RAIs on G1.3 "Truncation of the Lognormal Distribution and Value of the Standard Deviation for Ground Motion Models in the Central and Eastern United States"

A. Epsilon Truncation

1. Epsilon is not in the seismic records and it is a function for each attenuation model and, therefore, it is dependent on models being used. Please explain the significance of epsilon truncation discussion without mentioning specific models used.

2. The report indicates that there are some epsilon >3 records in San Francisco, CA from the Loma Prieta earthquake in 1989. However, using the latest NGA attenuation relationships, Boore and Atkinson (2005), Abrahamson and Silva (2005) and Campbell and Bozorgnia (2006), no instances of epsilon >3 were found, see table attached. Please explain the difference.

Station in San Francisco	Rrup km	Rjb km	Vs30 m/s	Obs 1-hz SA (*g*)	Epsilon(A&S)
Diamond Heights	71.33	71.23	582.9	.09743	**0.58824**
Cliff House	78.68	78.58	712.8	.2015	**1.97060**
Presidio	77.43	77.34	594.5	.2448	**2.02865**
Rincon Hill	74.14	74.04	873.1	.10072	**1.13037**
1295Shafter	68.16	68.05	338.5	.05979	**-0.75422**
Telegraph Hill	Etc.				

3. Please justify using Taiwan and other region's ground motion data to study the truncation issue and other ground motion related subjects because ground motions from Chi-Chi earthquake (Mw=7.6, 1999) have been noted for its low-amplitudes when compared to predictions from ground motion prediction based on predominantly California data.

B. Sigma Revision

1. The report indicates that there are three causes for changes in NGA's standard deviation model: a) a larger data set which including data from Taiwan, Turkey and other countries, b) corrections of meta-data for Abrahamson and Silva model (site correction), and c) the ground motion parameter was modified to use the geometric mean of the horizontal components after finding the optimal rotational angle. Are the three causes, especially the b) and C) common for every of 5 ground motion modeling teams or only for Abrahamson and Silva's team. Since the sigma change was observed by 5 ground motion modeling teams of the NGA, please clarify what kind of causes for each team.

2. The report indicates that the meta data change has no significant impact on the sigma. However, the 1997 data seem to be different significantly from the 2005 data in the inter-event part, when comparing Figures 5-4 and 5-5, . Please explain this difference (and also at regional and teleseismic distance) .

3. Please explain why variation in half-duration time derived from Harvard Moment Tensor catalog is a reliable indicator of source variation for different regions. Two strong aftershocks, which occurred on 9/22/1999 00:14 UT and 9/20/1999 21:46 UT, respectively, from Chi-Chi earthquake have the same moment magnitude (Mw= 6.4) and the same half-durations (4.0 seconds) in the Harvard Catalog, but two events produced substantially different PGA and SA (5 Hz) for stations within 70 km distance.

4. The author stated that the path effects should give the same variability in the CEUS and WUS because synthetic seismograms using various crustal models for the CEUS show the same variability as seismograms for the WUS. Please explain how much plane-layered models can capture the variability of path effects, where there is likely to be lateral variations of crustal structures.

5. Please explain what is the USNRC 2002 ground motion model referred in Section 6.

6. The report indicates that the inclusion of Chi-Chi mainshock causes the increase in the intra-event standard deviation at large magnitudes and the inclusion of additional earthquakes in the magnitude range of 5-6 have a similar variability of the event terms resulting in a reduction of the inter-event standard deviation of magnitudes less than 6.0. Since the WUS ground motion functions mean to be used to predict the ground motions in California and other west US earthquakes, is it appropriate to introduce data from other regions which will obviously bias the ground motion prediction in this specific geographic area? Is the sigma developed using additional data from other regions still be valid for the area?

7. Why the NGA standard deviation models for the cases of M=5 R=5, M=6 R=10 and M=7 R=30 Km, shown in Figures 6-1 to 6-3, are identical? How many earthquakes data were used to obtain the model for M=7 at a distance of 30 km? Please also explain if the A&S2005 ground motion model represents the NGA model, like it indicated in Figure 6-1 to 6-3?

8. On page 6-18, the report states that the standard deviation of the stress drop from the paper submitted to BSSA by Atkinson and Boore is 0.6 natural log units (median value 140 bar). However, this quote of standard deviation was not found in Atkinson and Boore's 2005 submittal. Please explain.

9. Atkinson and Boore provided a direct estimate of total sigma (aleatory with inter and intra event terms) contained in their 2004 report to USGS. In that report the sigma was calculated from the residuals of the observations with respect to the predictions of their

2004 attenuation relationships. Their 2005 submittal to BSSA used the same dataset as their 2004 ground motion functions appear to be the same as the 2005 ground motion function. The sigma reported in 2004 is 0.3 at 0.2 - 0.5 Hz and 0.4 at 5-10 Hz. It gives a direct estimate of aleatory sigma of 0.92 ln unit at 5 Hz. This sigma is significantly higher than 0.7 unit recommended by NGA. Please explain.

10. Please justify to use the sigma derived from stress drop as the inter-event sigma when using attenuation relationships derived with a different median stress drop than found by Atkinson and Boore (2005).