RADIOACTIVE WASTE ON-SITE STORAGE ALTERNATIVE

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ABSTRACT

The disposal of low level radioactive waste has become increasingly complicated over the past decade. Unfortunately, there is good reason for concern over the possibility of not having a disposal option available. This dilemma has forced both the large and small radwaste producer to plan for the unthinkable; no radwaste disposal. After exhausting the options of "Is it really radioactive", "Do we really have to produce it" and "Can we volume reduce it until it disappears", the only acceptable alternative is On-Site Storage.

The first, most frequently evaluated approach for the large producer is the construction of a relatively expensive storage building. However, with the likely possibility that at least one disposal site will remain available and the building never used, such expenditures are difficult to justify.

A low cost, but effective alternative, is the use of "On-Site Storage Containers" (OSSC) when and if required. Radwaste is only stored in the OSSC if a disposal site is not available. A small number of OSSC's would be purchased initially just to assure immediate access to storage. Only in the unlikely event of total disposal sites closure would additional OSSC's have to be obtained and even this is cost effective. With two or three months of storage available on site, production lead time is sufficient for the delivery of additional units at a rate faster than the waste can be produced.

The recommended OSSC design would be sized and shielding optimized to meet the needs of the waste generator. Normally, this would duplicate the shipping containers (casks or vans) currently in use. The reinforced concrete design presented is suitable for outside storage, contains a leakproof polyethylene liner and has remote sampling capability. Licensing would be under 10CFR50.59 for interim storage with long-term storage under 10CFR30 not an impossibility. Cost comparisons of this approach vs. building construction show that for a typical reactor plant installation, the OSSC offers direct savings even under the worst case assumption that no disposal sites are available and the time value of money is zero. Following realistic assumptions for the value of money, savings approaching three million dollars are realized. When the likely scenerio of continued site availability is considered, savings are between 6 to 20 million dollars. The possibility of leasing the OSSC's and eliminating all capital expenditures also provides further incentive for careful examination of this approach.

INTRODUCTION

A decade ago, "on-site storage" was an unknown phrase. In fact, at that time, "radwaste disposal" would only be recognized by relatively few people scattered throughout the nuclear industry. Disposal costs were at a $.78 per cubic foot level and with six sites distributed around the country, concern for long distance transportation costs was non-existent. In effect, radwaste disposal was efficiently accomplished with minimum involvement and at a very low total cost. Often radwaste disposal was carried out by plant operators on a part-time basis. However, since that time, four of the six disposal sites have been closed primarily due to political reasons, although frequently under the guise of technical problems. Transportation distances and associated costs have increased from several hundred miles to several thousands of miles. Regulatory restrictions as well as state and local taxes have increased the resulting disposal costs to an even greater proportion. However, even beyond this, the states have provided volume and inspection restrictions which make the continued availability of any disposal site quite suspect. In some cases, companies have been refused access to the existing sites due to a combination of procedural or operational errors. Therefore, the general concern of any organization dependent upon radwaste disposal continues to grow. The possibility of not having any disposal option available cannot be accepted by most organizations and contingency plans must be developed and implemented.

Resolution of this general problem was attempted by the Federal government by establishing the basis for a network of regional disposal sites. Although a 1986 deadline was set by Congress, real action has been very slow in most areas or states. With the exception of two regions with existing disposal sites, the remaining states are completely unprepared for this deadline.

The possibility of being denied access to the existing disposal sites is certainly finite whether due to regionalization, political or operational problems. This has forced both the large utility as well as the small radwaste producer to plan for the unthinkable, "no radwaste disposal". The first and economically most attractive alternative for any organization is to examine the whole arena in which radwaste is produced. This normally starts with "is it really radioactive?" and therefore can it be disposed of in a conventional way? If not, logic then extends to "do we really have to produce it?". This may involve minimizing the introduction of material into contaminated areas, not contaminating material which must be introduced or "getting out of the business" (normally not preferred). Another possibility, "can we volume reduce it until it disappears?", is an approach which usually makes the problem smaller or more easily handled but is not a complete solution (i.e., most curies remain). After advantage is taken of these three approaches, the only real remaining alternative is on-site storage. The small producer of relatively short half life material, generally hospitals or small industries, can consider little hideaways, back corners of rooms or relatively simple storage buildings. The larger producer of more active material, such as a nuclear power plant, has potential storage and exposure problems of considerable magnitude.

Typically, on-site storage for the large producer has been envisioned as a large concrete shielded facility encompassing sufficient volume for storage of the material produced over a period of five years. Conservative allowances are typically made for the amount of material which could be produced under adverse operational or accidental conditions. Then, the necessary provisions for cranes, loading docks, sampling stations, HVAC and decontamination areas are added. The cost of the resulting monolith is high and can range anywhere from 6 to 20 million dollars depending upon the assumptions made. This is an exceedingly large capital expenditure, especially, when one considers the likely possibility that a disposal site will be continuously available and the building never used! In spite of all the radwaste disposal problems to date and the associative political rhetoric, sites have been available. Such sites could remain accessible in the future until the regional compacts are established or on an emergency basis existing Federal sites made available. Also, the possibility that Congress would allow regional compacts to exist only in certain areas is unknown but obviously doubtful. With these strong possibilities, the expenditure of funds for an expensive building is unattractive unless no other "insurance" type alternative exists.

The "On-Site Storage Container" (OSSC) concept is such an alternative. This approach has the potential for eliminating all capital expenditures while providing the safeguards necessary to assure that a radwaste storage option is always available to the user.

ON-SITE STORAGE CONTAINER (OSSC) ALTERNATIVE

OSSC Concept

The OSSC concept is a building block storage approach based upon the use of containers approximately the size and shielding requirements of standard shipping transportation casks or vans. In effect, this is "an insurance Policy" concept. A relatively small premium (as an investment or lease charge) is made to secure a two to three month storage capacity. In the unlikely event that access to all disposal sites were prohibited, additional OSSC's could be purchased/leased as necessary. With the storage capability initially provided, ample time would exist for the production of additional units on an "as required" basis. Since the OSSC's are sized to duplicate both the volume and shielding characteristics of existing transportation containers, they can readily accept the normal configuration of liners, individual or palleted 55 gallon drums that are handled at the reactor facility. This eases subsequent off-loading for transport at a later date when a final repository is made available.

In addition to the long term requirements discussed, the OSSC's can also serve a very useful function during normal operations by providing temporary storage for short time operational surges. This offers a separate economical advantage by minimizing transportation cask and vehicle demurrage charges. Availability of properly packaged radwaste would be assured before such equipment would be requested.

The obvious advantage of the OSSC concept is flexibility. Other than the minor initial investment, no expenditures (capital or lease) would be required as long as a disposal alternative remains available. Under a mandated storage scenario, flexibility remains a key point in that the number of containers purchased can be keyed directly to both the actual radwaste production rate and its radiation level. No arbitrary assumptions are required to assure that the necessary storage volume would be available under upset conditions. Similarly, if radwaste elimination or volume reduction programs within the plant are found to be favorable, the containers ordered are simply matched to the lower radwaste production volumes.

The only requirement of the "insurance" program is that suitable arrangements be made for the potential production of containers well in advance of their possible required usage. Although molds exist for the rapid production of containers, in the event of the closure of all disposal sites, it would be necessary to give priority to the organizations having made a prior commitment.

OSSC Design Basis

The basic OSSC design is a concrete structure heavily reinforced with steel. Although it can be provided in essentially any size, the general configuration shown on Fig. 1 in conjunction with the dimensions shown on Fig. 2 appear to be most attractive. These are representative of the standard shipping casks typically being used at present. As such, they are useful building blocks that simplify future transportation and disposal operations.

As shown on Fig. 1, the OSSC has a removable lid which fully exposes the available storage volume. Its mating surface with the main container is gasketed and sloped to prevent rain intrusion. Lifting lugs are interlaced into the rebar and cast into the cement structure (Figs. 3 and 4). Sufficient lift capacity is provided such that a loaded OSSC may be lifted and moved by crane or on a transport trailer. The lift design capability for each configuration is proof tested by supporting the loaded OSSC by one of the three available lifting lugs (Fig. 5).

It is not anticipated that the OSSC would be used to store liquid waste. However, because of the usual conservative approach taken by the nuclear industry (belt and suspenders), a thick walled stand-alone polyethylene liner is included. A sampling/drain capability is provided through a syphon-type arrangement which also prevents inadvertent leakage. This sampling capability in conjunction with a periodic visual check on a representative container would meet the anticipated NRC inspection requirements.

In addition to the cask equivalent (shielded) OSSC's discussed above, large minimum shielding, storage containers for dry radwaste are also available. These would be more economical to use for material typically shipped in Standard Vans. Rectangular reinforced concrete containers of virtually any size may be provided. Thus large boxes or irregular configurations as well as standard 55

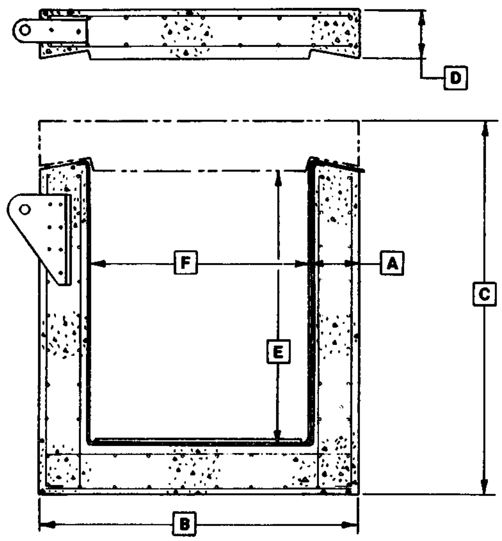

Fig. 1. OSSC Cross-Section.

OSSC DIMENSIONS
(INCHES)

CASK EQUIVALENT	A*	B*	C*	D*	E*	F*
CNSI 14-195H	13 1/8	105	108	14	80	78 1/8
CNSI 8-120	23	110	123	23	76	63
CNSI 21-300	8	101 1/4	127	8	110	84 1/8
CNSI 7-100	17 1/2	112 1/2	78	17 1/2	43	76 5/8
STANDARD VAN	6	N/A	N/A	N/A	(108 x 192 x 108h)	

OSSC CHARACTERISTICS

CASK EQUIV.	LINER CAP.	DRUM CAP.	CONTENT WT. LBS	COVER WT. LBS	EMPTY WT. INCLUDING COVER LBS	CONTAINER LOADED WT. LBS
CNSI 14-195H	200 ft^3	14	16,900	10,600	49,500	66,400
CNSI 8-120	126 ft^3	8	12,000	18,300	77,200	89,200
CNSI 21-300	322 ft^3	21	27,300	5,400	33,000	60,300
CNSI 7-100	87 ft^3	7	7,000	14,600	34,200	61,500
STANDARD VAN	1200 ft^3	96	-	21,300	75,000	-

Fig. 2. OSSC Dimensions and Characteristics.

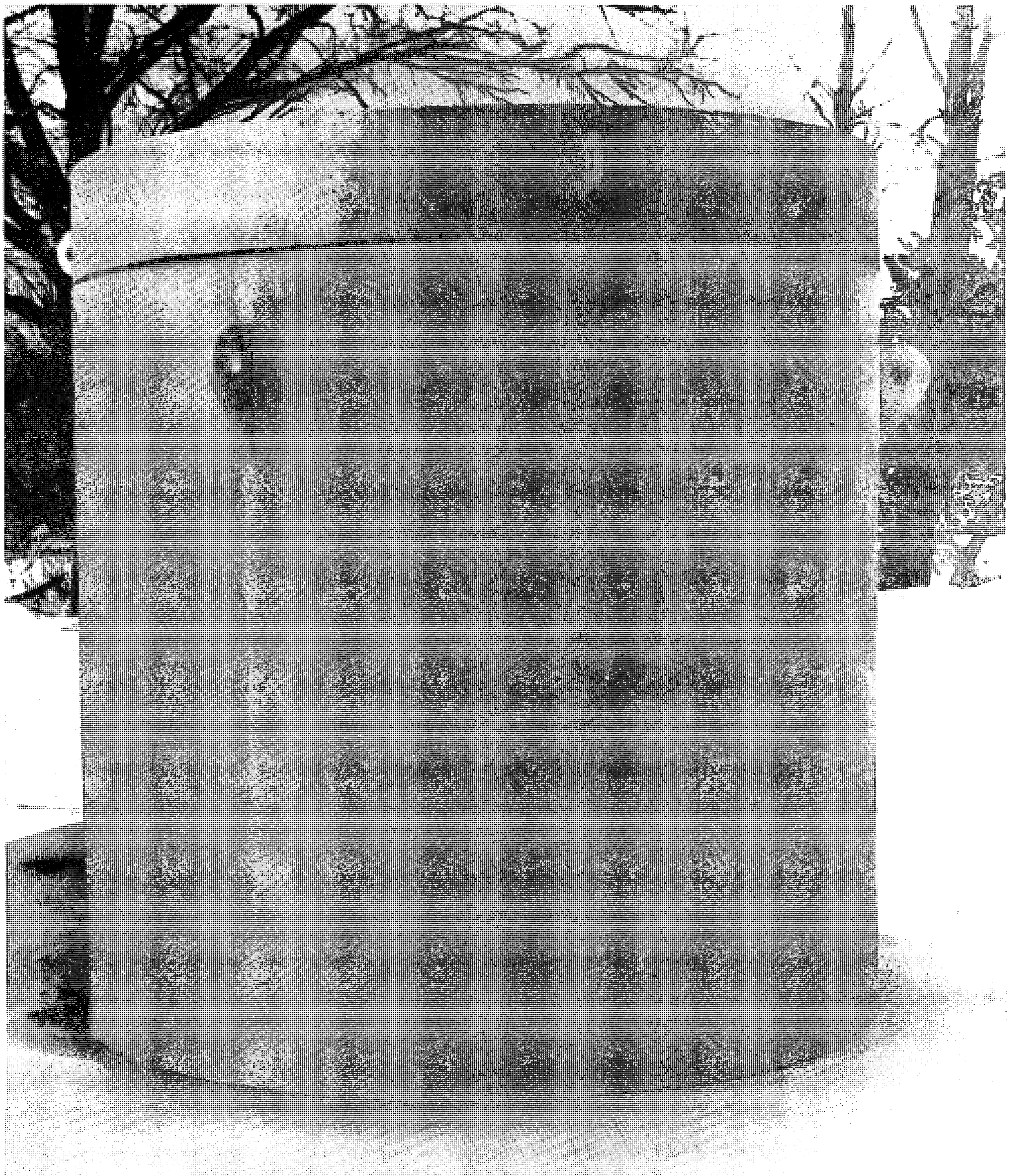

Fig. 3. OSSC 14-195 Configuration.

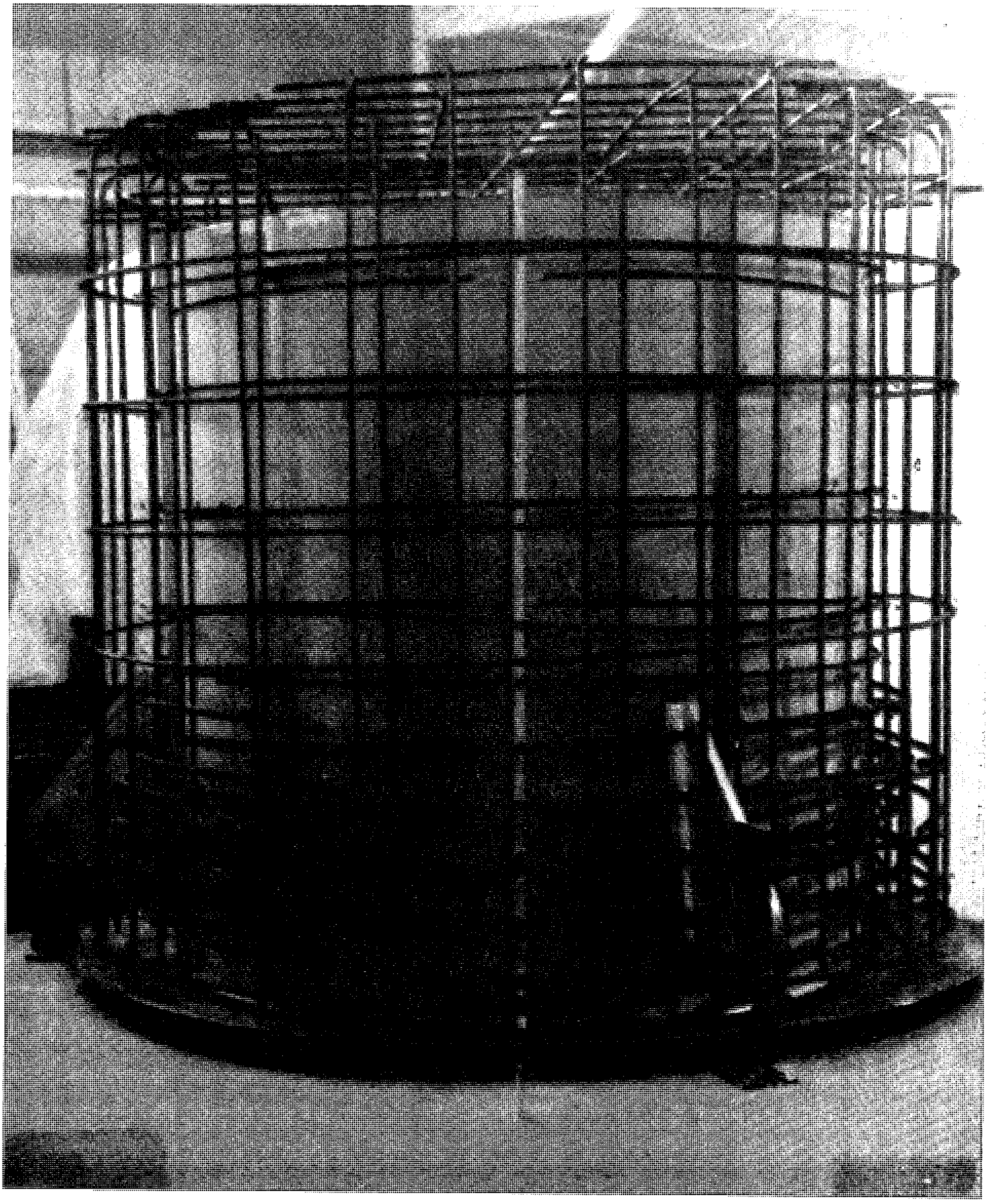

Fig. 4. OSSC 14-195 Steel Reinforcement.

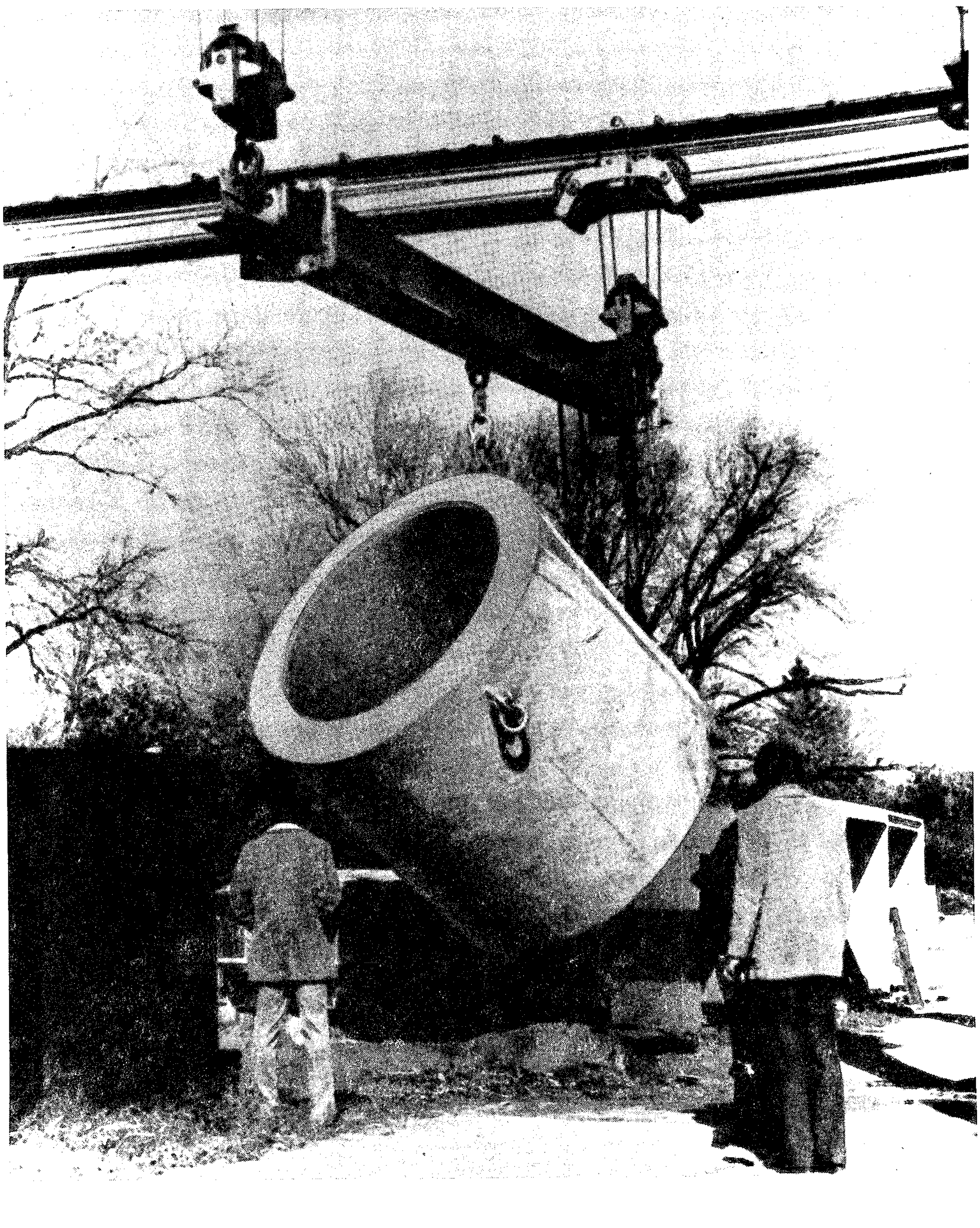

Fig. 5. OSSC Load TST.

gallon drums may be easily stored. One container with attractive storage features has internal dimensions of 9ft x 16ft x 9ft high with 6 inch sidewalls and a full lid with lifting rings. Container lifting lugs and liners are not normally provided but the sampling capability remains an inherent feature.

Any type of OSSC may be treated as a stand-alone container. These may be placed either (1) inside the reactor auxiliary building, as part of the normal waste processing/solidification operation, (2) inside the building for temporary operational storage purposes, (3) outside the building in a controlled area, or (4) just on-site in the "south forty" without surface preparation. Further, in the case of severe space limitations, the OSSC can be stacked.

Although not required for temporary storage, the design's inherent strength combined with its weight provides a structure that is not only weatherproof but also earthquakeproof and even tornadoproof under a wide range of conditions. It is anticipated that the OSSC would normally be used for relatively short-term contingency storage (less than five years) as allowed through a review by the reactor plant safety committee under 10CFR50.59. However, there is no apparent reason why this concept would not be found to be licensable as a long-term storage facility.

Economics

This section provides a simplified economic comparison of the OSSC and a comparable on-site storage building. A typical plant producing about 20,000 cubic feet per year was assumed. Approximately one-half of this volume would be compacted waste and one-half processed resin and liquid waste. Assuming reasonable filling efficiencies, this would provide approximately 3,000 drums per year for storage purposes. OSSC's sized to contain 21 drums were assumed on an average. Depending upon shielding requirements, more or less shielding could be required which would change both this specific OSSC selection as well as the building design.

Case 1 compares the on-site storage building vs. the OSSC for the likely case in which the burial sites are found to remain open to the radwaste producer.

Case 2 considers the worst case in which the radwaste site is assumed to be completely unavailable to the producer.

In both cases it is apparent that the economic advantage easily lies with the use of the OSSC. More exacting calculations could include both building and OSSC escalation costs, depreciation write-offs, property taxes (OSSC's are not taxable as property) and different "cost of money" figures. Such assumptions would vary for each user. However, when such a range of variables is examined, along with potential building costs well in excess of the $6 million assumed, the resulting economic conclusion favoring the use of the OSSC approach remains unchanged.

In addition, it is apparent that the OSSC offers the potential of eliminating all capital expenditures through a leasing arrangement. Such a lease arrangement would likely not be allowed if a major structure such as an on-site storage building was constructed.

CASE 1: DISPOSAL SITE AVAILABLE

STORAGE BUILDING COST (1) ...	$6,000,000	
CONSTRUCTION INTEREST (2) ...	430,000	
TOTAL BUILDING COST	$6,430,000	
OSSC COST (3)	$ 360,000	
NET SAVINGS		$6,070,000

CASE 2: DISPOSAL SITE UNAVAILABLE

BUILDING COST (SAME AS CASE 1)	$6,430,000	
OSSC COST (SAME AS CASE 1)	360,000	
ADDITIONAL OSSC FOR FIVE YEAR STORAGE (4)	3,330,000	
NET SAVINGS		$2,740,000

(1) Storage building cost is based on a 225 ft x 60 ft x 40 ft building capable of 5-year storage (15,000 drum) capacity at an estimated cost of between 6 to 20 million dollars.

(2) Building construction expenditures assumed evenly spread over a 12-month period at 15% cost of money.

(3) OSSC cost based on 3-month storage (36 containers at $10,000 each) with a priority production guarantee.

(4) 679 additional OSSC containers at $7,000 each based upon a quantity purchase. Since purchases are distributed evenly over the 5-year period, the total cost of $4,753,000 would be present valued to $3,330,000 for comparison purposes. Cost of money is assumed at 15%.

CONCLUSIONS

The on-site storage container approach is a preferred economic alternative to the construction of a permanent storage building. This is true when the disposal site is assumed to be inaccessible and overwhelmingly true under the likely condition that a disposal site will continue to be available to the radwaste producer. In addition, the OSSC may provide an immediate advantage during normal operations by reducing transportation and cask demurrage costs.