Predicting the mechanical debris, associated with nuclear detonation, stemming from several sources (blast-induced flight of structural fragments, pickup of material from the ground by blast winds, and crater throwout) is a significant problem. Designers of hardened sites are concerned with materials which may accumulate atop silo doors or damage vulnerable avobe-grade troops and equipment from the use of nuclear-demolition and tactical devices. Potential users of nuclear excavating devices are concerned with hazards to personnel, utilities and equipment.

This report describes the collection and analysis data on various aspects of debris formation and dispersion, and examples of data utilization in estimating debris environment in several situations. The approach in the study was to collect extensive data from past experimental analytical investigations bearing on debris formation and dispersion. By futher study the most meaningful formats were summarized to be used as inputs to approximate solutions for debris environment predictions.

An extensive regression study of several hundred HE incidents, accidental and experimental, is made to relate the maximum range of debris to explosion parameters and crater dimensions. Results showing consistency with the limited available nuclear data relating to crater throwout are also presented to describe the nature of the debris distribution function in general terms.

Fragmentation data from HE events and laboratory experiments are used to indicate the nature of fragment size distributions from structural demolition.

An analytical study of the motion of debris fragments caused by blast winds considers debris trajectories for various times of structural failure, fragment sizes, positive and negative phase winds, and initial elevations of the fragment.

Specific estimates are made of the debris hazards to troops of flying three limbs in the proximity of forest stands, the vulnerability of troop personnel to throwout debris from cratering and stream bed charges, and the debris environment about hardened antenna systems.

Useful estimates of debris environment can be made for many targeting situations with data contained in this report. Refinement of data is certainly essential, especially in experimental definition of fragmentation patterns of ideal structural elements, and in definition of crater lip contours near their extremities, i.e, the throwout debris within and beyond the extremities of the lip.