Lawrence Livermore National Laboratory
University of California

Berkeley Environmental Restoration Center

Dynamic Underground Stripping Project: LLNL Gasoline Spill Demonstration Report

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Preface

This report is a compendium of all the final reports for each of the component activities that constitute the Dynamic Underground Stripping demonstration at the LLNL gasoline spill site. The demonstration and cleanup efforts at that site from 1992 to early 1994 were funded jointly by the U.S. Department of Energy's Office of Technology Development and Office of Environmental Restoration. This report combines those efforts into sections that reflect the major technical aspects of the project: Summary, Characterization, Operations, Monitoring, Predictive Modeling, and the Accelerated Removal and Validation (ARV) Project.

The Dynamic Underground Stripping demonstration at the LLNL gasoline spill site was extremely successful, and all the project goals were met or exceeded. All aspects of this project reflect the integration of complementary technologies and process engineering. Some applications are obvious, such as the use of electrical heating and steam injection to heat the whole range of soil types. Others are not so apparent, such as the need to electrically isolate diagnostic and monitoring systems from the tremendous currents intentionally applied to the ground. The technical challenges in merely fielding these methods in a safe and effective manner at an operating industrial site were great. Safety in operation was a prime design parameter; our excellent safety record is one of the most satisfying accomplishments of this project. The combined achievements are greater than the sum of each individual component; this satisfies the requirements of true integration of method and application.

This report is a compilation of results from the demonstration project. As such, it represents collaboration among investigators from many organizations, both between LLNL and other agencies and organizations within LLNL itself. In particular, we wish to acknowledge the contributions of Professor Kent Udell and the team members from the University of California at Berkeley's Environmental Restoration Center, and the close collaboration between these individuals and LLNL researchers. The success of this project is largely due to the unique field-scale collaboration utilizing the complementary interests and research abilities of the University and the Laboratory researchers.

The successful demonstration of Dynamic Underground Stripping at the LLNL gasoline spill site was made possible through the combined efforts of a great many people, with a broad range of expertise. We acknowledge the efforts of the mechanical and environmental technicians; procurement, construction and plant engineering personnel; and other staff without whose contributions (often in difficult conditions and inclement weather) this project would not have been possible. Students from the University of California, Berkeley's Environmental Center also provided essential support.

We gratefully acknowledge the support of the U.S. Department of Energy's Office of Environmental Management for this demonstration. The demonstration of innovative technologies requires that the needs of both experimental and compliance-driven, cleanup operations be addressed. The efforts of the U.S. Department of Energy's representatives to reconcile the often conflicting requirements made this project possible. In particular, we wish to acknowledge the efforts of Clyde Frank, Pat Whitfield, Tom Crandall, Tom Anderson, Katie Hain, John Mathur, Kathy Angleberger, John Lehr, J. T. Davis, Richard Scott, Mike Brown and Bill Holman. During its three-year history, this project utilized the resources of many if not most of the organizations at LLNL. In particular, we wish to acknowledge the support of the following individuals: Jesse Yow, John Ziagos, Lee Younker, Bob Schock, J. I. Davis, Ann Heywood, Jay C. Davis, Alan Levy, Walt Sooy, Dennis Fisher, Harry Galles, Jens Mahler, and Bill McConahie.

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2. Characterization

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