

FUTURE LOW-LEVEL RADWASTE DISPOSAL TECHNOLOGY A BURIAL SITE OPERATOR'S CONCEPT

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ABSTRACT

Passage of the low-level radwaste compact legislation has ushered in a new era for disposal methodology. Although 10CFR61 provides adequate guidance for site design and waste form acceptability, it has been clearly demonstrated by proposed legislation in many states that future disposal sites will require engineered facilities to assure confinement of the waste for at least 500 years.

Chem-Nuclear Systems, Inc. has developed a containment system that is generically applicable to low-level radwaste disposal. CNSI's 16 years of site operations experience has been utilized to guide the design of the system assuring compliance with 10CFR61 and practicality from both cost and operations viewpoints. This system provides containment commensurate with each waste class, and is readily extended to provide confinement of mixed wastes. The engineered disposal system provides redundant control; and when properly mated with the individual site characteristics, provides a tertiary level of assurance that the waste will remain confined and will resist even the most determined intruder.

This paper provides the detailed description of the enhanced disposal systems design and operation.

REGULATORY DESIGN REQUIREMENTS

Chem-Nuclear, Inc. has made an extensive study of the design requirements for what will become the third generation of low level radioactive waste disposal sites in the United States. The major input for this study was obtained from the federal regulations, and either proposed or existing state laws regarding the waste compacts and their disposal sites. Table I summarizes the technical requirements. There are two general concerns expressed in the regulations in addition to the requirements listed in Table I. First, the disposal technology must preclude water from coming in contact with the waste. Second, the technology must minimize the potential for inadvertent intrusion after institutional controls have ceased. Additionally, some compacts have expressly prohibited the familiar shallow land burial technology.

WASTE VOLUME AND TYPE

Another goal of this study was to identify the volume, classification and activity of the waste that will be available for disposal at a future site. While the actual volume is dependent on the particular compact, the distribution of the waste by class and activity is a generic function. The volume and specific characteristics of the waste received at CNSI's Barnwell Disposal Facility in 1986 were used as a basis for predicting the relative mixture of waste for a future site. This data is presented in Table II. It is interesting to note that 95% of the waste volume is Class A, but only 18% of the activity is contained in this material. In contrast, the Class C waste is less than 1% of the volume, and contributes more than 48% of the activity. Chem-Nuclear Systems, Inc. expects that new or improved volume reduction technologies

and proposed regulatory changes will increase the volume of Class B material, while decreasing the Class A material. These changes have been addressed in Chem-Nuclear's proposed design.

Mixed wastes could also be acceptable at some proposed facilities. However, the volume of it is undetermined at this time. The mixed waste contribution to the total activity is anticipated to be negligible.

ENVIROLOK DESIGN

The CNSI Envirolok design represents a generic low-level waste disposal facility having the capacity required for disposal of approximately 8500 cubic meters (300,000 ft³) of waste per year. The site has a design operating life of 20 years. The site requires an area of 2.59 km² (640 acres). However, the active site is only 48.8 meters (1600 ft) by 48.8 meters (1600ft) located in the center of the buffer zone. This provides a minimum distance of 561 meters (1840 ft) between the active site and any adjacent, privately owned property. Figure 1 presents a pictorial view of the site during placement of the cap and drainage control.

The disposal modules are designed to contain one year's waste volume (Fig. 2). They will maintain the dose rate below 1 mr/Hr. on contact with their outside surface, and minimize access to the higher activity waste by locating it in the center of each module. Mixed waste would be disposed of in separate modules to facilitate remedial action that may be required by regulatory changes in the future.

The disposal modules are separated into 5 compartments. Four of these form the outer quadrants, and the fifth is located in the center for receipt of the higher activity Class

TABLE I

Design Requirements for Future Disposal Facilities.

Annual Dose to the general public must be less than: 25 mr-Whole body
75 mr-Thyroid
25 mr-Any other organ

Institutional Control Period-100 years

Confinement of Waste - Class A-100 years
Class B-300 years
Class C-500 years
Mixed-500 years

Intrusion Barriers-Required for all Class B and Class C Waste
Must have 500 year life

Engineered Containment-No credit allowed for site characteristics or 10CFR61 requirements

Monitoring-Each Disposal Module must have leak detection monitoring

Identification-Each Waste Package must be identified

Retrievability-Each Waste Package must be retrievable
Remedial Action must not disturb other Disposal Modules

TABLE II

Design Volumes and Waste Types.

Waste Class	Volume			Percent of Activity
	Cubic Meters	Cubic Feet	Percent of Total	
Class A Stable	1240.3	43,800	14.6%	13.55%
Class A Unstable	6821.6	240,900	80.3%	5.08%
Class B	365.3	12,900	4.3%	33.19%
Class C	68.0	2400	0.8%	48.18%
Total	8495.2	300,000	100%	100%

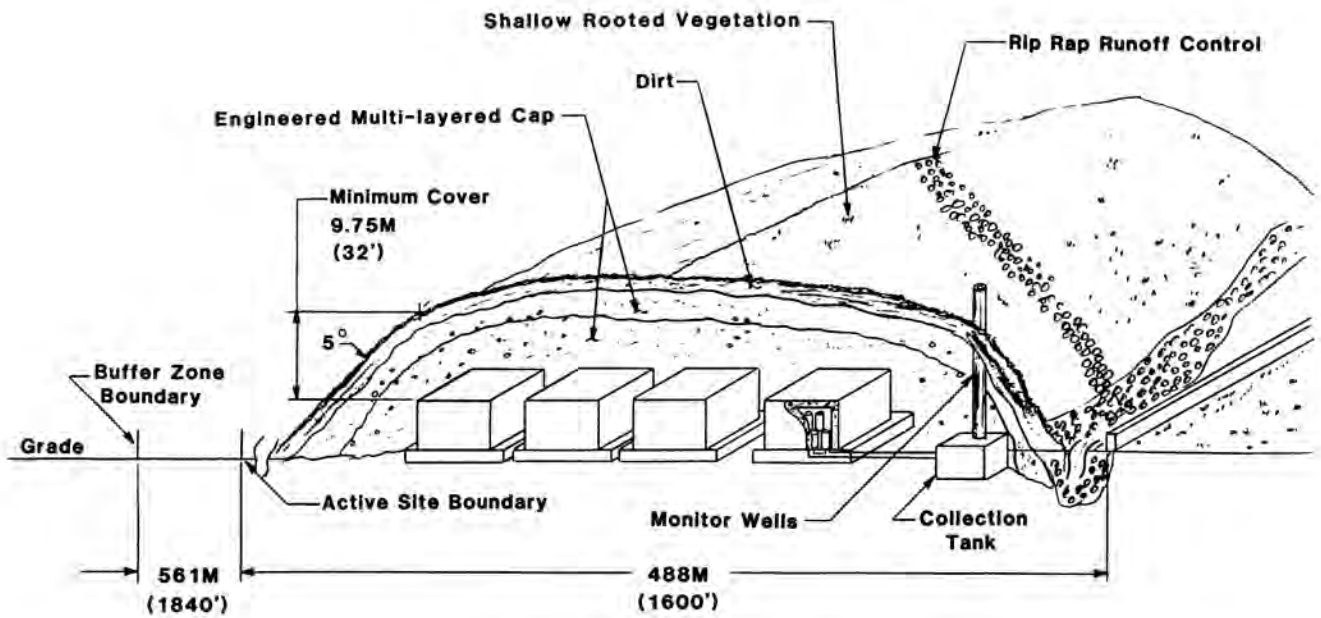


Fig. 1. EnviroLok Site Design.

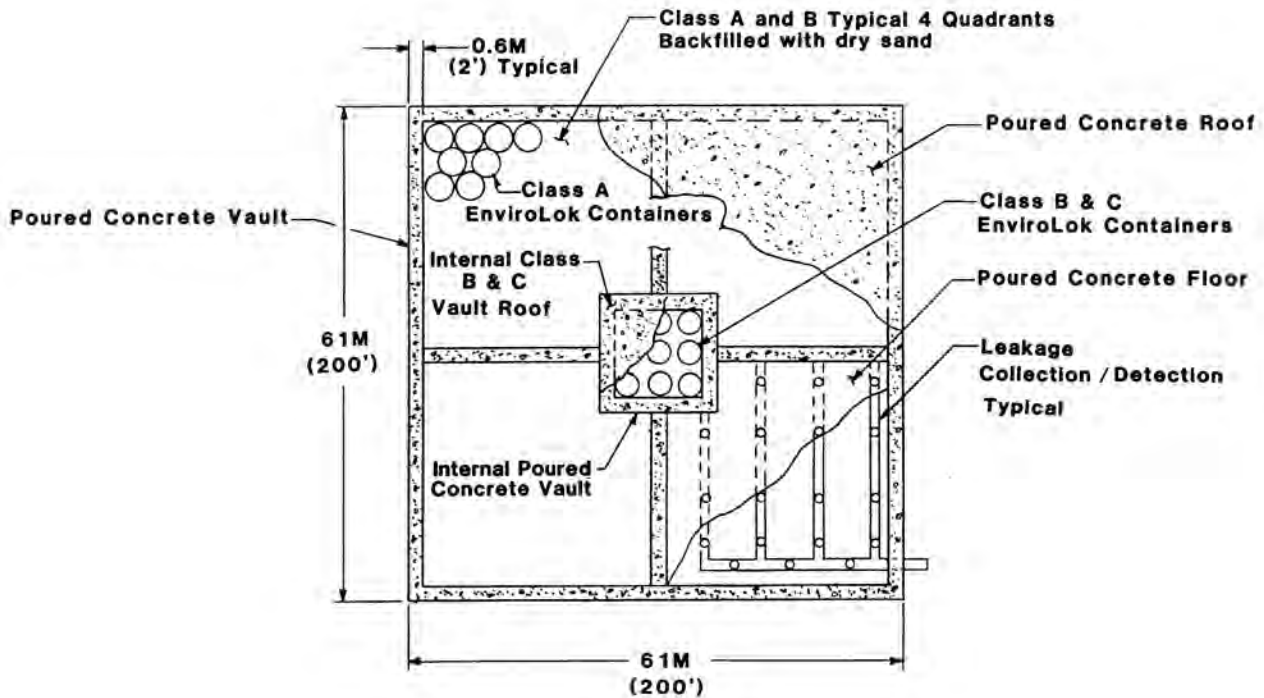


Fig. 2. CNSI EnviroLok Disposal Module.

B and C wastes. Each compartment is separately monitored to provide rapid detection of any liquid in the module. Designing the modules in this manner will also permit permanent closure of each compartment in a timely manner minimizing the amount of accessible waste on the site. Placement of the clay and earth cap will be deferred until 5 years after a module's closure. This will retain a high degree of monitorability during this period.

The site will be supported by the necessary ancillary services during its active life. These services will include repackaging, supercompaction, cask and equipment decontamination, construction, administration and health physics.

The CNSI Envirolok containers have been designed to optimize, containment, shielding, volume and cost for each class of waste. The proper use of these containers will ensure the maximum dose rate at contact with any package will be less than 200 mr/Hr. Figure 3 shows the containers that would be used in conjunction with each other to obtain the proper shielding and redundant containment where required. Table III demonstrates the versatility of these containers and the potential applications of each.

The containers have been designed to permit overpacking of the Class B and C containers in the Class A containers. Therefore, all Class B and C waste and mixed waste will have redundant, sealed containment. This also ensures that the ALARA concept is adhered to through the layered shielding of one container in another. The Class A containers provide 6.68 Cm (2.63 inches) of lead equivalent shielding while the B and C containers provide 4.65 Cm (1.83 inches) and 13.63 Cm (5.37 inches) of lead, respectively. When used together, the A plus B will provide 11.43 cm (4.5 inches), and the A plus C combination will provide up to 20.3 Cm (8 inches) of lead equivalent shielding. This will ensure that each waste package is below 200 mr/hr. at contact when it is placed in the disposal module.

COMPLIANCE WITH DESIGN CRITERIA

The CNSI Envirolok System meets all of the identified design criteria as shown in Table IV. This approach will provide safe disposal operations in future years, while minimizing the dose to the public and the operators of the site. It will also minimize and facilitate any remedial action by permitting early detection of any problem areas.

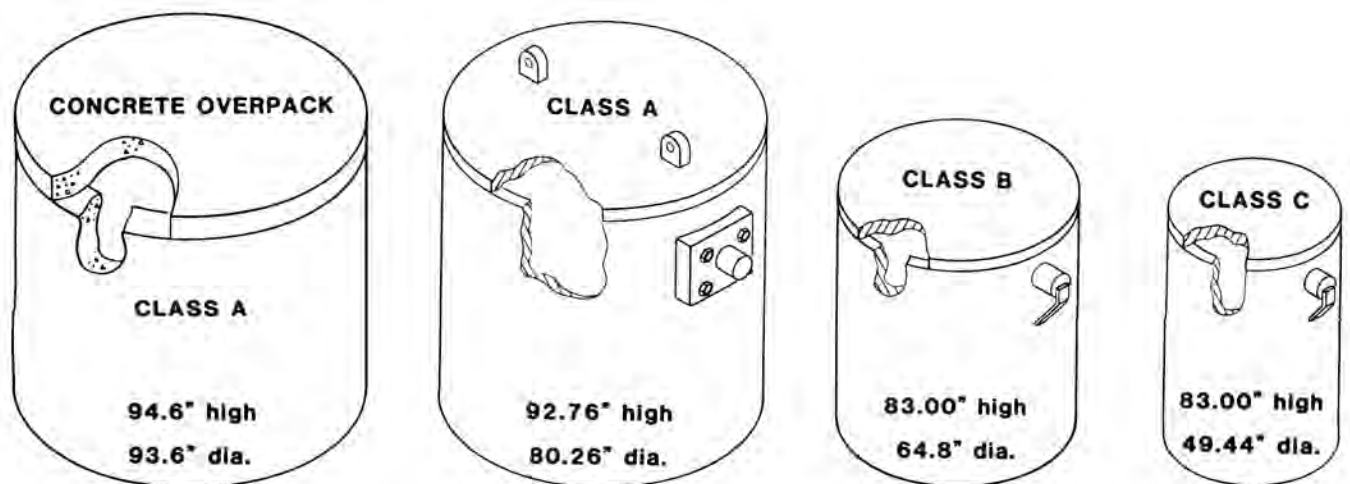


Fig. 3. EnviroLok Waste Containers for Transportation and Disposal.

TABLE III

Applications for EnviroLok Disposal Containers.

CONTAINER	APPLICATION								
	Encapsulation	Solidification	Dewatering	HIC	Mixed Waste	Transport Group	Ground Shield	Fuel Pool	Disposal
Concrete A	Yes	Yes	Yes	No	No	Less than Type A	2.63" Pb equiv	No	Classes AS & AU
EnviroLok-A	Yes	Yes	Yes	Yes	No	Type A	2.63" Pb equiv.	No	Classes AS & AU
EnviroLok-A & B	Yes	Yes	Yes	Yes	Yes	Type B	4.5" Pb equiv.	Yes	Classes A, B, C
EnviroLok - A & C	Yes	Yes	Yes	Yes	Yes	Type B	8" Pb equiv.)	Yes	Classes A, B, C

TABLE IV

Compliance with Design Criteria.

Dose To Public: Well below regulatory requirements.

Confinement: All wastes confined for minimum 300 years.
Class B,C and mixed waste confined for minimum 500 years.

Intrusion Barriers: Minimum Earth Cover = 9.75 Meters (32 feet).
Reinforced Concrete Disposal Module.
Reinforced Concrete Disposal Container.
Corrosion Resistant Container "X".

Engineered Containment: Design is applicable to above or below grade construction or to partially subgrade.
Totally independent of Site Characteristics,
EnviroLok Containers provide containment independent of waste form.

Monitoring: Each quadrant of each Disposal Module independently monitored during active period.
Each Disposal Module independently monitored during Institutional Control period.

Retrievability: Each Disposal Module accessible without disruption of adjacent modules.
Each Disposal Container accessible without breaching adjacent containers.

The design is applicable to almost any site regardless of the specific site geology. It can be adapted to permit construction of the modules above grade, below grade or partially below grade. The combination of the waste containers, disposal modules and multi-layer cap provide more than reasonable assurance that the waste will remain confined

and isolated from any source of water. The combination of deep (9 m) cover, reinforced concrete and the containers provide redundant protection from intrusion. The materials of construction have been carefully selected for their corrosion resistance and hardness. This will ensure frustration of even the most persistent intruder.