

Final Project Summary — PEER Lifelines Program

Project Title—ID Number	<i>Workshop on Ground Motions for Treasure Island National Geotechnical Experimental Site—2K01</i>		
Start/End Dates	9/01/01 – 6/30/04	Budget/ Funding Source	\$30,000 / Caltrans
Project Leader (boldface) and Other Team Members	Pedro de Alba (U of New Hampshire)		

1. Project goals and objectives

The basic objective of this project is to develop unbiased estimates of variability about the median (aleatory variability, randomness) and variability of the median (epistemic variability, uncertainty) for selected state-of-the-art strong-ground-motion prediction methods, by applying them to records of past earthquakes, and then to use these methods in a forward prediction of bedrock motion for a well-documented site (Treasure Island) in the San Francisco Bay Area.

2. Benefits of the results of this project to develop technologies and protocols to mitigate the vulnerability of electric systems and other lifelines to damage directly and indirectly caused by earthquakes. Also, benefits to develop assessment techniques to evaluate damage to electric systems caused by earthquakes and to assess fiscal impacts due to the loss of electric service to the community.

The results of this project are confidently expected to result in a better estimates of predicted risk for engineered facilities.

2. Brief description of the accomplishments of the project

To date, six predictors from the US and abroad have completed two rounds of calibration (regression) exercises designed to both evaluate the different models' ability to predict recorded motions as well as to develop model parameter values and their expected ranges.

4. Describe any instances where you are aware that your results have been used in industry

None to date

5. Methodology employed

As mentioned above, potential predictors were required to complete two rounds of qualification exercises. In the first round, to provide a basis for a preliminary qualification of participants, they were requested to apply their models to the closest twenty sites which recorded the 1994 M 6.7 Northridge earthquake. The project selection committee evaluated variability and bias for each model (e.g. Figure 1) Six predictors, five from the US and one from Russia, successfully completed the first exercise.

A second round was then requested of the participants, to better calibrate their models against earthquakes which closely resembled the scenario earthquakes of the final forward prediction. In this case, model predictions were required for six earthquakes: Imperial Valley, 1979; Loma Prieta, 1989; Landers, 1992; Northridge, 1994; Kobe, 1995; and Kocaeli 1999. Predictions were required for a total of 197 stations. The results of this second round are currently being evaluated by the selection committee.

For the third and final round, two scenario earthquakes will be used:

- a) A moment magnitude 7.1 event on the Hayward Fault. For this event, two scenarios will be required: a) initiation of rupture in the vicinity of Berkeley and b) initiation of rupture in the vicinity of Fremont, close to the end of the southern segment of the fault. The latter scenario should introduce significant directivity effects into the exercise. In both cases, the rupture will be assumed to extend through both segments of the fault, about 87 km.
- b) A moment magnitude 7.9 event on the San Andreas Fault, assuming a rupture of the four northern segments of the fault along a 475-km length, from just north of Santa Cruz in the south to Petrolia, 330 km north of San Francisco. In this case, predictors would be asked to assume at least two nucleation points: a) in the vicinity of San Francisco, and b) near Cape Mendocino.

Predictions will be required both for the bedrock underlying Treasure island and for the Yerba Buena Island rock outcrop. Results will be presented and discussed in the final workshop, which will include students and practitioners.

6. Other related work conducted within and/or outside PEER

Results of the first qualification round were used by Dr Paolo Bazzurro et al. in PEER-funded project 1G00
 Title: “Parameterization of Non-stationary Acceleration Time History” (Task 2 of the Addendum).
 Participants: Paolo Bazzurro, Nicolas Luco, and Brian Sjoberg

7. Recommendations for the future work: what do you think should be done next?

The current study will result in a very well-constrained prediction of ground motions on bedrock and outcropping rock for the Treasure Island site. Treasure Island was selected because it has a deep soft soil profile which will be driven into the non-linear response range by strong motion, and because this 88-m deep soil deposit and the underlying bedrock have been instrumented with accelerometers to a depth of 120 m. The next obvious step is to organize a second prediction exercise in which the bedrock and outcrop motions will be used to predict the response of this deposit to the scenario earthquakes.

8. Author(s), Title, and Date for the final report for this project

I. Beresnev, J. Boatwright, B. Chiou, P.de Alba, D. Dreger, A. Gusev, L. Hutchings, W. Silva , P. Somerville and Y. Zeng “Uncertainty in Strong-Motion Earthquake Predictions: A Case Study,” January 2005

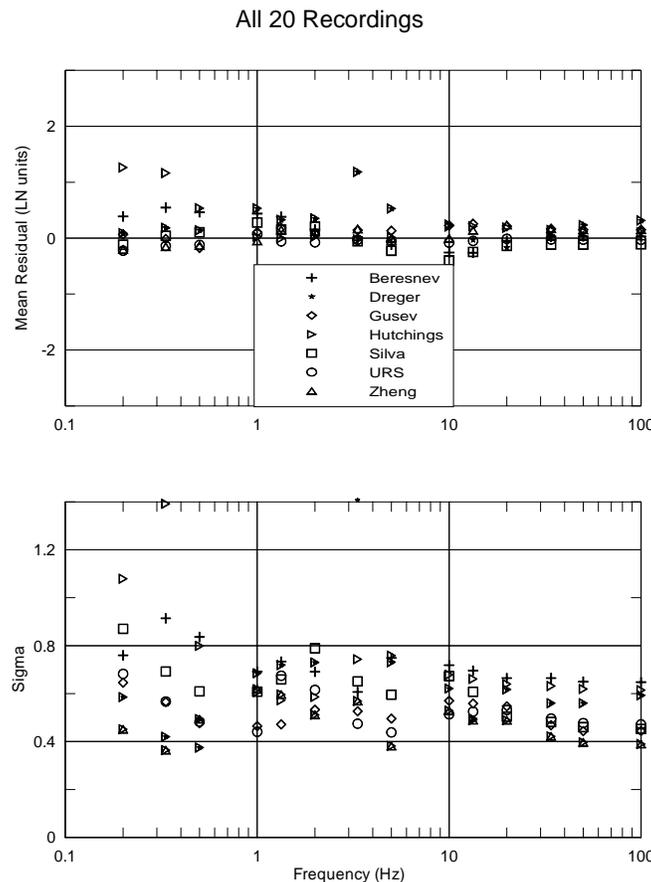


Figure 1. Model bias and modeling variability based on the 20 Northridge recordings (average horizontal spectral acceleration). A positive model bias reflects underprediction, negative reflects overprediction.