The Innovative Treatment and Remediation Demonstration (ITRD) Program:

Lessons learned in the introduction of innovative technologies at DOE Sites

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Abstract: The Innovative Treatment and Remediation Demonstration (ITRD) Program accelerates the use and acceptance of new cost-saving technologies to solve site-specific remediation problems at DOE sites. The ITRD process is designed to overcome the barriers to adoption of new remedial techniques. This process involves: 1) formation of a multi-agency Technical Advisory Group (TAG) composed of all relevant stakeholders to assess new technologies for site-specific requirements; 2) treatability and pilot studies for technologies selected by the TAG; and 3) evaluation of pilot test results to obtain cost and performance information. During FY2000, ITRD projects were underway at several DOE facilities including the Paducah Gaseous Diffusion Plant, the Oak Ridge Y-12 Plant, the Hanford Site, the Pantex Plant, the Mound Plant, and Los Alamos National Laboratories. The projects involved initial screening of 30+ technologies to remediate contaminated soils and groundwater, detailed evaluation of 12 different technologies, and planning or execution of several pilot deployments. Active source removal, passive barriers, bioremediation and monitored natural attenuation were evaluated for remediation of chlorinated solvents (dissolved and DNAPL), explosives and radionuclides.

The ITRD Program was initiated in 1993 by the DOE in cooperation with the Environmental Protection Agency's Technology Innovation Office to accelerate the implementation of innovative remediation technologies. When the Program was initiated, several barriers to the widespread use of innovative remediation technologies were identified. These included: 1) lack of validated full-scale cost and performance data for new technologies, 2) lack of industry and regulator familiarity with new technologies and their lack of involvement in innovative technology evaluations, and 3) industry's fear of penalties or fines associated with schedule delays and increased costs from the failure of a new technology to meet required clean-up levels. The ITRD program was developed to address and overcome these barriers. However, over the last decade, the DOE EM program structure has changed, our understanding of the scope of the remediation has become clearer and new aspects of the legal and contractual relationships between vendors, Site managers and DOE have become important. The purpose of this presentation is to highlight some of the innovative technologies being used at DOE sites under ITRD guidance and also to describe some changes in the approach used by the ITRD Program to deal with both these new technical and non-technical challenges.

The ITRD Program is based on a public-private technology demonstration concept that improves communications and teamwork among key participants. Government, industry, and regulatory agencies are directly involved in assessing, implementing, and evaluating technologies. The innovative technologies considered for evaluation are those that lack the cost and performance information that would otherwise permit their full consideration as remedial alternatives. These technologies have often shown promise in pilot-scale applications but have limited full-scale data. Some technology examples in this category include:

Bioremediation,
In situ dynamic stripping,
Soil washing and soil flushing,
Solvent and surfactant extraction,
Directed chemical treatment and *in situ* passive treatment, and
Advanced physical separation techniques.

After applicable innovative technologies for a particular site are reviewed by the TAG, treatment studies and engineering evaluations of technology cost and expected performance are conducted. The advisory groups recommend the best options for the site considering cost, performance, and regulatory issues.

The technologies selected for implementation are used to completely remediate small, one- to two-acre sites. Operations, treatment performance, and cost are closely monitored by the advisory groups. This information provides the necessary full-scale operational and evaluation data to validate the performance of these new technologies. In turn, validation by the independent technical group ultimately accelerates the acceptance of the technology for use at other sites within DOE and across the country.

ITRD projects include sites with complex industrial soil and ground water contamination problems. Contaminants at such sites include chlorinated solvents and petroleum products; pesticides, polychlorinated biphenyls (PCBs), and dioxins; heavy metals; explosives; and radionuclides. During FY2000-FY2001, a total of 10 projects were underway at seven DOE sites; the status of some of the projects is described in Table 1.

Recent changes in contracting procedures, available resources, and the progress of remediation at the sites necessitate several changes to the ITRD approach. These include: 1) better definition of procedures to protect intellectual property and to allow equal access for all vendors, 2) well-defined procedures for dispute resolution, especially where competing agendas impede progress, 3) use of standardized cost estimation tools, 4) more extensive use of decision-support tools and comparative risk analysis, and 5) greater consideration of the use of Monitored Natural Attenuation as part of a remediation approach. In some cases, the risks of aggressive removal of waste may exceed that of leaving it in place; the risk to workers from use of remedial technologies should receive more scrutiny. Demonstration of comparative risks requires sophisticated modeling, characterization and sampling systems; such tools often lack performance data and may not be readily accepted by all stakeholders. It has also been found that independent cost estimates should be obtained in situations where there is a large discrepancy between the estimates from the vendors of innovative technologies and the baseline cost estimate from DOE and the M&I contractor. The assumptions behind any baseline remediation plan should also be reviewed when considering innovative alternatives. In addition, innovative technologies may be more hazardous than standard techniques and the estimated cost for the technology should include consideration of additional training and safety precautions.

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC-94-AL85000.

Table 1. Summary of ITRD Projects

Project/Location	Description	Highlights/Examples of Evaluation of Innovative Technologies
Hanford 100N Area, Richland, WA	^{90}Sr groundwater plume moving toward Columbia River	Treatability studies for *in situ* stabilization of Sr using phosphates and *in situ* soil flushing to remove the Sr from zones of highest concentrations Modeling of effect of transient groundwater-river hydrologic interactions on transport to support evaluation of monitored natural attenuation.
Hanford 200 West Area/ Richland, WA	CCl_4 plume; possible occurrence of DNAPL	Model of CCl_4 transport in a groundwater plume using a version of the Hanford Site Wide model suggested that most of the potential source term would have to be removed to ensure compliance with relevant regulations. Detailed cost and performance prediction for use of Partitioning Interwell Tracer Tests (PITT) to locate and quantify DNAPL in the vadose zone led to rejection of this technology.
Paducah Gaseous Diffusion Plant/Paducah, KY	^{99}Tc and TCE plumes migrating towards the Ohio River	Treatability study to evaluate materials for a permeable reactive treatment zone lead to the selection of zero-valent iron for the pilot study. Preliminary work plan completed for pilot test of recirculating well C-Sparge technology. This method removes TCE by oxidation and ^{99}Tc by ion exchange.
Y-12 Plant/ Oak Ridge Reservation, TN	CCl_4 plumes, potential DNAPL in deep fractured rock	Treatability studies demonstrated efficacy of biostimulation with site-specific materials. Advanced simulation techniques being used to support design of a tracer test, evaluation of a pump test, and address the problems associated with delivery of nutrients for biostimulation in the fractured rock at great depths.
Explosives/ Pantex Plant, Amarillo, TX; Los Alamos National Laboratories, Los Alamos, NM	Soil, groundwater and surface water contaminated with metals and the high explosive (HE) residues	Compost treatment using soils mixed with zero valent iron and DARAMEND[5] Soils treated by *in situ* anaerobic bioremediation using injection of nitrogen gas into the subsurface. Directed treatment methods including chemical oxidation with permanganate, in situ redox manipulation (chemical reduction) and bioremediation technologies under evaluation to remediate perched water zone. Time Domain Electromagnetic aerial surveys used to characterize structure of perched zone.
Mound Site PRS 66, Miamisburg , OH	Large volume of soil and debris, including empty drums and other materials contaminated with ^{232}Th, ^{210}Po and ^{238}Pu.	Clear definition of end-point criteria for the clean-up is essential to success. Geostatistically derived sample and analysis plan was developed and the approach useable at other sites. Identification and validation of geophysical characterization tools and radionuclide field screening technologies still underway.
Mound Site Operable Unit 1, Miamisburg, OH	Contamination of soil and aquifer with volatile organic compounds (VOCs).	Combination of Air Sparging, and Soil Vapor Extraction removed 3500 lbs of VOCs. Directed Air Sparging for relatively tight zones fielded in FY2001 required to prevent off-site migration induced by remediation. Design, installation and operation of a system for on-site "real time" monitoring of VOC concentration allowed operational optimization.