Mercury Characterization and Remediation

DOE's Oak Ridge, TN site has many long-term intractable environmental problems associated with contaminants in fractured rocks, groundwater, and surface water. Mercury is a priority contaminant, as well as radionuclides (uranium, technetium, strontium, cesium), other metals (lead, cadmium) and co-contaminants (nitrate, PCBs, chlorinated solvents). The fate and transport of these contaminants remains poorly understood at Oak Ridge and across the DOE Complex. The Oak Ridge Integrated Facility Disposition (IFDP) Project involves demolishing and upgrading the infrastructure at the Y-12 Complex and at Oak Ridge National Laboratory (ORNL). IFDP will also require concomitant environmental remediation of soils, groundwater, and surface water. The project is complex, technically challenging, and expensive, with a current estimated cost of $1B for mercury remediation at the Y-12 Complex alone. Serious regulatory and public consequences will arise if decontamination and decommissioning (D&D) and remediation activities are not completely successful.

What Did the National Academy of Sciences Identify as the Key Technical Challenges?

- *Contaminant subsurface behavior is poorly understood (high risk) in part because of complex interactions between hydrologic and biogeochemical processes.*
- *Site and contaminant source characteristics limit usefulness of baseline (traditional) approaches.*
- *Computational models do not adequately incorporate site hydrogeology and contaminant geochemistry to predict remedial implementation or performance.*
- *Framework to gain regulatory approval for transitioning from active to passive (monitored natural attenuation [MNA]) remediation is lacking.*

How Will this Work Address the Technical Challenges to Site Remediation?

Key objectives are to 1) provide a better identification of contaminant distribution and pathways at Y-12 and ORNL, 2) develop a remediation and monitoring strategy for controlling contaminant release from source zones to groundwater and surface water, 3) develop innovative cleanup technologies applicable to DOE sites, and 4) effectively integrate science and engineering experts from various on-site and off-site organizations who can help address the mercury remediation problem.

Why Are New Remediation Strategies Needed?

Regulatory target concentrations for remediation are likely to be far below what can be achieved by conventional approaches. Innovative methods are required to identify and control contaminant fate and transport pathways, which will support the achievement of stringent regulatory standards during D&D. Remediation

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of waterborne contaminants focuses primarily on toxic mercury. Treatment technologies are being developed that will reduce the concentration and flux of mercury from subsurface flow paths within the industrial complex to surface water and prevent its conversion to methylmercury and subsequent bioaccumulation. This project is advancing along several avenues.

What Are the Transformational Concepts Advancing this Effort Over Others?

Contaminant Source Identification and Refinement of Transport Pathways will lead to better conceptual models for mercury transport in the subsurface and its impact on surface water compliance.

PROJECT IMPACT TO SITE MILESTONES

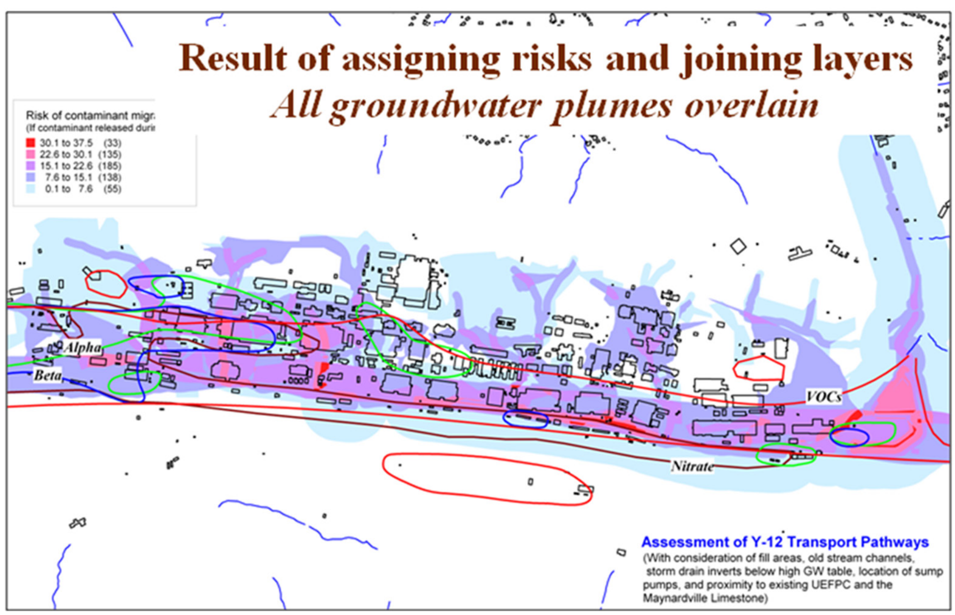
- Implementation of advanced remediation technologies may achieve compliance with National Pollutant Discharge Elimination System (NPDES) and total maximum daily load (TMDL) requirements
- Prevention of contaminant mobilization during D&D will lower ecological and human health risks
- Costs and time for the IFDP process will be reduced

Historical site records and direct field characterization are used to determine the quantity, distribution, chemical speciation, and transport pathways for mercury and other contaminants of concern to IFDP.

GIS-based Systems Analyses have yielded preliminary evaluations of flow paths, which are being refined with the assistance of IFDP personnel and other site experts.

Characterization activities are focused on identification of significant technical uncertainties in the current Y-12 site conceptual model. The development of a robust site conceptual model which describes the location and nature of primary and secondary mercury sources as well as approximate fluxes of mercury within the Y-12 system has been hampered by the complex site geology and stringent security requirements within the Y-12 complex. The improved conceptual model will support CERCLA/IFDP remediation strategies and will be used to predict mercury mobilization and release during decontamination and decommissioning (D&D) operations. This effort will also support development of a low-cost, real-time, direct-push approach for characterizing mercury in the shallow subsurface and in the vicinity of infrastructure. This approach builds on previous EM successes for the characterization of subsurface volatile organic compounds and can support both remedial and D&D activities.

Field tests of emerging remediation technologies, such as stannous chloride treatment of mercury at major outfalls, will demonstrate their efficiency and cost-effectiveness. This in turn will provide site managers and contractors the tools they require to address current environmental problems and respond quickly and appropriately to emerging contamination scenarios during IFDP activities.



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