	6.50	10	0.03487	0.79757	0.30877	0.19399
36	6.50	10	0.02312	0.78699	0.46158	0.19245
37	6.50	20	0.01700	0.81292	0.40440	0.18977
38	6.50	20	0.01701	0.80450	0.42581	0.19931
39	6.50	20	0.01283	0.78495	0.50653	0.19035
40	6.50	100	0.00316	0.80945	0.59371	0.18525
41	6.50	160	0.00208	0.82167	0.69273	0.19709
42	7.00	1	0.11074	0.78821	0.38796	0.20000
43	7.00	10	0.05961	0.77543	0.34455	0.20000
44	7.00	10	0.03930	0.76712	0.48181	0.20000
45	7.00	50	0.01376	0.79471	0.62554	0.20000
46	7.00	50	0.01248	0.78081	0.65245	0.20000
47	7.50	1	0.14308	0.78140	0.35964	0.20000
48	5.00	10	0.07049	0.79079	0.59501	0.20000
49	5.00	10	0.07945	0.76750	0.52931	0.20000
50	8.00	50	0.04597	0.81706	0.45953	0.20000
51	8.00	160	0.01879	0.81578	0.58322	0.20000

TABLE F6-13
P. G. SOMERVILLE: HORIZONTAL POINT ESTIMATES
PEAK GROUND VELOCITY

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	6.19240	0.75430	0.48845	0.11281
2	5.00	1	10.98591	0.75430	0.44195	0.11281
3	5.00	5	2.13188	0.75475	0.29240	0.11259
4	5.00	5	3.96052	0.74672	0.38568	0.10788
5	5.80	10	5.73685	0.70714	0.23293	0.17259
6	5.80	20	4.46827	0.70587	0.25751	0.17196
7	6.50	1	33.83729	0.69455	0.23259	0.19018
8	6.50	1	35.56729	0.69278	0.36673	0.19230
9	6.50	1	32.10643	0.68924	0.30448	0.19336
10	6.50	5	29.22446	0.69089	0.20506	0.18875
11	6.50	5	19.66437	0.68321	0.16941	0.18943
12	6.50	50	2.32895	0.69468	0.34012	0.18354
13	6.50	50	2.35763	0.69286	0.30174	0.18464
14	7.00	10	22.72798	0.68570	0.21177	0.19698
15	7.50	50	7.06813	0.68144	0.34854	0.20000
16	7.50	50	7.84944	0.67493	0.39502	0.20000
17	5.00	1	1.81194	0.74619	0.73224	0.10803
18	5.80	5	10.64026	0.70322	0.39214	0.17548
19	5.80	5	5.30738	0.69587	0.40784	0.17855
20	5.00	10	2.57144	0.74327	0.23137	0.10563
21	5.00	10	3.52047	0.74724	0.20853	0.10773
22	5.00	50	0.27154	0.74046	0.19880	0.10353
23	5.00	50	0.30210	0.74435	0.19384	0.10539
24	5.00	160	0.05051	0.73270	0.22300	0.10031
25	5.80	1	16.37890	0.70654	0.33392	0.17749
26	5.80	5	15.12992	0.69995	0.29071	0.17411
27	5.80	5	8.61951	0.69587	0.27074	0.17855
28	5.80	10	6.92135	0.71078	0.26388	0.17417
29	5.80	10	10.22196	0.70459	0.25593	0.17381
30	5.80	10	4.64371	0.69587	0.32568	0.17855
31	5.80	50	0.72668	0.71013	0.50384	0.16922
32	5.80	50	0.77207	0.70909	0.51733	0.17102
33	6.50	5	23.37201	0.69623	0.18464	0.18913
34	6.50	10	15.43033	0.69673	0.21861	0.18767
35	6.50	10	21.77278	0.69291	0.25140	0.18804
36	6.50	10	11.93642	0.68321	0.18789	0.18943
37	6.50	20	7.37069	0.69655	0.22603	0.18593
38	6.50	20	10.05950	0.69514	0.28043	0.18750
39	6.50	20	5.93595	0.67921	0.21433	0.18716
40	6.50	100	1.10247	0.69685	0.42514	0.18468
41	6.50	160	0.43038	0.70314	0.49181	0.18840
42	7.00	1	44.13552	0.68544	0.31694	0.19959
43	7.00	10	32.65550	0.68215	0.36959	0.19730
44	7.00	10	18.28486	0.67107	0.26776	0.19578
45	7.00	50	4.39625	0.68437	0.33475	0.19421
46	7.00	50	4.78176	0.68145	0.36190	0.19458
47	7.50	1	55.89795	0.67939	0.47824	0.20000
48	5.00	10	30.25994	0.68017	0.34578	0.20000
49	5.00	10	39.85450	0.67402	0.59017	0.20000
50	8.00	50	11.98477	0.68782	0.30368	0.20000
51	8.00	160	3.31111	0.69414	0.47062	0.20000

TABLE F6-14
P. G. SOMERVILLE: VERTICAL POINT ESTIMATES
PEAK GROUND ACCELERATION

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.07378	0.68879	0.60833	0.16487
2	5.00	1	0.09796	0.69571	0.38181	0.16406
3	5.00	5	0.02559	0.68912	0.41014	0.16484
4	5.00	5	0.03143	0.69383	0.25717	0.16424
5	5.80	10	0.05484	0.66131	0.29139	0.16307
6	5.80	20	0.05205	0.65132	0.48094	0.15984
7	6.50	1	0.31880	0.61061	0.28922	0.16555
8	6.50	1	0.34340	0.61640	0.20069	0.16863
9	6.50	1	0.33587	0.60731	0.20631	0.16382
10	6.50	5	0.28387	0.60837	0.21197	0.16464
11	6.50	5	0.21082	0.60731	0.20044	0.16382
12	6.50	50	0.01650	0.61043	0.37978	0.16558
13	6.50	50	0.01988	0.60896	0.33968	0.16502
14	7.00	10	0.18538	0.61075	0.19717	0.17078
15	7.50	50	0.03757	0.61342	0.26064	0.17526
16	7.50	50	0.04418	0.61299	0.38933	0.17499
17	5.00	1	0.02721	0.68100	0.47680	0.16622
18	5.80	5	0.08101	0.64918	0.43419	0.15918
19	5.80	5	0.05844	0.65283	0.44034	0.15927
20	5.00	10	0.03367	0.70077	0.26507	0.16368
21	5.00	10	0.06272	0.67609	0.47126	0.16747
22	5.00	50	0.00379	0.68582	0.21681	0.16543
23	5.00	50	0.00353	0.67487	0.20705	0.16789
24	5.00	160	0.00040	0.68792	0.45153	0.16507
25	5.80	1	0.16573	0.65169	0.44521	0.15950
26	5.80	5	0.16104	0.64918	0.34511	0.15918
27	5.80	5	0.10091	0.64999	0.29685	0.15841
28	5.80	10	0.06959	0.65626	0.28642	0.16110
29	5.80	10	0.11272	0.65184	0.37393	0.15985
30	5.80	10	0.05912	0.65086	0.30619	0.15866
31	5.80	50	0.00593	0.65165	0.72426	0.16001
32	5.80	50	0.00695	0.65499	0.64679	0.16083
33	6.50	5	0.24040	0.60752	0.20043	0.16431
34	6.50	10	0.14494	0.61287	0.19855	0.16664
35	6.50	10	0.23415	0.61562	0.33336	0.16804
36	6.50	10	0.12774	0.60556	0.20593	0.16302
37	6.50	20	0.06978	0.61164	0.22117	0.16607
38	6.50	20	0.11311	0.61711	0.42433	0.16881
39	6.50	20	0.05738	0.60403	0.26757	0.16237
40	6.50	100	0.00635	0.61462	0.42089	0.16746
41	6.50	160	0.00194	0.61043	0.57122	0.16558
42	7.00	1	0.38450	0.61379	0.23054	0.17269
43	7.00	10	0.28262	0.61563	0.30664	0.17356
44	7.00	10	0.16071	0.60976	0.21314	0.17056
45	7.00	50	0.02533	0.61346	0.23752	0.17214
46	7.00	50	0.03102	0.61346	0.44565	0.17214
47	7.50	1	0.56608	0.62222	0.34497	0.18242
48	5.00	10	0.22360	0.61272	0.20075	0.17500
49	5.00	10	0.32582	0.61763	0.32960	0.17837
50	8.00	50	0.05658	0.62428	0.25618	0.18716
51	8.00	160	0.01068	0.62600	0.39057	0.18808

TABLE F6-15
P. G. SOMERVILLE: VERTICAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 0.05 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.15772	0.70749	0.76790	0.16445
2	5.00	1	0.20636	0.70749	0.41530	0.16445
3	5.00	5	0.04953	0.70556	0.60813	0.16506
4	5.00	5	0.06307	0.71540	0.34975	0.16229
5	5.80	10	0.10625	0.68165	0.46289	0.16527
6	5.80	20	0.09462	0.67475	0.39269	0.16364
7	6.50	1	0.67470	0.63947	0.49673	0.15854
8	6.50	1	0.70605	0.64225	0.32958	0.15997
9	6.50	1	0.70342	0.63577	0.29604	0.15662
10	6.50	5	0.59567	0.63853	0.27704	0.15815
11	6.50	5	0.41764	0.63402	0.37116	0.15585
12	6.50	50	0.02526	0.64049	0.46268	0.15908
13	6.50	50	0.03119	0.64133	0.36746	0.15946
14	7.00	10	0.35760	0.63993	0.38624	0.16145
15	7.50	50	0.05804	0.64166	0.29617	0.16428
16	7.50	50	0.06865	0.64208	0.33342	0.16455
17	5.00	1	0.05422	0.70922	0.65489	0.16394
18	5.80	5	0.15984	0.67869	0.59931	0.16438
19	5.80	5	0.11461	0.68203	0.51714	0.16521
20	5.00	10	0.06652	0.73120	0.44195	0.15945
21	5.00	10	0.12529	0.70780	0.32486	0.16437
22	5.00	50	0.00629	0.70590	0.30308	0.16497
23	5.00	50	0.00655	0.71558	0.27563	0.16223
24	5.00	160	0.00049	0.70968	0.52859	0.16381
25	5.80	1	0.34670	0.68313	0.65271	0.16574
26	5.80	5	0.31565	0.67763	0.43895	0.16411
27	5.80	5	0.20463	0.67590	0.44077	0.16327
28	5.80	10	0.13755	0.68481	0.47950	0.16640
29	5.80	10	0.20970	0.67702	0.45211	0.16402
30	5.80	10	0.11064	0.67415	0.47794	0.16286
31	5.80	50	0.00969	0.67667	0.77705	0.16403
32	5.80	50	0.01110	0.68313	0.77305	0.16578
33	6.50	5	0.49492	0.63937	0.37995	0.15853
34	6.50	10	0.28340	0.64630	0.36624	0.16217
35	6.50	10	0.45400	0.64250	0.39416	0.16005
36	6.50	10	0.24953	0.63840	0.33306	0.15790
37	6.50	20	0.12885	0.64181	0.32264	0.15969
38	6.50	20	0.21089	0.64665	0.42316	0.16232
39	6.50	20	0.10462	0.63490	0.34463	0.15622
40	6.50	100	0.00825	0.64217	0.47322	0.15986
41	6.50	160	0.00263	0.63735	0.57091	0.15778
42	7.00	1	0.82059	0.64473	0.40287	0.16449
43	7.00	10	0.55246	0.64778	0.38121	0.16632
44	7.00	10	0.31272	0.64028	0.31713	0.16189
45	7.00	50	0.04108	0.64226	0.30352	0.16268
46	7.00	50	0.04971	0.64163	0.40652	0.16232
47	7.50	1	1.18734	0.65404	0.34735	0.17433
48	5.00	10	0.43726	0.64068	0.37812	0.16377
49	5.00	10	0.64258	0.64665	0.40857	0.16789
50	8.00	50	0.08547	0.66203	0.29039	0.17689
51	8.00	160	0.01236	0.65859	0.43773	0.17525

TABLE F6-16
P. G. SOMERVILLE: VERTICAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 0.10 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.16010	0.74611	0.57763	0.16184
2	5.00	1	0.22337	0.75476	0.35306	0.16219
3	5.00	5	0.05690	0.75452	0.29900	0.16220
4	5.00	5	0.07365	0.76393	0.20953	0.16329
5	5.80	10	0.11966	0.69210	0.23728	0.17931
6	5.80	20	0.11051	0.68580	0.50707	0.17535
7	6.50	1	0.73823	0.64401	0.30713	0.16749
8	6.50	1	0.81988	0.64744	0.18027	0.17011
9	6.50	1	0.81870	0.64556	0.18794	0.16913
10	6.50	5	0.62633	0.64477	0.23455	0.16788
11	6.50	5	0.48760	0.64381	0.18300	0.16774
12	6.50	50	0.03099	0.64588	0.39884	0.16841
13	6.50	50	0.03811	0.64672	0.36705	0.16902
14	7.00	10	0.38956	0.64615	0.22586	0.17258
15	7.50	50	0.07112	0.64937	0.27952	0.17817
16	7.50	50	0.08301	0.64682	0.33218	0.17576
17	5.00	1	0.06011	0.74611	0.37151	0.16184
18	5.80	5	0.18698	0.68620	0.38200	0.17567
19	5.80	5	0.13471	0.68460	0.37525	0.17492
20	5.00	10	0.07480	0.76120	0.19357	0.16293
21	5.00	10	0.14081	0.73993	0.50731	0.16195
22	5.00	50	0.00726	0.75879	0.25986	0.16267
23	5.00	50	0.00723	0.74363	0.23044	0.16185
24	5.00	160	0.00060	0.74995	0.50419	0.16196
25	5.80	1	0.38666	0.68319	0.37642	0.17407
26	5.80	5	0.35789	0.68620	0.34186	0.17567
27	5.80	5	0.22123	0.68109	0.30115	0.17299
28	5.80	10	0.14538	0.69000	0.30249	0.17792
29	5.80	10	0.24753	0.69000	0.43017	0.17792
30	5.80	10	0.12627	0.68197	0.30673	0.17345
31	5.80	50	0.01192	0.69144	0.59903	0.17871
32	5.80	50	0.01278	0.69039	0.69742	0.17803
33	6.50	5	0.53015	0.64647	0.19864	0.16914
34	6.50	10	0.31970	0.64768	0.20723	0.16996
35	6.50	10	0.51149	0.64768	0.37936	0.16996
36	6.50	10	0.29303	0.64294	0.17847	0.16706
37	6.50	20	0.14115	0.64636	0.23173	0.16885
38	6.50	20	0.23712	0.65162	0.47233	0.17299
39	6.50	20	0.12456	0.64053	0.20182	0.16526
40	6.50	100	0.01040	0.64253	0.48776	0.16611
41	6.50	160	0.00327	0.64526	0.48243	0.16796
42	7.00	1	0.88551	0.64860	0.21343	0.17525
43	7.00	10	0.61710	0.65486	0.33202	0.18076
44	7.00	10	0.35691	0.64348	0.18161	0.17130
45	7.00	50	0.04823	0.64532	0.27453	0.17159
46	7.00	50	0.05975	0.64721	0.39348	0.17321
47	7.50	1	1.28060	0.65447	0.31953	0.18430
48	5.00	10	0.47984	0.64734	0.23851	0.17655
49	5.00	10	0.73446	0.65181	0.32953	0.18095
50	8.00	50	0.10233	0.68628	0.30746	0.19296
51	8.00	160	0.01305	0.68714	0.46111	0.19349

TABLE F6-17
P. G. SOMERVILLE: VERTICAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 0.20 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.09737	0.70790	0.46283	0.15812
2	5.00	1	0.12227	0.72519	0.39050	0.15806
3	5.00	5	0.04052	0.72272	0.18015	0.15790
4	5.00	5	0.04497	0.71844	0.20833	0.15778
5	5.80	10	0.08398	0.66224	0.18203	0.18448
6	5.80	20	0.08352	0.65903	0.65002	0.18247
7	6.50	1	0.49988	0.63131	0.17124	0.17447
8	6.50	1	0.51212	0.62938	0.18859	0.17289
9	6.50	1	0.51422	0.62618	0.23132	0.17140
10	6.50	5	0.46260	0.62753	0.32639	0.17104
11	6.50	5	0.33509	0.62246	0.25549	0.16853
12	6.50	50	0.02766	0.62344	0.45348	0.16774
13	6.50	50	0.03472	0.62889	0.50463	0.17147
14	7.00	10	0.30345	0.63424	0.27424	0.17130
15	7.50	50	0.06965	0.63346	0.37064	0.17292
16	7.50	50	0.08244	0.63537	0.43457	0.17464
17	5.00	1	0.04035	0.72260	0.19173	0.15791
18	5.80	5	0.12461	0.65555	0.37005	0.18102
19	5.80	5	0.09263	0.65653	0.44917	0.18261
20	5.00	10	0.04271	0.72746	0.18553	0.15821
21	5.00	10	0.09779	0.71852	0.74214	0.15778
22	5.00	50	0.00690	0.72542	0.44304	0.15803
23	5.00	50	0.00621	0.70016	0.24477	0.15911
24	5.00	160	0.00072	0.71658	0.49537	0.15778
25	5.80	1	0.24341	0.65564	0.32974	0.18135
26	5.80	5	0.24503	0.66296	0.42537	0.18511
27	5.80	5	0.15421	0.65653	0.28785	0.18261
28	5.80	10	0.10607	0.66751	0.19628	0.18788
29	5.80	10	0.17645	0.66540	0.55566	0.18646
30	5.80	10	0.09044	0.65368	0.29935	0.18107
31	5.80	50	0.01039	0.66293	0.58305	0.18449
32	5.80	50	0.01318	0.66293	0.61210	0.18449
33	6.50	5	0.36537	0.62583	0.22202	0.16980
34	6.50	10	0.22157	0.62249	0.22821	0.16739
35	6.50	10	0.36529	0.62989	0.45026	0.17263
36	6.50	10	0.21717	0.62246	0.25934	0.16853
37	6.50	20	0.11352	0.62844	0.34263	0.17133
38	6.50	20	0.18856	0.63707	0.61682	0.17837
39	6.50	20	0.10412	0.62334	0.35721	0.16918
40	6.50	100	0.01150	0.63245	0.60045	0.17420
41	6.50	160	0.00411	0.62972	0.54124	0.17209
42	7.00	1	0.60068	0.63310	0.19069	0.17094
43	7.00	10	0.47908	0.64146	0.43190	0.17788
44	7.00	10	0.28186	0.63245	0.29635	0.17142
45	7.00	50	0.04658	0.63267	0.34077	0.16961
46	7.00	50	0.05956	0.63330	0.51532	0.17013
47	7.50	1	0.85330	0.64043	0.44020	0.18075
48	5.00	10	0.38870	0.63707	0.28920	0.17668
49	5.00	10	0.56272	0.63921	0.38650	0.17877
50	8.00	50	0.10036	0.68291	0.37053	0.18694
51	8.00	160	0.01642	0.67430	0.53252	0.18193

TABLE F6-18
P. G. SOMERVILLE: VERTICAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 0.50 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.03422	0.72666	0.54012	0.10665
2	5.00	1	0.04993	0.72882	0.41620	0.10695
3	5.00	5	0.01232	0.73947	0.35201	0.10923
4	5.00	5	0.01741	0.72663	0.21465	0.10662
5	5.80	10	0.04662	0.65851	0.24269	0.18656
6	5.80	20	0.05016	0.66082	0.72138	0.18736
7	6.50	1	0.26071	0.62923	0.17557	0.18081
8	6.50	1	0.30714	0.62730	0.24440	0.17909
9	6.50	1	0.29822	0.62503	0.26336	0.18029
10	6.50	5	0.25551	0.62428	0.34690	0.17539
11	6.50	5	0.20449	0.62240	0.30592	0.17795
12	6.50	50	0.02245	0.62466	0.41703	0.17416
13	6.50	50	0.03038	0.62403	0.45203	0.17368
14	7.00	10	0.20587	0.62996	0.42429	0.17897
15	7.50	50	0.06178	0.63173	0.46813	0.18414
16	7.50	50	0.06727	0.62919	0.42753	0.18167
17	5.00	1	0.01432	0.76125	0.30912	0.11776
18	5.80	5	0.06382	0.66273	0.31794	0.19017
19	5.80	5	0.04414	0.65166	0.32333	0.18853
20	5.00	10	0.01813	0.72279	0.22900	0.10622
21	5.00	10	0.03611	0.71939	0.64392	0.10603
22	5.00	50	0.00319	0.73923	0.29197	0.10918
23	5.00	50	0.00357	0.72281	0.30218	0.10620
24	5.00	160	0.00052	0.73081	0.56655	0.10723
25	5.80	1	0.10242	0.65806	0.45303	0.18849
26	5.80	5	0.12047	0.67098	0.44117	0.19668
27	5.80	5	0.08359	0.65407	0.29963	0.19000
28	5.80	10	0.06043	0.66503	0.29652	0.19111
29	5.80	10	0.09647	0.66693	0.58754	0.19256
30	5.80	10	0.05001	0.66479	0.29310	0.19770
31	5.80	50	0.00650	0.65852	0.75795	0.18518
32	5.80	50	0.00892	0.66290	0.69756	0.18809
33	6.50	5	0.21349	0.63320	0.31690	0.18321
34	6.50	10	0.14788	0.63188	0.44315	0.18135
35	6.50	10	0.23830	0.63103	0.59458	0.18058
36	6.50	10	0.14073	0.62240	0.40740	0.17795
37	6.50	20	0.07789	0.63162	0.45983	0.18051
38	6.50	20	0.13040	0.63541	0.70133	0.18403
39	6.50	20	0.06610	0.62240	0.34585	0.17795
40	6.50	100	0.01098	0.62948	0.51170	0.17806
41	6.50	160	0.00465	0.62865	0.47417	0.17735
42	7.00	1	0.37356	0.63806	0.24628	0.18873
43	7.00	10	0.31077	0.63633	0.55801	0.18526
44	7.00	10	0.18731	0.62710	0.37192	0.17995
45	7.00	50	0.03612	0.63112	0.34425	0.17919
46	7.00	50	0.04877	0.63175	0.54639	0.17978
47	7.50	1	0.47227	0.63670	0.34192	0.19122
48	5.00	10	0.25397	0.62957	0.37017	0.18263
49	5.00	10	0.34902	0.63234	0.40330	0.18541
50	8.00	50	0.09759	0.68433	0.52539	0.19740
51	8.00	160	0.02225	0.68735	0.52815	0.19908

TABLE F6-19
P. G. SOMERVILLE: VERTICAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 1.00 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.01487	0.72396	0.59915	0.06096
2	5.00	1	0.02009	0.74355	0.52136	0.06759
3	5.00	5	0.00514	0.73143	0.46037	0.06258
4	5.00	5	0.00709	0.72107	0.28922	0.06060
5	5.80	10	0.02063	0.68152	0.24850	0.16501
6	5.80	20	0.02121	0.67694	0.45973	0.16960
7	6.50	1	0.12704	0.65261	0.33598	0.17161
8	6.50	1	0.14949	0.64528	0.23075	0.17320
9	6.50	1	0.13288	0.64060	0.26323	0.17300
10	6.50	5	0.12916	0.64549	0.36728	0.17189
11	6.50	5	0.10138	0.63557	0.18932	0.16874
12	6.50	50	0.01184	0.65215	0.56161	0.16763
13	6.50	50	0.01778	0.63964	0.51927	0.16506
14	7.00	10	0.09980	0.65692	0.19090	0.17820
15	7.50	50	0.03706	0.64962	0.33361	0.17571
16	7.50	50	0.04440	0.64416	0.54776	0.17808
17	5.00	1	0.00498	0.72222	0.57960	0.06073
18	5.80	5	0.03013	0.67793	0.40827	0.17218
19	5.80	5	0.02336	0.67826	0.41718	0.18000
20	5.00	10	0.00561	0.71512	0.46046	0.06052
21	5.00	10	0.01065	0.72115	0.40098	0.06060
22	5.00	50	0.00109	0.72258	0.54108	0.06072
23	5.00	50	0.00164	0.72429	0.31752	0.06093
24	5.00	160	0.00027	0.72813	0.84266	0.06164
25	5.80	1	0.05079	0.69639	0.51719	0.17954
26	5.80	5	0.05576	0.68263	0.52813	0.17563
27	5.80	5	0.04016	0.67278	0.28952	0.17625
28	5.80	10	0.02737	0.68492	0.21740	0.16725
29	5.80	10	0.04364	0.67425	0.48164	0.16882
30	5.80	10	0.02979	0.67913	0.34723	0.18065
31	5.80	50	0.00354	0.69126	0.90359	0.17011
32	5.80	50	0.00544	0.67645	0.65565	0.16837
33	6.50	5	0.10058	0.65256	0.22116	0.17007
34	6.50	10	0.07520	0.65221	0.24430	0.16905
35	6.50	10	0.09753	0.63706	0.31782	0.16436
36	6.50	10	0.07775	0.63622	0.30979	0.16927
37	6.50	20	0.03587	0.65356	0.31777	0.16953
38	6.50	20	0.06067	0.63910	0.44461	0.16526
39	6.50	20	0.04127	0.63250	0.33262	0.16636
40	6.50	100	0.00668	0.64728	0.42363	0.16373
41	6.50	160	0.00300	0.65321	0.66840	0.16854
42	7.00	1	0.16517	0.66079	0.34362	0.18386
43	7.00	10	0.15615	0.64781	0.41130	0.17729
44	7.00	10	0.10686	0.64346	0.27268	0.17740
45	7.00	50	0.02192	0.65112	0.41624	0.17186
46	7.00	50	0.02905	0.64397	0.57490	0.17276
47	7.50	1	0.23897	0.67597	0.31835	0.20000
48	5.00	10	0.13373	0.64966	0.20006	0.17622
49	5.00	10	0.18746	0.64416	0.36136	0.17863
50	8.00	50	0.05750	0.69457	0.26407	0.20000
51	8.00	160	0.01873	0.68676	0.37409	0.19792

TABLE F6-20
P. G. SOMERVILLE: VERTICAL POINT ESTIMATES
SPECTRAL ACCELERATION AT 2.00 SEC PERIOD

CASE NO.	MAGNITUDE	DISTANCE (KM)	MU	SIGMA	SIGMA MU	SIGMA SIGMA
1	5.00	1	0.00528	0.75061	0.58970	0.05000
2	5.00	1	0.00737	0.74177	0.55608	0.05000
3	5.00	5	0.00163	0.74874	0.58722	0.05000
4	5.00	5	0.00221	0.74347	0.27709	0.05000
5	5.80	10	0.00829	0.71014	0.38829	0.17663
6	5.80	20	0.00728	0.70218	0.42240	0.19370
7	6.50	1	0.07362	0.67633	0.35637	0.19223
8	6.50	1	0.08710	0.65272	0.37668	0.19073
9	6.50	1	0.07256	0.64898	0.27299	0.18843
10	6.50	5	0.07212	0.65664	0.51043	0.19334
11	6.50	5	0.05199	0.64898	0.31616	0.18843
12	6.50	50	0.00603	0.67365	0.52647	0.18233
13	6.50	50	0.00952	0.65708	0.96688	0.18877
14	7.00	10	0.04515	0.66836	0.36952	0.18848
15	7.50	50	0.01758	0.67308	0.77941	0.19735
16	7.50	50	0.02587	0.65546	1.14281	0.20000
17	5.00	1	0.00132	0.74575	0.89256	0.05000
18	5.80	5	0.01465	0.68790	0.40234	0.18453
19	5.80	5	0.00813	0.68909	0.51553	0.19023
20	5.00	10	0.00163	0.74340	0.65642	0.05000
21	5.00	10	0.00406	0.74077	0.50402	0.05000
22	5.00	50	0.00030	0.74672	0.88321	0.05000
23	5.00	50	0.00085	0.74239	0.55950	0.05000
24	5.00	160	0.00006	0.76401	1.58506	0.05895
25	5.80	1	0.02657	0.72484	0.42309	0.19681
26	5.80	5	0.02763	0.69635	0.60058	0.19235
27	5.80	5	0.01876	0.69785	0.43628	0.19876
28	5.80	10	0.00988	0.70928	0.37559	0.17583
29	5.80	10	0.01468	0.70392	0.58568	0.19781
30	5.80	10	0.01200	0.69500	0.60653	0.19588
31	5.80	50	0.00136	0.70513	0.90701	0.16811
32	5.80	50	0.00261	0.70217	1.00268	0.19151
33	6.50	5	0.04904	0.67365	0.28416	0.18732
34	6.50	10	0.03521	0.67660	0.23218	0.18886
35	6.50	10	0.04713	0.66486	0.54750	0.20000
36	6.50	10	0.03764	0.65992	0.49680	0.20000
37	6.50	20	0.01769	0.67608	0.32514	0.18656
38	6.50	20	0.02765	0.66031	0.71023	0.19400
39	6.50	20	0.01883	0.65051	0.65120	0.19011
40	6.50	100	0.00272	0.67622	0.65840	0.18507
41	6.50	160	0.00165	0.67900	0.76614	0.18814
42	7.00	1	0.09073	0.66920	0.46200	0.19194
43	7.00	10	0.07471	0.65909	0.53847	0.20000
44	7.00	10	0.04910	0.65445	0.48829	0.20000
45	7.00	50	0.01057	0.67032	0.66237	0.18831
46	7.00	50	0.01771	0.65447	0.98430	0.19427
47	7.50	1	0.10482	0.68098	0.41106	0.20000
48	5.00	10	0.06140	0.68036	0.50301	0.20000
49	5.00	10	0.10125	0.67152	0.66516	0.20000
50	8.00	50	0.04051	0.73228	0.37460	0.20000
51	8.00	160	0.01646	0.73621	0.55947	0.20000