SITE SUBSURFACE CHARACTERIZATION/ANALYSIS 2006 Nova Award Nomination 8

Site Characterization and Analysis Penetrometer System (SCAPS): Assessing Site Contamination and *Sensors for SCAPS*

What the innovation is: A suite of cost-effective sensing and sampling technologies were developed and fielded under the SCAPS umbrella that provide the unique capability for in situ real-time determination of subsurface geophysical properties and the detection, discrimination, and quantification of a wide variety of subsurface contaminants in soil and groundwater.

Why it is innovative: The SCAPS provides for the first time the capability to provide real or near real-time screening of subsurface media (vadose and saturated zones) in situ for petroleum, oils and lubricants (POL), chlorinated solvents, volatile organic compounds (VOC), explosive compounds, metals, and radionuclide contamination. The ERDC has been awarded 13 patents for SCAPS related sensor and hybrid sensor/sampler probe technologies. Small < 2 inch diameter cone penetrometer contaminant sensor or hybrid sensor/sampler probes were developed that are hydraulically pushed to depths of approximately 50 m in nominally consolidated fine-grained soils. Geophysical (soil classification & stratigraphy) and/or contaminant specific sensor data are collected either continuously during the vertical push with 2 cm spacial resolution or at selected interrogation depths via onboard real-time data acquisition/processing system and provides 3-dimensional visualization of soil stratigraphy and contaminant plumes. SCAPS hybrid sensor/sampler probes provide the capability to detect and quantify analyte and contaminant vapors in situ when interfaced to onboard field portable analytical equipment such as an ion trap mass spectrometer or gas chromatograph. The SCAPS contaminant sensor probes also have the capability to prevent cross-layer contamination by sealing penetrometer holes during probe retraction using an ERDC developed grouting module attached to the sensor probe.

What it changed or replaced: Prior to the implementation of SCAPS technologies, monitoring wells were placed on grid patterns without knowing whether contaminants were present, near, or migrating; and soil and water samples were collected and sent offsite for costly and time-consuming chemical analysis. The use of SCAPS onsite contaminant sensing technologies minimizes the number of soil and water samples that are required for offsite chemical analysis, identifies the vertical and horizontal boundaries of contaminant plumes, and optimizes the placement of monitoring wells. SCAPS technologies typically save from 25-50% per site when compared to conventional drill and sampling techniques. Documented Savings: (1) $1M at the Point Loma Fleet Fuel Farm, CA, by determining areas free of contamination that were scheduled for excavation; (2) $300K at an Aberdeen Proving Ground, MD, VOC spill site versus conventional well installation and sampling technologies; and (3) >$800K for radionuclide detection in situ at the R-Reactor site, Savannah River Site, SC, versus offsite laboratory analysis. SCAPS POL and VOC technologies have been awarded California Environmental Technology and Interstate Technology Regulatory Council Certifications.

Where/when it originated, has been used, and is expected to be used in the future: The U.S. Army Engineer Research and Development Center (ERDC) originated the concept of SCAPS as an in situ subsurface geophysical and contaminant interrogation system in 1989 and developed SCAPS sensing and sampling capabilities in response to a critical need of the U.S. Government to characterize soil and groundwater conditions on military installations. The ERDC partnered with the U.S. Army Environmental Center (AEC) and the Strategic Environmental Research and Development Program / Environmental Strategic Technology Certification Program Office to demonstrate, validate, and transition SCAPS technologies. The SCAPS technologies have been used at more than 100 sites by the Corps of Engineers Kansas City, Savannah, and Tulsa Districts, and other DoD, DOE, and Army licensed commercial operators. It is expected to be used on active government installations, formerly used defense sites, base realignment and closure sites, and private sector sites.

If an innovative project, specifically identify each of its innovations: The innovations are the development of real-time data acquisition and processing software and the development of SCAPS small diameter sensor and hybrid sensor/sampler penetrometer probes for onsite in situ analysis of subsurface media for contamination. The ERDC developed the following probe technologies: the laser induced fluorescence petroleum, oil, and lubricant (POL) sensor detects fluorescing POL in soil or groundwater; the thermal desorption sampler is a hybrid sensor/sampler that provides near real-time detection of volatile organic compounds (VOCs) in soil; the hydrosparge sampler uses an ERDC repeat multi-port sampler or a commercial small diameter groundwater sampler interfaced to a direct sparging device to detect VOCs in groundwater; explosives (TNT, RDX, HMX) chemical sensor probe; chlorinated solvent chemical sensor probe; X-Ray Fluorescence (XRF) and Laser Induced Breakdown Spectroscopy probes to detect heavy metals; sodium iodide and high pressure xenon gas spectral gamma probes for radionuclide detection; and a multi-sensor isotopic XRF and spectral gamma probe.

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SCAPS Truck Conducting Characterization of Subsurface Soil Layering and Contamination

SCAPS Real-Time Data Acquisition and Onboard Data Processing

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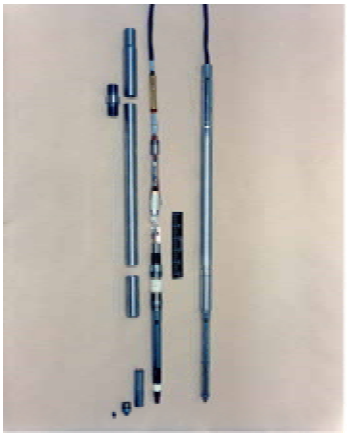
Thermal Desorption VOC



Electro-Chemical Explosives (TNT, HMX, RDX)

Laser Induced Petroleum (POL) Sensor Hybrid Sensor/Sampler ensor