

**INTRODUCING COMMERCIAL POLLUTION PREVENTION
TECHNOLOGIES AT THE SAVANNAH RIVER SITE...
TAKING THE NEXT STEP**

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ABSTRACT

The focus of pollution prevention at the Savannah River Site (SRS) is evolving from improving work practices to improving processes through deployment of new technologies. SRS has achieved significant waste reduction over the past several years through low-tech common-sense changes in operational practices and substitution of materials. Examples include waste segregation, Green-is-Clean, decontamination, launderable personal protective equipment, and reusable radiological enclosures. These initiatives have produced dramatic improvements from a modest investment in materials and equipment. As these types of pollution prevention opportunities become more elusive, the SRS is relying on innovative technologies to achieve program goals.

In fiscal year 1998, the SRS saved more than \$4 million from deployment of new pollution prevention technologies, and implementation of FY97 technologies. These include improved radiological waste assay equipment that allows for less conservative estimates for segregation of low level from transuranic radioactive waste, deployment of aerosol capture coatings and other commercial coatings to recover contaminated areas, and the use of remote cameras for routine surveillance and monitoring. The SRS continues to identify new technologies for demonstration and deployment. Some of the technologies under evaluation are a low emissions technology for cleaning launderable materials with high levels of contamination, a process for using dissolvable radioactive decontamination materials in place of consumables, technologies for digesting asbestos waste in situ, and new facility waste characterization technologies. The SRS has found that use of new technologies not only reduces waste and pollution, it also results in reduced worker exposure to hazardous materials and reduces facility operational life cycle costs.

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. Constructed in the 1950s for the production of nuclear-defense related materials, all five of the original production nuclear reactors are 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.

SRS has reduced its annual generation rate of radioactive and hazardous waste from ~27,000 cubic meters per year in 1991 to ~7,000 cubic meters in 1998. This reduction is due to waste reduction initiatives and has been impacted by operational mission and scope changes. Since 1991, SRS has documented initiatives contributing to a cumulative avoidance of ~70,000 cubic meters of hazardous and radioactive waste. These reductions were driven by awareness of waste cost and limited waste disposal space and were achieved primarily by simple changes in work practices. Initiatives included volume reduction through better waste packaging, recovery of radiological areas, modifying radiological posting levels and requirements to allow better waste segregation, utilizing launderable substitutes for consumables used in radiological areas, and incorporating waste minimization into job planning. Although the SRS still has opportunities to expand these types of initiatives, the waste reduction impacts are declining. To continue improvement in pollution prevention (P2), there is a need to shift the P2 Program focus from improving work practices to improving plant processes. This requires the introduction of new technologies and often plant capital upgrades. The following is a synopsis of some of the current and planned SRS technology demonstrations and deployments.

TECHNOLOGIES DEPLOYED

Passive Aerosol Generator and Capture Technology - This vendor proprietary technology fills voids such as airlocks and glove boxes with a dense aerosol that contains capture polymers with particle sizes allowing it to initially act as a gas. The condensing aerosol covers 100% of exposed surfaces trapping airborne and surface contaminants. This reduces the potential of personnel exposure and an estimated 25% reduction of secondary waste generation associated with maintenance or decontamination and decommission (D&D) of the radiological contaminated area. This technology was used for cleanup and complete recovery of a plutonium glove box in 1998 and was estimated to save over \$290,000 due to waste reduction and project efficiency savings from this project. This proven technology will be used for future major D&D of highly contaminated areas.

Radioactive Material Assay Equipment - New radioactive material assay technologies allow more efficient management of waste through improved waste characterization and segregation. It is estimated that more than 25% of SRS's current radioactive waste streams are being managed as higher risk waste types at higher costs due to assay uncertainties. SRS is pursuing the following improved assay technologies:

- a Canberra "Q-squared" assay instrument to segregate transuranic (TRU) and low level waste (LLW) with opportunity to reduce TRU waste by $>10 \text{ m}^3/\text{yr}$ at FB-Line (May 1998 deployment);
- demonstrate "Long Range Alpha Detector" (LRAD) gas flow monitor for monitoring and releasing smooth surfaced items potentially contaminated with alpha emitting radionuclides (planned demonstration);

- a conveyORIZED radiological monitor with the sensitivity to detect to unconditional radiological release levels (in progress);
- upgrade an existing box monitor with current technologies for assaying radiological waste (in progress); and
- X-ray K-Edge detector - a beam of x-rays is sent through an object to a detector on the other side. Some of the x-rays of known precise energies for a given element (e.g., 116 Kev for Uranium) are preferentially absorbed. The amount of absorption determines the amount of the element. This technology is potentially useful for assay measurements of uranium holdup in facility process equipment. (in progress).

Instacote® Deployment at Radiological Areas - This surface coating system which sprays a polymer (Instacote®) lining guaranteed against chipping, peeling, or deterioration for 10 years is accelerating site contamination area recovery and will simplify future cleanup activities. Equipment has been procured and successfully deployed at outside high-level waste tank farm facilities to expedite radiological area recoveries.

Consolidated Incinerator Facility (CIF) Filter Cleaning – This state-of-the-art ultrasonic decontamination technique using a commercial proprietary dry-cleaning fluid allows reuse of HEPA pre-filters at the SRS waste incinerator (CIF) five to ten times before disposal. The closed loop system uses computer controls for rinsing, washing, and drying functions with contaminants trapped on a filter for disposal as a solid waste. There are no liquid or air emissions from the process. This process will be tested to prove effectiveness to decontaminate small tools in 1999.

Alpha Laundry – SRS will demonstrate a process for cleaning clothing and other launderable goods utilizing more traditional dry cleaning techniques with similar cleaning fluids (Sonatol – manufactured by Entropic Systems Inc.) as used for filter cleaning discussed above. This will avoid disposal of items (estimated at 400 m³/yr) that have been contaminated to levels above those acceptable for offsite laundering at a commercial nuclear laundry. This process will be demonstrated in 1999.

Lab Cell Equipment Deployments – The Defense Waste Processing Facility (DWPF) is installing the following equipment to support waste minimization in shielded analytical cells: an in-cell waste grinder, a water polisher, and a liquid sampler modification. These combined process upgrades will reduce the generation of highly contaminated cell waste by >6 m³ per year. Installation and startup of the water polisher and waste grinder have been completed with facility modifications for the liquid sampler to be completed in 1999.

CO² Pellet Decontamination System - DWPF canyon equipment requires decontamination prior to equipment repair. The current baseline technology being used for this decontamination is liquid chemical washing. A CO² pellet decontamination system has been installed and successfully tested to eliminate liquid

washing. A large agitator was decontaminated with the new system avoiding the generation of 38,000 liters of liquid decon waste.

Remote Cameras - Remote cameras are being deployed in SRS plutonium production facilities to avoid entries required for routine surveillance and monitoring in some contaminated areas. Benefits will include personnel risk reduction and low-level radioactive waste (LLW) savings estimated at $>60 \text{ m}^3/\text{yr}$. Equipment has been received and an analysis of facility operational safety was completed to ensure surveillance quality is maintained. The equipment will be installed by March 1999 with plans to expand deployment if successful.

High Level Waste (HLW) Evaporator in-line, continuous sampler - Operators are required to don radiological protective clothing to sample evaporator overheads for process control each shift. A remote monitored, in-line sampler will eliminate the need to enter the contamination area and pull radiological waste evaporator overhead samples. Design of the sampler will be unique to this process but usable at other tank farm evaporators at SRS and possibly the Hanford site. Design has been funded with scheduled build and installation in 1999. Projected annual savings will be \$85K.

Vegetation Assay - Sampling and analysis of the vegetation from radiological site remediation is typically required for disposal characterization. A test of a technique for measuring Cs-137 content in vegetation was conducted in 1997 at the Savannah River Site utilizing a portable real time analysis technique. Results of high, medium, and low activity vegetation indicated that the instrumentation could routinely enable segregation of vegetation into clean and contaminated categories. Application of this technology to planned and future vegetation removal activities will substantially reduce the volume of material requiring handling, processing, and disposal as waste products thus reducing costs.

GeoSiphon Cell Treatment System - The GeoSiphon Cell is an emerging technology placed into operation in 1995 utilizing granular cast iron and natural siphoning to treat a chlorinated volatile organic contamination plume on the SRS site. Differing from a powered air-stripping unit, the GeoSiphon Cell uses natural groundwater hydraulic pressure to draw contaminants into a treatment cell by using the natural hydraulic head difference between the cell and the Savannah River. The treatment cell is capable of using various media to remove water pollutants. After treatment the water is discharged into the Savannah River. Test data from the GeoSiphon Cell Treatment System shows that the solvent contamination of nearly 200 parts per billion is reduced to less than detectable levels after treatment using iron as an oxidizer in the cell.

Purge Water Management System (PWMS) - The PWMS is an innovative technology that could result in the elimination or significant reduction of purged groundwater generated during routine groundwater sampling. The PWMS is a closed-loop aqueous system comprised of a water accumulation tank, and a wellhead connection assembly for conveyance and return of groundwater at the well. The

technology has a moderate to broad range of applicability to monitoring wells at SRS. A complete technical evaluation is expected to lead to regulator acceptance. The technology can be considered for other DOE sites and a patent is pending at this time.

Investigative Derived Waste Management Plan - Stagnant (purge) water must be pumped out of each monitoring well prior to sampling to ensure that a representative sample is collected. The Investigative Derived Waste Management Plan (IDWP) is a software application that quickly retrieves existing data from an Oracle database and analyzes contamination levels in that data to determine if the purge water can be managed through land application or if it requires containerization and treatment. IDWP is available from any network computer with X-Windowing capabilities and has a user-friendly interface that allows multiple users to quickly and consistently produce containerization lists with accurate well statistics. Additionally, IDWP can create text files from user-specified data retrieved from GIMS and graphics files of plots of analytic concentration through time.

Mixed waste stabilization studies - New mixed (radioactive and hazardous) liquid waste stabilization formulations will increase waste loading for stabilizing waste resulting in decreased disposal volumes and improved waste form durability. Argonne National Lab and the Savannah River Technology Center (SRTC) are working to increase SRS waste incinerator (CIF) waste loading with new phosphate-bonded ceramics binder technology and a commercial Super-cement formulation. SRTC will perform treatability studies using actual CIF wastes with the selected technology to be installed when funded.

ETF Organic Removal System Improvements - The Effluent Treatment Facility (ETF), a SRS wastewater facility, uses large carbon beds to remove organic contaminants as part of process wastewater treatment. These 140 cubic meter beds contained in a stainless steel tank for chemical compatibility have a process life of approximately two years and require disposal due to inability to regenerate or remove/sluice carbon media from the tank. Development studies are funded in FY99 for ETF carbon bed process improvements with deployment of technologies following approved process design changes and funding.

OREX Substitutes - Materials made with OREX, hot water dissolvable polyvinyl alcohol (PVA) material, will eliminate solid radioactive waste disposal of some consumables such as decontamination wipes and mop heads. The Savannah River Technology Center and the Nuclear Materials Stabilization Division are currently evaluating chemical compatibility of the OREX process by-products with the Site's liquid radioactive waste processing systems. The OREX manufacturer, ISOLYZER Co. is being asked to look at PVA chemical destruction technology. This process is being used successfully to eliminate biological and pathogenic waste in the medical industry. SRS solid waste savings are estimated at $>140 \text{ m}^3$ per year of transuranic (TRU) waste and highly contaminated low level waste.

During FY97-98, seventeen pollution prevention technologies were deployed resulting in reduced employee and environmental risk and FY98 estimated cost savings of \$4.15M. Avoided waste disposal costs, material cost savings, productivity improvement, and radioactive laundry savings constitute the majority of the savings. The SRS estimates a FY00 cost savings impact of \$10.2M resulting from technology deployments from the previous three years.

A FRAMEWORK FOR CHANGE

Driving this change in program focus is not without its challenges. Historical initiatives were broad crosscutting improvement opportunities that could be led by non-line organization programs and committees. New technologies are process specific and require the line organization to step up and actively pursue and deploy the improvements. Secondly, many of these new technologies result in avoided future costs and do not generate current budget year cost savings. Investment dollars to achieve future savings is a lower budget priority in the current DOE fiscal climate. The SRS is addressing the challenge on a number of fronts.

Use of contractor performance based incentives (PBI) is a powerful management tool to drive line organization accountability and accelerate technology deployment. Contract incentives have been used successfully over the past several years to accelerate implementation of pollution prevention initiatives. Prior to FY98, pollution prevention PBIs focused on increasing avoided waste volumes over what was planned. Starting in FY98, the key program performance measure shifted to life cycle cost savings resulting from pollution prevention initiatives. This change has effectively driven identification and deployment of technologies and new approaches that offer the best overall value to the SRS and the DOE. Program success and achievement of goals can only be accomplished with strong line organization ownership and accountability.

Identification, development, and deployment of new technologies does not lend itself to traditional DOE planning and budgeting procedures. Typically, specific resource needs for new technologies are not defined far enough in advance to be incorporated into budgets. The SRS implemented a generator set-aside fee in FY95 to provide a stable source of dollars for emergent pollution prevention initiatives. The set-aside fee is a tax on waste generation that is pooled and provides typically \$700K to \$900K funding per year. Many of the initiatives discussed in this paper were supported by set-aside fee dollars. As program budgets decline, the set-aside fee will be relied on increasingly as a source of technology investment funds for pollution prevention.

CONCLUSION

The development and deployment of these technologies demonstrate SRS's commitment to continuous improvement in pollution prevention, cost-effectiveness and environmental stewardship. The SRS Pollution Prevention Program supports these and other initiatives through establishment aggressive goals and providing leveraged funding to support goal attainment. SRS will continue to seek P2 improvement opportunities and share successes with others through public forums and technology-specific conferences and workshops.