History of Remedial Process Optimization

Although geospatial methods were developed in the 1800s and early 1900s, federal agencies only recently have begun using these methods for optimizing environmental projects. Optimization efforts started in earnest with the remedial system evaluation process developed by the U.S. Army Corps of Engineers (USACE) in the late 1990s, and the subsequent remedial performance optimization process. The U.S. Air Force (USAF) also began efforts for remedial process optimization at about the same time. Early guides for optimization developed by USACE detailing the conduct of optimization have grown to include checklists and guides to optimize specific systems for more than 20 different situations; see USACE guidance (USACE) and USACE checklists (USACE 1999).

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In the late 1990s the USACE, the Air Force Center for Environmental Excellence (AFCEE), now known as the Air Force Civil Engineer Center (AFCEC), began to use statistical methods to optimize long-term groundwater remediation cleanups to improve plume capture and the efficacy of these systems. Recognizing the usefulness of these optimization methods, USEPA's Technology Innovation Office adopted the emerging technology in 1997. Since then, USEPA, USACE, and USAF collaboration has resulted in refinements, new tools, and standardization. Additionally, Navy's Facilities Command (NAVFAC) published guidance on optimizing groundwater monitoring systems and began to develop resources which now include guidance documents on optimizing remedy selection and design, optimizing remedial action operation, and optimizing long term monitoring (US Navy 2014).

In 2004, the Navy issued a policy that required optimizing remedial actions during remedy selection, design, remedial action operation, and monitoring phases for all environmental restoration projects. This policy was updated in 2012. Information for remediation optimization is also included in the Federal Remediation Technologies Roundtable (Federal Remediation Technologies Roundtable 2014). From 2000 to 2010, USEPA conducted over 100 optimization support events at Superfund NPL sites. Optimization capabilities were further enhanced by the growing development and refinement of models used today and described elsewhere in this document and training in the use of Monitoring and Remedial Optimization System (MAROS–developed by AFCEE) was provided to all USEPA Regional Offices. USEPA also established their optimization web presence on the Clu-in website (USEPA 2013a), conducting webinars on various topics related to optimization techniques and methods including Triad.

Concurrently, ITRC developed guidance for states on optimization. ITRC (ITRC 2004) published *Remediation Process Optimization: Identifying Opportunities for Enhanced and More Efficient Site Remediation* (RPO-1) and other related optimization fact sheets in collaboration with the Federal Agencies and offered classes in these techniques, procedures, and methods.

Based on a decade of successful optimization experience and other federal agency/private sector advances, in 2010 the Technology Innovation and Field Service Division, a successor to TIO in USEPA's Superfund office, formed a National Optimization Workgroup and began development of its optimization strategy culminating in the publication in September 2012 of USEPA's National Strategy to Expand Superfund Optimization Practices from Site Assessment to Site Completion (Strategy)(USEPA 2012a). The Strategy is composed of four elements: Planning and Outreach, Implementation, Communication and Training and Measurement. This Strategy is intended to leverage USEPA regional, HQ, States and contract resources for reviews, develop regional optimization programs and expertise, and track optimization results for all reviews. USEPA defined optimization broadly in the Strategy.

Shortly after the publication of USEPA's Strategy, NAVFAC updated its optimization policy and several of its guidance documents, including Guidance for Optimizing Remedial Action Operation UG-NAVFAC EXWC-EV-1301 in October 2012 (US Navy 2012).

Optimization has expanded from its original concentration on remedial action and long term monitoring to application throughout the cleanup lifecycle focusing on protectiveness, cost effectiveness, and technical improvements. USEPA has developed Standard Operating Procedures, blueprints for the conduct of site visits, checklists for optimization in each pipeline stage, and other supporting documents. Optimization events have increased markedly within USEPA and in other federal agencies, with more than 100 additional events conducted at NPL sites at USEPA alone from 2010 to 2015. USEPA's Strategy is in full implementation, with results being tracked and monitored. A team of project leaders and regional resources is being trained to integrate optimization principles, practices, and methods into day-today operations within

USEPA’s Superfund program.

Table 19 describes the status of optimization activities in the federal agencies. Private sector optimization is also underway as these techniques become more widely accepted and applied.

Table 19. Status of optimization activities in U.S. federal agencies. Source: Courtesy of Dr. Carol Dona USACE presented at the Federal Remedial Technologies roundtable November 2014.

Agency	Optimization Policy (Y/N)	Remedial Phases	Comments
DOD	Y	Postconstruction and including remedy selection	General requirement to optimize – no specific requirements
Army	Y	Same as DOD	
USACE	Y	Same as DOD, also RA-O	Required optimizations on existing FUDS remedial systems with annual O&M costs>$100,000
Navy	Y	All	Optimization across all remedial phases
Air Force	Y	All	Performance-based contracting (PBC) requires optimization approaches with major focus of achieving accelerated site completion
DOE	N		
USEPA	Y	All	Formal program, selected third party optimizations, also recognizes processes typically used by project team such as CSM, TRIAD, or GR, as included in optimization