DETERMINATION OF EQUIVALENT NUCLEAR YIELD AND OVERPRESSURE FROM AIRBLAST SIMULATION TESTS USING FOURIER METHODS

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Some characteristics of overpressure-time waveforms from high explosive simulations of nuclear airblast are substantially different from the characteristics of an idealized nuclear event. HEST, for example, produces
high frequency components which are not present in the idealized loading. The DABS technique, generally accepted as a higher fidelity nuclear airblast simulator, also contains imperfections, usually in the form of enhanced late time impulse.

Because of waveform differences between simulated and nuclear events it is difficult to relate the simulation loading histories to the parameters which define the nuclear loading waveform, namely peak overpressure (pso) and yield(W). The early time spikes and later time variations make it necessary to employ considerable judgment when determining a best fit waveform to the data. All time domain fitting methods and, indeed, the acceptance of HEST as a useful simulator, assume that the high frequencies of
the HEST waveform do not drive the response of systems of interest. Yet time domain fitting is complicated by the fact that high frequencies and low frequencies are superimposed in time. This complication is especially difficult in the interpretation of HEST peak overpressure because the absolute peak overpressure is associated with a high frequency spike. Frequency domain analysis provides an advantageous alternative for the analysis of simulation test records. In the frequency domain, high and low frequencies are unfolded and the contributions to given frequencies from the entire excitation time are revealed. Hence, fitting can concentrate on the most important frequency ranges of the system of interest without the bias of other frequencies.

This paper summarizes a DNA supported study which utilized Fourier transforms of data for the determination of pso and W. The Fourier amplitude spectra of measured simulation blast pressure data were compared to spectra for ideal nuclear waveforms. Equivalent nuclear fits to the spectra of the HEST data were determined by concentrating on frequencies in the low intermediate (up to several hundred Hz) range. By low pass filtering nuclear pressure-time histories became nearly identical below a certain cut-off frequency. This cutoff frequency is one quantitative measure of the fidelity of the airblast simulation.