RADIOLOGICAL WASTE MINIMIZATION AT SRS ¾ AN INTEGRATED APPROACH

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ABSTRACT

Since the early 1990s when the Solid Waste Division formed the Waste Minimization/P2 group, Low Level Waste (LLW) disposal has decreased from 973,000 cubic feet to less than 200,000 cubic feet, a 80% decrease in annual LLW disposal. This paper will provide details of the various programmatic and technological implementation strategies that have successfully been deployed to improve working conditions by minimizing the radiological risks to the workers, public, and the environment.

Savannah River Site (SRS) performed a benchmarking operation of the best performers among commercial nuclear plants in 1994. A team visited several facilities and generated a list of the "Best Management Practices" for inclusion in the strategic plan for implementing change at the site. Consultants performed assessments in various divisions to identify current practices and provide recommendations to improve program performance. The site has aggressively pursued the implementation of the major aspects of the recommendations that resulted from the assessments. Following are the major programs that have evolved to achieve the outstanding success in minimizing the generation of LLW:

- Implementation of an aggressive Contaminated Area (CA) recovery Program.
- Implementation of a Site-Wide Green-Is-Clean (GIC) program.
- Replacement of high volume disposable items with Recyclable alternatives.
- Implementation of Second Sort program to direct clean material to GIC from LLW.
- Implementation of a Contaminated Large Equipment Disposition Program.

All of the programmatic and technological aspects of this successful program are directly transferable to other DOE facilities and industry.

This paper will define the approach taken by the Savannah River Site Waste Minimization/Pollution Prevention (P2) Program to reduce the amount of Low Level Waste (LLW) disposed at the site. The integrated approach to Waste Minimization/P2 at SRS has resulted in significant reduction in the annual volume of LLW disposed, decreased radiological risk to the workers, and significant savings to the customer, and ultimately, the taxpayer.

INTRODUCTION

SRS occupies approximately 310 square miles, (about the size of the area inside the Washington, D.C. beltway) and is located 12 miles south of Aiken, South Carolina on the Savannah River, which forms the boundary between South Carolina and Georgia. Augusta, Georgia is about 25 miles northwest of the site. The Savannah River Site was constructed in the early 1950s and began production of materials used in nuclear weapons, mainly tritium and plutonium-239. Five reactors were built at the site for production of nuclear materials, along with two chemical separations plants (canyons), a heavy water extraction plant, a nuclear fuel and target fabrication facility, a tritium extraction and loading facility and waste management facilities. SRS produced 36 metric tons of plutonium from 1953 to 1988. As a result of the end of the Cold War in the early 1990s,the site's mission has changed to environmental clean-up; maintaining the nuclear weapons stockpile; and managing excess nuclear materials. SRS is the nation's only facility for recycling and reloading tritium, and is one of the primary DOE sites with missions that address concerns of national security and non-proliferation.

Savannah River Site has a broad, visionary Environmental Management System (EMS), that has been certified to the international standard ISO 14001, to carryout the objectives and directives of the SRS EMS Policy. The EMS promotes and measures continual improvement in performance by establishing and maintaining documented environmental program objectives and targets corresponding to SRS vision, mission, and core values.

The Savannah River Site has integrated the Waste Minimization/Pollution Prevention strategies into all Site processes, programs and plans. Senior management support has been consistent and visible since the program's inception. The site continues to evaluate new technologies for application in supporting site missions as well as accelerating the site clean up per established DOE-HQ Secretarial Leadership Goals and "Greening the Government" Executive Orders.

The EMS is imbedded into the Integrated Safety Management System (ISMS) using procedure compliance as the driver. In 1999, DOE-SR informed the Defense Nuclear Facility Safety Board (DNFSB) and the DOE-HQ Safety Management Implementation Team (SMIT) that ISMS is fully implemented within WSRC, the SRS M&O Contractor, and that ISMS is now in a mode of maintenance and continuous improvement. As part of the ISMS Strategic Improvement Plan, pollution prevention, waste minimization and energy efficiency techniques within SRS work activities are targeted for continual maintenance and improvement. Examples of improvement opportunities recognized include: opportunities for feedback and continuous improvement in the area of radiological and environmental risks reduction, full integration of ISM principles into radiological programs and procedures, and integration of environmental ALARA principles into ISMS deployment training at the SRS.

The low risk, conservative practices of managing all potentially radioactive contaminated materials as radioactive waste is being challenged at the SRS. The volume and toxicity of waste generated are being reduced and waste segregation programs are being deployed. The Administrative Control Limit (ACL) for employee exposure in mrem/year Total Effective Dose Equivalent (TEDE) has been reduced from 1500 mrem in 1993 to the current 500 mrem/year. Since the early 1990s, routine radioactive and hazardous waste disposal has decreased 80% (figure 1).

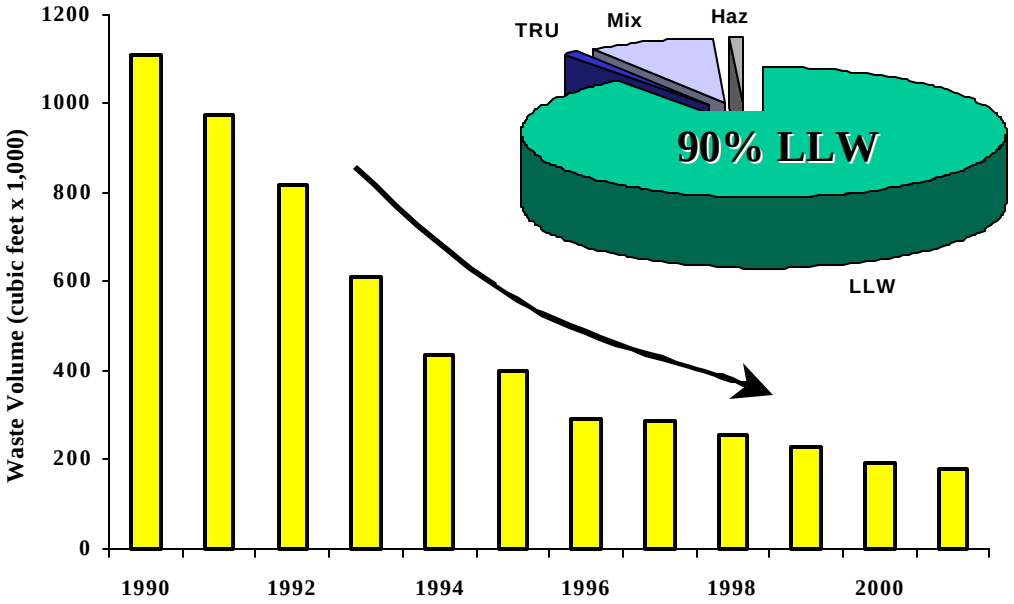

Fig. 1, SRS Routine Radioactive and Hazardous Waste Disposal

Based on techniques demonstrated to be effective during low-risk pilots, significant improvement strategies have been integrated into the Sites operations. Long term planning such as the ISMS Strategic Plan and Radiological Strategic and Improvement Plans are being used within the Sites Environmental Management System to drive continuous improvement above compliance.

Following are details of five programmatic and technological implementation strategies that have successfully been deployed to improve working conditions by minimizing the radiological risks to the workers, public, and the environment.

Contaminated Area (CA) Recovery Program

The most common sources of radioactive waste at all nuclear facilities are routinely accessed contaminated areas. The site has aggressively pursued the elimination of Contaminated Areas (CA) and significantly reducing the hazards associated with High Contamination/Airborne Radioactivity Areas (HCA/ARA) by performing decontamination activities sufficient to eliminate or reduce the source of contamination.

Initially, the site committed to recover 20% of the active recoverable contaminated areas per year. Within a four-year period, the goal had been integrated into the Radiological Improvement Plan. Today, achieving this goal is a performance standard and is supported by management site wide.

SRS has established and funded two decontamination teams in the F and H areas. These teams are funded through Generator Set-Aside Fees (GSAF). GSAF monies result from a tax that is levied by the Solid Waste Division on generators for the LLW, hazardous, and TRU wastes received by SWD at the burial ground. Collected funds are redistributed to the generators through this program to fund rollback and High Return on Investment (HROI) activities. Each team works on projects prioritized by the facility ALARA and management organizations to recover areas that will maximize the ROI for the facility and minimize the radiological risk to workers routinely occupying the areas.

SRS also has established a Facility Decontamination and Decommissioning division to perform decontamination services for the site. This division is primarily comprised of former reactor operators that have received extensive training and has been provided up to date equipment to perform services for site facilities requiring decontamination or decommissioning services.

In 2001, the site recovered approximately 90,000 square feet of Contaminated Area. The cost to perform the decontamination was $900,000 with annual savings of over $4,860,000. The benefits associated with performing roll back activities are: reduction in LLW generation, reduction in PPE laundry costs, reduced heat stress and improved working conditions, and improved productivity.

Through the years the site has upgraded the equipment used to perform rollback work to take advantage of technological improvements. Some difficult to decontaminate areas required the application of an encapsulation technology. Typically, these areas were painted/coated to fix contaminants. Typical paint has short life and durability requiring rework and increased surveillance. Polyurea spray coating (a durable, commercially available plastic coating) has been used to recover difficult to decontaminate radiologically contaminated areas.

After several years of using this technology to reclaim areas, the site procured a new system to compliment the old equipment and to perform large area applications indoors. The spray is used to isolate leaking flanges on HVAC ducting inside facilities as well as encapsulating floor surfaces in rooms where legacy spills have contaminated the concrete to a depth exceeding the limits for surface removal.

A walk behind vacuum enclosed scabbling system was purchased to perform decontamination activities in areas where the contaminants could be eliminated by removing a thin layer of the surface. This system allows the operator to walk behind the unit without requiring respiratory protection due to the efficiency of the vacuum system in containing the dust. This allows rapid recovery of large areas while maximizing the comfort of the worker by keeping the operator walking versus kneeling.

In 2001, the site performed a verification operation to confirm the status of all areas that had been rolled back since 1996. Each area was walked down and the status verified by reviewing postings and observing work practices in the areas. There were 210 separate areas that were rolled back between 1996 and 2000. Four areas had been "lost" after the initial decontamination and roll back had been performed. Three of the areas were recontaminated due to sources that could not be isolated due to configuration and operational constraints. An abandoned pad at one facility would be cost prohibitive to recover with no return on the investment due to the area being abandoned and not routinely occupied by site personnel.

Green-Is-Clean Program

The site established a "green-is clean" (GIC) program in 1996. The program segregates clean Radiological Buffer Area (RBA) waste from contaminated LLW. This program recognizes that not all of the waste generated outside of Contaminated Areas, but within an RBA is contaminated. Segregating and surveying the waste generated outside of CA's but within RBA's has reduced the volume of LLW produced significantly.

When the GIC program is combined with an aggressive contaminated area recovery program, the volume of LLW generated shifts from suspect contaminated to clean. The cost to dispose of LLW is \$106/ ft^3 versus \$45/ton to dispose of sanitary waste.

The GIC program was started in 1996 and within one year, all nuclear facilities had implemented the program. During that first year of operation, the final survey of material resulted in one bag in 1,000 bags having detectable radioactivity inside. In 2001, one bag in 10,000 was found to have detectable radioactivity. All bags that contained radioactivity were caught during the final survey operation prior to sending the material to the landfill.

The average annual GIC waste disposed is 28,000 ft^3 with savings of \$2.9 million.

Consumable Item Replacement Program

During the on-site assessments, bags of LLW were sorted and analyzed at various facilities. The composite results (Figure 2) of the analyses indicated that 73% of the LLW consisted of the following six items: plastic bags, plastic/paper sheeting, recoverable clothing, plastic shoe covers, miscellaneous paper, and atomic swipes. At the time, this represented 214,000 ft^3 of LLW that was disposed on-site.

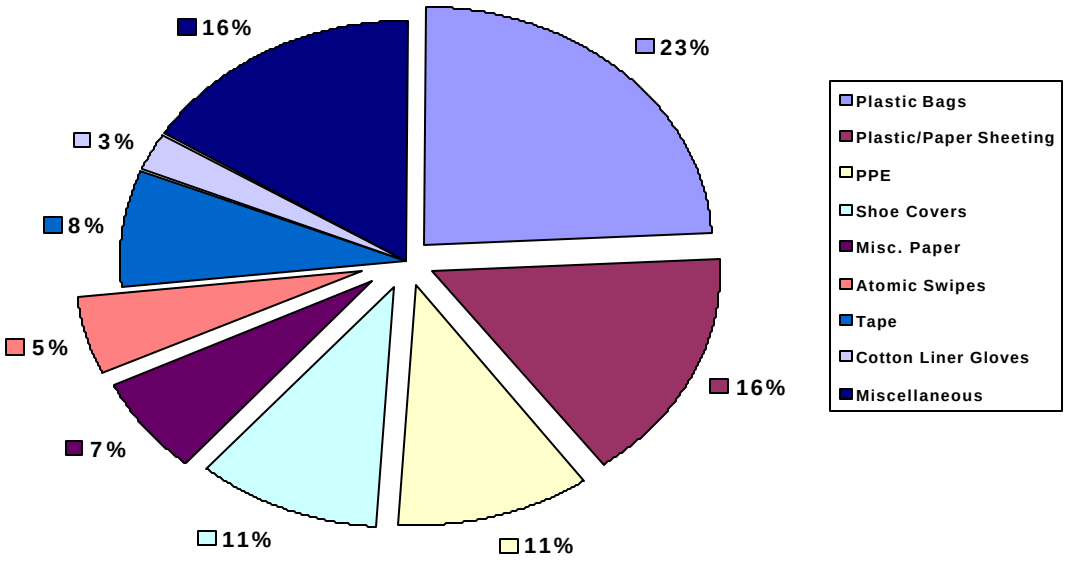

Fig. 2, SRS LLW Job Control Waste Composition Analysis

The Solid Waste Division initiated a campaign to eliminate the large majority of these items from the LLW stream by procuring launderable replacements for the site divisions requesting assistance in establishing change in their facilities. Launderable tarps to replace rolled plastic and paper sheeting have been implemented in several divisions. Plastic shoe covers have been replaced with launderable items. Launderable mop heads and decontamination cloths have been procured and stocked in the warehouse for use to replace disposable items.

During 2001 the site laundered an average of 160 tarps per month. This resulted in savings of approximately 4,000 ft^3 of LLW per month. The annual savings were $424,000 minus the laundry cost of $7,200 per year. Clearly, this program will expand to allow further savings as the tarp design and implementation improvements take place.

Some "lessons-learned" in the first years of the program are worthy of note. Each facility was instructed to mark each of the tarps with the facility location and number to ensure they were returned to the place of origin after laundering. Some did not mark the items and the tarps were not returned to the appropriate facility. Tarps are not used at all facilities because of reluctance on the part of personnel. The tarps are designed to be put together using Velcro and grommet arrangements, which will allow the construction of huts and windbreaks. Some individuals fear that it would take too long to construct these structures but site studies indicate construction time is cut by a factor of four when using tarps versus rolled goods. The Solid Waste Division plans to provide personnel to assist in the planning of containment and windbreak construction during 2002 to ensure maximum use of the launderable tarps.

The launderable shoe cover program has been fully implemented in the lab areas of the site. The remainder of the site has sporadically replaced the disposable shoe covers with launderable replacements. Solid Waste Division personnel have performed walkdowns of the change rooms to ensure adequate numbers of launderable shoe covers are in place. In those facilities that do not use very many launderable shoe covers, personnel observed large quantities of disposable shoe covers in the rooms. When disposable items are easier for personnel to use and readily available, launderable substitutes will not be selected routinely.

Some facilities have changed the facility exit protocol to include wearing the disposable shoe covers and cotton liners through the PCM 1-B and disposing them in the GIC container if clean. This is a large improvement, but needs to be expanded to all facilities where disposable shoe covers are used extensively.

The average monthly usage of disposable shoe covers in 2001 was 36,325 pair versus 146,000 pair in 1995. The launderable shoe cover average monthly usage was 509 pair. Clearly, expansion of this program will yield large returns. The radical change in the numbers used currently is accounted for by considering the decrease in the number of CA's that require dress out.

Disposable plastic sheeting and Kraft paper average monthly usage were 95,942 ft^2 and 48,274 ft^2 respectively during 2001. Launderable tarp average monthly usage was 4,213 ft^2 during the year. The goal of the site is to reduce disposable usage by 20% during 2002. This goal is incorporated into the Radiological Improvement Plan and will be part of the Performance Based Incentive for the SWD during 2002.

Second Sort and Clean Waste Diversion Programs

In 2000, the site set up pilot programs to take bags of waste from inside CA's that contained minimal radioactivity based on survey information, and diverted the waste into the GIC program by performing a 100% smear and probe survey of all the material contained in the bag. Contaminated items were removed and placed in the LLW, and the clean waste was diverted to the sanitary waste stream.

Clean waste diversion pilot programs have been implemented at four facilities at Savannah River Site. Two of the High Level Waste Division tank farms, plutonium processing facility, HB-Line, and the respirator processing facility have all established a program to survey and release material that had been placed in the LLW for disposal on site.

During 2001, H-Tank Farm pilot processed 3,863 ft^3 of LLW and diverted 89% to the GIC disposal path with associated savings of $264,300 after subtracting the labor cost. The F-Tank Farm pilot processed 2,795 ft^3 and diverted 87% with associated savings of $145,573 during eight months in 2001. The HB-Line project processed 3,200 ft^3 and diverted 100% with associated savings of $339,200. This facility is posted for potential contamination and has very few areas where contamination exists outside the gloveboxes. The respirator facility diverted 1425 ft^3 and saved $151,050. The total savings for the year 2001 were $900,123.

Research indicates that approximately 60% of all the LLW generated and disposed on-site could be diverted to the sanitary waste stream if sufficient progress were made to accelerate the survey process. To that end, the Savannah River Site Technology Center has studied commercially available instrumentation systems and technically qualified them for use at the site.

A conveyor monitor is used to survey hand tools that are at low risk of being contaminated that come from a well-characterized waste stream. Hand tools that may otherwise have been disposed as low-level waste are being recycled and used in the applications for which they were intended. In all, 250 cubic feet of hand tools have been recycled for use resulting in a cost avoidance of $96,000. A box monitor has also been tested for use to survey waste that is at low risk of being contaminated that comes from a well-characterized waste stream. The box monitor will be deployed in the high-level waste tank farm waste release program, one of the existing programs, in FY02. Box monitor use will be qualified against current survey protocols. The site expects to increase the throughput by a factor of five, which will increase the volume diverted by the same amount. This will result in savings of approximately $3.5 million annually.

Commodity Management Centers (CMC) used at SRS provide centralized control and inventory of specific resource assets to maximize site utilization. The CMC concept was applied to Radiological Monitoring Equipment (RME) in FY01. The Radiological Monitoring Group manages the administration, coordinated use, calibration and maintenance, and technical oversight for the RME Program. The effect has been to streamline activities and increase efficiency and cost effectiveness.

An excess building, Building 253-H, was modified in FY01 using waste fee funding in order to work on RME that is contaminated. Much of the semi-portable RME that is contaminated is transported to this centralized location for calibration and repair. This alleviated the practice of disposing of that RME and other Material and Test Equipment that was impractical to calibrate and/or repair in the field. The centralized location reduces duplication of efforts such as maintenance training program and procedures. In the two months since RME Hot Shop startup in late September 2001, processing RME from only one SRS operating division has saved $240,000 in equipment and waste cost. Estimated savings are ~$2 million per year for RME operations.

Contaminated Large Equipment Disposition Program

For the past ten years, SRS has accumulated large amounts of contaminated stainless steel equipment and stored it on-site for inclusion in the Beneficial Reuse program as directed by the Department of Energy. When the site evaluated the cost to process this material through commercial decontamination and metal melting facilities, the site determined the cost to be prohibitive. The other factor that contributed to the demise of the Beneficial Reuse program was the lack of customers for the products to be manufactured from slightly contaminated material. The Secretarial Moratorium placed on metal recycle caused the establishment of the program that is described below.

To date, the site has identified approximately 750,000 cubic feet of CLE to be considered by a subcommittee established to determine the path forward for this material. The CLE Dispositioning subcommittee is chaired by the Facilities Decontamination and Decommissioning group and is comprised of members representing all divisions on the site which have an inventory to disposition as well as Solid Waste Division (SWD) personnel. Subcommittee members perform field walk downs and the results are provided to the full group with recommendations for disposition identified on a checklist documenting the fieldwork. The committee evaluates each component or group of components and considers estimates for decontamination, and segmentation for volume reduction. Disposition paths are identified and schedules evolved to execute the planned disposition.

In 2001, the committee dispositioned 50,000 ft^3 of this legacy equipment. Because the site is under the Secretarial Moratorium on metal recycle, a large portion of the equipment was disposed as sanitary waste rather than being recycled via smelter operations. In all, 30,000 ft^3 was disposed as Low Level Waste and the remaining 20,000 ft^3 was released for reuse or disposed as sanitary waste. This program resulted in savings of $2.1 million dollars in 2001.

This program has succeeded during 2001. Since metals could not be released for recycle via a smelting operation, much of the steel was disposed in a landfill rather than being recycled. Hopefully, revision to DOE Order 5400.5 in 2002 will result in the lifting of this moratorium and the establishment of a protocol that will allow the site to direct much of the material that meets regulatory release criteria into the recycle stream.

SUMMARY

The Savannah River site has integrated the various program initiatives established since the inception of the Waste Minimization/Pollution Prevention group. Through the educational efforts and seed money used from GSAF funds, the group has established a successful program to minimize the generation of LLW and improve the working conditions for the personnel who routinely access radiological hazard areas. Through the efforts of this dedicated group of professionals, the site is routinely recognized for achieving excellence in environmental stewardship and pollution prevention.