

**Nuclear Explosion Monitoring Research and Engineering (NEMR&E) Program**  
***Quarterly Report DOE DE-FC52-06NA27319***

**Research Title: “Advanced Waveform Simulation for Seismic Monitoring Events”**

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**Reporting Period: May 1, 2007-July 31, 2007**

**Technical Progress:**

**A. Description of Activities**

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Presentation at the 3D Modeling Workshop, June 6-7, 2007, held at the Double Tree Hotel, Berkeley, CA. Title: “*Modeling Broadband Regional Arrays.*”

This quarter involved considerable efforts in helping people run the so-called “Cut-And-Paste” code for determining local short events. We worked closely with our DOE partners, Arthur Rodgers at LLNL and Chandan Saikia at AFTAC. This code is now being used routinely.

We also prepared a paper for the 29<sup>th</sup> *Monitoring Research Review*, see abstract.

**Abstract**

Comprehensive test ban monitoring in terms of location and discrimination has progressed significantly in recent years. However, the characterization of sources and the estimation of low yields remains a particular challenge. As the recent Korean shot demonstrated, we can probably expect to have a small set of teleseismic, far-regional and high-frequency regional data to analyze in estimating the yield of an event. Since stacking helps to bring signals out of the noise, it becomes useful to conduct comparable analyses on neighboring events, earthquakes in this case. If these auxiliary events have accurate moments and source descriptions, we have a means of directly comparing effective source strengths. Although we will rely on modeling codes, 1D, 2D, and 3D, we will also apply a broadband calibration procedure to use longer periods ( $P > 5s$ ) waveform data to calibrate short-period ( $P$  between .5 to 2 Hz) and high-frequency ( $P$  between 2 to

10 Hz) as path specify station corrections from well-known regional sources. We have expanded our basic Cut-and-Paste (CAP) methodology to include not only timing shifts but also amplitude (f) corrections at recording sites. The name of this method was derived from source inversions that allow timing shifts between “waveform segments” (or cutting the seismogram up and re-assembling) to correct for crustal variation. For convenience, we will refer to these f-dependent refinements as CAP+ for (SP) and CAP++ for still higher frequency. These methods allow the retrieval of source parameters using only P-waveforms where radiation patterns are obvious as demonstrated in this report and are well suited for explosion P-wave data. The method is easily extended to all distances because it uses Green’s function although there may be some changes required in  $t^*$  to adjust for offsets between local vs. teleseismic distances. In short, we use a mixture of model-dependent and empirical corrections to tackle the path effects. Although we rely on the large TriNet array as a testbed for refining methods, we will present some preliminary results on Korea and Iran.

**B. Progress – on track.**

**C. Progress is following the stated Work Statement.**