SAVANNAH RIVER SITE INTEGRATED SOLID WASTE MANAGEMENT STRATEGY

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ABSTRACT

Changing Department of Energy (DOE)and Savannah River Site (SRS) missions, and regulatory, social and economic priorities mandate an increased efficiency throughout the DOE complex. An integrated management strategy which blends prioritization, research, development and coordination will function best to fulfill current and future needs.

DOE COMPLEX NEEDS

The Site Waste Management Organizations at the Savannah River Site (SRS) have taken a look ahead at the future needs for waste treatment and disposal and have planned a strategy that will provide for treatment and disposal of all waste streams that are presently generated at SRS. There are many needs for treatment and disposal options at the site which have been identified and many more are expected to become visible at the onset of the decommissioning and decontamination efforts.

It is evident that future technology needs must be identified at the beginning of project planning, and prior to the start of design. These technology needs can then be coordinated with the EM-50 Office of Technology Development, DOE Headquarters, and prioritized to the benefit of SRS and other DOE sites across the complex. This approach will assure that the best technologies and designs are incorporated into all future projects.

INTRODUCTION TO WASTE MANAGEMENT, HISTORICAL AND CURRENT

This paper will address the active management of the following major categories of solid wastes generated at SRS, low level radioactive wastes, hazardous, mixed (hazardous and radioactive), transuranic (TRU), and sanitary wastes. These wastes are categorized to standards established by the Environmental Protection Agency (EPA), South Carolina Department of Health and Environment Control (SCDHEC) and specified DOE Orders. The wastes are managed to meet these requirements in a manner which protects the environment and the public.

Savannah River Site Waste Management (SRS WM) objectives are to minimize the generation of waste, and to provide waste handling, treatment, storage, and disposal facilities within the site to comply with applicable federal and state regulations, and DOE Orders to protect the public and environment.

Some of the facilities required to treat, store and dispose of wastes are currently in operation; others are in active design or construction; still others are in the conceptual planning stage.

The strategy for achieving SRS WM objectives is to:

- Ensure that there is a method to dispose of the waste, before waste is generated.
- Reduce/minimize waste generation.
- Recycle/reuse wastes as much as practical.
- Design new treatment and disposal facilities using the most cost efficient and best available technologies.
- Prioritize Site Waste Management problems

CURRENT LOW LEVEL WASTES PRACTICES

<u>Low Activity Wastes</u>

The SRS characterizes Solid Low Level Wastes as Low Activity Wastes (LAW), and Intermediate Level Wastes. Solid Low Activity Waste is defined as waste that radiates less than 200 mrem/hr at 10 cm from an unshielded container and contains less than 10 nCi/g of TRU contaminants. The following materials are typical examples of solid LAW that are routinely handled:

- Operating and laboratory waste: small equipment, protective clothing, analytical waste, decontamination residue, plastic sheeting, and gloves.
- Contaminated equipment: obsolete or failed tanks, pipe, jumpers, and naval hardware.
- Reactor and reactor fuel hardware: irradiated fuel components and housings not containing fuel.
- Spent lithium-aluminum (Li-Al) targets: the irradiated Li-Al from which tritium has been extracted.
- Spent deionizer resin from reactor areas.

The following containers are currently used for waste burial:

- 55 gallon steel drums
- Metal boxes, 45 cubic foot and 90 cubic foot, and
- Engineered steel boxes.

Building debris, soil and other bulky material that do not fit in standard containers are shipped to the Solid Waste Disposal Facility (SWDF) in a non containerized form.

Approximately 30 to 40 percent of the low level radioactive waste volume is being reduced by compaction. The 90 cubic foot container compactors are achieving volume reduction of 5 to 8:1 and are capable of compacting waste types typically placed in cardboard waste boxes. Current programs to increase compaction efforts include compacting tritium-contaminated waste and educating generators to improve container packing efficiency.

The primary disposal mode for solid low level radioactive waste is burial in Engineered Low Level earthen Trenches (ELLT). Criteria for selection of trench sites include:

- Ground water table at least ten feet below the bottom of prospective trenches.
- Absence of perched ground water tables that would cause leaching of buried waste.
- Soil containing enough clay to maintain the integrity of the excavation walls without support.
- Topography conducive to level trenching and controlled surface water runoff.

The trench floor is sloped slightly to one side and end, so that rainwater will run into a sump located at the low corner of the trench. The sump is used to eliminate the potential for standing water while the trench is being filled. Rain water is monitored to confirm that no contamination exists before it is released to surface drainage. If contamination is detected, the liquid will be disposed of via the plant liquid waste handling system.

Since the waste boxes are now stacked instead of dumped as in conventional trenches, the ELLT has more efficient space utilization. Since there is no need for the ten feet of soil between conventional trenches, the amount of land available for waste disposal has been increased as well. The space between the sloped walls and the stacked waste boxes may be used for disposal of 55 gallon drums, bulky waste in containers, and contaminated soil.

Intermediate Level Waste

Intermediate activity beta-gamma waste is characterized as wastes measuring greater than 200 mrem/hr at 10 cm from the unshielded container and containing less than 10 nCi/g of TRU contamination. Waste with low radiation rates and tritium contaminants that have the potential for off gassing is buried as intermediate level activity waste.

Currently intermediate level and bulky non contai ıerized low level (alpha, beta and gamma) wastes are disposı d of in slit trenches and Greater Confinement Disposal (GCD) bore holes. The term slit trench refers to a narrow trench excavated approximately 20 feet wide, 20 feet deep and up to 1000 feet long. The emplaced waste is immediately back filled with soil to minimize radiation exposure to personnel and eliminate the possibility of spreading contamination. It consists of twenty 9 foot diameter bore holes 30 feet deep. Nineteen of these bore holes have a 7 foot diameter fiberglass liner and one has a stainless steel liner. Waste is emplaced in the liners and stabilized by 1 to 2 feet of grout addition. When the liners are full, a concrete cap is poured in place. The bore hole is then covered with a clay cap. Monitoring wells (dry wells) are placed in each bore hole and around the perimeter of the GCD site. Monitoring and modeling of the operation will proceed with waste emplacement.

A second method of GCD emplacement is the GCD-engineered trench (GCD-ET). This trench was constructed for the disposal of reactor scrap metal, spent melt crucibles, and the more bulky waste forms. Reinforced concrete forms the walls of the 4-celled, 100 foot long, 50 foot wide disposal trench. To minimize rainwater intrusion, steel covers are placed over each disposal cell when it is not in use. Also, drainage is provided to channel water away from the trench. A leachate collection system was installed below the floor of the trench to monitor the performance of the disposal cells.

FUTURE PRACTICE, ENGINEERED VAULTS

The amount of Low Level Waste generated at SRS and received from offsite DOE facilities was approximately 600,000 cubic feet in 1992. At this rate, the existing SWDF may reach its capacity for boxed waste before mid year 1993. In addition, current Solid Waste Disposal Facility (SWDF) disposal practices are inconsistent with new DOE guidance, revised DOE Order 5820.2A performance requirements, and current disposal concepts being proposed by compact states for commercially generated LLW, emphasizing the need for engineered barriers in conjunction with favorable site characteristics to isolate the waste from the environment.

A 100 acre site in the north portion of SWDF is being developed to meet projected SRS solid low level radioactive waste storage/disposal requirements for the next 20 years. This facility is being designed to meet the performance objectives of DOE Order 5820.2A, including the EPA proposed 4 mrem/yr effective dose equivalent for ground water at the facility's perimeter.

The project includes site work (fencing, lighting, monitoring wells, railroad spur and siding, and access roads) and initial waste storage/disposal units (intermediate level, low level, long-lived waste, and support equipment). All subsequent waste storage/disposal units will be provided by future projects.

The current SWDF practice of dividing wastes into low and intermediate level fractions will be expanded to include new classifications as indicated in the following four waste categories. These categories provide for the segregation and storage of tritiated and long-lived wastes to meet the ground water performance objectives of DOE Order 5820.2A. Initial disposal units will consist of below grade, concrete vaults designed to have sufficient strength to withstand the stresses of final closure. The storage portion of the facility will consist of concrete vaults and storage buildings. Each waste category will be handled as follows:

- Intermediate level non tritium (ILNT) waste will be disposed of in a total of ten below grade concrete vaults. The vaults will be further divided into seven cells, each measuring 25 feet long by 46 feet wide by 28 feet high. (The E-Area SWDF Expansion project will provide the initial vault with greater than two years capacity.) The waste will be delivered by trucks and emplaced by a mobile gantry crane designed to straddle the vault cells. Each cell will be protected by a removable metal rain cover and pre stressed, removable concrete shielding Tees. Wastes will be grouted in place to: 1) reduce the potential for contamination, 2) minimize sky shine, and 3) provide a working surface for the next layer of wastes. This operation is an *improvement to* the current GCD-ET operation.
- Intermediate level tritium (ILT) waste will be disposed in a new onsite radioactive waste storage and disposal facility. The new site being developed will include a total of ten concrete ILT vaults over the lifetime of the facility (20 years). The initial vault will be 28 feet deep by 46 feet wide by 50 feet long and will accommodate a number of different tritium waste forms. All wastes will be packaged in metal containers prior to receipt at the disposal facility and

emplacement by using a mobile gantry crane. One primary waste form will be a cylindrical shaped stainless steel crucible (20 feet long by 18 inches in diameter) used in tritium recovery. These crucibles will be placed inside silos within the vault to provide shielding and contamination control. An open portion of the vault, covered with shielding tees and rain covers, will be used to dispose nonstandard size containers and waste forms.

Maintaining tritium waste in a dry environment is essential to meeting ground water performance objectives for the long term storage of this waste (100 years). The initial vault will contain a sump to remove any water that may accumulate and a sheet metal rain cover to maintain waste forms in dry condition. The vault is to be constructed a minimum of ten feet above the 100 year historical high water table. A concept similar to a French drain will provide a capillary break between the vault and surrounding soil to further reduce the potential of perched water in the vault.

- Low Activity Waste will be disposed of in 20 below grade concrete vaults, each measuring 648 feet long by 145 feet wide by 25 feet high. Each vault will contain 12 cells which are 54 foot wide. Vaults will be constructed on poured in place concrete pads with side walls. Precast concrete girder and roof panels will support an 18 inch thick, poured in place concrete roof over each vault. The project will provide the initial vault, which will contain greater than one year capacity. Most low activity waste will be delivered in 4x4x6 foot steel boxes and will be stacked four high using an extendible boom forklift. This operation is an improvement to the current ELLT operation for low activity waste.
- Long-Lived Waste is defined as waste that has large curie quantities of long-lived, mobile isotopes that have major environmental impacts (such as Carbon-14) and less than 100 nCi/g of TRU. A typical Long-Lived waste is dewatered, spent deionizer resin. Long-lived waste will be placed by forklift on a concrete pad enclosed by a 50 by 50 by 21 foot high metal building. The project will provide the first of seven buildings. Wastes will be placed in containers to prevent the release of contamination; adequate shielding will be provided.

CURRENT HAZARDOUS AND MIXED WASTE PRACTICES

Waste is considered hazardous if it exhibits any of the characteristics of ignitability, corrosivity, reactivity, or other characteristics as defined in the Toxicity Characteristic Leaching Procedure (TCLP) as defined by the Resource Conservation and Recovery Act (RCRA) or if it is a listed hazardous waste in RCRA. Typical hazardous wastes at SRS are heavy metals and chlorinated solvents.

Non radioactive hazardous waste is stored onsite in three SCDHEC permitted storage buildings. The buildings are constructed with sloped floors, dikes, and sumps to provide adequate containment in the event of a spill. The waste storage containers are primarily 5 gallon and 55 gallon Department of Transportation (DOT) approved containers. Many of these containers are inside 83 gallon overpacks which serve as a secondary container for those containers of questionable integrity.

The site has a contract with an offsite vendor to ship some of the hazardous waste offsite for treatment and disposal. This allows the site to maintain its current capabilities of storing hazardous waste without having to add more storage facilities.

MIXED WASTES

Mixed waste as defined by EPA/ SC Hazardous Waste Management Regulations, is hazardous waste, that is also radioactively contaminated. This waste is segregated for storage in SCDHEC permitted facilities until treatment and disposal facilities are constructed.

There are two facilities which will provide treatment and disposal for the mixed waste streams at SRS. One is the Hazardous Wastes/Mixed Wastes (HW/MW) Disposal Facility Project and the other is the Consolidated Incineration Facility.

The HW/MW Disposal Facility is being designed to treat and dispose of hazardous and mixed waste. The project is divided into two stages: Stage I is the initial Disposal Vaults, and Stage II is the Treatment building. The project will provide RCRA permitted treatment and disposal for solid hazardous and mixed waste that cannot be disposed of in existing or planned facilities. This facility will also provide an option to the transport of hazardous waste offsite, for treatment and disposal.

The Treatment Building will contain equipment and processes to treat hazardous and mixed waste streams to provide a suitable waste form for disposal in the vaults.

This project is presently being reviewed to determine a new scope, schedule and cost of the project due to the EPA recommended Best Demonstrated Available Technologies (BDATS). There is also coordination between DOE-SR and DOE-HQ related to the national program for HW/MW to determine the best path forward for the project. The final design of the Hazardous/Mixed Waste Treatment Building is on hold pending DOE-HQ approval of the proposed changes.

CONSOLIDATED INCINERATION FACILITY (CIF)

In the early 1980's, the Savannah River Site had planned to build three incinerators for the disposal of on-site waste. There would have been one incinerator for radioactive solid waste, one for mixed waste, and one for benzene from the Defense Waste Processing Facility (DWPF). In 1987, a decision was made to consolidate the incineration needs into one incinerator, the CIF. At that time, several alternatives to incineration were considered. Among the alternatives that were considered were supercritical water oxidation, steam gasification detoxifier, chemical neutralization/oxidation, and plasma arc pyrolysis. Incineration was chosen as the preferred and best available technology primarily because the other processes were in the developmental stage or had not been used in large scale operations.

Although the EPA had not issued the Resource Conservation and Recovery Act (RCRA) treatment standards in 1987, the re-authorization of RCRA in 1984 required that hazardous waste treatment facilities be in place by May 1990. This resulted in an expedited design and procurement schedule for CIF. EPA did promulgate the treatment standards in 1990 and granted two one-year national capacity variances, which moved the need date for operation to May 1992. SRS negotiated with EPA and signed a Federal Facility

Compliance Agreement (FFCA) allowing construction to start on the CIF within 90 days of receipt of the RCRA Part B permit and operation to begin within 39 months of receipt of the permit. The RCRA Part B permit application was submitted to SCDHEC in August 1988, but was not approved and effective until November 1992. During this time, the new regulations of 1990 had to be factored into the permit process. Public hearings were held on the permit application with very few adverse comments received, all of which were resolved prior to permit approval. A proactive approach on the public participation/public comment process resulted in a timely issuance of the permit once it was placed on notice for public comment.

The NEPA process took a similar path in processing for CIF. The determination was made in 1988 that an Environmental Assessment (EA) was the appropriate documentation of environmental impacts for CIF. The draft EA was prepared and submitted to DOE-HQ in August 1988. The EA was approved and a draft Finding Of No Significant Impact (FONSI) was placed in the Federal Register in July 1992. The FONSI was finally issued in December 1992. All the final permits for air, water, and NESHAPS had also been received by this time. Due to the urgent need for waste treatment and disposal facilities under RCRA, the CIF final design was completed and procurement was over 90 percent completed during this lengthly permit and environmental impact assessment process. The finalization of design and procurement of equipment has given SRS a head start on this project which allowed construction to start on schedule and will help to meet our future FFCA commitment for operation.

The Deputy Secretary of Energy, through DOE's Key Decision process for Major System Acquisitions, granted approval to start construction in December 1992. The fixed price contract for construction of CIF has been awarded and construction started in January of this year, in order to meet our FFCA commitment of starting construction within 90 days of receipt of the RCRA Part B permit. The construction schedule is such that SRS plans to complete construction, complete the trial burn, and be in final operation of the CIF by the FFCA commitment date of 39 months from receipt of the Part B permit.

The CIF is designed to treat low level radioactive, hazardous and mixed wastes. The wastes to be treated will include wastes defined as hazardous by South Carolina Hazardous Waste Management Regulations and federal RCRA Regulations, wastes contaminated with low levels of beta-gamma radioactivity, and mixed wastes that are both hazardous and low level radioactive. The facility will not treat wastes containing dioxins or PCBs.

Facilities to be provided on the CIF project consist of a main process building that includes an area for boxed waste handling, a rotary kiln incinerating system which utilizes a primary and secondary combustion chamber, incinerator ash removal and off-gas cleaning system, control room and necessary support facilities. The rotary kiln primary combustion chamber will be used for the incineration of solids and various organic and aqueous liquid wastes. A secondary combustion chamber will also incinerate organic solvent wastes as well as destroy any remaining traces of hazardous constituents in the rotary kiln off-gas. Off-gas exiting the secondary combustion chamber will be cooled and treated by a wet off-gas treatment system. Pollutants below regulatory limits in the off-gas are discharged to the atmosphere.

The liquid waste blowdown stream from the off-gas system will be stabilized and disposed of in the HW/MW Disposal Facility vaults, which will be similar to the low activity waste vaults. An area is provided for installation of a facility to provide a solidification process for incinerator ash. This ash will be solidified in the interim by a vendor. The CIF is scheduled to begin operation in the first quarter of 1995.

CURRENT TRANSURANIC (TRU) WASTE PRACTICES

TRU waste is defined as waste consisting of elements with an atomic number greater than 92 or with alpha emitting TRU radionuclides with half lives greater than 20 years and concentrations greater than 100 nCi/g of waste at the time of assay.

TRU waste was originally buried in plastic bags and cardboard boxes in earthen trenches designated specifically for this waste. Beginning in 1965, TRU waste was segregated according to content. Waste containing equal or greater than 0.1 Ci per package was placed in prefabricated concrete containers and then buried. These retrievable containers are 6 feet in diameter by 6.5 feet high. Waste that did not fit into prefabricated concrete containers was encapsulated in concrete. TRU waste from Savannah River Technical Center (SRTC) was buried in cubical concrete containers. Waste containing less than 0.1 Ci per package was buried in trenches designed for alpha waste.

Currently, all suspect TRU waste containers are being stored on concrete pads. Containers are normally 55 gallon drums, but boxes of larger size may be used to contain bulky items. Per DOE-SR Order 5820.2A, the lower concentration limit for TRU waste is greater than 100 nCi/g. SRS continues to store alpha waste contaminated in the 10 nCi/g to 100 nCi/g range as TRU waste until site specific radiological performance assessment defines disposition options.

TRU wastes contaminated to levels less than 0.5 Ci/drum are stored and protected from contact with water in containers that can be retrieved intact for at least twenty years from the time of storage. Drums containing waste contaminated greater than 10 nCi/g and less than 0.5 Ci are placed directly on RCRA permitted concrete pads. Drums containing greater than 0.5 Ci are stored inside concrete culverts on concrete pads. In the past, containers were stored on concrete pads and covered with four feet of earth. To reduce retrieval costs, SRS is no longer covering the filled pads with a soil overburden.

Recent changes to the TRU waste storage facilities include construction of four additional TRU waste storage pads and the installation of protective structures over TRU pads where vented waste containers are stored. The additional storage pads were necessary to provide additional storage, due to the delayed start of Waste Isolation Pilot Plant (WIPP). Protective structures are being added to prevent rainwater intrusion into vented TRU waste containers currently stored on the pads.

Practically all of the TRU waste placed on the TRU waste storage pads prior to January 1990 is suspected to be co-contaminated with hazardous constituents. This mixed waste is currently being stored under EPA interim status and in accordance with SCDHEC regulations.

EXPERIMENTAL TRU WASTE ASSAY FACILITY (ETWAF)

Beginning in April 1986, all newly generated TRU waste was received into the ETWAF. In the ETWAF, drums are first weighed and assayed using the TRU Waste Assay System to determine whether the waste is contaminated to a level greater than 100 nCi/g and also to determine other information required by the WIPP-Waste Acceptance Criteria (WAC). Drums containing less than 100 nCi/g are segregated and will be managed in accordance with the radiological performance assessment. Drums greater than 100 nCi/g are then x-rayed to verify that contents meet the WIPP-WAC. Contents of each drum are recorded on videotape, and the results of the x-ray are also recorded.

FUTURE TRU WASTE FACILITY (TWF) PROJECT

The TWF, an FY 1990 line item, will provide facilities to retrieve and process TRU waste and prepare it for certification and permanent disposal at the WIPP facility.

A phased approach was developed, allowing for retrieval of drums nominally less than 0.5 Ci/drum nearing their 20 year retrievable life expectancy starting in 1995. This approach will also provide for facilities to be designed and constructed in conjunction with testing programs at WIPP to be carried out through 1996 or 1997. The Low Activity TRU Facility (LATF) will provide characterization, sorting, and segregating of the less than 0.5 curie drum wastes for future shipment. A future facility, High Activity TRU Facility (HATF) (a forecasted FY 1998 line item), will provide for retrieval of the rest of the retrievably stored wastes greater than 0.5 curies/drum, perform some of the same tasks mentioned above, but in addition, provide a final waste form treatment such as Vitrification and stabilization, if required, to meet transportation and future WIPP or other federal repository criteria. Currently, Title 1 design for both parts of Phase 1 is about to begin.

Due to the delays in startup of WIPP, phase 1 retrieval will include the installation of a weather enclosure over the specific pad being worked. A telescoping excavator will remove the soil to within six inches of the drums. A high efficiency particulate air filter (HEPA) filtered vacuum truck will remove the remaining soil from around the containers. A specially designed lifting device, which encapsulates the drum, will be used to lift and remove the drums from the stack. The drum will then be placed into an over pack, moved into a portable HEPA filtered containment facility where the drum will be punctured, using a special remote device. The head space will be sampled for volatile organic compound (VOC) concentration, and purged to provide an inert atmosphere, then fitted with a special carbon composite filter. The overpack will then be fitted with a lid and removed to new storage.

The second part of Phase 1, a Low Activity TRU Facility (LATF) will be constructed to process the retrieved drums in addition to those already in above ground storage. Drums will be received at the facility and placed into an airlock, where they will be routed to an assay system, and the radioactive isotope and concentration will be determined. This assay will verify whether or not the drum is low level or TRU waste which will determine future processing. Drums which qualify as TRU waste will be x-rayed and then moved into a processing cell where they will be opened. The contents will be segregated, characterized, sorted, and repackaged for removal from the facility. All waste will leave the facility through bagless transfer ports, either drums or WIPP waste boxes.

Phase II of the project will be defined in a new line item which will provide the capability to treat the High Activity Waste (HAW) drums, boxes, etc., for shipment to WIPP or another repository. This treatment activity will be designed after WIPP startup testing is completed and a better understanding of the requirements for the HAW stream is achieved.

SANITARY WASTE

SRS operates its own sanitary waste landfill, where all Savannah River sanitary waste is sent for disposal. At present, Savannah River generates approximately 900 cubic feet of sanitary wastes per day. Waste minimization efforts and proposed paper recycling will further reduce this number. The method of disposal being used is the trench method which will be discontinued upon completion of the interim landfill, currently projected to occur by the end of January 1993.

New methods in waste handling and disposal are being implemented to extend the life of the interim sanitary landfill expansion. The technology that will be used is the pit method, which has been developed, tested, implemented, and proved at landfills throughout the country in a variety of topographies and geologic formations. A weigh scale system will be used to better determine how much waste is being disposed in the landfill, and to determine the success of site waste minimization efforts. This landfill will provide disposal capacity for the site until 1997, when the new sanitary landfill will be completed.

Future Sanitary Landfill Facility

The New Sanitary Landfill will provide a 20 year capacity for sanitary waste disposal in accordance with rigorous federal and SCDHEC requirements and is in the process of site characterization at present. This landfill will incorporate a synthetic liner and leachate collection system to satisfy the new requirements of RCRA Part D and SC Solid Waste Management Act of 1991. A performance assessment system will monitor for leaks in the liner.

CONCLUSION

The Site Waste Management Organizations at Savannah River are continually monitoring changes in regulatory requirements and developing technologies to determine possible impacts to project scope or schedule which have the potential to affect project costs. Also, the Waste Management Organizations are in the process of establishing a group which will review and prioritize future projects and the proposed technologies which will be used for each. This group will be called the Technology Review Board, and will consist of the Assistant Manager for the DOE Site Waste Management Organization and senior WSRC management.

This group will review the sites needs and proposed projects, and then choose the strategy which will best meet the sites needs and one that also meshes with the national programs across the DOE complex.