INTEGRATED EVALUATION OF LLW DISPOSAL FACILITY FINANCIAL ASSURANCE NEEDS

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ABSTRACT

The federal laws and regulations that specify financial assurance at LLW disposal facilities are reviewed. Potential financial loss scenarios are identified and evaluated in the case of a hypothetical disposal facility. The alternatives available to provide the necessary financial assurances are identified. A recommendation for providing financial assurances for the hypothetical facility is presented.

INTRODUCTION

Under provisions of 10 CFR 61, the applicant for a license to develop and operate a low-level radioactive waste (LLW) disposal facility is required to assure that the financial needs of developing, operating, closing, and maintaining the facility in the long term are adequately met. Among states and compacts who are developing and regulating the development of LLW disposal facilities, there is a need for more information about the potential financial losses that might occur, the magnitudes and dependencies of these potential losses and an assessment of financial assurances that are available to address the risks. The work reported here was sponsored by USDOE to provide the needed guidance on financial assurances (1).

FINANCIAL LOSS SCENARIOS

In order to assess the potential financial liabilities associated with a LLW disposal facility, several financial loss scenarios have been postulated. The scenarios represent situations that are not expected to occur at a disposal facility. They are intended to describe the broad range of unanticipated and worst-case events which could create financial liabilities to the entity responsible for the facility. These scenarios constitute an upper limit on the magnitude of financial loss potential.

The hypothetical disposal facility, used as the basis for numerical evaluations, is assumed to be located on the coastal plain of the northeastern U.S. and is designed to receive 235,000 cubic feet of waste per year over its 30-year operating life. A chronology of potential liabilities and unusual costs is presented in Table I, which forms a partial basis for much of the analyses for the financial loss scenarios.

Numerous financial loss scenarios have been postulated for the waste disposal facility. Of these the following were judged to encompass all possibilities and represent worst-case conditions for loss estimates:

- Normal Operations.
- Operational Accidents.
- Premature Vault Failure.
- Extreme Natural Occurrences.
- Trespasser.

Normal Operations

During the conduct of disposal operations at the disposal facility, workers are exposed to direct radiation from waste containers. Residents near the site could potentially be exposed by inhaling very low concentrations of airborne radioactive materials that might be released to the atmosphere during operations. Although any health effects to workers attributable to conditions in the workplace would be covered by Workers' Compensation insurance these analyses conservatively treat workers as members of the general public. The health risk to a resident near the site has also been estimated for the hypothetical site. The nearest resident to the site is located one kilometer away. Due to the short length of a typical site visit and the extensive precautions taken to protect visitors from exposure to radiation, the health risk to a site visitor is extremely low and not further quantified.

Operational Accident

The most probable type of accident is a forklift accident in which a waste container is damaged. The container is dropped and a fraction of the contents are released. Waste handling at the reference facility occurs indoors, so contamination is contained within the waste handling building. The second accident involves a crane malfunction. A crane transferring a highly radioactive waste container at the disposal unit was assumed to malfunction so that the waste

TABLE I

Chronology of Potential Liabilities and Unusual Costs

Time Period (yrs)	Who/What	How
0-5	Workers (50) and Families	Start-up accidents Industrial accidents
	Neighbors	Releases (atmospheric, surface water) from accidents Property devaluation and economic depression Legal challenges
	Site Damage	Start-up accidents Catastrophic natural events
	Trespasser	Exposure to radiation Carries contamination off-site
6-30	Workers (50) and Families	Industrial accidents Genetic effects due to routine exposures
	Neighbors	Releases (atmospheric, surface water) from accidents or vault failure Property devaluation and economic depression Legal challenges
	Site Damage	Catastrophic natural events
	Trespasser	Exposure to radiation Carries contamination off-site
31-32	Workers (20) and Families	Industrial accidents Genetic effects due to routine exposures
	Neighbors	Releases from catastrophic natural events or vault failure
33-35	Workers (15) and Families	Industrial accidents Route exposures
	Neighbors	Releases from catastrophic natural events or vault failure
36-45	Workers (10) and Families	Industrial accidents Routine exposures
	Neighbors	Releases from catastrophic natural events or vault failure Nuclide migration via groundwater
	Site Damage	Catastrophic natural events Vault failure
46-60	Workers (7) and Families	Industrial accidents Routine exposures
	Neighbors	Releases from catastrophic natural events or vault failure Nuclide migration via groundwater
	Site Damage	Catastrophic natural events Vault failure
61-135	Workers (5) and Families	Industrial accidents Routine exposures
	Neighbors	Releases from catastrophic natural events or vault failure Nuclide migration via groundwater
	Site Damage	Catastrophic natural events Vault failure

container remains suspended in the air. Two workers are required to repair the crane.

The third accident event assumes that a disgruntled worker places an explosive device near a disposal unit with the intent of damaging equipment and dispersing radioactivity on the site. The explosion breaches a box of Class A trash. The entire contents of the box are scattered over a radius of 30 feet. One worker was assumed to be exposed and an individual at the fence line observes the event and remains in the path of the contaminated cloud, breathing normally until it passes. The detonation of the explosive is followed immediately by rain which transports some of the material off-site in surface water and contaminates culinary water to an off-site resident.

Premature Vault Failure

The premature vault failure scenario assumes that one or more of the concrete disposal units is found to be performing unacceptably while the waste is still considered to be hazardous. A range of possible actions in response to a premature vault failure includes the following:

- Repairs to the defective vault.
- Waste stabilization or relocation.
- Extension of the groundwater monitoring system.
- Groundwater remediation.

The complete relocation of all waste disposed at the facility is not considered in these evaluations because the siting and design requirements imposed on new facilities are far superior to those applied to older LLW disposal facilities which have failed but which have not been wholly relocated.

Extreme Occurrences

In addition to damaging buildings at the site, an extreme event (earthquakes, windstorms, floods, or fires) is assumed to cause damage to the disposal units, although the concrete vaults are designed to withstand such effects. As a result of the assumed damage, waste containers may rupture and radioactive materials may be released. A windstorm or fire at the facility is a concern only if it happens during the operational period of the facility. Radioactivity could be released from Class A waste containers and transported off-site in air and water.

Financial losses for the extreme natural events scenario may result from the need to repair damaged buildings and disposal vaults, clean up contaminated areas, implement extended monitoring program, stabilize waste, relocate some waste, repair damaged earthen cover, remediate groundwater, monitor the health of exposed off-site population, or defend against legal claims for health effects and property devaluation.

Trespasser

The trespasser scenario assumes that an unauthorized individual enters the disposal site property during the 30-year operating period, despite responsible and reasonable security measures in effect at the facility. The trespasser is assumed to be a juvenile scavenger who enters the site, opens some of the waste containers, becomes contaminated, and carries some of the contamination off-site. The scavenger's activities are discovered either by monitoring personnel who discover contamination at the site or through reports from the individual's family or friends who suspect he may have been contaminated. Possible financial losses associated with a trespasser scenario include periodic health monitoring, legal defense, payment of judgements, and cleanup of contaminated on-site and off-site areas.

Scenario Evaluations

The potential financial losses to a facility operator have been quantified for the hypothetical facility by evaluating five loss scenarios. For each scenario the expected costs to the facility operator have been estimated by combining the maximum potential losses with the probability of occurrence. The potential losses incurred by the facility operator included legal defense, payment of health related claims, payment of property damage claims, environmental cleanup, remediation in response to failure of the disposal vaults, and the cost of health monitoring for individuals exposed to radiation. The financial loss scenarios and associated potential expected costs are summarized in Table II.

A Monte Carlo simulation was performed to evaluate the probable variation of actual losses about the expected average value. Table III summarizes the estimated probabilities of claims against an arbitrary fund in a given year exceeding the accumulated balance in the fund by various amounts. The probabilities are calculated under three scenarios. The first scenario assumes that the surcharge collected is expected, on average, to exactly equal the projected claims against the fund. The second and third scenarios assume that the surcharge will be 150 percent and 200 percent of the break-even charge.

FINANCIAL ASSURANCE MECHANISMS

There are three types of insurance losses which require coverage:

- Injury to workers.
- On-site cleanup costs.
- Liability to third parties for property and/or bodily injury.

Injury to workers is easily protected through the purchase of traditional Workers' Compensation insurance policies. Coverage for on-site cleanup is substantially more

TABLE II

Summary of Estimated and Expected Costs Associated with Financial Loss Scenarios

Financial Loss Scenario	Largest Estimated Cost	Present Value of Expected Cost
Normal Operations	$44,000	$21,000
Operational Accidents	930,000	500,000
Premature Vault Failure	5,900,000	25,000
Extreme Natural Occurrences	34,000,000	1,900,000
Trespasser	145,000	41,000
Total*		$2,500,000

* Total may not equal the sum of individual components because of roundoff error.

TABLE III

Probability of a Deficit in the Fund

Col (1)	Col (2)	Col (3)	Col (4)
Maximum Fund Deficit in Any One Year (in 1990 $'s)	Probability of Deficit at Least as Large as Col (1) During Years 0-135 Given Surcharge of:		
	Break-Even	150% Break-Even	200% Break-Even
25,000,000	1%	1%	1%
10,000,000	7%	6%	5%
5,000,000	12%	10%	8%
2,500,000	18%	14%	12%
1,000,000	25%	18%	16%
500,000	29%	20%	17%
250,000	31%	22%	18%
100,000	34%	23%	20%
<100,000	100%	100%	100%

NOTE: Cols (2) - (4) represent the probability that sometime during the first 135 years of the life of the facility, claims against the fund will exceed the accumulated balance in the fund by at least the amount in Col (1).

difficult, since it is not currently available from commercial insurers. Liability protection for losses caused or alleged to be caused to property or persons who are not employees of the facility is required. Although unlikely, such losses have the potential to be financially catastrophic and therefore require special consideration. Third-party liability insurance is generally available for LLW disposal facilities in the U.S. from only one source, American Nuclear Insurers (ANI). The limit of such protection is currently $25 million. Any need for protection beyond that limit might be met through self-insurance.

Commercial insurance is a financial arrangement where one state-licensed party agrees to compensate another party for a loss that results from the occurrence of a specified event. Insurance may also be defined as a device for reducing risk by combining a sufficient number of (risk) exposure units to make their individual losses collectively predictable. The predictable loss is then shared proportionately by all units in the combination.

The only commercially available source of liability insurance for LLW disposal facilities is ANI. ANI has provided third-party liability coverage to LLW disposal facilities and continues to do so for existing facilities. ANI will not guarantee to provide liability protection in the future. It may, however, provide insurance during the post-closure and institutional care periods, subject to its underwriting requirements and the maintenance of adequate engineering safeguards at that facility.

An alternative to traditional commercial insurance is self-insurance. Self-insurance is defined as a formal decision to retain risk rather than purchase commercial insurance. A self-insurance program is distinguished from non-insurance or risk retention through systems and procedures that provide for the payment of losses when they occur. Self-insurance is not simply the absence of insurance. It is a planned, methodical approach to the assumption of risk, including the allocation of resources to pay losses when they occur. Self-insurance is most appropriate when:

- The insured finds insurance to be too expensive.
- the insured finds insurance unavailable.
- Losses are frequent and small.
- Losses are not infrequent and large.

Not all of these characteristics are typical of the LLW disposal industry. Nevertheless, given that traditional commercial insurance may not be available, particularly at a reasonable cost, it is necessary to consider self-insurance as an alternative.

Self-insurance for each facility alone could be utilized to develop a source of funds that would be available to satisfy losses, should they occur. Funds could be collected from waste generators through a surcharge on disposed waste, deposited in a fund, and paid out as losses occur (i.e., pre-funded). Alternatively, losses could be post-funded. That is, funds are not collected before the loss occurs, but firm contractual arrangements are made to assure future funding, should the need develop. A major reservation with post-funding potential financial losses is the probability that not all generators which utilized the disposal facility would be available, capable, or even in existence when the losses must be funded.

Self-insurance of each facility alone seems to be a logical solution to the lack of traditional commercial insurance, except for the inherent uncertain actuarial stability. Insurance pools are a variation on self-insurance, where a number of members gather together to form a group self-insurance mechanism providing a special type of insurance. Sharing the risk through an insurance pool (many or all LLW disposal facilities together) offers the advantage over individual self-insurance of being more economically efficient (i.e., committing less capital to the protective fund). However, an important limiting condition for implementing insurance pools to service LLW disposal facilities is the challenge of obtaining agreement from all states or Compacts to participate in a pooled arrangement. As in any group situation, there are more competing interests, to satisfy in a group than in a single entity. The current LLW disposal industry tends to be fragmented with little centralized or shared planning between states and regions. This points to the need for some centralized sponsorship in order to implement the pooled sharing of risks for many or all new LLW disposal facilities.

Financial assurance mechanisms to protect against the costs of on-site cleanup include:

- Individual pre-funded self insurance.
- Individual post-funded self insurance.
- Pooled pre-funded self insurance.
- Pooled post-funded self insurance.
- Surety bonds.
- Financial guarantees.

For protection against third-party liability costs the same options exist, with the addition of commercial insurance through ANI.

The question of how best to construct a financial assurance mechanism for low-level waste facilities is complex. Based on the characteristics of the LLW disposal industry and the current availability of insurance coverage, a possible financial assurance program for the hypothetical LLW disposal facility was developed as summarized below:

- Obtain commercially available insurance - covers the Workers' Compensation exposure entirely; can currently provide up to $25 million in liability coverage.
- Provide pre-funded self-insurance for $10 million (to cover the physical cleanup costs) and an additional $9 million (post-funded) to cover excess liability loss potentials. For any actual facility, site-specific analyses of loss potentials would be necessary to determine the required levels of coverage, as well as the burning and excess layers.
- Participate in a post-funded industry insurance pool for protection against all loss potentials in excess of these projected by individual self-insurance programs. The insurance pool could be created by a post-loss assessment on the waste generators, according to the amount of waste probably in terms of activity rather than volume disposed in all facilities. The pool would theoretically need to be unlimited. The pool would be available to pay excess losses above the cleanup costs determined by each individual facility ($10 million in this example); the commercial third-party liability insurance and excess liability self-insurance protection ($34 million); or a combination of the two.

The financial assurance program suggested for the hypothetical facility is summarized in Table IV. The suggested program is a sequence of coverages, starting with commercial insurance for the most likely loss potentials, continuing with individual self-insurance for less likely loss potentials, and concluding with pooled self-insurance for least likely loss potentials. The details of the financial assurance program for any actual LLW disposal facility must be determined on the basis of site-specific analyses. The availability of an industry insurance pool is contingent upon agreement among Compacts and states. At present, no discussions have been held to seriously consider this possibility.

The combination of exposures, life cycle, insurance availability, and catastrophic but remote loss potential, leads to the following suggestions:

- Workers Compensation insurance should be mandated and purchased by the facility operator, on be-

TABLE IV

Summary of Financial Assurance Program Suggested for Hypothetical LLW Disposal Facility

Potential Loss Type	Provide Assurance By:
Claims from Workers	Workers Compensation Insurance
On-Site Cleanup Costs	Individually self-insure (pre-funded) to $10 million Self-insurance through a post-funded pool excess of $10 million
Third-Party Liability Claims	Commercial Insurance to $25 million limit* Individually self-insure (post-funded) excess of $25 million to $34 million limit* Self-insure through a post-funded pool excess of $34 million

* If commercial liability insurance is not available, individually insure (post-funded) to $34 million limit.

half of all employees, during the active and post-closure phases of the facility.

- Individual facilities should consider accumulating and maintaining self-insurance funds sufficient to cover remedial action costs up to a total of several million dollars, depending on the site.
- Losses exceeding self-insurance coverage identified above might be funded by post-loss assessment against all waste generators using such facilities.
- LLW disposal facilities should consider purchasing $25 million of insurance from commercial sources, if available.
- For losses exceeding $25 million, LLW disposal facilities should consider participating in a pool to provide a combination of pre-funded and post-funded protection against third party liability claims.

REFERENCES

1. R.D. BAIRD and G.B. MERRELL, Rogers and Associates Engineering Corporation; R. BETTERLEY and P. LEHMULLER, Betterley Risk Consultants, Inc.; R. BIONDI and M. PESTCOE, Milliman & Robertson, Inc., "Integrated Evaluation of Financial Assurance Needs for LLW Disposal Facilities," RAE-9006/1-1, prepared for EG&G Idaho, Inc. by Rogers and Associates Engineering Corporation, Betterley Risk Consultants, Inc., and Milliman & Robertson, Inc. (Draft Report).