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GREATER CONFINEMENT DISPOSAL PROGRAM AT THE SAVANNAH RIVER PLANT

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ABSTRACT

The first facility to demonstrate Greater Confinement Disposal (GCD) in a humid environment in the United States has been built and is operating at the Savannah River Plant. GCD practices of waste segregation, packaging, emplacement below the root zone, and waste stabilization are being used in the demonstration. Activity concentrations to select wastes for GCD are based on a study of SRP burial records, and are equal to or less than those for Class B waste in 10CFR61. The first disposal units to be constructed are 9-foot diameter, thirty-foot deep boreholes which will be used to dispose of wastes from production reactors, tritiated wastes, and selected wastes from off-site. In 1984 an engineered GCD trench will be constructed for disposal of boxed wastes and large bulky items.

INTRODUCTION

The Savannah River Plant is demonstrating a greatly improved method of disposal of low-level radioactive waste called Greater Confinement Disposal (GCD). A GCD facility has been constructed within the present burial ground at the Savannah River Plant to dispose of the higher activity fraction of SRP low-level waste. This facility is the first of its kind to be built in a humid area of the United States.

While past practices of low-level waste management over the thirty years of plant operation have proven successful in the short term, we have recently detected small amounts of tritium and traces of two other radionuclides outside the limits of the disposal area. The levels of radioactivity are very low, and present no environment hazard; however, we feel that by implementing Greater Confinement Disposal and other state-of-the-art waste management practices these releases can be stopped. Increased knowledge of the relative importance of the various pathways by which material can reach the environment and the actual transport mechanisms involved have led to the development of engineering techniques which can effectively reduce or eliminate release of radioactivity from disposal sites.

Interest in Greater Confinement Disposal is by no means limited to Savannah River. The term itself originated with the Low-Level Waste Management Program of the Department of Energy, which has been hosting discussions on the topic for several years. The recently approved Nuclear Regulatory Commission regulation 10CFR61 sets forth the way in which solid low-level radioactive waste will be handled by commercial disposal facilities. This regulation defines how sites will operate primarily in terms of performance criteria, and leaves the actual operation and design up to the individual license applicants. The regulation defines waste classes based on activity concentration, segregation of waste classes, and stabilization requirements for each class of waste. The facility at Savannah River meets or exceeds the performance criteria and technical requirements set forth in 10CFR61.

GREATER CONFINEMENT DISPOSAL - DEFINITION AND DESCRIPTION

At Savannah River we define Greater Confinement Disposal as an integrated system of waste management which provides a greater degree of isolation of radionuclides from the environment than is provided by Shallow Land Burial. With this definition we emphasize that disposal is only the final step of waste management. Efforts to reduce waste volume, by combustion, compaction, or process changes, and standardization of waste containers for more efficient packing in disposal units are part of the same overall system.

The overall goal of Greater Confinement Disposal is to construct and operate a system which will provide for "near-zero release" of radionuclides from waste material and will require no maintenance after closure. We expect the system to last at least 300 years in the environment of the Savannah River Plant. This time will allow tritium and the thirty-year half lived isotopes of cesium and strontium to decay to innocuous levels.

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Pathway analyses done at the Savannah River Laboratory have shown that material transport occurs at the site by two mechanisms, transport by ground water and uptake by plant roots. In order for Greater Confinement Disposal to succeed these two vectors must be eliminated or greatly reduced. To this end GCD will provide for:

- Deeper burial, to place the top of the waste below the root zone of plants indigenous to the area.
- Grouting of void spaces between waste forms, to prevent future subsidence and channelling of water to the waste.
- Placing a low-permeability clay cap over the disposal units as soon as possible after they are filled to reduce percolate water-waste contact to a minimum.

TRIGGER VALUES FOR GCD

The critical step in the implementation of Greater Confinement Disposal is to identify and segregate those specific waste types with activity levels high enough to warrant the degree of isolation from the environment provided by GCD. At Savannah River a large percentage of the volume of waste generated is classified as "suspect", which means that it has no measurable radioactivity, but that it was generated in areas where the potential for contamination exists. Disposal of these wastes by GCD cannot be justified either technically or economically. In order to take this critical step we needed the answers to two basic questions, 1) what level of activity would trigger waste into GCD, and 2) what are the specific waste types which meet the activity criteria.

Each waste shipment sent to the SRP burial ground is accompanied by a burial slip, on which information about the shipment is entered. Each month these are keypunched and entered into the central computer facility at SRP. Examination of these records led to the answers to the two questions.

A statistical study was performed on the volume and activity distribution of wastes sent to the burial ground in the years 1979-1981. The data showed that 95% of the activity made up only 5% of the waste volume in a given year. The distribution of each radionuclide was then examined and was found to be similar. This 95%-5% criteria was used to determine trigger values for GCD emplacement. When compared to trigger values for Class B waste in 10CFR61 the SRP GCD trigger values are equal to or lower those for the NRC. This comparison is shown in Table I.

The trigger values obtained were then applied to the burial records for 1982 to determine what specific waste types would have been sent to GCD if there had been such a facility at that time. In 1982 SRP disposed of 694,000 cubic feet of beta-gamma waste containing 64,000 curies. Of this, 97% of the activity (62,330 curies) in 5% of the volume would have been routed to GCD. The actual waste types identified as candidates for Greater Confinement Disposal were quite limited in number. The majority of GCD level waste is irradiated scrap metal, certain tritiated wastes, and laboratory waste from the separations area.

TABLE I

Radioactivity Concentration Limits for GCD

	SLB/GCD Class.	10CFR61 Class.		
	µCi/cc	µCi/cc		
Column	1[a]	2[b]	3[c]	4[d]
Radionuclide				
Part I SRP Radionuclide Classification				
H-3	2.0	40	All Class B	
Co-60	100	700	All Class B	
Sr-90	0.04	0.04	150	7000
Cs-137	1.0	1.0	44	4600
Fission Prod.	0.04		Not Listed	
Induced Act.	1.0		Not Listed	
Enr. Uranium	0.005		Not Listed	
Nat. Uranium	0.005		Not Listed	
Part II Other Radionuclides Listed by NRC (10CFR61)				
C-14	TBD[e]	0.8[f]	-	8
C-14 (in metal)	TBD	8[f]	-	80
Ni-59 (in metal)	TBD	22[f]	-	220
Ni-63	TBD	3.5	70	700
Ni-63 (in metal)	TBD	35	700	7000
Nb-94 (in metal)	TBD	0.02[f]	-	0.2
Tc-99	TBD	0.3[f]	-	3
I-129	TBD	0.008[f]	-	0.08

a If radionuclide concentration is greater than Column 1, 2, or 3 waste goes to GCD.

b If less than Column 2, NRC Class A. If greater than Column 2, but less than Column 3, NRC Class B.

c If greater than Column 3, but less than Column 4, NRC Class C.

d If greater than Column 4, not suitable for burial by NRC 10CFR61 regulations.

e To be determined.

f If concentration is greater than Column 2, waste is NRC Class C.

The study made of the waste buried in 1982 was also used to estimate the size and number of disposal units to be constructed. By separating the wastes above the GCD trigger values on the basis of their size and form we determined that if we had had a GCD facility in 1982 we would have filled forty nine-foot diameter boreholes and 35 linear feet of a trench fifty feet wide and twenty feet high. Eighty-five percent of the total activity buried in 1982 would have been put into the boreholes.

It is advantageous to place the higher activity waste into boreholes. The deep, relatively narrow geometry of the borehole provides a great deal of shielding and will help reduce operator exposure to radiation. Since each individual disposal unit has a rather small volume, compared with a trench, they will be loaded with waste, stabilized, and closed more quickly, again reducing exposure rates to the operating personnel.

DISPOSAL UNIT DESCRIPTION

We decided to demonstrate both borehole and engineered trench disposal units for Greater Confinement Disposal based on the types of waste to be handled. Boreholes would accommodate cylindrical shapes and loose scrap metal, while engineered trenches would be used for boxed waste and the more bulky waste forms. Each disposal unit has unique features. Boreholes can be quickly constructed in the clayey-sand soil native to SRP. They can be kept covered when not in use, thus eliminating contact between the waste and water before closure. Engineered trenches are relatively major construction projects, but they provide more flexibility in the geometry of waste forms which can be emplaced. In order to begin Greater Confinement Disposal at the earliest possible date boreholes were chosen as the first disposal unit to be constructed, with completion planned for early 1984. Trench construction is planned to begin in 1984.

The design and layout of the borehole disposal units are shown in Fig. 1. For each disposal unit a nine-foot diameter hole is augered to a depth of 34.5 feet and a top collar and removable cover are immediately emplaced to provide support for the upper part of the hole and prevent precipitation from entering the hole when it is not actually in operation. A gravel support bed is installed. A one-foot thick concrete pad is then poured to provide a firm base for the seven-foot diameter, twenty-foot long fiberglass liner. The liner is emplaced while the concrete is still wet so that the bottom is fully supported, then the annular space between the liner and the hole is grouted while water is pumped into the liner to reduce stress. Construction of 20 of the 80 boreholes pictured in Fig. 1 took place throughout the month of December, 1983, when over 5 inches of rain fell. The sides of the holes did not slough, and the bottoms remained dry at all times. Adjacent to the liner in each borehole is a monitoring well with a screen that extends below the bottom of the liner.

The engineered trench to be used for Greater Confinement Disposal will basically be a trench within a trench. The first trench will be excavated to a depth of ten feet below grade. From this level a twenty-foot deep disposal trench will be constructed by driving sheet piling and excavating an area of one-hundred feet by fifty feet. The disposal trench will be divided into four cells divided by sheet pile walls. Each cell will have a concrete bottom and an individual drainage collection system, and will be provided with a removable cover to reduce the amount of precipitation reaching the cell bottom. This trench design is illustrated in Fig. 2. Containerized waste will be placed in the cells. When a layer has been completed, grout will be poured to fill the void spaces between the packages and form a stable monolith.

After a disposal unit has been completely filled with waste and grouted, a two-foot thick clay cap will be placed over the unit to minimize water percolation to the waste forms. Enough backfill will be added to provide at least sixteen feet between the surface and the top of the waste. At this depth and in the climate of South Carolina the clay cap will be in an environment of constant high humidity and should not undergo freeze-thaw action. There will be no subsidence of backfill into the waste since each disposal unit will be a solid monolith. Under these conditions the clay cap should remain intact and continue to provide protection for hundreds of years.

FACILITY OPERATION

At the present time we are using borehole disposal units for drums of tritiated waste. We are using two methods of emplacement and plan to evaluate each. Specially designed metal pallets which hold a layer of seven drums are used in some boreholes. A battery-powered vacuum drum lifter is also being tested. In either case, after a layer has been emplaced enough grout is pumped into the hole to anchor the drums. After a second layer has been put into place grout is again pumped in to cover the first layer and anchor the second. This process is repeated until six layers of drums have been emplaced. The final layer is grouted to the top of the drums, then a two-foot thich layer of concrete is poured on top. At this point the borehole is ready for closure.

There are two other waste types which will go to borehole disposal units in the near future. Irradiated scrap metal is sent to the burial ground now in shielded casks which are top unloading, and will not fit inside the boreholes. We have work in progress to design and fabricate a bottom unloading cask for this material. The new cask will be lowered into the borehole and emptied. Then about one cubic yard of grout will be pumped into the hole to fill the void spaces within and between the metal pieces.

The third waste type is a stainless steel cylinder nineteen feet high and sixteen inches in diameter which contains tritiated waste. A rack has been designed to enable vertical placement of these cylinders in the borehole. The present method of handling these is below grade in a trench to provide operator shielding, since there is appreciable gamma contamination on the outside surface. Holding the cylinder in the air to verticalize it with the present equipment would expose the operator to an unacceptable level of radiation. This problem is under investigation. The solution may involve a new cask design, secondary containment, process changes at the generator, or some combination of the three.

THE FUTURE OF GREATER CONFINEMENT DISPOSAL AT SRP

The next few years will be a period of demonstration and transition, for GCD requires fundamental changes in the way in which waste is managed, not only in terms of disposal, but in steps which the generators must take as well. We will have a period of education, evaluation, and testing. The waste generators must effectively segregate the waste according to activity and combustibility. We are

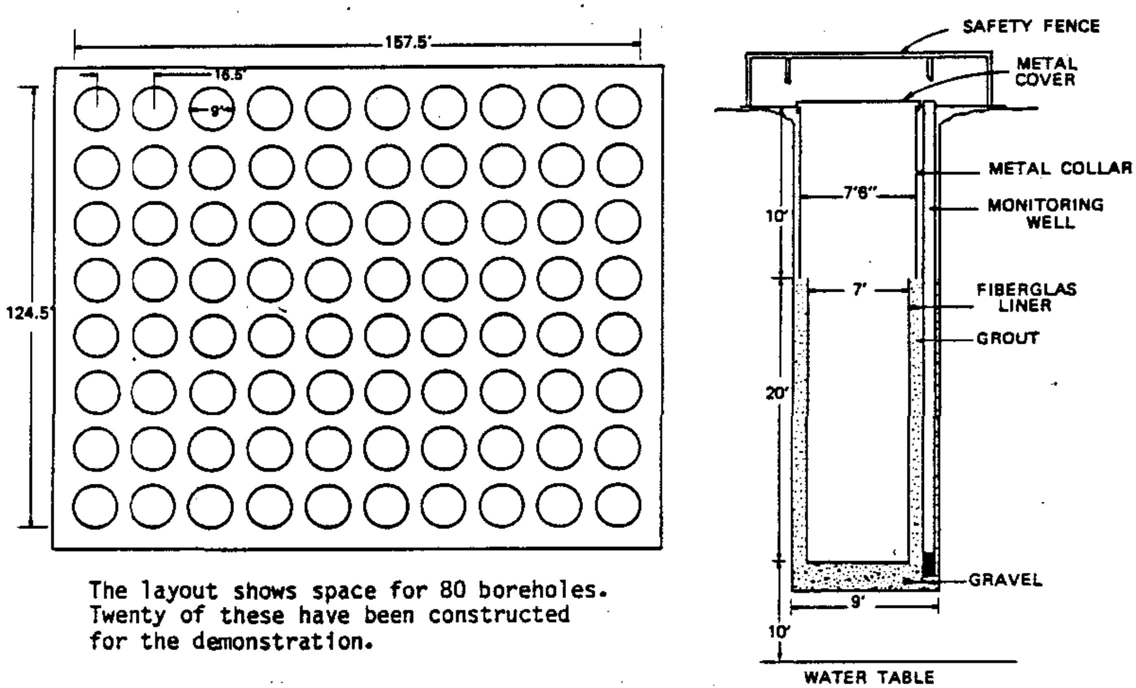

Fig. 1. Borehole Design and Layout Plan.

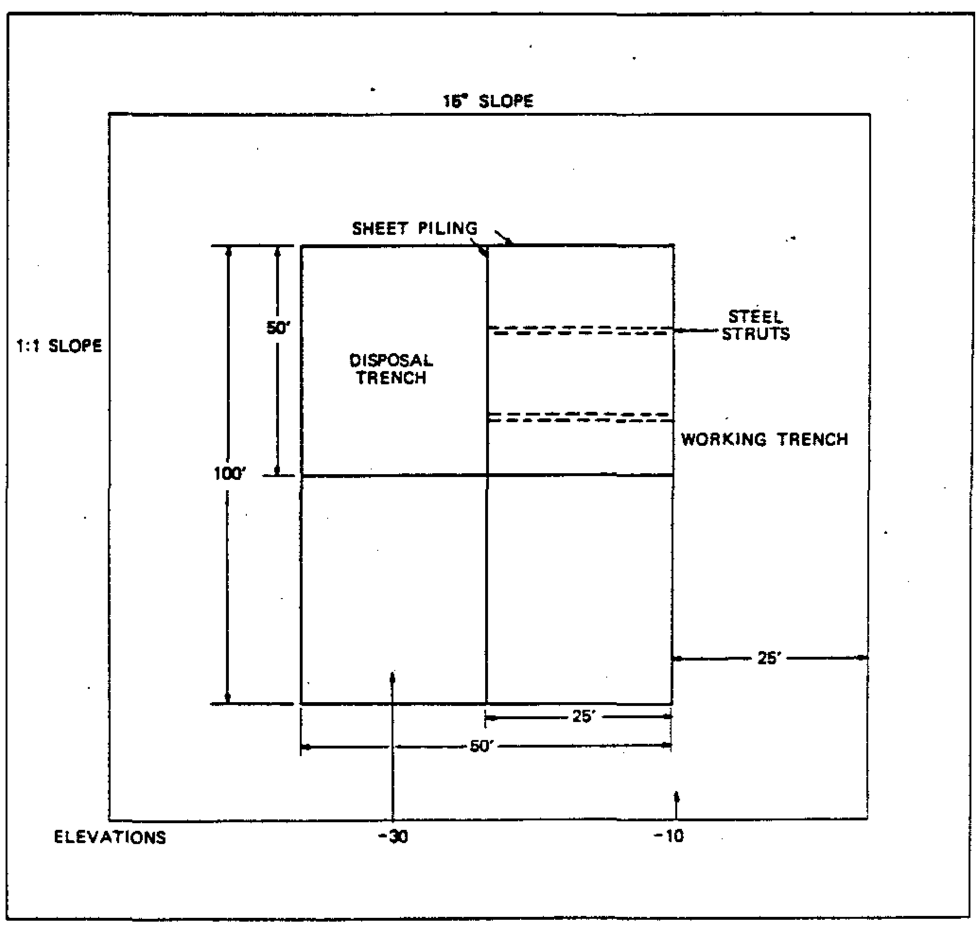

Fig. 2. Plan View of GCD Engineered Trench.

also investigating compaction for some non-combustible waste, which will most likely be done at each generating location. Steps such as these will help make the most efficient use of the GCD facility, and they need the active participation of the waste generators.

Practices at the disposal site will be changed as well. The construction and operation of GCD disposal units is new, as is the practice of stabilization of waste forms. In 1984 we will install our first clay cap and complete the rest of our closure plan for GCD. These operations will require new job skills and employee education.

Each GCD borehole has a monitoring well which will be used to determine what activity, if any, leaches from the borehole itself. In addition, six of the boreholes will have monitoring devices capable of collecting water samples from the unsaturated zone adjacent to the borehole. Each cell of the GCD trench will have its own leachate collection system. The monitoring program will be used over the course of several years to determine the effectiveness of the GCD concept.