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Site Characterization and Analysis Penetrometer System (SCAPS) : Assessing Site Cotamination

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SITE CHARACTERIZATION AND ANALYSIS PENETROMETER SYSTEM (SCAPS): ASSESSING SITE CONTAMINATION

THE NEED

Contaminated sites are the legacy of a long period of industrialization involving unconsidered production and handling of hazardous substances and unregulated dumping of wastes. The expansion of industry and subsequent increase in the amounts of industrial wastes have led to considerable environmental problems in all industrialized countries.

While a number of techniques exist for the remediation of contaminated soils, one of the largest problems is often the initial site assessment. It can be a difficult, expensive and time-consuming process to determine the exact extent of site contamination; often involving the digging of test pits and wells, and the analysis of samples by commercial laboratories. The inherent inaccuracies in these processes also generate further costs; to be sure of meeting regulatory requirements contractors often remove (or treat) more soil than is strictly necessary. As a result there is a great potential market for a system that can help contractors assess levels of contamination without the need for large-scale test bores and pits.

THE TECHNOLOGY

The U.S. Army Engineer Waterways Experiment Station (WES) under the sponsorship of the U.S. Army Environmental Center (AEC) initiated the development of the Site Characterization and Analysis Penetrometer System (SCAPS) Research, Development, and Technology Demonstration Program to provide the Department of Defense (DoD) with a rapid and cost-effective means to characterize soil conditions at DoD sites undergoing installation restoration (cleanup). WES partnered with the U.S. Naval Command, Control and Ocean Surveillance Center and the U.S. Air Force Armstrong Laboratory to accelerate and coordinate the Tri-Service SCAPS technology development, demonstration, and technology transition under the sponsorship of the Strategic Environmental Research and Development Program (SERDP). The Department of Energy has partnered with WES via an interagency agreement to receive SCAPS technology. The Environmental Protection Agency has joined with the Tri-Service SCAPS developers to conduct validation studies that will lead to regulatory acceptance of SCAPS contaminant sensing and sampling technologies.

SCAPS is a rapid in-field soil and groundwater analysis system investigating soil conditions to depths of up to a hundred feet or more. The SCAPS platform consists of a 20-ton truck equipped with vertical hydraulic rams that are used to force a cone penetrometer into the ground at a speed of 2cm/sec to depths of approximately 50m in nominally consolidated fine-grained soils when using a 100m umbilical cable (25m when using 50m umbilical cables).

FIGURE 1 SCAPS SYSTEM LOADED ON TRUCK (COURTESY OF FUJITA RESEARCH)

During a vertical push, data is continuously collected and recorded with 2cm spatial resolution. The truck consists of two separate enclosed compartments. Each compartment is temperature controlled and monitored for air quality.

FIGURE 2 DIAGRAM OF SAMPLING IN SCAPS SYSTEM (COURTESY OF FUJITA RESEARCH)

SCAPS multi-sensor penetrometer probes are equipped to simultaneously measure tip and sleeve resistances to determine soil stratigraphy, layer boundaries, and soil type as well as contaminant specific sensor data to determine the presence of pollutants in each soil strata. The SCAPS data acquisition room contains a real-time data acquisition and processing computer system; electronic signal processing equipment; and a networked post processing computer system for 3-dimensional visualization of soil

stratigraphy and contaminant plumes. A mobile laboratory truck, equipped with field portable ion trap mass spectrometer and/or gas chromatography equipment, accompanies SCAPS for near real-time analytical analysis of analyze vapor samples collected by SCAPS in situ samplers.

A variety of sensors can be attached to the probe to detect different compounds. Sensors to detect petroleum compounds and metals have been demonstrated.

A trailer mounted grout pumping system accompanies the SCAPS truck. This system is attached to a specially designed grouting system that has been incorporated into the SCAPS probe to facilitate backfilling the hole with grout as the penetrometer push rods and probe are retracted. This feature prevents subsurface cross-layer contamination. The SCAPS truck is also equipped with a specially designed steam cleaning system mounted beneath the truck rod handling room that removes soil and contaminants that may adhere to the push rods and probe during retraction. Contaminated effluent is collected for proper disposal.

FIGURE 3 THE NITROGEN LASER FOR GENERATING BURSTS OF UV LIGHT INTO THE OPTIC FIBER (COURTESY OF LIQUEFACTION.COM)

BENEFITS

The use of SCAPS reduces the time and cost of site characterization and restoration monitoring by providing rapid on-site real-time data acquisition/processing (i.e., in situ sample analysis) and on-site 3-dimensional visualization of subsurface soil stratigraphy and regions of potential contamination.

SCAPS provides its relatively non-intrusive and minimal environmental impact operation.

SCAPS prevents cross layer contamination by grouting through the penetrometer probe during rod retraction. Determination of locations that are free of contamination in SCAPS derives cost-avoidance due to reducing the number of conventional monitoring wells, samples and analytical laboratory tests required to characterize and monitor cleanup activities.

STATUS

The basic technology (i.e., the truck mounted cone penetrometer) is commercial. Sensors and sampling devices for VOCs and for explosive compounds are still being field-tested. Those for characterizing soil and identifying metals and petroleum are commercial.

The Tri-Service operates four Army and three Navy SCAPS vehicles. The Army maintains the original SCAPS truck at WES for research, development, and demonstration/validation purposes. Three SCAPS are operated by the Corps of Engineers (COE) Kansas City, Savannah, and Tulsa Districts for operational site characterization and monitoring field investigations at government facilities. The Air Force conducts SCAPS work via contract to the COE and private contractors. SCAPS technologies were transitioned to the Department of Energy via a WES/DOE interagency agreement. Tri-Service SCAPS technologies have also been transitioned to the private sector via licensing agreements, cooperative research and development agreements, and technology reinvestment programs.

Camp Pendleton, California (SCAPS system saved \$600,000) In mid 1995, the US Navy was planning to spend \$620,000 to dewater or move 19,000 cubic yards of soil from a site containing fuel residue. A SCAPS investigation of the site produced a more accurate "picture" of the contamination boundaries, showing the plume was smaller than indicated by a prior investigation. The SCAPS results showed dewatering wasn't necessary and only half the original amount of soil needed excavation and treatment. Total savings: more than a year of work and \$600,000.

FISC Fuel Farm, Point Loma, California (SCAPS system saved \$1 Million) An initial analysis of this site suggested the presence of more than 9,000 tons of diesel-contaminated soil. The Navy's proposal to excavate and remediate the soil with thermal desorption would have cost approximately \$1 million. However a SCAPS investigation indicated the contamination was mostly near the surface and did not extend to the water table. The data allowed the Navy to close the site without spending any money on remediation — levels of contamination were deemed acceptable by San Diego County regulators.

BARRIERS

SCAPS has a limited use as a monitoring tool. A new hole has to be punched every quarter because the holes collapse after the penetrometer is withdrawn.

Verification of the Hydrosparged sample is difficult to obtain, as only a small volume of water is sampled.

POINT OF CONTACT

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