TEXAS LOW-LEVEL RADIOACTIVE WASTE DISPOSAL FACILITY DESIGN USING MODULAR CONCRETE CANISTERS FOR ALL WASTE

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ABSTRACT

The design bases of the principal design features of the proposed Texas LLW disposal facility are presented. The principal design features are described. The estimated costs to develop, construct, operate, close, and maintain the facility are summarized.

INTRODUCTION

The preliminary design for the Texas LLW disposal facility has undergone a rigorous review by several concerned and interested parties. The concerns raised have been examined and addressed during the process of developing the preliminary design into the design to be used as the basis for the facility license application. The facility design now being put forward (1) meets not only all applicable performance objectives and technical requirements but does so in a manner that satisfies the concerns raised by the interested party reviews.

In the Texas LLW disposal facility a total of about 2,000,000 ft^3 waste may be disposed over a 30-year operation period (2). Of the total, about 1,800,000 ft^3 is Class A waste and 210,000 ft^3 is Class B and Class C waste.

GENERAL FACILITY DESCRIPTION

The Texas LLW disposal facility consists of the Class A disposal area, Class B/C disposal area, general support area, administrative area, fencing systems, buffer zone, and water control systems. Figure 1 schematically depicts the general layout of the facility.

Class A Disposal Units

Disposal of Class A waste at the Texas facility will involve below-grade* placement of waste in concrete containers, followed by placement of a multi-layer earthen cover. One Class A disposal unit is constructed about every two years and will contain about 120,000 ft^3 of waste. Canister placement consists of two high and ten wide in the disposal unit. The pea gravel below the canisters promotes drainage of percolating water, if any, from the disposal units. As the modular concrete canisters are placed, voids between them are backfilled with pea gravel. Waste will be placed so the top of the waste is no closer to natural grade than 14 ft 6 in. (4.4 m) and so a total of not less than 16 ft 6 in. (5 m) of total cover thickness exists. The cover system is constructed with a slope of 2 percent to the sides.

Class B/C Disposal Units

Class B and C waste is disposed in much the same way as is Class A waste. Each Class B/C disposal unit will accommodate Class B/C waste expected to be delivered to the facility over a nominal six-year period, or about 42,000 ft^3 (1,200 m^3). Canister placement is only one tier high and six canisters wide in the disposal unit. There is no less than 16 ft 6 in. (15 m) of cover between the top of the Class C waste and the top of the cover system. Therefore, the cover system satisfies the requirements placed on it as an intrusion barrier for the Class C waste. The cover system is constructed with a slope of 3 percent to the sides.

Modular Concrete Canisters

The design criteria for the modular concrete canisters are summarized in Table I. The canister dimensions and a cross section are shown in Fig. 2. It is designed to satisfy loading conditions specified in ACI 349-85. Additionally, it is designed to be watertight under ACI 350-89, to control cracking according to ACI 224-80 and to be durable under ACI 201.2R-77.

Water Control Features

There are several water control features which minimize the potential for runon from off-site locations, for precipitation to percolate into the disposal unit, and for contact between disposed waste and percolating water. They include:

- PMF Protection Berm
- Perimeter Ditch
- Surface Water Diversion Berm
- Disposal Unit Cover Systems
- Percolating Water Drainage System
- Surface Water Drainage System
- Retention Ponds

* The term below-grade disposal indicates that all the waste will be placed below the natural (existing) grade at the disposal site. Since an earthen cover will be placed over the waste, the disposal can also be termed "below-ground".

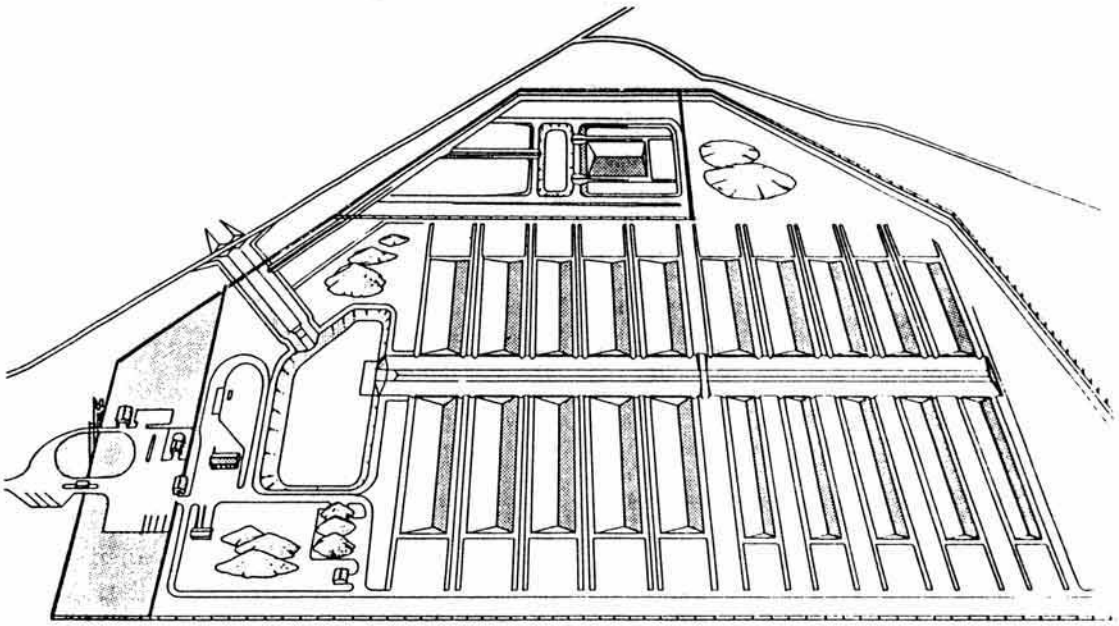

Fig. 1. Layout of Texas LLW disposal facility.

TABLE I

Summary of Design Conditions for Modular Concrete Canisters

Parameter	Normal Conditions	Abnormal Conditions	Severe Conditions
Seismic Event Structural Design	0.2 g	0.7 g	0.7 g with uniform horizontal loading for lateral soil pressure
Stability (during operations only)	0.0 g	0.2 g	>0.2 g
Cracking Control	Dry soil with membrane	Moist soil without membrane	Moist soil without membrane
Tensile Stress	Born by concrete up to concrete tensile strength	Not born by concrete	Not born by concrete
Lifting Loops (during operations only)	Canister empty	Canister filled and grouted but without roof	canister filled and grouted but without roof

The PMF Protection Berm is provided on three sides of the disposal facility, as shown in Fig. 1. This berm's construction provides at least 3 ft (0.91 m) above the natural grade, which is high enough to divert projected surface water runoff. The berm is 36 ft (11 m) wide at its crest and 63 ft (19 m) wide at its base. A perimeter ditch is provided on the inside of the PMF Protection Berm to catch runoff from the PMF Protection Berm and to conduct the runoff away from the disposal areas. Design of the perimeter ditch provides nominal slopes ranging from 0.55 percent to about 0.85 percent. The Surface Water Diversion Berm is constructed between the LLW disposal areas and the potential mixed waste disposal area to assure that the areas are hydrologically separate.

All cover systems provide a minimum of 16 ft 6 in. (5.0 m) cover on top of the concrete canisters. The disposal unit

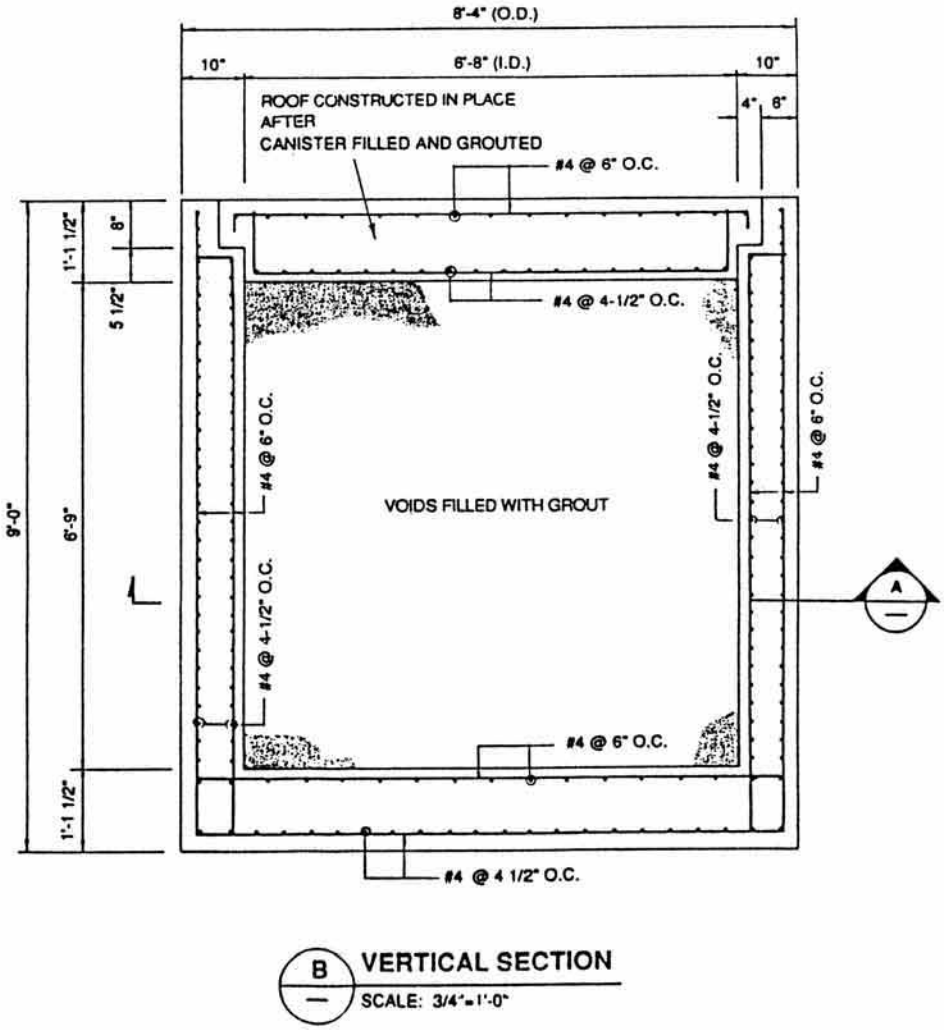

Fig. 2. Cross section of concrete canister.

cover systems are connected to the drainage ditches to ensure that there is no potential that water in the ditches could flow from the ditch into the cover system.

The Percolating Water Drainage system consists of French drains provided along the length of all disposal units, sumps, and drainage fields. A drainage field is placed at the lower end of each disposal unit. This drainage field is capable of accumulating and holding water that might discharge from the French drains without overflowing and backing into the disposal unit.

The Surface Water Drainage System consists of drainage ditches adjacent to the disposal units and the Storm Collection Channel. The drainage ditches conduct runoff from precipitation events away from the disposal units without excess potential for erosion.

The Storm Collection Channel is constructed down the center of the LLW disposal area and sized to accommodate runoff from the Probable Maximum Precipitation (PMP) event. It is 7 ft (2.1 m) deep at final grade and is about 214 ft (65 m) wide.

Support Facilities

Other buildings and facilities are provided at the disposal facility to support the disposal operations. These include:

- Administration/Health Physics Building
- Operations Support Building
- Waste Storage Building
- Maintenance Building
- Guard House
- Pump Facility and Septic System

ECONOMIC ASSESSMENT

The constant-dollar (1990) costs associated with development, construction, operation, closure, and institutional control of the proposed disposal facility are summarized in Table II.

Based on the cost and schedule information, financial evaluations were prepared to describe the viability of the

proposed project. In these projections the following assumptions were made:

- The proposed project is publicly financed.
- All capital is provided in the year required from the Texas State Treasury in the form of debts.
- The interest cost of public debt is 7 percent per year.
- Excess earnings (current earnings in excess of current costs) are invested at 7 percent per year.
- There are no tax effects.
- All development and operating costs are recovered through the disposal charge.
- A surcharge is imposed on all disposed waste to cover the costs of closure and maintenance during the institutional control period.
- All funds accumulated for closure and institutional control are deposited in an escrow account administered by the State of Texas beyond the control of the owner/operator.
- All escrow funds draw interest at 2 percent per year consistent with a secure investment.
- The annual inflation rate was taken to be nil.

A summary of the financial assessments if presented in Table II.

REFERENCES

1. BAIRD, R.D., ET AL., "Design and Analysis of the Texas LLW Disposal Facility Using Modular Concrete Canisters for all Waste," prepared for Texas Low-Level Radioactive Waste Disposal Authority by Rogers and Associates Engineering Corporation, RAE-8953/5-1, 2 Vol., Revised Draft, January 1991.
2. SHUMAN, R., AND R.D. BAIRD, "Characterization of Low-Level Radioactive and Mixed Waste Generated in the State of Texas," prepared for Texas Low-Level Radioactive Waste Disposal Authority by Rogers and Associates Engineering Corporation, RAE-8943/2-2, April 1990.

TABLE II

Summary of Financial Assessment

Estimated Costs (Millions of Constant 1990 Dollars)	
Development and Construction	41.
Operations	172.
Closure	13.
Institutional Control	23.
Total Lifecycle Control	249.
Unit Charges (1990 $/ft^3)	
Disposal During First 20 Years of Operations	180.
Disposal During final 10 Years of Operations	67.
Closure/Maintenance Surcharge	15.
Annual Revenues (Millions of Constant 1990 $/yr)	
During First 20 Years of Operations	10.8
During Final 10 Years of Operations	4.0
Balance Sheet (Millions of Constant 1990 Dollars)	
Debt at Commencement of Operations	50.
Debt After 20 Years of Operations	0.
Accumulated Retained Earnings After 20 Years of Operations	10.
Debt at End of Operations	0.
Accumulated Retained Earnings at End of Operations	0.
Closure and Maintenance Escrow Fund (Millions of Constant 1990 Dollars)	
Net Value at End of Operations	36.
Net Value After Site Closure	26.
Net Value After 100 Years of Institutional Control	100.
Minimum Balance (immediately following closure)	26.
Assumed Economic Conditions	
Cost of Debt (Percent Per Year)	7.
Interest Rate on Retained Earnings (Percent Per Year)	7.
Interest Rate on Closure and Maintenance Escrow Fund	2.
Inflation Rate (Percent Per Year)	0.
No Tax Effects	