ACCELERATING CLOSURE AT DOE SITES WITH EM'S SCIENCE AND TECHNOLOGY PROGRAM

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ABSTRACT

Technical support is important for all U.S. Department of Energy (DOE) facilities facing difficult technical issues, aggressive remediation schedules, and tight budgets. It is especially vital for closure sites, which typically are smaller and have fewer resources available to apply to remediation activities. In many cases, closure sites and other small sites no longer have staff with the expertise required to overcome technical barriers on their own.

As closure deadlines approach, special technical expertise is needed to identify, evaluate, and implement new and innovative approaches that will result in significant cost and schedule improvement for the waste disposition pathway. Site "problem holders" must have access to world-class scientific and engineering expertise from DOE national laboratories and research facilities, private industry, and universities to address immediate critical problems. In order to have confidence in the feasibility and results of innovative approaches, site contractors need to have the benefit of the valuable experiences of technicians who have faced similar problems and found solutions.

The DOE Environmental Management (EM) Science and Technology (S&T) program recognizes the need of the closure sites to solve problems aggressively and is highly responsive to this need. Technical support from the S&T program can take many forms, such as providing expertise, reviewing the baseline, addressing a specific technical problem, evaluating commercially available technologies, or co-funding a high-risk alternative. This paper describes the approach by which closure sites are quickly and easily able to obtain technical support from the S&T program and provides examples of successfully completed and ongoing technical solutions activities.

THE EM PROBLEM

DOE's Office of Environmental Management is leading an aggressive national program to compete the cleanup of environmental waste from nuclear materials production activities. EM has set an overall goal of reducing the cleanup life-cycle cost by $100B and accelerating the closure schedule by 30 years—completing cleanup at most of its sites by 2006. Some sites will be turned over to new landlords, and other sites will continue pursuing DOE missions.

This cleanup program is technically complex, closely regulated, and expensive. There are still many technical challenges that must be solved to achieve closure goals. The contamination at the closure sites is uniquely hazardous and chemically complex. Contaminants like spent nuclear fuel, liquid high-level radioactive waste, nuclear materials, and mixtures of hazardous and radioactive compounds are found in a wide range of contaminated media, such as groundwater, soil, and nuclear production facilities. Much of the hazardous materials and contamination cannot be easily removed because many current approaches may pose risks to human health or the environment.

Many of the site closure plans still have technical gaps where answers are not clear. To meet accelerated schedules with limited funding, contractors have made assumptions that require the use of new technology or approaches. Sometimes, the technology does not yet exist. Often the technology is available but must be tested and proven for specific site conditions.

Alternative technical solutions are normally not pursued by site contractors within the framework of cost plus incentive fee contracts. In most cases, alternative solutions are not sufficiently developed to a point at which the contractor believes that the likelihood of success—in terms of reduced cost, reduced scope, accelerated schedule, or reduced worker exposure—is enough to off-set the risk associated with the investment of baseline funds. However, where there is a good probability that the alternative solution will be beneficial for the government, it is appropriate for the government to share in the risk of developing an alternative solution. Under some of the latest contract agreements, DOE is in a position to realize the major portion of any cost savings associated with project enhancement resulting from the implementation of innovative alternatives.

As closure deadlines approach, special technical expertise is needed to identify, evaluate, and implement new and innovative approaches that will result in significant cost and schedule improvement for the waste disposition pathway. Site "problem holders" must have access to world-class scientific and engineering expertise from DOE national laboratories and research facilities, private industry, and universities to address immediate critical problems. In order to have confidence in the feasibility and results of innovative approaches, site contractors need to have the benefit of the valuable experiences of technicians who have faced similar problems and found solutions.

CLOSURE SITE CHALLENGES

Technical support is important for all DOE facilities facing difficult technical issues, aggressive remediation schedules, and tight budgets. It is especially vital for closure sites, which typically are smaller and have fewer resources available to apply to remediation activities. In many cases, closure sites and other small sites no longer have staff with the expertise required to overcome technical barriers on their own.

Despite some unresolved technical problems for which there are currently no answers, DOE Ohio sites and the Rocky Flats Environmental Technology Site (RFETS) have committed to a very ambitious schedule to achieve closure by 2006, which is three years earlier than originally

planned. The Ohio sites include environmental management projects at Ashtabula, Columbus, Fernald, and Miamisburg.

At the Fernald Environmental Management Project (FEMP), principal activities center on the treatment and disposition of contaminated material stored in silos, finding disposition paths for unique and orphan wastes, and treatment of contaminated soils under the silos and buildings. At the Miamisburg Environmental Management Project (MEMP), principal activities include decommissioning and demolition of the radiologically contaminated facilities and the treatment of contaminated soils. Both sites also need assistance in the development of their long-term stewardship and monitoring plans.

S&T activities at RFETS will be focused primarily on the treatment and disposal of small-volume radioactive and hazardous wastes where no treatment and disposition pathway currently exists. Other potential support areas include subsurface identification, characterization and in situ treatment of buried pipelines and utilities; characterization and decontamination of highly contaminated facilities; and supporting critical environmental restoration activities such as landfill cap and cover designs. Support will also be needed in the development of the long-term stewardship and monitoring plans.

In addition, a number of small sites no longer have the technical staff resources to address the few remaining problems that keep them from closing. The S&T program is working with DOE's National Focus Project to address technical site-specific risks to completion. Focus Project teams have identified technical problems at 16 sites in the areas of soil and groundwater contamination, waste management, and deactivation and decommissioning.

TECHNICAL SUPPORT APPROACH

Technical support is a major function for the S&T program, helping closure sites define and solve problems, identify alternatives and opportunities, and successfully transition technology into field application. The S&T program recognizes the closure sites' need to solve problems aggressively and is highly responsive to this need. A phone call or an e-mail with a one-page description of the need is all that it takes to get the process under way.

The S&T program can quickly mobilize technical experts from across the country and muster scientific expertise and field experience to address end-user needs. Types of support range from brief, one-to-one consultations to teams of a dozen or more technical experts who can spend a week or more at a site.

Technology solutions deployed with S&T program support are improving detection, characterization, and remediation of contamination; refining waste management; ensuring worker safety; minimizing risk; and significantly reducing cleanup schedules and expenses. The S&T program also tackles complex technical issues for which there are only limited data and partial scientific understanding.

To evaluate the performance of the technical support efforts, the S&T program is tracking the number of requests received, services provided, and tasks completed. Follow-up discussions will document the number of recommendations accepted by the sites, the cost saved, and schedule

acceleration achieved, as well as the ratio of technical assistance funds invested to the amount of project dollars saved. A record of lessons learned is being compiled for use in addressing similar problems at other DOE sites as they begin closure activities. Site managers will also prepare periodic evaluations of technical support activities.

THE EM S&T RESPONSE

Technical support from the S&T program can take many forms:

- provide teams of knowledgeable experts,
- review the baseline to identify technical risks associated with site closure,
- address a specific technical problem,
- identify and evaluate commercially available technologies, or
- co-fund a high-risk alternative

Here are some examples of recent activities illustrating the kinds of help available in these areas.

Provide Needed Expertise

Evaluation of Proposals

Site representatives from the Ashtabula Environmental Management Project (AEMP) requested technical support to evaluate the merits of replacing an existing wastewater treatment plant with a new modular design. A five-member team with expertise in wastewater treatment visited the site, evaluated current capabilities, and compared the merits of the existing design with the proposed plant.

The team found no significant operations or economic advantages for replacing the existing plant. In addition, the team identified issues that could adversely impact the operation of the treatment plant and recommended adoption of a wastewater minimization strategy. The findings and recommendations will help the site avoid the cost and schedule delay associated with bringing a new facility online.

In Situ Characterization

AEMP also requested technical support from the S&T program in defining new cost- and time-effective approaches for contaminated soils, concrete, and groundwater. A technical assistance team assembled and reviewed key site information prior to convening with DOE and contractor personnel for a three-and-a-half-day meeting to better understand baseline technologies, limitations, and site-specific issues. After listening to presentations about the nature and extent of known contamination, the team divided into several groups to brainstorm ideas and develop viable solutions.

The approach selected by the technical assistance team for soils will save costs by reducing the volume of soil that needs to be shipped off site and save time by using real-time characterization instruments during excavation. Regarding the contamination in groundwater and concrete, the

team identified several issues that needed to be resolved prior to selecting and evaluating suggested approaches.

The team also outlined a number of areas in which they could provide sustained support to ensure that any appropriate recommendations could be successfully implemented. These areas included coordinating demonstrations, working on a closure plan, identifying data gaps to substantiate cost/benefit analysis, and assisting in risk assessment

Buried Piping

The Ohio Field Office submitted technical support requests focused on the characterization of underground piping at three sites, each with significant underground piping that must be characterized, removed, and properly disposed. The S&T program convened a team of national experts in the areas of radiochemistry, health physics, decontamination and decommissioning, and environmental engineering and held a two-day workshop with staff from the three sites and the Ohio Field Office.

The technical assistance team recommended using the "graded approach" to characterize underground piping located in uncontaminated areas or piping contaminated with radionuclides that can be easily remediated in place. They also strongly recommended that the sites work with the appropriate regulatory bodies to determine rational release criteria specific to buried underground piping systems, which should be less stringent than those for surface facilities. Development of a rationale and strategy to demonstrate that piping can be safely left in place would provide significant cost and schedule benefits to the sites.

Cleanup Monitoring and Verification

The Mound site (at Miamisburg) has a number of areas where soils are contaminated with Pu-238. For most of the common radioactive contaminants, cleanup verification can be conducted in an efficient manner using field instruments as a tentative indication that cleanup is complete, with soil samples sent to an off-site lab for final verification. However, for Pu-238, field detectors are not sensitive enough for measurement at the cleanup goal level, resulting in work stoppages while time-consuming lab analysis is conducted on site. Mound has asked for support from the S&T program in developing a more sensitive field detector for Pu-238. The S&T program is making arrangements with another DOE site for the use of a cone penetrometer truck equipped with a gamma detector.

Complete Baseline Review

Process Reviews

RFETS has approximately 100 drums of legacy transuranic-contaminated ion exchange resin waste. Numerous accidents involving ion exchange resins have raised concerns about the safety of leaving the spent ion exchange resins in their current state. The baseline technology consists of repackaging, immobilization, characterization, and certification prior to shipment to the Waste Isolation Pilot Plant (WIPP) at a cost of over $1M, not including the design and construction cost for the processing system. In response to a request from RFETS, the S&T program assembled a

technical team to assist in determining whether the resins pose a safety hazard which must be mitigated prior to shipment and disposal at WIPP.

Benchmarking and Value Engineering

Plutonium contamination is widespread in surface soils and subsurface sediments throughout the DOE complex. Plutonium is generally considered to be relatively immobile, but transport of this contaminant, albeit at very low concentrations, has been observed at many DOE sites.

RFETS has asked the S&T program to compare subsurface plutonium transport observed at the Idaho National Engineering and Environmental Laboratory with conditions that exist at RFETS. The comparison of the two sites will address hydrogeology, measured plutonium concentrations, locations and depths of groundwater samples, analytical techniques used, contamination sources, and other factors necessary to make a meaningful comparison between the two sites. Preliminary information from the comparison study has proven valuable and is already being used by RFETS in working with regulatory and stakeholder groups involved in the remediation efforts.

Help with Specific Technical Problems

Address One Part of the Baseline

For the Plutonium Stabilization and Packaging System (PuSPS), RFETS has asked for assistance in reviewing existing technical data from a stabilization furnace failure discovered last summer, determining applicability to other material stabilization runs, and finding whether similar materials requiring stabilization exist at other DOE sites. The task also includes a cost/benefit/risk analysis. By addressing one part of the closure baseline, the S&T program can help reduce potential employee exposure, reduce expensive furnace downtime, and keep material processing on schedule.

Optimize the Baseline

The S&T program provided a technical assistance team to develop the technical justification for reducing the temperature for processing (stabilizing) high-chloride plutonium oxides at RFETS. At the baseline calcination temperature, chlorides are vaporized, threatening stabilization equipment, raising worker exposure, increasing waste volumes, and introducing impurities into the stabilized material that will need to be removed later.

The team also considered the potential safety benefits of lower-temperature operation and determined that a reduction in operational risks, as well as financial and schedule risk, should result from stabilization at a lower temperature. The recommendation was subsequently supported during an independent peer review and accepted by the Defense Nuclear Facilities Safety Board, allowing RFETS to proceed with the accelerated cleanup.

Provide Analysis, Results, and Recommendations to Improve the Baseline

A technical assistance team composed of technical experts from national labs, technology centers, and universities was assembled in response to a request from the Soil and Disposal

Facility Project (SDFP) at FEMP. The team was tasked with recommending approaches to remediating volatile organic compound–contaminated soils.

The selected treatment technology had to be timely—feasible to implement and complete by the "end of the year" to support overall closure and restoration activities and help meet the 2006 closure deadline. The technology had to treat the target soil to meet FEMP waste acceptance criteria for disposition at the on-site disposal facility and had to be cost-effective in comparison to the baseline.

During a two-and-a-half day meeting, the team discussed the primary issues at the contaminated areas, brainstormed potential innovative and cost-effective solutions, evaluated alternatives, and made general recommendations to SDFP. The baseline cost was estimated at $2.5 million; the solution recommended by the technical assistance team will cost approximately $400,000.

Evaluate Commercially Available Alternative Technologies

Vendor Events

Some wastes at RFETS are "orphan" by virtue of their activity level and lack of an associated disposal facility. Others are orphans because of their organic content or, in the case of transuranic wastes, the gas generation from the organics. Still others are orphans because they are mixed (only low-level waste can be sent to Nevada Test Site). These organics are often in a difficult physical form. On-site treatment is not a favorable option for the waste streams because preparation for closure has reduced site capabilities.

The S&T program helped RFETS organize an open forum for vendors and subcontractors to discuss procurement related to five orphan waste streams. Six prescreened vendors participated in the forum, designed to enable them to learn more about these orphan waste streams and RFETS personnel to learn more about the vendors' services. The meeting also provided a forum to define the technical and regulatory path forward for each waste stream, facilitated the movement of procurement decisions for the five categories of waste, and gave vendors a unique opportunity to explore potential teaming approaches.

A vendor forum was also conducted at FEMP to help address technical issues with waste material in silos. The material in Fernald Silo 3 must be retrieved to permit disposal of the waste and deactivation and decommissioning of the concrete silo structure. The baseline plan is to use pneumatic vacuum retrieval wands in conjunction with a mechanical excavator to retrieve the waste. FEMP is looking for an alternative that offers improved safety, reliability, and performance over the baseline design.

The S&T program is helping FEMP to screen bulk material retrieval vendors, select designs for mock-up demonstration testing, complete a test plan and mock-up facility, test prototype equipment and control systems, and support the installation and operation of the full-scale equipment. The technical assistance team held a vendor workshop to solicit alternative methods of waste retrieval from the silo. Several vendors participated in the workshop, and others are expected to provide proposals.

Replacing the baseline design with a different retrieval system is expected to significantly improve safety, reliability, and performance, with the potential of significantly decreasing downtime and associated cost and schedule impacts. The deployment of this technology has potential application at other DOE sites.

Co-Fund High-Risk Alternatives

FEMP has approximately 1,400 containers of organically contaminated low-level mixed waste (LLMW) which requires treatment and disposal. The baseline treatment option has significant technical, cost, and schedule problems. With technical solutions and technical deployment support from the S&T program, FEMP is committed to establishing a vacuum-assisted thermal desorption (VTD) treatment facility at an off-site location in FY03. VTD was recommended by a blue ribbon panel that evaluated technologies to treatment by incineration. VTD has been commercially proven and can readily be enhanced with pretreatment and posttreatment systems to treat the identified waste streams in a safe, cost-effective, and timely manner.

FEMP has received $3.3M from the S&T program to initiate procurement activities, award a VTD contract, and begin container preparation for shipment to the off-site treatment facility. Most of the funds obligated for the treatment contract will address the costs associated with the deployment and the performance of the facility. The S&T program has committed to supporting FEMP in FY03 with both technical and financial support of this project. The VTD treatment facility will benefit other sites by providing a proven treatment option for other DOE LLMW.

SUMMARY

During the first 12 months of the EM Science and Technology program's concentrated focus on technical support for closure site activities, it received and responded to over 20 requests from five sites for help on specific technical issues or problems. In every case but one, the recommendations of the technical assistance teams were accepted by the sites. (In the remaining case, it was determined to be too late in the remediation process to replace the baseline approach.)

Through activities such as design reviews, on-site technical assistance teams, workshops, and vendor forums, the program has provided site "problem holders" access to world-class scientific and engineering expertise to address immediate, critical problems. Site contractors are already experiencing cost reductions, safety improvements, and schedule accelerations and are gaining increasing confidence in the feasibility and results of innovative approaches to site cleanup efforts.