2004 SCEC PROJECT REPORT

SCEC Participation in Phase NGA-H of the PEER-Lifelines /SCEC /USGS Next Generation Attenuation (NGA) Program

Project 04018

PRINCIPAL INVESTIGATOR: Dr Paul Somerville, URS Group, Inc.

SCEC is a co-sponsor and co-participant with PEER-Lifelines and the USGS in Next Generation Attenuation (NGA) Project. Ground motion attenuation relationships are the backbone of modern earthquake hazard assessment. These relationships are used in all earthquake hazard assessments ranging from the U.S. National and California seismic hazards maps, to site-specific assessments, both deterministic and probabilistic, used for specific facilities ranging from bridges to dams to power plants. Hazard assessment results are used to establish design strategies and details of the built environment and to predict their performance.

The next phase of the NGA Project, NGA-H (Hybrid), will begin in 2005 and last for three years. SCEC will have a much greater role in this new phase of the NGA project, because it will be based on both simulated ground motions and on recorded ground motions. Unlike the NGA-E models, which are based mainly on recorded strong motion data with guidance from simulated ground motions, the NGA-H models will be much more strongly constrained by strong motion simulations. These simulations will be combined with strong motion recordings to more directly constrain features of the attenuation model that are poorly constrained by currently available strong motion data.

The objective of this program is for SCEC scientists to participate in Phase H of the Next Generation Attenuation (NGA) Project. Our interface partners for this activity are the NGA Project Management Team and the sponsors of the NGA Program, including Caltrans, PG&E, and CEC. The overall goals of the NGA-H Project were described by Norm Abrahamson at the SCEC Annual Meeting. A work plan for the NGA-H project has not yet been defined, but the proposed approach is outlined below.

On November 12, a conference call was held to plan SCEC activities. One goal is to have more SCEC scientists doing broadband simulations. The work for this project will begin with a Workshop on Broadband Strong Motion Simulation, to be arranged by Rob Graves, deputy leader of the Ground Motion Focus Group. Preliminary informal discussions may be held at the AGU, and the workshop may be held in January. Topics for the workshop include the specification of the earthquake source for long period simulations using a standard specification of slip time history on the fault that is compatible with the output of dynamic and pseudodynamic rupture models, and the selection of goodness of fit criteria for objectively quantifying how well the simulation procedures work.

As an exercise before the workshop, individuals or groups interested in providing broadband simulations should perform the validation exercise for the Northridge earthquake following the NGA Validation Guidelines. Robert Graves will provide a reference rupture model of the Northridge earthquake for this purpose.

Compared with the NGA-E models, which were based primarily on recorded strong motion data with some constraints from ground motion simulations, the NGA-H models will be much more strongly constrained by strong motion simulations using validated broadband simulation procedures. These simulations will be combined with strong motion recordings to more directly constrain features of the attenuation model that are poorly constrained by currently available strong motion data. These include rupture directivity effects, footwall vs. hanging wall effects for dipping faults, style of faulting effects, depth to faulting effects (i.e. buried vs. surface rupture), static stress drop (or ruptured area), depth to basement rock, and basin effects. To address these effects, the main roles of SCEC work will be on source and path effects, with the goal of guiding the selection of predictor variables (e.g. source parameters) and the modeling of their effects on strong ground motions, and providing ground motion simulations that will be combined with recorded strong motions for the development of hybrid models (NGA-H) that include these effects.

Special focal points of the SCEC work will be on the effects of near-fault rupture directivity and of shallow versus deep faulting on strong ground motions. This work will include the use of results from dynamic rupture models and foam experiments to shed light on the physics of rupture directivity and shallow/deep faulting effects on strong ground motion, and to explain observations of these effects in strong motion recordings of earthquakes; the development of pseudodynamic models to facilitate the representation of the physics of these phenomena in earthquake source models; and kinematic ground-motion simulations of these effects using pseudodynamic source models to guide the development of functional forms of ground-motion models representing these effects.