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EGG-TIO-M01582

EGG-TIO-M0 1582 cy 1

HIGH INTEGRITY CONTAINER FOR

HIGH SPECIFIC ACTIVITY WASTES*

E. Dykes 2-23-83

R. L. Chapman, EG&G Idaho, Inc.

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The cleanup of the nuclear plant accident at Three Mile Island's Unit 2 has produced some high specific activity wastes which are not suitable for disposal by conventional means. The purpose of the work described in this paper is to develop a burial container suitable for safely disposing of certain of these wastes in a waste burial ground.

The first step in the container development program was to establish a comprehensive set of requirements to be satisfied by the container. An extensive program to determine requirements was spearheaded by the Transportation Technology Center at Sandia National Laboratories.[1] Table 1 summarizes the key requirements, which are also translated into design goals.

The maximum gas generation rate is conservatively estimated to be 0.052 mole per day. The vent gas system is designed to release this much gas while maintaining its ability to retain water at pressures up to 275 kPa. The vent system consists of 5- m pore size stainless steel filter elements,

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* Work supported by the U.S. Department of Energy, Assistant Secretary for Nuclear Energy, Office of Coordination and Special Projects, under DOE Contract No. DE-AC07-76ID01570.

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a 3-μm polyethylene filter assembly, a PVC water trap designed to self-purge infiltrated water as gas is released from the container, and a 3-μm polyethylene external filter to prevent intrusion of mud and debris. The filter train is surrounded by a lead shield to prevent deterioration of the polyethylene filter materials.

The structural design was influenced by four requirements: burial depth, stacking, handling, and hydrostatic loads. These resulted in a combined external design load of 1 MPa applied uniformly. Structural design was also influenced by a desire to minimize cost. Other factors that influenced design are chemical environment, life requirements, and radiation field.

The disposable high integrity container consists of a right circular cylinder of reinforced concrete, 1.56 m OD, 2.13 m high, with 0.15-m-thick cylindrical walls, and 0.28-m-thick ends (see Figure 1). The container uses an epoxy-coated carbon steel inner liner which also serves as the inside concrete form. A rebar cage and headed studs welded to the inner liner are used to strengthen and maintain integrity of the concrete shell. A permanently sealed lid is used to close the container after the payload has been placed inside.

The primary migration boundary consists of epoxy materials applied to a carbon steel substrate. The inner surface of the container utilizes the Carboline Company's Phenoline AE-600 system.

Two other migration barriers are provided for redundancy. The outer surface of the carbon steel inner liner is coated with Phenoline 300 orange primer and Phenoline 302 finish. Finally, the outer surface of the concrete will be coated with Carboline 195 surface and Carboline 191 HB. These coatings are nuclear qualified to greater than 10^9 Rad.

Nine kg of hydrated aluminum oxide will be placed inside the container to serve as an amphoteric agent to maintain the pH of the contents to greater than 5. A high-density polyethylene liner will be placed inside the container to protect the epoxy liners from damage due to contact with the payload container. A lead-in collar is placed in the container to protect the finish from chipping or abrasion during loading.

The high integrity container design uses a combination of redundancy, passive elements, and design conservation to achieve the desired functional life expectancy. Simplicity of design and low-cost materials are used to minimize unit costs. The authors are satisfied that all design requirements and objectives are satisfied by the design.

REFERENCE

1. M. G. Vigil, et al., "Proposed Design Requirements for High Integrity Containers Used to Store, Transport, and Dispose of High Specific Activity, Low Level Radioactive Wastes from Three Mile Island Unit II," Sandia National Laboratories Energy Report, SAND-81-0567, TIC-098, WC-71 (April 1981).

TABLE 1. SYSTEM DESIGN REQUIREMENTS

Parameter/ Function	Design Requirement	Design Goal
Life	300 years	300 years
Vent	Prevent pressure buildup	0.052 mole/day
Lift provisions	Vertical load 3g	Factors of 3 on yield and 5 on ultimate
Stacking	Stack 6 high	265 kPa
Contour	Avoid water entrapment in voids/pockets	Smooth vertical sides, no pockets
Neutralizing agent	Permitted	Neutralize all corrosives by factor of 10
Decay heat	8 watts	--
Internal atmosphere	Saturated air with H_2, SO_x, CO, CO_2, NO_2, H_2	--
Chloride content	2-200 ppm in free-standing liquid	--
pH	pH 2 to 11	Neutralized to pH 7 to 9; coating design requirement pH 6 to 10
Contact dose	Spec. estimate--20.00 Gy/hr	Internal coating = 32.76 Gy/hr; Seal = 4.43 Gy/hr
Becquerel deposition	80% of Bq in 0.54 m^3 at top	Uniform deposition over top 0.15 m of resin
Soil physicals	O_2 = 3 mg/ℓ; Cl = 0 to 300 ppm pH = 4 to 9; water = 0 to 100% sat. sulfates present	Eastern and western conditions separated
Burial depth	Up to 30 m	30-m burial depth capability in water-saturated soil

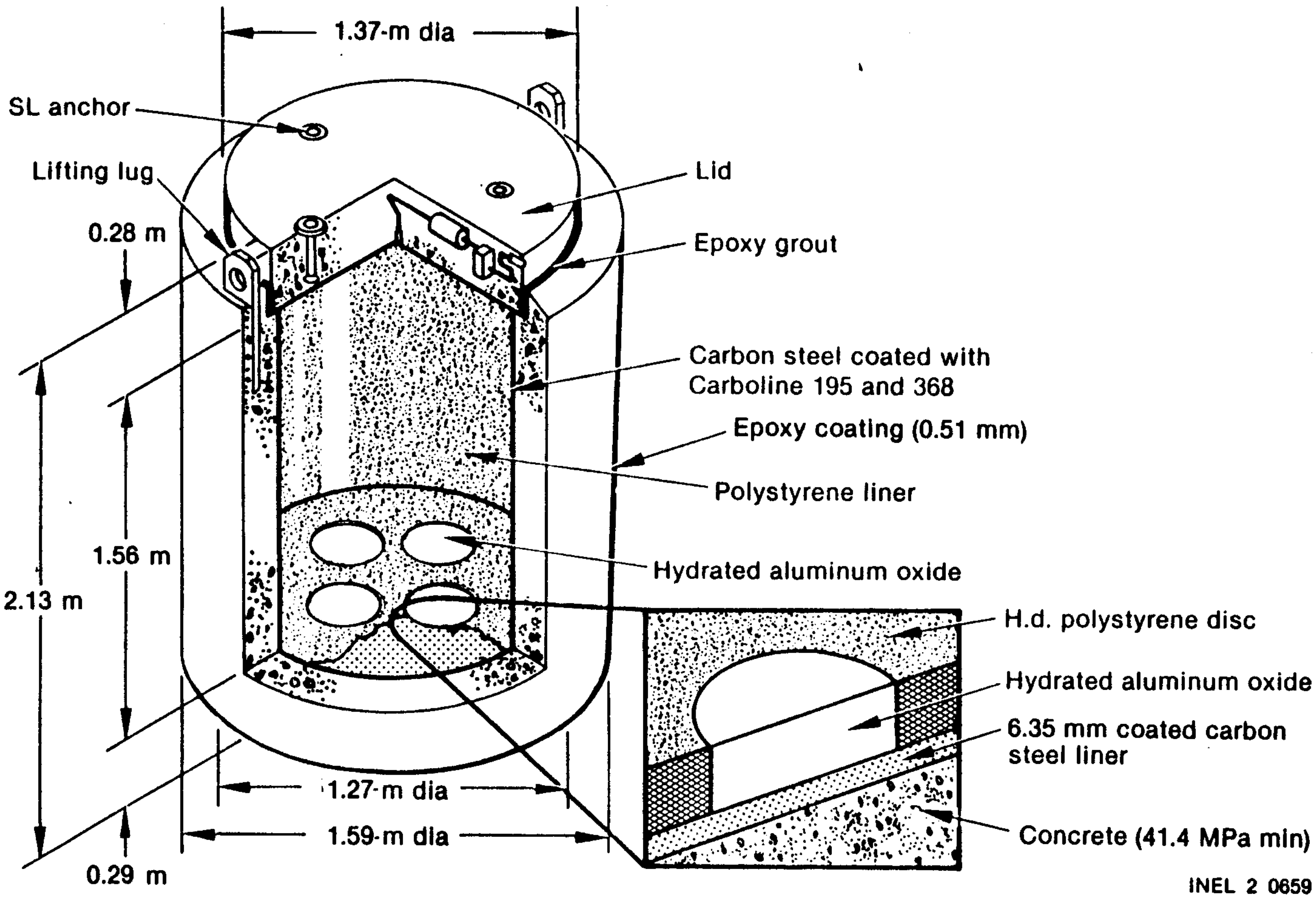

Figure 1. High Integrity Container

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