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PROGRAM FOR LOW-LEVEL RADIOACTIVE WASTE DISPOSAL AT THE SAVANNAH RIVER SITE, A U.S. NUCLEAR MATERIALS PRODUCTION FACILITY

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ABSTRACT

An integrated program has been developed for disposal of low-level radioactive wastes and associated mixed (radioactive-hazardous) and transuranic (TRU) wastes generated at the Savannah River Site (SRS). The program, supported by existing as well as new planned facilities, features a systems management approach, in which final disposal sites are specially designed and constructed for appropriately segregated waste streams, and intermediate treatment facilities are provided to reduce volumes and convert wastes to stable forms prior to disposal. Currently-existing shallow land burial facilities are comprehensively monitored for release of contaminants to underlying groundwaters, with only short-lived tritium exhibiting significant migration. Transport modeling is employed to define closure procedures capable of preventing long-term contamination. New facilities to be provided for disposal of the low-level radioactive wastes feature concrete-stabilized wasteforms contained within vault structures that are capable of restricting releases including tritium and other radionuclides to acceptably low levels. Future development studies will center around waste minimization initiatives.

INTRODUCTION

Planning for low-level radioactive waste management at the Savannah River Site (SRS) encompasses strategies for disposal of a wide variety of solid and liquid wastes in ways that ensure compliance with applicable Federal, State, and Department of Energy (DOE) regulations designed to avoid deleterious health and environmental effects (1). The general objectives of these strategies are as follows:

1. Minimize waste generation and promote waste recycle to the extent practical.

2. Segregate wastes according to type, hazard level, and disposal method.

3. Reduce waste volumes by incineration and compaction, and convert wastes to stable form for disposal.

4. Package, store, and dispose of wastes in appropriately designed, constructed, and monitored facilities.

The purpose of this report is to outline programs developed to meet these objectives at SRS (2).

Regulatory Requirements

Comprehensive guidelines for management of radioactive wastes at U.S. Nuclear Materials Production sites are provided in a recently-issued DOE Order (3). The order prescribes uniform policies for management of DOE low-level wastes that are designed to protect the health and safety of the public, preserve the environment of the waste management facilities, and ensure no legacy requiring remedial action remains after site operations have been terminated. Disposal of the DOE wastes is not regulated in accord with A, B, and C classifications prescribed for civilian low-level wastes, although the Class C waste characteristics define the upper limits for DOE low-level wastes. The DOE wastes must be managed using appropriate combinations of waste generation reduction, segregation, treatment and disposal practices to meet specified performance objectives. Systems analyses are prescribed to achieve maximum cost effectiveness. Where practical, the wastes should be disposed of on the site at which they are generated. Disposal of wastes that contain also hazardous components (mixed wastes) must conform to requirements of the Resource Conservation and Recovery Act (RCRA), as well as the DOE Order.

Performance objectives specified require that external exposures and concentrations of radioactive materials released to the environment in surface and groundwaters, air, soil, plants, and animals do not result in committed effective dose equivalents that exceed 25 mrem/yr to any member of the public, or 100 mrem/yr continuous exposure or 500 mrem for a single acute exposure to an inadvertent intruder. Degradation of groundwater resources must be prevented consistent with Federal, State, and local requirements. This is interpreted as conformance with drinking water standards for radionuclides limiting exposures to less than 4 mrem/yr(4). Site-specific performance assessments are required to demonstrate compliance with these objectives, to support the overall combination of waste management practices used, and to monitor actual disposal site performance.

SRS Waste Management Plan

The SRS plan for management of low-level radioactive and related mixed and transuranic (TRU) wastes accommodates a broad range of waste streams and disposal strategies. An outline of the plan is given in Figure 1, illustrating processes and facilities currently employed as well as those projected for future operation. Wastes categorized generally as low and intermediate activity solid wastes, aqueous sludges and concentrates, mixed radioactive and hazardous wastes, and TRU wastes are processed through intermediate storage and treatment facilities and sent to final disposal in appropriate burial grounds, vaults, and repositories. The waste treatment and disposal facilities depend on the types and quantities of waste generated in each category. Typical examples of radioactive and mixed wastes requiring disposal include contaminated equipment, reactor hardware and resins, spent lithium-aluminum targets, contaminated oil, scintillation fluid, mercury from gas pumps, cadmium from control rods and neutron shields, and job control waste from laboratory and production operations.

Current and planned programs for disposal of such radioactive and mixed wastes are outlined in this paper. Disposal of the alpha radioactive (TRU) waste is presented only for that part less than 100 nCi/g that is consigned as low-level waste to onsite facilities; the higher activity TRU wastes (>100 nCi/g) will be transported offsite for geologic disposal in the Waste Isolation Pilot Plant (WIPP). Plans for similar offsite disposal of the SRS high-level radioactive wastes in conjunction with commercial high-level wastes in a Federal repository are presented elsewhere.

EXISTING DISPOSAL FACILITIES

Shallow Land Burial

In past and current practices, low-level radioactive solids have been consigned to shallow land burial (2,5). Two sites designated "old" and "new" burial grounds have been utilized for shallow land burial at SRS. The old burial ground occupying 308,000 m^2 (76 acres) was used to dispose of radioactive solid waste produced at the site from 1952 to 1974, as well as some shipments from other USDOE facilities. The new burial ground occupying 482,000 m^2 (119 acres) was put into service in 1972 and is currently operating.

From 1952 to 1986 the burial grounds have received 430,000 m^3 of low-level wastes, containing more than 10,000,000 Ci of radioactivity (currently 3,000,000 Ci). A radionuclide inventory of wastes buried nonretrievably is shown in Table 1. Wastes of various types and radioactivity levels have been placed in different sections of the burial grounds, as illustrated in Figure 2. Beta-gamma radioactive wastes of low (<300 mR/hr at 7.6 cm) and intermediate (>300 mR/hr at 7.6 cm) radioactivity levels and alpha radioactive wastes were buried in separate trenches.

Until 1965 the alpha radioactive wastes contained in plastic bags and cardboard boxes were buried like other wastes. Between 1965 and 1974 the alpha radioactive wastes were segregated by activity level; wastes containing less than 0.1 Ci per package were placed in shallow land burial and the remainder was retrievably stored in concrete containers in the trenches. Since 1974, TRU wastes contaminated with greater than 10 nCi/g have been stored in the burial grounds within galvanized drums and concrete containers that can be retrieved intact for at least 20 years from the time of storage. Transuranic wastes contaminated with less than 10 nCi/g are designated low-level alpha wastes and are buried in the same trenches as the other low level wastes.

Radioactive wastes that also contain hazardous inorganic substances, such as mercury, lead, cadmium, degraded solvents, and tritiated pump oils, have also been placed in shallow land burial. In current practice the organic fluids are stored in underground tanks awaiting incineration. Disposal of hazardous substances in the shallow land burial trenches has been discontinued since 1985, and newly-generated solid mixed wastes are temporarily stored in a building permitted by State authorities pending final disposal in a new facility. A 235,000-m^2 (58-acre) area within the new shallow land burial ground containing previously buried mixed wastes has been designated the Mixed Waste Management Facility (MWMF) and scheduled for closure in the near future (5).

Greater Confinement Disposal

A modified form of near-surface burial is provided by Greater Confinement Disposal (GCD) employing natural and engineered barriers to afford a greater degree of waste isolation than the shallow land burial trenches (6). The GCD concept features deeper burial to minimize water, plant root, animal, and future human intrusion, stabilized waste forms to prevent subsidence leading to ponding of surface waters, and low-permeability caps to reduce water infiltration. The GCD concepts are generally employed for disposal of the higher activity fractions of low-level wastes.

The two types of GCD facilities in use at SRS utilize boreholes and trench designs, as shown in Figure 3. The borehole design features a 2.1-m (7-ft) diameter, 6.1-m (20-ft) length, vertical cylindrical cavity with a 1.5-cm (1/2-in.)-thick fiberglass liner. The liner is stabilized by a 0.3-in.-thick concrete layer on the outside, grout is poured around all the waste on the inside, and a 0.3-in.-thick concrete layer is placed over the waste. Twenty boreholes are in service in the shallow land burial grounds located within the GCD area shown in Figure 2.

The GCD trench facility provides four concrete-lined cells, each 23-m (75-ft) by 15-m (50-ft) and 6-m (20-ft) deep situated typically 9 m (30 ft) below ground surface. The cells are fitted with a rain-tight cover during waste loading. Waste is emplaced in the cells about 0.3 m (1 ft) from the walls, and the intervening space filled with grout. Total waste volume provided in one GCD trench is about 2,800 m^3 (100,000 ft^3), equivalent to 2 years accumulation of GCD-type waste. The trench design is used principally for emplacement of high activity waste-forms too large for the GCD boreholes.

Performance Assessments

The performance of the shallow land burial sites is monitored by a series of groundwater wells situated throughout and around the perimeters of the sites. The wells penetrate to about 15 m (50 ft) below the surface with access centered at the water table. Well water is monitored for gross alpha radiation, gross nonvolatile beta radiation, tritium and selected other radionuclides, and some chemically toxic elements.

The monitoring results indicate that, except for tritium, the buried wastes have not migrated in significant quantities to the groundwater (7). Except for an anomalously high well that penetrates a disposal trench, only small quantities of alpha and nonvolatile beta radioactivities are detected after 30 years of disposal site operation. Tritium, in contrast, is readily released from the wastes and is present as a plume in the groundwater representing 1 to 2% (40,000 Ci) of the buried waste inventory. Maximum concentrations of the short-lived (12 years) radionuclide in the monitoring wells range up to about 1,000,000 pCi/L and average about 90,000 pCi/L, which is approximately the same as the drinking water limit. The drinking water limit serves as a reference value only, since institutional controls preclude the use of the burial ground water as a drinking water source. Small quantities of tritium have migrated about 1,000 ft to a downgradient outcrop.

Because of strong sorption on soils, no significant migration of plutonium to the groundwater is expected. Maximum plutonium-239 levels somewhat above drinking water limits in two monitoring wells are attributed to a plutonium contaminated spill in the 1960's. Excluding the anomalous wells, average plutonium-239 levels are much lower than drinking water limits, and the plutonium-238 levels are similarly low. No significant quantities of uranium nuclides or neptunium-137 are detected.

The beta radionuclide strontium-90 is detected at average concentrations below drinking water limits, except for one well anomalously above this value. All gamma radionuclides, including cesium-137 and cobalt-60, are below detection levels. Cesium strongly sorbed on soil is not expected to have reached the groundwater, and the absence of cobalt-60 may be related to its short (5 years) half-life.

The long-lived, beta-gamma-emitting radionuclides carbon-14 (half-life 5,700 yr), technetium-99 (half-life 200,000 yr), and iodine-129 (half-life 16 million yr) are of concern because of their high mobility in soil. Limited sampling indicates C-14, present in the burial ground in an estimated inventory of 6,800 Ci, is at levels in groundwater still substantially below drinking water limits. Tc-99, with a relatively small inventory (about 20 Ci) in the burial ground, is observed only infrequently above detection limits and at very low levels compared to drinking water limits in burial ground waters. I-129, present in the burial ground in very low solubility form as silver-iodide coated beryl saddles, is not measured above detection levels in the groundwaters.

Nonradioactive but chemically hazardous species monitored in the groundwater wells include mercury (inventory 10,000 kg), lead (inventory 100,000 kg), and cadmium (inventory 2,000 kg). Mercury concentrations observed are generally minor, with only one well exceeding the drinking water limit. Maximum measured levels for lead and cadmium exceed drinking water limits in wells within the burial grounds, but are below those limits in perimeter wells. Preliminary studies indicate that several organic substances related to the waste oil, spent solvents, and scintillation fluids stored in the buried grounds may also be present in the monitoring well waters.

Closure Requirements

Closure requirements for SRS waste disposal facilities are projected using transport models to predict long-term exposures to radioactive and chemically hazardous wastes released from the facilities for various closure options. The limiting pathway for shallow land burial sites is generally found to be associated with infiltrating rainwater that carries the waste contaminant into the groundwater system. Closure caps that limit infiltrating rainwater are therefore featured in the closure options. Satisfactory performance is achieved by designs that limit contamination of groundwaters to those permitted by EPA drinking water standards.

Releases of radionuclide contaminants from the SRS burial grounds have been modeled for two waste fractions, including (1) a minor highly-mobile component that reaches the groundwater prior to closure; and (2) a major component with slower transport mobility. Only the slowly migrating contaminants, which may reach peak groundwater concentrations after several thousand years, depend on the closure option considered. The results of the modeling for the slowly migrating contaminants indicate that highly effective clay caps are required for satisfactory closure of the SRP shallow land burial sites.

Without a clay cap [only 4.6-m (15-ft) soil cover] provided during closure, contaminants including tritium, U-238, Np-237, and Pu-239 are projected in concentrations exceeding drinking water standards. Provision of a clay cap restricting water to a less than 0.02 m/yr infiltration rate greatly reduces projected doses from these radionuclides, and in conjunction with recovery of retrievable TRU wastes, provides a satisfactory closure that ensures no significant contamination of burial ground waters. Modification of the clay cap to include impermeable double liners and leachate pumping systems or multiple concrete/clay configurations will provide only limited additional protection, because of the relatively short life assumed for these modifications compared with the time of peak contaminant exposures.

Based on the waste transport modeling, closure plans have been developed for both SRP shallow land burial sites. For the old burial ground, a program of waste removal, stabilization, and capping is planned (8). Retrievably-stored TRU waste will be exhumed, grid wells will be closed, and emptied solvent tanks will be stabilized in place by filling with cement grout.

A closure cap consisting of native soil, low permeability clay, and gravel will be emplaced on the old burial ground site. A schematic design of the cap is shown in Figure 4. A program of groundwater surveillance using perimeter wells will monitor closure performance. Site surveillance and monitoring will be carried out over a 100-yr period of institutional control.

The MWMF portion of the new burial ground will be closed in a similar fashion, except dynamic compaction will be utilized to minimize potential subsidence of this more recently utilized burial site (9). Dynamic compaction is achieved by dropping a known weight from a specific height onto the waste trenches to reduce void space.

NEW DISPOSAL FACILITIES

New Low-Level Waste Disposal Facility

A new solid waste disposal facility incorporating state-of-the-art containment features has been designed to replace the existing shallow land burial trenches (2,10). The new facility features below-grade concrete vaults to provide the degree of groundwater protection required by the new DOE Orders. The low-level wastes will be consigned to the new facility in accord with classifications designated (1) tritium-contaminated waste; (2) long-lived (>30 yr half-life) beta-gamma waste; and (3) other low-level radioactive waste. The tritium wastes will be stored for at least 120-yr to permit decay (about 10 half-lives) before final disposal. The long-lived wastes will be stored indefinitely until a final disposal method, such as geologic disposal, is developed. The remaining low-level wastes will be committed to final disposal in the below-grade vaults.

The below-grade vaults will be subdivided into cells as needed to provide structural stability and operational flexibility and will be designed specifically for wastes that are not self supporting. They will be constructed of air-entrained concrete comprised of equal proportions of Portland cement and Grade 120 slag. The slag cement has been demonstrated capable of retarding migration of reducible waste species such as Tc^{+7}.

Final closure of the vaults will proceed as each unit is filled. A concrete top designed to shed rainwater and withstand closure stresses will be emplaced on the vault and covered with natural materials such as soil, clay, and gravel to a minimum depth of 5 m (16 ft). Groundwater monitoring wells will be provided at the site perimeter. Institutional control of the site is expected for 100 yr after closure.

For the wastes requiring interim storage prior to final disposal, two types of facilities are provided. Tritiated wastes will be stored in above-grade concrete vaults. Final closure of these vaults will not begin until after the 120-yr decay period, during which time the performance of the vaults will be monitored by perimeter wells. If vault leaks are detected, the tritiated wastes can be recovered and relocated before major groundwater contamination occurs. The long-lived, beta-gamma wastes will be stored above grade in a metal building on a concrete pad, awaiting appropriate final disposal.

Saltstone Facility

Concentrated liquid wastes and sludges will be disposed of as a stabilized concrete form called saltstone. The Saltstone Facility, originally developed for immobilization of decontaminated salt solutions produced during processing of SRS high-level nuclear wastes (11), is being extended to accommodate similar low-level waste streams. Two types of Saltstone Facility are currently projected: one for low-level wastes, and one for mixed wastes. In each case the aqueous wastes mixed with immobilizing additives will be poured as grout into large concrete vaults. Wastes currently designated for disposal in the Saltstone Facilities will include, besides the decontaminated salt solution from high-level waste processing, the uranium-containing sludges and solutions from several fuel fabrication operations, aqueous concentrates from liquid waste treatment facilities, and possibly the low-level waste ashes resulting from intermediate incineration operations.

Containment principles governing design of all new SRS waste disposal facilities were evolved in the course of the Saltstone Facility development. The facility features a series of near-surface concrete vaults, illustrated in Figure 5, which serve as forms for the cast saltstone and provide a diffusive barrier to the environment. A slag-based saltstone formulation, consisting of 25 wt % slag, 25 wt % Class F fly ash, and 4% hydrated lime or Portland cement mixed with the alkaline salt solution is poured as grout into the vaults. Slag is also substituted for 40% of the cement in the vault concrete mix. The vaults are sized to contain about one year's saltstone generation (43,000 m^3). On decommissioning, clay caps will be placed over the vaults, and drainage systems installed between the caps to reduce the volumes of rainwater infiltrating the disposal site.

Performance criteria imposed on the saltstone facility design require groundwater quality at the disposal site boundary meet drinking water standards. Performance modeling validated by field tests of saltstone lysimeters have demonstrated the capability of the Saltstone Facility to meet these standards (11). Improved retention of Tc-99 and chromium in the slag saltstone results from their chemical reduction by ferrous iron (Fe^{+2}); decreased leaching of nitrates is attributed to the finer pore structure of the slag mix compared to a standard cement mix (12).

Hazardous Waste/Mixed Waste Disposal Facility

Mixed wastes containing hazardous as well as radioactive materials generated at SRS will be consigned to final disposal in a special facility conforming to RCRA requirements. The Hazardous Waste/Mixed Waste Disposal Facility (HW/MWDF) has been proposed for final disposal of the solid hazardous and mixed wastes presently in temporary storage, as well as those generated in the future (13). By the end of 1990, about 2,000 m^3 of such wastes awaiting treatment and disposal will have been accumulated, and new mixed waste will be generated at a projected rate of 376 m^3/yr.

Examples of these wastes are radioactively-contaminated equipment, lead shielding, contaminated soil, spent filters and resins, and certain incinerator ashes.

The HW/MWDF will consist of a series of above-grade, reinforced concrete vaults illustrated in Figure 6, each of which will contain about 20 months' waste generation. An initial six vaults will allow disposal of the accumulated waste in storage at startup plus 30 yr of projected waste generation. Additional disposal vaults will be constructed as needed.

Each vault of the HW/MWDF will contain double liners and a leachate collection system. Wastes in metal containers will be emplaced by mobile gantry crane. Grout may be added between rows of containers as needed to minimize radiation exposure and provide waste stabilization. Upon closure, cast reinforced concrete cover will be emplaced on the vaults and covered with low permeability caps and vegetation covers.

INTERMEDIATE TREATMENT FACILITIES

Final disposal of SRS low-level radioactive and mixed wastes will be supported by intermediate waste treatments designed to incinerate combustible materials and to size-reduce, compact, and stabilize other solid forms in suitable disposal packages.

Consolidated Incinerator Facility

Development of a full-scale incinerator is in progress for volume reduction and detoxification of SRS low-level, mixed, and hazardous wastes (14). Wastes to be burned include drummed liquids, sludges, and solids, and boxed job control wastes. Up to 1,000 m^3/yr of liquid wastes and 16,000 m^3/yr of solid waste will be processed. Incinerator ash and offgas scrubber blowdown will be immobilized in concrete form. The reduction in volume of original waste will be about 22 to 1.

The incineration system will consist of a rotary kiln primary combustion chamber followed by a tangentially-fired cylindrical secondary combustion chamber with the system designed to process up to 11 metric tons per day of solid and liquid waste. Under operating conditions, the wastes will be fired at 980°C and 100% excess air minimum in the rotary kiln and 1,100°C and 80% excess air minimum at the secondary chamber exit. Minimum retention time in the kiln is 90 minutes and minimum gas retention time in the secondary chamber is 2 seconds downstream of the high intensity waste burner.

Solid waste packaged in combustible containers will be fed to the kiln chamber by a ram system. High ash liquids will be fed to the primary chamber through a burner nozzle and low ash (high heat) liquids will be fed to the secondary combustion chamber through a high intensity vortex burner. The combustion gases exiting the secondary chamber will be cooled to saturation in a spray quench, then passed through a cyclone separator, mist eliminator, HEPA filtration, and induced draft blowers before release to the atmosphere. Ash from the kiln will be deposited into 208-L (55-gal) drums and mixed with cement and water by tumbling, to produce a stabilized waste product for final disposal in the Saltstone Facility. Blowdown water will be filtered to concentrate suspended solids and the concentrate transferred as an aqueous sludge for final disposal in the Saltstone Facility.

Waste Preparation Facility

Wastes not suitable for incineration will be processed through a waste preparation facility for size reduction, compaction, and stabilization prior to disposal. This facility is being designed principally for large pieces of contaminated equipment, such as piping, jumpers, ducting, scaffolding, glove boxes, tools, scrap metal, tanks, motors, pumps, and vehicles that can be effectively size-reduced to maximize the utilization of limited burial facility space. An overall volume reduction of 5 to 1 is projected. Increasing usage of this facility to reduce volumes of decommissioning wastes generated in future operations is anticipated. Drummed alpha radioactive waste not sent to WIPP will be processed through the Waste Preparation Facility for stabilization prior to onsite disposal as low-level waste. Capacity of the facility will be 5,660 m^3/yr, expandable to higher quantities of decommissioning waste in the future. The size-reduced waste will be sent to either the New Radioactive Waste Disposal Facility or the Hazardous/Mixed Waste Disposal Facility.

The Waste Preparation Facility will feature a disassembly cell supported by stabilization, storage, and shipping areas. Contaminated items will be size-reduced in the disassembly cell, equipped with a circular saw, a shearing machine, plasma-arc torches, a waste shredder, and a supercompactor. The size-reduced wastes packaged in concrete containers will be stabilized by injecting concrete grout, in preparation for final disposal. The steel-lined concrete cells of the facility will be housed in a sheet metal fabricated building that provides appropriate ventilation services.

Transuranic Waste Facility

The Transuranic Waste Facility (TWF), operated in conjunction with a Waste Certification Facility (WCF), will have equipment required to process TRU waste for permanent disposal at the Waste Isolation Pilot Plant in New Mexico. TRU waste containers retrieved from storage at the waste burial ground will be vented, purged, x-rayed, assayed, and repackaged for shipment. The facility will provide capability for size reduction of large waste not suitable for shipment in standard containers and for solidification of liquids, resins, and sludges. The retrieved wastes in conjunction with newly-generated TRU wastes will be certified to meet WIPP waste acceptance criteria and packaged for shipment in the WCF (15). Wastes containing less than 100 nCi/g TRU will be processed through the Waste Preparation Facility for stabilization in containers prior to onsite disposal as low-level alpha wastes.

WASTE MINIMIZATION PROGRAM

Future initiatives in the SRP low-level radioactive waste program will emphasize waste minimization objectives of DOE policy (16). Methods for waste minimization to be utilized include:

- Waste reduction or elimination at the source including process modifications and substitution of alternative process materials to reduce wastes and optimize product output.
- Waste volume reduction after generation, including segregation of nonradioactive and nontoxic materials.
- Waste treatment and stabilization, including recycling and reuse.
- Delisting of materials to remove them from the RCRA hazardous chemical list, by demonstration that waste is nonhazardous, and reclassification to certify certain wastes generated as nonradioactive.
- Awareness training, to educate workers in waste minimization opportunities.

The site strategy is to identify and inventory all site waste streams, select candidate streams for reductions based on regulatory requirements and cost effectiveness considerations, implement facility specific reduction programs, and monitor progress. The waste minimization activities will be supported by development of computerized waste stream tracking systems to monitor waste generation rate reduction on a unit production basis.

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TABLE 1

Radionuclide Inventory from 1952 through 1985 for Waste Buried in Trenches in SRS Burial Grounds

Radionuclide	Volume (m^3)	Amount Buried (Ci) Original	Decayed
^{3}H	24,000	4,090,000	1,830,000
Fission products	266,000	711,000	18,729
Induced activity	30,800	3,410,000	348,000
^{60}Co	4,920	1,110,000	413,000
^{137}Cs	-	-	~10,000
^{90}Sr	-	-	~10,000
^{238}Pu	15,381	4,040	3,530
^{239}Pu	26,900	600	600
^{244}Cm	6,910	4,850	3,050
Other alpha emitters	54,200	151.8	145.8

Other alpha composition (percent by original activity)

^{233}U	1.2
Depleted U	38.2
Enriched U	36.3
Natural U	4.2
^{242}Pu	0.002
^{241}Am	4.1
^{252}Cf	15.8
^{237}Np	0.1
^{232}Th	0.04

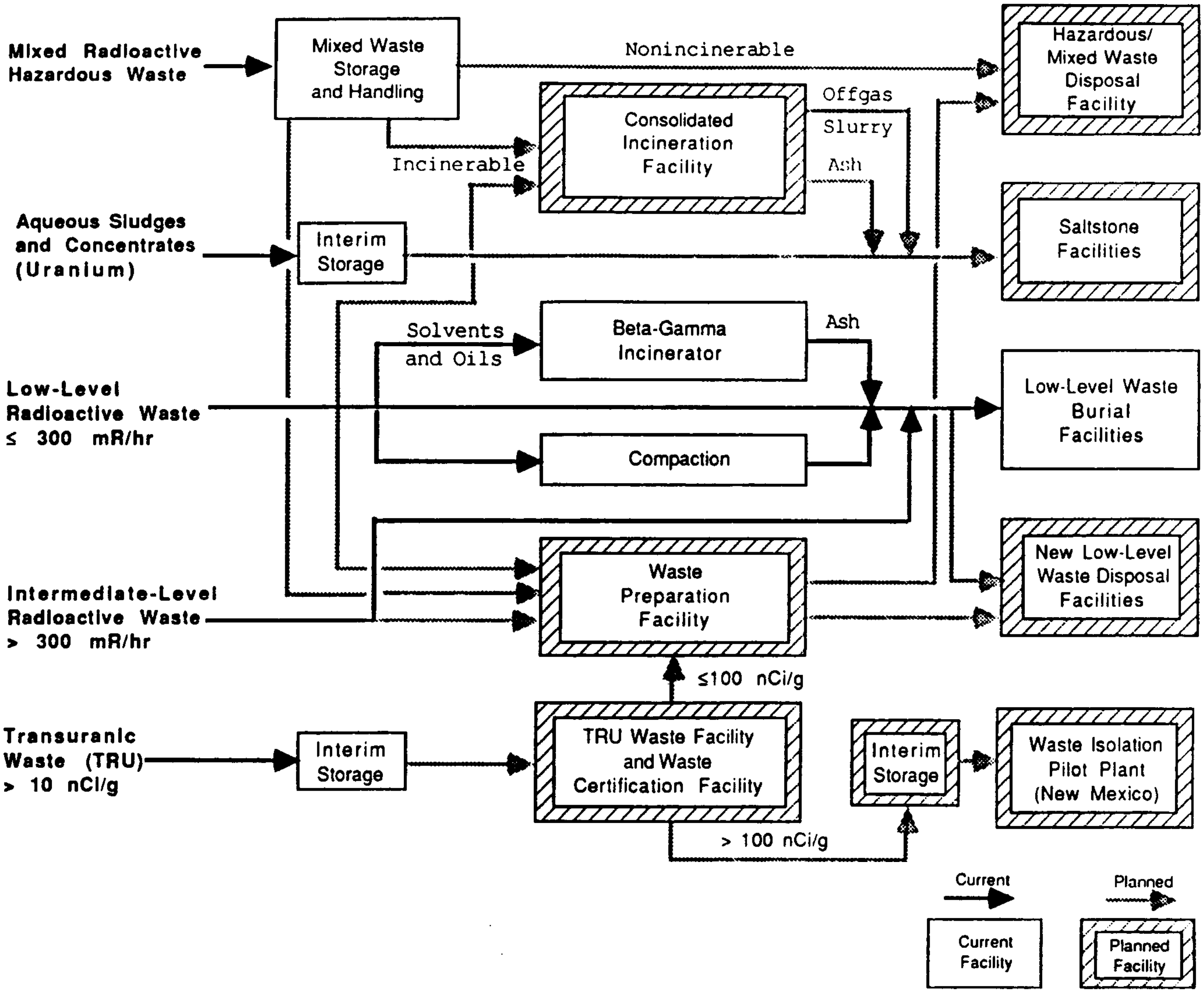


Fig. 1 Savannah River Site Solid Low-Level Waste Management Plan

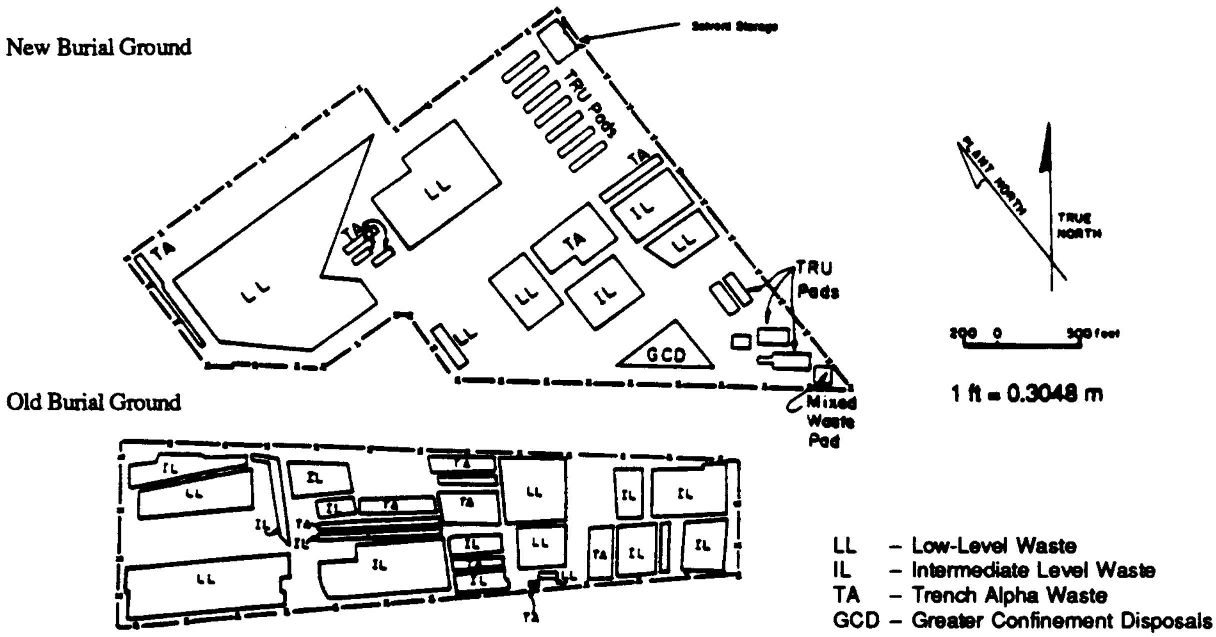
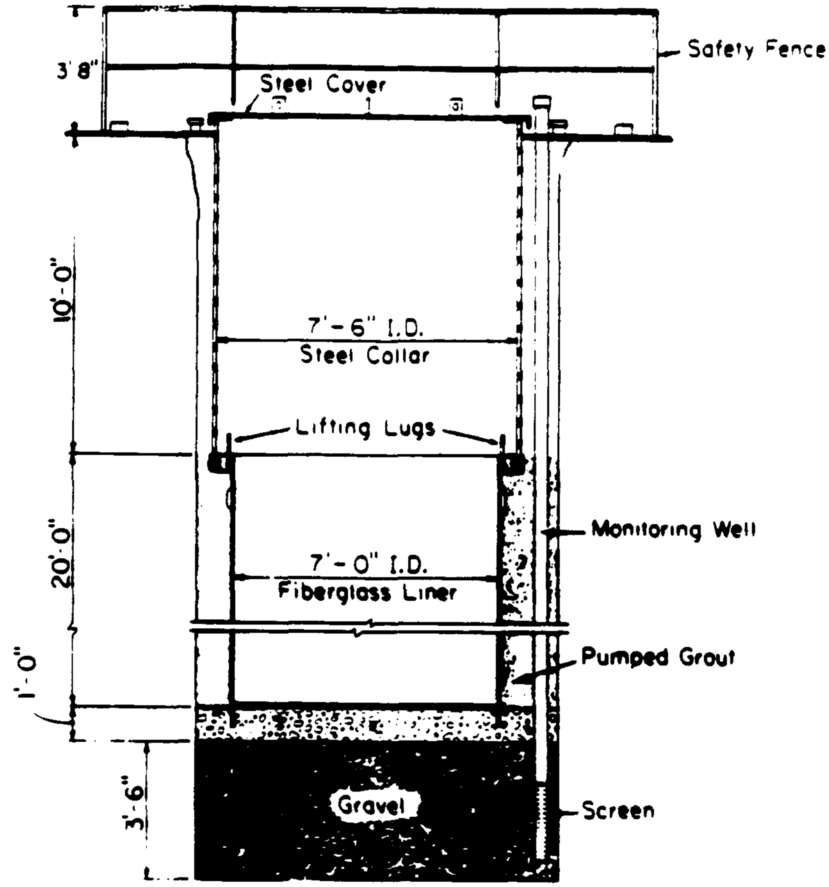
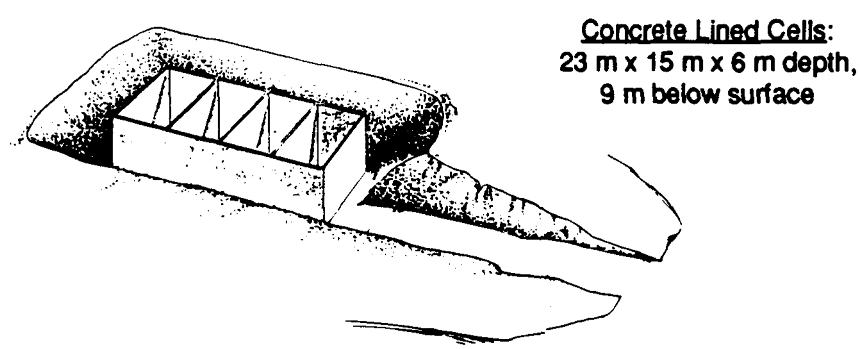


Fig. 2 SRS Low-Level Waste Burial Grounds



GCD BOREHOLE



GCD Engineered Trench

Fig. 3 Greater Confinement Disposal Designs

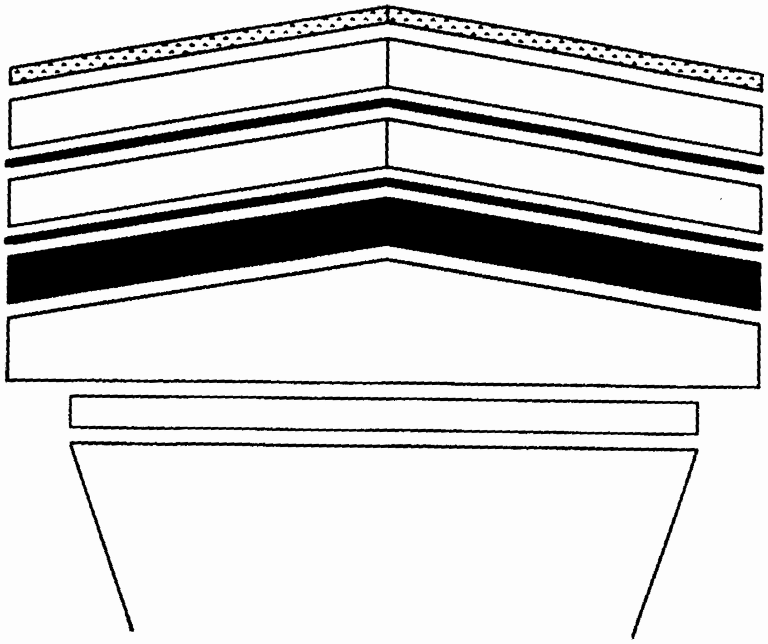


Fig. 4 Cap Design Schematic Cross Section

W8905003

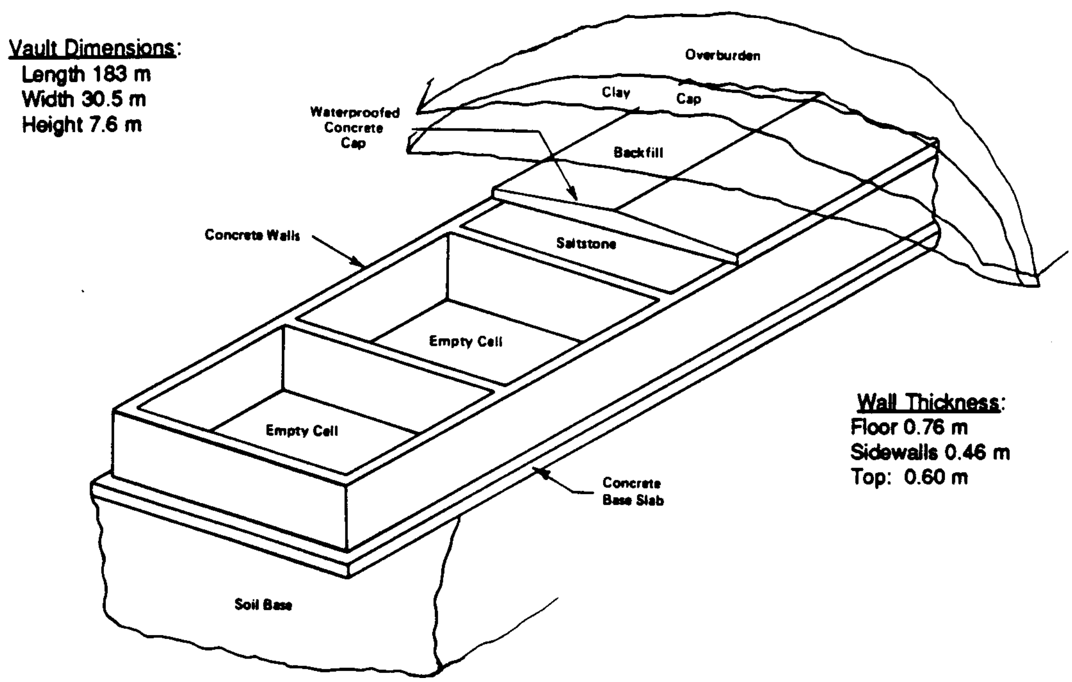
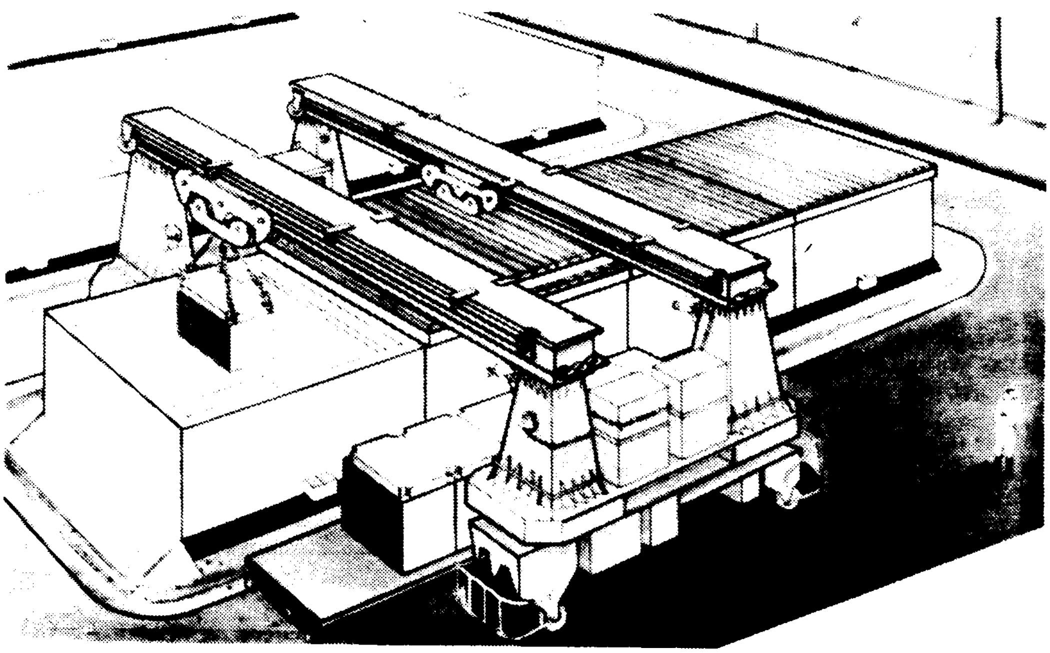


Fig. 5 Saltstone Surface Vault



<u>Vault Dimensions</u>:
Length 53.5 m
Width 12.5 m
Height 7.0 m
Wall Thickness 46.0 cm

Fig. 6 Conceptual Design of HW/MWDF