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GREATER CONFINEMENT DISPOSAL TEST

AT THE NEVADA TEST SITE[a]

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ABSTRACT

The Greater Confinement Disposal Test (GCDT) at the Nevada Test Site will be a full scale demonstration of intermediate depth burial for disposal of defense low-level radioactive wastes considered unsuitable for shallow land burial. The GCDT project will demonstrate that these wastes can be efficaciously disposed at a depth of approximately 30 meters where the probability of future inadvertent human instrusion and of potential waste migration are negligible. The GCDT will be instrumented to collect data on properties of the disposal medium (alluvial sediments). Tracers will be injected to assess the transport potential of wastes through the medium. Tracer data will be analyzed to determine the effectiveness of the disposal method.

BACKGROUND

In 1980 the Department of Energy's (DOE) National Low-Level Waste Management Program began to review alternatives to the shallow land burial of low-level radioactive waste (LLW). Although the majority of LLW is routinely and safely disposed in shallow land burial (SLB), a portion was considered unsuitable for SLB because of its high specific activity or potential for migration into biopathways. Of particular concern was the hypothetical inadvertent human intrusion scenario where an individual establishes a residence on or near an abandoned disposal facility. In this scenario, the individual becomes exposed to radiation and radioactive material by (1) inadvertently excavating or disturbing the cover materials of the SLB trenches, (2) consuming contaminated food crops grown on the site, or (3) consuming contaminated ground or surface waters into which waste materials have migrated. Although considered an improbable "worst case" scenario, a decision was made to assess alternate disposal methods that would minimize the potential adverse consequences of human intrusion and would reduce the probability of its occurance.

In 1981 the National Low-Level Waste Management Program and the DOE's Nevada Operations Office began a project to demonstrate the feasibility of "greater depth" burial in the alluvial sediments of the Nevada Test Site. The project was to demonstrate the disposal of defense LLW at a depth sufficient to minimize or to eliminate natural environmental intrusion processes (for example, animal burrowing, rain water percolating, plant rooting) into the waste zone and to substantially reduce the potential for inadvertent human intrusion.

During the same time frame the Nuclear Regulatory Commission (NRC) issued draft guidance on LLW disposal (10 CFR 61) # and identified three categories of wastes based on concentration guidelines. Class "A" wastes would be routinely disposed in SLB without segregating the waste. Class "B" has rigorous requirements on waste form to ensure stability prior to SLB. Class "C" wastes must in addition be treated and disposed in a manner that would reduce the potential consequences of human intrusion. Wastes having concentrations exceeding Class "C" were considered unsuitable for near surface disposal and were to be considered separately by the NRC.

The concept of confinment is to somehow reduce the rate or manner that wastes could enter the biosphere. Zero confinement is simply unrestricted release into a biopathway. Total confinement is isolation. As wastes are treated, packaged, and disposed each process adds some level of confinement. Usually the process of least importance to confinement is packaging. The processes of most importance are disposal method and location.

The term "greater confinement disposal" (GCD) was coined to identify disposal methods which provide greater confinement or protection than usually afforded by near surface or shallow land burial.

SCOPE AND OBJECTIVES

In defining the scope and objectives of the Greater Confinement Disposal Test (GCDT) we had three primary goals. The first goal was to meet the radiological performance guidelines as required by DOE Order 5480.1, Chapter XI # . The second goal was to collect and analyze sound technical data on potential waste migration from an intermediate depth disposal facility. The third goal was to develop operational procedures for the handling and disposal of waste.

We recognized that compromises would be required between the operational and the experimental research aspects of the project. For example, to assess the potential for migration and to verify predictive performance models, a series of tracers needs to be injected, then monitored. Consequently, instrumentation has to be placed close to the waste, limiting the volume of waste disposed. Another example is tracer selection. The optimum tracer for studying movement of moisture is tritiated water. Because tritiated waste will be disposed in the GCDT, alternate tracers were selected to eliminate the possibility of cross-contamination of tracers and wastes.

WASTE SOURCES FOR GCDT

All the wastes to be disposed of in the GCDT will be high specific activity LLW (HSA-LLW). One of the operational objectives of this test will be to demonstrate disposal of both remote # and contact-handled HSA-LLW. The wastes selected (Table I) represent extremes in the low-level waste category.

Large concentrations of tritium have always presented a problem to disposal operators because of tritium's environmental mobility and ability to diffuse through packaging and solidification matricies. Disposal of decommissioned irradiator sources also presents some unique problems. The sources must be remote # handled and may have surface temperatures of several hundred degrees. Many of these sources will still be extremely hazardous after several hundreds of years and must therefore be disposed so that the potential for human intrusion is minimal.

TABLE I. GCDT Waste Sources

Bulk Contact - Handled Source

Sixteen 208-liter drums containing tritiated water solidified in a bitumen matrix placed on pallets of four drums. Each pallet will weight approximately 1814 kg and contain ~40,000 Ci H-3.

Total Volume: 4.5 m^3
Total Curies: ~160,000

Bulk Noncontact - Handled Source

Four additional 208-liters drums of solidified tritiated water with each drum to be handled individually under simulated conditions of contact dose greater than 200 mR.

Total Volume: 1 m^3
Total Curies: ~40,000

Special Remote - Handled Source

Three irradiator sources to be free-air transferred from shielded casks, then placed downhole.

~100,000 Ci Sr-90
~25,000 Ci Cs-137
~500 Ci Co-60
~20 Ci Ra-226
Total Volume: 0.23 m^3
Total Curies: ~125,520

The Los Alamos National Laboratory is currently performing computer model simulations of GCDT waste loading configurations. Results thus far indicate thermal equilibrium after approximately 24 months with a maximum temperature at one meter from the source of ~300°C.

TEST FACILITIES

Two test facilities are being constructed for this project. The principal facility is the GCDT from which most major experimental data will be collected. The second facility is the Shallow Land Burial Test Plot (STP), which serves two functions (1) to provide experimental calibration data and (2) to provide data on near-surface (or SLB) conditions to be compared with data from the GCDT.

GCDT Facility Description

The basic design for the GCDT is a 3-m diameter waste disposal shaft drilled to a depth of 37 meters. Nine monitoring holes 61 cm in diameter and 37 m deep will be drilled around the center emplacement shaft. Corrugated metal pipe forms were placed at each hole location, and PVC conduit pipes were run from each hole to the edge of the pad area. The conduit pipes will carry instrumentation lines from the monitoring holes. A 19.5 x 19.5 m concrete pad was poured to support drilling operations and to reduce sloughing of surface soils downhole (Fig. 1).

Three instrument strings composed of thermocouples, thermocouple psychrometers, and soil atmosphere samplers were constructed and wrapped with 5-cm thick fiberglass insulation to shield the instrument lines from thermal effects. These strings were attached to an instrumented tripod, which was subsequently placed at the bottom of the emplacement shaft. The tripod was then covered with 6 m of backfill (Fig. 2).

The monitoring holes contain a variety of instrumentation. Holes have instrument strings like those placed in the center borehole. The other three have access tubes installed so that neutron scatter and gamma scintellation probes can be inserted.

STP Facility Description

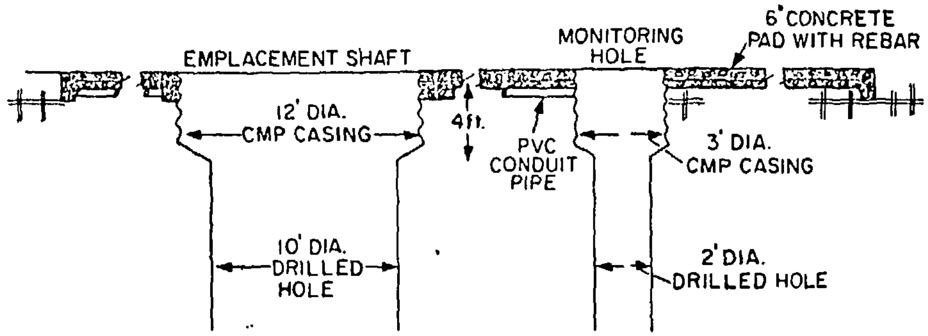
The STP is a small scale simulation of the GCDT and is located approximately 15 m from the GCDT pad. A 3-m diameter by 6.1 m deep hole was drilled. Instrument lines and pipes similar to those described for the GCDT were fabricated and emplaced. A 208-liter drum, filled with aluminum turnings and two 1000-watt resistance heaters, was placed in the STP to simulate the heat generating waste. The hole was then backfilled.

Test Design

Experiments to be conducted in the GCDT and STP are designed to collect data on gaseous and vapor phase transport in aluvial sediments under non-isothermal conditions. Gaseous flurocarbon tracers of varying moecular weights will be released in the waste zone and will diffuse to the sampling points. Gas samples will be collected and analyzed using an electron capture gas chromatograph. The thermcouple psychrometers and neutron moisture probe data will provide information on moisture movements. The thermocouples will provide data on temperature profiles. Together these data will allow us to determine the effective diffusion and transport rates in the aluvium and ultimately allow predictive modeling of potential radionuclide migration. The first sets of tracer experiments will be performed in the STP. It is hoped we will learn during these experiments how to perfect our sampling and analysis techniques. After several initial tracer runs, the heaters buried in the STP will be turned on to simulate the heat generating wastes to be disposed in the GCDT.

Data collected will help refine the GCDT design and will allow calibration of instrument systems. The data will also be used in preparing comparative assessments of shallow disposal and greater depth disposal.

Experiments in the STP are scheduled to begin in April 1983 and we anticipate starting the GCDT experiments in October 1983.



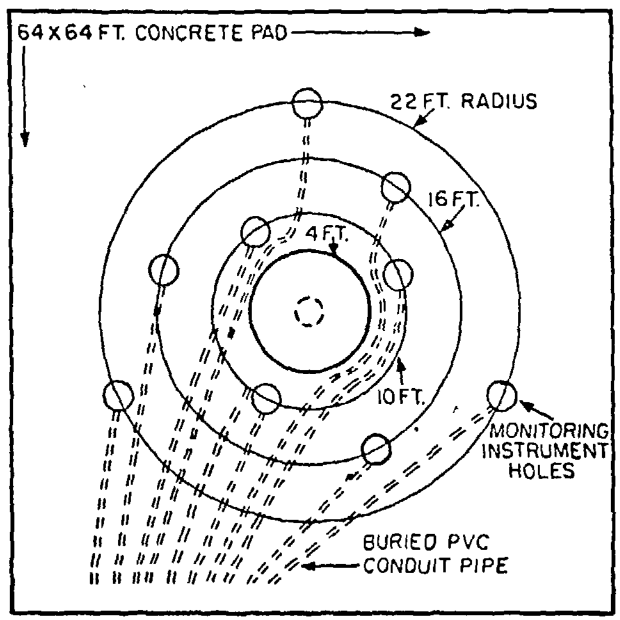


Figure 1. Design of GCDT Support Pad and Drilled Holes

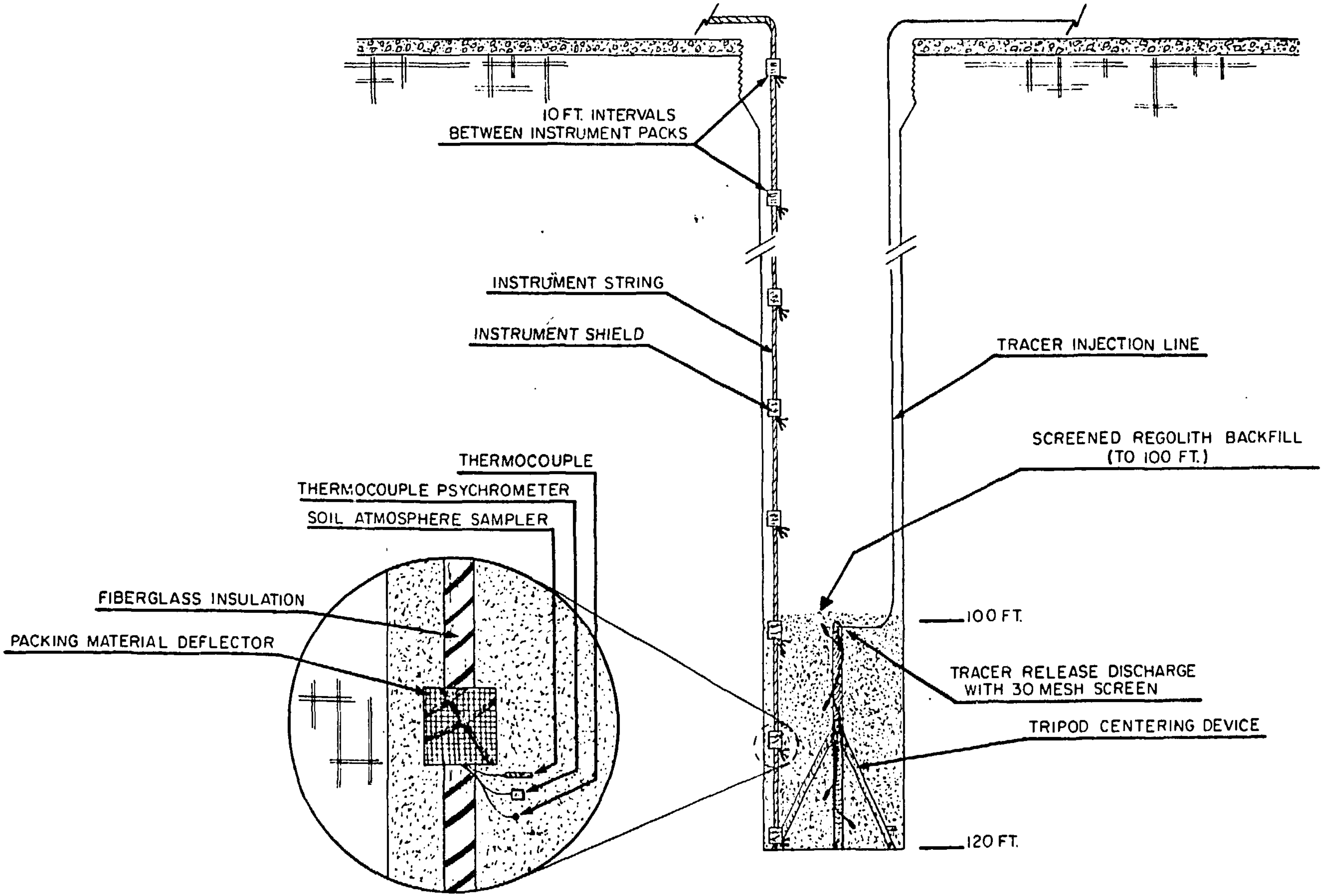


Figure 2. Instrumentation Arrangement in GCDT Emplacement Shaft.