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MULTI-STATE EVALUATION OF

AN EXPEDITED SITE CHARACTERIZATION TECHNOLOGY:

SITE CHARACTERIZATION AND ANALYSIS PENETROMETER SYSTEM

LASER-INDUCED FLUORESCENCE

(SCAPS-LIF)

MAY 1996

WESTERN GOVERNORS' ASSOCIATION DOIT INITIATIVE
INTERSTATE TECHNOLOGY AND REGULATORY COOPERATION WORKGROUP
CONE PENETROMETER TASK GROUP REPORT

This report was prepared by the Cone Penetrometer Site Characterization Technology Task Group established through Interstate Technology and Regulatory Cooperation Work Group as part of the DOIT Initiative. Task Group members responsible for the preparation of this report include:

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EXECUTIVE SUMMARY

A series of different sensors are currently being developed for deployment with cone penetrometer systems which offer the potential to more rapidly and efficiently characterize hazardous waste sites. One such system, the Site Characterization and Analysis Penetrometer System Laser-Induced Fluorescence (SCAPS-LIF) technology provides real-time in-situ detection of total petroleum hydrocarbon contamination both above and below the water table. The Cone Penetrometer Site Characterization Technology Task Group was established by the Interstate Technology and Regulatory Cooperation (ITRC) work group to facilitate interstate acceptance of the SCAPS-LIF and other cone-penetrometer-based site characterization technologies. Task Group members were given the opportunity to participate in Cal/EPA's hazardous waste environmental technology certification evaluation process. The certification evaluation process included examination of the applicable research and technical literature, data from previous field studies and two field demonstrations of the SCAPS-LIF technology. The field demonstrations were conducted in conjunction with the U.S. EPA Consortium for Site Characterization Technology and followed the general performance evaluation protocol guidance established for that program. In addition to witnessing the field demonstrations and reviewing the results, members also had the opportunity to review and effect changes in the proposed work plan for the second field demonstration at Albuquerque.

The Cal/EPA certification process and the protocols and results of the field demonstrations were investigated by the Cone Penetrometer Site Characterization Technology Task Group with regard to potential application and acceptance of the technology in their respective states. The approaches, policies and practices of state regulatory agencies toward acceptance of the evaluation protocol and data were investigated. Key issues relating to data acceptance and application for the SCAPS-LIF technology in the respective states are discussed.

Based on their participation in this project, all Task Group members accepted the technical merits of the SCAPS-LIF technology, and have obtained or are pursuing formal acceptance of the SCAPS-LIF technology from their respective state agencies. Further, the Task Group recommends that the ITRC membership states consider and pursue acceptance of the technology in these states based on the results of this effort.

ACKNOWLEDGMENTS

The Task Group would like to acknowledge the U.S. Department of the Navy, Naval Command, Control, and Ocean Surveillance Center, RDT&E Division (NRaD) for their support and effort in making this project a success. In particular, contributions of Tom Hampton, Dr. Stephen Lieberman, and Dr. David Knowles are very much appreciated. The Task Group also would like to acknowledge the contributions of the U.S. EPA Consortium and their verification entity, Sandia National Laboratories, in the development, implementation, and oversight of the two field demonstrations conducted as an integral part of this project.

TABLE OF CONTENTS

INTRODUCTION

There is widespread recognition that the current approaches to characterizing hazardous wastes sites are time-consuming, inefficient, and expensive. New cost-effective approaches and technologies are desperately needed that can quickly and accurately delineate the three- dimensional nature of subsurface contamination. Traditional methods rely on a reiterative and seemingly endless process of sample borings and monitoring wells to characterize sites. New sensors are currently being developed for deployment using a cone penetrometer platform which have the potential for continuous, real-time analysis for the presence of contaminants and other site characterization parameters. Use of such site characterization technology can both optimize and reduce the number of required sampling borings and groundwater monitoring wells to characterize a site, as well as potentially eliminate the phased reiterative approach inherent with conventional technology.

One of these newly developed cone penetrometer-based site characterization technologies is the Site Characterization and Analysis Penetrometer System Laser-Induced Fluorometry (SCAPS- LIF) sensor for real-time in-situ subsurface field screening of petroleum, oil and lubricants (POLs). The method is based on a cone penetrometer deployed fiber optic-based LIF sensor system. The U.S. Department of the Navy, Naval Command, Control and Ocean Surveillance Center-Research, Development, Test and Evaluation Division (NRaD) developed the SCAPS- LIF technology through a collaborative effort with the Army and Air Force under the auspices of the Tri-Service SCAPS Program.

A process was initiated to facilitate interstate acceptance of the SCAPS-LIF site characterization technology. States were asked to consider the California AB2060 Hazardous Waste Technology Certification process and the U.S. EPA Consortium for Site Characterization Technology (Consortium) verification process as mechanisms for providing the required data and analyses for acceptance and use of the SCAPS-LIF technology in their respective states. The process provided participating states the opportunity for full involvement in the technology evaluation process.

This report examines states' concerns in accepting an innovative site characterization technology, and more specifically, the SCAPS-LIF sensor technology. Based on each state's level of involvement in the technology evaluation process, they were asked to identify concerns, if any, their state would have in accepting the technology. Each participating state representative was also requested to give their perspective on 1) the California Hazardous Waste Technology Certification process as a means to facilitate their state's acceptance of the technology, and 2) the acceptability of the demonstration protocols and resultant data from two field demonstrations conducted under the auspices of both the Consortium and the California Certification Program.

A primary goal of the Task Group was to gain each member state's formal acceptance of the SCAPS-LIF technology, and further, to promote formal acceptance of the SCAPS-LIF by all ITRC member states.

TECHNOLOGY DESCRIPTION

The Site Characterization and Analysis Penetrometer System (SCAPS) Laser-Induced Fluorescence (LIF) technology is a real-time, in-situ, subsurface, field screening method for petroleum, oil and lubricants

(POLs) that contain Polynuclear Aromatic Compounds (PNAs). The technology was developed by the U.S. Department of the Navy as part of a collaborative effort with the Army and Air Force under the auspices of the Tri-Service SCAPS Program. The system is one of a planned family of sensors collectively called the Site Characterization and Analysis Penetrometer System, or SCAPS, that will combine remote sensors with a cone penetrometer platform to provide rapid, in-situ, subsurface measurements of many different contaminants and soil characteristics. The method uses a fiber optic-based laser-induced fluorescence (LIF) sensor system deployed with a standard 20 ton cone penetrometer. Application of the technology is limited to contaminants containing PNA compounds which fluoresce when exposed to 337 nanometer (nm) wavelength ultraviolet (UV) light. The chemical sensing scheme utilizes a fluorescence technique in which an optical response is stimulated in PNAs present in hydrocarbon contaminants in the soil. The PNAs are excited by 337 nm UV light from a pulsed nitrogen laser, with the most effective fluorescence response coming from PNAs with three or more aromatic rings. The excitation pulse is transmitted down the probe along an optical fiber that can be up to 100 meters (m) in length, and through a sapphire window built into the side of the cone penetrometer tip. The induced fluorescence signal from PNAs in the soil adjacent to the sapphire window is returned over a second fiber to the surface where it is dispersed with a spectrograph, and quantified with a photo diode array. The sensor output is processed by an on-board computer to provide real-time information about the intensity of the fluorescence signal as an indicator of the relative contaminant concentration. The spectral signature of the sensor output provides information about fuel product type or potential interferences.

The sensor is intended to provide rapid, qualitative to semi-quantitative information about the distribution of subsurface petroleum contamination. The sensor is intended as a method to delineate the boundaries of the subsurface contaminant plume prior to installing monitoring wells or collecting soil samples. It is not intended as a complete replacement for traditional soil samples and monitoring wells; but rather to maximize the effectiveness, and minimize the number, of conventional borings. The traditional approach to site characterization, which depends on collection of discrete soil and water samples followed by laboratory analyses, is usually a slow, iterative and costly process because the samples are collected with little prior knowledge as to the extent or exact location of the contaminant plume. Significant delays occur in site characterization while samples are analyzed. Subsequent borings must be drilled with no knowledge of the results from other boring locations, or the process must stop to await results from previous sampling.

A photo diode array detector system is used to quantify the fluorescence emission spectrum in the wavelength region of from 350 to 720 nm. As the SCAPS-LIF probe is pushed into the soil, real- time plots are generated of depth versus maximum fluorescence intensity and the wavelength at which the maximum intensity occurs. Differences in the wavelength of maximum peak intensity offer the potential to differentiate between the target analyte and background fluorescence emissions from other sources such as naturally occurring fluorophores which may be present in the soil (e.g., carbonate minerals).

Additionally, the data acquisition system records the fluorescence emission spectrum for each measurement interval. The detector is gated to record the spectra at the time interval corresponding to the estimated maximum intensity signal. These spectra can be viewed in the field and compared to those of the various fuel products which are suspected or possible contaminants at the site or be used to differentiate different sources of contaminant(s) or background fluorescence.

At the typical probe push rate of 1 meter/minute the LIF sensor provides vertical spatial resolution of 2-4 cm, which allows small scale features to be delineated that would be missed by conventional sampling protocols. Because the LIF sensor provides real-time chemical information while the system is in the field, sampling plans can be adjusted in the field to improve tracking and delineation of subsurface plumes and their boundaries.

BACKGROUND

At their August, 1995 meeting in San Francisco the DOIT Interstate Technology and Regulatory Cooperation Work Group (ITRC) formally established the Cone Penetrometer Site Characterization Task Group (CPTG). Formation of the CPTG recognized the need for new and innovative technologies to characterize sites in a more efficient, cost-effective and timely manner. The initial focus of the CPTG was

interstate regulatory acceptance of the SCAPS-LIF technology since considerable efforts were already underway to verify and certify its performance.

The CPTG effort is a natural follow-on to the work initiated through the Develop On-Site Innovative Technology (DOIT) Military Bases Working Group to demonstrate the SCAPS-LIF technology at Port Hueneme. One of the DOIT enhancements to the Port Hueneme demonstration was, in fact, interstate technology acceptance. The Port Hueneme demonstration of the SCAPS-LIF technology provided detailed technology performance information for the California Certification program, the U.S. EPA Consortium for Site Characterization Technology, as well as the DOIT Military Bases Working Group. Thus, the stage was set for a thorough and detailed examination of the technology which could be held up as a model for states' acceptance. Representatives of the states of California, Idaho, Utah, Nebraska and Texas were already involved in evaluating the SCAPS-LIF for acceptance in their respective states through the Port Hueneme demonstration. These state representatives had been provided the full Cal/EPA certification application package, had an opportunity to review and comment on the proposed draft work plan for Port Hueneme demonstration, had witnessed the technology in operation at the Port Hueneme demonstration, and had been provided NRaD's report containing laboratory results and field data for the Port Hueneme demonstration. The field demonstration work plan, which these states were given the opportunity to review, was prepared by NRaD to address the Consortium draft guidance manual for the preparation of site characterization technology demonstration plans and was jointly reviewed and approved by both the California certification program and the U.S. EPA Consortium. When the ITRC established the CPTG.,

California, Idaho, Utah, and Nebraska continued to participate through this new task group, and representatives from several other states joined, including New Mexico, Louisiana and New Jersey.

The Port Hueneme Demonstration of the SCAPS-LIF technology constituted the first of two field demonstrations conducted to provide data for the technology evaluations under the California Certification and the Consortium Programs. The contamination at Port Hueneme was shallow and concentrated in a narrow zone with a relatively homogenous lithology, classified as sands. The second field demonstration was conducted near Albuquerque, New Mexico to test the technology at a site with varying stratigraphy and deeper vadose zone contamination. Fortuitously, the second demonstration was scheduled to allow all state representatives on the Task Group to become fully involved in the Cal/EPA Hazardous Waste Technology Certification Process as well as the U.S. EPA Consortium verification process. State representatives who were new to this effort were provided with the entire set of reports and information which had been provided earlier to the other Task Group members who were involved in the Port Hueneme DOIT demonstration project, including the full Cal/EPA certification application package. The timing of the project thus allowed all Task Group members the opportunity to review the certification application package, to review and comment on the demonstration work plan and associated evaluation protocol for the second demonstration at Albuquerque, to oversee the Albuquerque field demonstration activities, to review and comment on the data and associated reports generated from the Port Hueneme and Albuquerque demonstrations, and to act as peer reviewers in Cal/EPA certification decision process.

METHODOLOGY

The Interstate Technology and Regulatory Cooperation (ITRC) Work Group is directed at encouraging state-to-state relationships and activities to advance the development, demonstration and deployment of innovative environmental technologies. The approach taken by the Cone Penetrometer Task Group (CPTG) was to directly involve Task Group members, as fully as possible into the technology evaluation process as a means of facilitating interstate acceptance and use of the technology. With the opportunity for full and open involvement, as well as complete access to the available data, it was hoped that Task Group members, representing the various regulatory programs within their respective states, could reach some degree of acceptance of the technology within their respective state programs. Further, it was hoped that the full ITRC could likewise reach some degree of acceptance based on the CPTG example.

The involvement focused heavily upon the technology evaluation processes being developed through the California Hazardous Waste Technology Certification Program and the Consortium for Site Characterization verification program. Task Group members, representing their respective state agencies,

were asked to review and consider the use of the California Hazardous Waste Technology Certification process. They were provided with the same information being used as the basis for the California program's certification decision. This included technical articles, research papers, reports on results of previous field studies, and the SCAPS-LIF technology field demonstration work plan and associated evaluation protocol which was jointly approved by the California Certification and Consortium programs. CPTG members were also given the opportunity to participate in or witness one or both of the field demonstrations. Further, CPTG members were involved in a peer review capacity in the California certification evaluation and decision process, and asked to review and consider this process as a means to facilitate acceptance of environmental technology in their respective states. This approach of full and open involvement in the technology evaluation process hopefully can serve as the basis for a model process that states could use to facilitate interstate acceptance of a cone-penetrometer based site characterization technology.

Inasmuch as the California certification program evaluation and the Consortium field verification of the SCAPS-LIF technology were underway prior to establishing the Cone Penetrometer Task Group, it was necessary to bring all members up to date on the project and to provide them with all the technical information related to these efforts. CPTG members previously involved in the evaluation of the SCAPS-LIF technology through the Military Bases Working Group demonstration project at Port Hueneme had already received the complete California certification application package and the draft and final demonstration work plans for the Port Hueneme demonstration project. Additionally these Task Group members had an opportunity to review and comment on the demonstration work plan and to observe the Port Hueneme field demonstration activities first-hand. This provided members not only first-hand knowledge of how the technology operates, but the opportunity to discuss the technology's operational principles and application with the team of scientists, engineers, and technicians who developed and operate the system.

Upon formation of the CPTG, all members new to the SCAPS-LIF evaluation effort were provided the same information package already provided to other members. Adequate time was allowed for review of the technical information before an initial meeting of the Task Group was held at NRaD's San Diego facility on September 28, 1995. In addition to setting the course of the Task Group, the meeting accomplished the following:

- Task Group members received a detailed overview of the testing and development information/data currently available for the SCAPS-LIF technology through a series of presentations provided by the technology developer (NRaD). This format allowed direct interchange/dialogue between the scientists and engineers responsible for the development of the technology and the Task Group members who represented the concerns of their state regulatory agencies.

- Task Group members were given an overview of the California AB2060 Hazardous Waste Technology Certification program and how it has been applied to the SCAPS-LIF technology certification evaluation. Task Group members were briefed on the scope and contents of the SCAPS-LIF technology certification application package which included, in addition to the field demonstration work plan for the two sites and associated results:

- A summary and analysis by the developer of the scientific principles and operational parameters involved in the use of the SCAPS-LIF technology.

- an analysis of data from previous field validation studies completed by the developer at a variety of sites.

- 15 papers and journal articles which presented results from a number of engineering, research, and development studies conducted by NRaD and other researchers related to the use of the SCAPS-LIF sensor for detection of petroleum hydrocarbons in soil.

- Detailed reports on each of NRaD's previous field studies of the SCAPS-LIF technology which

were conducted at eight sites in California and one site in Arizona with varying geologic conditions and contaminants.

- Operation and Maintenance Technical Manual (including Health and Safety plan).

Drafts of the program Process Description document and Preliminary Application were briefly described and distributed. The latter document identifies the basic information and data submission requirements for acceptance into the California Certification Program.

- The demonstration workplan and results for the Port Hueneme SCAPS-LIF technology demonstration were presented to Task Group members for discussion. The Port Hueneme demonstration was the first of two field demonstrations conducted by NRaD for both the Cal/EPA Hazardous Waste Certification Program and the U.S. EPA managed Consortium for Site Characterization. The workplan for these demonstrations, jointly approved by both the Consortium and the Cal/EPA Certification Program, was prepared by the technology developer, NRaD, and followed the draft technology evaluation protocols guidance developed by the Consortium for Site Characterization.

- The draft demonstration workplan for the Albuquerque site, an addendum to the Consortium SCAPS-LIF Demonstration Plan, was presented to the Task Group. As the Albuquerque demonstration wasn't scheduled to be conducted until November, members were given ample time for review and comment on the draft plan so that any significant concerns they could identify from their state's perspective might be incorporated into the workplan. Additionally, this format allowed Task Group members to give any immediate feedback they might have concerning the draft plan.

Task Group members from six states, including California, Idaho, Utah, New Mexico, Nebraska, and Louisiana, observed one or more days of the field demonstration of SCAPS-LIF technology conducted at the tank farm site at Sandia Laboratories near Albuquerque, New Mexico during November 6-8, 1995. A number of these same members had also been able to attend the Port Hueneme field demonstration. The New Jersey representative on the Task Group, although unable to attend the initial meeting or either field demonstration, was able to observe operation of the technology first-hand at a New Jersey site, and, in fact, working with NRaD, organized an "east coast demonstration" of the SCAPS-LIF technology which was attended by numerous New Jersey state regulatory agency representatives, EPA Region 2 and 3 representatives and New Jersey DOD facility staff. An additional demonstration was conducted by NRaD at a naval facility located near New Orleans, Louisiana to coincide with the January 1996 ITRC meeting held in New Orleans which allowed the full ITRC membership, as well as the Task Group members, an opportunity to observe the technology in operation. The two field demonstrations which were conducted in New Jersey and Louisiana were not part of the California certification evaluation process.

Finally, Task Group members were invited to participate in AB2060 Hazardous Waste Technology Certification process. Specifically members were invited to peer review the draft certification evaluation report and to provide review and comment on the proposed certification decision for the SCAPS-LIF technology.

Based on their involvement in the technology evaluation process described above, Task Group members were requested to formalize their input in writing on several key issues:

* Comprehensiveness of the AB2060 Technology Certification Program's evaluation process as applied to the SCAPS-LIF technology. (Note, this process included evaluation of past field studies, applicable literature & research papers, and the two field demonstration projects.)

* Acceptability of the field demonstration plans and associated protocols for the SCAPS- LIF technology (i.e., the demonstration plan jointly reviewed and approved by the California Certification program and the Consortium which was developed by NRaD in accordance with the draft Consortium guidance on preparation of site characterization technology demonstration plans.)

* Usefulness of the data generated via the two demonstrations conducted at the Port Hueneme and Albuquerque sites toward accepting the technology and implementing it in their respective states.

* How cone penetrometer site characterization technologies, particularly the SCAPS-LIF technology, are regulated in their respective states and regulatory programs.

* Impacts of regulatory issues, including specific regulatory requirements or barriers, affecting the acceptance or use of the SCAPS-LIF technology in their states.

* Usefulness of the California AB2060 technology certification process as a means to facilitate acceptance and use of technologies in their states.

Task Group members were not asked to represent their state or their state agency in providing formal input to the Task Group. Therefore, unless noted otherwise, written comments received from Task Group members were treated as representing their opinions as members of the ITRC Task Group and NOT necessarily the official positions of their respective states or state agencies. Task Group members were asked to provide input on these issues based on the concerns of their of their respective regulatory programs and their professional experience in these programs. That being said, members that desired to make a policy decision on behalf of their state were not precluded from doing so.

FINDINGS

1. The ITRC has provided an effective platform for this technology to be recognized by multiple states.

2. The ITRC process has increased technology transfer across state lines. The ITRC membership consists of state agency representatives with a primary interest and authority in promoting new and innovative environmentally beneficial technology within their respective programs and therefore is an excellent, if not ideal, forum to promote technology transfer.

3. Task Group members have obtained or are pursuing full or partial acceptance of the technology for use in their respective states. "Acceptance" for the SCAPS-LIF technology means endorsing use of the technology within the limitations and conditions set forth in the proposed California certification decision, with the understanding that some states may have statutory requirements that must be addressed.

- **California** Department of Toxic Substances Control (DTSC) noticed their proposed decision to certify the SCAPS-LIF technology on March 1, 1995;

- **Louisiana** Department of Environmental Quality has issued a letter stating their acceptance of the SCAPS-LIF technology for application in their state;

- **New Jersey** Department of Environmental Protection (NJDEP) has issued a letter stating that with the appropritae number and placement of confirmatory laboratory samples, the SCAPS-LIF technology is an acceptable field screening method for use at hazardous waste site investigations within the state of New Jersey.

- **Utah** Department of Environmental Quality, Division of Solid and Hazardous Waste (DSHW) has issued a letter stating that SCAPS-LIF is a useful technology for in-situ field screening of subsurface POLs containing PAHs, and that SCAPS-LIF data will be accepted by Utah (DSHW) provided an appropriate number of confirmatory sample analyses are completed;

- **Nebraska** Department of Environmental Quality (NDEQ) has issued a letter stating NDEQ would consider accepting data gathered by the SCAPS-LIF technology, and once California has certified the SCAPS-LIF technology, will encourage its use in Nebraska;

- **Idaho** Division of Environmental Quality LUST program has issued a letter stating their intent to recommend that their agency acknowledge the technology as appropriate for field screening of subsurface petroleum hydrocarbon contamination in Idaho;

- Task Group members from **Utah** and **New Mexico** are pursuing full acceptance of the SCAPS-LIF through their respective agencies: the Utah Department of Environmental Quality, and the New Mexico Environment Department.

4. The model of multi-state involvement in the technology evaluation process initiated through this Cone Penetrometer Task Group was found to be valuable to states, and an effective use of states' resources. Task Group members found that the opportunity to observe operation of the technology in the field was virtually essential in gaining confidence in the data and the evaluation process. Additionally, full access to supporting data and information available through the California Certification evaluation process, including input to the development of field demonstration workplans, gave members confidence in the level of evaluation being performed relative to their respective programs' needs and gave members considerable confidence in relying on the California Certification process for the required detailed evaluation.

5. California certification would give credibility to a technology and potentially reduces the resource requirements necessary for other states to evaluate the technology for use in their respective states.

6. The technology evaluation process and protocols used by the California Hazardous Waste Technology Certification Program to evaluate the SCAPS-LIF technology were found to be extensive and thorough.

7. Task Group members accepted the technical merits of the SCAPS-LIF technology as a site characterization field screening technology for petroleum hydrocarbons containing significant concentrations polynuclear aromatic hydrocarbons when used in accordance with conditions and limitations stated in the proposed California Certification Decision.

8. The noticed proposed certification decision for the SCAPS-LIF technology for use as a site characterization field screening technology for real-time detection of subsurface petroleum hydrocarbon contamination was found technically acceptable by Task Group members. Although the certification provided guidance on the required number and location of confirmatory samples necessary to accept the SCAPS-LIF data at a specific site, it allows considerable latitude in determining the required number and location of confirmatory borings. At least one state, New Jersey, had regulations that established specific sampling requirements for field screening methods. However, the state of New Jersey's requirements incorporated flexibility within the framework of the regulations to allow for a variance. Additionally, concern was expressed that the SCAPS-LIF technology was not being certified as a semi-quantitative method, but only for a detect/non-detect capability, and that this could limit the use of the technology in differentiating and locating the highest contamination or source areas.

9. Data generated through the field demonstrations conducted at two sites as part of the overall technology evaluation process were found to be more than acceptable to states. The fact that the field demonstration workplan and implementation were jointly reviewed, approved, and overseen by the California Certification program and the U.S. EPA Consortium gave a high degree of credibility to data. Task Group members accepted the data as if they had directly overseen the demonstration in their own respective programs. The overall scope of the field demonstrations could probably have been reduced, particularly with regard to the Port Hueneme pre-demonstration work which was duplicative of the formal field demonstation, costly and unnecessary.

10. The majority of states represented in the Task Group do not have a formal mechanism available to "accept" a technology. The exceptions are California with its certification program, and New Jersey which has specific regulatory requirements for use of site characterization field screening technologies, as well as a Field Analysis Manual that identifies acceptable field screening technologies and conditions for their use. For states without an established mechanism in place, the ability of a state to fully accept a field screening technology such as SCAPS-LIF is a function of organizational structure and management

policy. Typically, the RCRA, CERCLA, and LUST programs are administered by separate divisions or departments within a state. Each of these programs has separate authority related to acceptance and use of a field screening technology such as SCAPS-LIF. Practically, these programs do not communicate with one another and act somewhat autonomously even when organized within the same department. Acceptance by one of these programs therefore does not generally translate into acceptance by the others.

11. Regulatory agency organizational structure and management policies in some states may pose a barrier to formal acceptance of technologies. Several Task Group members expressed concern that gaining full acceptance of the SCAPS-LIF technology through the LUST, CERCLA and RCRA programs would be difficult or problematic even though organizationally, these three programs reside within the same department in their states. State programs not represented by Task Group members did not have the opportunity to participate in the technology evaluation, and may want to perform their own detailed evaluation before considering acceptance of the technology. Additionally, because these programs do have a formal mechanism available to accept a technology, management may be reluctant to making such a decision.

12. California certification of other new sensor technologies deployed using the SCAPS can serve as a basis for states' acceptance of these technologies. Task Group members' states varied on the level of involvement in the certification evaluation process required before their respective states would consider acceptance of other new SCAPS-deployed sensors certified through the California program. The level of involvement desired by states depends both on the state program involved and on the sensor technology being certified. State acceptances of other new SCAPS-deployed sensor technologies could require as little as acceptance of the California Certification decision, or up to some level of full involvement in the certification evaluation process, including:

- Review and input into the technology evaluation work plan.
- Review of the California certification application package and input into the certification evaluation report.
- "Hands on" participation in technology field demonstration activities involving observation of the technology operating at a site with conditions representative of those encountered in their respective states.
- Review and input into the California certification decision.
- Interaction with the technology vendor.

All Task Group members were comfortable in accepting future California certification decisions on enhancements to the SCAPS-LIF sensor technology. Such enhancements to improve system performance could include changing the laser system to reduce the wavelength of uv light transmitted or modifying the data collection and analysis software.

For acceptance of new sensors, several Task Group members expressed a critical need in selecting or approving the site where the technology would be demonstrated to ensure results were applicable to conditions and concerns typically encountered in their states, and that direct observation of the technology in operation was essential.

13. Task Group members support continued development of other SCAPS-deployed sensor technologies for accelerated site characterization. A number of other sensor technologies are currently under development by the U.S. Navy and others which show promise and, when developed and commercialized, would potentially have widespread application in most states. In particular a sensor which detects chlorinated hydrocarbons, particularly those which are dense non-aqueous phase liquids, would be an important and valuable breakthrough in hazardous waste site characterization technology. Sensors which detect and quantify toxic metals would also have application in most states for

characterization of hazardous waste sites, particularly for mining waste problems. Additionally, sensors under development to characterize fate and transport parameters, such as the TDR (time domain reflectometry) moisture sensor and subsurface video microscope (lithologic logging; grain size/porosity analysis) were viewed by Task Group members as valuable site characterization and monitoring tools.

14. Task Group members supported continued research and development efforts to enhance the capability of the SCAPS-LIF sensor technology toward detection of BTEX and other lower molecular weight hydrocarbons of concern.

15. Whether or not to consider use of a site characterization field screening technology such as SCAPS-LIF is highly dependent on cost as well as performance. Task Group members expressed a need to have comparative cost data on the use of SCAPS-LIF technology in order to promote its use in their states.

16. The Task Group finds that the U.S. EPA should consider inclusion of the SCAPS-LIF technology into their SW-846 document as a site characterization field screening method for real-time detection of petroleum hydrocarbon contamination when used in accordance with the conditions and limitations set forth in the proposed California certification decision.

17. The DOD-owned SCAPS-LIF technology is available primarily for use at DOD facilities. Although this is a significant market, the technology is applicable to many non-DOD sites, particularly at oil refineries. Through this project, most state representatives became aware of the ROST system, a cone penetrometer deployed LIF sensor system similar to the SCAPS-LIF, which is available on a commercial basis from Lockheed-Martin (formerly Loral Corporation).

18. Public stakeholder involvement in the technology evaluation and acceptance process was achieved through the WGA Military Bases Working Group Port Hueneme Demonstration Project involving the SCAPS-LIF technology. Additional public stakeholder involvement was realized through presentations of the SCAPS-LIF technology evaluation process to the stakeholder representatives on the ITRC and soliciting their input and comments. The California certification notice also provides a forum for public comment and input on the SCAPS-LIF technology certification evaluation and decision.

RECOMMENDATION

1. The ITRC member states should consider and pursue formal acceptance of the SCAPS-LIF technology based on the example of this Task Group.

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