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FINAL REPORT
SELECTION OF ALTERNATIVE FOR DECOMMISSIONING LOW LEVEL RADIOACTIVE WASTE VAULT AT DEFENCE RESEARCH ESTABLISHMENT SUFFIELD
VOLUME 2

Acres International Limited
Calgary, Alberta

December 1991

DEFENCE RESEARCH ESTABLISHMENT SUFFIELD, RALSTON, ALBERTA

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DEPARTMENT OF NATIONAL DEFENCE
DEFENCE RESEARCH ESTABLISHMENT SUFFIELD

FINAL REPORT
Selection of Alternative for Decommissioning Low Level Radioactive Waste Vault at Defence Research Establishment, Suffield

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1 Introduction

Acres International Ltd. and AECL Research were retained by the Department of Supply and Services on behalf of the Defense Research Establishment Suffield to assess the disposal options for the radioactive waste material in the low-level radioactive vault. The following activities were included:

1. Identify a licensed disposal site that will accept all the radioactive materials which will meet AECB approval and to develop a cost estimate.

2. Identify the risks and opportunities for on-site storage including:

   i) storage in the DRES Radioactive Waste Burial site;
   ii) storage in the existing vault; and
   iii) storage in an aboveground facility on site.

   And, in cooperation with DRES, to choose one of these options for completion of the cost estimate.

3. Provide one cost estimate for doing i, ii or iii.

4. Estimate all required packaging material and packaging of waste according to applicable Transport Packaging of Radioactive Materials Regulations for the waste. The waste in the vault will also be evaluated as to what extra packaging material may be needed to meet transportation requirements.

5. Meet with DRES to review our findings in the form of a draft report at Suffield, Alberta, including Rabb and Lambert, for a one-day working meeting.

6. Complete final report for issue to DRES including an original plus eight copies. The final report will compile all findings relating to the cost and technical implications and our recommendations to allow DRES to complete Phase II of the work.

The methodology for this work involved three steps. Acres and AECL Research prepared a working paper for discussion with DRES. The working paper was changed and subsequently issued as a draft for review. The draft changes were then issued as the

final report, including Volume 1, "Inventory of Vault Radioactive Waste Material," and Volume 2, the Final Report, called "Selection of Alternative for Decommissioning Low Level Radioactive Waste Vault at Defence Research Establishment, Suffield."

2 Description of Selection Methodology for Decommissioning Alternatives

The methodology for comparison of alternatives and selection of the preferred alternative is as follows:

Selection Methodology Objectives (Section 3)
Objectives will be developed to form the basis for sorting and choosing the preferred Decommissioning Alternative. Once the objectives have been established, they will each be assigned a relative score from 1 to 10. The score will be used to compute weights for each scored objective when comparing the alternatives.

Establish the Decommissioning Alternatives (Section 4)
In this section, we have provided a description for each alternative, the estimated cost, any regulatory or reliability concerns or other relevant data and information.

Our Section 4 cost estimates are comparative estimates which exclude certain common elements such as project management costs, DRES contract supervision costs, and ongoing costs for current program delivery such as inspections. In Section 6, we detail these costs so that any budgetary concerns can be addressed by DRES.

Comparison (Section 5)
Section 5 presents a spreadsheet comparing the disposal alternatives. Each alternative will be compared to each objective. The best alternative will be given a ranked score of 10. The other alternatives will be given lower scores relative to the best. A weight for each alternative will be developed by multiplying the score for the alternative by the relative weighting which we gave to each objective. As an example, the following illustration is provided:

RANK	WEIGHT	OBJECTIVE	ALT.A	ALT.B	ALT.C
1	10	Cost	10/100	9/90	8/80
2	9	Performance	10/90	9/81	8/72
			190	**171**	**152**

In comparing these alternatives, Alternative A had the best score. Once this ranking has been completed in a spreadsheet format, any liabilities or risks associated with the nominated choice will be assessed. By "risks" or "liabilities" we mean that if we proceed to choose the indicated alternative, what are some of the things which could go wrong or alternatively what are some of the positive results which could occur.

3 Requirements

3.1 Selection Methodology Objective

The evaluation of the disposal alternatives will be done by using our four objectives as follows:

Regulatory Concerns:	Satisfy AECB requirements. Keep doses as low as reasonably achievable.
Environmental Concerns:	Minimize possibility of accidental release of radioactive material.
Cost:	Choose the lowest comparative cost for disposal.
Public Relations:	Minimize any negative public relations associated with storage and/or disposal of the material.

The objectives have been ranked. The highest ranked objective received a score of 10. The next received a score of 9, and so on, as follows:

Rank	Weight	Description
1	10	Regulatory Concerns
2	9	Environmental Concerns
3	8	Cost
4	7	Public Relations

3.2 Decommissioning Requirements

The AECB requires that nuclear facilities be decommissioned satisfactorily in the interests of health, safety, security and protection of the environment, according to plans approved by the AECB.[1] The activities required for the waste storage vault include (i) removal of the radioactive waste, (ii) survey of the vault to ensure surfaces meet the unrestricted release criteria and (iii) decontamination of the surfaces if required.

The unrestricted release criteria given in Table 1 are currently considered acceptable by the AECB.[2] However, there is no guarantee that these release criteria will be acceptable in the future. The AECB is currently considering the more restrictive criteria of 0.05 Bq/cm^2 alpha and 0.5 Bq/cm^2 beta/gamma, averaged over 100 cm^2. Costs associated with surveying to demonstrate contamination is below these lower levels will be significantly greater than the survey costs estimated in this report.

Table 1
UNRESTRICTED RELEASE CRITERIA

	Bq/cm^2	Pancake G.M. (cpm)*
Total Contamination	(averaged over 300 cm^2	
Alpha	0.37	12
Beta/Gamma	3.7	120
Loose (on swipe)	0	<12
General Radiation Field (above background) 0.05 μSv/h		

* The detector efficiency for an open-window pancake G.M. detector with both a Ludlum Model 3 ratemeter and a Thyac III ratemeter is taken as 37 cpm/Bq. The limits noted are with background subtracted.

1 AECB Regulatory Document R-90, Policy on the Decommissioning of Nuclear Facilities, August 1988

2 Phone conversation between D. Howard (AECB Project Officer) and R. P. Lambert, 1991 November 19.

3.3 Requirements for Disposal at AECL Research, CRL

There is currently no approved disposal facility in Canada for this radioactive waste. AECL Research at Chalk River Laboratories (CRL) is expected to have approved disposal facilities within 5 years. Current practice in Canada, endorsed by the AECB, is for all waste to be shipped to CRL.

AECL Research, Chalk River Laboratories (CRL), Waste Management Systems will accept the radioactive wastes for storage and eventual disposal. A quote for accepting the waste is given in Appendix A. The estimated price, FOB Chalk River, is $108,377.09.

3.4 Transportation Requirements

The following regulations apply to the transportation of the radioactive waste:

i) The Atomic Energy Control Act, "Transport Packaging of Radioactive Materials Regulations," and

ii) Transport Canada, "Transportation of Dangerous Goods Regulation".

It is recommended the waste be shipped by exclusive use vehicle from DRES to CRL. The cost estimate is $3,000.00.

If DRES chooses to ship the waste using military transport, the drivers should be certified to transport dangerous goods and the vehicles must be placarded.

All filled drums, except drums 63 and 64, meet the specifications for Group 1 Low Specific Activity Material (LSA) as defined in the "Transport Packaging of Radioactive Materials Regulations". These drums must be stencilled or marked with the notation "MFAS RADIOACTIVE LSA/EXCLUSIVE USE/USAGE EXCLUSIF".

Drums 63 and 64 meet the specifications for Low Level Solid Radioactive Material (LLS). The sources are within lead shielding within 45-gal. drums. The lead shielding must be secured and surrounded by styrofoam or wood blocks to ensure the castle will not move about in the drum and will not open in the event the drum falls 1.2 m. Drums 63 and 64 must be stencilled or marked with the notation "MFAS RADIOACTIVE LLS/EXCLUSIVE USE/USAGE EXCLUSIF".

The 22 empty drums must be packaged for shipment in good industrial strength containers. Wooden crates lined with a plastic sheet to prevent contamination from leaking out and moisture from getting into the crates are acceptable. It would be desirable to flatten or compact the drums to minimize the size of the crate(s), however, this is felt to be difficult without spreading radioactive contamination. The contaminated empty drums meet the specifications for LSA. The crates must be stencilled or marked with the notation "MFAS RADIOACTIVE LSA/EXCLUSIVE USE/USAGE EXCLUSIF".

Each drum should be inspected as it is removed from the vault to verify correct labelling, the integrity of the drums, radiation fields and the seal. Each waste package must incorporate a seal which will provide evidence that the package has not been opened during shipment to CRL. The AECB should be given advance notice of when the waste is to be removed from the vault so that they can be present, if they wish, to inspect and verify the acceptability of the packages and labelling.

3.5 Storage Requirements

The following requirements have been identified for storage should the decision be to store the waste until an approved radioactive waste disposal site is established in Canada.

i) the waste must be easily retrievable;
ii) the waste packages can be physically monitored (visual inspections for damage, radiation surveys, contamination leak tests);
iii) the waste will not enter the environment;
iv) the ALARA principle must be satisfied, i.e. the equivalent dose to workers and members of the public must be as low as reasonably achievable, taking into account relevant social and economic factors; and
v) the storage should be cost effective.

4 Introduction

The Decommissioning Alternatives which follow will begin with a brief description of the alternative where we provide details on what the alternative actually is.

We also provide information on estimated costs. These have been identified as Order of Magnitude costs. These costs are only to be used for comparative purposes. Their accuracy is ±30%. When we have determined our choice, a more thorough and accurate cost estimate in the ±15% range can be made.

Finally, under Concerns/Discussion, we provide descriptions for each alternative.

4.1 Description of Decommissioning Alternatives

4.2 Storage of Waste in the Existing Vault

4.2.1 Description

The waste would be left in the existing vault until an approved radioactive waste disposal site is established in Canada. It is anticipated an approved site will exist at Chalk River Laboratories within approximately 5 years. A monitoring program, acceptable to the AECB, to ensure the drums are not damaged or degraded would be required. The program would require regular visual inspections of the drums for damage, visual inspection of the vault for damage and water problems.

4.2.2 Estimated Cost

Eventually remove the waste from the vault	≈	$3,000
Site survey for release[1] and surveying of drums during loading	≈	$7,000
Shipping costs	≈	$3,000
Charges by CRL for accepting the wastes	≈	$110,000
Comparative Cost Estimate	≈	$123,000

4.2.3 Concerns/Discussion

- No additional regulatory concerns.
- Structure of outer building - the condition of the building is deteriorating and may not remain safe for occupants to enter for inspections, and may be inconvenient to maintain. Should the building fail or be removed, a continued cost for providing protection from the weather for the vault will be required as the vault is not weatherproof.
- Any movement of the waste is an additional cost in comparison to leaving the waste where it is currently stored. The monitoring costs are minimal.
- There are some costs associated with operating the exhaust fan and electric lighting.
- The waste will eventually have to be removed and the facility decommissioned regardless of what option is chosen.

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1 Assuming unrestricted release criteria in Table 1 is acceptable and minimum decontamination is required.

4.3 Storage of Waste in the DRES Radioactive Waste Burial Site

4.3.1 Description

The waste is transferred from the vault to the existing waste burial site involving placing the waste in a land trench. The vault is decommissioned, surveyed to ensure the release criteria is met, and decontaminated as required.

There is an existing monitoring program associated with the currently approved burial site.

Eventually, the waste in the trenches will have to be transferred to an approved disposal facility, when such a facility exists (estimated to be approximately 5 years). The waste storage drums may deteriorate in the land trenches and so the waste will have to be repackaged in approved transport containers.

4.3.2 Estimated Cost

Costs for opening another trench	≈	$2,000
Removal of the waste from vault	≈	$3,000
Transporting the wastes from the vault to the trench	≈	$1,000
Site survey for release[1]	≈	$7,000
Eventual removal of the waste for disposal and repackaging of the waste for transport and transportation	≈	$38,000
Charges by CRL for accepting the wastes[2]	≈	$115,000
Comparative Cost Estimate	≈	$166,000

1 Assuming unrestricted release criteria in Table 1 is acceptable and minimum decontamination is required.

2 Assuming an additional cost of $5,000 due to drum repackaging.

4.3.3 Concerns/Discussion

- The indications are that AECB will not approve adding more waste to the trenches. Much of the waste would not be allowed in the trenches following current environmental practice.

- Wrong public perception (i.e., environmental concern even though there is currently wastes in the trenches.

- Added costs associated with repackaging and resurveying the wastes because the integrity of the containers is now questionable.

- There is the option of DRES attempting to have the site approved as a radioactive waste disposal site. This will require an environmental screening document and a strong case to the AECB. The cost of having AECB approve the site for disposal would probably exceed the cost of shipping the waste to CRL.

4.4 Storage in a New Aboveground Facility

4.4.1 Description

A metal building with a concrete floor is built on site, in a location acceptable to DRES to minimize monitoring costs and optimize convenience. The only service required is lighting. Heating is not required because the wastes are all solids and will not be affected by the cold. The building need only keep out the weather and need not be air tight; hence, natural ventilation should be sufficient for the little radon released from the drums (the wastes in the drums are sealed in plastic bags so there should be little, if any, release of radon gases.

Visual monitoring is required for drum damage and water in the building, and random tests are required for leakage of radioactive material.

4.4.2 Estimated Cost

Cost of the building for 100 45-gallon drums plus room to walk about for visual inspections (about 90 m^2)	≈	$23,000
Removal of waste from vault	≈	$3,000
Transporting the waste from the vault to the building	≈	$1,000
Fencing	≈	$15,000
Recurring service and maintenance costs (weed control, snow removal, daily attendance, security checks, clean-up, fire guards etc. @ $55,000/year ($150/365) for 5 years	≈	$275,000
Site survey for release[1] and surveying of drums during loading	≈	$7,000

1 Assuming unrestricted release criteria in Table 1 is acceptable and minimum decontamination is required.

Cost of moving the drums (for trans-shipment to approved disposal facility)	≈	$2,000
Eventual shipment of the wastes to an approved disposal facility	≈	$4,000
Charges by the disposal facility to accept the wastes	≈	$110,000
Comparative Cost Estimate	≈	$440,000

4.4.3 Concerns/Discussion

- The waste containers may deteriorate over the storage period. This is considered unlikely unless the drums come in contact with water.
- The monitoring program is minimal.
- AECB agrees the waste can be shipped as part of a total job when cleaning out the trenches.
- Double handling of the wastes at DRES results in added doses and a possible chance of accidental leakage due to handling. This is considered unlikely, and the doses are minimal.
- The current trend in legislative requirements is a movement towards stricter regulations. This will probably raise the costs and difficulty associated with shipment and decommissioning.

4.5 Transfer of the Waste to Chalk River Laboratories

4.5.1 Description

Shipping the wastes immediately to CRL for storage and eventual disposal. All future costs and liability associated with the wastes becomes AECL Research's. AECL Research is establishing a disposal site to meet the AECB's approval at CRL. The estimated time for completion of the IRUS facility and approval of the facility is 5 years. Decommissioning the vault is as discussed above.

4.5.2 Estimated Cost

Removal of waste from vault	≈	$3,000
Shipping	≈	$3,000
Site survey for release and surveying of drums during loading[1]	≈	$7,000
AECL Research's storage quote	≈	$108,000
Comparative Cost Estimate	≈	$121,000

4.5.3 Concerns/Discussion

- In AECL Research's costs for accepting the wastes there is a cost for the temporary storage and double handling. However, this is small and would probably be expended by inflation over the five years following disposal of the facility.

- All other alternatives are simply postponing this step.

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1 Assuming unrestricted release criteria in Table 1 is acceptable and minimum decontamination is required.

5 Comparison of Disposal Alternatives

5.1 Discussion

In Section 5.2 called "Selection of Best Balanced Decommissioning Alternative," we have built on the work preceding to compare each alternative to the four different objectives.

The transfer to Chalk River received a 10 as the best alternative when considering the Regulatory Concerns objective. Warehousing the material received a score of 8, leaving the material in the vault received a 7, and placing the material in a trench received a 5. Each score was then multipled by 10 (the value of the Regulatory Concerns objective) for its weighted score. This then gave transfer a weighted score of 10 x 10 for 100, warehousing an 80, leave a 70 and trench an 80.

From the perspective of the Environmental Concerns, Cost, and Public Relations objectives, our evaluation indicated that transferring the product to Chalk River is the highest scoring alternative with a total of 330. The lowest score went to the trench system at 227. The leave alternative was second highest at 270, and the warehouse alternative was third at 264.

As a result, we recommend our choice as the Transfer Alternative to the Chalk River Laboratories of AECL Research.

5.2 SELECTION OF BEST BALANCED DECOMMISSIONING ALTERNATIVE

OBJECTIVES:

Rank	Weight	Description
1	10	Regulatory Concerns - satisfy AECB requirements.
2	9	Environmental Concerns - minimize possibility of accidental release of radioactive material at Suffield.
3	8	Cost - choose the lowest Order of Magnitude cost for disposal.
4	7	Public Relations - minimize any negative public relations associated with storage and/or disposal of the material.

ALTERNATIVE DESCRIPTION:

Alternative #1	**Leave**	Leave it in the vault.
Alternative #2	**Trench**	Use existing trench system for low level radioactive waste disposal.
Alternative #3	**Warehouse**	Low level radioactive waste warehouse.
Alternative #4	**Transfer**	Transfer to Chalk River for disposal.

	ALTERNATIVES							
Objectives (Weight)	**ALTERNATIVE #1 LEAVE**	**Score/ Weighted Score**	**ALTERNATIVE #2 TRENCH**	**Score/ Weighted Score**	**ALTERNATIVE #3 WAREHOUSE**	**Score/ Weighted Score**	**ALTERNATIVE #4 TRANSFER**	**Score/ Weighted Score**
#1 Regulatory Concerns (10)	(1) Building is old. (2) Continued monitoring needed. (3) Eventually mat'l likely will require ultimate disposal.	7/70	(1) Monitoring required. (2) AECB likely would require ultimate disposal in the future. (3) All present mat'l would not be authorized for disposal.	5/50	(1) Monitoring is needed. (2) Material will need ultimate disposal.	8/80	(1) No monitoring. (2) AECL assumes disposal responsibility.	10/100
#2 Environmental Concerns (9)	(1) Possibility of release is low.	9/81	(1) Possibility of release would be low.	8/72	(1) Possibility of release would be low.	8/72	(1) Possibility of a release would be low during transfer and non-existant during storage.	10/90
#3 Cost (8)	$123,000	9/63	$166,000	8/56	$440,000	7/49	$121,000	10/70
#4 Public Relations (7)	(1) Negative public relations possible. (2) Probability low.	8/56	(1) Negative public relations possible.	7/49	(1) Negative public relations possible.	9/63	(1) Positive public relations possible.	10/70
	#1	270	#2	227	#3	264	#4	330
RISKS/LIABILITIES: If we choose to transfer the contents of the vault to AECL, the major risk involves a highway traffic accident. It should be noted, however, that this eventuality ultimately exists with each of the others.								
The recommended choice is Alternative #4 - Transfer to Chalk River for Disposal.								

6 Preferred Decommissioning Alternative

6.1 Description

The low level radioactive waste in the vault has been sorted, catalogued, and placed in shipping drums with the appropriate labelling. The vault has been cleaned and the radioactive measurements in the vicinity of the stored waste and in the vault have been completed. Since the low level radioactive waste is stored 10 feet below ground surface, each barrel has to be moved up the stairs to ground level. We anticipate that a medium-speed mechanical winch attached to a drawbed will be used to move each drum to the floor at ground level. In the vault proper, a hydraulic motor engine jack will be needed, along with a drum mover, to allow the drum to be lashed onto the drawbed. The drawbed will then be winched up the existing stairwell. The existing stairwell has been designed to allow an existing drawbed to be winched to the floor at ground level. The empty drums in the vault will be placed in a large box suitable for storage and shipping. Once at ground level, the shipping container will be handled by a Bobcat with a drum grapple or equivalent mechanical lifting equipment and loaded onto the designated transport carrier for transportation to the AECL Research Chalk River laboratory for storage and disposal.

During the emptying of the vault and while in the vault, each drum should be evaluated for shipping criteria respecting radioactivity and proper labelling. We suggest a returnable supply of overpack drums be kept on hand. Approximately five overpacks should be kept in the event there is a reason to use these drums. The company supplying these drums should be advised that DRES would like the right to return any unused drums since they cost $200 each.

It is anticipated that the AECB will have their inspectors on site during the emptying of the vault and the loading of the trucks. Similarly, DRES would be responsible for ensuring that all measurements and documentation are handled in accordance with regulations. In turn, the carrier should be an approved transporter for this type of material. This activity should be supervised so that there is no damage to the shipping containers nor injuries to the people doing the job.

6.2 List of Equipment

The following is a tentative list of equipment for completing the work:

Rental Equipment

1 drum mover (to be located in vault)
1 engine hoist (to be located in vault)
1 electric winch (suitable to move a drawbed up a 45° incline with a 600# barrel)
2 snatch block pulleys
1 Bobcat with a drum grapple
radioactive measuring equipment
5 salvage barrels

Expendable Equipment

- 100 ft. 1/2" polyrope
- 10 sets of protective clothing and face masks
- measuring equipment expendables
- drum locking tabs
- wrenches, screwdrivers
- pens, marking equipment, labels
- 10 mil poly
- large box for handling empty drums

6.3 Schedule of Activities

- Finalize contractual arrangements, including:
  - drum removal,
  - transportation, and
  - vault decommissioning and radioactive measurements.
- Arrange for timing and access to DRES compound.
- Finalize all equipment needs and secure equipment.
- Arrange for attendance at site of all personnel.
- Meet at site and conduct safety briefing.
- Place equipment at site.
- Remove waste from vault.

- Place empty drums into large box.
- Conduct site survey for release and survey of drums during loading.
- Load all waste material onto dedicated transport carrier.
- Ship to CRL.
- Offload at CRL for storage and disposal.

6.4 Estimated Cost

During the comparison of Disposal Alternatives, we developed Order of Magnitude cost estimates for alternative. The accuracy of these estimates would be ±30%.

The following estimated costs are for the chosen alternative called "Transfer of the Waste to Chalk River Laboratories". Their accuracy is ±15%, which means that each item is based on a current quote.

Rental Equipment (for one week)

1 drum mover	$200	
1 engine hoist	250	
1 electric winch	300	
1 Bobcat for 1 day	300	
1 wooden box	250	
		$1,300
Expendable Equipment		
polyrope, 10 sets of protective clothing, wrenches, screwdrivers, pens, marking equipment, labels, poly	$200	
labour (loading assistance) 50 manhours @ $30/hour	$1,500	
		$1,700
Costs of transportation to CRL from Suffield		$3,000
Site Survey for release and surveying of drums during loading, includes:		
50 hours @ $85/hour	$4,250	
Supervision 8 hours @ $120/hour	960	
		$5,210
Transportation & Lodging	$1,500	$1,500
AECL Research's storage quote	$108,000	$108,000
Subtotal		$117,710
15% Contingency = $8,239 (Rounded to)	$8,200	
Project Management Costs @ 6% (Rounded to)	$7,600	
		$ 15,800
Subtotal		$133,510
GST @ 7% (Rounded to)		$ 9,300
GRAND TOTAL		**$142,810**