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CONTINUED DEVELOPMENT OF HYBRID DIRECTIONAL BORING TECHNOLOGY

and

NEW HORIZONTAL LOGGING DEVELOPMENT FOR CHARACTERIZATION, MONITORING AND INSTRUMENT EMPLACEMENT AT ENVIRONMENTAL SITES

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ABSTRACT

This work in partnership with industry is a continuation of cost-effective, innovative, directional boring development begun in FY90 and planned to extend into FY94. Several demonstrations of the strategy of building hybrid hardware from utilities installation, geothermal, and soil mechanics technologies have been performed at Sandia National Laboratories (SNL) and at Charles Machine Works (CMW) test sites as well as at a commercial refinery site. Additional tests at the SNL Directional Boring Test Range (DBTR) and a lagoon site are planned in calendar 1991.

A new companion project to develop and demonstrate a hybrid capability for horizontal logging with penetrometers, specialty instruments and samplers has been taken from concept to early prototype hardware. The project goal of extending the tracking/locating capability of the shallow boring equipment to 80′ is being pursued with encouraging results at 40′ depths. Boring costs, not including tailored well completions dictated by individual site parameters, are estimated at $20 to $50 per foot. Applications continue to emerge for this work and interest continues to be expressed by DoD and EPA researchers and environmental site engineers.

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DISCLAIMER

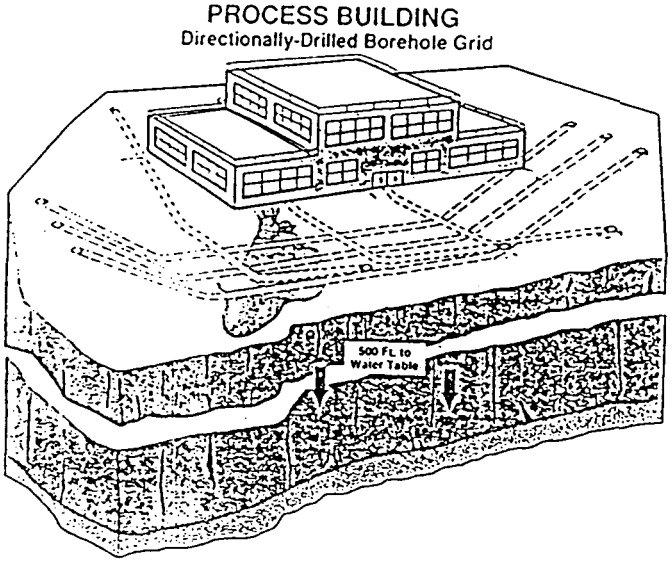
INTRODUCTION

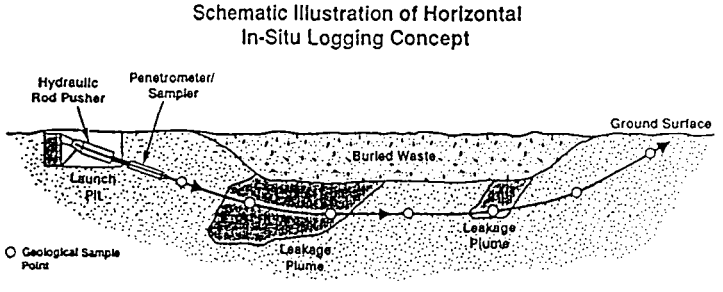
This paper is presented in outline form with a minimum of text. Reduced-scale information panels are used to communicate the bulk of the project information. Abstract and Summary sections are deliberately brief discussions of the work. The authors welcome and encourage personal contact by any readers needing more detailed information.

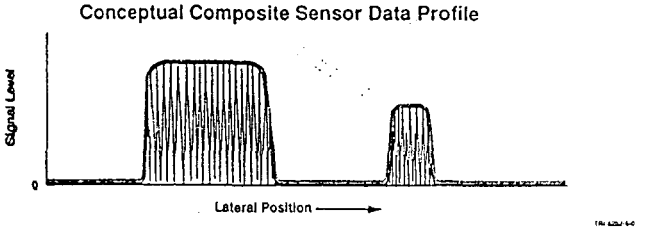
The first year of the 3-year industrial partnership between SNL and CMW has been spent assessing needs at various DOE and industry sites, surveying a broad range of candidate equipment for creating hybrid hardware, and evaluating the possibilities of developing enhanced capabilities for existing tracking and locating equipment. Several field tests have been performed at SNL and CMW test ranges and at a commercial refinery. Wireline coring, cone penetrometer, and push coring equipment have been purchased. A funding base has been developed from two Integrated Demonstration Projects: Savannah River VOC Extraction from Saturated Soil and Sandia National Laboratories Mixed Waste Landfill.

A companion project for horizontal logging of waste sites has been initiated. This project is best described by visualizing standard cone penetrometer hardware that requires a heavy truck for vertical thrusting being horizontally positioned in a shallow excavation and thrusted horizontally with a large hydraulic cylinder. The thrusting hardware used, the instrument package, and the sampling apparatus are more complicated than described by this illustration; however, from a practical viewpoint, a unique capability is being developed that will permit near in situ characterization of the underlying geology with minimal risk of invading the actual environmental problem site or spreading existing contamination to the water table.

Current regulatory requirements for a prescribed number of vertical monitoring wells that require drilling to the water table cause unnecessary risk of inadvertent contamination of the water table by the drilling and well completion operations. This regulatory strategy is particularly inappropriate for the western states where the water tables are very deep.







SNL/CMW HORIZONTAL BORING/LOGGING/SAMPLING PARTNERSHIP

FY 91 FUNDING SOURCES:

* SNL: In-House Environmental Restoration--Technology Development
* CMW: In-House--New Product Research and Development

FY 92 FUNDING SOURCES:

* OTD-SNL: Mixed Waste Landfill Integrated Demonstration
* CMW: In-House--New Product Research and Development
* OTD-SRS: VOC in Saturated Soils Integrated Demonstration

General Program Tasks

- Demonstrate current technology at a site selected by the sponsor. Tests conducted jointly with industry partner using Sandia-designed instrumentation and sampling packages
- Joint design work on steering systems, enhanced depth capability, and instrumentation adaptation
- Demonstrate steerable system at depths up to 100 ft with enhanced sampling/instrumentation capabilities
- Demonstrate mature hybrid technology at appropriate site
- Application of enhanced technology to implement caging concept at an appropriate waste site

Advantages of Proposed Drilling Technologies Program for Environmental Drilling

- Short development time
- Basic technology already exists in several industries. Hybrid systems required for environmental applications.
- Drilling tests during development can provide valuable site data throughout the program
- Working directly with industry insures broad availability of the technology
- Sandia/industry interaction provides a proven basis for incrementing commercial capability to include advanced and needed technology improvements

Horizontal Logging and Sampling Program for Environmental Sites

- Maximum Use of Existing Hardware
- Hybridization from Diverse Technologies
- Minimal Secondary Waste Generation
- Steerable/Trackable Instrumentation Packages
- Pristine Sample Recovery
- 600' – 1000' Horizontal Logging Runs
- Multiple Penetrations
- Several Lateral/Depth Combinations

Typical Candidate Hardware for Integration

- Hydraulic Thrust Systems
- Tracking/Steering Hardware
- Cone Penetrometers
- Fluid/Moisture, Temperature, Pressure Sensors
- Sidewall Coring Apparatus (Second Generation)
- Various Geophysical Source/Sensing Equipment
- Various Soil, Fluid, and Volatile Samplers
- Push Coring Systems
- Pneumatic Sleeve Emplacement Equipment
- Fluorescence System/Optical Fiber Sensors/Laser Excitation
- Additional Undefined, Specialty Hardware as Project Evolves

Attributes

- No Addition of Fluids
- Minimal Spoils Removal
- Near In-Situ Sampling
- Rugged Packaging of Instrumentation
- Multiple Discrete Samples per Run in Second Generation Systems
- Cost-Effectiveness

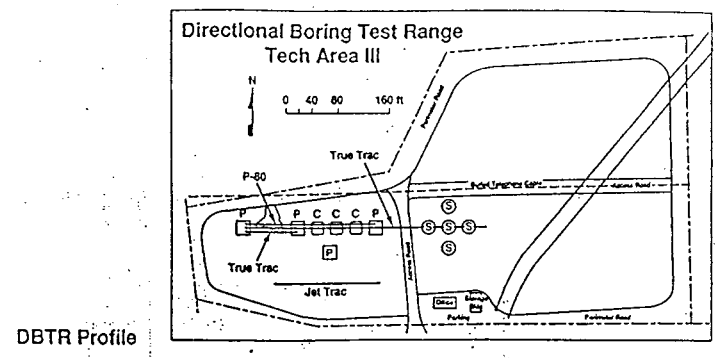
SUMMARY OF FY 91 TESTING

LOCATIONS: SNL, CMW, Commercial Refinery

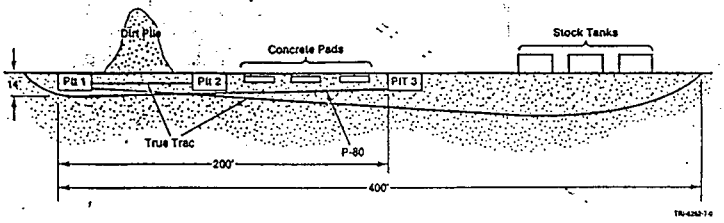
MAXIMUM DEPTH: 40'

EQUIPMENT: Air-assisted Boring
Dry Bore Thrusting
Commercial Penetrometer
Commercial Sampler
Commercial On-board Tracking/Locating Electronics

RESULTS: Very Encouraging
Depth Extension to 40' (Project Goal: 80-100')
Information Developed on Installation Rates for 30' Depth
River Crossing Electronics Compatible with Project Hardware
Horizontal Logging/Sampling Feasibility Demonstrated

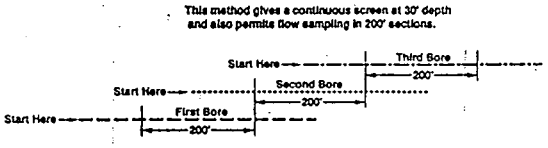


DBTR Profile

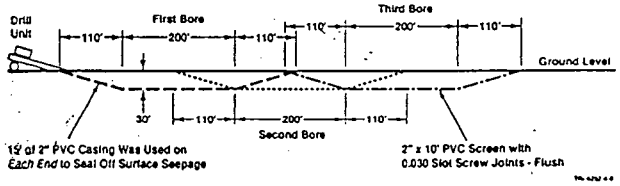


Cascaded Borehole Demonstration

Surface Track



Vertical Track



FY 92 PROJECT PLANNING

BORING AND THRUSTING

* Prototype Machinery Development/Refinement
* Continued Testing at SNL and CMW Test Ranges
* Demonstrations at SRS and SNL Problem Sites

HORIZONTAL LOGGING AND SAMPLING

- Adaptation of Basic Instruments to Demonstrate Technique
- Refinement of Technique
* Development of Multiport Sampler

SPECIFICS OF CONE PENETROMETER AND SAMPLER ADAPTATION FOR HORIZONTAL LOGGING

(This section will include information obtained from a test series at the SNL Directional Boring Test Range that is scheduled from 8/19 to 9/6. We want the latest test results to be reported in the proceedings of the conference, but test schedules may preclude a final textual review above Division level.)

SUMMARY

The national laboratory/industry partnership for developing a family of specialized boring equipment for environmental applications is working diligently to balance scientific and regulatory requirements with practical application and appropriate hardware. The original concept of developing hybrid hardware for environmental applications by bringing together existing hardware from various industries is proving to be workable and beneficial. The need for long-term research and development is minimized by this strategy. Reduced costs for short-term development and long-term application to environmental restoration are a direct benefit of this work.

Plans for FY92 include additional testing at benign sites, development and fabrication of additional hybrid hardware, and boring, sampling and logging at two chemically contaminated sites. Several subtasks in locating/tracking, sampling, and nuclear logging will be pursued in depth during FY92.

Technical details of this project and potential applications are discussed on a continuing basis with other researchers at DOE, DoD, EPA, and Corp of Engineers facilities and with industry machinery design and testing engineers.