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COMBINING TECHNICAL APPROACHES AND REGULATORY STRATEGIES TO PRODUCE CLEANUP: ER AT THE SAVANNAH RIVER SITE

W. Dean Hoffman and R. Kim Cauthen
WSRC

ABSTRACT

The Environmental Restoration Program at the Savannah River Site (SRS) has placed over 50 percent of its 515 waste units into the remediation phase. This success is based on an evolution of technology and a strong regulatory relationship.

The purpose of this paper is to share the technical approaches in environmental cleanup for each area of the SRS and discuss current and future plans for soil and groundwater. In addition, the paper will detail the regulatory strategies that complement the technology to achieve cleanup toward end states in each area.

The presentation will include power point video selections of technology in the field and discussions of key regulatory decisions. It is intended that this experience be shared to show how environmental progress can be made if technical and regulatory approaches are properly matched.

ENVIRONMENTAL RESTORATION AT SRS: A RECORD OF RESULTS

The Savannah River Site's (SRS) Environmental Restoration Program achieves cleanup results. Initiated in 1990, the SRS program began with an inventory of 500 acres of waste sites. Today more than 340 acres are in interim or final remediation status.

Over the years, SRS environmental professionals have worked effectively with the U.S. Department of Energy (US DOE), the U.S. Environmental Protection Agency (US EPA) and the South Carolina Department of Health and Environmental Control (SCDHEC) to prioritize and accelerate waste site cleanup activities. As a result, over one-half of the total 515 waste units are either remediated, in remediation, or have been determined to need no further action. Additionally, four billion gallons of groundwater have been remediated, and more than a million pounds of solvents have been removed from soils and groundwater.

In the past four years alone, the SRS Environmental Restoration Program has achieved more than $50 million in cost efficiencies. These cost savings are largely attributable to the site's strategy, that promotes the utilization of innovative technologies, encourages an across-the-board exchange of expertise, and endorses the acceleration of cleanup activities where possible.

The SRS Environmental Restoration Program takes a corporate perspective and exchanges information with other sites. As a result, SRS routinely shares with other DOE sites its experience and expertise related to field remediation, new technology deployment, cost effectiveness, regulatory commitment, public involvement, and safety.

The purpose of this paper is to share the technical approaches in environmental cleanup for each area of the SRS and discuss current and future plans for soil and groundwater. In addition, the paper details the regulatory strategies that complement the technology to achieve cleanup toward end states in each area.

TECHNICAL STRATEGY AND DEPLOYMENT

SRS utilizes innovative technology and approaches to increase remediation effectiveness and efficiency. In situ approaches are favored to minimize movement of waste but safely stabilize contaminants in place. For example, SRS has replaced traditional kaolin clay capping, previously used as a protective cover over waste sites, with a new geosynthetic cap closure technology. The geosynthetic cap is more effective in preventing rainwater infiltration and is more cost effective as well. Soil solidification using special grout mixtures is the standard design for radioactive basins.

Since 1995 SRS has used a vacuum extraction technology and air sparging, versus pump and treat systems, to accelerate groundwater cleanup. The vacuum extraction systems remove solvents from the vadose zone, the layer of unsaturated soils above the groundwater, and thereby, reduce the potential for more groundwater contamination. Additionally, vacuum extraction reduces cleanup costs, expedites remediation, and increases public and regulatory acceptance.

The BaroBall™, a passive remediation device designed by Savannah River Technology Center researchers, has been deployed to efficiently remove contaminated soil vapor from the subsurface. BaroBall™ uses natural atmospheric pressure fluctuations to expedite remediation and to prevent further migration of contaminants.

In 2000, SRS deployed yet another innovative technology to remediate solvents. Dynamic Underground Stripping (DUS), developed by Lawrence Livermore National Laboratory, combines Steam Enhanced Extraction with Electrical Resistance Tomography. DUS enhances the recovery of solvents from the subsurface by using steam injection and soil vapor/groundwater extraction. This technology makes it possible to extract the Dense Non-Aqueous Phase Liquid (DNAPL) contamination from the subsurface and treat it at the surface, greatly compressing the cleanup schedule.

SRS has deployed natural systems as part of its remediation program. For instance, SRS employs phytoremediation a natural attenuation process that utilizes naturally forested areas to cleanup tritium-contaminated ground water. This tritiated water, contained by a small sheet pile dam, is diverted from Fourmile Branch and used to irrigate the vegetation in the forested areas. The vegetation then consumes and safely releases the water by absorption and evapotranspiration, decreasing the concentration of the contamination.

Bioremediation is currently in use to complete the remediation of groundwater under a landfill site. Nutrients such as oxygen and methane are injected via horizontal wells to stimulate microbes, which consume solvents.

It is projected that over $300 million will be saved using these innovative technologies versus conventional approaches.

In order to obtain regulatory agency approval of these innovative technologies, SRS utilizes a regulatory strategy based on seven key actions:

Exchange agendas and goals with regulators
Negotiate cost effective remedies
Use issues resolution techniques during negotiations
Communicate at all levels with the regulators
Build relationships with frequent discussions
Generate early regulator involvement in all decisions
Conduct early discussion of key decisions with the public

By integrating the regulatory strategy above into the technical approaches of the projects SRS can: (1) build sustained relationships; (2) negotiate cost effective remedies; (3) become partners with the regulators during cleanup; (4) have joint ownership; (5) avoid dispute; (6) share success with the regulators and (7) exceed DOE commitments.

SRS's regulatory strategy has four main points of implementation. In order to maintain an effective regulatory strategy, ER must communicate with the regulators frequently, regularly, early and effectively.

In order to support frequent communication, SRS's Environmental Restoration Division has assigned personnel who are completely dedicated to regulator relationship issues. The ER project teams have daily contact with the regulatory agencies. This frequency increases the understanding of each party's position on project administrative and technical issues. Frequent conversations are key in discussing issues with the regulator and working together to resolve possible sticking points. As well, ERD has monthly project managers meetings, project scoping meeting and Internet meetings.

To support regular communications the three parties involved in the SRS's remediation activities (US DOE, EPA and SCDHEC) have set aside Wednesdays as set in stone meeting days. It is during this time that the three parties can meet and discuss proposals, answer questions regarding data or document content, etc. The ERD Technical Liaison will have already done some up front communication so that the conversation will go more smoothly and efficiently. As well, upper level management meet often during the assessment phase of the project so that they are more informed when important decisions are placed before them.

The three parties communicate early in the process, even before site characterization has begun. Discussion of unit history and process knowledge occurs during project scoping meetings before the first groundwater or soil sample is taken to ensure that the right areas are being targeted. The regulatory agencies become stakeholders and have joint ownership in the project. When the project is a success, they can share in that success with SRS.

In order to ensure that all the parties involved in the decision making process communicate effectively, ERD made a point to train all environmental personnel and the regulators on how to successfully negotiate. This negotiation training has been a key element in the success of the program. The three parties also meet either face to face or through internet meetings on a regular basis so that effective

communication occurs. The decision making process is through these discussions, not through impersonal letters back and forth. Written correspondence and documents are used to document decisions only. They are not used for making proposals for the first time.

TECHNICAL APPROACHES AND REGULATORY INVOLVEMENT

The Environmental Restoration Strategy is divided into Area-Specific Strategies for the Upper Three Runs, General Separations, and Reactor locations. Each strategy has a technical and regulatory supporting set of initiatives. Technical challenges are depicted in Table 1. Technical approaches to meet these needs are set out in Table 2.

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Table 1
Needs Assessment

Area	*Area Specific Remediation Status*	*Major Challenges*
Upper Three Runs A/M/B	Have Source Reduction Need Source Control Plume Control	•Dense Solvents •Solvent Plume
General Separations Burial Ground	Have Source Control Need Plume Control	•Tritium & Solvent Plumes
General Separations F&H	Have Source Control Need Plume Control	•Tritium Plumes
Reactors	Have Source Reduction Need Source Control Plume Control	•Cesium, Strontium & Tritium Plumes
D/TNX	Have Source Reduction Need Source Control Plume Control	•Tritium & Solvent Plumes

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Table 2
Area Specific Technical Approaches

Area	Conventional Approaches	Current Approaches	Future Approach
Upper Three runs (A/M/B)	Muck & Truck Pump & Treat	Soils: In situ: Soil Vapor Extraction, Bioremediation, Land Use Controls Groundwater: Pump & Treat, Air Recirculation Systems, Baroballs	Soils: Deploy Dynamic Underground Stripping Groundwater: Continue Tech Demos; Turn down current systems as legal limits allow; Pursue Monitored Natural Attenuation & Land Use Controls
General Separations (Burial Ground)	Muck & Truck Pump & Treat	Soils: In situ: Engineered Landfill Capping Groundwater: Phytoremediation	Soils: Offer technically equivalent cap vs. RCRA requirements at Old Burial Ground Groundwater: Phytoremediation; Pursue Monitored natural Attenuation and Land Use Controls
General Separations (F&H)	Muck & Truck Pump & Treat	Soils: In situ: Solidification & Baekfill Groundwater: Pump & Treat	Soils: Solidification & Backfill Groundwater: Turn down current systems as legal limits allow; Pursue Monitored Natural Attenuation & Land Use Controls
Reactors	Muck & Truck Pump & Treat	Soils: In situ: Solidification & Backfill Groundwater: Soil Vapor Extraction & Air Sparging	Soils: Solidification & Backfill Groundwater: Assess multiple concentration limits; Phytoremediation; Pursue Monitored Natural Attenuation & Land Use Controls
D/TNX	Muck & Truck Pump & Treat	Soils: In situ: Bioremediation; Backfill Groundwater: Geosiphon; Phytoremediation	Soils: Backfill ash sites under existing Solid Waste & Waste Water Permits Groundwater: Pursue Monitored Natural Attenuation & Land Use Controls

UPPER THREE RUNS AREAS

Technical Strategy

The strategy for these areas is to establish solvent plume control in the A/M Area with alternative to pump and treat methods such as solvent extraction, air recirculation, bioremediation, and barometric valves as well as source control with dynamic underground steaming.

To support this strategy it will be necessary to determine the best solution for dense non-aqueous phase liquids (DNAPLs); use monitored natural attenuation as a remediation strategy where applicable; and submit the permit modifications and records of decisions necessary to implement all contributing strategies.

Regulatory Involvement to Support the Strategy

The dynamic underground stripping technology was presented to the regulatory agencies very early in the idea process and there were frequent discussions regarding this new technology. Because of the experimental nature of the project, a one-year permit was approved. If this technology is successful, the stripping process could be used at other sites. By having the ability to try short-term technological demonstrations and treatability studies, SRS can prove the technology and achieve cleanup at a relatively low cost. This ability comes from the good communication established between the three parties.

GENERAL SEPARATIONS AREAS

Technical Strategy

The strategy for these areas is to achieve plume control in the F and H Areas with adjustments to existing groundwater systems to remove metals and redirect tritium.

ER will achieve plume control at the Burial Ground Complex with alternatives to pump and treat methods such as phytoremediation, and maintain source control in all areas without waste excavation or removal using engineered soil covers or geosynthetics.

To support this strategy it will be necessary to determine the best alternatives for cost-effective tritium and solvent migration control; and submit the permit modifications and records of decisions necessary to implement all contributing strategies.

Regulatory Involvement to Support the Strategy

ERD learned through trial and error that conventional approaches to remediation would not be successful in the F and H Areas. In fact, the three parties had to work together, step by step, through the groundwater contamination issues in this area. It was only after numerous meetings and an enormous amount of research that consensus was gained and the necessary permits granted. The

utilization of all four of the communication techniques mentioned previously proved to be beneficial in getting this project off the ground.

REACTORS AND D/TNX AREAS

Technical Strategy

The strategy for these areas is to establish source and plume control in all reactor areas using grout stabilization of sources and alternatives to pump and treat such as phytoremediation and solvent extraction.

ER will establish source and plume control in D/TNX areas by maximizing the use of natural systems including phytoremediation.

To support this strategy it will be necessary to determine the best alternatives for cost-effective tritium and solvent migration control; develop efficient stabilization technology for cesium and strontium; and submit the permit modifications and records of decisions necessary to implement all contributing strategies.

Regulatory Involvement to Support the Strategy

At issue most in remediation of the Reactors and D/TNX areas is the fact that the areas are very complex in nature. The D/TNX area is located within a flood plain. There are 5 reactor areas at SRS with multiple area awaiting cleanup within the reactor footprints. As well, SRS is working through issues related to weather (drought) and complicated source control. It has been recognized that ERD must build on previous successes with the regulatory agencies and gain consensus on remedies early in the assessment phase of the projects.

Table 3 summarizes the integration of technical approach and regulatory strategy by site area.

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Table 3
Summary Implementation Strategy

Area	Technology Implementation	Regulatory Implementation
Upper Three Runs A/M B	Establish solvent plume control in A/M Area with alternatives to pump and treat methods in such as solvent extraction, air recirculation, bioremediation, and barometric valves. Use phytoremediation as necessary.	Drive best solution for dense solvents (DNAPLs). Use monitored natural attenuation as a remediation strategy where applicable. Issue permit modifications and Records of Decision necessary to implement all contributing strategies.
General Separations Burial Ground F&H	Achieve plume control and surface water management in F/H Areas with adjustments to groundwater systems. Achieve plume control and surface water management Burial Ground Complex with alternatives to pump and treat methods such as phytoremediation. Maintain source control in all areas without waste excavation or removal using engineered soil covers or geosynthetics.	Implement best alternatives for cost effective tritium and solvent migration control. Include monitored natural attenuation where applicable. Negotiate passive systems and adjustments to existing systems. Move to controlled/ managed release to surface water. Issue permit modifications and Records of Decision to support strategies.
Reactors	Establish source and plume control and surface water management in all areas using stabilization of source and alternatives to pump and treat for plumes.	Implement best alternatives for cost effective tritium and solvent migration control. Develop efficient stabilization technology for cesium/strontium. Include monitored natural attenuation where applicable. Issue Records of Decision to support strategies.
D/TNX	Achieve plume control of solvents and tritium in groundwater with natural systems.	Pursue passive methods, monitored natural attenuation and land use control to manage solvents and tritium.

CONCLUSION

The SRS waste units and contaminated groundwater are being remediated in a manner that is cost effective and protective of human health and environment. As a part of these actions new technologies are being developed and successfully deployed. The regulators are an integral part of the successes at Savannah River Site.

The Environmental Restoration work is being completed under contract to the Department of Energy, by a partnership of Westinghouse Savannah River Company and Bechtel Savannah River Incorporated.