IMPROVING ESTIMATES OF VOLUMES TO BE PLACED IN THE MIDWEST COMPACT DISPOSAL FACILITY

Robert D. Baird
Arthur A. Sutherland
Rogers and Associates Engineering Corporation
Salt Lake City, Utah
Gregg S. Larson
Midwest Interstate Low-Level Radioactive Waste Commission
St. Paul, Minnesota

ABSTRACT

An intensive investigation of past, current, and projected volumes and treatment methods was conducted for low-level radioactive waste from the Midwest Compact region. The investigation included numerous site visits to interview cognizant personnel and seek insights that could help refine projections of future waste from normal operations. Estimates of potential waste volumes from unscheduled events at nuclear power plants and from such factors as changes in the regulatory and political environments were also developed. The information was combined to determine the range of potential waste volumes going to the Compact's first regional disposal facility.

INTRODUCTION

It is important for all states and compacts that are developing new low-level radioactive waste disposal facilities to project as accurately as possible the volumes of waste that will be placed in these facilities. If the projections are too low, they may result in early closure of the facility because the area devoted to disposal of low-level radioactive waste will be filled before the scheduled closure of the facility. If the projections are too high, additional costs will be incurred for acquiring land that won't be needed unless the lifetime of the facility is extended.

The Midwest Interstate Low-Level Radioactive Waste Commission is charged with the responsibility of assuring availability of disposal capacity for LLW generated within its region. The Midwest Compact has designated Michigan as the first host state and intends to have a disposal facility in Michigan that will last for a period of 20 years. In the past Michigan indicated that it might set a limit on the volume of LLW, among other things, that can be placed in the facility in that state. All of these factors dictate that a good estimate of waste volume for the projected lifetime of the Compact's first facility must be established.

Earlier projections, based primarily on telephone interviews with some waste generators and waste volume information contained in surveys conducted by the Conference of Radiation Control Program Directors and the separate states(1,2) indicated that an annual volume of about 170,000 cubic feet was expected to be received at the Compact's disposal facility. Recent history has indicated that the volumes of waste are dropping rapidly and that a new estimate should be developed.

The procedure followed in developing the estimate described in this paper was generally much more intensive than those that have been conducted by other states and compacts. The procedure sought, among other things, to get the appropriate personnel from the major waste generators to focus on their projections over the 20-year period that the Compact's first facility will operate. It differed from most other surveys primarily in the steps of preparing historical information, presenting it to the major waste generators, and then interviewing those generators face-to-face to get the very best projection that they could provide. It is felt that this approach is superior to the more common approach of sending out questionnaires and asking the waste generators to mail them back.

DATA COLLECTION METHODOLOGY

Collecting Data From Large Waste Generators: The major large generators --those that are expected to generate the majority of waste within the Compact were identified from information in a previous survey(3). These generators included all of the utilities within the region and 11 non-utility waste generators. Each of the large generators was projected to ship more than 1,000 cubic feet per year for disposal at the new regional disposal facility.

All the current utility waste generators (that is, twelve reactor stations) were visited, along with five large non-utility generators. The five non-utility generators visited were representative (in terms of representing industry, medical facilities, and universities) of the entire set of non-utility generators. Prior to each visit, information was assembled from existing sources on the history of waste shipped for disposal from the generator. Graphs and tables showing the year-by-year history of waste generation by major waste streams were prepared. The graphs and tables, along with a detailed questionnaire eliciting a variety of information about current and future waste volumes, were sent to the waste generators prior to the visits. The questionnaire included a portion devoted to decommissioning.

The purpose of the site visits was to review the answers to the questionnaire and the historical information collected, and to elicit from the appropriate personnel carefully considered projections of future waste treatment and volumes of waste to be sent for disposal and the reasons behind the projections. In addition to information about waste generated from normal operations (including refueling operations), information was sought about unusual and infrequent events at utility power stations that could generate significant volumes of waste. These unusual and infrequent events included such things as steam generator changes or retubing.

In addition to the five non-utility waste generators that were interviewed on-site, six large non-utility waste

generators and 19 small (less than 1,000 cubic feet per year) non-utility generators were interviewed by telephone. In all, waste generators expected, based on the previous surveys, to provide about 92% of the regions waste were contacted directly during this survey.

WASTE TREATMENT SCENARIOS USED FOR THE PROJECTIONS

Normal Operations: Detailed projections, by waste stream, were obtained from all the waste generators interviewed, either by telephone or on site, for their "normal operations" that is, all waste-producing activities except the unusual and infrequent events at utility reactors. The projections were elicited for the 20-year period for which the regional disposal facility is anticipated to be operating (1993 to 2012 inclusive). For some of the university and industrial waste generators these projections included plans for expansion of research or manufacturing efforts.

From the information provided by the waste generators about their plans for generating, treating, and shipping waste in the future, projections of the 20-year volume of waste to be sent to the regional disposal facility were developed for six different waste treatment scenarios for normal operations. These waste treatment scenarios were:

- The Base Case. The base case represents a continuation of current or projected waste treatment practices.
- Solidification of All Utility Process (Wet) Wastes.
- Supercompaction of All Trash.
- Solidification and Supercompaction (a combination of the preceding two scenarios).
- Loss of Offsite Supercompaction.
- Solidification With Loss of Offsite Supercompaction (a combination of the second scenario and the fifth scenario).

The scenario involving solidification of all utility process waste generally results in a large increase in waste volume above the base case. Solidification of process waste is being considered as a requirement on waste form by some compacts and states. The scenario of supercompaction of all trash presumes the availability of an offsite supercompaction facility after 1993 to which some waste generators can send their waste prior for treatment and transshipment for disposal. The loss of offsite supercompaction scenario presumes that no offsite supercompactor will be available to the waste generators (presently several of them are using offsite supercompaction services) and that they will find it uneconomical to develop supercompaction facilities at their own location. The remainder of the scenarios are combinations of those discussed in this paragraph.

None of these scenarios include incineration. That method of treatment was not addressed in the same detail because of the uncertainty about availability of an incineration facility.

Utility Unusual and Infrequent Events: As noted earlier, the utility waste generators were asked to describe unusual and infrequent events that could lead to the generation of significant volumes of waste during the 20-year operating period of the Compact's first disposal facility. The events described by the generators included such things as steam generator changes, resleeving of steam generators, disposal of contaminated soil and other materials that are presently on site, etc. Each event was assigned an estimated volume of additional low-level radioactive waste that could be required for disposal. Furthermore, each event was assigned, as a result of the conversations with utility personnel, to one of three probability categories high probability, some probability, or low probability. The probability categories were used to estimate a reasonable likely waste volume from all of the unusual and infrequent events described by the utility generators.

Miscellaneous Factors: Six "miscellaneous factors" that could have major impact on the volume of waste sent for disposal were defined and changes in waste disposal volumes that would occur if these events happened were estimated. The miscellaneous factors were:

- Waste contaminated with low levels of radioactivity will not require disposal at a regulated facility. In other words, certain waste could be considered "below regulatory concern".
- Some naturally occurring and accelerator produced radioactive materials (NARM) will require disposal in the Compact's facility.
- Nuclear power reactors will be dismantled immediately after they cease operation. (The nominal assumption is that they won't be dismantled during the time the region's first disposal facility operates).
- Disposal operations at the compact's first facility are delayed.
- The social and political climate regarding nuclear power might change, with sentiment becoming more in favor or less in favor of nuclear power.
- An accident occurs at a nuclear power plant within the Compact region.

PROJECTIONS OF VOLUMES OF WASTE SENT TO THE MIDWEST COMPACT'S FIRST REGIONAL DISPOSAL FACILITY

The information collected as described above was combined with the waste treatment scenarios and probabilities assigned to unusual and infrequent events to develop a number of estimates of the volumes of waste that would be sent to the region's first disposal facility. Estimates of waste from normal operations are shown in Table I. It can be seen that the estimated total volume varies from about 1.9 million cubic feet for the supercompaction scenario to about 2.8 million cubic feet for the solidification with loss of offsite

supercompaction scenario. The base case volume estimate is approximately 2.2 million cubic feet.

TABLE I
Estimates of Waste Volumes From Normal Operations
(thousands of cubic feet in 20 years)

Waste Treatment Scenario	Utilities	Large Non-Utility Generators	Small Non-Utility Generators	Total
Base Case	1,640	410	100	2,150
Solidification	1,910	410	100	2,420
Supercompaction	1,390	370	100	1,860
Solidification and Supercompaction	1,700	370	100	2,170
Loss of Offsite Supercompaction	1,800	540	160	2,500
Solidification With Loss of Offsite Supercompaction	2,070	540	160	2,770

The scenario with the smallest volume estimate in Table 1 represents a reduction of about 17 percent from the base case, while the scenario with the largest volume projection represents an increase of about 29 percent over the base case. The supercompaction scenario assumes that all compactible trash will be supercompacted to a volume reduction ratio of 8. The difference between the volume estimate for the supercompaction scenario and the base case is a result of additional compaction of trash beyond what is presently being done or will be done in the near future. The solidification with loss of offsite supercompaction scenario assumes that all reactor process (wet) waste must be solidified. This assumption leads to an increase in volume above current practice for reactor wet wastes. It also assumes that access to offsite supercompaction facilities will be lost and the generators will not replace that capability with onsite supercompactors. Consequently there is an increase in the volume of waste from generators that are currently using offsite supercompaction.

The information provided by the utilities on unusual and infrequent events at nuclear power plants was combined using a probabilistic approach. As noted earlier, three categories were established for these events: high probability, some probability, and low probability. The volumes attributable to those events that were characterized as having a high probability were assigned a probability of 0.9; those categorized as having some probability were assigned a probability of 0.5; and those with that were considered to have low probability were assigned a probability of 0.1. By weighting the volumes attributable to these events by the assigned probabilities, an estimate of the likely volume of waste to be sent to the regional disposal facility over its 20-year lifetime of 200,000 cubic feet was reached. Had all of the utility unusual and infrequent events been assigned a probability of 1 the estimate would have been 425,000 cubic feet. It is noteworthy that neither of these numbers represents a very large fraction of the total estimated volume from normal operations.

The estimates of incremental waste volumes from the miscellaneous factors are shown in Table II. For each factor, a minimum, probable, and maximum incremental volume were estimated. The two largest potential reductions in the waste volume to be shipped to the disposal facility would result from permitting BRC disposal at facilities other than the Compact's regional facility, and changes in political conditions that lead to early shutdown of the reactors within the Compact region. The largest increases in volume from miscellaneous factors would result from reactor decommissioning involving immediate dismantlement of the reactors, and from changes in political conditions that would encourage the construction and operation of additional utility power reactors within the region. An accident at a reactor of a magnitude similar to that at Three Mile Island is estimated to produce 300,000 cubic feet of additional low-level radioactive waste. The sum of incremental volumes from the probable volume estimates for all six miscellaneous factors is shown in Table II to result in a net reduction of approximately 120,000 cubic feet of waste over the 20-year life of the first regional disposal facility. While adding the values for probable incremental volumes is appropriate, adding the values in the minimum volume and maximum volume columns would represent very extreme combinations of situations.

Adding the probable values of volume projections from normal operations, utility unusual and infrequent events, and miscellaneous factors results in an estimated total volume to be sent to the regional disposal facility of approximately 2.2 million cubic feet over the 20-year facility lifetime. This results from adding the volume estimates for the base case for normal operations and 200,000 cubic feet from unusual and infrequent events at utility reactors, and subtracting the 120,000 cubic feet for the sum of probable incremental volumes for miscellaneous factors.

A reasonable range of estimated volumes for disposal that brackets this most probable value is shown in Table III. The low volume estimate is the sum of the smallest volume estimate from normal operations, 200,000 cubic feet from utility unusual and infrequent events, and the reduction of 830,000 cubic feet that would result from maximum implementation of BRC disposal. The high estimated total volume results from the highest volume from the scenarios for normal operations, 200,000 cubic feet from utility unusual and infrequent events, and an increase of 580,000 cubic feet due to an improvement in the political climate for nuclear power leading to construction and operation of new reactors within the region.

SUMMARY

The following observations summarize the results of the detailed projections of volumes of waste to be sent to the Midwest Compact's first disposal facility:

- The probable volume to be sent to the facility in its 20-year lifetime is 2.2 million cubic feet.

TABLE II
Incremental Waste Volumes Attributable to Miscellaneous Factors

Factor	Implementation Date	Additional (Reduced) Disposal Volume (thousands of cubic feet) Minimum Volume	Probable Volume	Maximum Volume
Allowing BRC Disposal	1993	(970)	(260)	0
	1998	(730)	(200)	0
Regulation of NARM	1993	0	60	60
Waste Disposal	1998	0	50	50
Reactor Decommissioning		80	80	490
Delayed Startup of the Disposal Facility (3 yrs)		0	0	60
Changes in Political Conditions		(850)	0	700
Nuclear Power Accidents		0	0	300
	TOTAL	(120)		

TABLE III
Potential Range of 20-Year Volume Estimates

Source	Estimated Total Volume (thousands of cubic feet) Low	High
Normal Operations	1,860	2,770
Utility Unusual and Infrequent Events	200	200
Miscellaneous Factors	(830*)	580**
TOTALS	1,230	3,550
Percent of Probable Volume Estimate	55	159

* Maximum implementation of BRC disposal with all other miscellaneous factors are those for the probable-volume case.
** Significant improvement in the political climate for nuclear power with all other miscellaneous factors are those for the probable-volume case.

- A reasonable range for the volume estimate is from 1.2 million to 3.6 million cubic feet. This represents from 55 percent to 160 percent of the probable volume.
- In spite of the wide range of possible volumes to be sent to the regional disposal facility, the difference in land area required for disposal from the low estimate to the high estimate is only about 30 percent. Michigan law requires a 3,000 foot buffer zone surrounding the disposal area and this large buffer makes the total land needed relatively insensitive to the volume of waste placed in the disposal facility.
- The probable estimate translates to an average waste volume of approximately 110,000 cubic feet per year. The previous estimate, made in early 1987, was about 170,000 cubic feet per year. While the volume projections have declined rapidly in about two years, this decline is due largely to increased use of supercompaction and better

procedures to prevent the generation of waste. Waste volume is not expected to continue to decline at this rate.

REFERENCES

1. LARSON, G., "Utility Reactor Survey," memorandum to Commissioners and Staff, Midwest Interstate Low-Level Radioactive Waste Commission, January 6, 1987.
2. LARSON, G., "Non-Utility Generator Survey," memorandum to Commissioners and Staff, Midwest Interstate Low-Level Radioactive Waste Commission, January 16, 1987.
3. "Assessment of Waste Characteristics and Waste Management Practices for the Midwest Compact Region," Midwest Interstate Low-Level Radioactive Waste Commission Regional Management Plan, June 1986.