ERDA 77-42/2
Volume 2 of 2

Summary

Alternatives for Long-Term Management Of
Defense High-Level Radioactive Waste

Savannah River Plant
Aiken, South Carolina

Energy Research
& Development Administration

May 1977

Available from:

National Technical Information Service (NTIS)
U. S. Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22161

Price: Printed Copy: $3.50
Microfiche : $ 3.00

ERDA 77-42/2
Volume 2 of 2
UC-70

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FOREWORD

This document was prepared to provide other Government agencies and the public with information on possible alternatives which will be considered for the long-term management of Savannah River Plant high-level nuclear waste. It describes a number of alternative plans for long-term management or disposal of the high-level nuclear wastes now stored in tanks at the Savannah River Plant near Aiken, South Carolina. The description includes implementation technology, risks to the public, and preliminary budgetary cost estimates.

It does not, however, take into account social and public policy issues. Instead, the document presents factual information on the aspects of alternatives that are possible to quantify (costs and risks), so as to serve as a basis for discussion and judgment in future decision making. No selection of an alternative for implementation is made in this document. Comments will be taken into account in the preparation of a programmatic environmental impact statement, which will assess in detail all reasonable options for the long-term management of Savannah River Plant defense high-level radioactive waste. When a program is selected, it will be conducted in accordance with all environmental, health, and safety requirements.

I. INTRODUCTION

Since 1953, the Savannah River Plant (SRP), near Aiken, South Carolina, has been producing special nuclear materials, primarily plutonium and tritium, for defense purposes. The SRP facilities were constructed and initially operated for the Atomic Energy Commission. Operation since 1975 has continued under the direction of the Energy Research and Development Administration (ERDA).

The SRP operations produce high-level radioactive waste in the chemical processing of fuel and target elements after irradiation in the SRP nuclear reactors. This waste is stored as an alkaline liquid with a precipitated sludge until the decay heating has abated appreciably. Then the supernatant liquid is converted to salt cake to reduce volume and mobility. The storage facilities are large underground tanks that are engineered to provide reliable isolation of waste from the environment.

While high-level waste has been and is continuing to be stored safely in present facilities at SRP, it is important to establish long-range goals and policies that will govern ultimate management or disposal of the waste with assurance that the interest of future generations is considered. Many alternative approaches to long-term waste management have been identified, and a considerable amount of effort has been devoted to study and research into selected methods.

The purpose of this site-specific document is to describe the different alternatives along with their probable relative costs, risks, and uncertainties. A secondary purpose is to raise the issue of methodology for **decisionmaking** in nuclear waste management. The document does not attempt to arrive at any recommendations. **Before any long-range waste management plan is implemented, an environmental statement will be prepared to assess in detail the potential environmental impact of all the alternatives.**

The document does contain a **listing of the SRP** alternatives including a simple cost-risk analysis. In this analysis, risk is assumed to be the product of consequence times probability over the full range of possible hazards, and the consequences are assigned monetary values, so that risk can be treated as an equivalent cost. The waste management alternatives can then be ranked in order of total effective costs. Total effective cost is the sum of the estimated management costs and the estimated risk costs. At this time, many of the component estimates are preliminary and subject to revision. Also, a number of important considerations such as compatibility between commercial and defense waste management, social issues and public acceptance are not included in the analysis. For those readers who wish to make their own analyses, information on the different factors is available in the text.

II. SUMMARY

Implementation costs and risk costs are calculated in the text for 23 alternative plans for long-range management and isolation of the SRP high-level radioactive waste. For purposes of basic programmatic decision making, these 23 plans can be grouped into four main classes (Figure 1).

1. Convert the waste to a highly leach-resistant form, such as canned glass cylinders, and ship it offsite to a Federal repository.*
2. Convert the waste to a highly leach-resistant form, and store the waste in an engineered surface facility at SRP.*
3. Reconstitute the waste to a slurry, and dispose of it in a bedrock cavern under the SRP site.
4. Continue storage in tanks with the waste as salt cake and sludge.

Most of the alternative plans are in turn divided into four main functional modules:

1. Removal from Tanks.
2. Processing.
3. Transportation.
4. Storage.

These functional modules can be analyzed almost independently of each other. Thus, if the reader desires, it is relatively easy to extend the analysis to other cases by altering individual modules and by combining the limited number of modules into a large number of plans.

Costs for accomplishing each alternative were established from preliminary engineering studies that were based on the best available process specifications. The estimates are not budget quality, but they are sufficiently accurate for gross cost ranking of the alternatives. All of the alternatives are expensive to implement, but there are also large differences between them. Costs range from several hundred million to several billion dollars. The large cost differences between alternatives directly

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* Alternatives are also considered in which the waste is converted to a dry calcine or to a fused salt, the latter with no separation of the high activity fraction from the bulk of the waste.

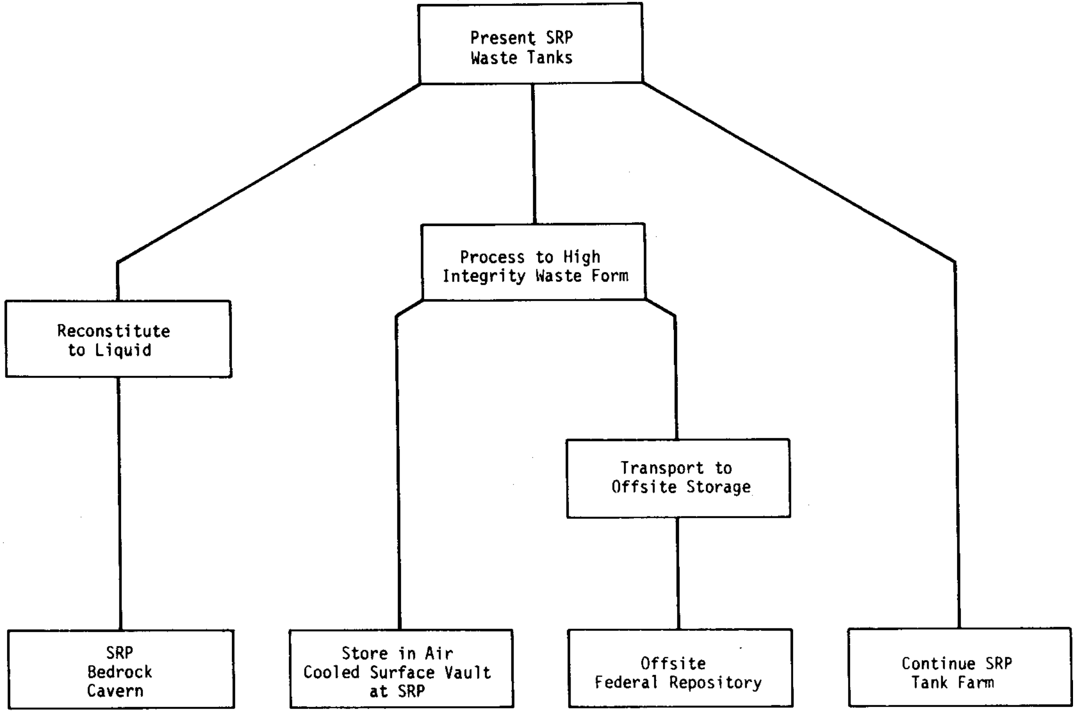

FIGURE 1. Major Alternative Plans

reflect the large differences in effort required between, at the low end, slurrying waste directly into an onsite cavern and, at the high end, constructing and operating extensive new processing and storage facilities.

Risks for each module are established by calculating the consequences and probabilities for each of the following types of events:

- Routine radioactive releases.
- Major process incidents.
- Natural disasters such as tornadoes and earthquakes.
- Sabotage.
- Airplane crash.
- Abandonment.

The diagram shown in Figure 2 gives the method used in making the risk estimates and shows the types of data available in the main text. It is intended that the technical basis and results of each step in the risk analysis be available in the text for scrutiny and comment.

Offsite risks are almost exclusively radiological. They are initially determined in man-rem exposure probabilities to the surrounding population over a 300-year period and in contamination probabilities to the surrounding land. (Contamination risks to land proved to be negligible when compared with population exposure risks.) The risks are then translated into dollars by assigning a cost of $1,000/man-rem* as recommended by the Office of Management and Budget and the Nuclear Regulatory Commission for cost-benefit analyses of reactor safety systems and radwaste systems.** On this basis, the dollar value of risks of all the alternatives

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* Man-rem is the total radiation dose commitment to a given population group; the sum of the individual doses received by a particular population group.

** OMB Circular A-94, Rev. 3/27/72.

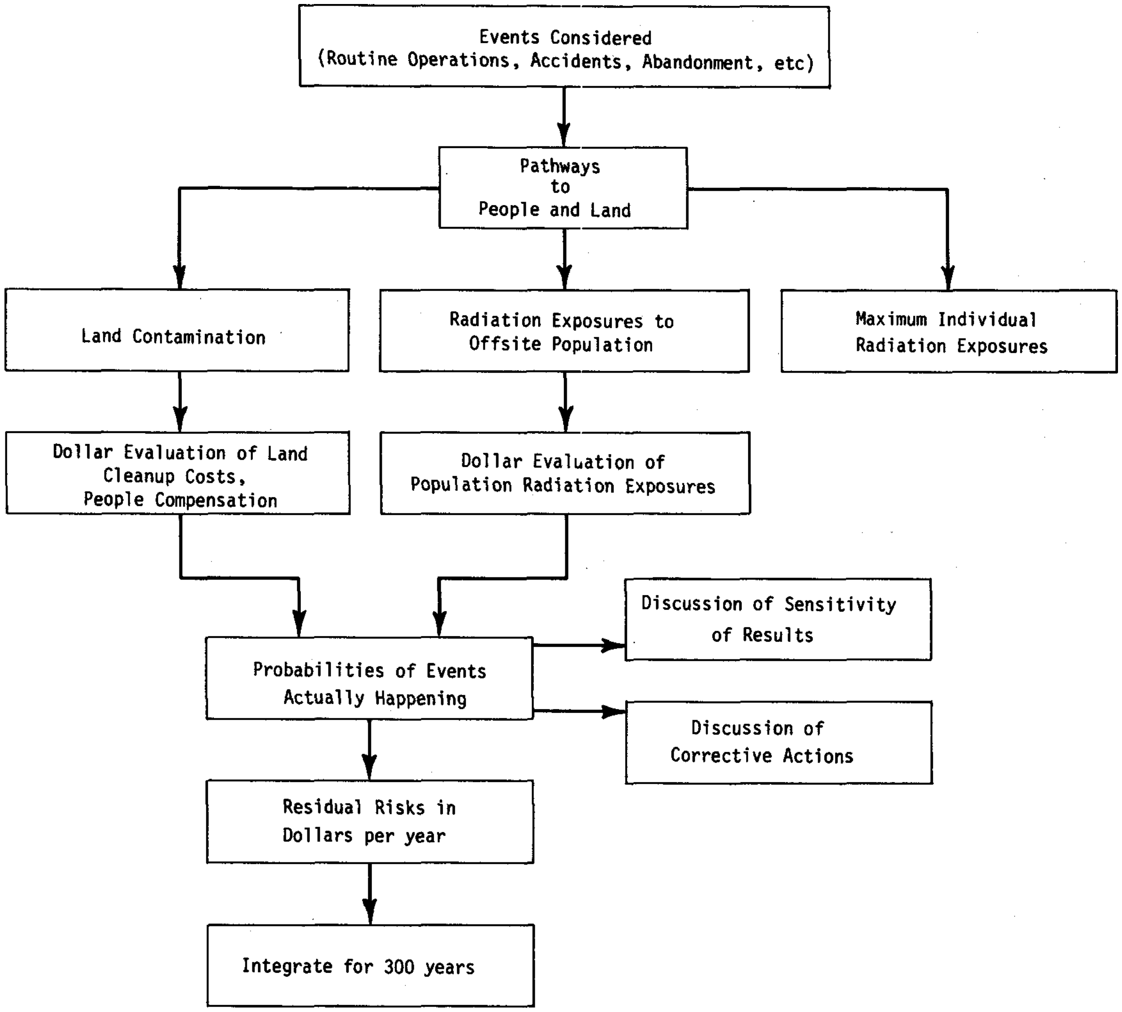

FIGURE 2. Method for Developing Risk Estimates

is small compared with the implementation cost of any alternative or with the cost differences among alternatives.*

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* The validity of interpreting man-rem exposure to a population as actual risk is in doubt and may be a gross overestimate of risk when exposure to the involved individuals is very low. The following excerpts on this subject are taken from Report No. 43 of the National Council on Radiation Protection (NCRP), January 15, 1975:

"The indications of a significant dose rate influence on radiation effects would make completely inappropriate the summing of doses at all levels of dose and dose rate in the form of total person-rem for purposes of calculating risks to the population on the basis of extrapolation of risk estimates derived from data at high doses and dose rates.

"The NCRP wishes to caution governmental policy-making agencies of the unreasonableness of interpreting or assuming 'upper limit' estimates of carcinogenic risks at low radiation levels as actual risks, and of basing unduly restrictive policies on such an interpretation or assumption."

Examination of radiological consequences directly in terms of possible man-rem exposures without application of probabilities or dollar values also indicates low risk. Offsite radiation doses that could result from credible events that have so far been identified are generally below the ERDA standard of 170 mrem/year for individual members of the public living near nuclear facilities. A few maximum individual doses could be above the 5-rem/year occupational limit for workers in the nuclear industry, but there is no credible potential for substantially higher offsite doses Although the calculated consequences are of concern, they are not major disasters nor do they have long-term effects on society. Producing an effect that could appropriately be called a disaster would require events such as sabotage with incredible amounts of conventional explosive or with nuclear weapons, impact of large meteorites, or other events so improbable as to be almost irrelevant in the consideration of the alternative plans. In particular, the consequences of sabotage are probably so small that, as this fact becomes accepted, the wastes are not likely to be an attractive target for terrorists.

Some of the important physical reasons why the hazards associated with the waste are limited include:

- Very large amounts of energy are required to create waste particles small enough to be widely distributed through the airborne pathway. This is true on a per curie basis for the salt cake and sludge currently stored in tanks as well as for the high-integrity forms like glass.

- There are no inherent internal sources of high energy in the waste management systems. Energy required to release radioactive particles would have to be introduced externally and in some abnormal manner.

- There are no radioactive noble gases or significant amounts of easily volatilized radioactive elements in the waste that could contribute to potential doses from the airborne pathway.

- High-integrity waste forms and engineered surface or geologic storage facilities can impose major barriers against waste migration.

- **Liquid releases from SRP would be absorbed in the soil or diluted many orders of magnitude by the onsite creeks and swamps and by the Savannah River before reaching drinking water users. Even if diversion systems fail and no corrective actions are taken, no large individual doses can occur. None of the alternatives propose handling liquid wastes at any site other than the SRP site.**

- The SRP waste facilities are within a large exclusion area surrounded by land of low population density.

Table 1 summarizes the results of the study for four waste management plans representative of the four main classes of SRP alternatives. Column 1 gives the estimated implementation cost in undiscounted 1976 dollars.* Column 2 gives the population dose risk in man-rem; this risk is evaluated as a sum of consequence times probability for the range of incidents discussed earlier. Column 3 gives the total effective cost, which is the sum of the implementation costs and the population dose risk (valued at $1,000/man-rem). Column 4 gives the cost in implementation dollars per man-rem reduction in probable population dose risk for choosing methods other than the lowest cost implementation method (i.e., bedrock storage of a waste slurry in a cavern below SRP).

In the first alternative, waste is slurried out of the tanks after the evaporated salts are redissolved in recirculated water. The waste is then separated into a high-activity fraction occupying about 10% of the solids volume and a decontaminated salt containing less than 6 nanocuries per gram of radioactivity. A glass is formed from the high-level fraction at a concentration of about 35% waste in the borosilicate glass formers. The glass is then put in single cans and transported to an offsite geologic storage site. The salt is canned and stored in a surface vault at SRP. Transportation risks for the high-integrity glass were found to be very low. The disposal risks from several candidate geologic repository formations are now being studied by other groups as part of ERDA's terminal storage program for wastes from commercial reactors. As the studies are completed, their results will be factored into the analysis given in this document. For this analysis, it was assumed an offsite Federal repository would be located in bedded salt or other formation with no likely pathway to a water supply. Therefore, the primary risks are caused by removal from tanks, processing, and transportation. All of the required processes have been demonstrated on a laboratory or pilot plant scale.

The second alternative is almost identical to Alternative 1 except the high level fraction is assumed to be double canned in steel cans — the external can is about 2 ft in diameter and 10 ft long — and is placed in a large engineered surface storage facility at the SRP site. In this particular version, the decontamination salt is also canned and stored in a surface vault. Costs are about 10% higher than for Alternative 1 because of the very large costs calculated for a surface storage facility which would give equivalent protection to geologic storage. Such costs more than offset the additional transportation step required in Alternative 1. Risk costs are estimated at $220,000 for this alternative versus about $900,000 for Alternative 1; they result mainly from removal from tanks and processing.

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* Note that these costs can be expected to increase substantially by escalation during the actual implementation period.

TABLE 1

Summary of Results of Study of Waste Management Alternatives

Alternative	*Budgetary Cost, billion 1976 dollars*[a]	*Population Dose Risk, thousand man-rem*[b]	*Total Effective Cost, billion 1976 dollars*[c]	*Incremental Cost/Risk $/man-rem*[d]
Glass Shipped Offsite to Federal Repository. See Plan 1, Table 3.	2.7	.90	2.7	41,000
Air-Cooled Vault with Glass at SRP. See Plan 5, Table 3.	2.9	.22	2.9	44,000
Liquid Waste Slurry Stored in SRP Bedrock Cavern. See Plan 22, Table 3.	0.18	62	0.24	Base
Continued Tank Farm Operation with Salt and Sludge. See Plan 23, Table 3.	0.24[e]	1.4	0.24	1,000

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a. Undiscounted.

b. Integrated for 300 years. Assumes population grows by a factor of 5 by 2140, then remains constant. No corrective action. These risks are a small fraction of the radiation exposure received by the same population from natural background (see Section IV).

c. Radiation doses were evaluated at $1000/man-rem.

d. Costs per man-rem reduction in risk, using the least expensive alternative (Liquid Stored in SRP Bedrock Cavern) as a base. For example, in Plan 1,

$$\frac{(2.7 - .18)(\text{billion dollars})}{(62 - .9)(\text{thousand man-rem})} = 41{,}000 \, \frac{\text{dollars}}{\text{man-rem}}$$

e. Includes undiscounted costs for one generation of new tanks, starting about year 2040. This investment is more than that required to create a trust fund to rebuild tanks into the indefinite future. Such a trust fund would require new legislation for its creation. If costs are simply summed over the full storage time, they amount to about $250 million every 50 to 100 years for tank surveillance and replacement.

The third alternative has the lowest processing costs of any of the alternatives. It involves slurrying the wastes from the existing tanks into a bedrock cavern dug in an impermeable Triassic mudstone under the Savannah River Plant site. This alternative was extensively investigated, and it appears to be feasible. However, in 1971 all further work on this alternative was deferred until the alternatives involving waste solidification could be investigated. The main radiation risk for Alternative 3 is the possibility of waste entering the Tuscaloosa aquifer above the Triassic mudstone as the result of an earthquake or sabotage before the shaft connecting the cavern to the surface has been sealed. The probability of occurrence of either of these events is low, and the total probability of contamination is reduced further by engineered features of the shaft and the immediate presence of the manpower and equipment needed to repair or seal the shaft. There is also a risk, estimated at 8×10^3 man-rem ($\$8 \times 10^6$), arising from the possibility of small cracks forming to connect the cavern to the aquifer. The probability of such cracks is not known with a good degree of certainty, but the assigned risk is believed to represent an upper limit.

The fourth alternative is continued storage in tanks with tank replacement every 50 to 100 years as required by tank condition. Basically, this alternative is an indefinite extension of present waste management practices, which will in fact prevail until another alternative is selected and funded. It is calculated to have the lowest overall cost if tank replacement cost is calculated on a discounted basis. It has the highest cost if tank costs for thousands of years are summed on an undiscounted basis. **The risk for Alternative 4 is dominated in about equal parts by a hypothetical explosive chemical reaction and by an assumed abandonment of the tanks.**

All the risks shown in Table 1 assume no measures are taken to reduce radiation doses to the population immediately after the occurrence. As discussed in the text in Section X, there are fairly straightforward corrective action steps that would probably be taken, and these steps have the capability of reducing most risks tenfold. The risks from Alternative 3 could be reduced about one hundredfold by such steps.

All the alternative plans provide for isolation of the decontaminated salt, either through storage in tanks or disposal by methods similar to those used for the high-level fraction. The consequences of introducing the decontaminated salt to the biosphere through hypothetical abandonment of tanks were also analyzed. The results show that no unusual hazard is associated with such dispersal.

The four major classes of SRP alternatives discussed above are expanded into 23 alternative plans by considering:

- Variations in the final form of the high-level fraction to include concrete and dry powder.
- A final waste form of fused salt with no separation of the high-level fraction from the large bulk of salt.
- Variations in the final storage or disposal mode to include an offsite surface vault and disposal of canned, solidified waste in an SRP bedrock cavern.
- Variations in the final storage or disposal mode for the decontaminated salt.

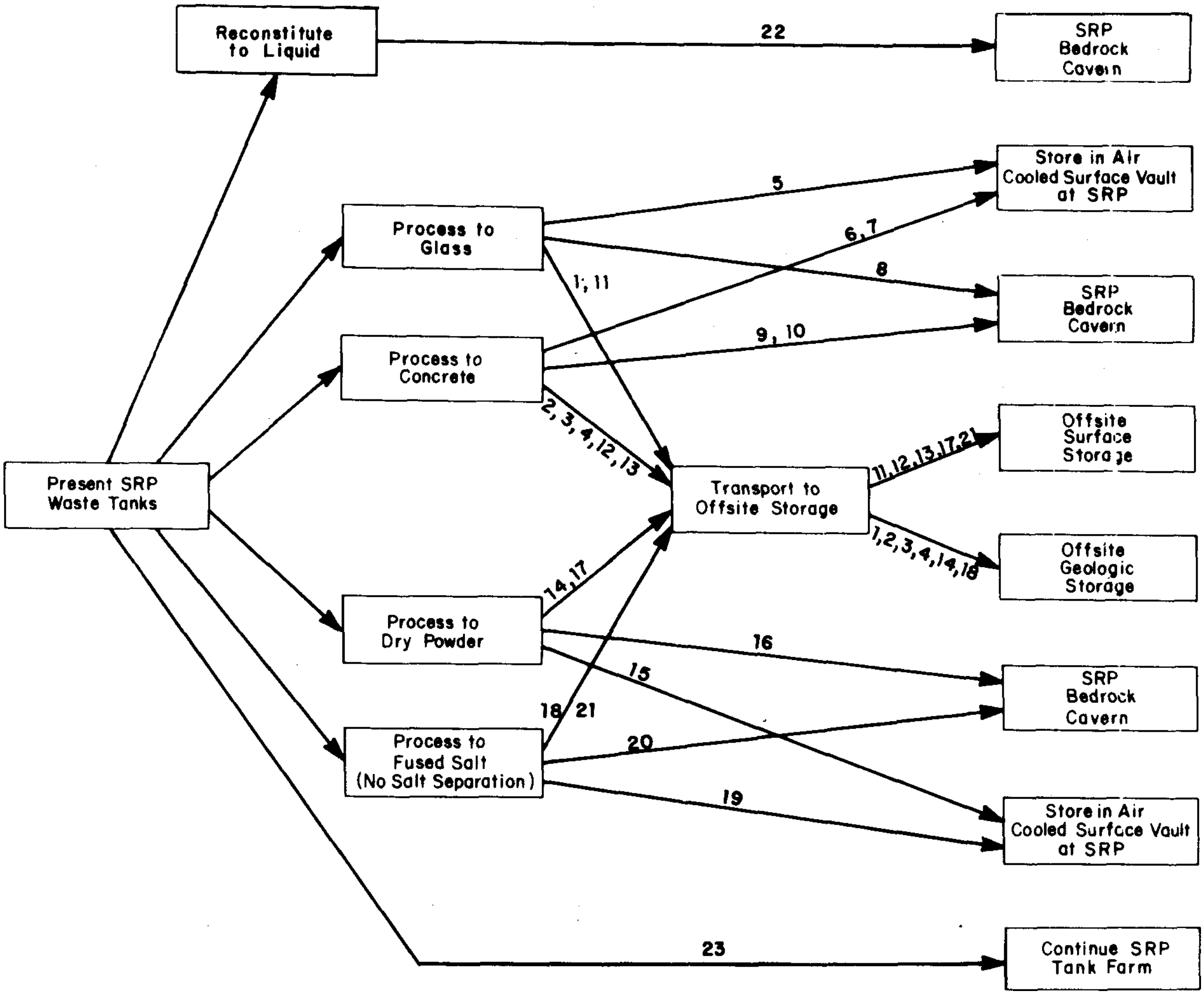
Figure 3 shows in schematic form how these 23 alternatives arise, and Table 2 gives the definition of important characteristics of each.

Considerable amounts of research, development, and small-scale demonstration have been done on the important aspects of all the alternatives, and all are judged attainable with additional development costs that are estimated to be small fractions of the total cost of any alternative. All the geologic disposal options would require construction and observation of large-scale exploratory shafts for a time period long enough to give a high level of confidence of their continued integrity after sealing.

The 23 alternatives are different in method of implementation, in monetary cost, in risk, and in administrative responsibility left to future generations. However, they all come to the same logical cost and risk endpoint in that:

- Each alternative isolates the waste from man's environment with a low degree of risk far enough into the future that the waste poses a negligible threat.
- The cost for carrying each alternative into such future time is given, assuming a monetary discounting philosophy. The cost consequences for not discounting are presented.
- The risks integrated into such future time are given, without discounting, and including the risk of abandonment.

The fact that the risk from each alternative is in a reasonable range for consideration regarding its acceptability is demonstrated by the finding that:



(Numbers shown on the arrows are alternative plan numbers used in Tables 2 and 3.)

The following salt disposal options are discussed for alternative plans that produce separated, decontaminated salt:

1. Storage in Surface Vault at SRP (Plans 1,2,5,6,11,12, 14,15,17).
2. Storage in Offsite Surface Vault (Plan 13).
3. Storage in Decontaminated SRP Tanks (Plans 3,7).
4. Disposal as liquid in SRP Bedrock (Plan 10).
5. Stored as Canned Solid in SRP Bedrock (Plans 8,9,16).
6. Offsite Geologic Disposal (Plan 4).

Note: Plans 18-23 do not produce separated, decontaminated salt.

FIGURE 3. Major Alternative Plans for SRP High-Level Waste Management

TABLE 2

Definition of 23 Alternative Plans

	High Activity Fraction											*Decontaminated Salt Fraction*							
	Waste Form						*Location*					*Waste Form*			*Location*				
							On Site			*Off Site*					*On Site*			*Off Site*	
Plan Number	*Glass*	*Concrete*	*Dry Powder*	*Fused Salt*	*Salt Sludge*	*Liquid*	*Geol.*	*Vault*	*Tanks*	*Geol.*	*Vault*	*Dry Bulk*	*Canned*	*Liquid*	*Geol.*	*Vault*	*Tanks*	*Geol.*	*Vault*
1	x									x			x			x			
2		x								x			x			x			
3		x								x		x					x		
4		x								x			x					x	
5	x							x					x			x			
6		x						x					x			x			
7		x						x				x					x		
8	x						x						x		x				
9		x					x						x		x				
10		x					x							x	x				
11	x										x		x			x			
12		x									x		x			x			
13		x									x		x						x
14			x							x			x			x			
15			x					x					x			x			
16			x				x						x		x				
17			x								x		x			x			
18				x						x									
19				x				x											
20				x			x												
21				x							x								
22						x	x												
23					x				x										

Note:

Plans 18 through 23 do not produce separated, decontaminated salt.

- The population dose risk evaluated in dollars is small compared to the budgetary cost of implementation.

- Individual doses to members of the general public, even if some of the more unlikely events did occur, are small compared to currently accepted standards and compared to variations in doses from naturally occurring radioactivity.

Table 3 gives a summary of budgetary costs and population dose risks for each of the 23 alternative plans. A sample cost-risk analysis is also given, using the methods described previously for Table 1.

Within the framework of the preliminary analysis, the following may be stated:

- A number of alternatives exist for safely managing the SRP high-level radioactive wastes at costs (in constant dollars) between 10 and 30% of the costs of the operations originally generating the wastes.*

- Continued storage in tanks has the lowest combination of costs and risks provided that discounted rather than total costs are used for tank replacement at 50- to 100-year intervals over the next 1,000 years or more. However, undiscounted costs are very high and the time span requiring positive action is very long. Thus, it may be desired to remove the wastes to a completely inaccessible location.

- Bedrock disposal of wastes under the Savannah River Plant site has the second lowest combination of cost and risk, and the lowest budgetary costs.

- Geological disposal of a high-integrity waste form such as glass canisters in a Federal repository is a very low-risk option that offers close compatibility to a method being developed for permanent disposition of high-activity wastes generated in processing of commercial power reactor fuels.

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* Because of the low fuel burnup and other special requirements of radioisotope generation at SRP, these costs are much higher on a percentage basis than those of power reactor waste management. Comparable management of power reactor waste is estimated to be only about 1% of the power generation costs.

TABLE 3

Summary of Costs and Risks for 23 Alternative Plans

Plan Number	*Description*	*Budgetary Cost, billion 1976 dollars*[a]	*Population Dose Risk, thousand man-rem*[b]	*Total Effective Cost, billion 1976 dollars*[c]	*Incremental Cost/Risk, $/man-rem*[d]
1	Glass Disposed of in Offsite Geologic Storage and Canned Decontaminated Salt Cake Stored in Outside Surface Storage Facility	2.7	.90	2.7	41,000
2	Concrete Disposed of in Offsite Geologic Storage and Canned Decontaminated Salt Cake Stored in Onsite Surface Storage Facility	2.4	.90	2.4	36,000
3	Concrete Disposed of in Offsite Geologic Storage and Decontaminated Salt Cake Stored in Onsite Underground Waste Tanks	1.2	.90	1.2	17,000
4	Concrete and Canned Decontaminated Salt Cake Disposed of in Offsite Geologic Storage	1.9	.90	1.9	28,000
5	Glass and Canned Decontaminated Salt Cake Stored in Onsite Surface Storage Facility	2.9	.22	2.9	44,000
6	Concrete and Canned Decontaminated Salt Cake Stored in Onsite Surface Storage Facility	2.8	.22	2.8	42,000
7	Concrete Stored in Onsite Surface Storage Facility and Decontaminated Salt Cake Returned to Onsite Waste Tanks	1.7	.22	1.7	25,000
8	Glass and Canned Decontaminated Salt Cake Disposed of in SRP Bedrock	2.0	.34	2.0	30,000
9	Concrete and Canned Decontaminated Salt Cake Disposed of in SRP Bedrock	1.8	.34	1.8	26,000
10	Concrete and Decontaminated Salt Solution Disposed of in SRP Bedrock	1.3	.34	1.3	18,000
11	Glass Stored in Offsite Surface Storage Facility and Decontaminated Canned Salt Cake Stored in Onsite Surface Storage Facility	3.0	.53	3.0	46,000
12	Concrete Stored in Offsite Surface Storage Facility and Canned Decontaminated Salt Cake Stored in Onsite Surface Storage Facility	3.0	.73	3.0	46,000
13	Concrete and Decontaminated Salt Cake Stored in Offsite Surface Storage Facility	3.4	.73	3.4	53,000

TABLE 3, Continued

Summary of Costs and Risks for 23 Alternative Plans

Plan Number	*Description*	*Budgetary Cost, billion 1976 dollars*[a]	*Population Dose Risk, thousand man-rem*[b]	*Total Effective Cost, billion 1976 dollars*[c]	*Incremental Cost/Risk, $/man-rem*[d]
14	Dry Powder Disposed of in Offsite Geologic Storage and Canned Decontaminated Salt Cake Stored in Onsite Surface Storage Facility	2.3	.93	2.3	35,000
15	Dry Powder and Canned Decontaminated Salt Cake Stored in Onsite Surface Storage Facility	2.5	.38	2.5	38,000
16	Dry Powder and Canned Decontaminated Salt Cake Disposed of in SRP Bedrock	1.8	8.6	1.8	30,000
17	Dry Powder Stored in Offsite Surface Storage Facility and Canned Decontaminated Salt Cake Stored in Onsite Storage Facility	2.6	.89	2.6	40,000
18	Fused Salt Disposed of in Offsite Geologic Storage - No Separation of Radioactivity	1.1	1.0	1.1	15,000
19	Fused Salt Stored in Onsite Surface Storage Facility - No Separation of Radioactivity	3.0	.22	3.0	46,000
20	Fused Salt Disposed of in Bedrock - No Separation of Radioactivity	.90	8.6	.91	14,000
21	Fused Salt Stored in Offsite Surface Storage Facility - No Separation of Radioactivity	3.5	1.0	3.5	54,000
22	Unprocessed Waste Slurry Disposed of in SRP Bedrock	.18	62	.24	Base
23	Storage of Waste as Sludge and Damp Salt Cake in Onsite Waste Tanks (Present SRP Waste Management Technique)	.24[e]	1.4	.24	1,000

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a. Undiscounted.

b. Integrated for 300 years. Assumes population grows by a factor of 5 by 2140, then remains constant. No corrective action.

c. Radiation doses were evaluated at $1000/man-rem.

d. Cost per man-rem reduction in risk, using the least expensive alternative plan as a base (Plan 22, Unprocessed Waste Slurry Stored in Bedrock).

e. Includes undiscounted costs for one generation of new tanks, starting about year 2040. This investment is more than that required to create a trust fund to rebuild tanks into the indefinite future. Such a trust fund would require new legislation for its creation.

The framework of this analysis will eventually have to be expanded to include cost-like penalties that might be assigned to alternatives to account for judgments and convictions of those who must eventually participate in the ultimate decision.

Another area where cost-like evaluations or social value judgments could be applied is with regard to tradeoffs between responsibilities and benefits left to future generations. The largest difference in such responsibilities among the various alternatives is between continued tank farm operation and offsite geologic disposal; some social implications of these differences are discussed below. Assuming the identified, quantified risks given in the analysis are acceptable for either option, then items important for further consideration for decision makers include monetary tradeoffs, future technological options, and manpower and land requirements.

For example, in considering monetary tradeoffs, future generations would be left with the cost of building new tanks every 50 to 100 years and with their surveillance and maintenance, compared with negligible surveillance cost for a sealed geologic repository. The cost listed in Table 3 includes a trust fund to supply these requirements and the tank farm option is still less expensive by as much as $2.5 billion. The compounded future wealth generated by this $2.5 billion difference if it entered the private/public investment mainstream in a productive way could be a very large net positive benefit for future generations.

Regarding future technological options, continued tank farm operation vs. geologic disposal would leave open alternative uses or disposal methods that might become available from technological advances. Furthermore, after a period of about 300 years the annual risk from tank storage is reduced about one thousandfold from the 1980 risk. A decision about the risks and responsibilities left to generations beyond the 300-year point might then be made using the summation of the judgment and technology of those to come during the intervening 300 years instead of 1980 judgment and technology.

In considering manpower requirements, continued tank farm operation would involve a commitment by future generations to supply a few trained people for maintenance, surveillance, and replacement. On the other hand, a sealed geologic repository could probably be monitored by one part-time, less well-trained person.

It is emphasized that neither the cost-risk analyses given in Table 3 nor the above examples of social value considerations are meant to pre-select any alternative plan as best. Instead they are offered to stimulate consideration and comments by the public and from government and private organizations. These factors could significantly influence the ranking of alternatives and they will be considered in the future Environmental Impact Statement on long-term management of the defense high-level waste at the Savannah River Plant.

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☆ U.S. GOVERNMENT PRINTING OFFICE : 1977 0-240-979/36