ETV VERIFICATION STATEMENT

Cone Penetrometer-Deployed Sensors: Site Characterization and Analysis Penetrometer System

Technology Type:	Cone Penetrometer-Deployed Sensor
Application:	In-Situ Detection Of Petroleum Hydrocarbons
Technology Name:	Site Characterization And Analysis Penetrometer System (Scaps)
Company:	U.S. Navy, Naval Command, Control, And Ocean Surveilance Center, Research, Developement, Test and Evaluation Division
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The U. S. Environmental Protection Agency (EPA) has created a program to facilitate the deployment of innovative technologies through performance verification and information dissemination. The goal of the Environmental Technology Verification (ETV) Program is to further environmental protection by substantially accelerating the acceptance of improved and more cost effective technologies. The ETV Program is intended to assist and inform those involved in the design, distribution, permitting, and purchase of environmental technologies. This document summarizes the results of a demonstration of the Site Characterization and Analysis Penetrometer System (SCAPS) developed by the RDT&E Division of the Naval Command, Control and Ocean Surveillance Center (NCCOSC), in collaboration with the U.S. Army and U. S. Air Force.

PROGRAM OPERATION

The EPA, in partnership with recognized testing organizations, objectively and systematically evaluates the performance of innovative technologies. Together, with the full participation of the technology developer, they develop plans, conduct tests, collect and analyze data, and report findings. The evaluations are conducted according to a rigorous demonstration plan and established protocols. EPA's National Exposure Research Laboratory which conducts demonstrations of field characterization and monitoring technologies, selected the U. S. Department of Energy's Sandia National Laboratories as a testing organization.

DEMONSTRATION DESCRIPTION

In May and October, 1995, two cone penetrometer-deployed sensor systems were demonstrated to evaluate how well they could measure subsurface petroleum hydrocarbon contamination. The performance of each system was evaluated by comparing field analysis results to those obtained using conventional sampling and analytical methods. These methods included using a hollow stem auger in conjunction with a split spoon sampler and subsequent analysis of the collected sample by a reference laboratory using EPA Method 418.1 for total petroleum hydrocarbons (TPH). The primary objectives of the demonstration were to (1) verify technology performance, (2) determine how well the developer's field instrument performs in comparison to conventional laboratory methods, (3) determine the logistical and economic resources needed to operate the instrument, and (4) produce a verified data set for use in considering the technology for future use in hazardous waste investigations. Field demonstrations were conducted at two geologically and climatologically different sites: (1) the Hydrocarbon National Test Site located at Naval Construction Battalion Center (NCBC) Port Hueneme, California, in May 1995, and (2) the Steam Plant Tank Farm at Sandia National Laboratories (SNL), Albuquerque, New Mexico, in November 1995. The conditions at each of these sites represent what are considered typical conditions

under which the technology would be expected to operate, but it is not considered all inclusive. Details of the demonstration, including a data summary and a discussion of results may be found in the report entitled "The Site Characterization and Analysis Penetrometer System (SCAPS) Laser-Induced Fluorescence (LIF) Sensor and Support System."The EPA document number for this report is EPA/600/R-97/019.

TECHNOLOGY DESCRIPTION

The SCAPS LIF system uses a pulsed nitrogen laser coupled with an optical detector to measure fluorescence via optical fibers. The measurement is made through a sapphire window on a probe that is pushed into the ground with a truck-mounted cone penetrometer testing (CPT) platform. The LIF method provides data on the in situ distribution of petroleum hydrocarbons based on the fluorescence response induced in the polycyclic aromatic hydrocarbon (PAH) compounds that are components of petroleum hydrocarbons. The method provides a "detect/non-detect" field screening capability relative to a detection limit derived for a specific fuel product on a site-specific soil matrix. The SCAPS LIF technique does not provide species-specific quantitation but can be used as a field screening, qualitative method which can also produce semi-quantitative results at concentrations within two orders of magnitude of its detection limit for fluorescent fuel hydrocarbons. The estimated cost of using the SCAPS LIF system varies between $12 and $20 per foot depending upon whether the operators provide a turnkey operation or the customer provides field deployment assistance. Under normal condition, 200 feet of pushes can be advanced per day.

VERIFICATION OF PERFORMANCE

The findings of the demonstration for each of the performance claims is as follows:

- The ROSTTM system was easily integrated with a conventional cone penetrometer truck. Full integration was accomplished in less than two hours.
- Push rate was 3ft/min. Data was collected every 0.2 ft or less if the cone was slowed or stopped.
- Average percent agreement with conventional analysis for both sites was 94 percent correct with 1 percent false positives and 5 percent false negatives.
- Good agreement with the pattern of contamination was derived from an analysis of the subsurface soil samples.
- All spectral data was stored and easily retrieved in real time.
- Real time sensor data acquisition was achieved during both demonstrations.

The results of the demonstrations satisfy the requirements set forth in the demonstration plan for the SCAPS LIF system. The system located the plume accurately with higher matching percentage than the developer claimed. The false negative rate for the combined demonstrations was 4.9 percent, nearly identical to the five percent claimed by the developer. Disagreements with the laboratory results were primarily confined to regions where contaminant concentration levels were close to the detection threshold. A portion of these discrepancies could be the result of variability in laboratory results where random errors are estimated to be in the range of 10 to 15 percent. The SCAPS rods and umbilical allow a maximum push of 150 ft without signal loss.

The SCAPS technology worked well in both the saturated and unsaturated zones. This may be an important feature at sites where it is necessary to delineate the continuity of the contamination across the interface. The main savings attributable to the SCAPS LIF system is that it can substantially reduce the number of wells drilled at a site. In a general site characterization effort, it can provide site characterization data in less time and far less expensively than conventional drilling and sampling. Investigation-derived wastes are minimal. This technology can provide useful, cost-effective data for environmental problem solving and decision making.

Undoubtedly, it will be employed in a variety of applications, ranging from serving as a complement to data generated in a fixed analytical laboratory to generating data that will stand alone in the decision

making process. The SCAPS LIF system is an emerging technology worthy of pursuit in site investigations where petroleum hydrocarbons are suspected. The technology offers a number of advantages over conventional drilling and sampling technologies for the purpose of screening a site for the nature and extent of contamination. It does not entirely take the place of a conventional sampling program, but adds significant benefits in terms of resolution of the nature and extent of contamination. This information, when used properly, could provide a more complete picture of the contamination, and also could be used to predict future sampling locations.

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