

# "A COMPUTER PROGRAM TO PREDICT THE PROBABILITY OF OVERLAP OR CROWDING OF ADJACENT-PERIOD MILLISECOND-DELAYED INITIATORS"

Stephen A. Rholl, Research physicist  
Mark S. Stagg, Civil engineer  
Twin Cities Research Center, Bureau of Mines,  
U.S. Department of the Interior,  
Minneapolis, MN.

## ABSTRACT

The firing times of millisecond-delayed initiators are random variables that exhibit varying degrees of scatter. This scatter can cause crowding and overlap of adjacent delay periods, which results in adverse effects on safety, fragmentation, and blasting vibrations.

The Bureau of Mines developed a computer program to calculate the probability that initiators from an interval of adjacent periods would fire out of sequence or that crowding might occur. The program assumes that the firing times are normally distributed and that the mean and standard deviation can be adequately estimated by sampling the initiator population.

Results of the program are given using delay-time statistics that are typical of commercially available initiators. The effect of more precise initiators on the probability of overlap or crowding is presented. The results allow blasters to determine the initiator accuracy needed to insure that overlaps or crowding do not occur for a given probability. The implications of improved-accuracy initiators as they pertain to fragmentation are discussed. The initiator accuracy required to maintain a 1-ms/ft of burden separation while shooting at 2 or 4 ms/ft is shown.