OVERVIEW OF SAVANNAH RIVER PLANT WASTE MANAGEMENT OPERATIONS

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ABSTRACT

The Du Pont Savannah River Plant (SRP) Waste Management Program is committed to the safe handling, storage, and disposal of wastes that result from the production of special nuclear materials for the U.S. Department of Energy (U.S. DOE). High-level radioactive liquid waste is stored in underground carbon steel tanks with double containment, and the volume is reduced by evaporation. An effluent treatment facility is being constructed to treat low-level liquid hazardous and radioactive waste. Solid low-level waste operations have been improved through the use of engineered low-level trenches, and transuranic waste handling procedures were modified in 1974 to meet new DOE criteria requiring 20-year retrievable storage. An improved disposal technique, Greater Confinement Disposal, is being demonstrated for intermediate-level waste. Nonradioactive hazardous waste is stored on site in RCRA interim status storage buildings. Technological advancements will continue to be a major part of the waste management effort at SRP, along with compliance with progressive federal, state, and local environmental legislation.

INTRODUCTION

The Savannah River Plant (SRP), built and operated by E. I. du Pont de Nemours and Company, is located on a 300 square-mile site near Aiken, South Carolina (Fig. 1). SRP generates liquid and solid radioactive and hazardous waste as a result of the production of special nuclear materials for the U. S. Department of Energy (U. S. DOE). The Waste Management Program at SRP is committed to safe handling, storage, and disposal of these wastes. Waste management technological advancements are a major part of our effort. In addition, Waste Management is committed to compliance with progressive federal, state, and local environmental legislation regulating the storage and disposal of radioactive and hazardous wastes.

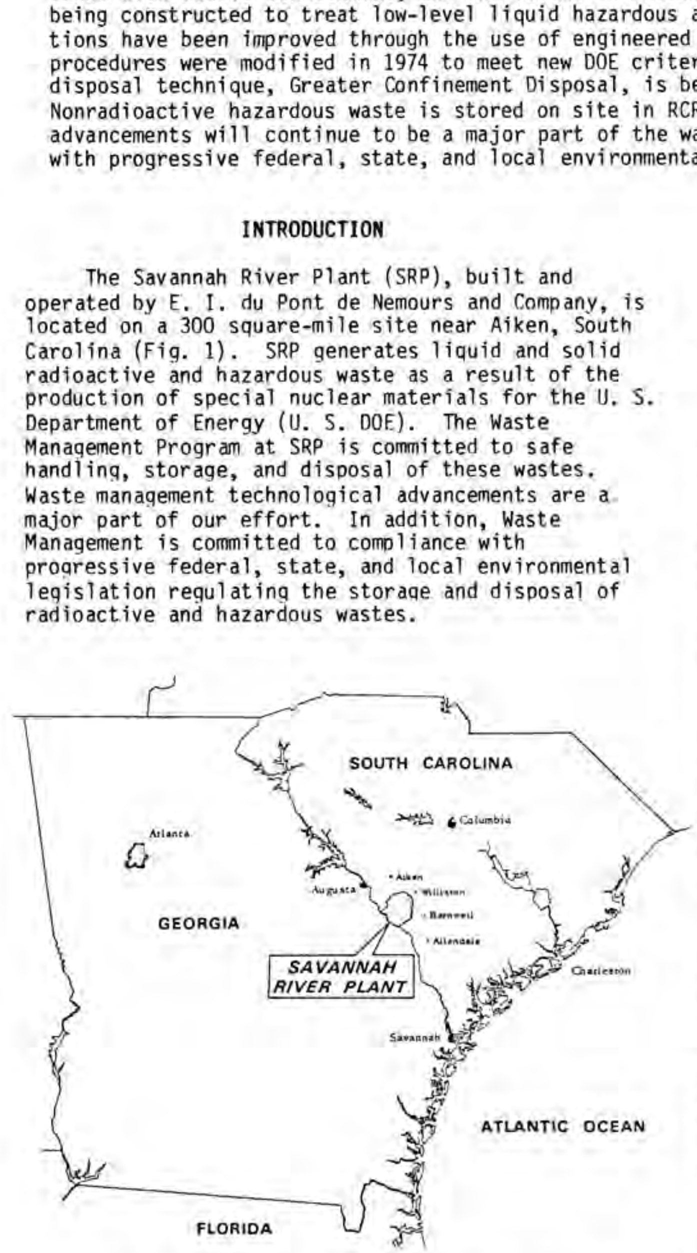

Fig. 1. Location of Savannah River Plant

WASTE GENERATION

Wastes generated at SRP include high-level and low-level radioactive liquid waste, solid radioactive waste (low-level, intermediate-level, and transuranic), nonradioactive hazardous waste, and mixed waste (radioactive and hazardous).

High-level liquid waste is primarily generated in the chemical separations facilities and is sent to the two waste management tank farms. The chemical separations facilities consists of two main operating areas: F Area and H Area. Each area has a large shielded separations building, known as a canyon, where the actual chemical processing of irradiated fuel and targets takes place. The Purex process, used in F Area for processing of irradiated depleted uranium fuel, begins with the dissolution of the metal uranium fuel elements in nitric acid, followed by a feed preparation step before solvent extraction. The process uses three cycles of solvent extraction to separate the actinides (uranium and plutonium) and the fission products from each other. The H-Area canyon building is used for the recovery of enriched uranium from SRP reactor fuel. The solvent extraction operations are similar to those of the Purex process, with some modifications as required by differences in the fuels.

Low-level radioactive liquid waste consists primarily of the general purpose evaporator overheads, the tank farm evaporator overheads, and the nitric acid recovery unit overheads.

Solid radioactive waste is generated plantwide. Solid waste includes operating and laboratory waste such as small equipment, plastic sheeting, protective clothing, soil, used equipment from the canyons, spent lithium-aluminum targets, reactor hardware that does not contain fuel, and other job control waste.

Nonradioactive hazardous waste is also generated plantwide, predominantly from Construction, Raw Materials, and the Savannah River Laboratory (SRL). This waste includes paint solvents, extrusion press oil, halogenated degreasing solvent, machine coolant, and lithium-aluminum dross.

Mixed waste is generated primarily by the tritium processing facilities and includes tritiated oil, mercury, lead, and scintillation fluids.

RADIOACTIVE LIQUID WASTE

Approximately 32 million gallons of high-level radioactive liquid waste are stored at SRP in 51 subsurface carbon steel waste tanks with double containment. The tanks are located in two tank farms in the separations areas near the center of the plant. There are four different tank designs. Three designs (Types I, II, and III) have double steel walls or a single steel wall with a five-foot high annulus pan, forced (water) cooling systems, and are used for high heat waste and low heat waste. The fourth design (Type IV) has one steel wall, no forced cooling, and is primarily for low heat waste. Type III tanks were built most recently and were heat-treated to relieve the welding stresses generated during fabrication. The Type III tanks hold 1,300,000 gallons and are 85 feet in diameter and 33 feet high. A cross section of a Type III waste tank is shown in Fig. 2. All tanks (Types I, II, III, and IV) are surrounded by reinforced concrete and are equipped with a filtered ventilation system. Surveillance instrumentation includes conductivity probes to detect leakage, temperature monitors, hydrogen monitors, and radiation monitors. Wastes from the separations facilities are neutralized to excess alkalinity before transfer to the waste tanks.

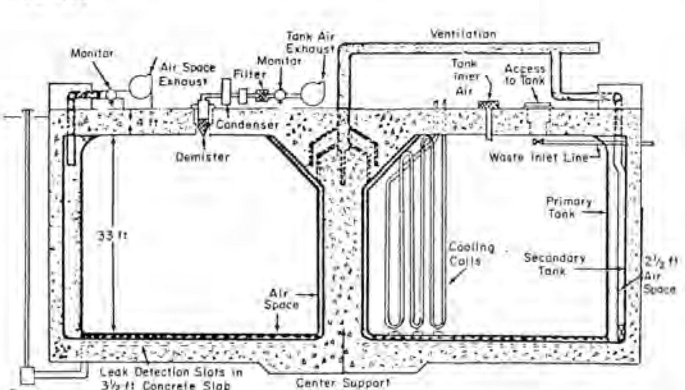

Fig. 2. Type III Waste Tank

The radioactive liquid waste is routinely processed through evaporators and cesium removal columns. Each tank farm has two single stage, bent-tube evaporators that are used to concentrate the alkaline waste after receipt from the canyons. The principal features of the evaporators are shown in Fig. 3. Some of the waste is allowed to age prior to evaporation. This allows decay time for short-lived radionuclides. Separation of the waste sludge from the supernate also takes place during aging. The waste can be reduced to about 20 to 25% of its original volume and immobilized as crystallized salt by successive evaporations of the liquid supernate.

Each tank farm evaporator has an associated cesium removal column. The evaporator overheads are continuously monitored for radioactivity, and if they are below a prescribed level, they are sent through the cesium removal column to further reduce the Cs-137 content. If the Cs-137 concentration is above the prescribed level, the waste stream is recycled for additional evaporation. The evaporators achieve a condensate decontamination factor of greater than 10^6. The cesium removal columns contain ion exchange resin and give a decontamination factor for Cs-137 of about 200. The cesium removal column effluent is sent to a hold tank where it is sampled, and if the concentration is acceptable, the processed condensate is sent to the seepage basins. An effluent treatment facility, scheduled for completion in 1988, has been designed to treat the low-level liquid waste currently sent to the seepage basins to National Pollutant Discharge Elimination System (NPDES) limits. The treatment facility will use filtration, reverse osmosis, and ion exchange.

A high-level waste transfer and processing program has been initiated in recent years to provide long-term waste management. The first objective of the program is to transfer the waste currently stored in single-walled or older double-walled tanks to newer double-walled tanks. The second objective is to prepare the waste for feed to the Defense Waste Processing Facility (DWPF). The waste removal program includes removal of salt and sludge by mechanical agitators, spray washing of the tank interior walls, and steam/water cleaning of the tank annuli as required. The waste processing program includes aluminum dissolution, washing of the sludge, and decontamination of the salt for incorporation into saltstone. The high-level waste sludge and salt precipitate will be sent to the DWPF where it will be solidified into borosilicate glass for disposal in a federal repository. The DWPF is scheduled for completion in 1989.

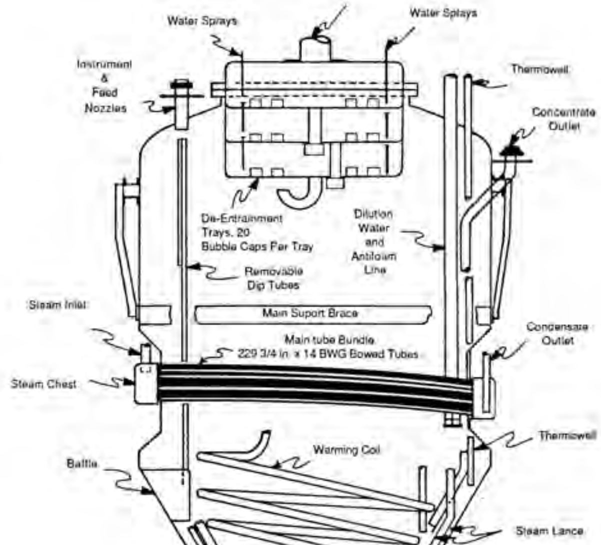

Fig. 3. Waste Evaporator

SOLID RADIOACTIVE WASTE

Solid radioactive waste at SRP is disposed of at the low-level waste disposal facility, which is located between the two 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. Beginning in 1986, separate facilities were provided for mixed waste.

Low-level waste is defined as solid waste that radiates less than 300 mR/hr at three inches from an unshielded container. It also contains less than 10 nCi of transuranic nuclides per gram of waste. Low-level waste is placed in 90 ft^3 carbon steel boxes (B-25 boxes) and placed in an engineered low-level trench excavated 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 corner of the trench.

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 trenches. An improved disposal technique, Greater Confinement Disposal (GCD), is being demonstrated. The objective of GCD is to provide a near zero release facility that will provide improved containment of radionuclides and require minimum maintenance after closure. The two GCD concepts are the GCD boreholes and the GCD engineered trench.

The boreholes are each nine feet in diameter and 30 ft deep; each one contains a seven ft diameter, 20 ft deep fiberglass liner that is grouted in place. All waste placed in the boreholes will be stabilized with grout. When all of the boreholes are filled, they will be covered with a bentonite-clay cap covered with native clay so that the distance from the surface to the waste will be a minimum of sixteen feet.

The GCD engineered trench is constructed of poured concrete forms for the walls and floor and has dimensions of 50 ft by 100 ft. It has four cells with a leachate collection system for each cell. A steel rain cover will be placed over each cell when it is not use. Modifications to the trench will also allow disposal of intermediate-level byproduct waste. Fig. 4 illustrates a GCD trench.

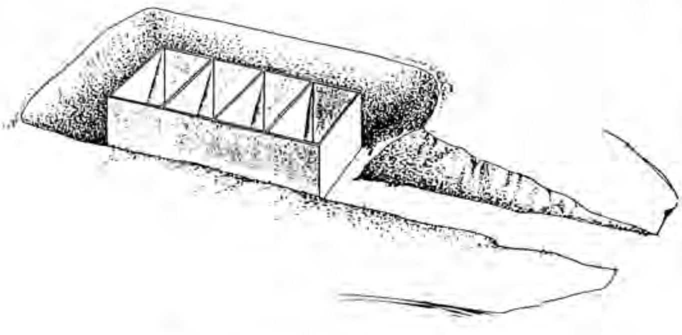

Fig. 4. GCD Engineered Trench

Transuranic (TRU) waste at SRP has historically been waste that is contaminated with more than 10 nCi of transuranics per gram of waste; however, SR Order 5820.2 dated November 1985 raised the limit for transuranics to 100 nCi/g. In 1974, Savannah River began storing TRU waste retrievably on concrete pads. TRU waste is placed in carbon steel containers or in galvanized 55-gallon drums at the source of generation. Once at the disposal facility, drums containing more than 0.5 Ci are contained in concrete culverts, with up to 14 drums in a culvert.

DOE sites have developed plans for the eventual disposal of retrievably stored and newly generated TRU waste at the Waste Isolation Pilot Plant (WIPP). The SRP plan required the construction of the Waste Certification Facility and the TRU Waste Facility. The first phase of the Waste Certification Facility, the Experimental TRU Waste Assay Facility, started up in 1986 and provides equipment to x-ray, assay, and weigh 55-gallon TRU waste drums. The second phase of the Waste Certification Facility will be completed in 1987. It will add facilities to barcode and assemble drums for shipment and load drums into the transport container. The TRU Waste Facility is scheduled to have facilities to retrieve TRU waste stored in the burial ground and prepare it for certification or low-level waste disposal beginning in 1994.

An alternate TRU waste management plan has been developed in case it is determined that Pu-238 waste cannot be transported to or disposed at WIPP. In that case, a TRU Waste Processing Facility would be constructed to incinerate and decontaminate Pu-238 contaminated waste. The waste streams from this facility would eventually be incorporated into DWPF glass.

Mixed waste is hazardous waste that is also radioactively contaminated. Mixed waste storage is regulated by the South Carolina Department of Health and Environmental Control (SCDHEC). A covered, diked facility that meets SCDHEC regulations has been constructed and permitted for the interim storage of mixed wastes.

Solid waste volume reduction programs have been initiated by several departments at SRP. The compaction programs reduce the volume of radioactive waste requiring disposal at the burial ground by about 5:1.

NONRADIOACTIVE HAZARDOUS WASTE

Nonradioactive hazardous waste (NRHW) is stored on site in three RCRA interim status hazardous waste storage buildings (Fig. 5). 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. Ignitable waste is separated from the other waste by a fire wall. The buildings contain over 2,500 55-gallon drums, over 85 five-gallon drums, and 489 ninety ft^3 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 Incineration Facility (CIF), stabilization with cement, neutralization, and disposal in an above-ground vault.

Fig. 5. Nonradioactive Hazardous Waste Storage Building

INCINERATION

The Beta-Gamma Incinerator (BGI), a demonstration facility at Savannah River that has been in operation since 1984, was constructed to demonstrate incineration of contaminated spent solvent and combustible low-level beta-gamma waste. The BGI has successfully demonstrated the incineration of 140,000 gallons of contaminated solvent and approximately 20,000 ft^3 of low level solid waste. The BGI will continue to operate until the proposed CIF is completed in 1992. The CIF will incinerate the combustible low-level wastes and hazardous wastes that are generated onsite.

CONCLUSION

The SRP Waste Management Program will continue to incorporate the latest technology to provide safe and environmentally sound storage and disposal of the radioactive and hazardous wastes generated at the site.

ACKNOWLEDGMENT

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