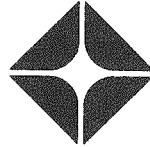


Atlantic Richfield Hanford Company  
Richland, Washington 99352

ARH-2075



HANFORD RADIOCHEMICAL SITE  
DECOMMISSIONING DEMONSTRATION PROGRAM

By

D. C. Nelson  
G. L. Ritter  
M. J. Szulinski

August 9, 1971

PREPARED FOR THE U.S. ENERGY RESEARCH AND DEVELOPMENT  
ADMINISTRATION UNDER CONTRACT E (45-1) 2130

PRELIMINARY REPORT

THIS REPORT CONTAINS INFORMATION OF A PRELIMINARY NATURE. IT IS SUBJECT TO REVISION OR CORRECTION AND THEREFORE DOES NOT REPRESENT A FINAL REPORT. IT WAS PREPARED PRIMARILY FOR INTERNAL USE WITHIN THE ATLANTIC RICHFIELD HANFORD COMPANY. ANY EXPRESSED VIEWS AND OPINIONS ARE THOSE OF THE AUTHOR AND NOT NECESSARILY OF THE COMPANY.

NOTICE

THIS REPORT WAS PREPARED AS AN ACCOUNT OF WORK SPONSORED BY THE UNITED STATES GOVERNMENT. NEITHER THE UNITED STATES NOR THE UNITED STATES ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION, NOR ANY OF THEIR EMPLOYEES, NOR ANY OF THEIR CONTRACTORS, SUBCONTRACTORS OR THEIR EMPLOYEES, MAKES ANY WARRANTY, EXPRESS OR IMPLIED, OR ASSUMES ANY LEGAL LIABILITY OR RESPONSIBILITY FOR THE ACCURACY, COMPLETENESS OR USEFULNESS OR ANY INFORMATION, APPARATUS, PRODUCT OR PROCESS DISCLOSED, OR REPRESENTS THAT ITS USE WOULD NOT INFRINGE PRIVATELY OWNED RIGHTS.

**MASTER**

54-6000-085 (8-75)

DISSEMINATION OF THIS REPORT IS UNLIMITED

## **DISCLAIMER**

**This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.**

## **DISCLAIMER**

**Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.**

UNCLASSIFIED

ARH-2075

This document is classified by:  
M. J. Szulinski

HANFORD RADIOCHEMICAL SITE  
DECOMMISSIONING DEMONSTRATION PROGRAM

By

D. C. Nelson

Process Systems Design and Development  
Facilities Engineering Department

G. L. Ritter\*

Separations Process Engineering  
Operations Support Engineering Department

M. J. Szulinski

Advance Process Development Section  
Research and Development Department

Chemical Processing Division

August 9, 1971

ATLANTIC RICHFIELD HANFORD COMPANY  
RICHLAND, WASHINGTON

\* Currently with Jersey Nuclear Company

UNCLASSIFIED



HANFORD RADIOCHEMICAL SITE  
DECOMMISSIONING DEMONSTRATION PROGRAM

I. INTRODUCTION

Many radiochemical plants and waste disposal facilities have been shutdown or deactivated at Hanford during the past 25 years of site operation due to the development of advanced processing technologies, the reduction or completion of production assignments, the exhaustion of waste disposal site capabilities, and/or pollution abatement efforts. In addition, many facilities now active will be shutdown in the several years ahead. Table 1 below lists the principal inactive and active processing and waste disposal facilities in and immediately near the 200 Areas. Figures 1 and 2 show the geographical location of these facilities and indicate the land areas that have been used to dispose of solid and liquid radioactive wastes.

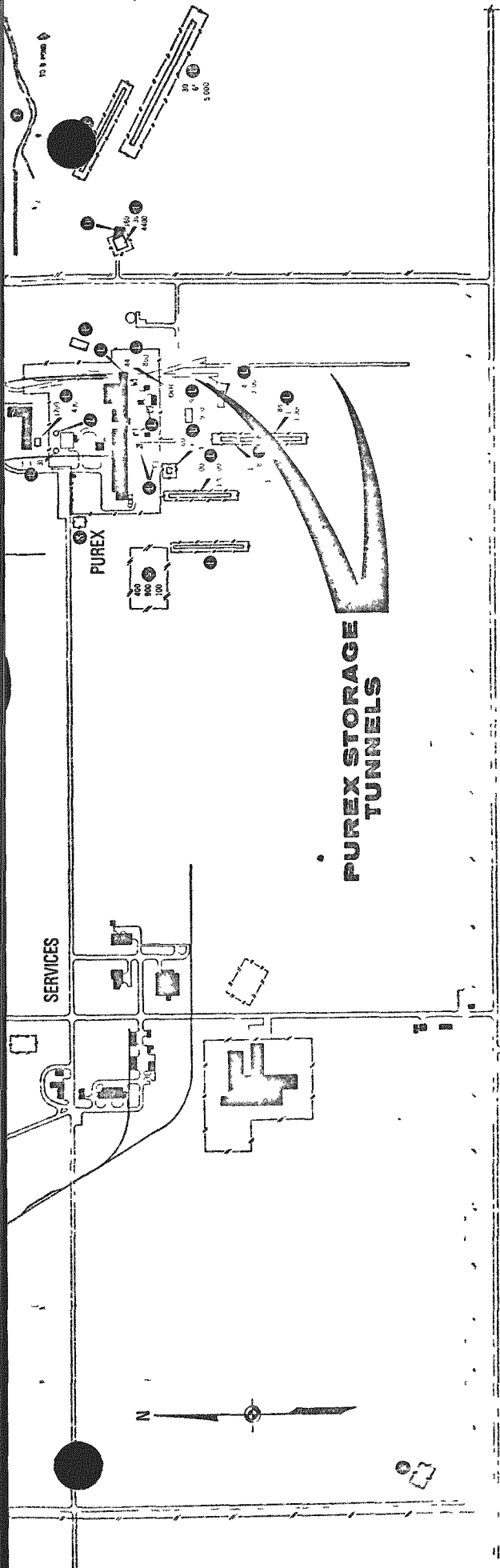
When the Hanford production mission is completed, it will be necessary to continue the waste management program including management of the Hanford area. The eventual goal for the Hanford site may range from continued surveillance of specific areas to complete and unconditional release. A study of the alternatives within this broad range of goals will require evaluation of the economic and technical feasibility of consolidating these contaminated materials or of preparing them for long-term storage, such as in deep caverns at Hanford or a salt mine at another location. New nuclear facilities, which may be located on the Hanford site will be designed for a higher degree of containment within the intent of the Code of Federal Regulations, Title 10, Part 20 (Standards

for Protection Against Radiation) and Part 50 (Licensing of Production and Utilization Facilities).

Appendix F of 10 CFR 50 requires that nuclear fuels reprocessing plants be designed such that the inventory of high-level liquid radioactive wastes be limited to that produced in the prior five years, that the waste be shipped to a federal repository as a contained solid within 10 years of separation and that the plant be designed to facilitate decontamination and removal of all significant radioactive wastes when the facility is decommissioned.

Much work has been done on conversion of liquid wastes to storable solids. Very little work has been done, however, in establishing the technology for retrieving buried equipment and wastes or excavating deeply buried contaminated soils. Process facilities have been decontaminated in the past for maintenance or construction purposes; however, the technology has been highly empirical and the results unpredictable.

The technology for restoring or decommissioning Hanford can be developed and demonstrated in the currently inactive radiochemical plants and waste disposal facilities. Such work will be required to establish Hanford Site Management programs and will provide spin-off to commercial processors in providing technology for designing plants for decontamination and in eventual decommissioning of the plants.



0 3 0

**INVENTORY CODING:**

50 — Kg URANIUM  
 432 — gm PLUTONIUM  
 20 000 — BETA CURIES  
 FISSION PRODUCTS  
 (NO VALUE SIGNIFIED IN  
 THREE-NUMBER STACK BY A  
 SINGLE HORIZONTAL DASH )

**LEGEND:**

☐ SOLID  
 ☐ LIQUID  
 ☐ UNPLANNED

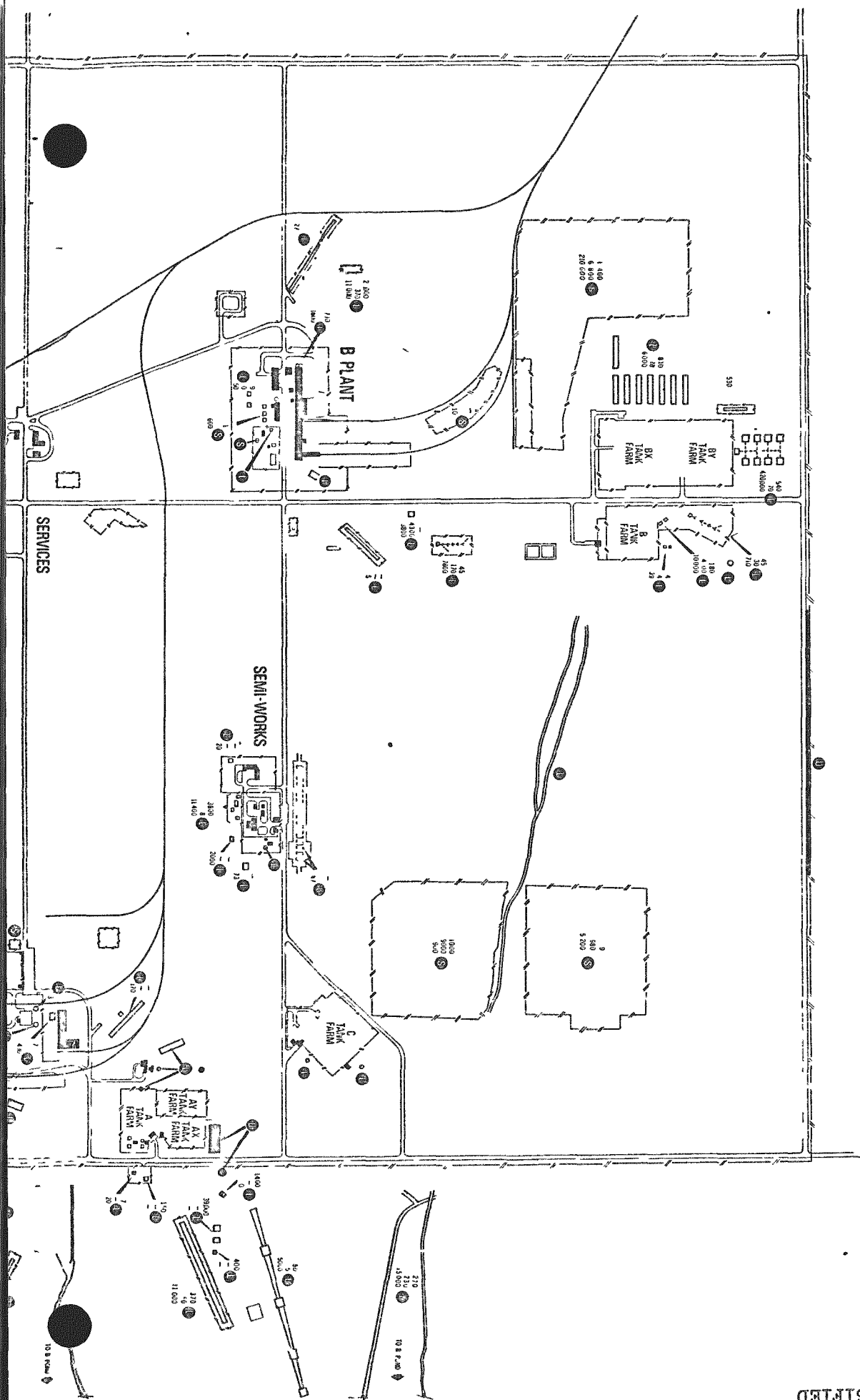
	Kg URANIUM	gm PLUTONIUM	CURIES BETA
TOTAL LIQUID	85,000	11,000	2,340,000
TOTAL SOLID	2,700	17,000	217,000
200-E TOTAL	87,700	28,000	2,557,000
CURIES REMAINING AFTER RADIOACTIVE DECAY THROUGH CY 1965 (124 000)			

**NOTES**

- 1 ALL INVENTORY FIGURES COMPILED THROUGH CAL-  
 ENDAR YEAR 1969
- 2 FISSION PRODUCTS VALUES SHOWN ARE THOSE AT  
 TIME OF DISPOSAL. NO DECAY INCLUDED

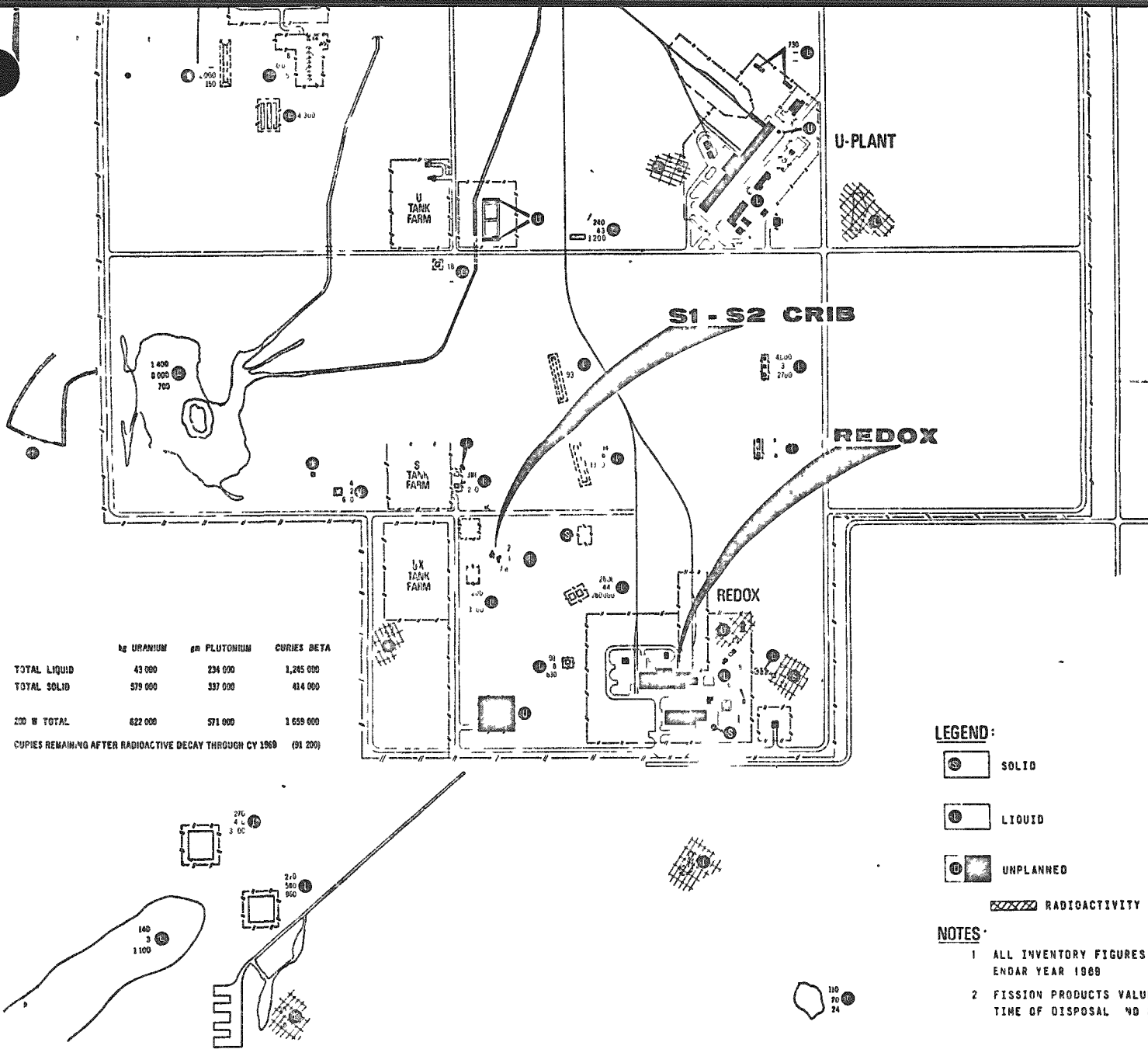
RWH 8 70  
 RWH 1/70 Rev  
 44-71-1000-1000

**FIGURE 1 - RADIOACTIVE WASTE STORAGE SITES 200 EAST AREA**



100' 0" 1" = 100'  
 100' 0" 1" = 100'  
 100' 0" 1" = 100'

UNCLASSIFIED



	kg URANIUM	gm PLUTONIUM	CURIES BETA
TOTAL LIQUID	43 000	234 000	1,245 000
TOTAL SOLID	579 000	537 000	414 000
200 W TOTAL	622 000	571 000	1 659 000
COPIES REMAINING AFTER RADIOACTIVE DECAY THROUGH CY 1960			(91 200)

**LEGEND:**

- SOLID
- LIQUID
- UNPLANNED

**INVENTORY CODING:**

- 50 — kg URANIUM
- 430 — gm PLUTONIUM
- 20 000 — BETA CURIES FISSION PRODUCTS
- (NO VALUE SIGNIFIED IN THREE-NUMBER STACK BY A SINGLE HORIZONTAL DASH)

RADIOACTIVITY NO LONGER DETECTABLE

**NOTES:**

- 1 ALL INVENTORY FIGURES COMPILED THROUGH CALENDAR YEAR 1969
- 2 FISSION PRODUCTS VALUES SHOWN ARE THOSE AT TIME OF DISPOSAL NO DECAY INCLUDED

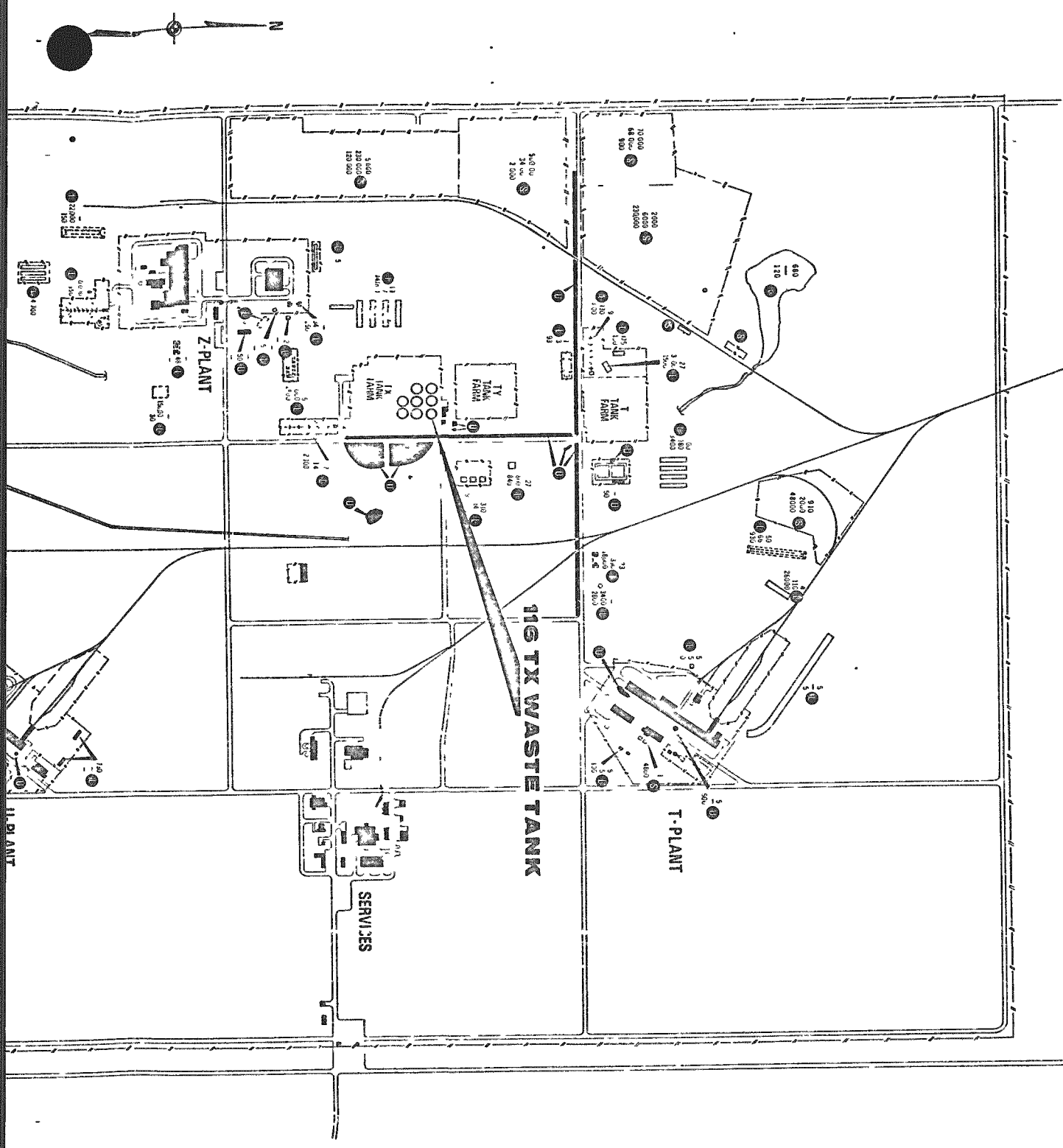
RWH 5 70

RWH 9/70 Rev.

UNCLASSIFIED

**FIGURE 2 - RADIOACTIVE WASTE STORAGE SITES 200 WEST AREA**

ARR - 2075



UNCLASSIFIED

UNCLASSIFIED

TABLE I  
RADIOCHEMICAL PROCESSING AND WASTE DISPOSAL FACILITIES

<u>Facility</u>	<u>Use</u>	<u>Total No.</u>	<u>Active*</u>	<u>Pu, Kg</u>	<u><sup>90</sup>Sr, Kg</u>	<u><sup>137</sup>Cs, Kg</u>	<u>Acres Used</u>
<u>Processing Facilities</u>							
Purex Plant	Fuels Reprocessing	1	1				3
Redox Plant	Fuels Reprocessing	1	0				2
Z Plant	Plutonium Processing	1	1				3
B Plant	Fuels Reprocessing & Waste Processing	1	1				2
U Plant	Fuels Reprocessing & Uranium Recovery	1	0				1 1/2
T Plant	Fuels Reprocessing & Equipment Decontamination	1	1				1 1/2
UO <sub>2</sub> Plant	UNH Calcination	1	1				1 1/2
Semiworks	Pilot Plant & Fission Products Processing	1	0				1/2
<u>Waste Disposal Facilities</u>							
Purex Tunnel	Large Failed Equipment	2	1				1 1/2
Underground Tanks	Non-Boiling Waste Storage	124	124				70
Underground Tanks	Boiling Waste Storage	27	27				
Ponds & Ditches	Low-Level Waste	16	9	9.0	<0.77	<0.62	210
Regular Cribs	Intermediate-Level Waste	95	23	193.7	31.2	16.9	6 1/2
Specific Retention Cribs	Intermediate-Level Waste (organics)	65	3	71.1	11.8	32.2	9
Burial Grounds	Solid Waste	19	4	354.9	-	-	140
TOTALS		356	196	628.7	44.0	49.0	452

\*January 1, 1970

UNCLASSIFIED

- 5 -

ARH-2075

II. PROGRAM OBJECTIVES AND SCOPE

The objective of the proposed program is to innovate, develop, and demonstrate technologies necessary to decommission the Hanford radiochemical plant areas (and outlying zones) to the extent that:

1. The sites can be released for private ownership, unrestricted public access and use, or
2. The sites can be maintained under Atomic Energy Commission (AEC) ownership with restricted public use but unrestricted access.

This program would proceed in two phases, with some overlap, over a period of several years.

Phase I: Perform engineering studies and develop the technologies and equipment necessary to decontaminate, consolidate, and/or package for interim storage all contaminated elements of the Hanford radiochemical sites.

Phase II: Demonstrate the capabilities developed in Phase I for decommissioning representative elements of the radiochemical sites.

A third phase, not a part of this demonstration program, could implement on a "production" basis the technologies for decommissioning selected portions or all of the radiochemical processing and waste disposal facilities.



### III. PROGRAM JUSTIFICATION

A program to develop and demonstrate technologies for decommissioning the Hanford radiochemical plant processing sites is needed to:

1. Provide readily available technologies so that the sites can be decommissioned when desirable.
2. Develop criteria for decommissioning these sites.
3. Provide a basis for making reliable cost estimates for decommissioning the sites.

The program could also provide spin-off technology for improving the design of future reprocessing plants and for eventual decommissioning of the plant site.

### IV. PROGRAM DESCRIPTION

Five tasks were selected for development and demonstration of restoration techniques which are relevant to both Hanford and the nuclear industry. These are:

1. Restoration of a burial ground; demonstrated at a typical burial ground.
2. Decommissioning a separations plant; demonstrated by decontamination of three Redox Plant dissolver cells.
3. Restoration of a separations plant waste interim storage tank farm; demonstrated by removal, both salt cake and tank, of the 116-TX tank.
4. Restoration of a liquid disposal area; demonstrated by excavation of contaminated soil beneath the 216 S1 - S2 crib, and for disposal of Redox Plant waste.

5. Disposal of large contaminated equipment; demonstrated by size reduction of a Purex Plant waste concentrator, a dissolver, and a plutonium stripper-concentrator.

The rationale for selecting these is as follows:

1. Burial Ground

It is estimated that approximately 2.4 million cubic feet of industrial wastes (high-level gamma including major equipment pieces) and 2.8 million cubic feet of "dry" wastes (combustibles, etc.) have been buried in the 200 East and 200 West Areas. These materials are contained in fenced areas which enclose 2.8 and 3.5 million square feet. Both plutonium and high-level fission products are buried. Retrieval of these materials may become necessary. Two burial grounds, 300-N and 300 Wye, have been used by the 300 Areas for storage of high-level gamma, low-level gamma, and plutonium bearing wastes. Since excavation of the high-level contamination and of the large bulky equipment will be difficult and will require development of techniques, restoration of a portion of a burial ground is proposed. If plans develop to move the (300) Area burial grounds, it would be expeditious to precede the operation with the experimental program at either the 300-N or 300 Wye Area.

2. Redox Dissolver Cell Decommissioning

The Redox Plant is reasonably typical of current separations plants. Most of the processing cells are relatively large and contain many pieces of processing equipment. There are three relatively small dissolver cells, however, each originally equipped with:

- a. a process vessel,
- b. a dissolver,
- c. a silver reactor, and
- d. an off-gas filter

The cells and equipment are highly contaminated.

It is proposed that the three dissolver cells be used to demonstrate separations plant decommissioning techniques since the triplication of reasonably sized facilities will allow development of different techniques. For example, it is proposed that one cell be stripped of equipment and decontaminated for uncontrolled entry, while two cells be decontaminated with as much of the equipment in place as possible. Alternative techniques would be developed in the two cells.

3. Tank 116-TX Removal

Currently, there are 151 buried waste tanks (Table I) at Hanford. Many of these, as a result of In-Tank Solidification (ITS), will be processed to the residue (salt cake) remaining after evaporation of the aqueous component. If the decision is made to transfer this material to another location for long-term storage (non-dispersible surface storage, deep cavern storage, salt mine storage, etc.) it will be necessary to remove the salt cake from the tank and package or prepare it for the storage mode. To restore the Hanford site, it may be necessary to physically remove

the tank. Commercial reprocessing plants will also use tanks for interim storage of radioactive waste solutions before they are processed and shipped to a repository for long-term storage. Although it is likely that the details of tanks used in commercial reprocessing plants will differ from those in use at Hanford, much of the technology of removing these tanks can be solved using Hanford tanks and typical mock-ups.

The 116-TX Tank is reasonably typical of the tanks and material expected in the Hanford Waste Management Program; it is one of the first tanks processed to solidification; and, it is located at the corner of the TX farm tank array and should provide feasible access for removal equipment.

4. 216 S1-S2 Crib Site Restoration

Currently there are 140 sites, designated as cribs, which have been used for disposal of solutions containing radioactivity. Various criteria have been used for determining the amount of material disposed of at a particular site and for determining that a particular site is exhausted; e.g., the use of a crib may be terminated when radioactivity is detected in the groundwater, or in a "specific retention" crib, the liquid volume of solutions may be sufficiently small such that it is retained by the soil beneath the crib and above the groundwater.

The liquid disposal area, designated as the 216 S1-S2 crib was used during operation of the Padco Plant. It contains both actinides and fission

products. It is relatively small in contaminated area, and is typical of most 200 Area cribs. Low-level radioactivity has been measured in test wells down to the water table.

Further studies of the 216 S1-S2 crib, with excavation of the site to achieve various degrees of residual contamination, will provide technology required to restore the larger liquid disposal areas.

5. Disposal of Large Contaminated Equipment

Failed process equipment of a size which can fit in a burial box (typical 18 x 14 x 7 feet) is packaged and buried in the 200 Areas Burial Ground. Some Purex equipment is too large for such treatment, and too highly radioactive to permit disassembly to packaging size requirements. These large equipment pieces are stored in two storage tunnels connected to the Purex Building. In decommissioning the Purex facility, it will be necessary to dispose of these stored equipment pieces. Typical pieces which are readily accessible are:

- a. A waste concentrator (Process Piece F-6), typical of high beta, gamma contamination.
- b. A dissolver (Process Piece, A, B or C-3), typical of high alpha, beta, gamma contamination.
- c. A plutonium stripper - concentrator (L-Cell Package), typical of high alpha contamination.

Indicative of the problems of handling such equipment are the statistics of the F-6 concentrator which stands 37 feet tall, weighs 41 tons, and is typical of several concentrators which will require eventual disposal.

Development of techniques for fragmentation of the large equipment assemblies into pieces which can be handled or transported by conventional means, will contribute to the technology required to decommission the Purex and similar facilities.

#### Scope of Process Development and Proposed Demonstrations

The objective of the Hanford Radiochemical Site Decommissioning Demonstration Program is to establish the technology for alternative degrees of release in decommissioning the radiochemical processing and related waste disposal areas.

The scope of process development and demonstration programs will be to:

1. Package the recovered material (soil, steel, salt cake, concrete) for interim storage at Hanford; and
2. To process a small portion of these recovered materials through a waste processing pilot plant, to develop and demonstrate long range storage alternatives.

As an operating convenience, combustible waste generated in the course of the demonstration program will be burned or oxidized in a new incinerator or incineration alternative. Oxidation of recovered combustibles may be demonstrated only, since the status of these buried combustibles is unknown.

Uncontaminated soil is defined as that containing less than 5 pCi/g of soil of alpha emitting nuclides, or less than 10 percent of the concentration guides given in 10 CFR 20, Appendix B, Table II, Column 2, expressed in terms of grams rather than ml, i.e., less than 0.03 and 2.0 pCi/g of soil for  $^{90}\text{Sr}$  and  $^{137}\text{Cs}$  respectively. High-level waste is defined as that containing greater than 10 nCi/g alpha or greater than 1 nCi/g beta-gamma. Material between these limits would be stored as low-level material.

#### Proposed Demonstration

The entire development and demonstration program is considered to be an extended development program; however, some preliminary work needs to be done before the equipment required in the demonstration phase of the program can be designed.

Work at the demonstration site would be preceded by an experimental program in support of the work required and by a developmental measurement program to determine levels, areas, and composition of contamination. Engineering and design studies would be performed in support of required facilities, and with completion of construction, the operational phase of the demonstration would begin. An overall flowsheet for the operation is presented in Figure 3.

Demonstration of excavation of typical segments of a burial ground would suffice for development of the technology; however, if plans should be made to consolidate all radioactive materials on the 200 Area plateau, it would be desirable to perform the development work on a 300 Area burial site immediately preceding the total excavation. Costing of the program is based on demonstration work on typical segments.

To restore the S1-S2 crib site to an uncontaminated status, would require excavation down to groundwater at about 200 feet below the surface. Studies were made on excavation of the crib site to:

1. 30 feet below crib bottom (approximately 99 percent of radioactivity removed),
2. 60 feet below crib bottom, and
3. uncontaminated residues (excavation to groundwater).

However, since it is likely that all plutonium will be located near the point of liquid entry, costing was done on the basis excavating 30 feet below the crib bottom.

The individual sub-programs are discussed in greater detail in the appendices.

An engineering pilot plant is proposed to study and develop techniques for preparation for long-term storage. The flowsheet for the pilot plant is shown in Figure 4. Although some economies in this facility could be achieved by using existing and proposed Hanford processes, it is likely that such a facility would be very useful in general studies of solid waste management problems.

Process development requirements in support of the demonstrations are listed in Table II. In order to permit an appraisal of the process development required in support of the individual programs, a minimum effort requirement is also listed. This minimum effort would only support the operational effort of the demonstration and would not develop



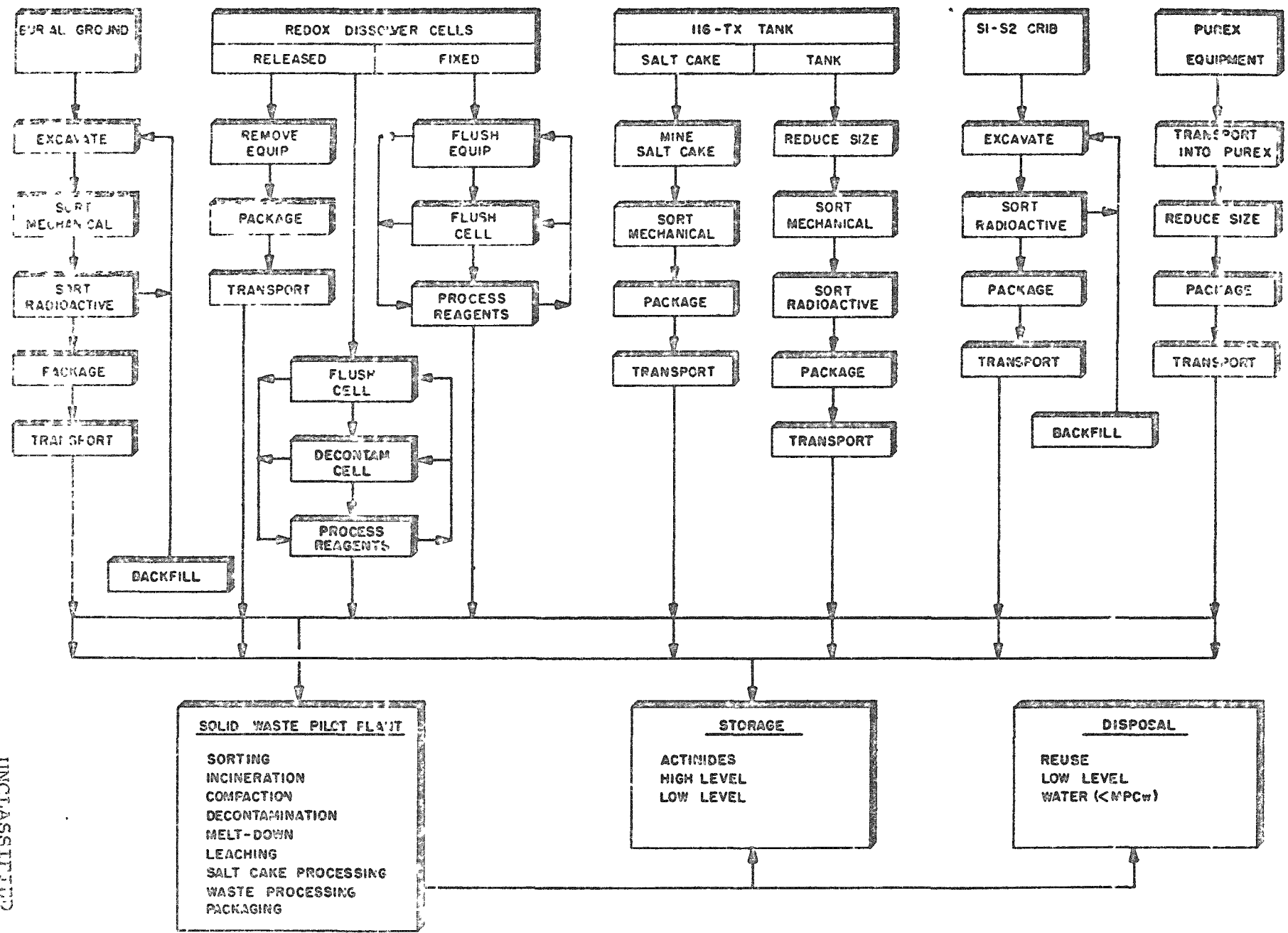
the alternatives which would contribute toward optimization of long-term storage. The technology developed in each category will, in most cases, apply to more than one sub-program. Similarly, the technology developed in the total program will apply to essentially all site restoration problems at Hanford or at any commercial solvent extraction separations plant. Process development costs will be incurred in support of the operations and in operation of the solid waste pilot plant. This process development support is included in the process technology cost, which is estimated at 15 percent of the operating cost. The process development cost at the solid waste pilot plant is included in the operating cost for that facility.

As indicated in Table II, some of the required process development work is currently in progress or is planned. The scope of this work, however, is limited to current needs and budgets and would be expanded to meet proposed objectives and schedules.

Additional related process development work is required, some of which is in progress, to define alternatives for perpetual storage and to minimize the cost of preparation.

The proposed site restoration demonstration schedule is presented in Figure 5 and the estimated costs for the total and individual sub-programs are tabulated in Table III and summarized in Table IV.

UNCLASSIFIED

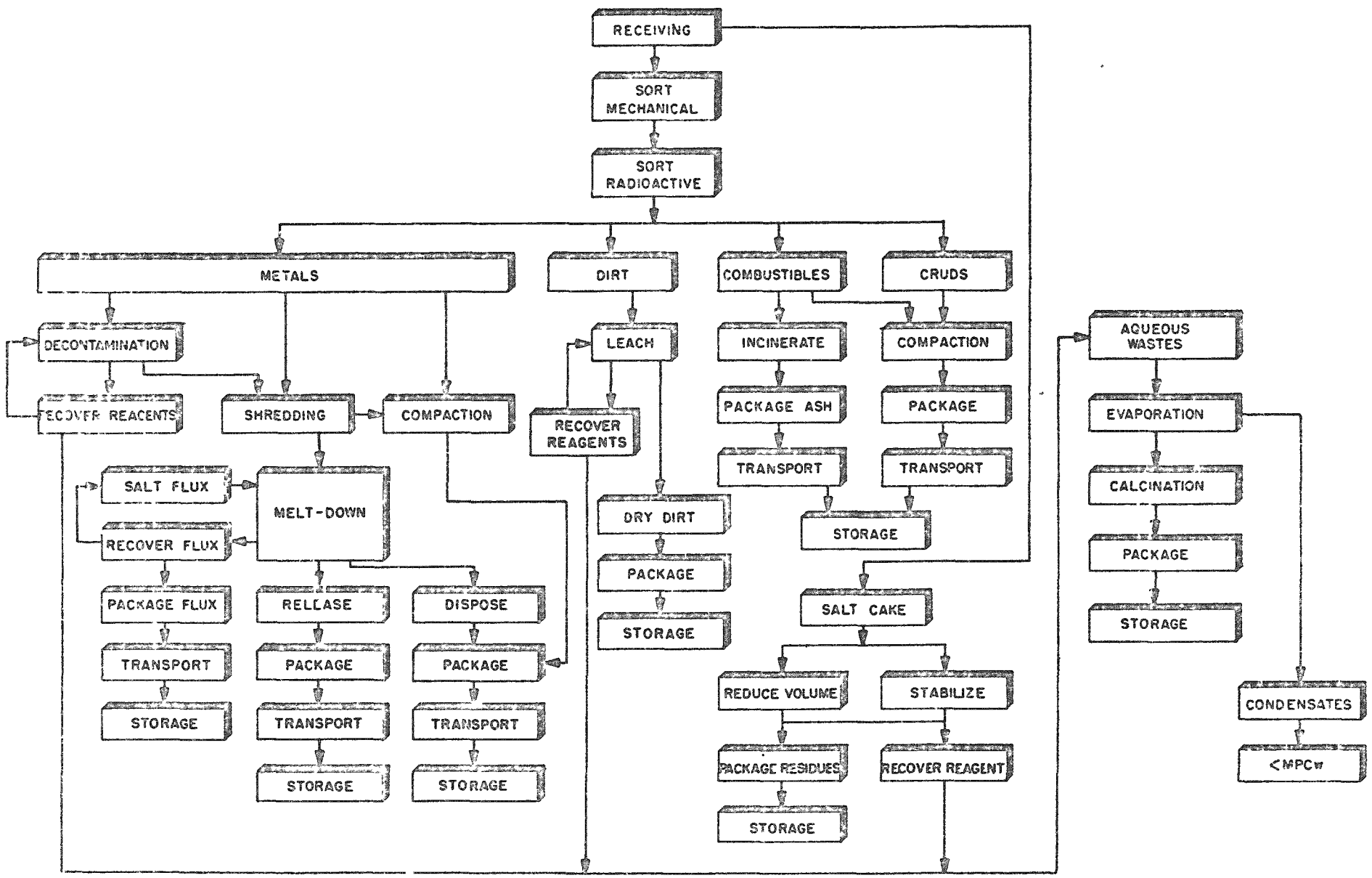


UNCLASSIFIED

**SITE RESTORATION DEMONSTRATION**

FIGURE - 3

UNCLASSIFIED



SOLID WASTE PILOT PLANT  
FIGURE -4

TABLE II

PROCESS DEVELOPMENT - REQUIREMENTS

(Cost in millions of 1971 dollars)

Technology Required	Man Years		Equip. Dollars	Total Dollars	Program (3)				
	ARHCO	PNL			Burial Ground	Redox	116TX Tank	S1-S2 Crib	Purex Tunnel
Site Contamination Measurement	5	1/2			X			X	
Excavation Techniques	2	1	0.20		X			X	
Packaging and Storage	1/4	1/2			X		X	X	X
Concrete Decontamination(2)	1/4	1			X	X	X	X	X
Characterization(1)	1/2	1			X	X	X	X	X
Large Equipment Size Reduction(2)	4	2	0.15		X	X	X	X	X
Salt Cake Mining	4	1	0.10				X		
Salt Cake Packaging	1/4	1/2					X		
116TX Tank Size Reduction	7	1	0.20				X		
Instrumentation, Sorting, Survey(1)	1	1	0.10		X	X	X	X	X
Incineration, Alternatives(1)	1/2	2			X	X	X	X	X
Equipment Decontamination(1)	1	3			X	X	X	X	X
Consolidation, Metal Recovery(1)	1/4	2			X	X		X	X
Soil Decontamination(2)	1/4	1			X			X	
Aqueous Effluents Disposal(2)	1/4	1			X	X	X	X	X
ARHCO	26.5				15	8	19	11	8
MAN YEARS									
PNL		18.5			16	14	13	11	13
Dollars(4) (Rounded)	ARHCO	1.00	0.75	1.75	1.00	0.60	1.00	0.75	0.60
PNL		1.25		1.25	1.00	0.90	0.85	0.75	0.85
TOTAL				3.00	2.00	1.50	2.00	1.50	1.50
Minimum Support - Total					0.70	0.35	1.60	0.60	0.5

(1) Some work in effect during FY 1971.

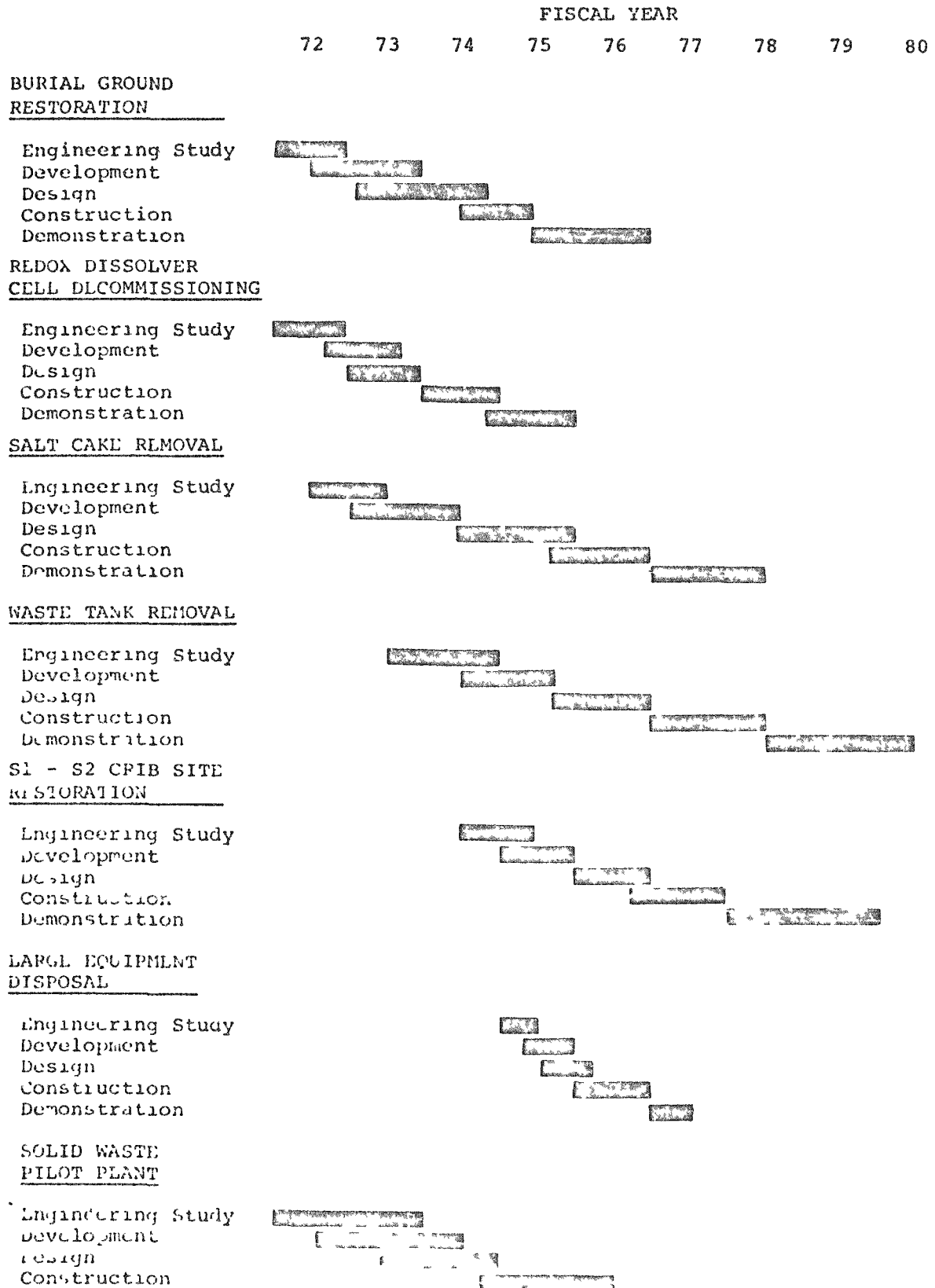
(2) Some work planned during FY 1972.

(3) X denotes support of longer range goals. X denotes minimum support effort for individual program.

(4) Note costs exclude capital and operating cost of solid waste pilot plant.

UNCLASSIFIED

UNCLASSIFIED



DECOMMISSIONING AND DEMONSTRATION PROGRAM SCHEDULE

FIGURE 5

TABLE III

## COST SCHEDULE

(Cost in millions of 1971 dollars)

Subprogram	FY 72	FY 73	FY 74	FY 75	FY 76	FY 77	FY 78	FY 79	FY 80	Totals
Process Development: PNL	0.45	0.40	0.40							1.25
ARHCO (1)	0.75	0.70	0.30							1.75
Process Technology (2)			0.03	0.50	0.85	0.30	0.40	0.25		
<u>Burial Ground</u>										
Capital		1.0	3.0							4.0
Operating				1.0	1.0					2.0
Containers				0.10	0.25					0.35
Storage (Trench)				0.1	0.1					0.2
<u>Redox Dissolver Cell Decommissioning</u>										
Capital		0.1	0.4							0.5
Operating			0.2	0.9						1.1
<u>TK-116TX Removal</u>										
Salt Cake										
Capital			0.2	0.5	0.8					1.5
Operating					0.3	1.7	0.8			2.8
Containers						0.1	0.05			0.15
Storage (U Plant)					0.5					0.5
Tank										
Capital				0.1	0.4	2.0	1.0			3.5
Operating							0.9	1.7	0.8	3.4
Containers							0.05	0.1	0.05	0.2
Storage (Trench)							0.05	0.05		0.1
<u>SI-S2 Crib Site Removal (3)</u>										
Capital					0.5	2.0				2.5
Operating						0.3	0.9	0.9		2.1
Containers							0.2	0.3		0.5
Storage (Trench)							0.2	0.1		0.3
<u>Large Equipment Disposal</u>										
Capital				0.05	0.2					0.25
Operating						0.2				0.2
SUBTOTALS	1.2	2.2	4.5	2.75	4.05	6.30	4.15	3.15	0.85	29.15
<u>Solid Waste Pilot Plant</u>										
Capital		0.4	2.0	3.0	1.6					7.0
Operating					0.1	0.75	0.75	0.75	0.75	3.10
TOTALS	1.2	2.6	6.5	5.75	5.75	7.05	4.90	3.90	1.6	39.25

(1) Includes Equipment

(2) Included in Subprogram Operating Cost

(3) The SI-S2 costs include excavating and packaging soil from the first 30 feet beneath the cribs to remove most of the  $^{239}\text{Pu}$ ,  $^{90}\text{Sr}$ , and  $^{137}\text{Cs}$ . Costs to remove all long-lived radionuclides to less than 0.1 MPC (10 CFR 20, Table II, Column 2) would total 38 million dollars--excluding process development.

TABLE IV  
COST SUMMARY  
(Cost in millions of 1971 dollars)

	Capital	Operating	Containers	Storage	Total (1)	(2)	(3)
						Process Development	
<u>Burial Ground</u>							
Demonstration	4.0	2.0	0.35	0.2	6.55	0.75	2.0
<u>Redox Dissolver Cell Decommissioning</u>	0.5	1.1			1.6	0.35	1.5
<u>116TK Tank Removal</u>							
Salt Cake	1.5	2.8	0.15	0.5	4.95		
Tank	3.5	3.4	0.2	0.1	7.2		
Total	5.0	6.2	0.35	0.6	12.15	1.6	2.0
<u>S1-S2 Crib Site Removal</u>							
30 Feet Below Crib	2.5	2.1	0.5	0.3	5.4	0.6	1.5
To 0.1 MPC <sub>w</sub>	3.5	6.5	17.0	11.0	38.0		
<u>Large Equipment Disposal</u>	0.25	0.2			0.45	0.5	1.5
<u>Solid Waste Pilot Plant</u>	7.0	3.10 <sup>(4)</sup>			10.10 <sup>(4)</sup>		
<u>Total (6)</u>	19.25	14.7	1.2	1.1	36.25		3.0 <sup>(5)</sup>

- (1) Total Excludes Process Development
- (2) Direct Support of Program Only
- (3) Includes Longer Range Goals
- (4) To End of FY 1980
- (5) See Table II - Process Development Programs Overlap - Cost of Total is Less Than Sum of Parts
- (6) Includes S1-S2 Crib Excavation to 30 Feet

UNCLASSIFIED

UNCLASSIFIED

APPENDIX



A. BURIAL GROUND RESTORATION1. Description

Major burial grounds are located at both 200 East and 200 West Areas. In addition, two areas, 300-N and 300 Wye, have been used by the 300 Areas. The 200 Area burial grounds are divided into two major categories:

- (1) Industrial Wastes, (including equipment) and
- (2) Dry Wastes (including combustibles).

Currently, the industrial type wastes are contained in an area of about 62 acres and the dry wastes in an area of about 78 acres.

Sketches of typical burial grounds are shown in Figure 6. The equipment is boxed and buried in trenches. Smaller laboratory wastes are contained in drums or in "caissons" depending upon their radiation levels.

2. Flowsketch and Facilities

Removing the many types of radioactive solid wastes from the burial grounds will require adaptation of existing mining and excavating equipment and techniques to a remote type of operation. The wastes will be

excavated and sorted mechanically. This sorting might be comprised of the following categories:

- a. Large and Small Metallic Materials
- b. Large and Small Combustible Materials
- c. "Cruds" (Miscellaneous unsortable - laboratory materials, partially decomposed combustibles, etc.)
- d. Drums
- e. "Caisson" Contents
- f. Demolished Caissons
- g. Dirt

Further sorting would be required according to its transuranium content and according to high- or low-level beta-gamma contamination.

It is likely that most of the actual waste excavated will be in the high-level waste category. It is assumed that penetration of radioactivity beneath the burial ground is not excessive and that the contamination level would be acceptable five feet below the waste materials. This assumption would need to be verified by surveys before the project begins, to provide engineering scope data, and by surveys during the course of the excavation.

Conceptually, the excavation would be performed by building a mobile mining, sorting, packaging facility

that would travel over the area to be excavated. This traveling facility could be developed from concepts such as:

1. Air Support Structures
2. Inflated Structures
3. Frames and Curtain Walled Structures
4. Conventional
5. Tents

Development of an acceptable low cost containment technique could result in a substantial capital saving.

The technology for restoration of a burial ground can be developed by excavating about 200 feet of trench, and one "caisson". If plans are implemented to consolidate most of the radioactivity on the 200 Area plateaus, it may be desirable to develop the excavation techniques at one of the 300 Area burial grounds. In this manner, the excavation development program could be followed by the proposed operation with a likely substantial savings in capital requirements.

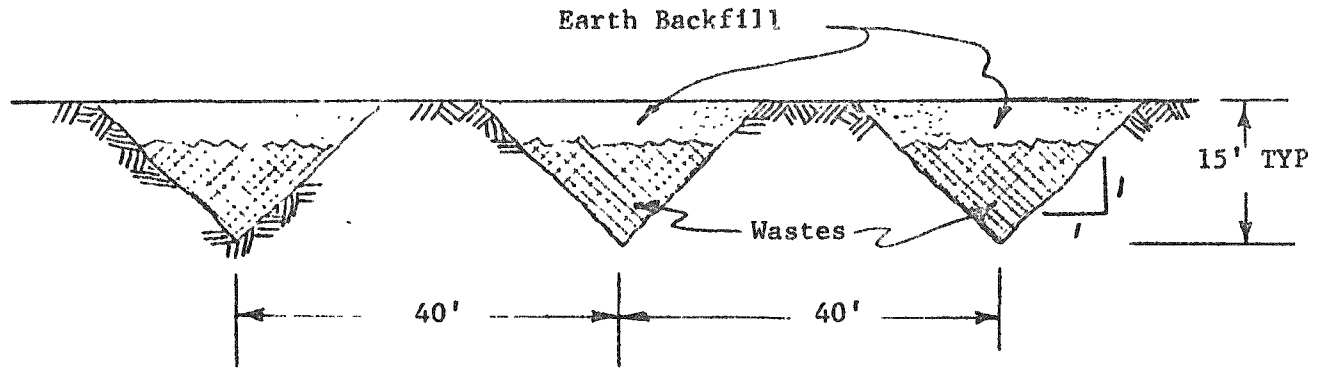
A flowsketch for demonstration of restoration of a burial ground is shown in Figure 7. The scope of the operation would be limited to excavation of about 200 feet of trenches, and one "caisson". In this alternative, approximately 500,000 cubic feet would be excavated of which about 200,000 cubic feet would be contaminated.

### 3. Development Requirements

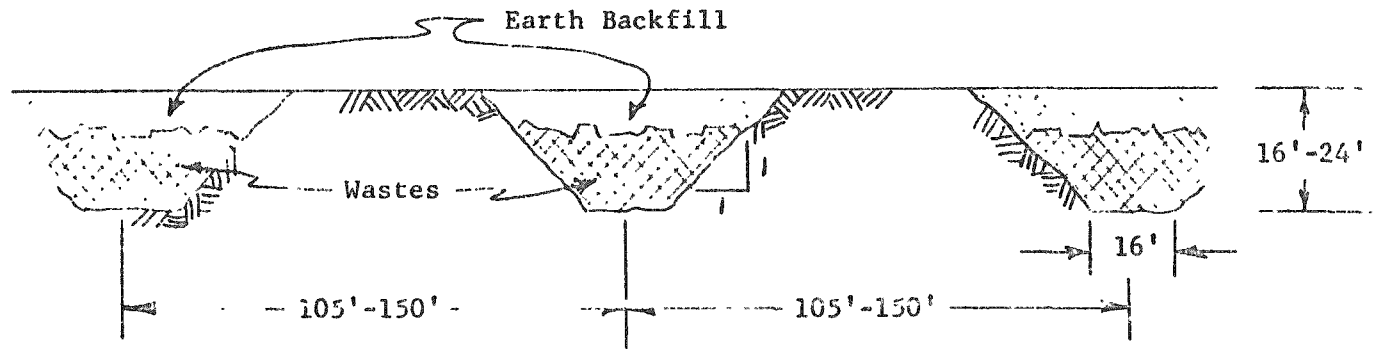
Adaptation of existing mining-excavation techniques to a mobile containment system with mechanical and radioactive sorting would be required. Development of site contamination and characterization measurement techniques would be necessary before the operation started. Packaging requirements, with respect to transportation and storage criteria and storage stability, need to be developed. Techniques for preparation for long-term storage, such as large equipment size reduction, equipment decontamination, equipment consolidation, incineration and soil decontamination need to be studied. The process development requirements are tabulated in Table II.

### 4. Schedule and Costs

A proposed schedule, based on a development program is given in Figure 5. The proposed expenditure patterns are given in Table III. In summary, a demonstration program should cost about 6.6 million dollars, and could be accomplished by the end of FY 1976. In addition, process development in support of the program would cost 0.75 to 2.0 million dollars, depending upon the scope of the work as directed toward long-term storage. These costs are exclusive of the construction and operation of a solid waste pilot plant.



Dry Waste Burial Ground - Cross Section



Industrial Waste Burial Ground - Cross Section

FIGURE 6 - TYPICAL WASTE BURIAL GROUNDS

UNCLASSIFIED

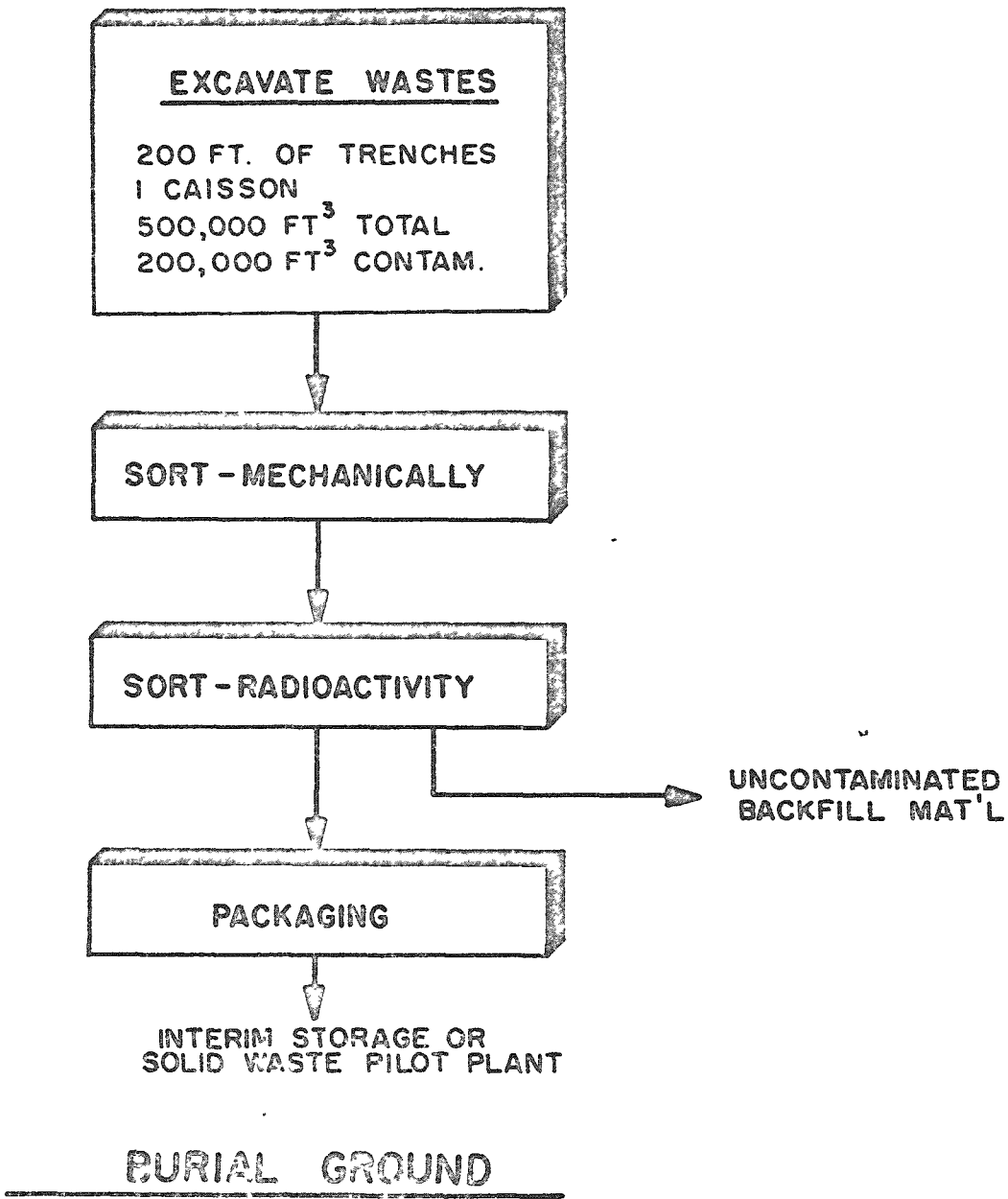


FIGURE - 7

## B. Redox Dissolver Cell Decommissioning

### 1. Description

The Redox Plant was the first solvent extraction separations plant to be built and operated in the United States. It was put into operation during 1952, to replace the Bismuth Phosphate process and was shutdown during 1966, when the Hanford production load was assumed by the Purex facility. Its design is reasonably typical, from a decommissioning standpoint, of current separations plants. A view of the Redox Plant is shown in Figure 8. Most of the processing cells are relatively large and contain many pieces of processing equipment. There are three relatively small dissolver cells, however, each originally equipped with:

- a. a process vessel,
- b. a dissolver,
- c. a silver reactor, and
- d. an off-gas filter.

These three cells can be used to demonstrate separations plant decommissioning techniques. The cell layout is shown in Figure 9.

### 2. Flowsketch and Facilities

Since there are three dissolver cells, it will be possible to test, or develop, different techniques

for decommissioning the cells. It is proposed, for example, that one cell be stripped of equipment and decontaminated, while two cells be decontaminated with as much of the equipment in place as possible. It is likely that it would be necessary to remove the off-gas filter and silver reactor since in place decontamination of these pieces of equipment is not very likely. A flow sketch of the proposed operation is shown in Figure 10.

Solutions generated in the course the decontamination operation would be collected and concentrated in existing Redox equipment. Condensates would contain lower than MPC<sub>w</sub> concentrations of radioactivity. The high salt waste residues from decontamination solutions would be disposed of in the existing In-Tank Solidification (ITS) program.

### 3. Development Requirements

Development work to determine best methods for equipment and concrete decontamination are required. Metallic equipment surfaces will likely decontaminate with solutions or with pressure abrasion with or without particulate matter, while concrete surfaces will likely also require further decontamination by actually removing the surface. This surface removal might be achieved by chipping, by flame spallation, sand blasting, etc. Processes will need to be developed to control the volume and composition of waste products. An important part of the program will be development of survey techniques which will permit release. The process development requirements are tabulated in Table II.



4. Schedule and Costs

A proposed schedule is given in Figure 5, and the proposed expenditure pattern is given in Table III. In summary, this program should cost about 1.6 million dollars. In addition, process development in support of the program would cost 0.35 to 1.5 million dollars depending upon the scope of the work as directed toward long-term storage. These costs are exclusive of the construction and operation of a solid waste pilot plant.

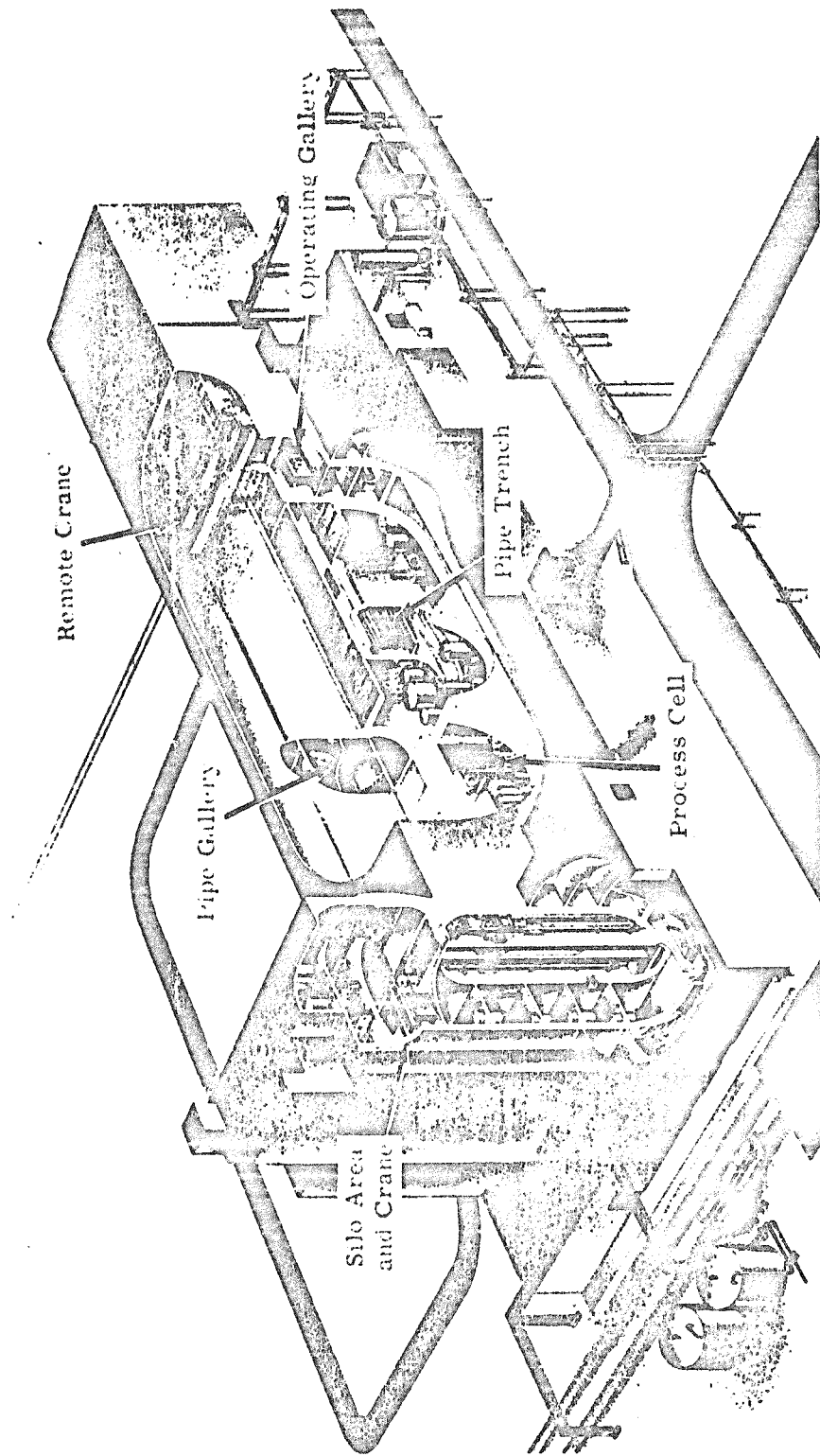


FIGURE 8

Redox Plant

A1, B1, C1. VESSEL 4 1/2' O. X 7' H1.  
 A2, B2, C2. DISSOLVER  
 A3, B3, C3. SILVER REACTOR  
 A4, B4, C4. FILTER



RR TUNNEL

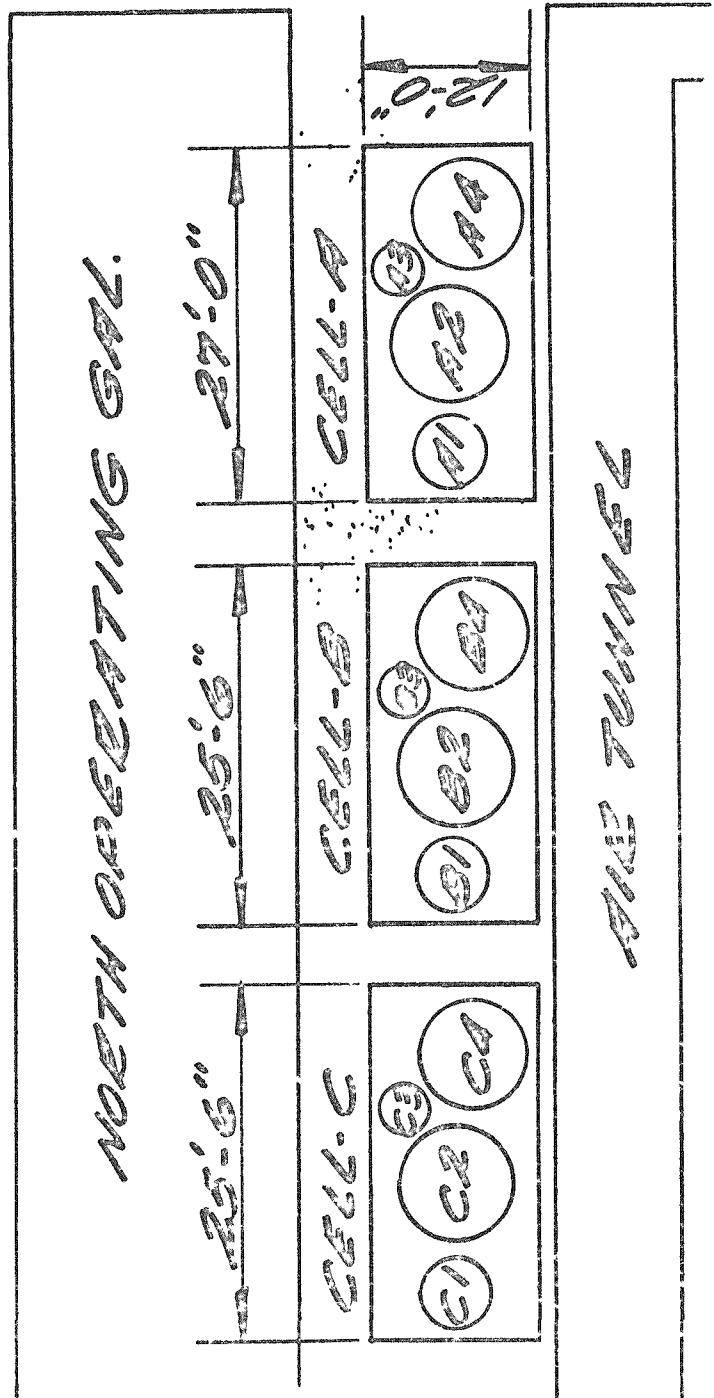
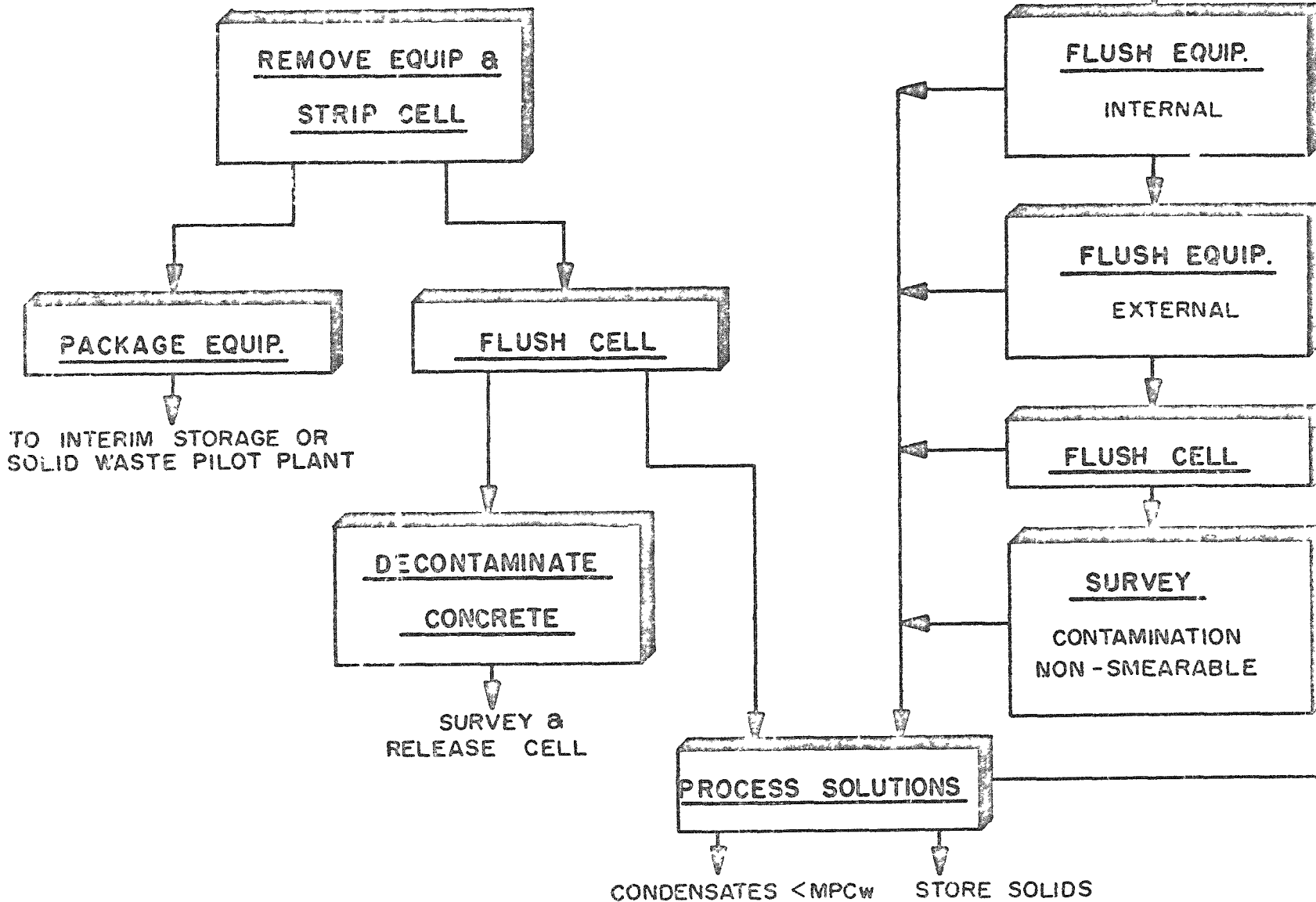


FIGURE 9 RLDox DISSOLVER CELLS A, B, & C

CELL "A"  
(UNCONDITIONAL RELEASE)

CELLS "B" & "C"  
(CONTROLLED RELEASE)



UNCLASSIFIED

- 34 -

ARRH-2075

REDOX DISSOLVER CELLS DECOMMISSIONING

FIGURE-10

C. Salt Cake and Tank Removal (TK-116TX)

1. Description

Tank 116-TX is one of 18 tanks comprising the 241-TX Tank Farm in the 200 West Area. The tank is 75 feet in diameter and about 39 feet tall from the base to the top of the dome. Earth covers the tank to a depth of about 8 feet. It is constructed of reinforced concrete (15 inch thick sidewalls) and lined on the bottom and sidewalls with mild steel. The tank is capable of containing 750,000 gallons of non-boiling liquid waste.

The tank has most recently been used for collecting salts which precipitate from the bottom's solution of the 242-T waste evaporator. At the present time, the tank contains about 675,000 gallons of salt cake and interstitial mother liquor. Also, about 128 tons (80,000 gallons) of diatomite have been added to the surface of the tank to adsorb free standing liquid. An estimated 225,000 gallons of mother liquor will be removed from the tank leaving a damp salt cake having a moisture content of 10-15 percent by weight.

The composition and physical properties of the salt cake are shown in Table V.

TABLE V

COMPOSITION AND PROPERTIES  
OF SALT CAKE IN TK-116TX

Salt Particle Density, g/ml		1.86
Thermal Conductivity, Btu/hr-ft-°F (dry)		0.22 - 0.28
Water Leachability	<sup>137</sup> Cs	90 - 98 percent
	<sup>90</sup> Sr	3 - 5 percent
Major ions, dry weight percent	Na	15 - 30
	Fe	0.02 - 0.5
	Al	0.2 - 0.5
	Si	<0.05
	CO <sub>3</sub>	2
	NO <sub>3</sub>	Balance
Radionuclides, Ci/gal dry salt	<sup>137</sup> Cs	0.07 - 0.33
	<sup>90</sup> Sr	$1.5 \times 10^{-4}$ - $7.7 \times 10^{-4}$
	<sup>106</sup> RuRh	$1.5 \times 10^{-3}$ - $3.9 \times 10^{-3}$

This tank was selected for the demonstration because it contains salt cake which is believed to be typical of the majority of the material to be handled in the Hanford Waste Management program. The tank is conveniently located at the northeast corner of the 241-TX Tank Farm so that access is feasible. (See Figure 2.) The tank is nearly as large as the largest at Hanford (750,000 gallon capacity versus 1,000,000 gallon capacity), making the demonstration a full-scale test of the salt cake mining and tank removal techniques.

## 2. Salt Cake and Tank Removal Flowsketch and Facilities

A flowsketch for removing the salt cake from TK-116TX is shown in Figure 11. About 90,000 ft<sup>3</sup> of salt cake weighing about 4000 tons would be mined from the tank and packaged for transportation to an interim storage site. Tools, rods, old liquid level measuring tapes and other miscellaneous metallic materials which are likely to be present in the tank would be removed and

packaged separately. As an alternative, some of the salt cake would be sent to the solid waste pilot plant for processing to reduce the bulk volume, and/or the solubility prior to storage. Salt cake which is not so processed would be packaged in vented containers for storage in the U Plant canyon (see Section G).

A conceptual equipment scheme for removing and packaging the salt cake is shown in Figure 12. A remotely operated hydrocrane to break up and pick up the salt cake, an elevator bucket system and a packaging station located above ground might be used. Television cameras and periscopes would be required to view the in-tank operations. The packaging operation would be controlled from a shielded operating station.

Following removal of the salt cake, the tank itself would be dismantled and removed as shown in the flow-sketch in Figure 13. A steel containment building would be built over the tank. Using remotely operated equipment, such as torches, lasers, hydrocranes and manipulators, the steel liner would be cut up and packaged. The concrete would be demolished. Some mechanical sorting might be required to segregate steel, concrete, and dirt. Also, sorting based on radioactivity content may be desirable. The packages containing the waste would be transported by shielded rail cars to the interim storage site (see Section G).

### 3. Development Requirements

Equipment systems designed for remote operation must be developed. Salt cake mining and packaging equipment would be unique and require special construction

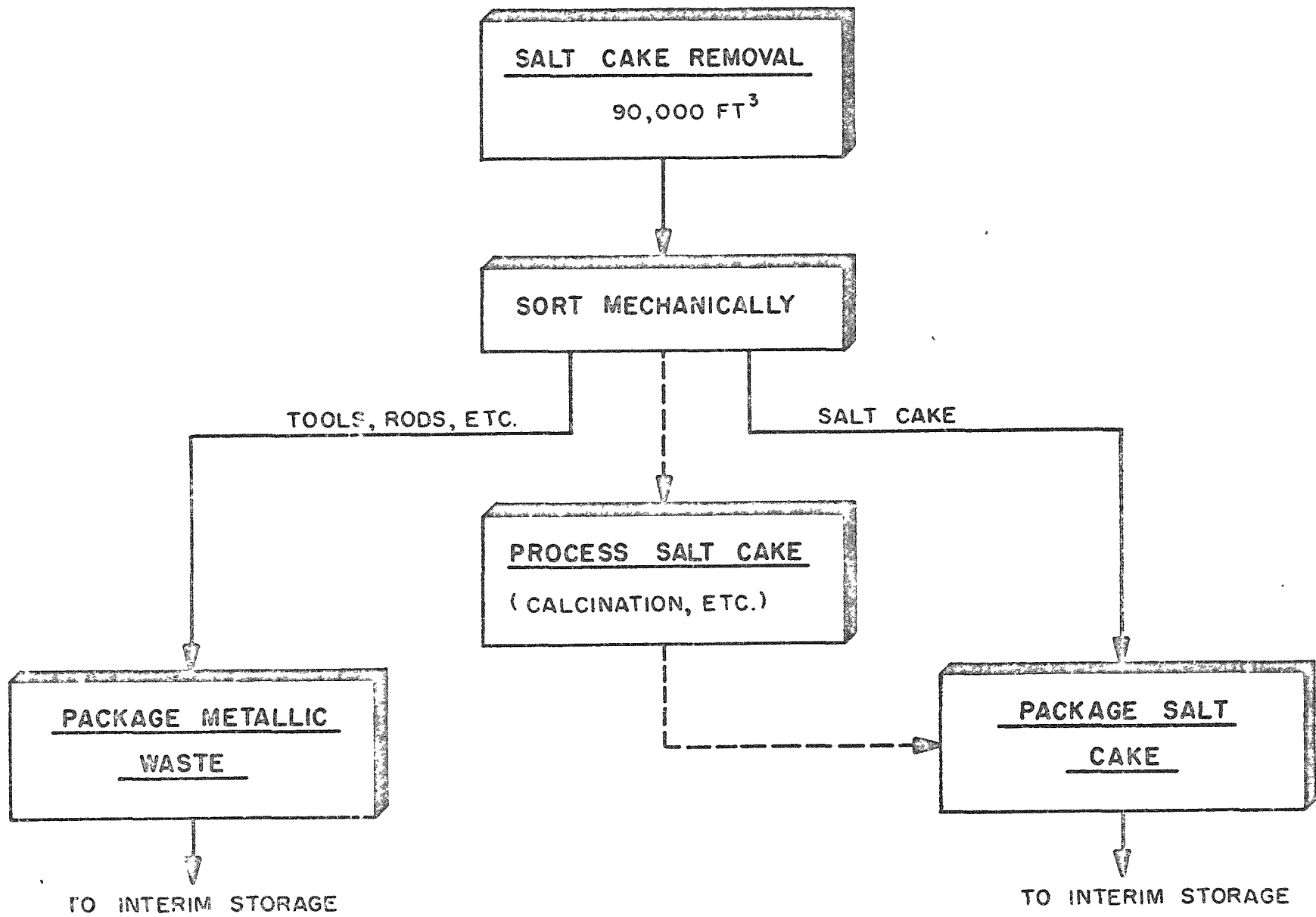
for remote operation and maintenance. Equipment systems to remove the tank would also need to be developed. Special emphasis is needed for methods to cut up the steel liner and demolish the reinforced concrete shell.

4. Schedule and Costs

A proposed schedule is given in Figure 5, and the proposed expenditure pattern is given in Table III. In summary, this program should cost about 12.2 million dollars. In addition, process development in support of the program would cost 1.6 to 2.0 million dollars depending upon the scope of the work as directed toward long-term storage. These costs are exclusive of the construction and operation of a solid waste pilot plant.



UNCLASSIFIED



SALT CAKE REMOVAL  
FIGURE - II

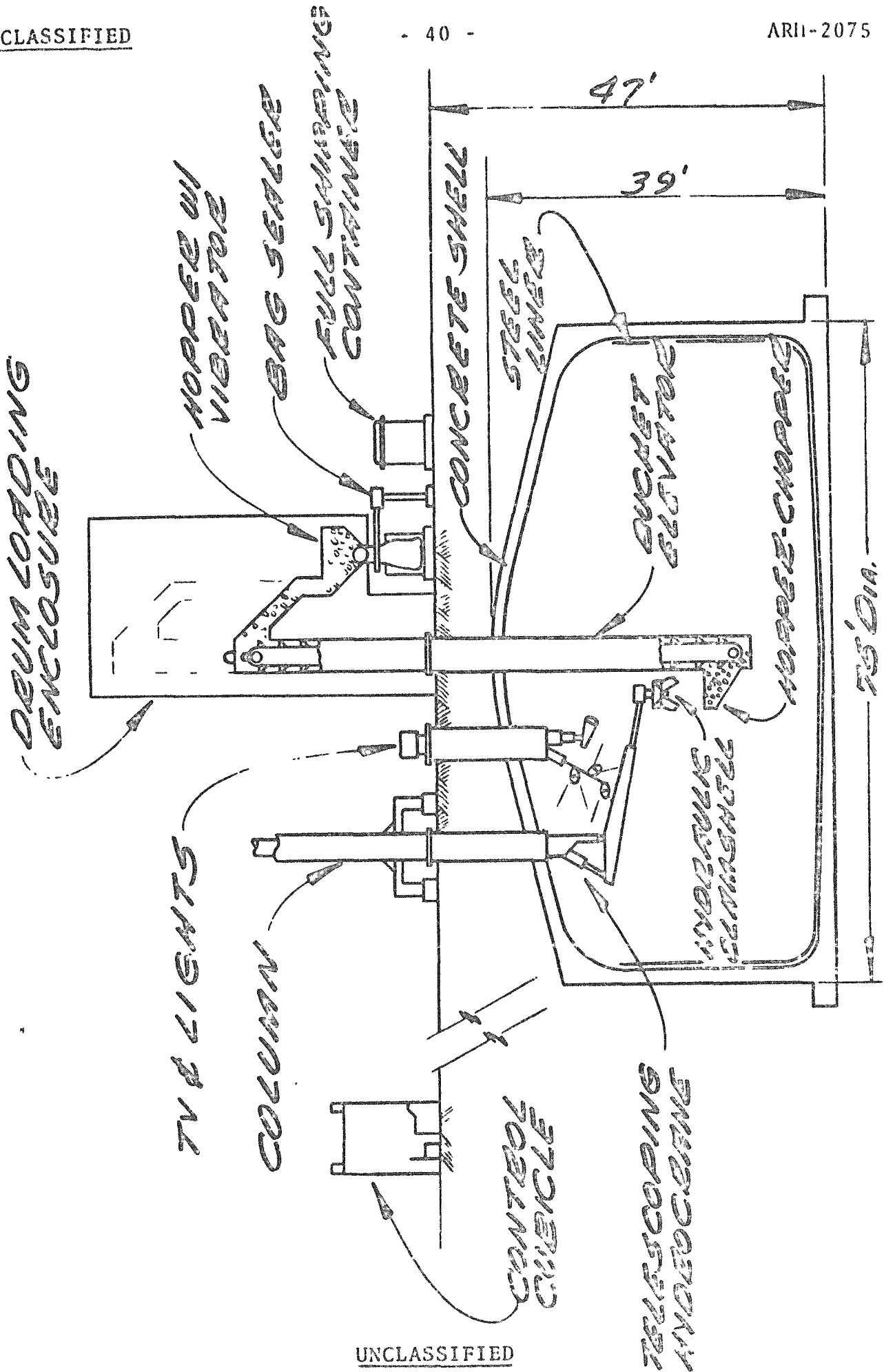
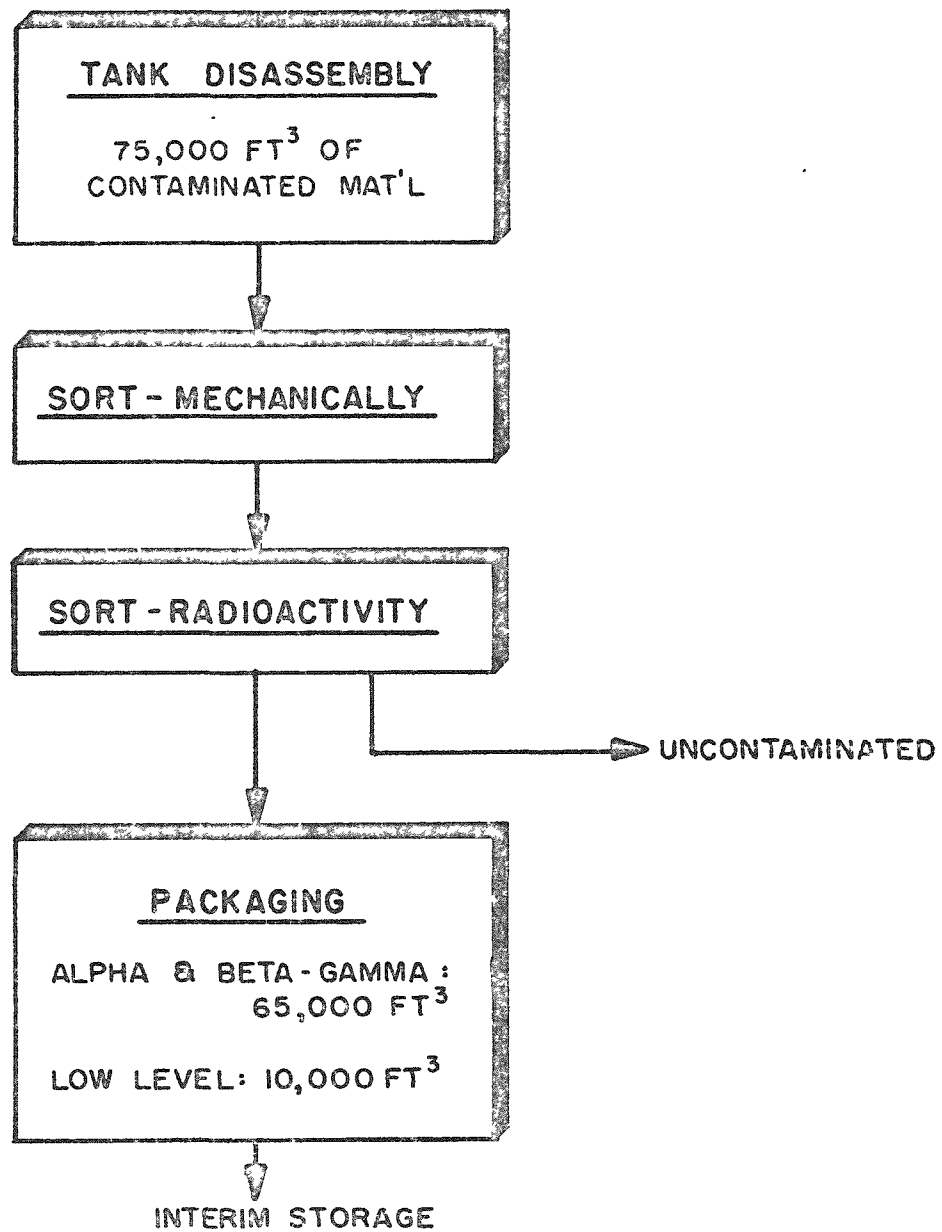


FIGURE 12 SALT CAKE REMOVAL

UNCLASSIFIED



WASTE TANK (TK 116-TX) REMOVAL  
FIGURE - 13

D. 216 S1-S2 Crib Site Restoration

1. Description

The 216 S1-S2 Cribs consist of two timbered structures buried in an excavation 35 feet deep, 40 feet wide and 90 feet long as shown in Figure 14. The timbered "cribs" are each 12 x 12 x 9 feet high.

The 216 S1-S2 Cribs were first used for disposal of liquid wastes (process condensates) from the Redox Plant in January 1952. During a four-year period through January 1956, approximately 39 million gallons of waste liquid were discharged into the ground via this crib site. Contained in these wastes were an estimated 750,000 beta curies of mixed fission products, including 3,000 curies of strontium-90 and 2,000 curies of cesium-137. Also, some 1,200 grams of plutonium and 2,300 kilograms of uranium were discharged. The crib site was removed from service in January 1956, when the strontium-90 and cesium-137 concentrations in samples taken from monitoring wells drilled through the site reached predetermined limits.

The spatial distribution of several radionuclides in the soil underlying the crib site was determined in 1956 and later in 1966.<sup>(1)</sup> Gamma activity profiles were obtained in several wells to determine the vertical and horizontal distribution of gamma emitting radionuclides. In addition, radiochemical analyses were obtained from soil samples cored from several wells. Figures 15 and 16, taken from reference 1, illustrate the results of this work. The results indicate that greater than 99.9 percent of the cesium and most of

the strontium in the soil is contained within the first 20 to 30 feet below the bottom of the two cribs.

The spatial distribution of plutonium was not determined through field measurements; however, based upon results of laboratory soil column tests using waste solutions similar to those which were discharged to the 216 S1-S2 Cribs, the plutonium should have been readily removed from the waste and should now be located within the first few feet of soil column beneath the cribs.

2. Excavation and Packaging Flowsketch and Facilities

The objective of this sub-program is to excavate radioactively contaminated soil beneath the 216 S1-S2 Crib site and package it in containers for interim storage. A flowsketch illustrating the proposed operation is shown in Figure 17. Equipment would be assembled for excavating, radioactively sorting and packaging the contaminated soil. This equipment would be operated within a steel structure situated over the site. Conventional mining or excavating equipment, modified for remote operation, would be utilized for the excavation work. The radioactive waste sorting and packaging equipment would also be designed for remote operation.

The volume of radioactively contaminated soil to be excavated will increase as the limits for the allowable residual contamination in the soil are reduced. The flowsketch shows the estimated volumes of contaminated and uncontaminated soil which must be handled assuming various residual contamination levels. In the first case, soil would be removed to a depth of

about 30 feet below the bottom of the crib. This would remove essentially all the soil contaminated with plutonium and most of the cesium and strontium (based upon Figures 15 and 16). Soil not removed would still be contaminated with  $^{90}\text{Sr}$  at greater than  $10^{-1}$   $\mu\text{Ci/g}$ , however. In case (2), soil would be removed to a depth of 60 feet below the bottom of the crib in order to reduce the  $^{137}\text{Cs}$  and  $^{90}\text{Sr}$  concentrations in the remaining soil to less than about  $5 \times 10^{-3}$   $\mu\text{Ci/g}$ . Finally, in case (3), soil would be removed down to the water table to reduce the concentrations of long-lived radionuclides in the remaining soil to less than 0.1 of the limits for soluble radionuclides given in 10 CFR 20, Appendix B, Table II, Column 2. Expressed in terms of grams of soil rather than per ml for  $^{90}\text{Sr}$ ,  $^{137}\text{Cs}$ , and  $^{239}\text{Pu}$ , the 10 CFR 20 limits are  $3 \times 10^{-7}$ ,  $2 \times 10^{-5}$ , and  $5 \times 10^{-6}$   $\mu\text{Ci/ml}$ , respectively.

The contaminated soil would be sorted according to its alpha and beta-gamma activity prior to packaging. Soil contaminated to greater than 10 nCi/g total alpha and 1 nCi/g total beta-gamma would probably be packaged as a highly contaminated waste since the radiation exposure level would exceed 1 mrem/hr at 1 meter from a filled container and sufficient transuranic elements (principally plutonium-239) are present to warrant special care in handling and storage. For this study noncontaminated waste is defined to contain less than 5 pCi/g of total alpha and less than 10 percent of the concentration guides given in 10 CFR 20, Appendix B, Table II, Column 2.

As the volume of soil to be handled and depth of mining is increased, the excavation, sorting and packaging equipment would become more complex and automated. The number of containers to hold the contaminated soil would increase proportional to the volume of contaminated soil. After filling and sealing the containers, they would be transported to an interim storage site in the 200 Areas (see Appendix, Section G below).

### 3. Development Requirements

Present techniques for defining the spatial distribution of the radionuclides in the soil would be improved. Monitoring and soil sampling wells that are drilled through the highly contaminated soil zones into lower contaminated zones are not wholly satisfactory since contamination can be carried from the upper to the lower zones.

Engineering studies would be performed and solids materials handling experts would be consulted to develop economical techniques for excavating, sorting and packaging the soil.

An instrumentation system for radioactively sorting the contaminated soil with very low activity detection limits is needed. The system must be reliable and automated in order to sort the very large quantities of soil potentially involved.

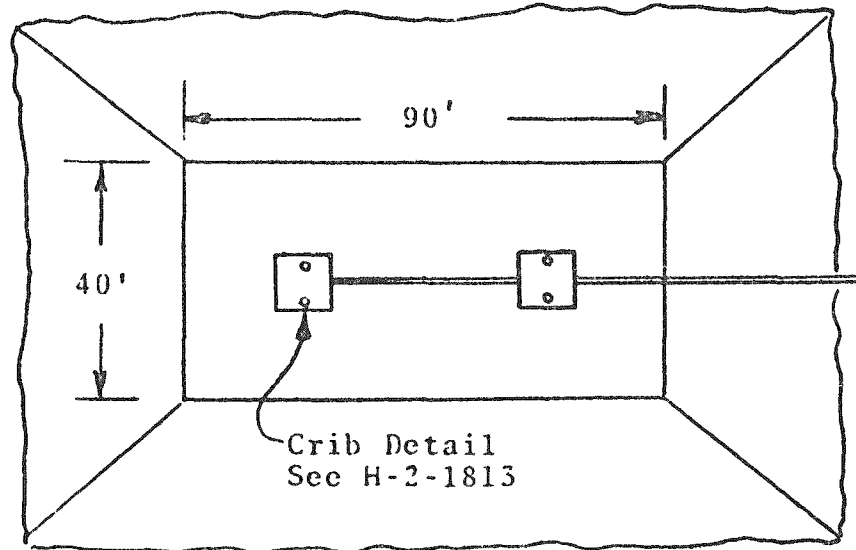
### 4. Schedule and Costs

A proposed schedule is given in Figure 5, and the proposed expenditure pattern, for the alternative of

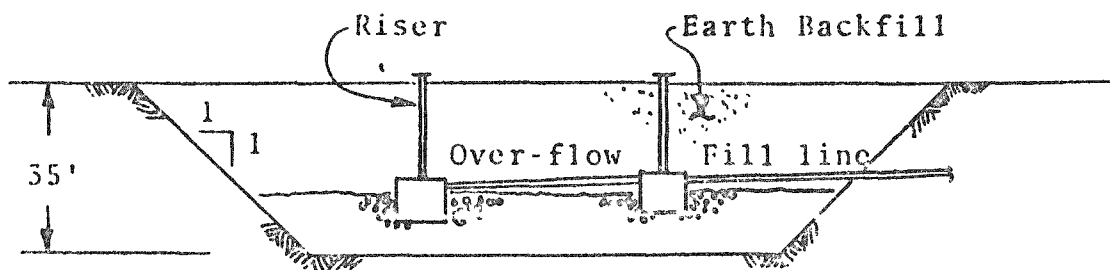
excavating to 30 feet below crib bottom, is given in Table III. In summary, this program should cost about 5.4 million dollars. In addition, process development in support of the program would cost 0.6 to 1.5 million dollars depending upon the scope of the work as directed toward long-term storage. These costs are exclusive of the construction and operation of a solid waste pilot plant. The expenditure pattern for the three cases studied is presented in Table VI.

Reference 1: Brown, D. J., "Migration Characteristics of Radionuclides through Sediments Underlying the Hanford Reservation," ISO-SA-32, May 29, 1967.



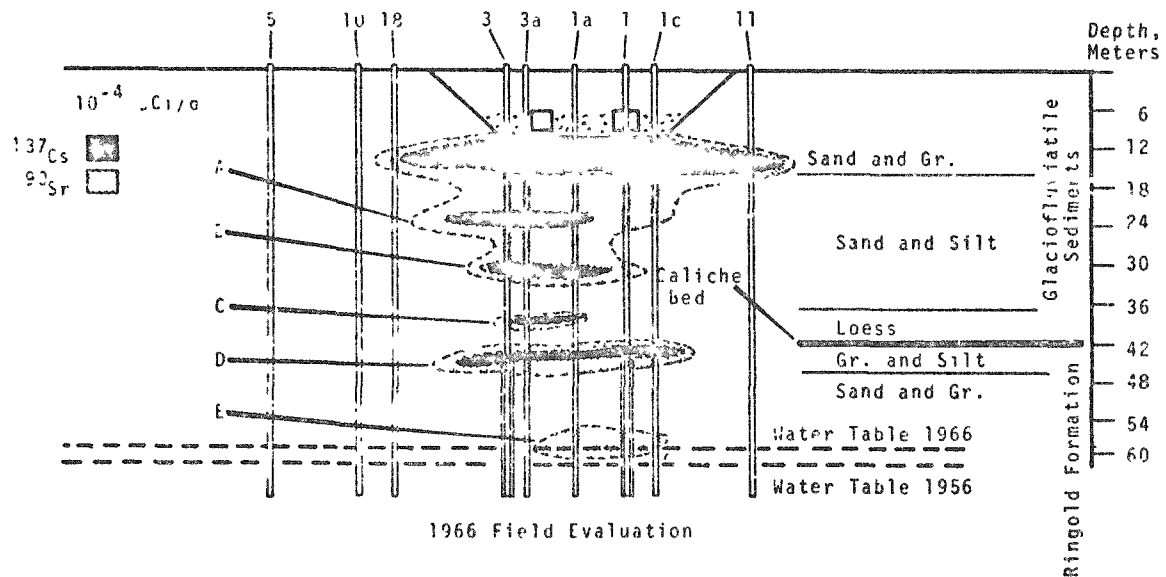
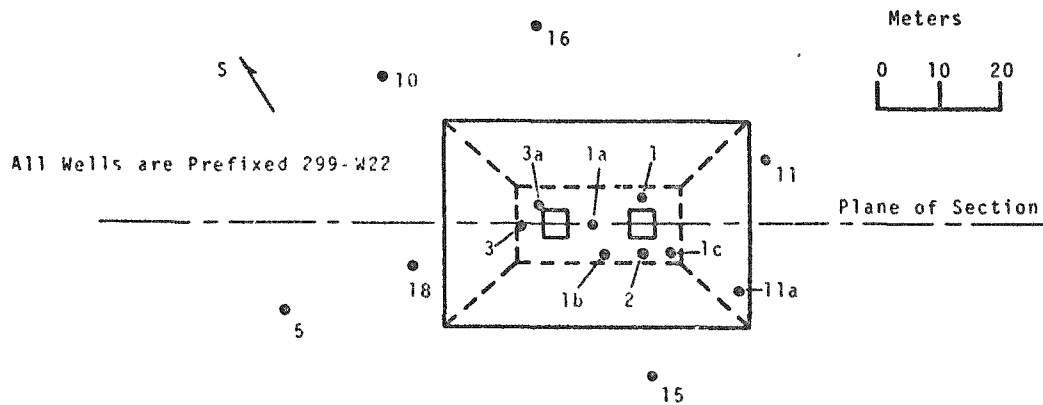
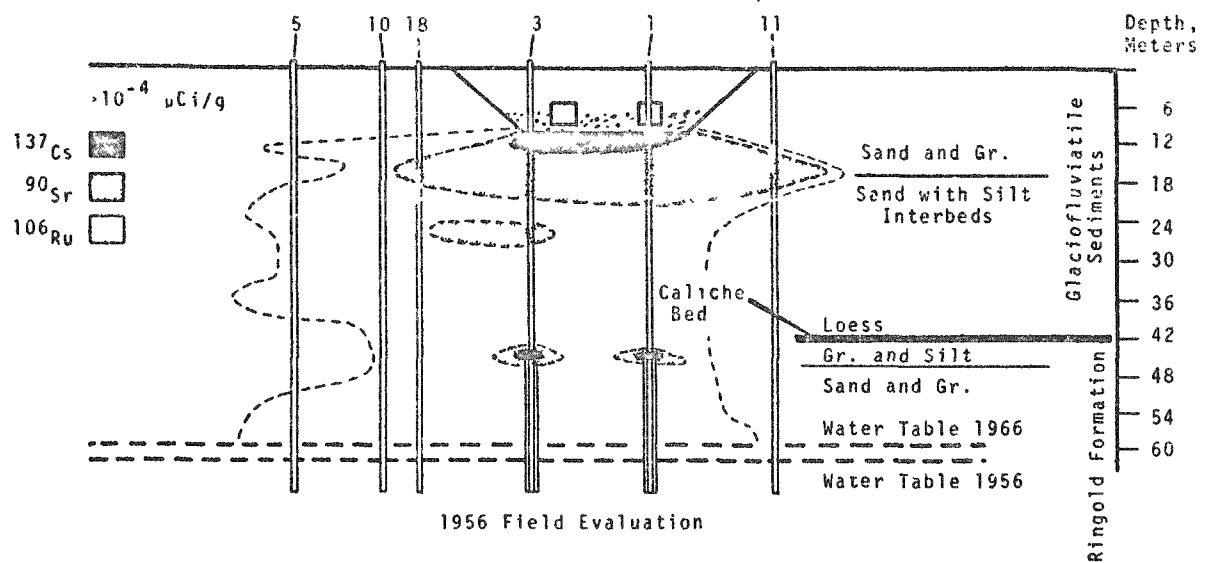


Plan View



Section View

FIGURE 14 S1 - S2 CRIB



Radionuclide Distribution Beneath the 216-S 1 and 2 Crib Site From 1956 and 1966 Field Evaluation Data

FIGURE 15

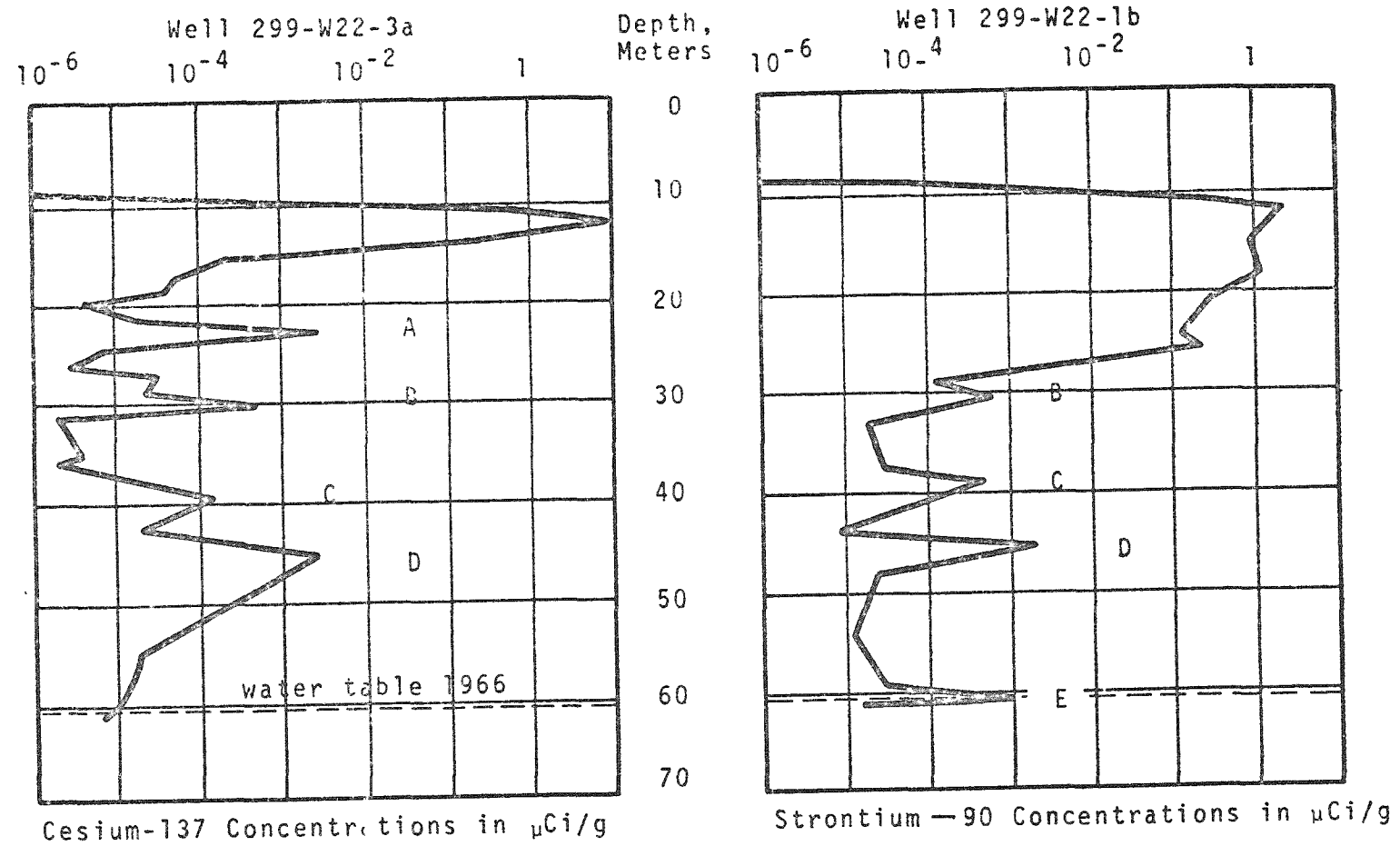
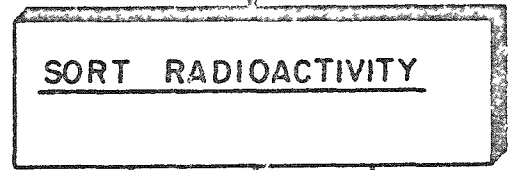
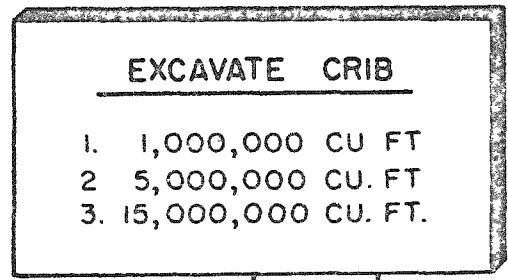


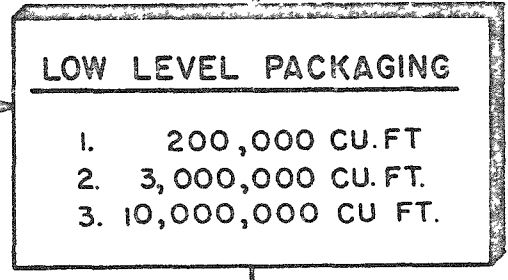
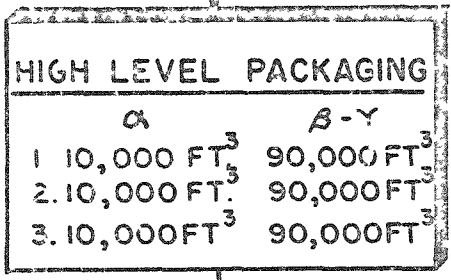
FIGURE 16  
Cesium-137 and Strontium-90 Concentration Profiles In Sediments  
Underlying The 216-S 1 and 2 Cribs, 1966

\* TERMS DEFINED IN TEXT



\*  $\alpha > 10n \text{ Ci/g SOIL}$   
 $\beta\text{-}\gamma > 1n \text{ Ci/g SOIL}$

\*  $\alpha < 5 \text{ pCi/g SOIL}$   
 $\beta\text{-}\gamma: \sum \frac{\text{Ci/cc}}{\text{MPCW}} < 0.1$



- 700,000 CU. FT
- 1,900,000 CU. FT.
- 4,900,000 CU. FT.

INTEFIM STORAGE  
 OR SOLID WASTE PILOT PLANT

**SITE RESTORATION OF 216-S1 & S2 CRIBS**

FIGURE-17

UNCLASSIFIED

TABLE VI  
EXPENDITURE PATTERN FOR 216 S1-S2 CRIB SITE RESTORATION

	Costs in Millions of 1971 Dollars						Sub Total	Storage	Total
	<u>FY-76</u>	<u>FY-77</u>	<u>FY-78</u>	<u>FY-79</u>	<u>FY-80</u>	<u>FY-81</u>			
<u>Case 1 (Excavate 30 feet) (2)</u>									
Capital	0.5	2.0							
Operating		0.3	0.9	0.9					
Containers			0.2	0.3					
Total	0.5	2.3	1.1	1.2			5.1	0.3	5.4
<u>Case 2 (Excavate 60 feet) (3)</u>									
Capital	0.5	2.5							
Operating		0.4	1.2	1.2	1.2				
Containers			1.5	1.5	2.0				
Total	0.5	2.9	2.7	2.7	3.2		12.0	3.0	15.0
<u>Case 3 (Excavate to groundwater)</u>									
Capital	0.5	3.0							
Operating		0.5	1.5	1.5	1.5	1.5			
Containers			3.0	4.5	4.5	5.0			
Total	0.5	3.5	4.5	6.0	6.0	6.5	27.0	11.0	38.0

(1) Excluding Process Development and Pilot Plant Costs

(2) Below Crib Bottom

UNCLASSIFIED

- 51 -

ARRH-2075

## E. Disposal of Large Equipment

### 1. Description

Most failed process equipment is boxed and buried. Some Purex equipment, however, is too large and too highly radioactive for this treatment and is stored in one of two tunnels. These tunnels are connected directly to the Purex Canyon so that the failed equipment can be loaded on a railroad car and stored, without leaving the facility. The first tunnel, about 400 feet long, was filled with eight cars of equipment. The second tunnel, 1680 feet long, is about 15 percent filled.

When the Purex Plant is decommissioned, it will be necessary to dispose of this equipment.

Easily available stored equipment are a waste concentrator (F6) which is stored in the old tunnel, and a dissolver and a plutonium stripper concentrator (L Cell package) which were removed from service during 1971. Two of the above items are shown in Figures 18 and 19. Indicative of the problems of handling such equipment are the statistics of the waste concentrator which stands 37 feet tall and weighs 41 tons. The concentrator is typical of several such pieces of equipment with predominantly beta-gamma contamination. The dissolver will present alpha contamination in addition to the beta-gamma, while the plutonium stripper-concentrator will be predominantly alpha contaminated.

## 2. Flowsketch and Facilities

Decommissioning the Purex Plant and the storage tunnels will require that the equipment be retrieved, moved into the Purex Canyon and dismantled or fragmented into pieces that can be packaged for storage or that can be processed for long-term storage. For the purpose of the demonstration it is proposed that most of the equipment be placed in interim storage with a portion processed through the Solid Waste Pilot Plant to develop and test long-term storage techniques and to attempt recovery of the stainless steel. Processing in the Solid Waste Pilot Plant would likely consist of work on surface decontamination, and further size reduction by shredding, compaction, and melt-down. The proposed flowsheet is presented in Figure 20. Processing in the Solid Waste Pilot Plant is presented in Figure 4.

## 3. Development Requirements

Techniques to dismantle or cut up the equipment into manageable sizes need to be developed. Tentatively, it is proposed that this might be by laser, by a remotely operated torch, or possibly by use of shaped explosive charges. Further size reduction and consolidation techniques, such as shredding, compaction and melt-down and possible recovery of the metal by a combination of decontamination processes, including melt-down in the presence of a flux need to be explored further. The process development requirements are tabulated in Table II.

#### 4. Schedule and Costs

A proposed schedule is given in Figure 5 and the proposed expenditure pattern is given in Table III. In summary, this program should cost about 0.5 million dollars. In addition, process development in support of the program would cost 0.5 to 1.5 million dollars depending upon the scope of the work as directed toward long-term storage. These costs are exclusive of the construction and operation of a Solid Waste Pilot Plant which would be required for demonstration of optimized long-term storage, including potential metal recovery processes. The Pilot Plant is estimated to cost 7 million dollars with an operating cost of about 0.75 million dollars per year.



CONCENTRATOR DIMENSIONS

HEIGHT	30'
LENGTH	17'
WIDTH	11'
WEIGHT	41 TON (WITHOUT
	REBOILERS OR CONDENSER)
TOTAL ASSEMBLY	111 TON

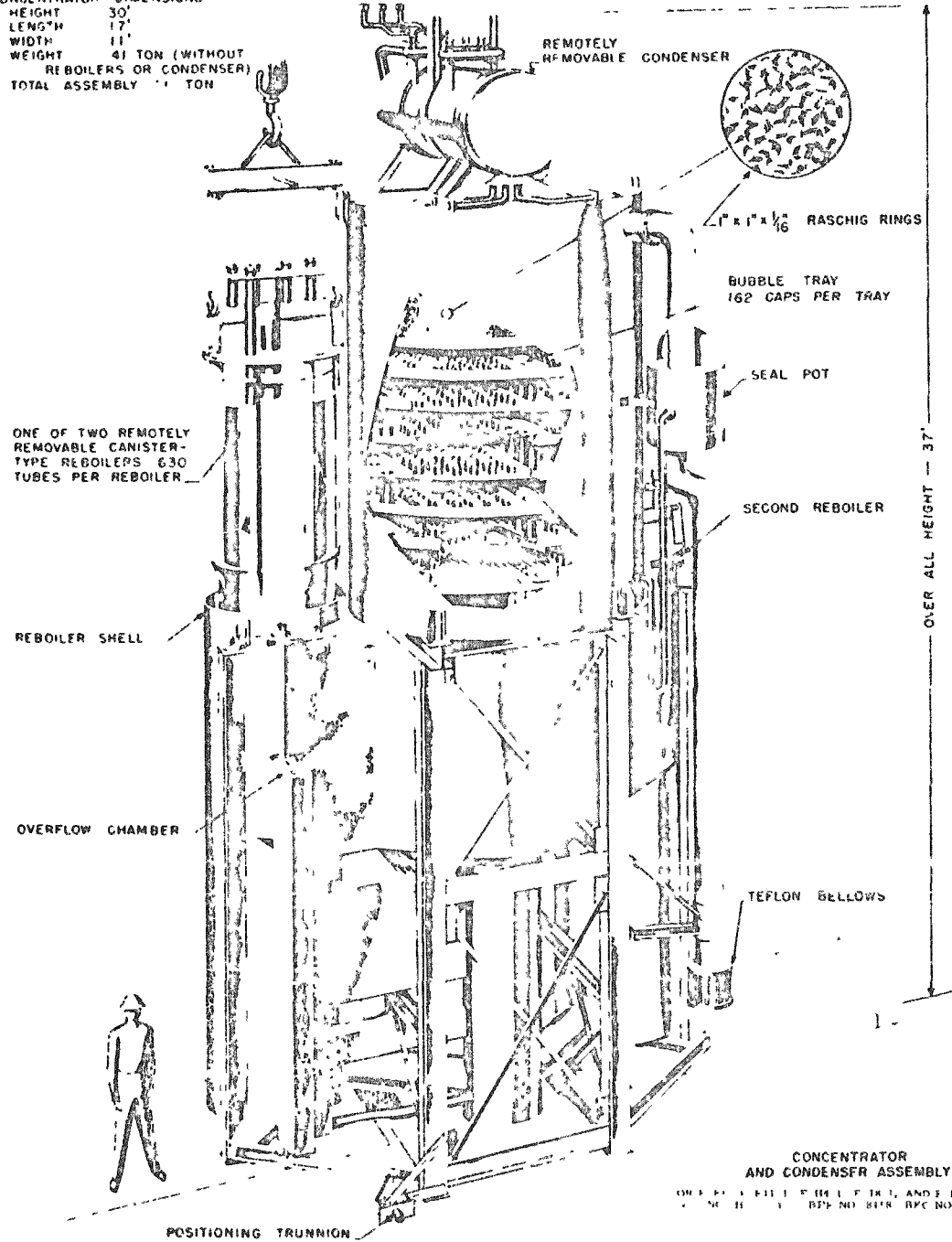
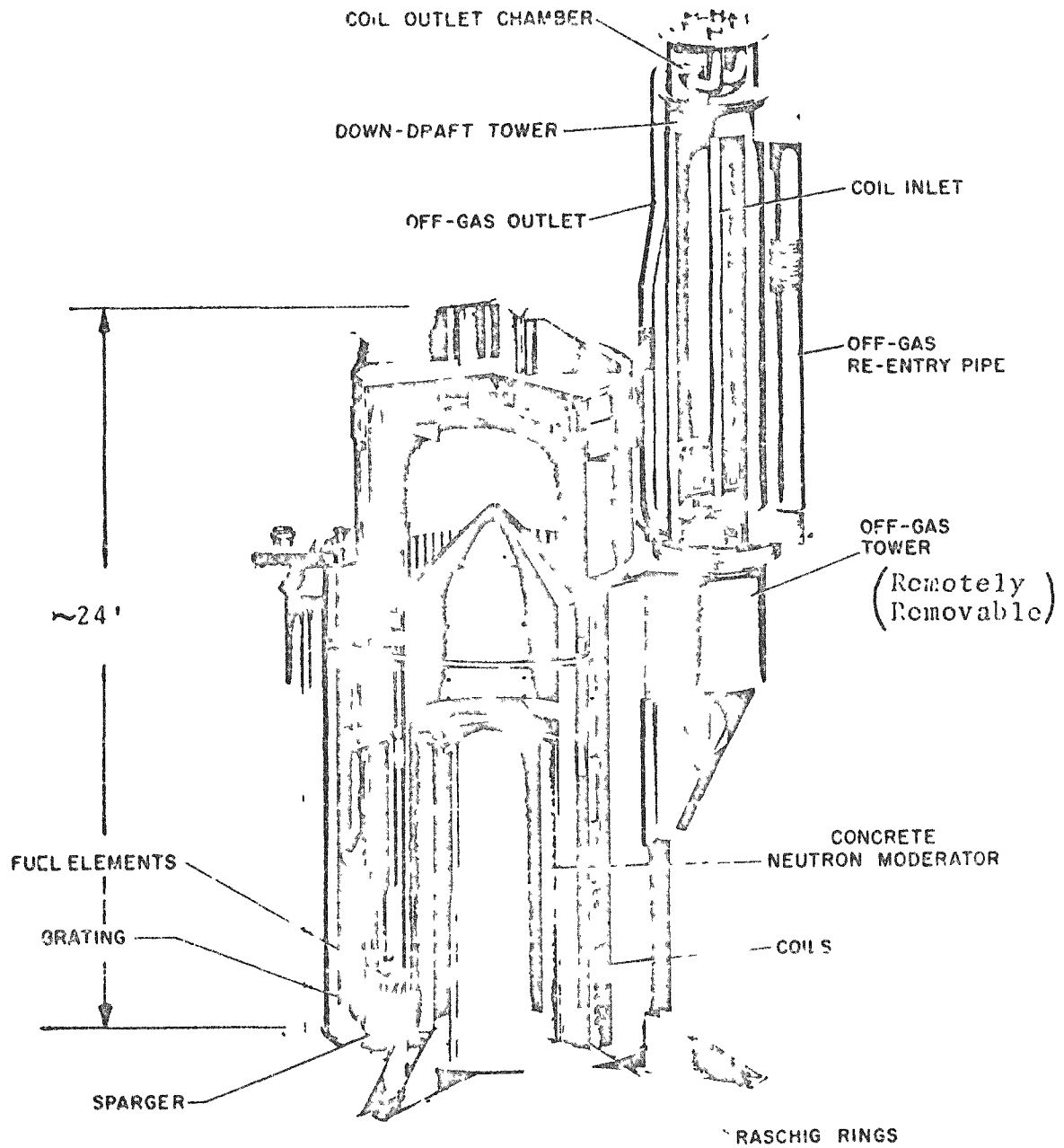
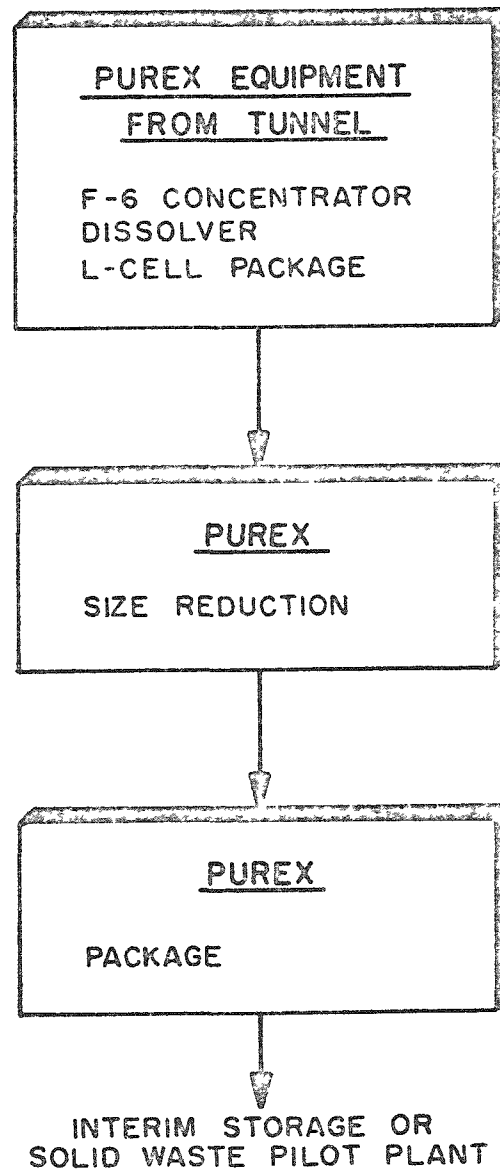


FIGURE 13



DISSOLVER

FIGURE 19



UNCLASSIFIED

LARGE CONTAMINATED EQUIPMENT

FIGURE-20

F. Interim Storage1. Flowsketch and Facilities Description

It is assumed that some form of interim storage with retrievability within 10 to 20 years will be needed. Several storage locations at Hanford are possible. Three storage modes are shown in the flowsketch, Figure 21, and others could be conceived. The contaminated solid wastes, which have been sorted according to types of solid waste and radionuclide content, could be stored in the inactive U Plant Canyon building, in concrete-lined covered trenches or in new structures built above the ground surface. The U Plant building cannot contain all the radioactive solid wastes projected to result from this demonstration program. The most radioactive material, such as salt cake, would probably be stored in U Plant while the less radioactive material would be stored in the trenches or surface facilities. Low-level solid waste, defined for this study, to contain less than 10 nCi/g total alpha and 1 nCi/g total beta-gamma, might be particularly suited for above ground interim storage. Radiation exposure from large volumes of this waste would be about 1 mrem/hr at 1 meter distance so that storage in unshielded facilities might be adequate, i.e., structures built solely for confinement and protection from the weather elements.

The most suitable interim storage location for the various types of solid wastes would be determined after completing detailed engineering studies to evaluate the alternatives including safety and economics. However, for the purpose of estimating capital costs to store the solid waste, it is assumed that the salt cake would be stored in U Plant and the remaining wastes would be stored in trenches. In both cases, the packaged waste would be readily retrievable.

## 2. Costs and Schedule

Costs have been estimated for interim storage of the contaminated solid waste derived from the demonstration program. The costs shown in Table VI include only the costs to prepare U Plant for storage of salt cake and to construct new burial trenches for storage of all other waste material. The operating costs for placing the waste containers in U Plant and the trenches have been included with the operating costs for each site restoration demonstration program described earlier.

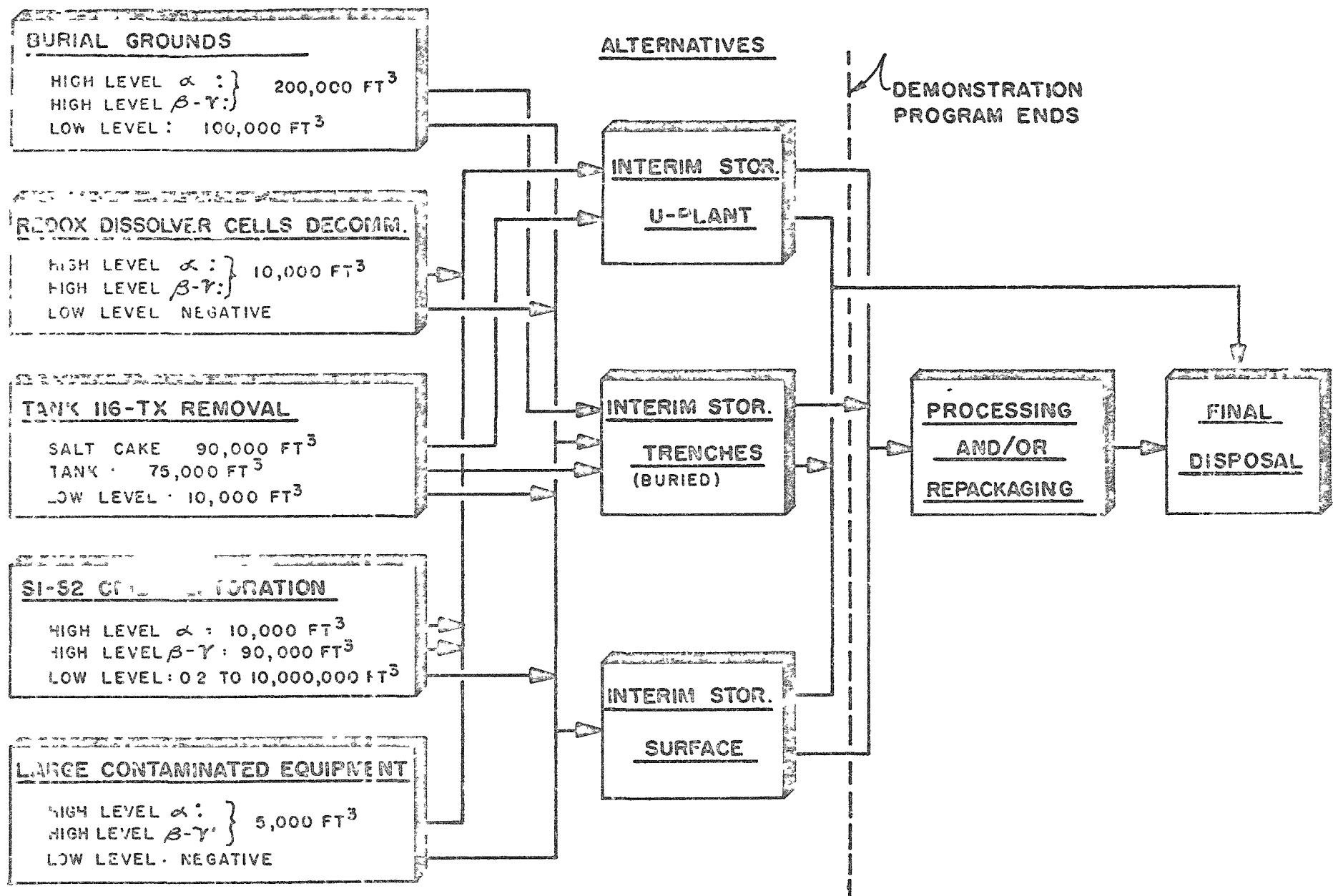
UNCLASSIFIED

TABLE VII  
INTERIM STORAGE  
COSTS AND SCHEDULES

<u>Storage Mode</u>	<u>Millions of 1971 Dollars</u>									
	<u>FY-73</u>	<u>FY-74</u>	<u>FY-75</u>	<u>FY-76</u>	<u>FY-77</u>	<u>FY-78</u>	<u>FY-79</u>	<u>FY-80</u>	<u>FY-81</u>	<u>Total</u>
U Plant										0.5
Salt Cake			0.5							
Trenches										
Burial Ground										0.2
Demonstration			0.1	0.1						
Tank 116-T4					0.05	0.05				0.1
S1-S2										0.3
Case 1						0.2	0.1			
Case 2						1.0	1.0	1.0		3.0
Case 3						3.0	3.0	3.0	2.0	11.0
Redox, Purex Equipment										Negligible

60

UNCLASSIFIED



UNCLASSIFIED

INTERIM STORAGE OF RADIOACTIVE MATERIALS  
FIGURE-21