**Background:**
The requirement for technology to discriminate metal fragments from intact munitions when screening the 2 million acres of United States military or former military sites for the presence of unexploded ordnance (UXO) was highlighted in the 2003 Defense Science Board report. The report described the cost of a current 100:1 false-alarm rate (FAR) as being on the order of $30 billion, where 99% of excavated targets are associated with scrap metal or artifacts. The report called for a reduction in the FAR to 10:1, and this project aims to reduce it to 5:1. This project will deliver a new approach to discriminating UXO from clutter and leverages the experience of Flagstaff GeoConsultants P/L and ElectroMagnetic Imaging Technology P/L in the mining exploration industry. Ongoing research focuses on the use of pulsed induction electromagnetic (EM) methods to perform shape characterization of conductive ore bodies.

**Objective:**
The objective of this project is to characterize noise levels and capabilities of three-component fluxgate and superconducting quantum interference device (SQUID) sensors to detect the pulse EM-induced field for the future B-Field Electromagnetic Array for Munitions and Ordnance Discrimination (BEAMOD) system. Specific objectives include: (1) characterize the noise levels, sensitivity, and linearity of the sensors; (2) evaluate the benefits of measuring the EM magnetic field rather than time rate of change of the vector magnetic field of an EM response and quantify the higher sensitivity to intact and/or buried UXO versus near-surface scrap that is achievable with these sensors; and (3) suppress interfering EM noise from infrastructure such as power lines and communication equipment, thus achieving a lower noise floor.

**Process/Technology Description:**
This project will start with transmitter loop design and laboratory bench tests conducted with a single vector EM sensor. Two types of magnetic field sensors will be investigated, a fluxgate sensor and a high-temperature SQUID device. Linearity in the presence of the transmitter primary field and sensor noise floor in the presence of EM noise are two essential components of this study.

Researchers will conduct concurrently a numerical modeling study of the response of intact UXO with 20 millimeter (mm), 60 mm, and 155 mm diameters to quantify likely detection capabilities in the presence of the measured instrument noise floors. Sensor noise and signal levels also will be verified under field conditions.

**Expected Benefits:**
Use of an array of vector sensors in EM data acquisition will reduce the FAR when detecting metal objects such as UXO. Researchers envisage a reduction in FAR on the order of 5:1 that, if applied over the 2 million acres of affected land in the United States, has the potential of saving approximately $24 billion in unnecessary excavation of scrap items. (Anticipated Project Completion - 2006)

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