THE SAVANNAH RIVER SITE (SRS) INTEGRATED APPROACH TO ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT

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ABSTRACT

SRS is a major defense nuclear materials production facility located near Aiken, South Carolina. The SRS was constructed in the early 1950's, and is owned by the DOE and operated by the WSRC.

The site, which occupies an almost circular area of approximately 325 square miles, produces nuclear materials by manufacturing fuel and target components, irradiating them in nuclear reactors, chemically separating the desired products (primarily plutonium and tritium), and managing the resultant wastes (see Fig. 1). Wastes are generated from each of the processes onsite, and have been managed to date in a program referred to as Interim Waste. Historically, interim waste has included:

Seepage basins for low-level liquid radioactive waste, primarily tritium, that in many cases also included hazardous constituents in the discharges and were, therefore, mixed waste. The contaminants migrated through the groundwater system allowing time for radioactive constituents to decay somewhat before outcropping into onsite surface streams;

- Shallow land burial for low-level solid radioactive waste;
- Storage of transuranic wastes retrievably on concrete pads; and
- Storage of high-level liquid wastes in carbon steel waste tanks.

The SRS has developed an integrated approach to Environmental Restoration and Waste Management (ERWM) that has allowed the implementation of many improvements to the historical interim waste management program. The use of seepage basins is being discontinued and new effluent treatment facilities have been constructed which treat the liquid wastes for discharge to surface streams in accordance with National Pollutant Discharge Elimination System permits. New disposal facilities are being developed for low-level solid radioactive waste. The SRS has constructed the Defense Waste Processing Facility (DWPF), which will encapsulate the high activity fraction of the high-level liquid radioactive waste in borosilicate glass inside stainless steel canisters. DWPF is currently undergoing cold water testing for initial system checkout, with full radioactive operations scheduled for 1993. The decontaminated salt fraction of the high-level waste will be mixed with concrete, slag, and fly ash and poured as a grout into vaults. The development and implementation of new, improved waste treatment, disposal, and remediation technologies is an important aspect of this integrated program.

ENVIRONMENTAL IMPACT ASSESSMENT

In December 1987, Savannah River Operations Office (SR) published the Final Environmental Impact Statement, Waste Management Activities for Groundwater Protection (DOE/EIS-0120). This EIS addressed several ERWM issues at SRS:

- Closure and remedial actions at low-level radioactive, hazardous, and mixed waste sites; Continued use of seepage basins to receive disassembly basin purge water containing tritium from the reactor areas; and
- Construction of new waste management facilities, including a new disposal facility for low-level solid radioactive waste designed for zero discharge to the environment.

The SRS will be using this EIS as the basis for documentation needed to satisfy the requirements of the National Environmental Policy Act (NEPA) under DOE's policy of integrating NEPA and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund). Since the EIS does not address all of the known waste sites, options for additional NEPA documentation are being evaluated, which will probably lead to a supplement to this EIS.

ORGANIZATION

Like all DOE offices, SR reorganized recently to enhance and focus direction on the ERWM programs (see Figs. 2 and 3). WSRC has counterpart departments of each of these Divisions.

Unlike the DOE-Headquarters (HQ) ERWM organization, SR does not have a Division solely responsible for Technology Development, although the Waste Operations and Technical Division serves as the point of contact with the Office of Technology Development at DOE-HQ. Each ERWM Division includes within its scope of responsibilities associated Technology Development. Since the SRS Tech-

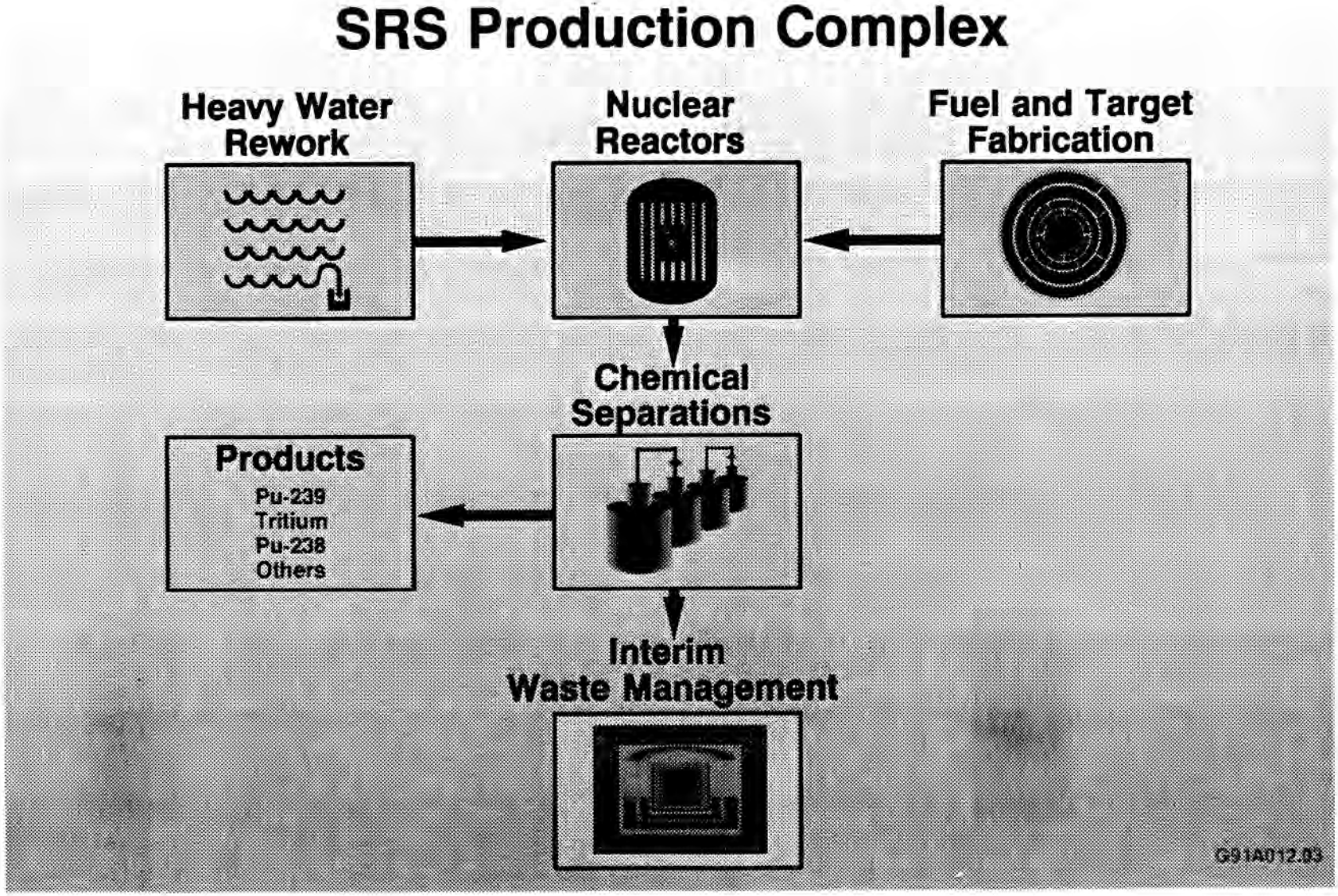

Fig. 1. SRS Production Complex.

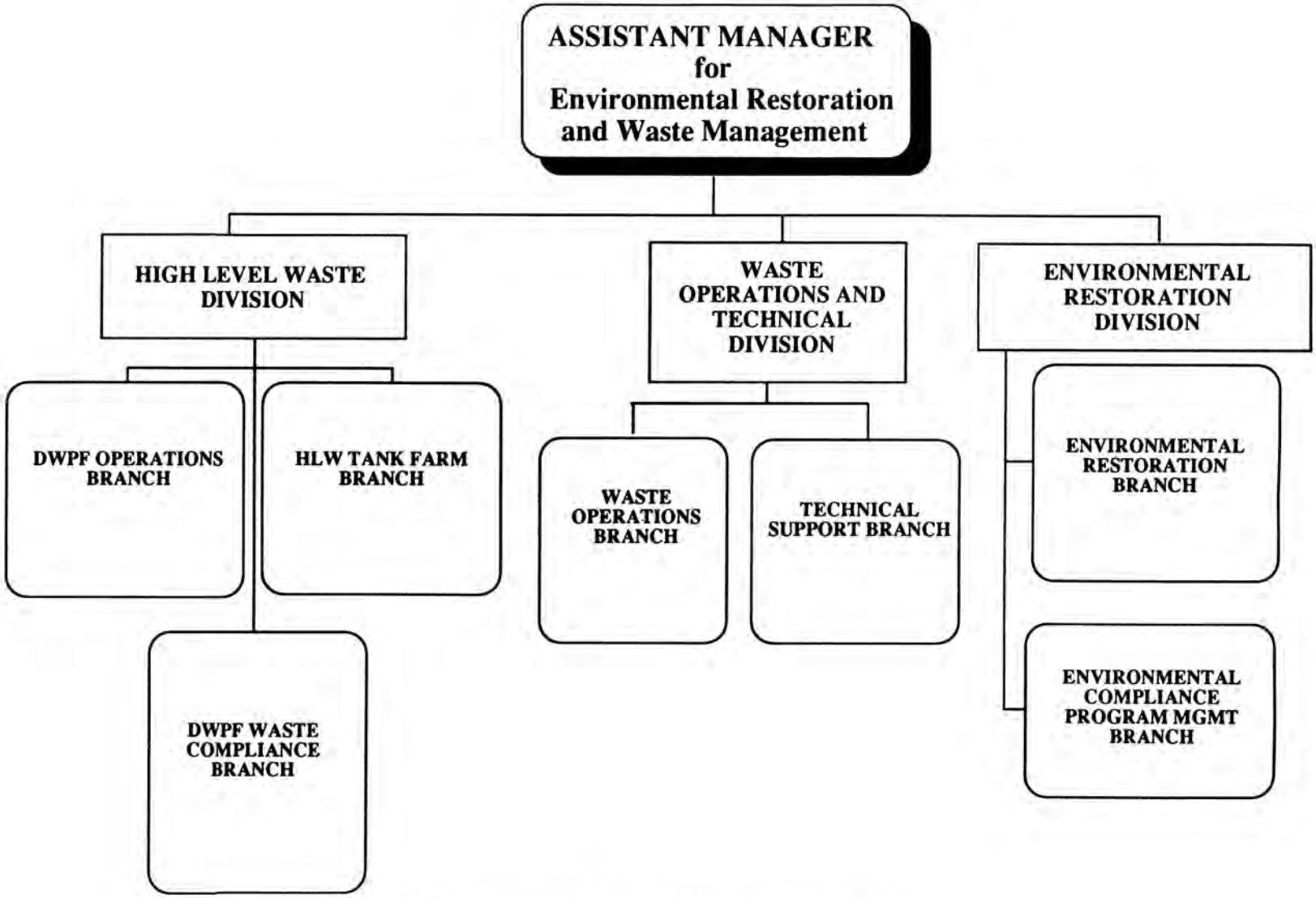

Fig. 2. Savannah River Divisions for ERWM Programs.

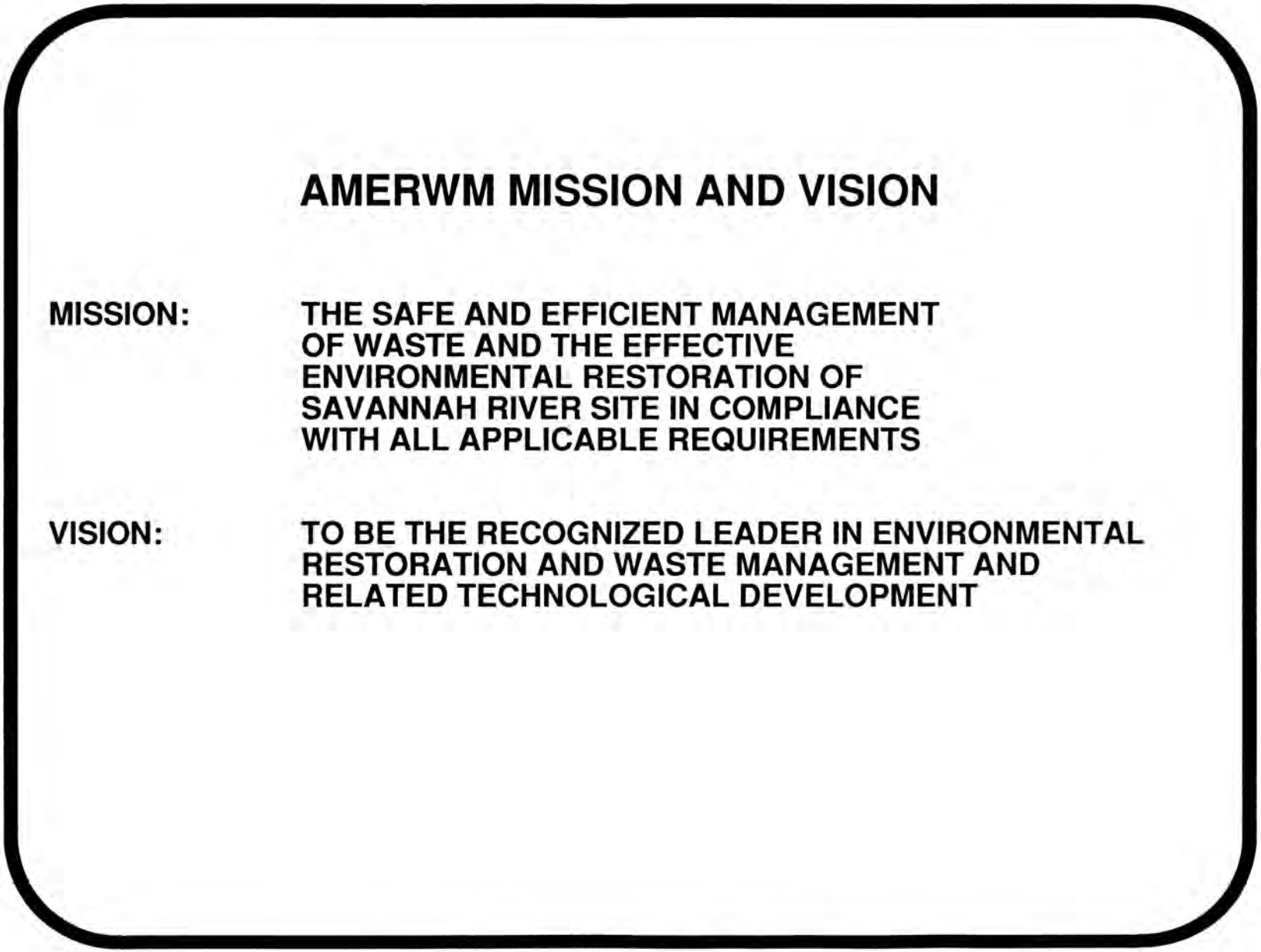

Fig. 3. AMERWM Mission.

nology Development Program is needs driven, this has proven to be most effective. It should be noted that the Savannah River Laboratory (SRL) is the organization within WSRC responsible for the Technology Development Program; SRL maintains close contact and coordination with the SRS operations departments responsible for environmental restoration and waste management.

REGULATORY INTERACTIONS

The SRS has worked diligently over the years to develop a positive working relationship with the cognizant regulatory agencies. Initially, this primarily involved assuring technical fixes to the more significant environmental problems; the jurisdictional issues were resolved over time. In 1985, a Memorandum of Agreement between the DOE-SR and the South Carolina Department of Health and Environmental Control (SCDHEC) was executed in which SR agreed to comply with State regulations where required as a matter of law and where not required by law as a matter of cooperation.

SR has entered into a number of settlement agreements with both the State and EPA to resolve compliance issues. All of these were initiated by self-reporting of the non-compliance. It has been SR's experience that this self-reporting both mitigates the impact of the non-compliance and increases credibility with the regulators.

A strong self-assessment program is needed. DOE-SR and WSRC have conducted walkdowns of all facilities to identify problems. These have been conducted by both line and oversight organizations. To enhance this program, training has been and continues to be, provided to the DOE-SR facility resident engineers in conducting walkdowns and identifying potential problems, especially with regard to hazardous waste storage and accumulation.

PLANNING

To develop and maintain an effective, integrated approach to Site environmental restoration and waste management programs, a strong planning program is needed. Over the past several years, three key planning documents have been developed: DOE-SR's Compliance Implementation Plan (CIP), the WSRC Environmental Implementation Plan (EIP), and the DOE-SR Programmatic Summary Report (PSR). The CIP was designed to provide the project engineer with the basic tools needed to identify all environmental requirements associated with his/her project and thereby allow the early preparation of permit applications and other environmental documentation and minimize potential delays. The EIP expands on the CIP by identifying specific projects that would be upcoming over a five-year period. The PSR tracks all environmental research programs being undertaken by all of the SR contractors involved in environmental research. These three plans, along with other documents and information, provided the necessary reference for development of SRS' input to the DOE ERWM Five Year Plan, and preparation of the SRS Site Specific ERWM Plan.

An important aspect of the Site Specific Plan is community involvement. SRS held a series of three public meetings (in Columbia, SC; Aiken, SC; and Savannah, GA) to receive public comments and concerns to be addressed in the Fiscal Year (FY) 1991 update to the Site Specific Plan. These meetings were conducted as workshops with displays of the environmental restoration and waste management activities and technologies, and discrete listening posts, one for waste management discussions and one for environmental restoration discussions. At the listening posts, the members of the public could as questions about any associated topics or express concerns about each program. The attendees were encouraged to participate in each listening post; all were also requested to complete an evaluation form. Key comments received during the discussions at the listening posts and from the evaluation form included:

- Favorable feedback on the format of the meeting,
- Concerns about conducting or restarting operations prior to completion of cleanup activities,
- Need for increased communication on what radioactivity is and its effects,
- Level of research and development activities communication on what radioactivity and nonradioactive), and
- Transfer of developing technology to the private sector.

WASTE MANAGEMENT

A comprehensive, integrated plan for waste management at the SRS has been developed as a way to approach the diversity of waste materials as well as minimizing the number, complexity and thus total cost required for waste management facilities. In

principle, it is based on a centralized concept where dedicated facilities will be operated to perform the treatment and/or disposal as needed:

1. Wastes are first categorized by waste type;
2. Dedicated treatment facilities for waste processing are established to convert the material to a stable waste form for disposal; and
3. Waste disposition (or storage for waste to be disposed offsite).

This concept, evaluated over several years of development, has focused on solving the waste management needs of the SRS and incorporated the best available technology.

Solid radioactive waste at SRS is disposed of at the low-level waste disposal facility which is located between the two chemical separations areas. In the past years, the low-level waste disposal facility has had facilities to manage solid radioactive wastes categorized as low-level waste, intermediate-level beta-gamma waste, and transuranic (TRU) waste. Separations facilities are provided for storage of mixed waste. Low-level waste is placed in 90 cu. ft. carbon steel boxes and placed in an engineered low-level trench excavated to 20 ft. deep, 135 ft wide, and up to 1,000 ft long. The boxes are stacked in the trench to achieve the most efficient use of the space, and the trench floor is slightly sloped so that rainwater will collect in a sump at the low point of the trench. The waste is typically consists of control waste and used process equipment.

Intermediate-level beta-gamma waste radiates more than 300 mR/hr at three inches from an unshielded container. This waste is disposed of in shallow land burial slit-trenches. An improved disposal technique, Greater Confinement Disposal (GCD), is being demonstrated. The objective of GCD is to provide improved containment of radionuclides and require minimum maintenance after closure. This concept has been used for the development of new disposal concept consisting of engineered vaults for containment of all low level waste that are currently under construction. Operation of these facilities will begin in 1992.

Mixed waste is hazardous waste that is also radioactively contaminated. Mixed waste storage is regulated by SCDHEC. A covered, diked facility that meets SCDHEC regulations has been constructed and permitted for the interim storage of mixed wastes. Waste will be stored until on-site facilities for treatment and disposal are available.

Nonradioactive hazardous wastes (NRHW) are sorted on site in three RCRA permitted hazardous waste storage buildings. A fourth storage building has been constructed. The buildings are constructed with sloped floors, dikes, and sumps to provide adequate containment in the event of a spill. Effective separation of noncompatible chemicals is provided. The buildings contain over 2,500 55-gallon drums, over 85 five-gallon drums, and 500 cu. ft. boxes of soil contaminated with organics, pesticides, and metals. Long-term disposal of this waste includes incineration of approximately 75% of the waste in the proposed Consolidated Incinerator Facility (CIF), followed by stabilization with cement, neutralization, and disposal in an above-ground vault referred to as the Hazard Waste/Mixed Waste Disposal Facility.

A comprehensive waste minimization program has been developed and is being implemented at SRS. While early in the implementation stages, benefits in this program have already been realized, especially for solid low level waste generation. The program has keyed on approaching waste reduction through employee awareness, program-specific goals for waste reduction as well as incentives for achieving waste reduction goals.

A Federal Facility Compliance Agreement (FFCA) is being negotiated with the U.S. Environmental Protection Agency - Region IV to address mixed wastes subject to RCRA's land disposal restrictions. This agreement is needed because there exists insufficient national capacity to treat and dispose of mixed wastes. Site policy is to the extent possible to treat and dispose of wastes SRS generated on-site. However, the development of this capability cannot be done within RCRA's time constraints, leading to this FFCA. As a sidelight, DWPF has been designated Best Demonstrated Available Technology for high-level liquid radioactive waste, which is also characterized as a mixed waste.

ENVIRONMENTAL RESTORATION

The Savannah River Site (SRS) has been actively involved with environmental restoration activities for over ten years. The Site began cataloguing waste sites in the late 1970's. The cataloguing included identification of the wastes disposed, the periods of waste disposal, and the location of the sites. These activities along with early site characterization resulted in the beginning of remediation in 1984 with a installation of a groundwater withdrawal system and the closure of seven waste pits. Following these early activities the Savannah River Site has to date closed seven seepage basins, a 58 acre portion of the low-level solid radioactive waste burial ground, and a major settling basin and its associated process inlet lines. Also, the original groundwater withdrawal system composed of eleven wells has been expanded to include two additional well systems.

The SRS conducted early environmental restoration activities under the South Carolina hazardous waste management regulations which were in conformance with the Resource Conservation and Recovery Act (RCRA). A provision of a 1987 RCRA Post Closure permit included requirements for addressing several inactive Solid Waste Management Units (RCRA 3004(u) sites) which were identified for the RCRA Facilities Investigation Program of EPA. The sites identified would have normally been included under a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Program; however, the EPA and the State chose to have regulatory authority over the SRS environmental restoration activities under RCRA as opposed to CERCLA at that time. In 1989 the Savannah River Site was placed on the National Priorities List and the waste sites that had been identified under RCRA became CERCLA sites as well.

In order to minimize duplication of efforts and maximize efficiency of resource utilization, the Site began a dialogue with the State of South Carolina and EPA Region IV to arrive at an agreed upon integration of RCRA and CERCLA requirements. The result of this dialogue will be

a Federal Facility Agreement (FFA). The FFA outlines requirements for RCRA/CERCLA integration and establishes deliverables and schedules. The Agreement also establishes an annual agreement of the three parties for environmental restoration work priorities at the Savannah River Site based upon the Site's Environmental Restoration budget allocation. A third important provision of the Agreement is the identification of the regulatory program under which the high-level liquid radioactive waste storage tanks will operate. It has been agreed that the high-level radioactive waste storage tanks will operate and be decommissioned under the South Carolina enforced provisions of the Clean Water Act. It is anticipated that this FFA will be signed by early spring of 1991.

The Savannah River Site has a long history of obtaining state permits for air discharge, surface water discharge, groundwater production and compliance, and underground injection. There are 70 NPDES outfalls, and the Site has over 1500 groundwater monitoring wells. Over 500 of these monitoring wells are in the RCRA quarterly reporting program. The Site has also obtained an underground injection permit to test the injection of air and steam in horizontal wells for the clean-up of organic solvents in the vadose zone and shallow groundwater table adjacent to a process sewer line.

Early in the environmental restoration process the Savannah River Site recognized that innovative technology could significantly aid the restoration program at the Site. A result of this has been the implementation of a number of test programs, including the above mentioned horizontal wells, which have directly or indirectly contributed in a positive way to the success of the SRS environmental restoration program.

The Savannah River Site Management and Operating Contractor has recently reorganized to better manage and conduct the environmental restoration program. Prior to late 1990, six operating departments were responsible for the environmental restoration activities in and around their specific operating areas. The Savannah River Laboratory provided technical support and the Environmental Protection Department provided program guidance and regulatory support. In late 1990 all of the inactive waste sites were brought under the responsibility of an Environmental Restoration Department (ER). This ER department has responsibility for investigations and remediation at all inactive waste sites. The Environmental Protection Department remains responsible for regulatory support, and the SRL provides technical support and is also the lead organization for Research, Development, Demonstration, Testing and Evaluation of activities related to waste site investigations and closures. Because there has been an early recognition that R&D support can make a significant contribution to environmental restoration success, the Savannah River Site has been able to bring the latest proven technology to its waste site cleanup program.

As part of its Environmental Restoration Program, the Savannah River Site is conducting a community outreach program. This program includes all of the elements required under CERCLA and has been expanded to include additional forms of community outreach and information dissemination. The SRS program integrates the requirements of RCRA, CERCLA, and other regulatory programs into one comprehensive outreach program. By integrating all of the various regulatory required notifications along with a community education program the Site has been able to eliminate much of the confusion the public was experiencing from multiple notification under separate regulatory programs.

The success of the Savannah River Site environmental restoration program can be traced to its integrated approach to the regulatory process and the other main elements of the program.

TECHNOLOGY DEVELOPMENT

Technology development (TD) at the Savannah River Site has always been a critical part of the site's ERWM programs. Now, new, progressive, innovative, more flexible approaches have been used for implementation of TD.

TD has also recognized that success is implementation as demonstrated by their successful application of the Integrated Demonstration (ID) concept at an actual ER site. This not only focused SR's TD and ER resources, but pulled resources from around the country together from DOE Laboratories, academia, and industry in a synergistic approach.

TD has been clearly recognized by SR as a critical link in the EM chain of success. The ID clearly showed that an operations site could work hand-in-hand with the regulators and achieve an impressive product in a timely fashion. The ID is now demonstrating the infiltration mechanisms for bringing R&D, academia and industry into the TD process while maintaining individual successes. Even more challenging is the technology transfer and integration aspects of TD for ERWM. Multiple barriers & obstacles exist which must be overcome at all levels of the system. The TD process has also afforded unlimited opportunities in the WM area, especially waste minimization by again optimizing resources at SR and within the DOE complex to save time and money, reduce risk, and increase safety.

At the very basis of SR's TD program, and a critical must, is a strong planning program. The Site's four main planning documents - CIP, EIP, PSR and the SRS Site Specific ERWM Five Year Plan - will serve as the impressive basis for the SR Site Roadmap (RM). The RM is being prepared to solidly link ER-WM-TD needs, programs,

schedules and deliverables together in a readable, useable document which everyone can relate to and identify with. For some, TD's more progressive approach is difficult to understand, but SR's TD's main purpose is to help ER and WM get their job done faster, better and cheaper. The best technologies, wherever they are inside DOE or out, will be developed or obtained, tested, evaluated, applied, transferred or integrated to get the EM job done. To date, SR has clearly demonstrated strong national leadership in TD and set many examples for others to follow in the ER-WM-TD team approach.

CONCLUSION

In conclusion, as we enter the 1990's, it is becoming even more important to use our resources wisely; integrating technology development in a needs-driven program is an important part of the process. Doing the right thing right the first time is critical to our success.