Federal Remediation Technologies Roundtable Meeting Summary

November 9, 2011

FEDERAL REMEDIATION TECHNOLOGIES ROUNDTABLE MEETING

Arlington, Virginia
November 9, 2011

FEDERAL REMEDIATION TECHNOLOGIES ROUNDTABLE MEETING
Arlington, Virginia
November 9, 2011

ACTION ITEMS

- ► Individuals interested in reviewing the draft Citizen's Guides updates should contact Linda Fiedler to receive copies; comments are due by November 30.
- ► Bill Lodder will inquire among the Department of Interior's land management agencies—Fish and Wildlife Service, National Park Service, Bureau of Land Management, and Bureau of Reclamation—to see if any of them would like to participate in FRTR activities.
- ► Comments or thoughts on the FRTR proposed operating principles should be sent to Mark Furhmann by November 30.
- ► Tom Nicholson will send information about the new NRC regulation on residual radioactivity at nuclear facilities to EMS for inclusion in the meeting summary.

WELCOME/INTRODUCTION

Jeff Heimerman, Acting Director of the Technology Innovation and Field Services Division (TIFSD) in the U.S. Environmental Protection Agency's (EPA) Office of Superfund Remediation and Technology Innovation (OSRTI), welcomed the attendees to the 43rd meeting of the Federal Remediation Technologies Roundtable (FRTR). The initial purpose of the FRTR was to bring together the technical groups within the agencies to share and learn about innovative and effective tools and strategies for cleaning up hazardous waste sites. Collectively, the FRTR has standardized the capture of information in cost and performance case studies and developed an immense repository of resources on its website. Since its inception, the meetings of the Roundtable have offered a venue to discuss the directions of the environmental remediation programs of the member agencies, and their impact on the technology market. The next step will be to determine the FRTR's future direction.

Jeff acknowledged the contributions of the meeting organizers: Carol Dona, U.S. Army Corps of Engineers (USACE); John Quander and Ed Gilbert (EPA/TIFSD); and Jessica Burns (EMS, Inc.). Following self introductions, the attendees were invited to make announcements of general interest.

FRTR ANNOUNCEMENTS AND MEETING OBJECTIVES

Green Remediation Subgroup Report

Carlos Pachon (EPA/TIFSD) outlined recent EPA developments in green remediation. He noted that social and economic elements are frequently considered now in discussions of green remediation, such as the importance of community involvement and the potential effect of cleanups on local employment and small business owners.

In September, OSRTI released a draft for public input of the *Methodology for Understanding and Reducing a Project's Environmental Footprint*, which presents green remediation metrics associated with environmental cleanups and a methodology for quantifying those metrics. The

draft document is posted on the CLU-IN website with a notice requesting comments by November 16, 2011 (www.clu-in.org/greenremediation/methodology/index.cfm).

The purpose of analyzing environmental footprints is to identify the largest components that can be minimized effectively and thereby achieve maximum results. Footprinting has been done at 18 sites, and new green remediation projects are under way. In EPA Region 9, the Superfund Program has signed a memorandum of understanding with some of the Department of Defense (DoD) services and is assisting with the development of spreadsheets for green remediation pilots. Work on projects in Region 6 is nearing completion.

To further the goal of maximizing use of renewable energy to power remediation site operations, the Agency is collaborating with the U.S. Department of Energy (DOE) to purchase bulk renewable energy certificates (RECs) from wind power sources. The purchase should be finalized by early December, and RECs will be allocated to each cleanup.

Carol Dona added that a major factor for consideration, now that a substantial body of information on green remediation metrics has been compiled, is how to use the footprinting results within the context of cleanups under the decision-making systems for Superfund and the Resource Conservation and Recovery Act (RCRA). She pointed out that the subcommittee began by working toward a common set of agency metrics and now must work toward a universal definition, as some of the member agencies define green and sustainable remediation more broadly than others.

FRTR Agency Announcements (Projects/Initiatives)

Greg Gervais, Chief of the TIFSD Technology Assessment Branch, announced the release of new information products and resources:

- The *Federal Remediation Technologies Roundtable Annual Summary of Activities* (EPA-542-F-11-012) was released in August 2011. The summary describes FRTR member-agency activities related to characterization of contamination in fractured media (the focus of the November 2010 FRTR meeting), and announces the new Fractured Bedrock Focus Area (www.clu-in.org/contaminantfocus/default.focus/sec/Fractured_Rock/) now posted on CLU-IN. The fact sheet also highlights recently published cost and performance case studies and reports. Twenty new case studies have been added to the FRTR cost and performance database (www.frtr.gov/costperf.htm).
- In September 2011, EPA published OSWER Directive 9355.5-32, *Clarification of OSWER's 1995 Technical Impracticability Waiver Policy*. This memorandum clarifies that the 1995 memorandum was intended to apply only to remedy decisions made in Fiscal Year 1995 and that the presence of dense non-aqueous phase liquid (DNAPL) contamination in and of itself should not be the sole basis for considering the use of a technical impracticability waiver. The directive is posted on the EPA website (www.epa.gov/superfund/health/conmedia/gwdocs/techimp.htm).
- TIFSD is updating the series of 2-page Citizen's Guide fact sheets, last published in 2001. The fact sheets describe in layman's terms the operation and application of the most frequently used innovative treatment technologies. Anyone interested in reviewing the draft updates can contact Greg or Linda Fiedler (EPA/TIFSD) for further information. Comments are requested by November 30.

Carol Dona identified several studies currently under way:

- One study involves 12 green and sustainable remediation (GSR) pilots, noting both savings and practical constraints in implementing GSR. The study and its report should be completed by March 2012. The study approach, *Final Installation Restoration Program (IRP) and Military Munitions Response Program (MMRP) Approach: Process for Consideration and Incorporation of Green and Sustainable Remediation (GSR) Practices in Army Environmental Remediation*, is documented at https://casi.erdc.usace.army.mil/focusareas/green_remediation/?contentRegion=Item&id=62056.
- A prioritization of optimization projects is identifying the sites with the greatest potential for optimization and then following up to see where the process is implemented.
- The Environmental Security Technology Certification Program (ESTCP) is sponsoring Project ER-201127, whose objective is to demonstrate/validate SiteWise™ and SRT™ and benchmark these tools against an industry-accepted life-cycle assessment software package (SimaPro).

Kevin Roughgarden (U.S. Army) reported that 15 Army projects are being analyzed to evaluate how well performance-based contracting is working.

Kirby Biggs (EPA/OSRTI) stated that a green remediation footprint analysis using the remediation design for the Grants Chlorinated Solvents site is providing a basis for comparison of the EPA Region 9 methodology results against those obtained with three different software tools: SiteWise™, SRT™, and SimaPro. Results should be available soon.

Kim Parker Brown, Naval Facilities Engineering Command (NAVFAC), stated that the Navy published its first formal optimization policy in 2004. An update to this policy is being prepared, with release expected by early 2012. In June 2011, the Navy updated its five-year review policy to support the continued evaluation and optimization of remedies, including optimization strategies that result in a more green and sustainable remedy. Navy remedial project managers (RPMs) are required to use the SiteWise™ tool for green and sustainable remediation calculations.

Tom Nicholson, Nuclear Regulatory Commission (NRC), announced that NRC issued a new regulation on June 17 concerning the estimation of residual radioactivity at nuclear facilities [FR 76(117):35512-35575(2011), http://pbadupws.nrc.gov/docs/ML1127/ML11272A154.pdf]. The regulation will affect considerations of whether remediation should occur immediately or be delayed until decommissioning. The rule is designed to prevent occurrence of future "legacy sites" with insufficient funds for decommissioning by requiring licensees to minimize the introduction of residual radioactivity at their sites during operations. Guidance is being developed for the rule, which becomes effective December 17, 2012. Tom will provide contact information for the leads for the regulation and the guidance upon request. Additionally, on November 28 and 29, The annual public meeting of the Federal Interagency Steering Committee on Multimedia Environmental Modeling (ISCMEM) will convene to discuss the latest developments in environmental modeling applications, tools, and frameworks, as well as new operational initiatives for FY2012 among the participating agencies. NRC, a participant in the ISCMEM, will host the meeting at its headquarters building in Rockville, Maryland. The

meeting is open to the public, and all interested parties may attend. Contact Mark Fuhrmann (NRC) to register.

Paul Beam (U.S. DOE) revealed that DOE's Office of Environmental Management (EM) has a new leader, Dave Huizenga. No major reorganization is expected, but if it occurs, the contacts for soil and groundwater likely will remain the same. In conjunction with the fall meeting of the Interstate Technology and Regulatory Council (ITRC), members of EM's Office of Groundwater and Soil Remediation met with invited experts to discuss the draft of *Scientific Opportunities for Monitoring on Environmental Remediation Sites*, a framework for improved monitoring that considers current issues for site closure and the potential for alternative end states.

David Morganwalp, U.S. Geological Survey (USGS), said that his agency realigned its offices at the beginning of the last fiscal year along seven broad mission areas: Core Science Systems, Ecosystems, Energy and Minerals, Environmental Health, Global Change, Natural Hazards, and Water. Mission area science strategy documents are being developed and posted for public comment on the USGS website (www.usgs.gov/start_with_science/). The programs for Toxic Substances Hydrology and Contaminant Biology now fall under Environmental Health.

Via phone, Andrea Leeson (SERDP/ESTCP) announced that the Strategic Environmental Research and Development Program (SERDP) and ESTCP will host the 2011 Partners in Environmental Technology Technical Symposium & Workshop on November 29-December 1, 2011, in Washington, D.C. Program abstracts have been posted (http://symposium2011.serdp-estcp.org/). Additionally, SERDP released a special solicitation for the Defense Coastal/Estuarine Research Program on September 20 and issued its FY2013 core solicitations on October 27 (www.serdp.org/Funding-Opportunities/SERDP-Solicitations). The FY2013 core solicitation statements of need for Environmental Restoration focus on 1) in situ remediation of 1,4-dioxane-contaminated groundwater and 2) improved assessment and optimization of remediation technologies for treatment of chlorinated solvent-contaminated groundwater.

PANEL DISCUSSION: OPTIMIZATION

Carol Dona introduced the panel of speakers and facilitated the subsequent discussion.

U.S. Army Corps of Engineers: 13 Lucky Years of Remediation Optimization

Dave Becker (USACE), with experience in over 60 remediation optimization projects conducted since 1997 (Attachment A). He observed the evolution of the remediation system evaluation (RSE) process beginning with its development in 1997 by the USACE Environmental and Munitions Center of Expertise. The central concept of the process is that it is an independent, expert, holistic evaluation of the post-construction remediation system. The RSE team looks for a balance between how costs can be trimmed and how well the system performs in achieving its remedial objective. The RSE process was first applied in 1998 in two studies, one for the Army and one for EPA.

Dave introduced Kathy Yager (EPA/TIFSD) as his EPA collaborator since 1998 in implementing RSEs at cleanup sites. These early efforts were so successful that EPA adopted and adapted the RSE process in 2000 for expanded use at fund-lead and other Superfund sites. USACE has

participated in about 35 RSEs for EPA, as well as other RSE projects with Army, Air Force, DOE, and NASA.

The key to RSE is independent review by subject matter experts in fields such as remedial engineering and hydrogeology. The RSE process involves data review, a site visit to interview staff and inspect equipment and facilities, data analysis to evaluate the monitoring program and subsurface and above-ground system performance, and generation of a report containing recommendations for changes designed to optimize systems and/or practices. Other optimization activities have included long-term monitoring optimization efforts, incorporating sustainability into RSEs, optimization as part of five-year reviews, value-engineering support, and feasibility study optimization. Dave has found that overcoming project inertia and achieving implementation of the RSE recommendations is a substantial challenge, especially when recommendations entail major changes, such as amending a record of decision (ROD).

Currently, USACE is assessing potential optimization benefits for Army cleanup programs, particularly in the area of long-term monitoring. A monitoring optimization project is under way for an EPA Region 2 site with a side-by-side comparison of the MAROS software and the Air Force's new 3TMO tool. Work also has begun to incorporate sustainability measures into the optimization process, such as by recommending the use of alternative energy sources to power remediation systems.

U.S. Air Force: Remediation Performance Optimization

John Gillespie, Air Force Center for Engineering and Environment (AFCEE), discussed how to fit optimization into a performance-based contracting environment (Attachment B). As an attorney with 25 years of experience in environmental remediation, John has a unique perspective into the technical and contractual aspects of this process. The Air Force Optimization Program is evolving, and project failures have occurred as contracting officers and technical project managers learn how to specify optimization-related goals for its contractors effectively and provide incentives to achieve those goals.

Within three or four years, the Air Force expects to have all of its installations under fence-to-fence performance-based contracts (PBCs), labeled “performance-based remediation,” or PBR. John sees the biggest failure of a remediation effort as the drive to achieve remedy in place (RIP) at the expense of detailed site characterization, a great disservice to later efforts not just at any single site, but to other sites within the facility.

PBR should be designed to emphasize the contractor’s responsibility for making appropriate decisions in the optimization of remedial systems, site closure and long-term monitoring activities, and sampling frequency. To improve the PBR process, it is important to reduce contractor uncertainty pre-PBR by providing as much information as possible, clearly defining the site areas of concern and the expectations for them (e.g., RIP), and crafting a contract vehicle that allows the site manager to spur the contractor to meet these expectations. The pre-PBR contribution can involve providing programmatic evaluation to support fence-to-fence PBRs, highlighting potential performance metrics, planning for surveillance during PBR, supporting execution of the Surveillance Plan, and evaluating progress against performance metrics and

milestones. Receiving multiple bids on a PBR priced within a fairly narrow range is evidence of successful reduction of contractor uncertainty.

EPA's Nationwide Optimization Strategy

Kirby Biggs defined optimization as "systematic site review by a team of independent technical experts, at any phase of a cleanup process, to identify opportunities to improve remedy protectiveness, effectiveness, and cost efficiency, and to facilitate progress toward site completion" (Attachment C). Kirby and Kathy Yager are co-chairs of the National Optimization Strategy, EPA's national strategy to expand Superfund optimization from investigation to site completion. Kirby also recognized the participation of Jennifer Hovis (EPA/OSRTI). OSRTI's Assessment and Remediation Division has participated in developing the strategy as well. Optimization is not a new effort for EPA; more than 12 years of activity with close to 120 reviews conducted so far are documented on the CLU-IN website at www.clu-in.org/techfocus/default.focus/sec/Remediation_Optimization/.

Full incorporation of the optimization process faces many challenges, beginning with the sheer size of the universe of sites that await remediation across the country. EPA's 2004 *Cleaning Up the Nation's Waste Sites: Markets and Technology Trends* estimated 294,000 sites to be cleaned up between 2004 and 2033 at a cost of $209 billion (www.clu-in.org/market/). Another challenge is managing the complexity of remediation, an inexact, continuously evolving science that must be conducted within constraints imposed by availability of resources, changes in technical capability, shifts in state and federal regulations, and adversarial perceptions and attitudes.

Over 30 training sessions have been conducted to communicate optimization lessons learned to EPA staff in all 10 Regions as well as to thousands of contractors and other professionals. Tools and protocols have been developed for use by RPMs. Optimization can be applied to all types of sites, remedies, and cleanup programs, including those conducted by the offices of Brownfields, RCRA, and Underground Storage Tanks.

Excellent results have been achieved for optimization conducted to date, but less than 10 percent of the 1,650 Superfund sites on the National Priorities List have been optimized, which means that only a fraction of the potential public health protection and savings in costs, energy, and time have been realized. The National Optimization Strategy proposes to expand optimization to more Superfund remedial sites (20 to 30 sites per year); leverage Regional and OSRTI resources; develop Regional optimization programs/expertise; and track optimization results for all sites. The strategy will be finalized and implementation will begin by the end of calendar 2011, with full strategy implementation expected by end of FY2012.

Department of the Navy — Approach to Optimization of Remedial Actions

Karla Harre, Naval Facilities Engineering Service Center, stated that the Navy's main optimization principles are based on policy and guidance documents developed by the Navy Optimization Workgroup, which comprises staff from each of the engineering field commands (Attachment D). She began working on optimization in 2004, when the Navy issued its *Policy for Optimizing Remedial and Removal Actions under the Environmental Restoration Program* (http://tinyurl.com/NavyOpt2004).

The Navy is in the process of updating the 2004 optimization policy to incorporate sustainability as part of the optimization process and to require the use of SiteWise™ during the feasibility study. A requirement for the RPM and consultant to perform an independent pre-feasibility remedial alternatives analysis has also been added.

Optimization planning is encouraged to begin in the early stages of the remediation process at every Navy response action site. Optimization considerations include how to keep the conceptual site model (CSM) updated, how to identify remedial action objectives, and how to take advantage of available technologies in a treatment-train strategy. This approach makes it easier to implement changes later in the cleanup process. The guidance also emphasizes evaluation of existing remedies by looking at the data, costs, and trends, followed by evaluation of alternatives. The goal is cost reduction and expedited site closure. Since 2004 the Navy has required Headquarters approval prior to the installation of every new pump-and-treat system to ensure that it is installed only where the use of such an expensive system is warranted.

A key part of the optimization process is the independent third-party evaluation. It is the RPM's responsibility to request the review, either from an outside contractor or from in-house technical support, that is independent of the project team. Each RPM is required to include the cost for optimization in project cost estimates and budget requests, and to enter information on site optimization efforts (recommendations, strategies, results, costs, and savings) into the NORM Optimization Module twice each year. NORM contains about 600 optimization evaluations conducted at over 400 sites. According the Navy's FY2011 midyear numbers, NORM data indicate a 5.5 return on investment and a cost avoidance of about $134 million.

The Navy's ERT2 Multimedia Training Tools website (www.ert2.org) is the gateway to a variety of online remediation training tools, including the Technology Transfer Optimization Portal and the Green and Sustainable Remediation Web Portal. These tools offer extensive descriptive information and links to case studies, guidance and policy documents, contacts, software, and other useful websites.

Question and Answer Session

Question: What tools other than MAROS is the Navy or DoD using for optimization, particularly tools relevant to geostatistical analysis at complex sites?

Answer(s): The tools used so far are chiefly employed for optimizing long-term monitoring. MAROS is important, but 3TMO and GTS are also used, along with software developed by contractors specifically for a particular project. These basically use a groundwater model with overlying software that runs the model repeatedly to find the best combination of well locations and pumping rates. At some sites, a performance tracking tool that compares actual quantities removed compared to the estimated quantities present can provide an idea of cleanup progress.

Question: Aside from the NORM Optimization Module, does the Navy use any other means to track the effectiveness of the optimization recommendations and their implementation?

Answer(s): Although the Navy RPMs are required to update their optimization information, implementation is an area of weakness. For example, the $134 million calculation for cost avoidance is based on information from only about 20 percent of the 400-plus sites because the cost avoidance information for many of them is not up to date. It is vital to have upper-level support so that management can emphasize the importance of optimization tracking during management/RPM budget discussions. Recommendation tracking and support by upper management are also of concern to other agencies—EPA is currently developing a strategy for tracking optimization recommendations and their implementation that will include engaging the attention of Regional and Headquarters management to increase the funding and visibility of these activities.

Comment: It is often more difficult for the RPM to track optimization results than for the on-the-ground contractor to do it. It would be useful for the contract to specify that the contractor is responsible for reporting and tracking the optimization results and associated cost impacts.

Question: Given the tendency to over-design a remediation system, would it not be more effective to design the system with optimization in mind and begin the process immediately after system startup?

Answer(s): One thing the Navy has seen is that cleanups begin with high levels of contamination that drop off significantly in the first few years. It would be valuable to evaluate progress earlier and more frequently to optimize system efficiency. It is important to set performance objectives for the technology and to have the design flexibility to make changes as needed, which includes moving to a different technology when the first one has reached its limits. Embracing the treatment train approach requires mental flexibility as well as design flexibility. Using a suite of technologies can bring in economies of scale and help cleanups evolve more effectively.

Question: What kind of experiences have the agencies had using numerical models to model the plume and the effects of the cleanup or containment processes used? The models would be used to aid in the analysis of when to alter system operation.

Answer(s): For PBCs, models are a good way to establish milestones in terms of system performance and to set decision points. A good numerical model would support the treatment-train strategy. A model being used in a project in the Southwest is helping the RPM to understand the external changes to the study area due to changes in municipal pumping and to make recurring changes to account for those external influences. EPA is exploring the concept of numerical modeling and crossover to 3D visualization of existing data for larger and more complex sites. The process involves looking at the predictive nature of the numerical model and then going back to look at the behavior of the plume with 3D visualization as a check on the strength of the predictive model. Where those two diverge is where the numerical models need to be improved. Essentially, this is historical plume morphology and behavior versus what the predictive model would say. Almost all the Air Force sites would have a groundwater flow model for predictive purposes and to show where the CSM is inadequate. MAROS and GTS used for long-term

monitoring will show when and where to drop or add wells. The majority of Navy sites use time-series data for very simple analysis and simple concentration data plots for determining sampling frequency and increasing or reducing sampling locations. Only a small percentage of sites will use more complex models.

Question: How does one deal with uncertainty when optimization decisions must be based on an uncertain model?

Answer(s): The model output has uncertainty, and so the optimization should have a factor of safety built into the objective function that accounts for the risk of results being different or else explore the sensitivity of the model results through different parameters to see how great the degree of uncertainty is. Optimization is basically a matter of pushing a remedy to the edge—to the brink of failure to meet constraints—in order to minimize costs. At a site where more sophisticated optimization tools are being used in conjunction with a flow and transport model, the target concentrations are set lower than the target MCL to account for those uncertainties.

Question: Do any of the agencies report experience with Monte Carlo analysis?

Answer(s): Monte Carlo techniques have been used at some very complex sites to evaluate the sensitivity of a model. At an Army site located in Utah the technique was used to evaluate the certainty of conclusions regarding the ability of natural attenuation to manage a plume when the pump-and-treat system was shut down. Numerical models require a certain amount of data—at least several years of data—which makes them difficult to use early in the cleanup process. MAROS needs at least two years of monitoring data and works better with five. A risk management model that can be used to evaluate in all parameters the risk of project failure is described in ITRC's 2011 *Project Risk Management for Site Remediation* (www.itrcweb.org/Documents/RRM-1.pdf), with some reference to Monte Carlo techniques.

Question: What are specific obstacles to tracking and following up on optimization recommendations?

Answer(s): The Air Force remediation program was still relatively decentralized in 1998, and some of the regions incorporated innovative ideas more slowly than others. Depending on the culture of a particular facility, an RPM might take optimization recommendations as an assault on the way he manages his project. The centralization of the Air Force cleanup program meant that pressure could be applied—usually by the program manager who funds the RPM's project and sets hard dates for deadlines—to require the use of optimization teams and the implementation and tracking of their recommendations. The message moves from the top down, and it may take several years for the contractors to assimilate it. The process is not yet perfect. In the Army, it is important to engage the interest of the project team in the idea of optimization and to avoid a retrospective inquisition. Top-down involvement is needed to apply pressure where new ideas and procedures meet resistance, even to the point of including optimization response as an objective in an RPM's performance evaluation. Incentives for contractors can also play a part. The Navy tends to perform its optimization

studies, evaluate them, and arrive at recommendations internally before it shares them with regulators, whereas involving the regulators earlier in the process might generate better buy-in. In EPA's process, a key weakness is the absence of funding to implement the recommendations. The recommendations seem to have better traction with new RPMs because they appreciate the help.

Comment: An optimization team makes recommendations and goes away. Natural inertia can prevent the recommendations from receiving any attention after the team leaves, or the team approach or recommendations may be incompatible with the project culture or the perspective of the site contractor. Additional interaction—a repeat visit and discussions—with the optimization team can reinforce its recommendations. In an EPA Region 3 pilot study, the optimization team performed a first-level streamlined evaluation, a lower-level RSE. The site's section chief was involved in every meeting. The team returned in six months to follow up with all of the original participants, including the section chief. This dynamic involvement of the site team, optimization team, and section chief achieved a good level of response and implementation of recommendations.

Additional information on conducting streamlined RSEs is available in the following report: *Pilot Project to Optimize Ground Water Remediation Systems at RCRA Corrective Action Facilities: Summary Report and Lessons Learned* (http://www.clu-in.org/download/remed/hyopt/application/rses/rcra_rses/revised_rcra_rse_summary_report_122205.pdf).

Question: Site managers and contractors may prefer not to hear the recommendations when there is no money to incorporate them into a risk-based remedy. How would you deal with that?

Answer(s): Optimization does not eliminate uncertainty, but it can reduce it. The recommendations give the RPM information to take to management and request the means to address the situation. When the remedy is not under control, it affects the prioritization of the review board. One recommendation is a fully funded national optimization program rather than a regional one. Managed as an enterprise system, the program would prioritize the sites with big life-cycle costs, and its efforts could be tracked at Headquarters.

Comment: From the perspective of a contractor who has worked under both PBCs and cost-reimbursable contracts, it is a major incentive to work proactively under a cost-reimbursable contract with the understanding that the savings from successful optimization accrue to the agency. The use of sophisticated tools can show how savings are achieved and demonstrate that the agency's return on investment is worthwhile. Under a PBC, this type of contract is good for the government but throws risk on the contractor, who must be innovative to minimize his risk. By combining a sophisticated tool like numerical modeling with optimization tools, it is possible to show when to pump, when to stop pumping, and when to switch to natural attenuation. Key points are effective communication with the client and using the right tool to demonstrate the level of success. Optimization is very practical in a PBC environment.

Question: How can the amount of site characterization be optimized in terms of follow-on activities?

Answer(s): The availability of newer tools—3D visualization, robust conceptual site modeling, the Triad approach to characterization, field techniques like incremental sampling—affords many advantageous and cost-effective methods for detailed site characterization. They allow users to understand the data gaps and fill in the CSM.

Question: Do any agencies plan to do more collaborative optimization training?

Answer(s): The Navy has several training opportunities planned. Its Remediation Innovative Technology Seminar (RITS) training, offered each year at different locations across the country, will be offered in Washington, D.C., on May 1-2, 2012. This RITS will have a double session on optimization in addition to sessions on DNAPL strategies, munitions response, sediment remediation, and PCB forensics. RITS is offered primarily to Navy RPMs and its contractors, but federal partners are welcome to attend. Additional RITS training will be offered in Charleston, Norfolk, Seattle, San Diego, and Hawaii. CECOS, the Naval Civil Engineer Corps Officers School, also provides training. CECOS will offer "Optimizing Remedy Selection and the Site Closeout Process" December 13-14 in Norfolk. Its "Navy Environmental Restoration Program (NERP)" course also will be given there February 14-16, 2012. NERP covers a variety of topics, including a session on Optimizing Remedy Selection. The Navy often partners with other DoD services and would welcome partnering with EPA as well. Over the next few years, the Air Force will invest in training staff for surveillance of remediation PBCs, relying heavily on the training offered by ITRC. EPA collaborates on a regular basis with ITRC, and over 400 webinars, including seven that specifically discuss optimization, are archived on CLU-IN (www.clu-in.org/live/archive/).

Question: How successfully have optimization recommendations been implemented in the five-year review process?

Answer(s): Where USACE has included recommendations directly in the five-year review, the recommendations have gained a visibility that they otherwise would not have had in a stand-alone optimization report. At a site in EPA Region 4, many of the recommendations were incorporated successfully in connection with the five-year review, but success in this respect still varies from site to site. In Air Force cleanups, conducting the optimization visit a year or two prior to the five-year review has been observed to boost the recommendations' visibility. The Navy's updated five-year review policy includes optimization in the review process with a cautionary note that RPMs should incorporate optimization incrementally and not wait for the five-year review to begin the process.

Question: What happens if the five-year review forces changes in the PBC?

Answer(s): Air Force contracts contain language that encompasses game-changing events.

Question: Have any participants in second- or third-generation optimization reviews on the same site observed any impact from a previous review?

Answer(s): USACE has revisited at least two sites where the impacts of initial evaluations were observable. At an Air Force site, the contractor and project team had followed the initial RSE recommendations so successfully that it was difficult to find additional aspects to optimize during the second visit. At the second site, where almost 10 years had elapsed between the first and second RSEs, a major recommendation involving a ROD amendment had been accomplished. Through regular optimization re-visits as often as every other year, the Air Force has saved considerable money on long-term monitoring efforts. One component of EPA's National Optimization Strategy is the idea that an RSE is not a one-time event—a follow-up visit can reinforce recommendations not yet implemented.

Question: Most of the information on optimization is reactive or corrective. Is there a forward-looking aspect?

Answer(s): The Navy encourages RPMs to consider optimization strategy in the front end of a cleanup, during the feasibility study and the design phase. EPA's draft National Optimization Strategy encourages expanding Superfund cleanup optimization from investigation to site completion. When optimization is an iterative process, there should be less to correct. Independent expert review early in the life of a project can pay big dividends; however, USACE experience indicates that the momentum of a project in certain phases of work can affect the acceptance of recommendations that might interfere with the schedule.

REPORT OF THE FRTR PRESENT AND FUTURE DIRECTIONS WORKING GROUP

In the six months since the spring 2011 meeting of the FRTR, the FRTR Present and Future Working Group has conferred in five conference calls to work out future directions for the organization. Greg Gervais thanked the workgroup members for their participation and expressed his appreciation that the Navy, NRC, DOE, USACE, and EPA had made staff time available for the effort. The workgroup has concluded that all the FRTR member agencies would benefit from a spirit of renewed collaboration and a higher volume of activity, and its recommendations are documented in a set of proposed operating principles.

Greg pointed out that the Roundtable is an inclusive rather than exclusive organization, but membership carries responsibility for a certain level of participation although with an understanding that each agency is structured and funded differently and has different strengths and constraints. Agency contributions that further FRTR activities include contractor support, website maintenance, preparation of case studies and other products, subcommittee participation, and development of meeting content.

Continuing cooperation and information sharing among FRTR member agencies helps all the agencies keep abreast of developments in advanced innovative remediation technologies and benefit from contributions to technical guidance. The semi-annual meetings and the FRTR website should continue to provide Roundtable forums for technology-related efforts of mutual interest, the sharing of collective technical experience with specific technologies, and the formation of partnerships to pursue cooperative initiatives and projects. FRTR activities benefit the entire cleanup community and through information sharing help prevent wasteful duplication of effort by federal environmental groups.

Recommendations for a FRTR Path Forward

Karla Harre, a participant in the FRTR Present and Future Working Group, summarized the group's conclusions (Attachment E). The workgroup proposed the formation of an FRTR Steering Committee made up of one committee member from each participating organization. The Steering Committee Chair would rotate once per year. The committee would be charged with the following responsibilities:

- Determining common technical challenges among member agencies and identifying those on which to focus future efforts.
- Determining if a subgroup should be established to enhance collaboration between organizations on a specific topic.
- Providing direction on website structure and content posted at www.frtr.gov.
- Selecting the topic for the next meeting, based on input from member agencies and on new technological advances and developments.

The member organizations would be responsible for periodically providing a meeting chair to organize the meeting, set the agenda, coordinate speakers and materials for the presentations (e.g., PowerPoint files, handouts), and lead the entire meeting. EPA would continue to provide the meeting space, meeting venue logistics, preparation of the meeting summary, and technical support including loading presentations on the Web (pending final decision regarding website hosting). Each agency member who attends the FRTR meeting would be responsible for advertising meetings ahead of time, and disseminating information from the meeting to appropriate members within their organization.

Moving forward, it is important to identify and collaborate on the top environmental remediation challenges that are common across the member agencies, identify areas where application of new or innovative technologies/methodologies could make a broad impact, and leverage technology transfer efforts. FRTR would continue to establish working groups composed of knowledgeable members charged with focusing on a specific topic. These subgroups would communicate monthly or quarterly to share information, resources, and lessons learned. The results of these collaborations would be used to identify further opportunities (e.g., conducting shared pilot studies, resource leveraging), and any collaboration products would be developed or assembled as topic-specific information for public posting on the FRTR website.

The semiannual meeting schedule would continue, but with wider advance notification of the availability of remote access to expand the meeting audience to technical personnel unable to travel. Meeting topics would be solicited prior to each meeting, and the Steering Committee would determine the final topic and identify a meeting chair with duties as described above, and enroll staff from his/her own agency and other FRTR participating agencies to support the completion of meeting chair duties, the Steering Committee will determine the final topic, and a meeting committee will be selected. The meeting chair and the Steering Committee chair will coordinate development of the agenda.

The Present and Futures working group solicited feedback on the proposed operating principles. Comments can be discussed with any of the subcommittee members and submitted via email to Mark Fuhrmann (NRC) by November 30. Comments will be incorporated for revision and

dissemination of the operating principles by December 30. Consensus is sought by January 30, 2012, from each member agency, which also is the date for each agency to identify a member for the Steering Committee.

Karla asked if any additional federal agencies should be added to the FRTR roster, and Bill Lodder (Department of Interior) said that he will inquire among Interior's land management agencies—Fish and Wildlife Service, National Park Service, Bureau of Land Management, and Bureau of Reclamation—to see if any of them would like to join. These agencies all have issues with landfills and abandoned mine lands.

OPTIMIZATION PRESENTATIONS

Optimization Reviews: An Opportunity to Consider Exit Strategies

Stephen Dyment (EPA/TIFSD) discussed synergies between optimization reviews and consideration of exit strategies (Attachment F). The EPA Superfund Optimization Program provides independent third party evaluations of sites at strategic locations along the Superfund pipeline from remedial investigation (RI) through long-term remedial action (LTRA). Traditionally, these evaluations have focused on technical components and data associated with elements of the CSM, remedial design, and subsequent remedial action. More recently, a focus within the Superfund program has emerged based on the need to better define exit strategies, particularly at complex, dynamic, and challenging groundwater sites. The emergence of a greater need for clearly defined and robust exit strategies coincides with many of the findings from the optimization reviews. The application of optimization therefore might provide opportunities for project regulatory stakeholders to collaborate on exit strategies that better define EPA headquarters, EPA region, and state expectations while meeting legal and programmatic requirements.

While the agency has not formally defined exit strategies, nor are they programmatic or legal project requirements, optimization practitioners and Superfund program experts consider them valuable planning tools. As such, a working definition for exit strategies in the context of groundwater cleanups might be considered "a means of establishing metrics to evaluate progress and attainment of groundwater remedial action objectives and associated cleanup levels." These strategies can consider site-specific elements that do not address a means of evaluating attainment of remedial objectives, and also may help position the team to communicate information or meet other program and administrative requirements expeditiously.

The challenge for project teams and regulators is to better define a framework to convey these exit strategies and consider interim milestones or trigger points that allow decision makers to determine when specific actions are warranted. An agreed-upon framework that not only defines technical, area-specific (e.g., source, dissolved plume), and remedial technology metrics but also considers organizational, programmatic, administrative, and stakeholder issues can help chart a path to meet a variety of project needs. This presentation explores previous optimization projects to provide a historical perspective of exit strategies and consider future applications that might provide improved clarity and program benefits.

Remedy Optimization in the Era of Performance-Based Contracting

Dave Becker (USACE) explained that the Environmental and Munitions Center of Expertise (EM CX) has been conducting remedy optimization since 1998 by using the RSE approach to provide an independent, expert, and holistic look at a remedy to ensure effectiveness, reduced costs, and a realistic exit strategy (Attachment G). RSEs are conducted at the request of an agency periodically until the desired end state is attained.

Although performance-based contracts (PBCs) do not provide specific instructions for the contractor to perform the work, they must provide clear objectives and realistic metrics for evaluating performance, usually over a term of five or more years. While a contractor, relatively unconstrained by contract requirements, is expected to optimize the remedy while meeting contract objectives the success of a PBC from the "owner's" point of view depends on crafting the objectives and metrics. Poorly stated goals and inappropriate metrics, particularly for long-term remedies, can result in unexpected risks (and costs) shifted back to the owner. A PBC normally would shift significant amounts of risk to the contractor, which comes at a premium in the contract price unless the contractor anticipates ways to shift risk back to the owner.

Remedy optimization can be valuable in several ways when PBCs are planned or in place. A RSE preformed prior to letting a PBC can provide "seed" ideas that all of the bidders can consider in preparing their bids, leading to lower PBC costs. Optimization evaluations conducted during a PBC, independent of the PBC contractor, can assess the progress of the remedy and identify pitfalls that the contractor's approach may be creating for the owner. It should be noted that the PBC contractor may not be very cooperative with the optimization. Ideas offered in the optimization can benefit the public and environment, particularly if GSR concepts are part of the optimization. The optimization evaluation can recommend alternative formulations of objectives and metrics for the PBCs.

It is not yet clear that PBCs guarantee cost savings for remedy implementation compared to traditional contracting and optimization approaches. Sharing of risk between owner and contractor, with periodic independent, expert optimization evaluations, might well provide more cost and time savings than PBCs; however, this approach would depend on the ability of the owner to assure that the optimization recommendations are implemented. There is not an easy way to test the approaches. The EM CX is currently developing suggestions for the Army's optimization efforts, and a report is in preparation.

Environmental Footprint Reduction through Remedy Optimization

Doug Sutton (Tetra Tech GEO) pointed out that there is a lot of overlap and synergy between environmental footprint reduction and optimization: optimization results in footprint reduction, and footprint reduction can lead to optimization, but remedial expertise is needed (Attachment H). Federal agencies have focused on optimizing operating environmental remedies, particularly pump and treat systems, for over 10 years with documented results in improving remedy protectiveness, reducing life-cycle costs, and speeding site closure. Although the resulting optimization reports did not document the environmental footprints of these remedies and the footprint reductions associated with the optimization recommendations, upon a retrospective examination the implementation of many of the recommendations did result in substantial footprint reductions. Optimization efforts now frequently consider the environmental footprint of

the remedy and the potential environmental footprint reductions associated with the optimization recommendations.
Doug provided case studies of optimization recommendations from 2001, recent optimization recommendations, and recent GSR evaluations to give a historical perspective on environmental footprint reduction.

- An initial optimization evaluation was conducted in 2001 (prior to recognition of the concept of an environmental remediation footprint) at an EPA site with USACE involvement. The effect of each recommendation for optimizing the operation of the multi-component treatment system was later estimated with respect to annual cost savings and changes in the energy footprint. The substantial cost and energy savings are documented on slide 13.
- By 2010, remedy optimization reports were providing footprint reduction details. At a water treatment plant for VOCs, the evaluators recommended discontinuing off-gas treatment with the catalytic oxidizer given that the untreated air was within the installation's air permit levels. This change eliminated a 25 HP blower and the use of about 900 mcf/month of natural gas at a cost reduction of ~$400,000 over five years.
- In a GSR evaluation, the reviewers determined that installing two separate pump-and-treat systems was more cost effective than having one treatment system that would require pumping water uphill through 20,000 feet of pipe. The decision also substantially reduced the project's environmental footprint.

Many historic optimization recommendations could lead to footprint reductions equal to or greater than footprint reductions from recent GSR recommendations. Recent optimization recommendations benefit from increased attention to footprint reduction and a quantitative footprint of the remedy. GSR recommendations also benefit from footprint quantification. Many GSR recommendations require remedial expertise beyond knowledge of best management practices. The site team, the individuals most familiar with the remedy information, can provide some of the expertise, but input from an independent remedial expert conveys an added benefit.

Navy Environmental Restoration Program Management and Monitoring Approach
Janice Nielsen (NAVFAC) described the utility of the Navy's management and monitoring approach, an interactive report format designed to convey a site's remediation history and progress (Attachment I). The Navy Facilities Engineering Command, Atlantic Environmental Restoration Division, has worked with the Base Realignment and Closure Program Management Office and the NAVFAC Engineering Service Center to develop a management and monitoring approach that is expected to result in high-quality documents and considerable cost avoidance for the Navy.

The goal is to capture the critical elements used by Navy RPMs for sites in the post-decision document phase, that is, to tell the story of the site in a concise, well organized, and easily assimilated format. The approach, designed for use at sites where land-use controls and monitoring are part of the remedy, focuses on clearly stating the cleanup goals and exit strategies. The methods used to evaluate the empirical data show how site conditions are changing over time. Understanding and communicating the actions necessary to facilitate site closure via an appealing and graphically informative medium can contribute to cost avoidance

from unnecessary sampling. This effort has been well-received by RPMs and is now being used to reach consensus for meeting cleanup goals, documenting optimization efforts, and supporting five-year reviews.

Although the document has been designed for interactive use via hyperlinks (based on the format of the Navy's ROD Toolkit), it also can be assembled in hard-copy components suitable for retention in an Administrative Record. The format is similar to that used in the Navy's five-year review and improved Record of Decision (iROD) documents. The presentation slides illustrate the level of information complexity that this tool is designed to manage.

Question: How much does preparing this document cost?
Answer: The initial report, the prototype, cost $50K. Later reports cost about $35K.
Question: What does the Tool Kit do?
Answer: It provides examples of how to develop and format a report.

Question: Do information technology staff have to help develop the reports?
Answer: No, it's very simple. Anyone can be taught how to use the Tool Kit in about five minutes.

Question: Has the Navy considered expanding into the Z dimension for the site depictions? Can the depiction of the plume be linked to the geology?
Answer: A range of levels of detail is available for depicting the CSM, from very simple to very complex and multi-layered.

Question: What kind of database is required to store and manage the data in these documents?
Answer: The data ultimately reside in the Navy's NIRIS database and can be exported into Microsoft Excel.

Remediation Process Optimization in the Age of Performance Contracts

John Gillespie (AFCEE) reflected that the Air Force started developing Remediation Process Optimization (RPO) concepts in 1997, mainly in response to the large number of pump-and-treat systems and monitoring networks that were installed early in the environmental restoration program execution (Attachment J). As these systems were operated over the course of several years, data and contaminant trend evaluation generally indicated much longer timeframes were necessary for remediation to reach goals. Early optimization efforts focused on individual systems and the changes that could be made to improve their performance. Long-term monitoring optimization (LTM-O) also became recognized as a means of focusing data collection on spatial distributions and reducing the number of extraneous wells being sampled. Again, the focus was on individual sites or installations, and the LTM planned did not have endpoints.

Although RPO and LTM-O helped improve performance relative to the original remedy and/or approach, the benefits were sometimes limited. Performance-based management (PBM) guidance was rolled out to address remediation approaches with documentation of the problem and site objectives, planned land use, development of CSMs and exit strategies, and development

of a contracting strategy to execute the work. PBM was the first Air Force optimization program to roll individual site strategies into an installation-wide program management approach.

At the same time that contracting strategies leaned more in the direction of installation-wide or regional contracts, the Air Force also focused on the "Remedy In Place (RIP) by 2012" initiative. This initiative placed a significant emphasis on getting many sites to RIP at the same time and within a few years. To meet the RIP 2012 goal, the Air Force needed to re-baseline its Environmental Restoration Program (ERP) so that resources for sites and installations could be allocated appropriately. In response to the need, AFCEE/TDV implemented the ERP-Optimization (ERP-O) program. Technical teams worked with the AFCEE/R-PMO and installations to evaluate and provide recommendations to address sites at risk of missing the RIP 2012 goal. While individual sites did receive technical evaluation and recommendations were developed, the focus was on identifying alternatives and areas where optimization would be beneficial. Technical RPO and LTM-O evaluation and implementation was left to individual installations for implementation.

Now that the RIP 2012 has largely been met, the Air Force is working toward new goals. The two highest priority goals are implementation of PBR contracts and attaining site closure at a certain percentage of sites. The role of RPO and LTM-O has shifted as a result of PBR implementation. Contractors likely will implement traditional RPO and LTM-O evaluations at sites as a recognized technical and regulatory means of adapting to site conditions. The terms of the typical PBR contract, however, emphasizes the contractor's responsibility in making decisions for sites in achievement of stated Air Force goals. As a result, evaluations and recommendations developed by the Air Force can be provided to the contractor only as information, not direction.

The ERP-O program has already shifted focus to provide technical and programmatic evaluations and recommendations in advance of PBRs. This shift allows the Air Force to evaluate the progress made to date and then develop Statements of Objective with appropriate goals defined. John underlined his points with a failure case study example. Under a "best effort" contract, the contractor agreed to deliver X number of site closures for Y amount of money. There were no detailed work plans. The contractor conducted reviews of 13 sites at one installation that were to have progressed from RI to ROD. The project failed after the contractor spent 85 percent of the funds and achieved no site closures because all the RIs were deficient. He not only spent all the money, he wanted more money. This caused a two-year delay in the cleanup, and the contract was "terminated for convenience."

Question: For some PBCs, the Army required insurance for non-performance, and the Army funded the premium to pay for the insurance. Does the Air Force do that? If so, do the insurers like to have an independent third party evaluate the site?

Answer: That approach was big for a while, but now there may be only a few insurance companies willing to undertake it. The Air Force does not require insurance.

Remediation Process Optimization and Long Term Monitoring Optimization: Identifying Opportunities for Enhanced and More Efficient Site Remediation – the New Jersey Experience

Tom O'Neill, New Jersey Department of Environmental Protection (NJDEP), described NJDEP's RPO effort to date, reviewed NJDEP's interaction with EPA at LTRA projects, and outlined the NJDEP's plans for the future of RPO (Attachment K). The State of New Jersey's Department of Environmental Protection has lead responsibility for over 80 publicly funded site remediation projects ranging from underground storage tank sites to Superfund sites with multiple areas of concern. In addition, U.S. EPA is the lead at several Superfund LTRA projects that have begun to transfer to New Jersey as the 10-year LTRA period is completed. In response to this workload, the NJDEP's Site Remediation Program is investigating ways to accelerate site closeout and has formed an RPO Team to examine RPO as a tool to aid in this effort. The latest pilot project involves the use of licensed site remediation professionals to conduct RPO. New Jersey participated on ITRC's RPO Team and applies the ITRC finding to New Jersey's RPO program.

RPO implementation activities can face hurdles on technical, institutional, contractual, and regulatory fronts. Technical issues can involve uncertainties and heterogeneities and the dynamic nature of remediation. Tom presented, as an example, a gas station site (Lakehurst Exxon) that was affecting a municipal well field. After acquiring responsibility for cleaning up the site in 1988, NJDEP installed over a dozen monitoring wells, removed 400 tons of contaminated soil, and implemented pump and treat and soil vapor extraction with air sparging. Although close hydraulic control of the site was maintained, cleanup goals were not achieved until after RPO recommendations were implemented to focus sparging and venting in particular areas and optimize sampling. The active treatment systems were turned off in 2005, and NJDEP subsequently issued a No Further Action letter.

A New Jersey State-lead Superfund site, a former drum recycling site listed in 1983, was contaminated with metals, PCBs, and chlorinated solvents. The pump and treat system showed a typical performance, constant recovery (parts per million) but no asymptotic curve. In 2006, EPA did an RSE with its own funding (posted at www.cluin.org/rse/) and recommended new wells, existing plant modifications, and a pilot test of in situ chemical oxidation. NJDEP followed some but not all of the recommendations and then conducted its own evaluation and design.

Tom pointed out the wealth of optimization guidance available on the ITRC website. The ITRC RPO Team compiled and consolidated RPO methods that can be applied at state, federal, and private-party lead contaminated sites in a 2004 ITRC Technical Regulatory Guidance Document, *Remediation Process Optimization: Identifying Opportunities for Enhanced and More Efficient Site Remediation*. Optimization information was developed further in 2006 in a series of RPO advanced-topic fact sheets, ITRC document numbers RPO-2 through RPO-6. RPO-7, *Improving Environmental Site Remediation through Performance-Based Environmental Management*, introduced a new-to-site-remediation project management methodology to state regulators. Other related work is influencing how NJDEP approaches RPO: ITRC's *Project Risk Management for Site Remediation* (RRM-1), and *Green and Sustainable Remediation: State of the Science and Practice* (GSR-1), available at www.itrcweb.org with many other useful publications.

PBMO: The Comprehensive Physics-Based Flow, Transport, and Management Optimization Tool Kit

Larry Deschaine (HydroGeoLogic, Inc.) explained that the PBMO is a robust, next-generation version of a tool developed along the lines of an ESTCP project (Attachment L). Its speed is a particular strength, PBMO is distinguished by its capabilities: surface and groundwater plume tracking, long-term monitoring optimization, optimal remedial design (minimize cost and time or maximize mass removal), and optimal source finding. PBMO also is model independent, so it can be connected with any flow and transport simulator. Its modular organizing logic allows decision makers to deploy a unique blend of physics-based simulators, expert systems (including management criteria), and formal optimization techniques.

The Tool Kit components have been deployed at contaminated sites for EPA and DoD. One of the great cost-saving aspects of optimization is recognizing when it is most cost effective to switch remediation emphasis from active to passive treatment. Larry highlighted PBMO's Optimal Design of Remedial Systems module and its deployment at several projects:

- An RDX/TNT plume Remedial Design Optimization case study was conducted at Umatilla Army Depot, a site in Oregon. PBMO was benchmarked against the public-domain MGO flow/transport optimization software. PBMO attained the globally optimal solution approximately 50 times faster than MGO (3.5 CPU hours for PBMO vs. 168 hrs (one week) of CPU time for MGO). The ESTCP project which used MGO took place 10 years ago.
- At Fort Ord, an NPL site in California, the requirement was to determine optimal flow rates and locations for pumping and injection to find the point in time to stop active extraction/ reinjection and transition to monitored natural attenuation (MNA) to achieve the alternate concentration limit in a 10-year timeframe. For this application, PBMO required about 75 flow and transport simulations and 4.5 CPU hrs to attain the optimal solution, which identified the optimal scheme, optimized the exit strategy, and provided for roughly $300K in cost savings. EPA and state regulators provided favorable feedback on the optimal remedial solution.
- PBMO was used at the Standard Chlorine of Delaware Superfund Site (EPA Region 3) for performance evaluation and potential enhancements of a well/slurry trench system hydraulic containment remedy. Analysis revealed that the treatment plant throughput was a limiting factor. Plant improvements were made, resulting in a 4.3-fold increase in system throughput within 8 months.
- At Anniston Army Depot, a long-term monitoring effort was able to go from 200 samples per year to 40 samples for adequate characterization of the site.

Question: What could this tool do with radioactive contaminants in the ground?
Answer: The input for the PBMO would require a physically based model that mimics the processes, plus the spreadsheet information on costs of removal that the general program manager uses.

Question: Were all the examples performed under fixed-price contracts?
Answer: Fort Ord was fixed price with insurance, and EPA Region 3 was cost reimbursable. Each contract vehicle had different advantages with respect to cost savings.

Question: Did you make money on the fixed-price contract?
Answer: We were fortunate to have insurance.

MEETING WRAP-UP/NEXT MEETING AGENDA

Balloting for the next FRTR meeting topic indicated "large, dilute plumes" as the topic of greatest interest to member agencies. Karla Harre volunteered to plan the agenda, and suggestions for agenda topics or presenters should be sent to her.

Carol Dona said that although the potential for establishing an optimization subcommittee had been touched upon, no decision was reached. Tom Nicholson suggested summarizing the highlights of the meeting into talking points to support further discussion and decision making in this regard. Carol nominated Dave Becker to develop the summary.

The next meeting will be scheduled in spring 2012. Greg Gervais thanked the meeting organizers, facilitators, and attendees, and the meeting was adjourned.

ATTACHMENTS

A. U.S. Army Corps of Engineers: 13 Lucky Years of Remediation Optimization
B. U.S. Air Force: Remediation Performance Optimization
C. EPA's Nationwide Optimization Strategy
D. Department of the Navy — Approach to Optimization of Remedial Actions
E. Recommendations for a FRTR Path Forward
F. Optimization Reviews: An Opportunity to Consider Exit Strategies
G. Remedy Optimization in the Era of Performance-Based Contracting
H. Environmental Footprint Reduction through Remedy Optimization
I. Navy Environmental Restoration Program Management and Monitoring Approach
J. Remediation Process Optimization in the Age of Performance Contracts
K. Remediation Process Optimization and Long Term Monitoring Optimization: Identifying Opportunities for Enhanced and More Efficient Site Remediation — the New Jersey Experience
L. PBMO: The Comprehensive Physics-Based Flow, Transport, and Management Optimization Tool Kit