SEGREGATION OF LOW-LEVEL DRY ACTIVE WASTE

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ABSTRACT

This paper describes an EPRI-sponsored project to provide the technical basis for exempting some extremely lightly contaminated radioactive trash from the disposal requirements of 10CFR61. The analysis shows that TVA's Sequoyah Plant could save more than $250,000 per year if the NRC would allow them to dispose of 200 mCi/yr of trash with a specific activity of less than 2 nCi/g in a near-by landfill. Only the driver of the trash hauler would receive a dose, 14 mrem/yr, that was a substantial fraction of the natural variation in background radiation. Landfill workers would receive a yearly dose of less than 0.6 mrem/yr; no member of the general populace would receive a measurable dose. The paper also discusses the development of procedures to ensure that the trash limits are met. This study will form the technical basis for TVA's request to NRC to grant the exemption from the 10CFR61 disposal requirements.

INTRODUCTION

This paper describes an EPRI-sponsored technical project that seeks to establish that a portion of the radwaste presently being shipped by TVA's Sequoyah Nuclear Plant to Richland could safely be buried in a near-by landfill. The work is an extension of an EPRI project reported on at Waste Management '84. (Ref. 1) The latter project evaluated monitoring techniques for the effective segregation of very lightly contaminated dry active waste (DAW) from the rest of the waste stream.

The earlier study (Ref. 2) established that a substantial portion of the Sequoyah DAW had extremely low activity: 40% of the waste volume contained only 1% of the activity. In contrast, the most active 10% of the DAW volume contained over 60% of the activity. These results suggest that TVA could achieve a substantial savings if the uncontaminated or very lightly contaminated trash were disposed of by less restrictive means. The current study is developing the technical basis for requesting the appropriate exemption from the NRC by showing that less restriction disposal would not result in a substantial health risk.

The work has been performed by National Nuclear Corporation (NNC) with the technical assistance of The Analytic Sciences Corporation (TASC) and the advice and consultation of Ms. Joyce Davis of General Physics Corporation. The project has enjoyed the strong support of EPRI and the continuing support and participation of TVA.

GENERAL PROCEDURE

Early last year the NRC issued a report entitled "De Minimis Waste Impacts Analysis Methodology" (Ref. 3) which presented "a calculational methodology that can be used to estimate impacts from disposal by less restrictive means." The two computer codes developed in the Commission's program and included in the report were used in our study. The two codes are, in a sense, the inverses of one another. The first is IMPACTS, which determines annual radiological impacts to individuals and populations from releases of de minimis wastes into less restrictive disposal pathways, including transportation as well as disposal impacts. The second is INVIMPS, which determines limiting concentrations of radionuclides based upon comparison with a set of individual dose limitation criteria. It was decided at the beginning of the program to use these NRC codes in order to assure that the basic methology would be unchallengable and that the acceptability of the exemption request would be decided on the basis of the exposure criteria developed.

Both codes contain extensive data bases of radionuclide properties, such as absorption, leach parameters, etc., and also parametric descriptions of generic disposal facilities such as open dumps, sanitary landfills and hazardous material facilities operating in various regions of the U.S. Data for calculating the effects of waste treatment processes such as sorting, incineration, etc., as well as transportation are also included. All of this generic information can be superseded by site-specific inputs.

For the Sequoyah analysis, INVIMPS was used to set volume and activity limits for wastes that could be shipped to a near-by sanitary landfill for disposal. The INVIMPS analyses suggested that up to 200 mCi/yr of Sequoyah trash could safely be buried in a nearby landfill. IMPACTS was then used to calculate the environmental impacts from the proposed actions. Only the IMPACTS results are reported below.

DATA DESCRIPTION

The following sections describe the mix of generic and site specific data used in the analyses and the results of the IMPACTS runs. They also contain

an analysis of the savings that would accrue if the NRC approved the disposal plan.

The data used in the IMPACTS analysis are of two kinds:

- site-specific value describing Sequoyah, the landfill and its operations, and the surrounding area
- values from the NRC data base describing a generic Southeastern sanitary landfill.

The data fall naturally into five categories:

- the waste
- off-site populations
- transportation
- the landfill operations
- the landfill hydrology and meteorology.

The waste shipped to the landfill would be counted in NNC's WCM-10 Waste Curie Monitor. This monitor is a very sensitive gross gamma counter using plastic scintillators and has counting capacity of about 300 l. It is described in detail in Ref. 2. The waste is in plastic bags when counted. If a bag contains less than 2 nCi/g it would be segregated from the rest of the DAW stream and shipped to the landfill. The typical bag contains 2 ft^3 of trash and weighs 16 lb., i.e., the trash has a typical density of 8 lb/ft^3 or 0.129 MT/m^3.

TVA has chosen to limit the activity of any bag sent to the landfill to 2 nCi/g. The choice is based on DOT regulations which define a load of waste with a specific activity of 2 nCi/g or more as "radioactive material". By limiting the specific activity of the individual bags, TVA ensures that the track carrying the exempt trash need not display a placard, even though bags containing significantly higher activities could be included without raising the total activity of the truckload to 2 nCi/g.

At 2 nCi/g, 200 mCi of waste would weigh 100 MT. However, if the average waste activity were only 1 nCi/g, 200 MT could be sent to the landfill. Table I contains the radionuclide concentration of the Sequoyah trash at various assumed specific activities. These isotopic distributions are based on values measured at Sequoyah. These values were used as inputs to IMPACTS runs which varied the specific activity of waste while maintaining a 200 mCi/yr total. The analyses showed that the environment impact of landfill disposal depends only on the total curies shipped per year, not on the assumed specific activity of any individual bag or shipment. The remainder of the analysis assumes the activity of the waste to be 2 nCi/g, but the results are applicable to any waste activity provided the 200 mCi/yr limit is observed.

The off-site population near the landfill and the transportation route were estimated using USGS maps and the latest census data. Table II summarizes the results.

TABLE I
ISOTOPIC ACTIVITIES IN Ci/m^3

NUCLIDE	TRASH SPECIFIC ACTIVITY		
	2 nCi/g	1 nCi/g	0.5 nCi/g
Mn-54	3.02×10^{-5}	1.51×10^{-5}	7.55×10^{-6}
Co-57	5.16×10^{-7}	2.58×10^{-7}	1.29×10^{-7}
Co-58	1.12×10^{-4}	5.60×10^{-5}	2.80×10^{-5}
Co-60	8.88×10^{-5}	4.44×10^{-5}	2.22×10^{-5}
I-131	7.74×10^{-6}	3.87×10^{-6}	1.94×10^{-6}
Cs-134	6.45×10^{-6}	3.23×10^{-6}	1.61×10^{-6}
Cs-137	1.24×10^{-5}	6.19×10^{-6}	3.10×10^{-6}
TOTAL	2.58×10^{-4}	1.29×10^{-4}	6.45×10^{-5}

TABLE II
OFF-SITE POPULATIONS

Distance From Landfill (mi)	Population
0-5	31,244
5-10	109,612
10-20	271,635
20-30	169,633
30-40	150,416
40-50	139,274

The transportation scenario is based on a single driver who picks up the material from Sequoyah in a 30-foot flat-bed truck. The driver sits eight feet from the nearest trash. The trip from Sequoyah to the landfill takes one hour. This scenario is considerably different from the scenario contained in the NRC programs. The principal differences are that the NRC assumes two drivers per shipment and a truck configuration that would lead to considerably larger doses than the vehicle actually used.

The actual landfill operations are quite similar to the generic Southeastern landfill which is described in the NRC analysis programs. There is only one important difference: the actual landfill receives more than an order-of-magnitude more waste per year than the hypothetical generic one. The other similarities were so strong that data describing the generic landfill were used unless they were affected by the greater disposal volume, in which case we modified the generic values appropriately.

Because the landfill in question is quite old, there are not detailed records describing its hydrology. However, all of the information that is available suggests that the NRC generic Southeastern hydrology is much more conservative than the true situation. Consequently, the analysis conservatively assumes NRC generic values, with one important exception. The percolation rate for rainfall was reevaluated using Chattanoga area data, and found to be approximately 2.5 times greater than the NRC's generic estimate. Consequently, all water flow calculations in the model use the larger percolation values. As a result, all leaching and dilution calculation also use the larger percolation values.

The precise windspeeds at the landfill could not be obtained. Instead, the TVA wind reports at Sequoyah were assumed to apply to the near-by landfill. The resulting parameters describing the wind dispersion of airborne waste are more conservative than the generic NRC model, and were used in the analysis.

ENVIRONMENTAL IMPACTS

Table III summarizes the maximum doses obtained from our analysis. The results are from IMPACTS calculations assuming 200 mCi/yr disposal in the landfill, except for the transportation worker calculations which were modified to include the true situation at Sequoyah.

The only person who would receive a dose of more than 1 mrem/yr is the truck driver who would receive 14.1 mrem/yr. Historically, the radiation dose rate in the cab of a low-level waste shipment from Sequoyah to Richland is 0.3 mrem/hr which results in a 13.2 mrem/trip dose to each of the two drivers. This compares favorably to the 14.1 mrem dose for a full year predicted to the trash hauler driver in this study.

TABLE III

Summary of Maximum Doses
for Impacts Calculations

IMPACT SCENARIO	UNITS	TOTAL BODY DOSE
Maximum Transportation Worker	rem/yr	0.014
Population Along Transportation Route	persm-rem/yr	0.101
Disposal Facility Worker	rem/year	0.0006
All Other Doses	rem/year	less than 0.000005

TABLE IV

Costs of Disposal of One
Cubic Foot of Uncompacted Trash

DISPOSAL SITE	CONTAINER	TRANSPORTATION	BURIAL	TOTAL
Barnwell	1.20	0.25	9.21	10.66
Richland	1.20	1.25	7.86	10.31
Summit	-	-	0.02	0.02

COST IMPACTS

The analysis compared the costs of transportation, and disposal of the waste at the landfill, Richland and Barnwell. Table IV summarizes the costs. In general, the cost of disposing of a cubic foot of uncompacted trash is more than $10 cheaper at the landfill than at either commercial low-level radioactive waste site. Figure I displays the potential savings in annual costs in the two situations.

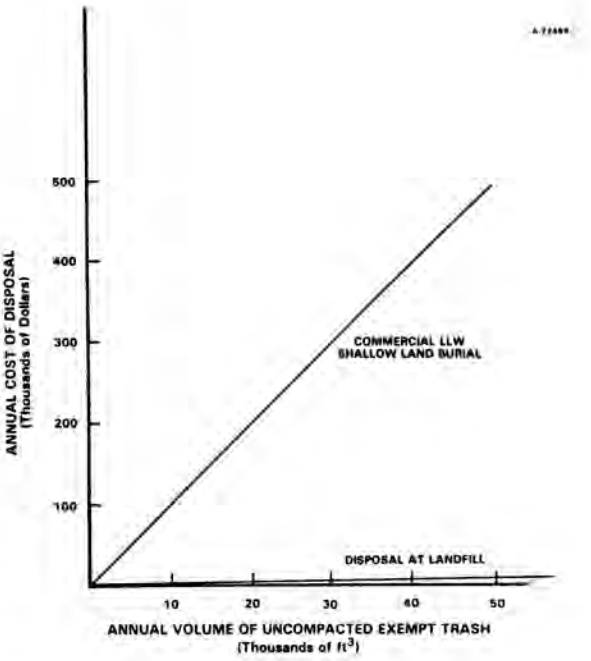

Fig. 1. Comparison of disposal costs.

CURRENT STATUS

The report (Ref. 4) describing the calculations of the environmental impact of the disposal of the lightly contaminated trash in the landfill will soon be provided to TVA. It forms one part of the license exemption request. In addition, the request will include information on the procedures and records that TVA will use to ensure that the exempt trash they send to the landfill is consistent with the analysis. Most importantly, TVA will establish that the 200 mCi/yr and 2 nCi/g limits are met.

The specific activity of each bag of trash will be measured in the WM-10 Waste Curie Monitor. In order to simplify the operating procedures, TVA will ship to the landfill only bags of trash with specific activities below 2 nCi/g. But it should be noted that our analysis is based on an assumed average of 2 nCi/g per shipment. This latter limit may eventually be used if the added record keeping and procedures needed to average over a shipment are deemed advantageous.

SUMMARY AND CONCLUSIONS

The disposal in a near-by landfill of up to 200 mCi/yr of exempt trash from TVA's Sequoyah Plant is feasible, cost-beneficial, and presents no undue risk to the public. Except for the driver of the trash hauler, no one outside the Sequoyah site would receive a dose that even approaches one percent of that which they receive annually from natural background radiation. If one driver is assigned to haul all the exempt trash from Sequoyah, the maximum dose he could receive is less than 15 mrem/yr a value that is within the variability of background and is generally undetectable against that background. This value is also less than three percent of the maximum allowed to persons off-site under NRC's regulations (10 CFR 20). Vacations, absences or changes in route assignments would reduce the annual dose to any individual driver even further. Workers at the landfill would receive

less than 0.5 mrem/yr during disposal operations, less than 0.1 percent of the allowable dose. The annual whole body dose to the maximum hypothetical person off-site would be less than 0.000002 mrem/yr.

The calculations upon which the above doses are based assume that the exempt trash disposed of every year, year-after-year, would contain activity at the 200 mCi limit. However, it is unlikely that this limit would be reached every year, a fact which introduces additional conservatism into the calculations.

Because TVA will limit the specific activity of waste shipped to the landfill to less than 2 nCi/g, more than the nominal 27,000 ft^3 of exempt trash could be shipped before the 200 mCi limit is reached. However, for the purposes of this analysis, the minimum volume has been used to calculate disposal costs, introducing another element of conservatism. At present, trash that could qualify as exempt is shipped with other low-level waste to Richland, Washington. The cost of packaging, transporting and burying 27,000 ft^3 of waste at Richland is $278,000. The comparable cost for disposal at the landfill is $650. This savings increases further if a greater volume of less activity waste is shipped.

While the potential cost savings associated with this change in disposal method are sizeable, cost is not the only consideration. The predicted lack of low-level waste disposal space dictates that its use be limited to material requiring such restrictive disposal. Other materials, such as the exempt trash described in this report, should be disposed of in other suitable facilities.

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