

PERFORMANCE MEASUREMENT FOR TECHNOLOGY DEPLOYMENT AT THE SAVANNAH RIVER SITE

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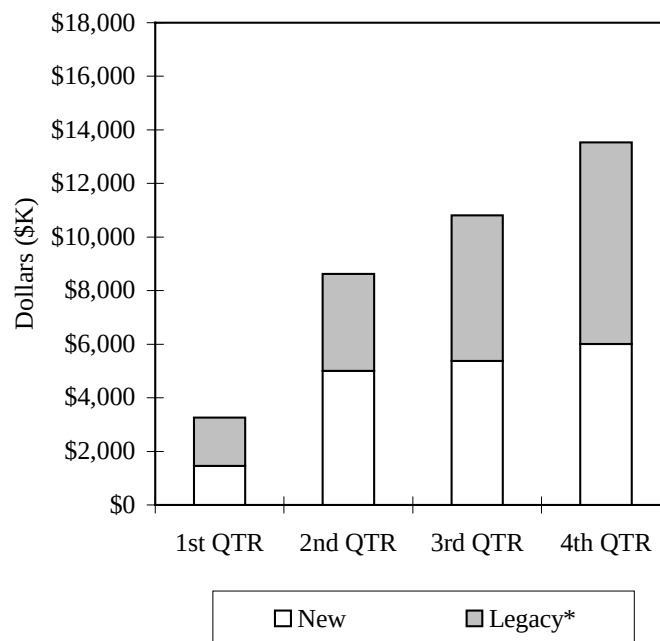
ABSTRACT

The Savannah River Site has successfully deployed innovative technologies to reduce life-cycle costs associated with its Environmental Management programs. We have experience with several different approaches to facilitating deployments and have established a disciplined process to drive success in the field. One of the major challenges has been to credibly document the cost savings realized from these deployments. Our results-based approach utilizes a comprehensive performance measurement system with a focus on quantifying the benefits of using innovative technology and sharing lessons learned with others. Program baselines and a formal protocol are prerequisite to a realistic analysis of benefits by the implementing organizations. We have found that a flexible, but disciplined, evaluation framework is needed in order to track multi-year benefits and unit costs. This recognizes that there are varying levels of complexity in quantifying the potential cost savings depending upon the type and number of technology applications used within a particular remedial or operational activity. In the future, we will continue to refine our suite of measures and methods to best capture the benefits of deploying innovative technologies at the Savannah River Site.

INTRODUCTION

The Savannah River Site (SRS) is a 780-km² U. S. Department of Energy (DOE) site managed and operated by the Westinghouse Savannah River Company. Originally constructed in the 1950s for the production of nuclear-defense related materials, all five of the original production reactors are permanently shut down. Current missions include the safe management of radioactive and hazardous wastes and spent nuclear fuel generated from past operations, as well as ongoing environmental restoration and waste management activities. The SRS is located in the Southern Coastal Plain and Sandhills Land Resource Area of west-central South Carolina.

The SRS has successfully deployed technologies to reduce risk and life cycle costs in its Environmental Management program. In fiscal year 1998, 39 technologies were deployed with an estimate of \$5.2 million in savings realized during that year and a projected outyear savings exceeding \$70 million for the expected duration of the projects. In addition, savings from prior year deployments contributed an estimated \$6.8 million savings. The SRS record of success in deploying new technologies demonstrates



*Cost savings from prior year deployments

Figure 1. Estimated cost savings from technology deployment at the Savannah River Site in fiscal year 1998

the Site's commitment to delivery of leading edge science and technology critical to accomplishing the DOE mission. We would not be able to credibly make that statement if we did not have a fairly comprehensive performance measurement system in place at the Site.

Performance measures for technology deployment tier off of goals contained in Accelerated Cleanup: Paths to Closure and the Site Strategic Plan. Program specific goals are detailed in each organization's Management Implementation Plan as well as the Site Technology Deployment Management Plan. These program-specific measures are rolled up into corporate technology performance measures for the Site. While we continue to count the number of technologies deployed at the site, cost savings estimates are prepared to demonstrate the benefits of utilizing new technologies and are the key to demonstrating program viability. A credible methodology and consistent approach is necessary to quantify savings in a manner readily explainable to our customers and stakeholders.

PERFORMANCE BASED INCENTIVES: THE SRS EXPERIENCE

Since 1994 we have tried several different approaches to facilitating the utilization of innovative technologies within the line programs (Table 1). To establish momentum, the Department utilized performance-based contract incentives at SRS beginning in fiscal year 1995 (FY95). In FY95, we developed the first incentive in the DOE complex designed to help establish the Site culture necessary for technology providers and technology users to effectively team in order to expedite getting innovative solutions deployed in the field. This incentive was part of a comprehensive Award Fee process that DOE utilizes to evaluate performance of the M&O Contractors. To earn fee, it required the deployment of at least eight technologies in the environmental restoration

program with a documented cost savings of \$2.5 million to be realized within the fiscal year of implementation. The approach to determining the cost savings was not defined. This incentive suffered from poor development whereby there was up-front loading of all capital, development, and implementation costs into the first year savings calculations. In hind sight, this proved to be an unrealistic approach which downscaled the actual savings overall. Additionally, this incentive actually threatened to de-incentivize the efforts of the Contractor, because deployments occurring late in the fiscal year would not realize any cost savings for that year. However, during the course of the year as we fine-tuned our approach to determining the cost savings, the momentum began to swing in favor of the program. The end users had direct evidence of the benefit to their program, being able to accomplish additional scope for their budget. In the course of FY95, several process improvement initiatives were conducted which poised the program for future success. The end result of the FY95 incentive was the deployment of nine technologies and ~\$1.7M cost savings realized within the first year of implementation. The contractor earned no fee under the performance incentive.

Fiscal Year	Incentive
1995	Deploy eight technologies to achieve \$2.5 M in cost savings
1996	• Demonstrate technologies while accomplishing actual clean up • Document cost savings of \$6M by deploying technologies to accomplish regulatory scope
1997 and beyond	Utilize new technologies to reduce life cycle program costs

Table 1. Performance incentives for utilization of innovative technologies at the Savannah River Site

In fiscal year 1996 (FY96), two separate performance-based incentives were utilized to stimulate technology deployment and to demonstrate technologies while accomplishing actual clean-up. Documentation of \$6.0 million in cost savings validated by DOE was required for the Contractor to earn the incentive fee. This incentive focused on a more rigid process for documenting savings, which was defined up front, by using the independently validated environmental restoration program baseline as a basis for comparing actual costs to planned costs for a defined work scope. This allowed life cycle cost savings to be determined; annualized savings were used to measure performance against this incentive. These incentives resulted in a dramatic culture change at SRS and improved the integration between developers and end users to expedite in-field deployments. This culture change was necessary to improve the success rate of future technology utilization endeavors. In addition, the FY96 performance based incentives resulted in a refined approach to quantifying cost savings. By utilizing the program baseline as a basis and annualized savings based on life-cycle, Site deployment costs were spread over the anticipated project life. An estimated \$7.1 million cost savings

(\$12.3 million overall) was realized as a result of innovative technologies deployed in the environmental restoration program under this incentive in FY96.

The disciplined framework that resulted from documenting the scope enhancements and cost savings through technology deployment in fiscal years 1995 and 1996 resulted in a different approach in subsequent years. Site programs are challenged to utilize new technologies to reduce their life cycle costs. This challenge is incorporated with end user incentives to achieve overall program efficiencies. For example, in fiscal year 1997 (FY97), \$18.9 million in total scope enhancements was realized in the environmental restoration program. An estimated \$10.6 million was saved due to technology deployments. The SRS is challenged to realize efficiencies within their programs to compensate for decreasing budgets and to meet Accelerated Cleanup: Paths to Closure targets. Utilization of new technologies is one way by which programs will realize savings within their program, which allows them to advance work scope from the outyears.

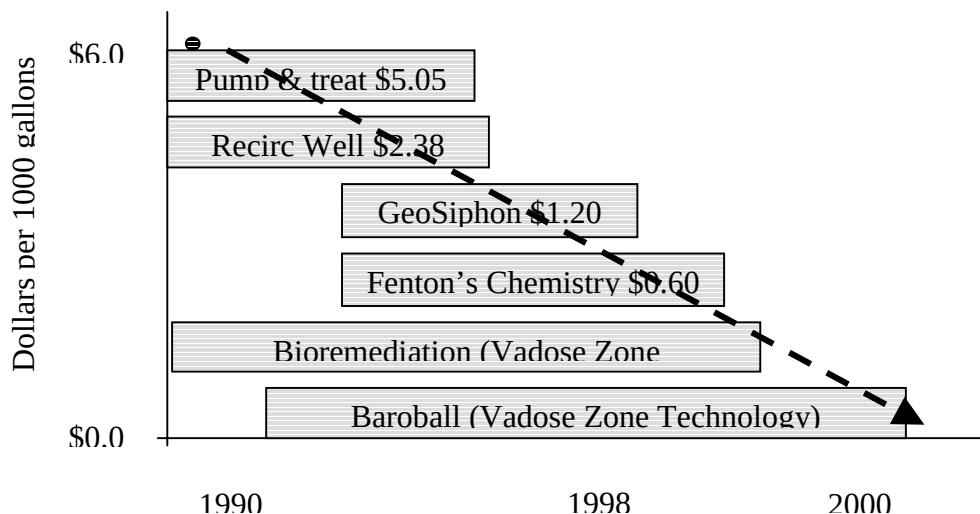


Figure 2. Representation of the reduction in technology unit cost projections over time.

PERFORMANCE EVALUATION FRAMEWORK

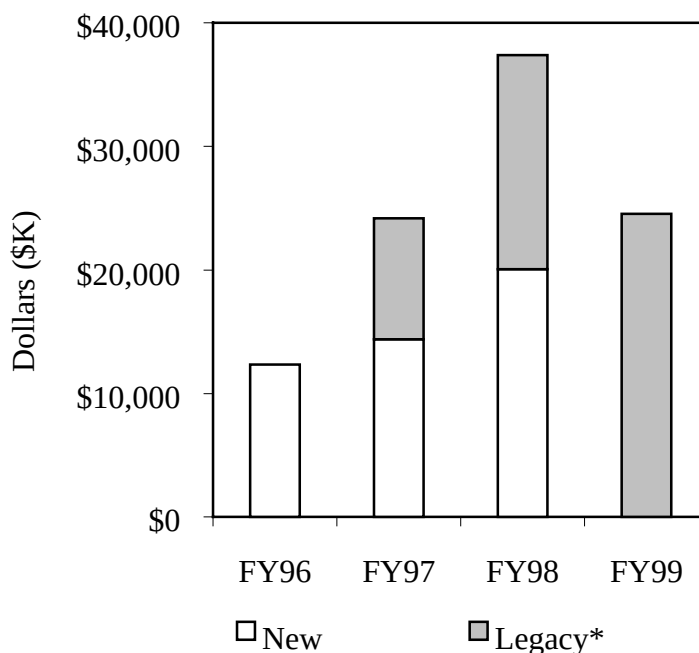
SRS routinely estimates the savings it realizes from deployment of innovative technologies. These savings are specific to the implementing program and do not represent the return on the overall research and development investment. The SRS Environmental Restoration Program utilizes a disciplined evaluation framework to forecast, track and verify cost savings achieved through the use of innovative technologies. Cost savings that may be realized are either baseline cost savings or other cost savings. Baseline cost savings are realized when the program or project baseline is revised to include the proposed technology. Program or project baselines must be done to a level of detail that facilitates a life cycle cost analysis. At that point a definitive cost analysis can be preformed through a formal baseline change control process. The

baseline cost savings are calculated and documented in accordance with the DOE's Office of Environmental Management Standard Life Cycle Cost Savings Analysis Methodology for Deployment of Innovative Technologies.

In addition we determine unit costs which serve as a useful tool for evaluating the benefit of a technology that is applied across several programs, projects or sites. Unit costs can also be helpful in determining differences in cost per unit of treatment among individual or suites of technologies (Figure 2).

"Other" cost savings result when a technology is deployed and savings can be determined through technical performance data or can not be derived from the baseline. In some cases, current available technologies do not exist in a baseline (e.g., there is no known way to remediate the constituents of concern). Then the cost analysis would be a comparison of an enabling technology against a "do nothing" scenario. Some examples of this include savings from repeated deployments after the technology is change controlled into the baseline, technologies implemented to address problems not identified in the baseline, and cost savings realized across several programs or projects.

Figure 3. Estimated cost savings from deployment of new technologies at SRS



*Cost savings from prior year deployments

The baseline utilized for estimating cost savings is the life cycle cost estimate for the specific waste site at which the technology is deployed. Cost savings calculations will be against the recognized baseline technology for that specific problem type in effect when the technology deployment decision is made. The deployment costs are derived from the dollars spent at the site to support the deployment of the technology. Prior investments in

the technology by DOE are not included. The numbers represented here are actual cost savings to the implementing organization, not return on DOE investment.

Cost savings are often realized in the years following the initial deployment (Figure 3). For example, enhanced bioremediation through the addition of nutrients and air at the SRS D-Area oil seepage basin was initially deployed in fiscal year 1996, however regulatory approval for this closure was not received until 1998. Cost savings from utilization of this enhancement technology were estimated to be around \$3.1 million, realized in fiscal year 1998.

EXAMPLES OF COST SAVINGS ESTIMATES FOR PLANNED DEPLOYMENTS

The following two examples are potential cost savings estimates for planned future full scale deployments based on initial performance results. The first example utilizes the validated program baseline and life cycle cost estimate as the basis for measuring savings. In the second example, unit costs more appropriately capture the true cost savings.

GeoSiphon

The TNX Area is located in the southwestern portion of SRS approximately 1,610 meters east of the Savannah River. It was the site of pilot-scale testing and evaluation of chemical processes used at the Defense Waste Processing Facility, Separations Area and Fuel & Target Manufacturing Areas. The TNX Area is on a terrace above the Savannah River at approximately 46.6 meters above mean sea level (m-msl). A portion of Savannah River flood plain lies immediately west of the TNX Area at 29 to 30.5 m-msl. A small levee divides the flood plain and serves as the bank of the river during high stages. The hydraulic gradients are such that groundwater flows progressively from the deeper aquifers to the more shallow aquifers and to the Savannah River. Groundwater contamination has been detected at TNX in the water table. The predominant contaminants detected in the TNX flood plain are trichloroethylene and nitrate.

The GeoSiphon Cell utilizes granular cast iron to treat chlorinated volatile organic compounds (CVOC) contaminated groundwater in situ. The GeoSiphon Cell is essentially a large diameter well, which contains the granular cast iron and passively induces flow by use of a siphon from the cell to the Savannah River. The flow is induced by the natural hydraulic head difference between the cell and the Savannah River. The passively induced flow draws contaminated groundwater through the treatment cells where the iron filings reduce the CVOCs to ethane, ethene, methane, and chloride ions. The treated water is subsequently discharged to the Savannah River.

To achieve required cleanup scope at TNX with the baseline technology of pump and treat it will be necessary to operate two pump and treat units for eight years as compared to operating 12 GeoSiphon cells for 14 years. The cost basis for this comparison was taken from the Environmental Restoration 1998 baseline for Pump & treat as modified for one additional pump and treat unit. The cost estimates for installation of GeoSiphon

Cells was taken from actual costs associated with the installation of two test cells during fiscal years 1997 and 1998.

The life cycle cost estimate for the pump and treat baseline is \$40.6 million as compared to the GeoSiphon system life cycle cost of \$21.3 million. The total estimated cost savings for full-scale deployment is over \$19 million.

Purge Water Management System (PWMS)

The PWMS represents a more streamlined approach to managing purge water than the current strategy at SRS and includes additional benefits such as waste minimization. By virtue of the system's design, no waste is generated because the contaminated purge water is returned to the originating aquifer. The current annual cost of containerizing and treating purge water at SRS is \$507,400. The annual cost for the use of the 396 proposed PWMS units across the Site is projected to be \$108,000. Based on these costs, the annual savings using the PWMS units is estimated to be \$399,400 after full deployment and \$3.994 million after ten years of operation.

CONCLUSION

The SRS is committed to continue to pursue the deployment of innovative technologies and approaches to solving complex site problems, while maximizing cost effectiveness and protecting worker and public safety and health. We see utilizing innovative technologies as one of the means to accomplish this. Through experience with performance-based incentives and the establishment of an end-user driven technology pull, the benefits of technology are evident. We will continue to refine and add to our slate of measures to comprehensively capture these benefits.