D. Non-destructive interrogative characterization of munitions

The aim of this technique is to characterize munitions into subgroups by providing interrogative information of the internal structure of the munition and the type of their fill. This grouping is used to diminish the number of samples to be analyzed on-site in the storages for the verification of the initial declarations.

Non-destructive methods for determining interior features of chemical weapons fall in three categories, radiographic imaging, neutron activation and ultrasonics.

For radiographic imaging, radiation sources are energetic x-rays and gamma-rays and imaging techniques range from film to high resolution reuseable matrices. The methods are established and reveal interior structure.

Neutron activation of chemical components within a round results in the emission of prompt and delayed radiation that provides a variety of signatures for atomic species in the fill. One method focuses on gamma-rays emitted at the moment of neutron capture rather than at a later time during radioactive decay of daughter nuclei. It has certain advantages over conventional analysis in efficient utilization of neutrons and greater suitability for in situ measurements in uncertain geometries. Some imaging capability also can be realized since low and intermediate Z elements produce distinct gamma ray emission signatures when promptly activated by 14 MeV neutrons. Identification and quantitation are obtained by measuring neutron time of flight and 3D images can be obtained even under conditions of one-sided access. Also, the elements in chemical weapons have absorption signatures in the energy range from 0.1 to 10.0 MeV.

There are two promising methods for ultra sonic interrogation of chemical munitions. Pulse-echo techniques are highly directional and require both optimum placement and acoustic coupling of transducers to indicate the physical state of the contents of a chemical round. Resonance ultrasound spectroscopy measures all elastic modulii of a solid body from a single swept frequency determination. The unique acoustic signature of an object is useful in assessing the similarity of objects and is four to six orders of magnitude better than state of the art measurements of structure and composition. Given an appropriate data base from munition types verified by chemical analysis, all subsequent measurements could be performed rapidly and non-destructively with minimum hazard.