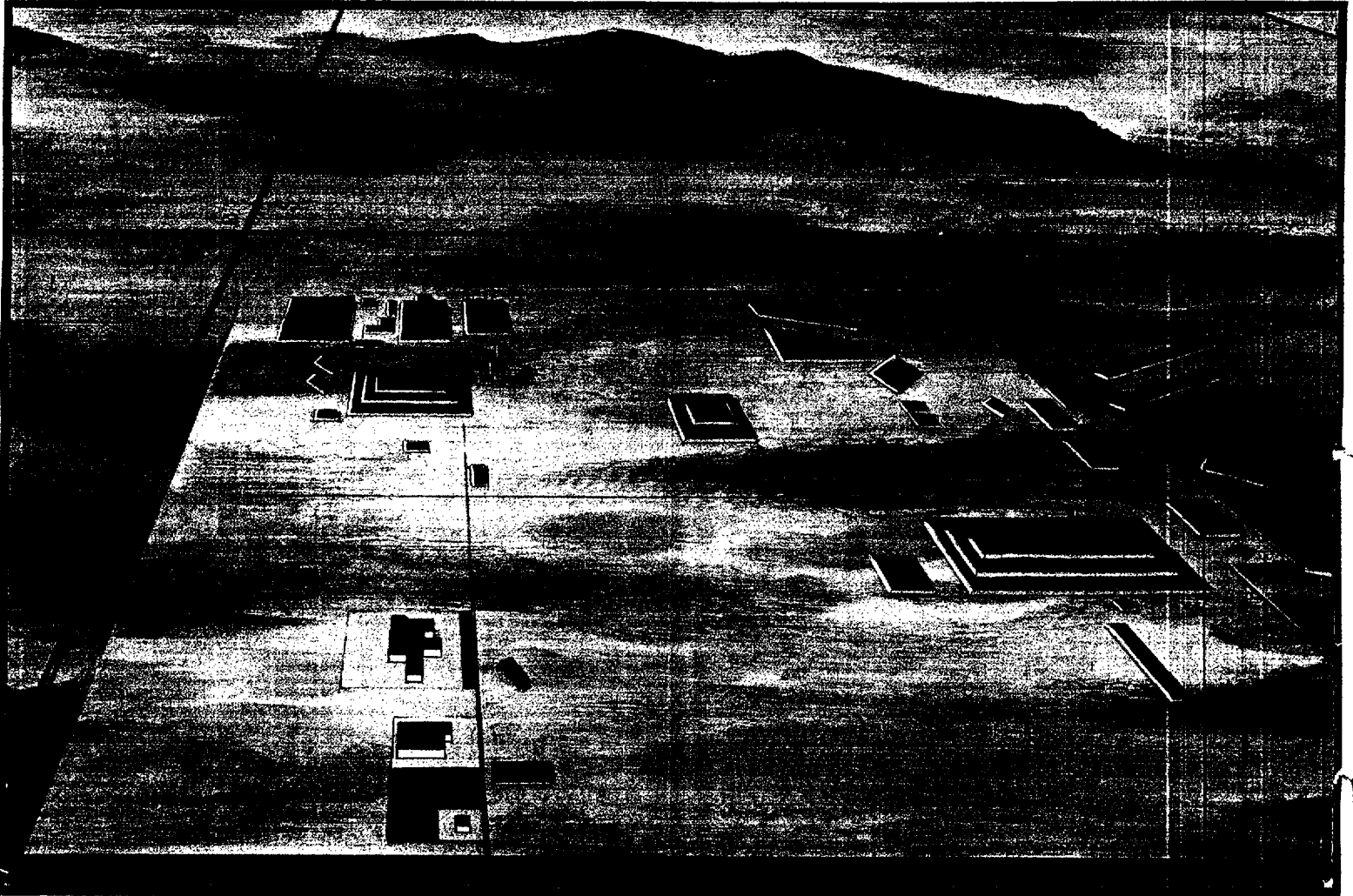


See folder for Nr.  
70 Brownlee Cr. White  
5-10-84

Volume I

# Hanford Defense Waste Disposal Program

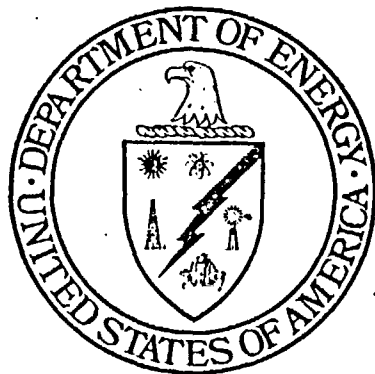


United States Environmental  
Protection Agency  
Staff Site Visit

B406190097 B40510  
PDR WASTE PDR  
WM-10

# Hanford 1983





**U.S. DEPARTMENT  
OF ENERGY**

**VOLUME I**

## **HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**PROGRAMMATIC & TECHNOLOGY STATUS  
BRIEFINGS TO**

**U.S. ENVIRONMENTAL PROTECTION AGENCY**

**RICHLAND, WASHINGTON  
OCTOBER 1983**



**DOE-RL  
HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

## **ABSTRACT**

**THIS HANDOUT BOOK CONTAINS INFORMATION AND DATA WHICH WAS PRESENTED TO THE U.S. ENVIRONMENTAL PROTECTION AGENCY STAFF MEMBERS DURING THE HANFORD SITE VISIT IN OCTOBER 1983**

**THE ENCLOSED SECTIONS DESCRIBE THE HANFORD WASTE HISTORY, SOURCES, SITES, COMPLEXITY, QUANTITY AND ALSO THE TECHNICAL AND PROGRAMMATIC RESOURCES WHICH ARE BEING APPLIED TO SUCCESSFULLY MEET THE HANFORD DEFENSE WASTE DISPOSAL PROGRAM GOALS AND OBJECTIVES.**

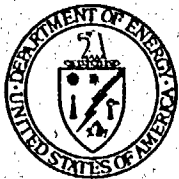
**PARTICULAR EMPHASIS IS GIVEN TO THE ISSUES AND CONCERNS REGARDING THE APPLICATION OF 40 CFR 191 TO THE HANFORD WASTE**





## **BRIEFING OBJECTIVES**

- **FAMILIARIZE EPA WITH HANFORD**
  - **PROCESSING, WASTE HISTORY**
  - **WASTE SITE DIVERSITY**
  - **DISPOSAL PLANS/ALTERNATIVES**  
**COMBINATION OF REPOSITORY AND IN-PLACE**  
**STABILIZATION**
  - **FINAL DISPOSAL DECISION BASIS/EIS ANALYSIS**



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**EPA STAFF SITE VISIT**

## **CONTENTS**

**SECTION 1 - DEFENSE WASTE MANAGEMENT PLAN**

**SECTION 2 - WASTE DESCRIPTION AND SITES**

**SECTION 3 - REFERENCE DISPOSAL PLAN AND ALTERNATIVES**

**SECTION 4 - APPLICATION OF PROPOSED 40 CFR 191 TO IN-PLACE  
STABILIZATION**

**SECTION 5 - HANFORD DEFENSE WASTE EIS AND APPROACH TO  
PERFORMANCE ASSESSMENT**

**SECTION 6 - ISSUES AND CONCERNS**



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**DEFENSE WASTE MANAGEMENT PLAN  
PURPOSE OF REPORT**

- **TO FULFILL THE REQUIREMENTS OF PUBLIC LAW 97-90  
THE NATIONAL SECURITY AND MILITARY  
APPLICATIONS OF NUCLEAR ENERGY ACT OF 1982**

**"THE PRESIDENT SHALL SUBMIT TO THE COMMITTEES ON  
ARMED SERVICES OF THE SENATE AND OF THE HOUSE OF  
REPRESENTATIVES NOT LATER THAN JUNE 30, 1983, A REPORT  
WHICH SETS FORTH HIS PLANS FOR THE PERMANENT  
DISPOSAL OF HIGH-LEVEL AND TRANSURANIC WASTES  
RESULTING FROM ATOMIC ENERGY DEFENSE ACTIVITIES"**



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**DEFENSE WASTE MANAGEMENT PLAN  
REPORT AS SPECIFIED IN PL 97-90**

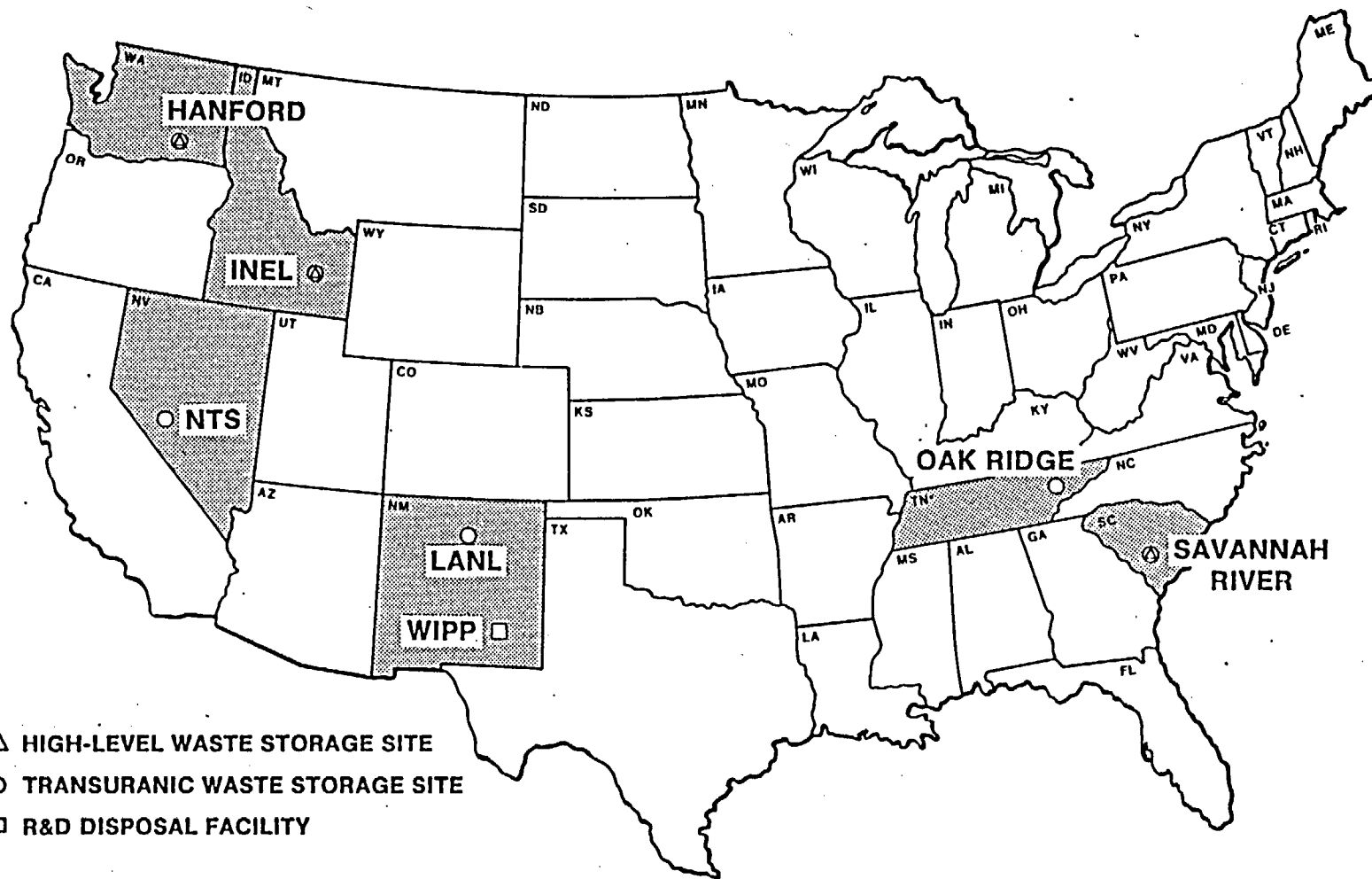
- **THE REPORT SHOULD DELINEATE "FOR EACH STATE IN WHICH WASTES ARE STORED IN INTERIM STORAGE FACILITIES ON THE DATE OF ENACTMENT OF THIS ACT" (DECEMBER 12, 1981)**
  - **A DETAILED PROGRAM MANAGEMENT PLAN**
  - **ESTIMATED EXPENDITURES THROUGH PERMANENT DISPOSAL**



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DEFENSE WASTE MANAGEMENT PLAN  
TRANSURANIC AND HIGH-LEVEL WASTE  
WASTE STORAGE SITES

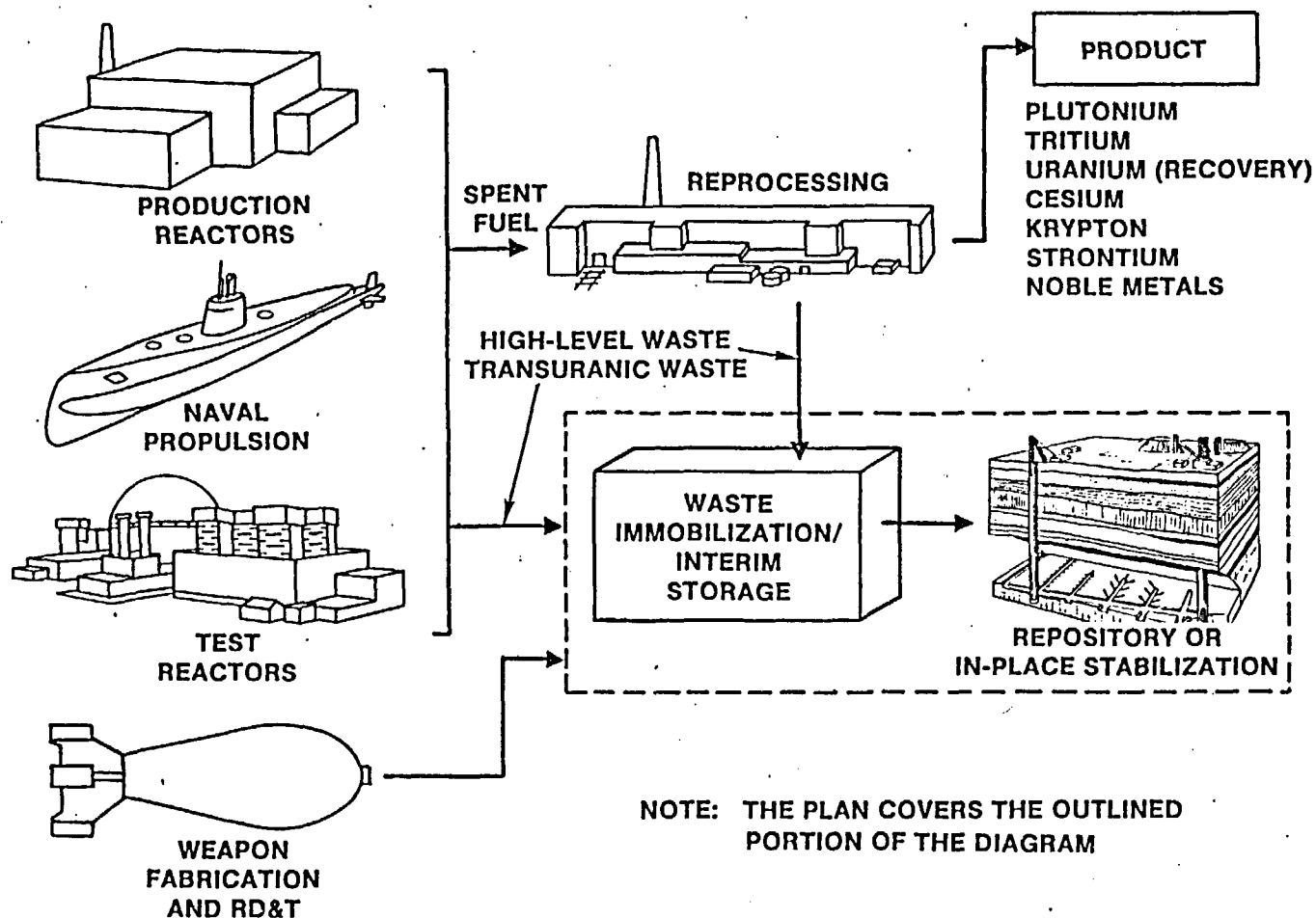




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DEFENSE WASTE MANAGEMENT PLAN  
DEFENSE NUCLEAR MATERIAL  
PRODUCTION AND UTILIZATION



NOTE: THE PLAN COVERS THE OUTLINED  
PORTION OF THE DIAGRAM



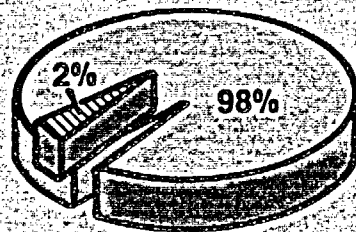
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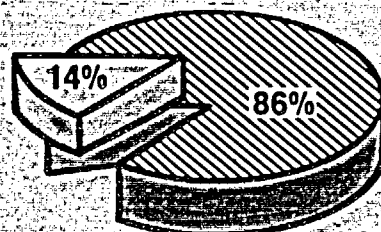
DEFENSE WASTE MANAGEMENT PLAN  
THE TOTAL NATIONAL  
HIGH-LEVEL WASTE INVENTORY

1981

VOLUME  
307,000 M<sup>3</sup>

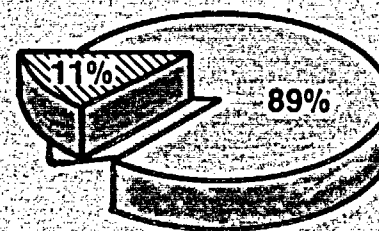


RADIOACTIVITY  
12,000 M CURIE

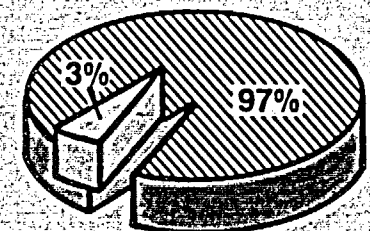


2000

VOLUME  
375,000 M<sup>3</sup>



RADIOACTIVITY  
57,000 M CURIE



COMMERCIAL

DEFENSE



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**DEFENSE WASTE MANAGEMENT PLAN  
DEFENSE HIGH-LEVEL WASTE**

- **DEFINITION**

**THE HIGHLY RADIOACTIVE MATERIALS THAT RESULT FROM THE REPROCESSING OF SPENT NUCLEAR FUEL, INCLUDING, BUT NOT LIMITED TO, LIQUID WASTE PRODUCED DIRECTLY IN REPROCESSING AND ANY SOLID DERIVED FROM THE LIQUID THAT CONTAINS FISSION PRODUCTS AND TRANSURANIC WASTE AND REQUIRES PERMANENT ISOLATION**

- **PLAN FOR PERMANENT DISPOSAL**

- **SEPARATE BYPRODUCTS WHERE TECHNICALLY OR ECONOMICALLY JUSTIFIED**
- **IMMOBILIZE NEW AND READILY RETRIEVABLE WASTE FOR DISPOSAL IN GEOLOGIC REPOSITORY**
- **OTHER WASTES WILL BE STABILIZED IN PLACE IF RETRIEVAL WOULD BE MORE HAZARDOUS AND WOULD NOT THEREFORE WARRANT THE COSTS AND RISKS**





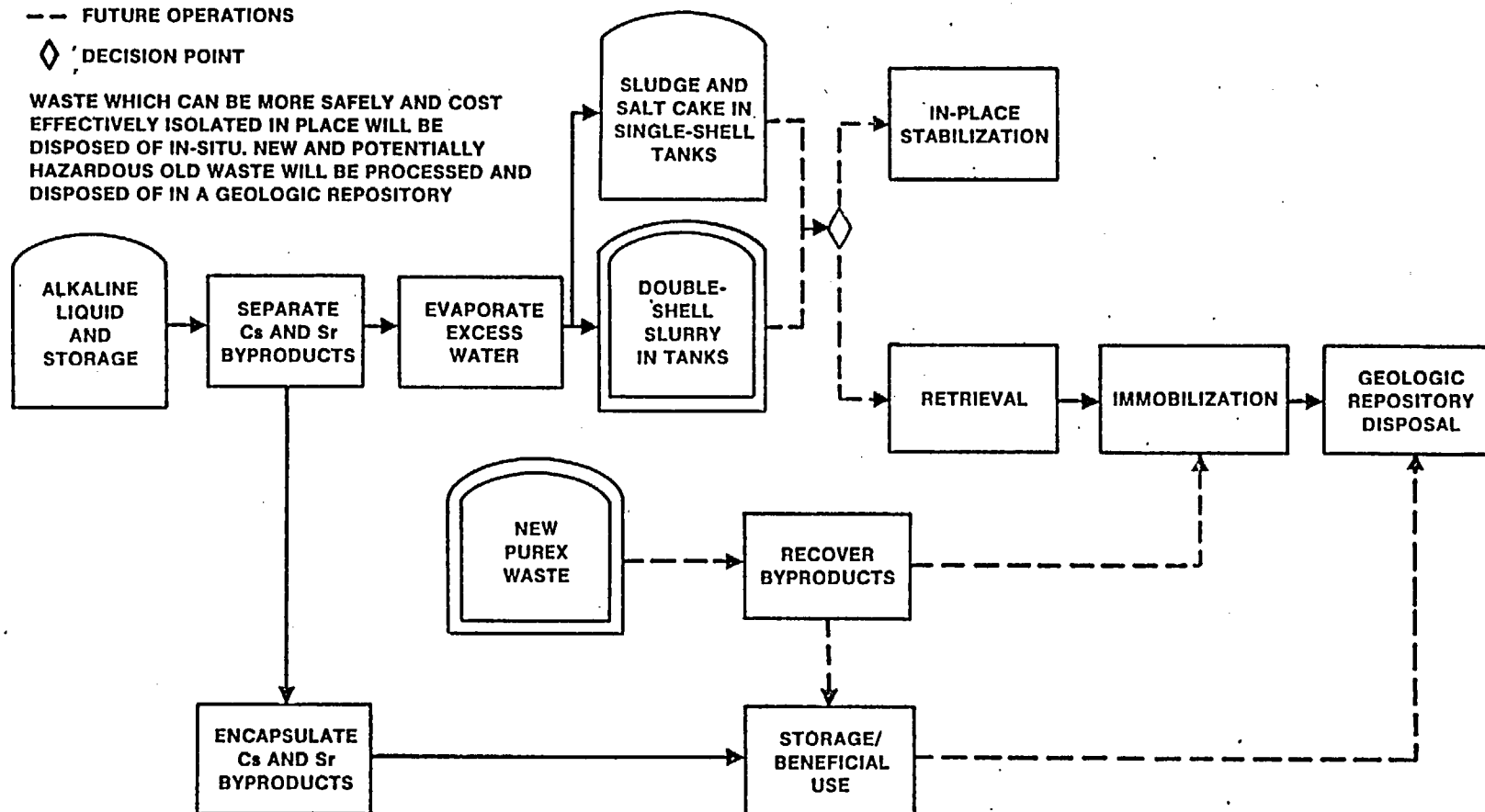
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DEFENSE WASTE MANAGEMENT PLAN  
HIGH-LEVEL WASTE MANAGEMENT  
AT THE HANFORD SITE

-- FUTURE OPERATIONS

◇ DECISION POINT

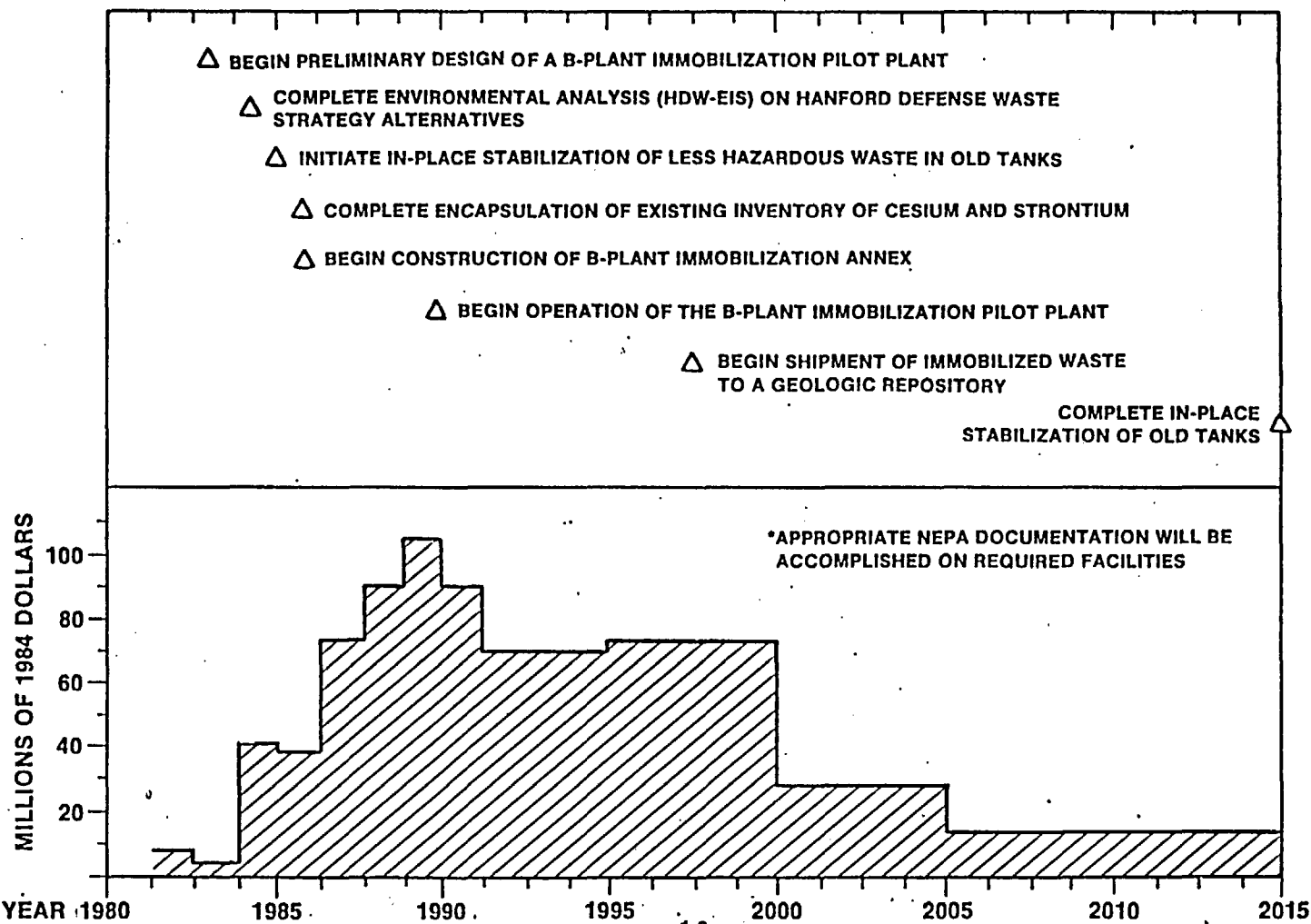
WASTE WHICH CAN BE MORE SAFELY AND COST EFFECTIVELY ISOLATED IN PLACE WILL BE DISPOSED OF IN-SITU. NEW AND POTENTIALLY HAZARDOUS OLD WASTE WILL BE PROCESSED AND DISPOSED OF IN A GEOLOGIC REPOSITORY





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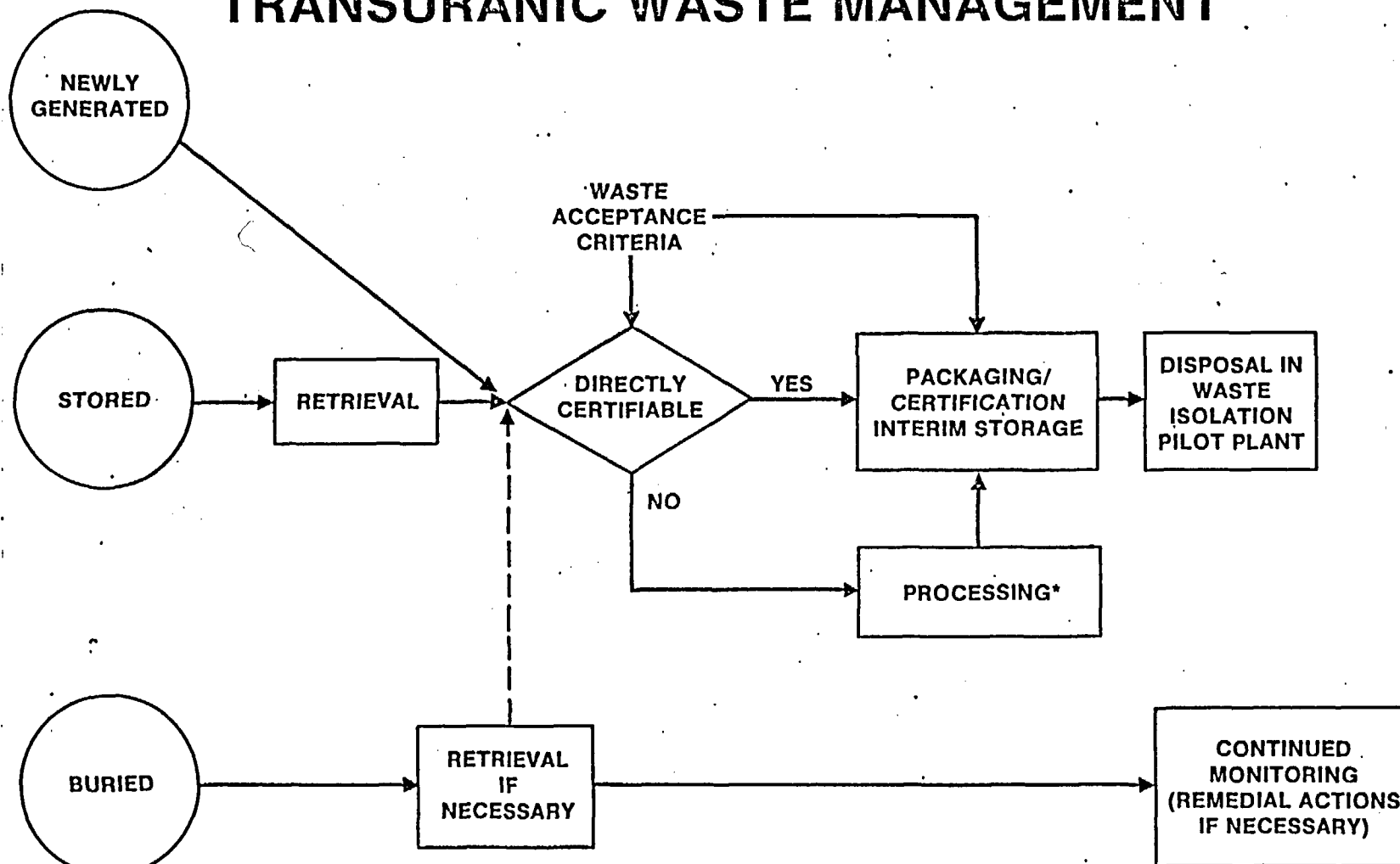
DEFENSE WASTE MANAGEMENT PLAN  
MAJOR MILESTONES AND COSTS  
FOR HANFORD HIGH-LEVEL WASTE\*





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DEFENSE WASTE MANAGEMENT PLAN  
TRANSURANIC WASTE MANAGEMENT

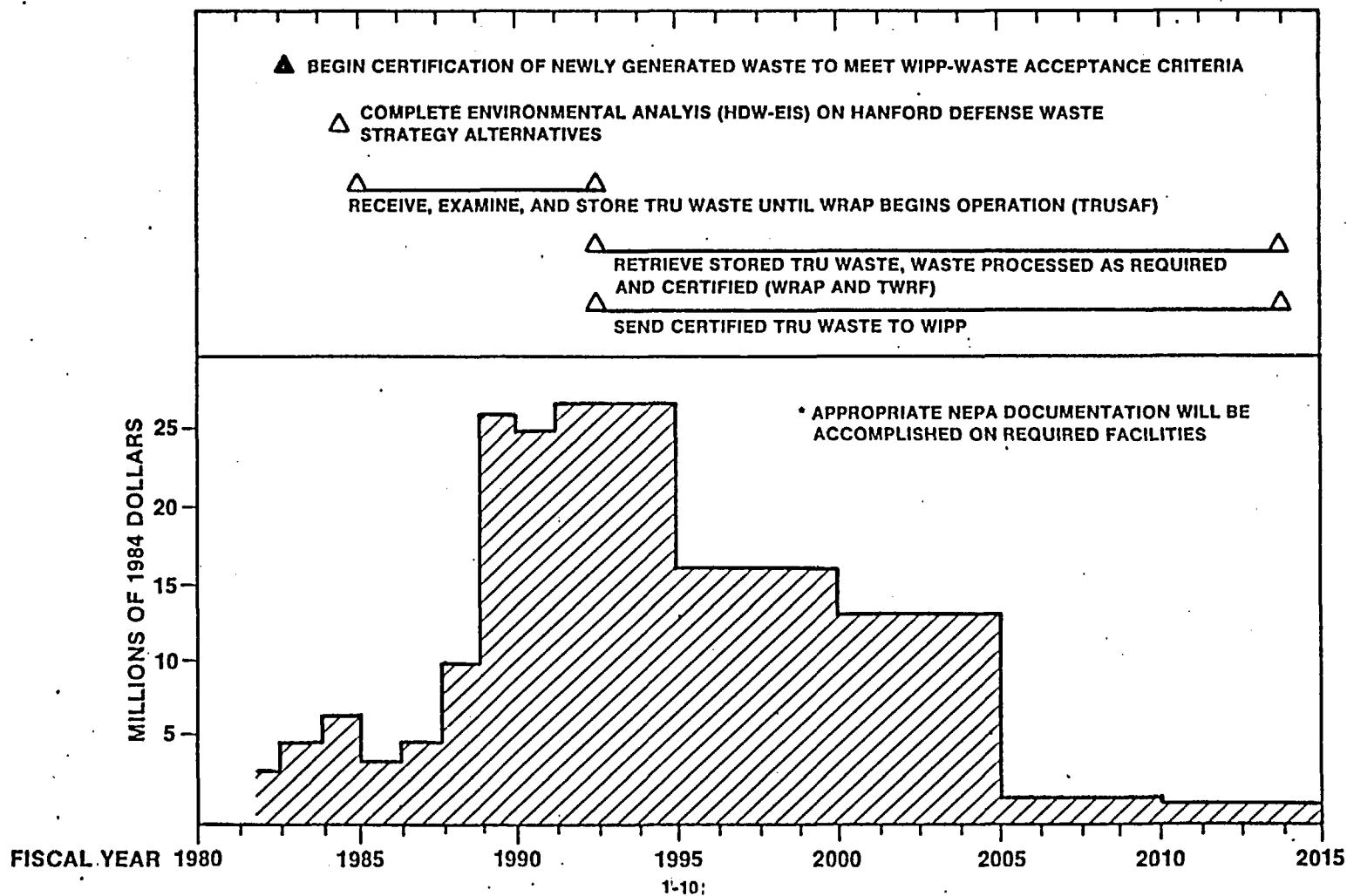


\* REMOTE HANDLED PROCESSED AT A SINGLE SITE



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HANFORD DEFENSE WASTE DISPOSAL PROGRAM

DEFENSE WASTE MANAGEMENT PLAN  
MAJOR MILESTONES AND COSTS  
FOR HANFORD-TRU WASTE MANAGEMENT\*





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**EPA STAFF SITE VISIT**

## **CONTENTS**

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**WASTE DESCRIPTION AND SITES  
HANFORD WASTE HISTORY**

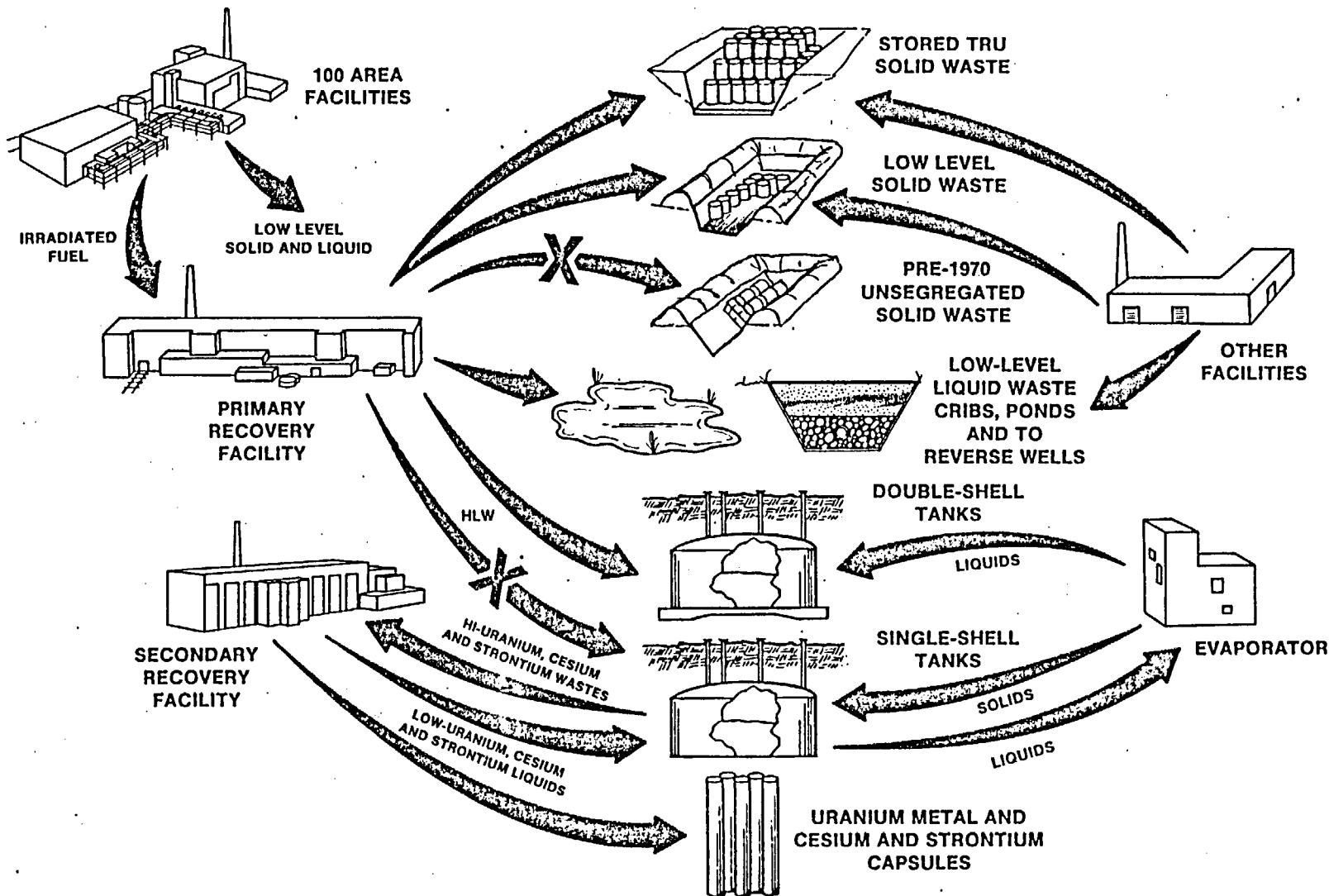
- **WASTE SOURCES**
- **WASTE SITES**
  - **DESCRIPTION**
  - **INVENTORIES**
  - **STATUS**



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EPA STAFF SITE VISIT

# HANFORD WASTE SOURCES AND STORAGE SITES





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**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES  
WASTE SOURCES**

- **PRIMARY RECOVERY PROCESSES**
- **SECONDARY RECOVERY PROCESSES**
- **WASTE MANAGEMENT PROCESSES**





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EPA STAFF SITE VISIT

WASTE DESCRIPTION AND SITES  
HANFORD PROCESSES  
PRIMARY RECOVERY PROCESS

PROCESS	MTHM* TOTAL FUEL PROCESSED	OPERATING PERIOD											
		1940's			1950's			1960's			1970's		
BISMUTH PHOSPHATE	7,000	12-44			2-56								
REDOX	19,000				1-52			8-66					
PUREX	67,000				1-56						12-71		
TOTAL	93,000												

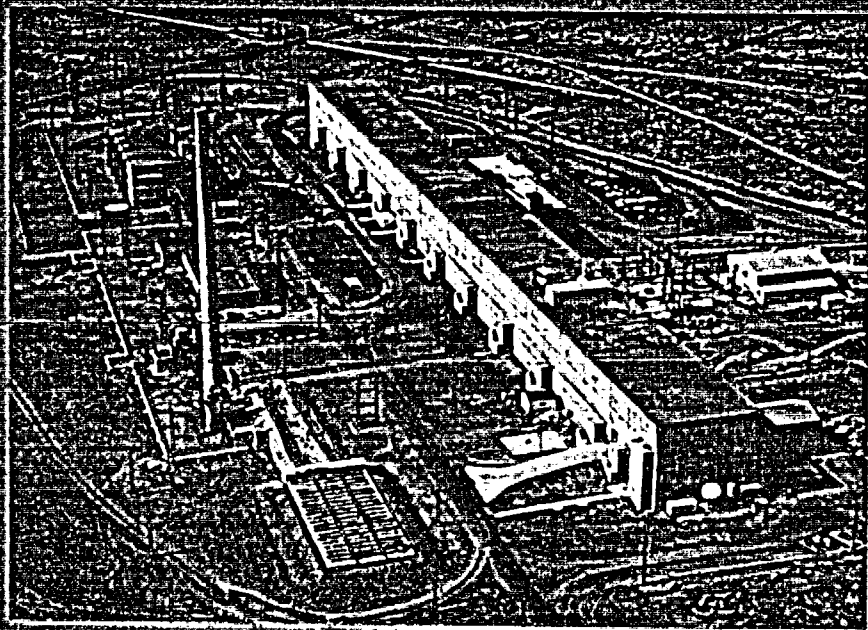
\*MTHM (METRIC TONS HEAVY METAL)



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EPA STAFF SITE VISIT

T PLANT

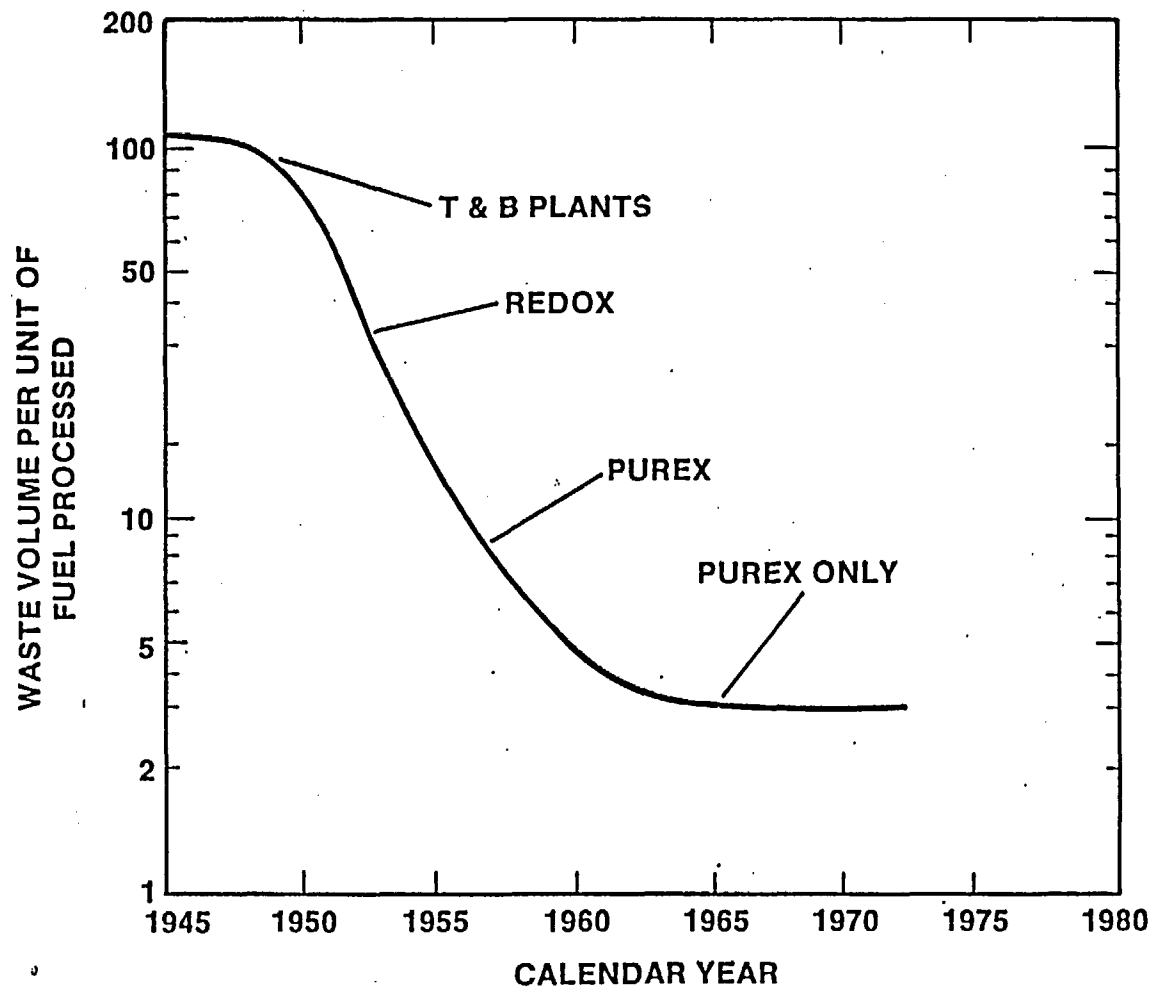


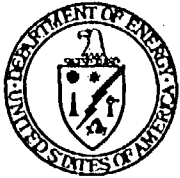


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EPA STAFF SITE VISIT

WASTE DESCRIPTION AND SITES  
**WASTE GENERATION**





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**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES  
WASTE SOURCES**

- **PRIMARY RECOVERY PROCESSES**
- **SECONDARY RECOVERY PROCESSES**
- **WASTE MANAGEMENT PROCESSES**



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EPA STAFF SITE VISIT

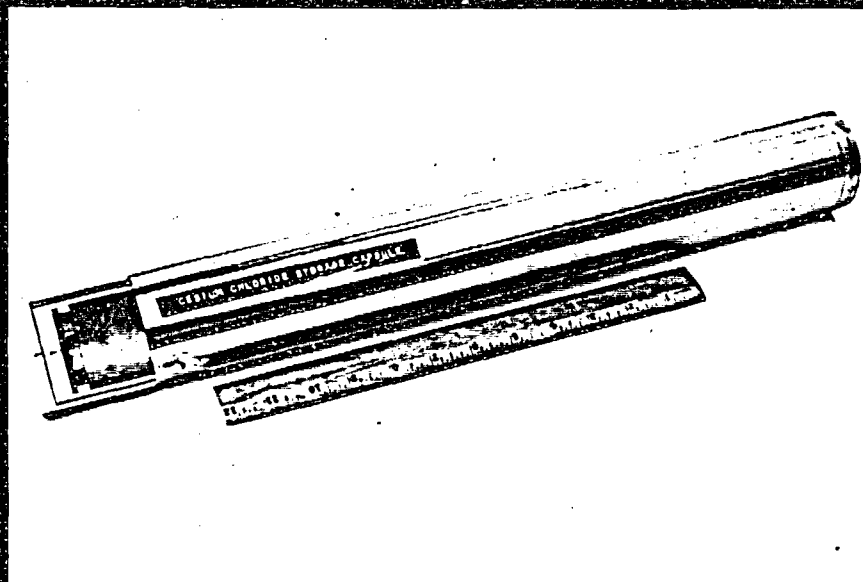
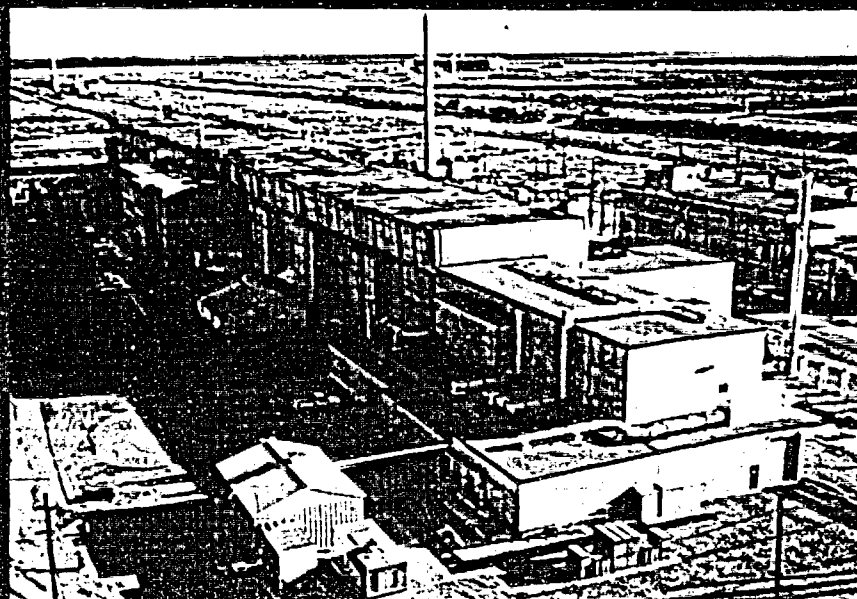
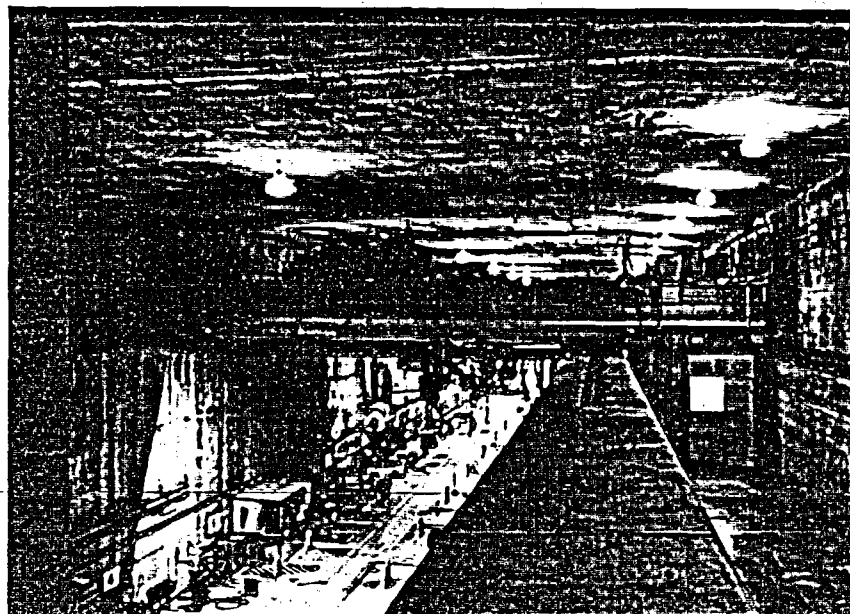
WASTE DESCRIPTION AND SITES  
HANFORD PROCESSES  
SECONDARY RECOVERY PROCESSES

PROCESS	OPERATING PERIOD																			
	1940's				1950's				1960's				1970's				1980's			
URANIUM RECOVERY					6-52			4-57												
CESIUM RECOVERY											8-67				4-76					
STRONTIUM RECOVERY											1-69				6-78					
CESIUM ENCAPSULATION														1-74					1-84	
STRONTIUM ENCAPSULATION														1-75					1-85	



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B-PLANT



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**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES  
WASTE SOURCES**

- **PRIMARY RECOVERY PROCESSES**
- **SECONDARY RECOVERY PROCESSES**
- **WASTE MANAGEMENT PROCESSES**



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EPA STAFF SITE VISIT

WASTE DESCRIPTION AND SITES  
HANFORD PROCESSES  
WASTE MANAGEMENT PROCESSES

PROCESS	OPERATING PERIOD				
	1940's	1950's	1960's	1970's	1980's
CASCADE	1-45	8-56			
SCAVENGE		9-54 5-57			
EVAPORATION		4-52 7-55	12-65 4-76		
IN-TANK SOLIDIFICATION			3-65 6-76		
* EVAPORATION-CRYSTALLIZATION				11-73	PRESENT

\* INCLUDES INTERSTITIAL LIQUID PUMPING

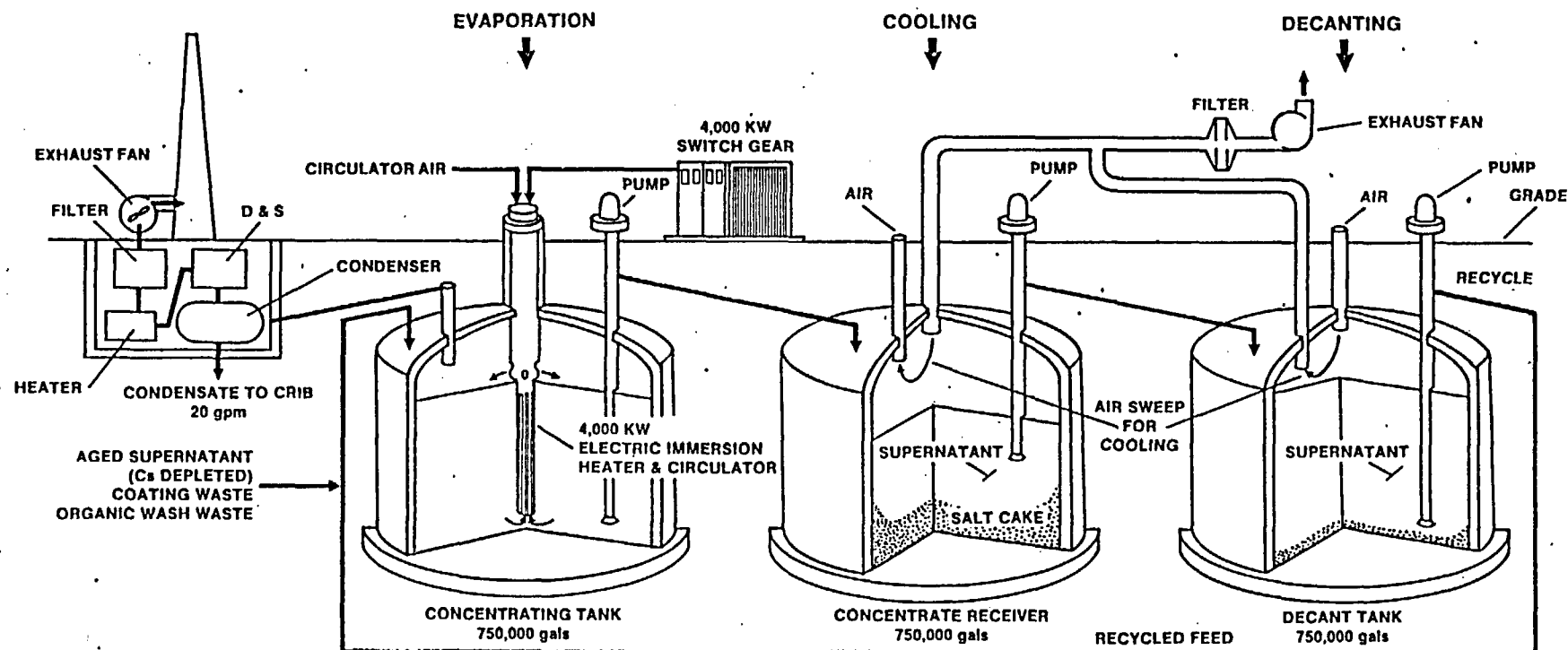




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WASTE DESCRIPTION AND SITES  
IN-TANK SOLIDIFICATION





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**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES  
WASTE SITES**

- **TANK WASTES**
  - SINGLE-SHELL
  - DOUBLE-SHELL
- **CAPSULES**
- **LIQUID WASTE DISPOSAL SITES**
  - LOW LEVEL
  - TRU
- **SOLID WASTE SITES**
  - LOW LEVEL
  - TRU
  - STORED TRU WASTES

}

PRE-1970

}

POST-1970

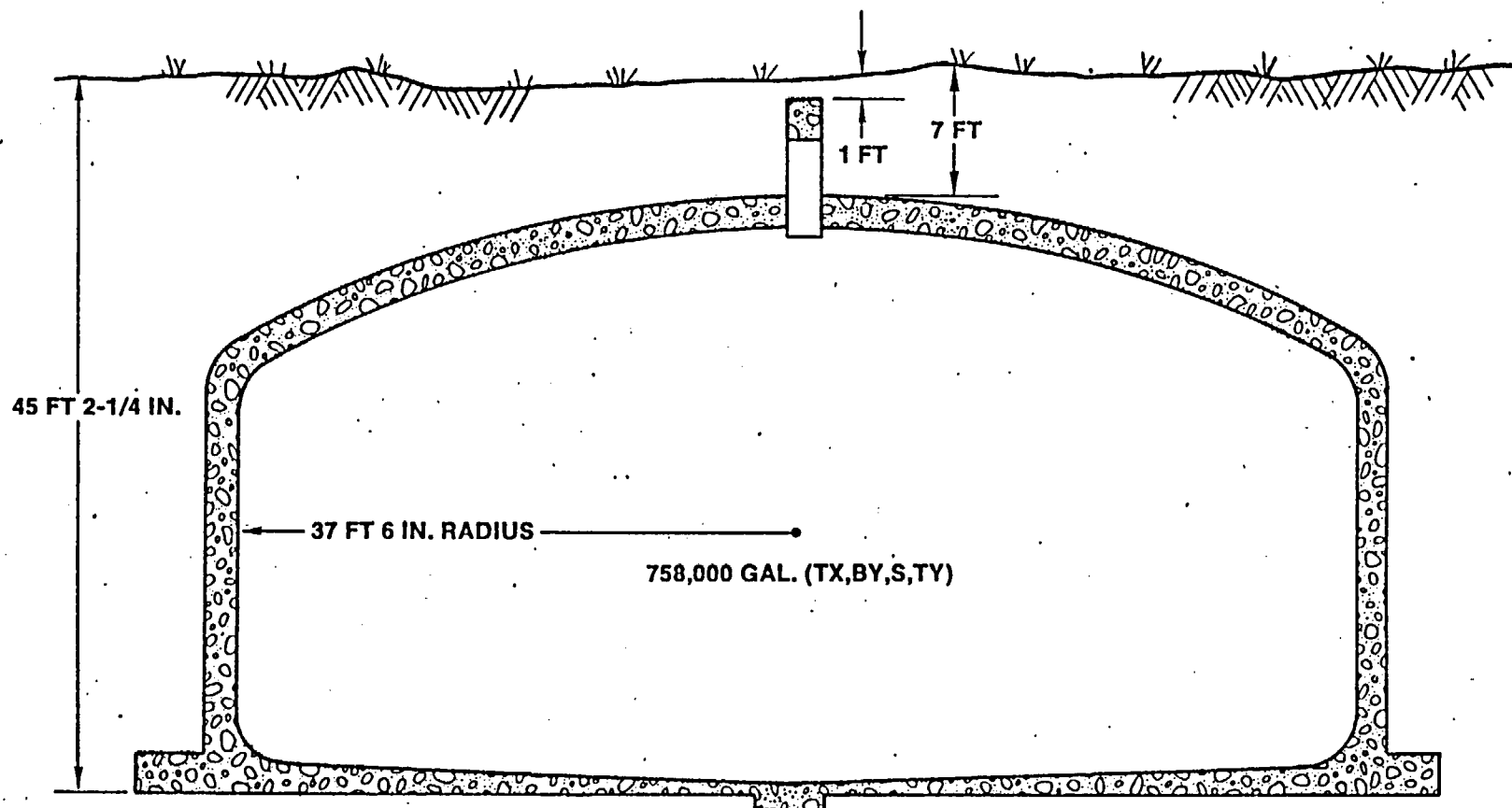


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EPA STAFF SITE VISIT

WASTE DESCRIPTION AND SITES

**SINGLE-SHELL TANK**  
TYPICAL CROSS-SECTION





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**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES**  
**WASTE DESCRIPTIONS**  
**SINGLE-SHELL TANK WASTE TYPES**

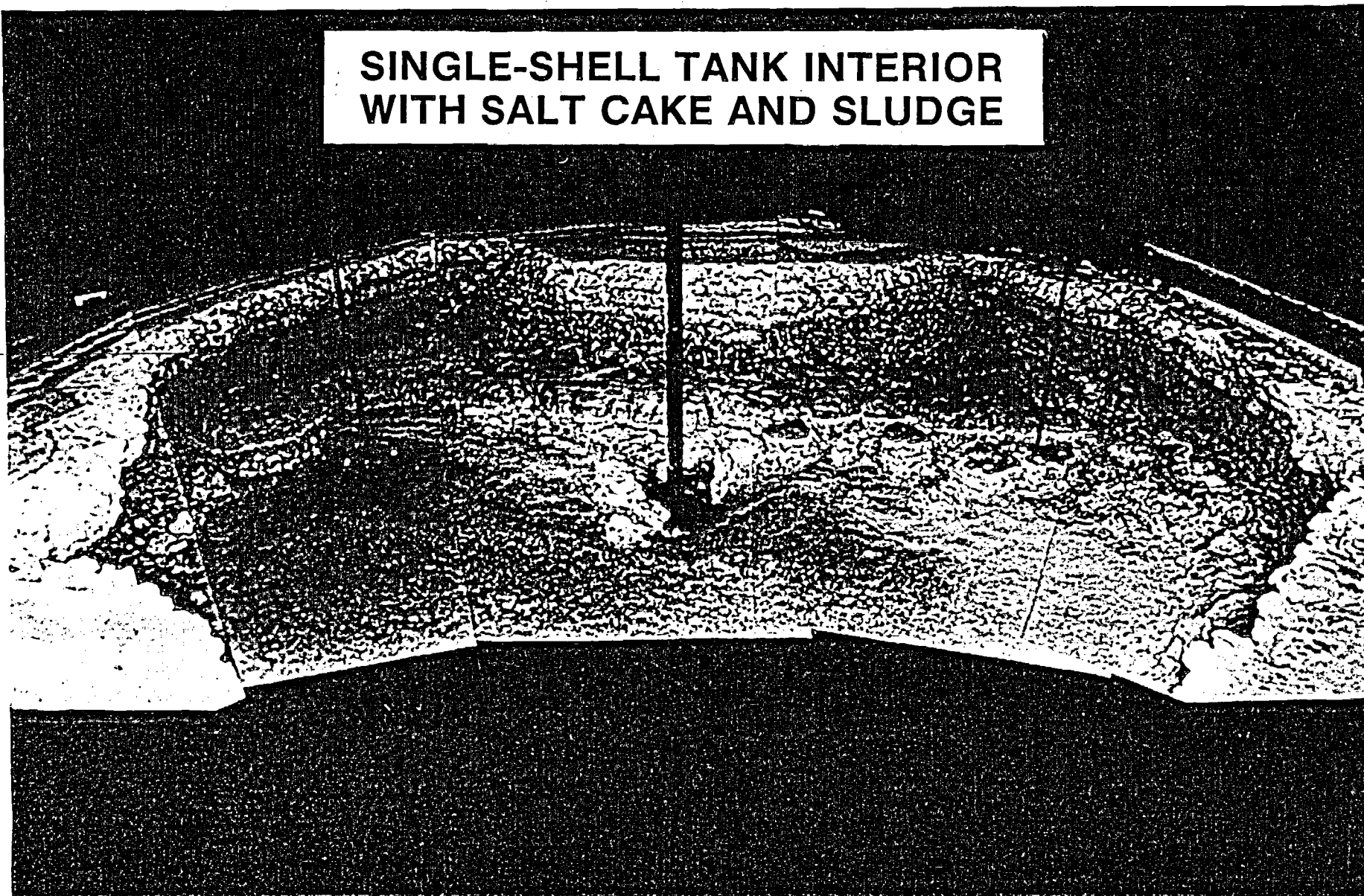
- **SLUDGE**                      - COMPOSED PRIMARILY OF INSOLUBLE METAL OXIDES AND HYDROXIDES WHICH PRECIPITATED FROM NEUTRALIZED HIGH-LEVEL WASTE SOLUTIONS
  
- **SALT CAKE**                      - COMPOSED PRIMARILY OF CRYSTALLIZED NITRATE SALTS (SODIUM NITRATE IN PARTICULAR), THE MAJORITY BEING PRODUCED BY OPERATION OF THE VACUUM EVAPORATOR - CRYSTALLIZERS
  
- **RESIDUAL LIQUIDS**              - AQUEOUS SOLUTIONS, RICH IN SODIUM HYDROXIDE AND SODIUM ALUMINATE. THE MAJORITY OF THE REMAINING RESIDUAL LIQUIDS ARE HELD INTERSTITIALLY IN THE WASTE LIQUIDS



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EPA STAFF SITE VISIT

**SINGLE-SHELL TANK INTERIOR  
WITH SALT CAKE AND SLUDGE**





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EPA STAFF SITE VISIT

WASTE DESCRIPTION AND SITES  
**WASTE INVENTORIES**  
SINGLE-SHELL TANKS  
(AS OF MAY, 1983)

TANK FARM DESIGNATIONS	NOMINAL TANK CAPACITIES (GAL)	NUMBER OF TANKS	WASTE VOLUMES (GAL)			
			SALT CAKE	SLUDGE	INTERSTITIAL LIQUID	TOTAL
A, AX, SX	1,000,000	25	5,249,000	1,774,000	2,485,000	7,215,000
BY, S, TX TY	758,000	48	16,444,000	2,923,000	3,587,000	19,508,000
B, BX, C, T, U	533,000	60	3,598,000	7,366,000	2,483,000	11,536,000
B, C, T, U	55,000	16	0	299,000	39,000	308,000
TOTAL		149	25,291,000	12,362,000	8,594,000	38,567,000
TOTAL INVENTORIES (CURIES)			$.2 \times 10^8$	$1.4 \times 10^8$	$.3 \times 10^8$	$1.9 \times 10^8$



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**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES  
SINGLE-SHELL TANK STATUS**

**149 SINGLE-SHELL TANKS, 58 KNOWN QUESTIONABLE  
INTEGRITY OR LEAKERS (488,600 GALLONS)**

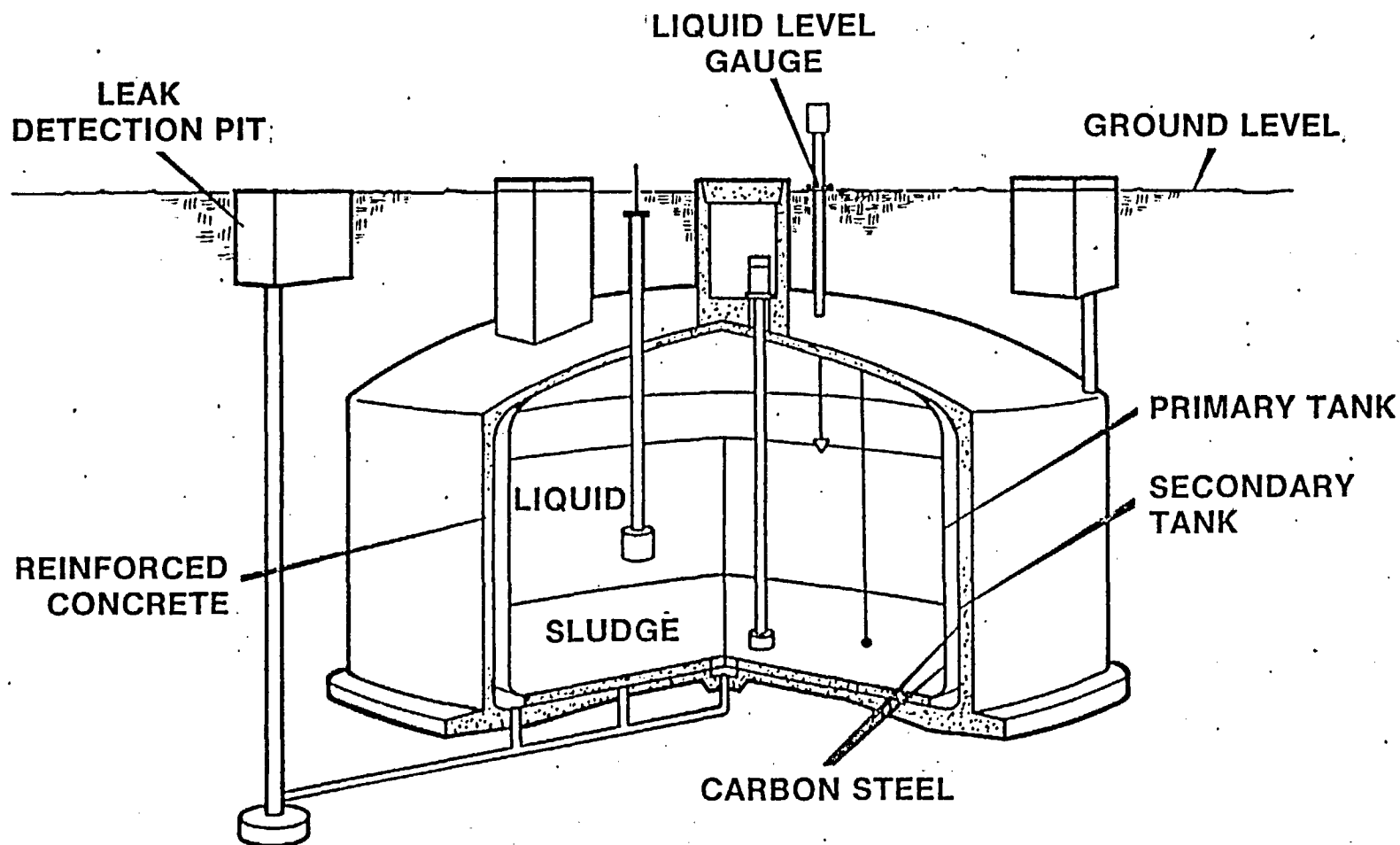
- NON-HOMOGENEOUS WASTE DISTRIBUTION IN TANKS**
- SEMI-SOLID WASTE CONDITION HAMPERS SINGLE RECOVERY  
SCHEMES**
- SLUICING TECHNOLOGY DOES NOT APPLY**



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WASTE DESCRIPTION AND SITES  
**DOUBLE-SHELL TANK**  
FOR BOILING WASTE







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**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES**  
**WASTE DESCRIPTIONS**  
**DOUBLE-SHELL TANK WASTE TYPES**

- **SLUDGE**
  - COMPOSED PRIMARILY OF INSOLUBLE METAL OXIDES AND HYDROXIDES WHICH PRECIPITATED FROM NEUTRALIZED HIGH-LEVEL WASTE SOLUTIONS
- **SALT CAKE**
  - COMPOSED PRIMARILY OF CRYSTALLIZED NITRATE SALTS (SODIUM NITRATE IN PARTICULAR), THE MAJORITY BEING PRODUCED BY OPERATION OF THE VACUUM EVAPORATOR
  - CRYSTALLIZERS
- **SLURRY**
  - AQUEOUS SOLUTIONS, RICH IN SODIUM HYDROXIDE AND SODIUM ALUMINATE IN WHICH MICROCRYSTALLITES OF SODIUM NITRATE, SODIUM NITRITE AND SODIUM ALUMINATE ARE SUSPENDED
- **LIQUID**
  - AQUEOUS SOLUTIONS, RICH IN THE METAL COMPLEXES FORMED BETWEEN ORGANIC AND INORGANIC LIQUIDS AND METALS, FISSION PRODUCTS AND ACTINIDES



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EPA STAFF SITE VISIT

WASTE DESCRIPTION AND SITES  
**WASTE INVENTORIES**  
DOUBLE-SHELL TANKS  
(AS OF MAY, 1983)

<u>TANK FARM DESIGNATIONS</u>	<u>NOMINAL TANK CAPABILITIES (GAL)</u>	<u>NUMBER OF TANKS</u>	<u>WASTE VOLUMES (GAL)</u>				
			<u>SALT CAKE</u>	<u>SLUDGE</u>	<u>SLURRY</u>	<u>LIQUID</u>	<u>TOTAL</u>
AN.	1,000,000	7	0	0	0	3,474,000	3,474,000
AW	1,000,000	6	0.	0.	0	2,632,000	2,632,000
AY	1,000,000	2	0	73,000	0	727,000	800,000
AZ	1,000,000	2	0	43,000	0	1,512,000	1,555,000
SY	1,000,000	3	240,000	0	1,078,000	953,000	2,271,000
TOTAL		20	240,000	116,000	1,078,000	9,298,000	10,732,000
TOTAL INVENTORIES (CURIES)			1 x 10 <sup>6</sup>	2 x 10 <sup>6</sup>	4 x 10 <sup>6</sup>	1 x 10 <sup>6</sup>	8 x 10 <sup>6</sup>



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**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES  
DOUBLE-SHELL TANK STATUS**

- **20 EXISTING TANKS WITH 20 MILLION GALLON CAPACITY**
- **8 TANKS UNDER CONSTRUCTION WITH 8 MILLION GALLON CAPACITY**
- **NOW A TOTAL OF 40,000 M<sup>3</sup> (11 MILLION GALLONS) IN 18 TANKS**
- **TANKS CONTAIN SLUDGE, SALT CAKE, RESIDUAL SLURRY, LIQUIDS**



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**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES  
WASTE SITES**

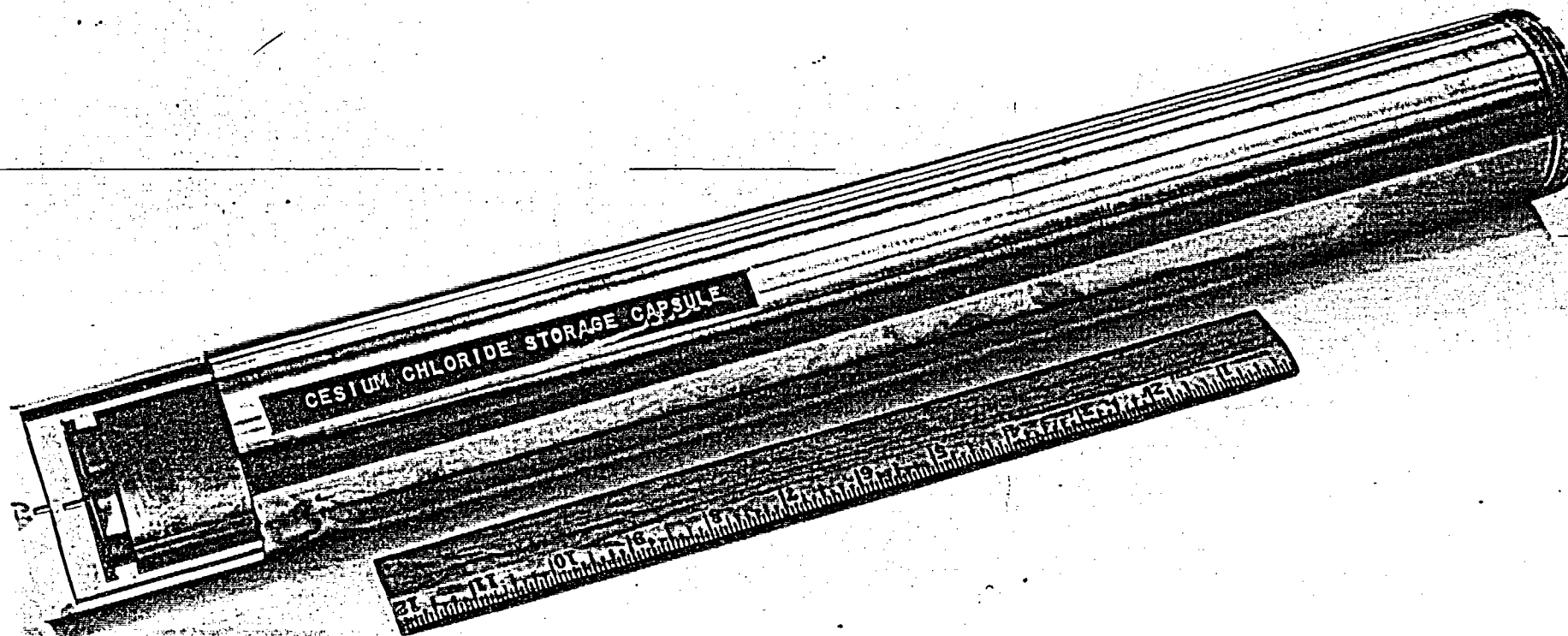
- **TANK WASTES**
  - SINGLE-SHELL
  - DOUBLE-SHELL
- **CAPSULES**
- **LIQUID WASTE DISPOSAL SITES**
  - LOW LEVEL
  - TRU
- **SOLID WASTE SITES**
  - LOW LEVEL } PRE-1970
  - TRU }
  - STORED TRU WASTES      POST-1970



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EPA STAFF SITE VISIT

**CESIUM CHLORIDE STORAGE CAPSULE**





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**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES**

**WASTE DESCRIPTIONS**  
**CESIUM AND STRONTIUM CAPSULES**

- **CESIUM CAPSULES**
  - WASTE FORM IS CESIUM CHLORIDE
  - DOUBLE-CONTAINMENT IN STAINLESS STEEL CAPSULES
  - UP TO 70,000 CURIES OF Cs-137 PER CAPSULE
- **STRONTIUM CAPSULES**
  - WASTE FORM IS STRONTIUM FLUORIDE
  - DOUBLE CONTAINMENT IN HASTELOY CAPSULES
  - UP TO 150,000 CURIES Sr-90 PER CAPSULE
- **CESIUM AND STRONTIUM SEPARATED FROM HIGH-LEVEL WASTES AND PURIFIED IN B-PLANT**
- **CONVERSION TO SALTS, ENCAPSULATION AND STORAGE IN WATER-FILLED POOLS IN THE WASTE ENCAPSULATION AND STORAGE FACILITY (WESF)**



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HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

**WASTE DESCRIPTIONS AND SITES  
CESIUM AND STRONTIUM CAPSULES**

<b>CAPSULES</b>	<b>NUMBER (1)</b>	<b>KILOWATTS (2) 1982</b>	<b>MILLIONS (2)(3) OF CURIES 1982</b>
<b>CESIUM</b>	<b>1600</b>	<b>423</b>	<b>182</b>
<b>STRONTIUM</b>	<b>730</b>	<b>331</b>	<b>98</b>

(1) NUMBERS OF CAPSULES IN 1996 INCLUDING PROJECTED NUMBER OF CAPSULES TO BE PRODUCED FROM EXISTING B-PLANT SOLUTIONS. DOES NOT INCLUDE FUTURE PUREX OPERATIONS. MANAGEMENT ALTERNATIVES CURRENTLY UNDER EVALUATION MAY CAUSE VARIATIONS IN THESE NUMBERS

(2) INCLUDES EXISTING Cs AND Sr NOT YET ENCAPSULATED

(3) INCLUDES DAUGHTERS AND PARENTS



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**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES  
STATUS  
CESIUM AND STRONTIUM CAPSULES**

- 1515 CESIUM AND 425 STRONTIUM CAPSULES ARE CURRENTLY STORED IN THE POOL CELL AT WESF
- BYPRODUCTS UTILIZATION PROGRAMS (SEWAGE AND FOOD IRRADIATION, HEAT SOURCE PRODUCTION) ARE BEING PURSUED
- CONCERN - CONTROLLED COOLING MUST BE MAINTAINED
- ACTIONS
  - DEVELOP IMPROVED LEAK DETECTION TECHNIQUES FOR POOL STORAGE
  - DEVELOP DRY STORAGE TECHNIQUES
  - LONG TERM GEOLOGIC DISPOSAL





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**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES  
WASTE SITES**

- **TANK WASTES**
    - SINGLE-SHELL
    - DOUBLE-SHELL
  - **CAPSULES**
  - **LIQUID WASTE DISPOSAL SITES**
    - LOW LEVEL
    - TRU
  - **SOLID WASTE SITES**
    - LOW LEVEL
    - TRU
    - STORED TRU WASTES
- } PRE-1970
- POST-1970

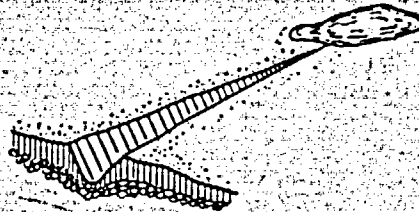


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EPA STAFF SITE VISIT

LOW-LEVEL WASTE  
DISPOSAL SITES

**DITCH** - A LONG, OPEN UNLINED  
EXCAVATION WHICH IS USED FOR  
DISPOSAL AND TRANSPORT OF LOW-  
LEVEL LIQUID WASTE

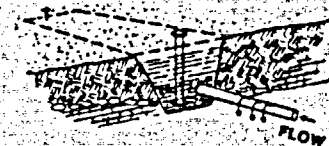


**POND** - A NATURAL OR MAN-MADE  
SURFACE DEPRESSION SOMETIMES  
SURROUNDED BY A DIKE, ALLOWS  
PERCOLATION OF LOW-LEVEL LIQUID  
WASTE

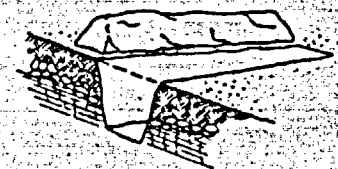


LOW-LEVEL WASTE  
DISPOSAL SITES

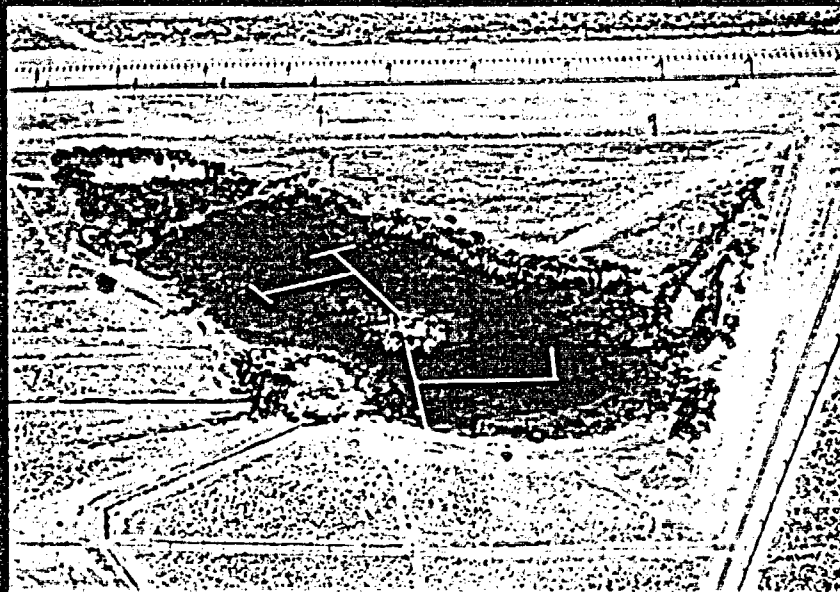
**CRIB** - A BURIED SYSTEM FOR  
DISPERSING LIQUID TO ALLOW  
PERCOLATION INTO THE GROUND

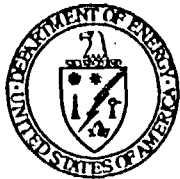


**TRENCH** - LONG, NARROW, UNLINED  
EXCAVATION USUALLY USED FOR  
DISPOSAL OF LIMITED QUANTITY OF  
MATERIAL, AFTER USE THEY ARE  
NORMALLY BACKFILLED



LIQUID WASTE  
DISPOSAL  
SITES





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**HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES**  
**WASTE DESCRIPTIONS**  
**LIQUID WASTE SITES**

- **LARGE VOLUMES OF WATER CONTAINING RADIOACTIVE MATERIALS TO VARYING LEVELS**
- **RELEASED TO CONTROLLED AREAS SUCH AS SOIL COLUMNS (CRIBS, REVERSE WELLS, ETC.) OR TO SEEPAGE STRUCTURES (PONDS, DITCHES, TRENCHES, ETC.)**
- **FAVORABLE ION EXCHANGE AND SORPTIVE PROPERTIES OF THE HANFORD SOILS REMOVE EXCHANGEABLE RADIOACTIVITY FROM THE LIQUID WASTES AND CONFINE IT IN THE SOIL COLUMN**

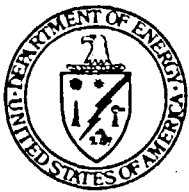


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EPA STAFF SITE VISIT

WASTE DESCRIPTION AND SITES  
LIQUID WASTE SITES

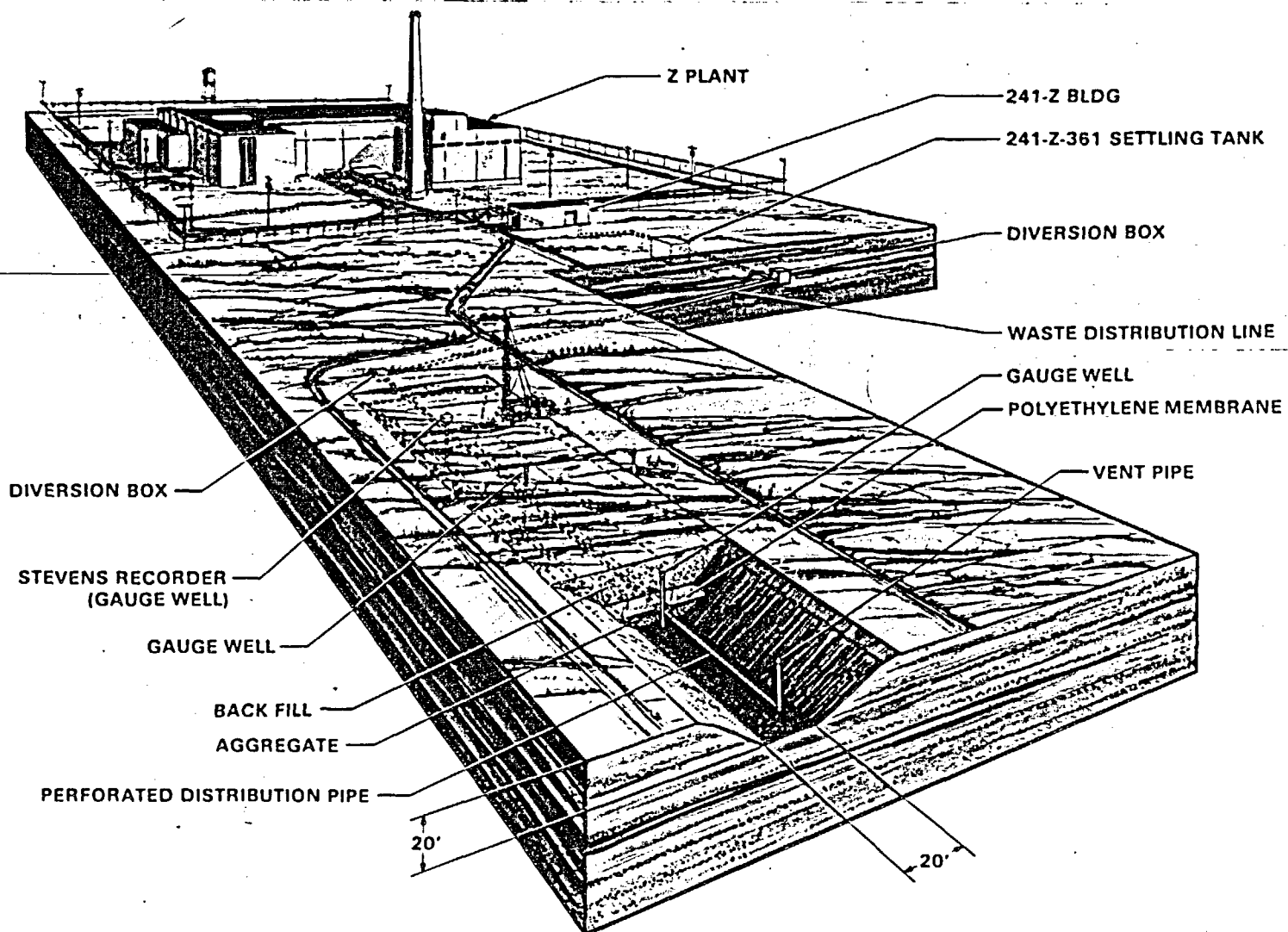
SITES	OPERATING PERIOD				
	1940's	1950's	1960's	1970's	1980's
TRU LIQUID					
CRIBS	1944			1973	
FRENCH DRAINS		1955	1962		
RETENTION TRENCHES		1954	1967		
REVERSE WELLS	1945 1947				
LOW-LEVEL WASTE					
LIQUID (PER DOE					
ORDER 5480.1)					
CRIBS	1944				PRESENT
DITCHES	1944				PRESENT
FRENCH DRAINS	1944				PRESENT
PONDS	1944				PRESENT
RETENTION TRENCHES		1954	1967		

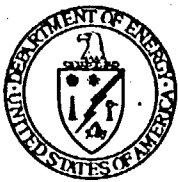


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HANFORD DEFENSE WASTE DISPOSAL PROGRAM

EPA STAFF SITE VISIT

WASTE DESCRIPTION AND SITES  
**WASTE SITE - CRIB**  
216-Z-12 CRIB CONSTRUCTION DETAILS

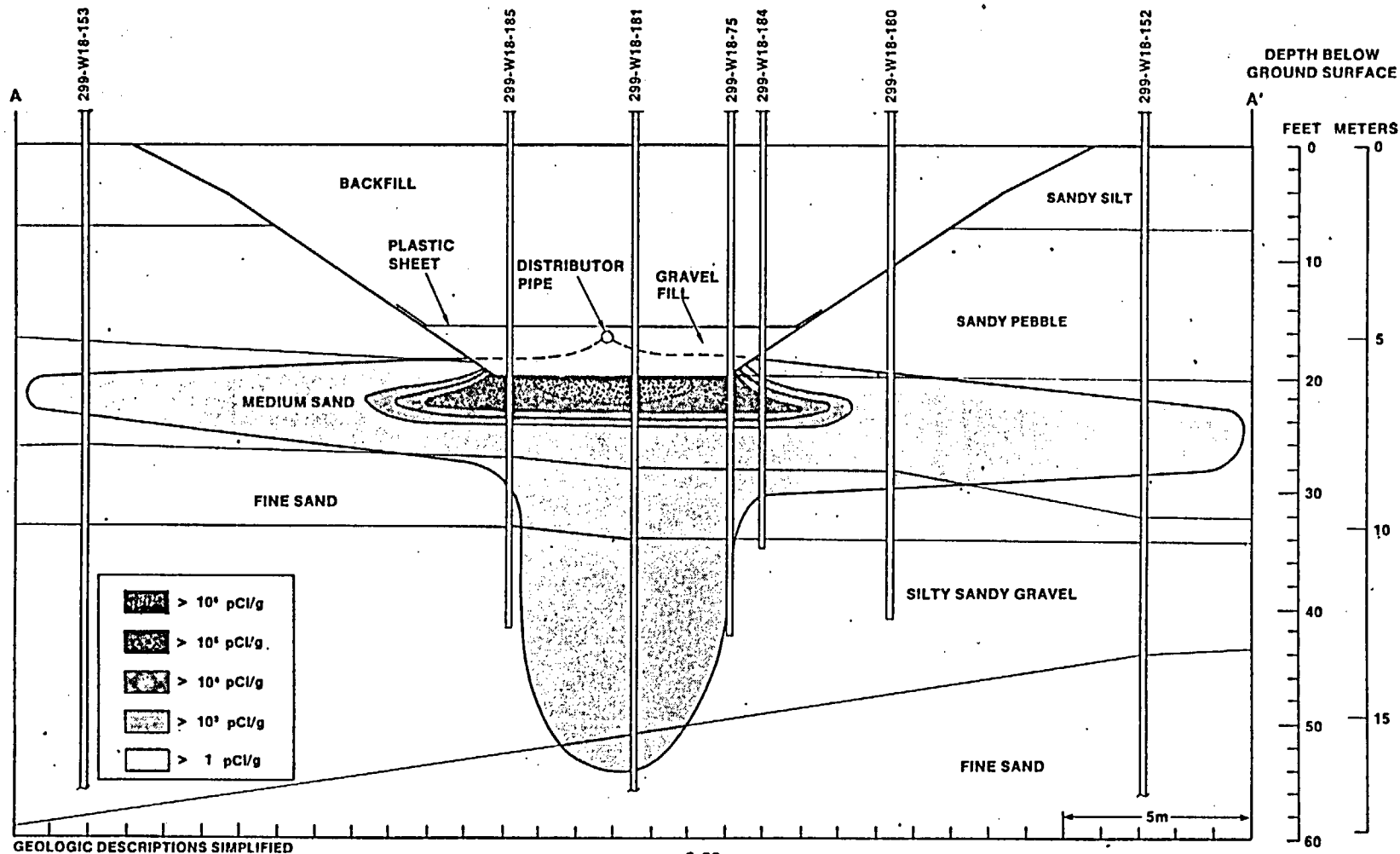


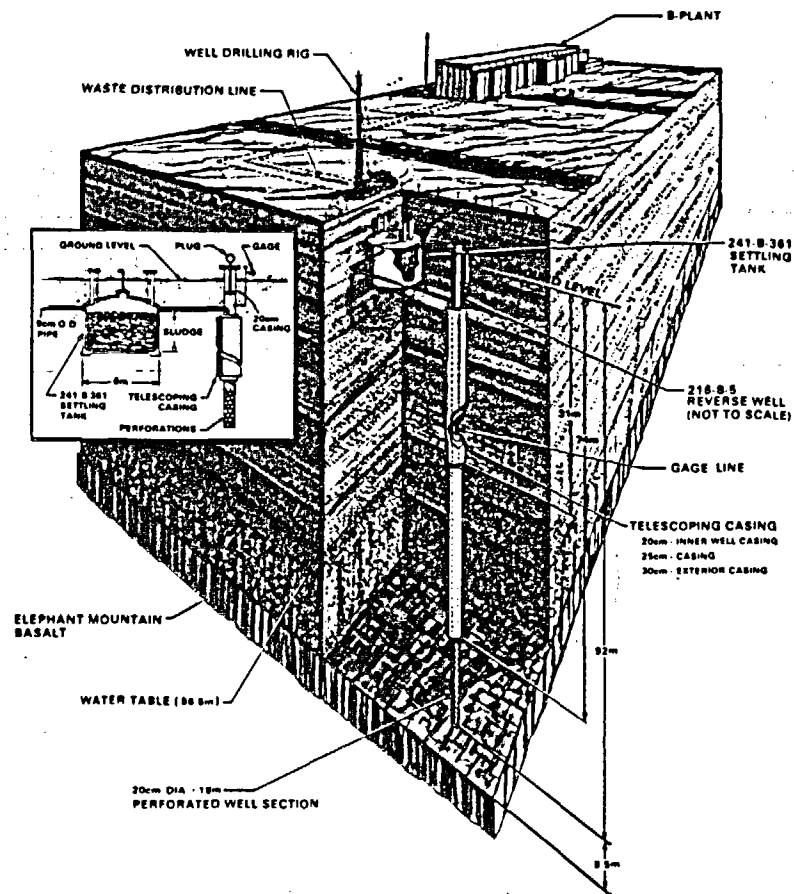


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EPA STAFF SITE VISIT

WASTE DESCRIPTION AND SITES  
TYPICAL TRU CRIB CONTAMINATION PLUME  
216-Z-12



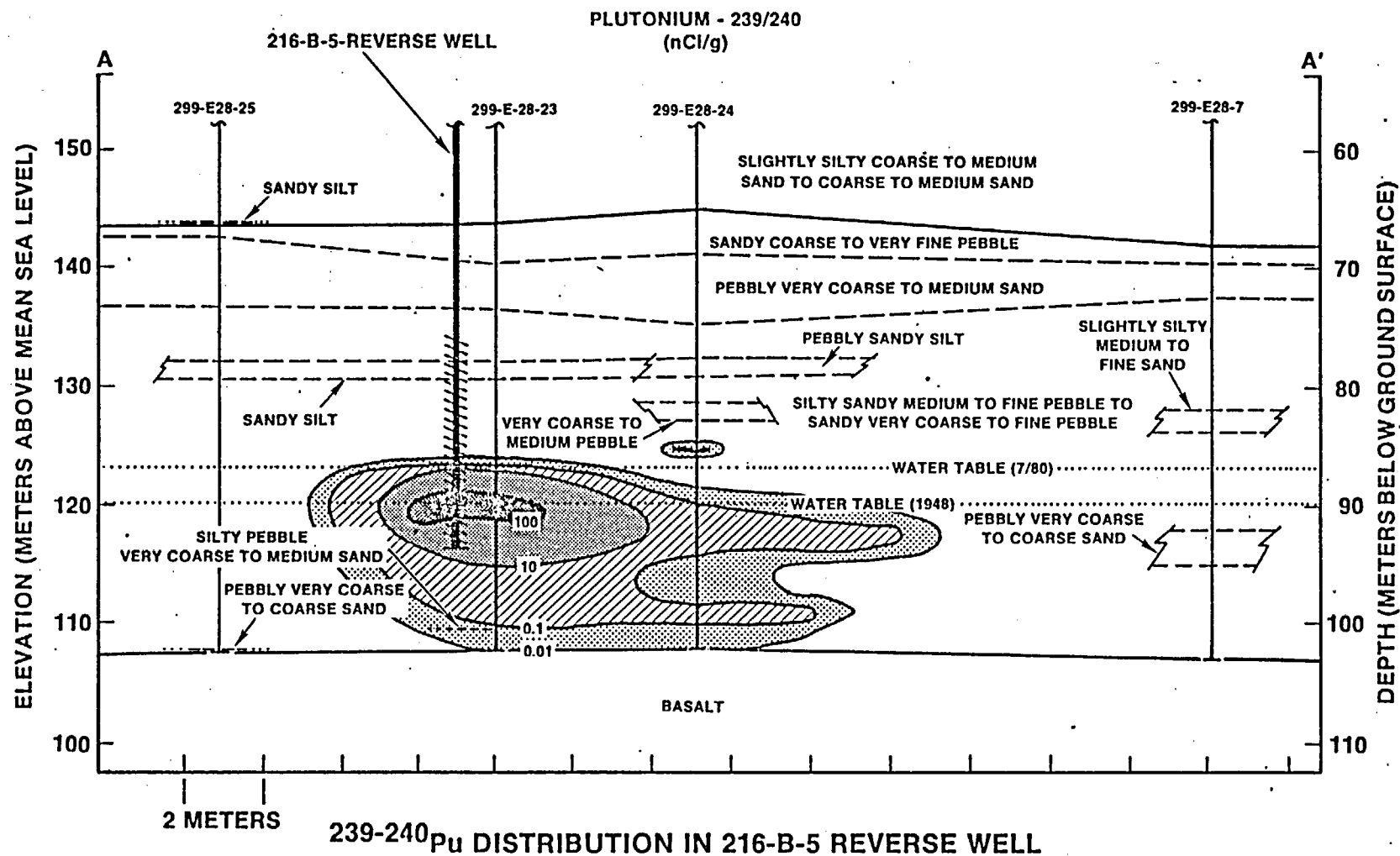




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EPA STAFF SITE VISIT

WASTE DESCRIPTION AND SITES  
**GEOLOGIC CROSS SECTION A-A'**







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EPA STAFF SITE VISIT

WASTE DESCRIPTION AND SITES  
**LIQUID WASTE DISPOSAL AND INVENTORIES**

	<u>NUMBER OF SITES</u>	<u>SURFACE AREA</u>	<u>VOLUME</u>	<u>CURIES*</u>
LOW LEVEL	284	461 ACRES	$\sim 4 \times 10^6 \text{ m}^3$	$6.4 \times 10^4$
TRU	24	5.3 ACRES	$\sim 36,000 \text{ m}^3$	$1.8 \times 10^4$ (ALPHA EMITTING) $5.2 \times 10^4$ (NON ALPHA EMITTING)

\* DECAYED TO 12/31/82



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**HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES**  
**WASTE SITES**

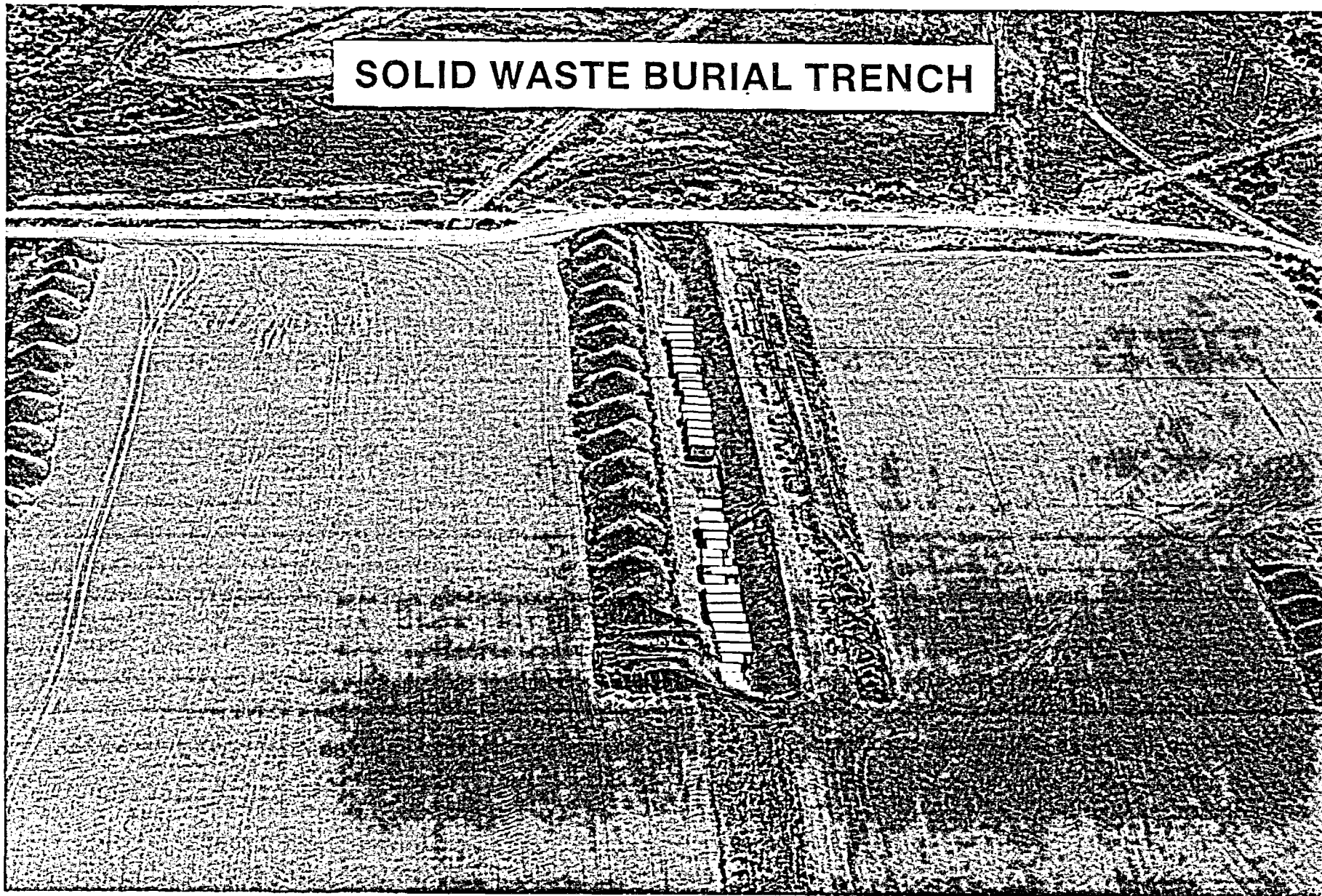
- **TANK WASTES**
  - SINGLE-SHELL
  - DOUBLE-SHELL
- **CAPSULES**
- **LIQUID WASTE DISPOSAL SITES**
  - LOW LEVEL
  - TRU
- **SOLID WASTE SITES**
  - LOW LEVEL } PRE-1970
  - TRU } PRE-1970
  - STORED TRU WASTES POST-1970



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EPA STAFF SITE VISIT

**SOLID WASTE BURIAL TRENCH**





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**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES  
WASTE DESCRIPTIONS  
SOLID WASTE SITES**

- **SOLID WASTE MATERIALS ARE OF A WIDELY DIVERSE NATURE, CONSISTING OF SUCH ITEMS AS FAILED PROCESS EQUIPMENT (PUMPS, COLUMNS, ETC.), LABORATORY WASTES AND "ROOM TRASH" (PAPER, PLASTICS, GLASSWARE, ETC.) AND DECONTAMINATION AND DECOMMISSIONING RUBBLE (CONCRETE, PIPING, SOILS, ETC.)**
- **PRIOR TO 1970, BOTH TRU AND NON-TRU WASTES (UNSEGREGATED) WERE DISPOSED OF BY SHALLOW LAND BURIAL**
- **AFTER 1970, TRU WASTES HAVE BEEN SEGREGATED AND PLACED IN A RETRIEVABLE STORAGE MODE**



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HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES  
SOLID WASTE SITES**

SITES	OPERATING PERIOD				
	1940's	1950's	1960's	1970's	1980's
VAULT	1944	1960			
CAISSONS (CULVERTS)		1953			PRESENT
BURIAL GROUNDS					
UNSEGREGATED WASTE (TRU AND LOW-LEVEL)	1944		1970		
TRU WASTE (STORED)				1970	PRESENT
NON TRU WASTE				1970	PRESENT
INDUSTRIAL WASTE	1945				PRESENT



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EPA STAFF SITE VISIT

WASTE DESCRIPTION AND SITES  
**SOLID WASTE SITE INVENTORIES**

	<u>NUMBER OF SITES</u>	<u>SURFACE AREA</u>	<u>VOLUME</u>	<u>CURIES**</u>
LOW LEVEL	55	97 ACRES	776,000 m <sup>3</sup>	3.6 x 10 <sup>6</sup>
TRU*	11	20 ACRES	124,000 m <sup>3</sup>	6.4 x 10 <sup>4</sup> (ALPHA EMITTING) 3.2 x 10 <sup>5</sup> (NON ALPHA EMITTING)

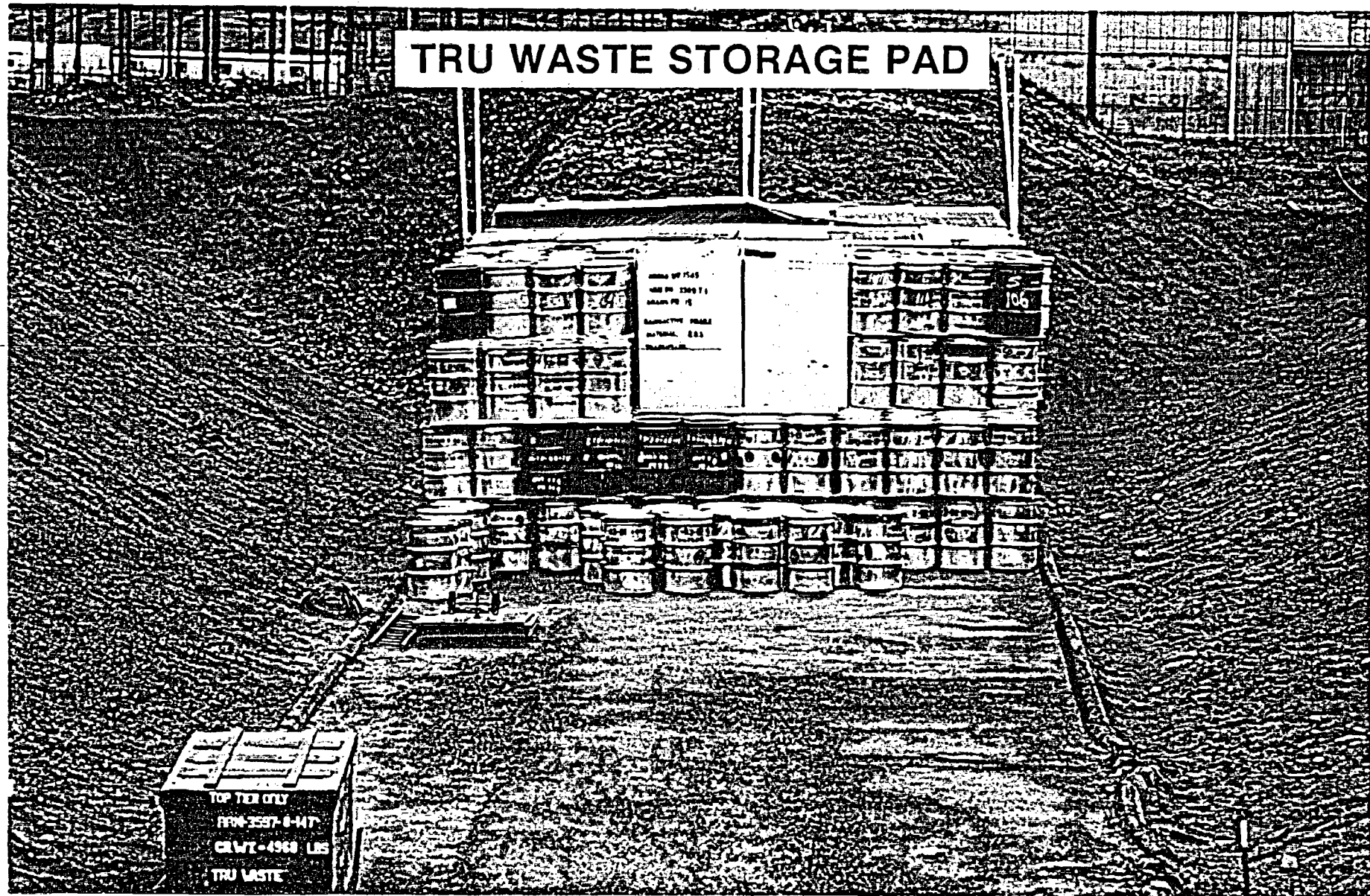
\* EXCLUDES STORED TRU WASTE

\*\* DECAYED TO 12/31/82



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EPA STAFF SITE VISIT



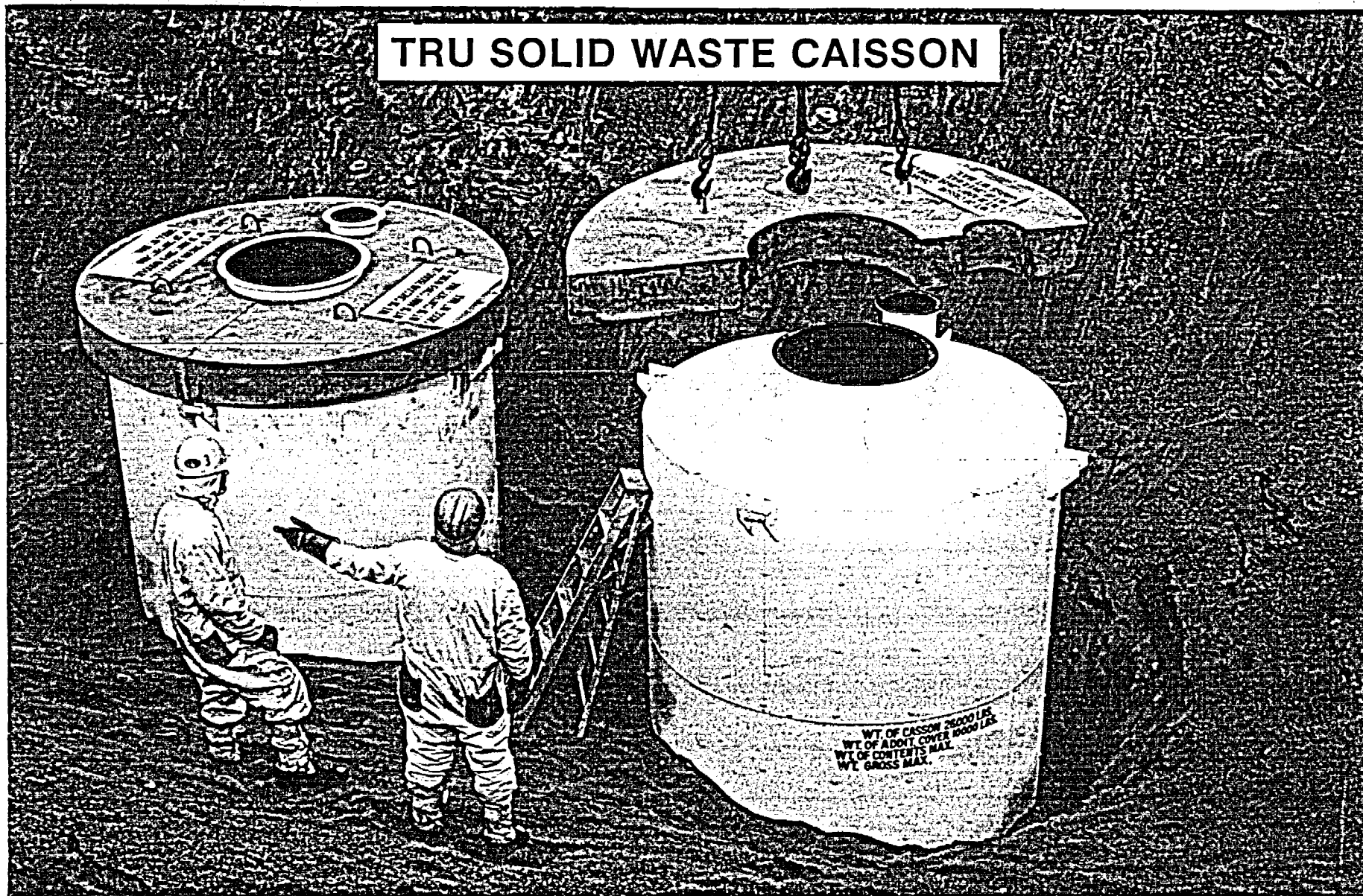




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EPA STAFF SITE VISIT

TRU SOLID WASTE CAISSON







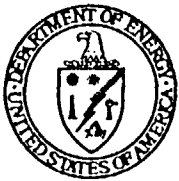
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EPA STAFF SITE VISIT

WASTE DESCRIPTION AND SITES  
**TRANSURANIC (TRU) STORED WASTE**

	<u>* VOLUME (m<sup>3</sup>)</u>	<u>Pu (Kg)</u>
<b>CONTACT HANDLED WASTE</b>		
• ON ASPHALT PADS	6,700	305
• IN TRENCHES (CONCRETE BOXES, FIBERGLASS REINFORCED BOXES, ETC.)	4,600	3
<b>REMOTE HANDLED WASTE</b>		
• PUREX TUNNELS AND CAISSONS	1,120	5

\*VOLUMES THROUGH 1982



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HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES  
HANFORD WASTE VOLUME AND RADIOACTIVITY  
IN PERSPECTIVE**

- **HANFORD HIGH-LEVEL WASTE IS SIMILAR IN VOLUME AND ACTIVITY TO SAVANNAH RIVER PLANT, BUT IS DIFFERENT DUE TO MULTIPLE PROCESSES, TANK LEAKS, AND CESIUM/STRONTIUM REMOVAL**
- **HANFORD HAS MORE RETRIEVABLY STORED TRU THAN ANY DOE SITE EXCEPT IDAHO NATIONAL ENGINEERING LABORATORY. HOWEVER, HANFORD HAS A NUMBER OF LIQUID AND SOLID WASTE SITES WHICH MAY ALSO BE CLASSIFIED AS TRU SITES BUT ARE NOT IN RETRIEVABLE STORAGE MODE**
- **HANFORD HAS MUCH MORE LOW-LEVEL WASTE THAN ANY OTHER DOE SITE, PRIMARILY DUE TO CONTAMINATED SOILS FROM DISPOSAL OF LOW-LEVEL LIQUID WASTES. EXTENSIVE CONTAMINATION OF SOIL FROM LIQUID WASTE DISPOSAL IS A HANFORD SPECIFIC CHARACTERISTIC**



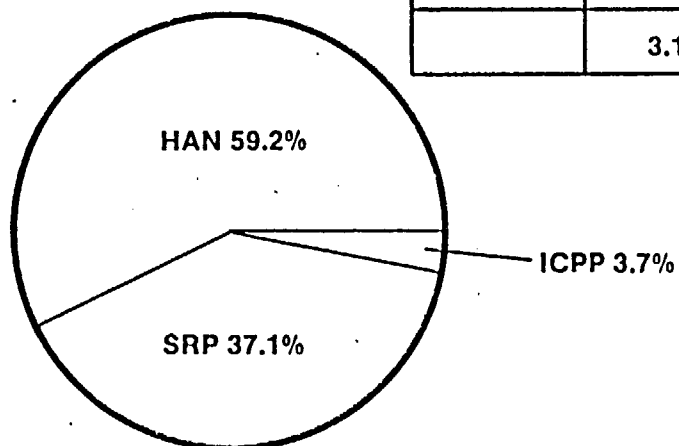
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EPA STAFF SITE VISIT

WASTE DESCRIPTION AND SITES  
TOTAL IN-TANK WASTE THROUGH 1982

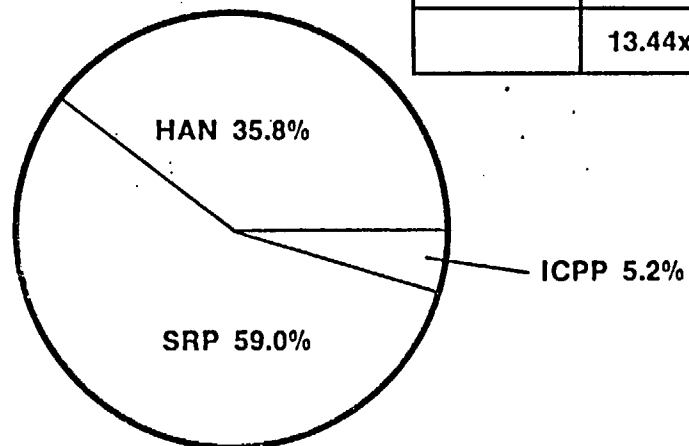
VOLUMES OF HLW

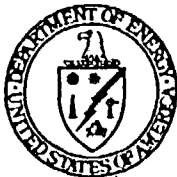
SITE	CUBIC METERS
HAN	$1.83 \times 10^5$
ICPP	$.12 \times 10^5$
SRP	$1.15 \times 10^5$
	$3.10 \times 10^5$



RADIOACTIVITY OF HLW

SITE	CURIES
HAN	$4.81 \times 10^8$
ICPP	$.70 \times 10^8$
SRP	$7.93 \times 10^8$
	$13.44 \times 10^8$





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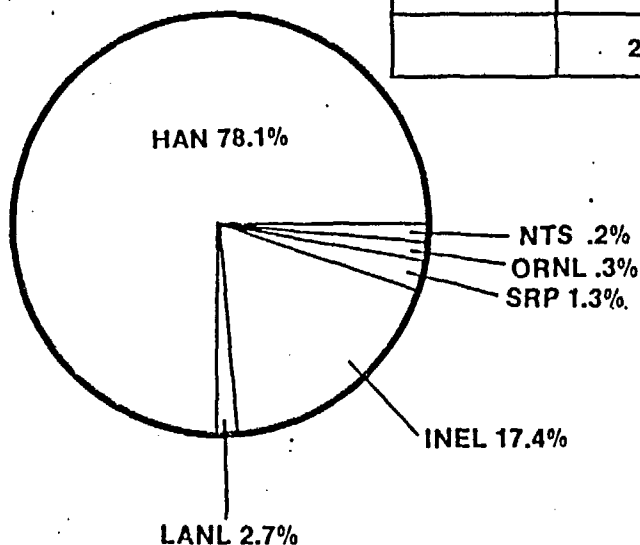
EPA STAFF SITE VISIT

WASTE DESCRIPTION AND SITES  
TOTAL TRANSURANIC (TRU) WASTE THROUGH 1982

INCLUDES STORED TRU AND NON-RETRIEVABLE TRU AT HANFORD

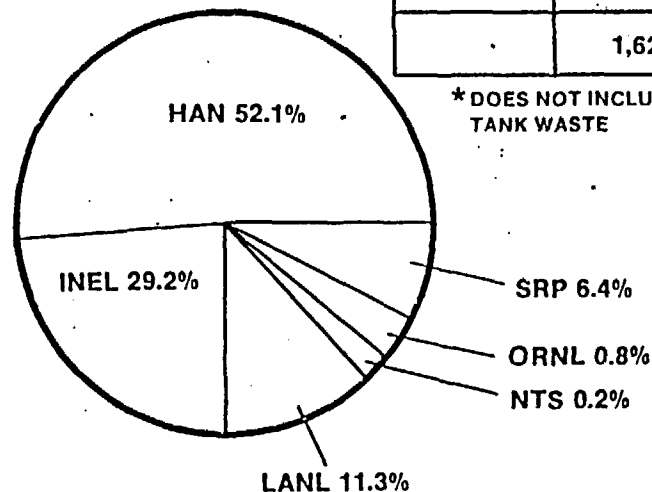
VOLUMES OF TRU WASTE

SITE	CUBIC METERS
HANF	1.700x10 <sup>5</sup>
INEL	.380x10 <sup>5</sup>
LANL	.059x10 <sup>5</sup>
NTS	.004x10 <sup>5</sup>
ORNL	.006x10 <sup>5</sup>
SRP	.029x10 <sup>5</sup>
	2.200x10 <sup>5</sup>



MASS OF TRU ELEMENTS IN WASTE

SITE	KG
HANF	848.0 *
INEL	476.0
LANL	184.0
NTS	3.2
ORNL	12.6
SRP	104.0
	1,628



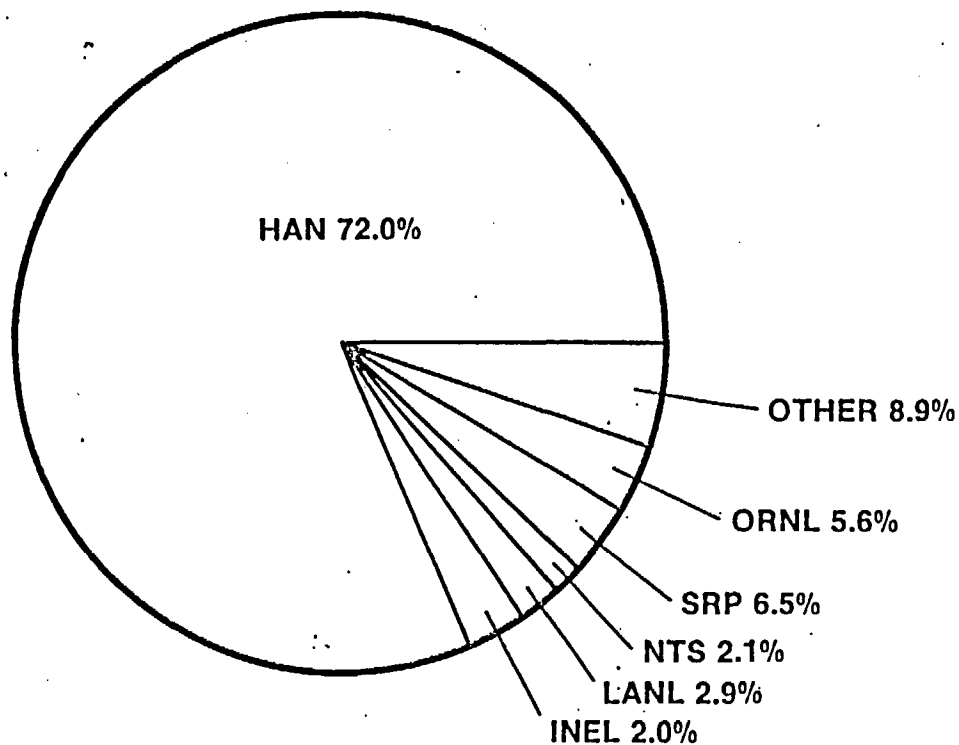
\* DOES NOT INCLUDE  
TANK WASTE



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EPA STAFF SITE VISIT

WASTE DESCRIPTION AND SITES  
**TOTAL LOW-LEVEL WASTE THROUGH 1982**  
VOLUME OF LOW-LEVEL WASTE



SITE	CUBIC METERS
HAN*	4.30x10 <sup>6</sup>
INEL	.12x10 <sup>6</sup>
LANL	.17x10 <sup>6</sup>
NTS	.12x10 <sup>6</sup>
SRP	.39x10 <sup>6</sup>
ORNL	.33x10 <sup>6</sup>
OTHER	.53x10 <sup>6</sup>
	5.97x10 <sup>6</sup>

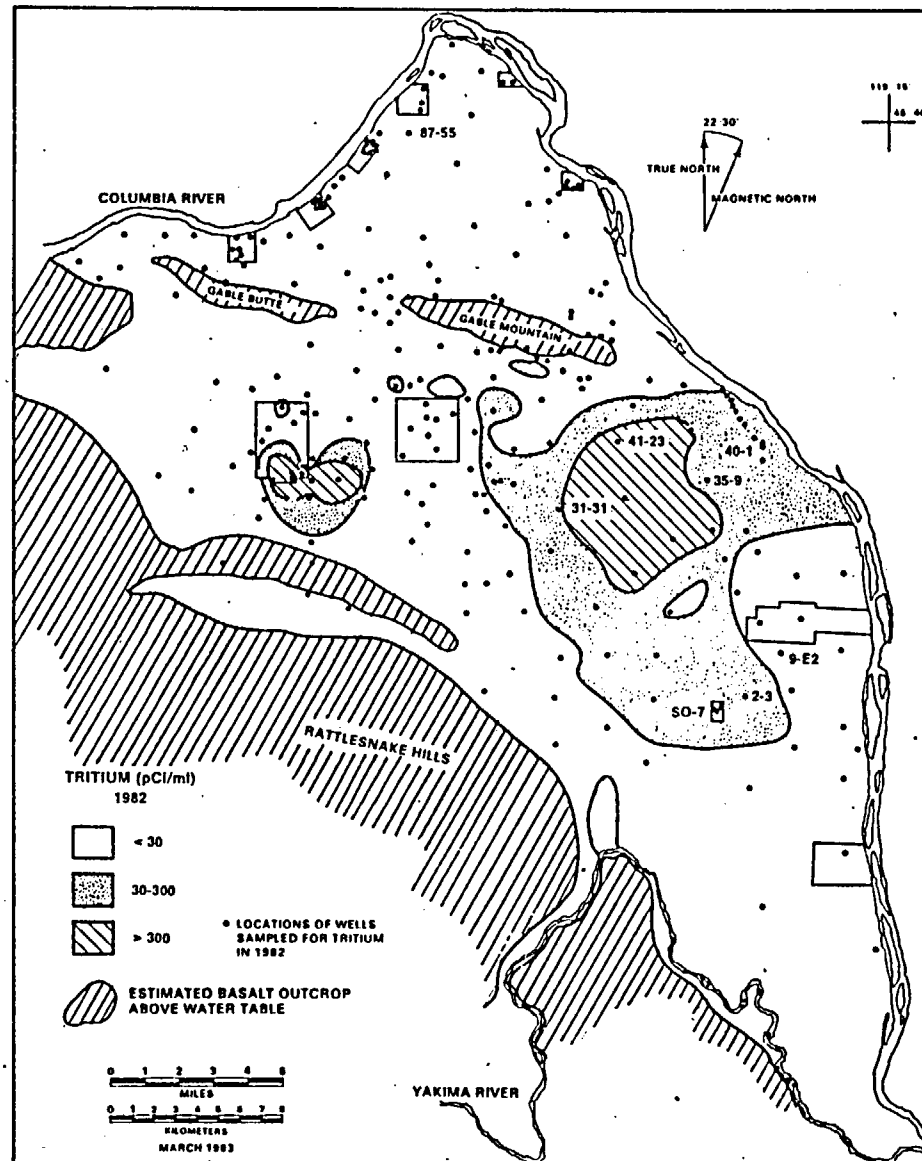
\* INCLUDES LIQUID  
DISPOSAL SITES

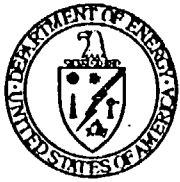


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EPA STAFF SITE VISIT

WASTE DESCRIPTION  
AND SITES  
TRITIUM  
DISTRIBUTION  
IN UNCONFINED  
GROUND WATER





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**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES  
RADIATION IN UNCONFINED GROUND WATER  
AT HANFORD IN 1982**

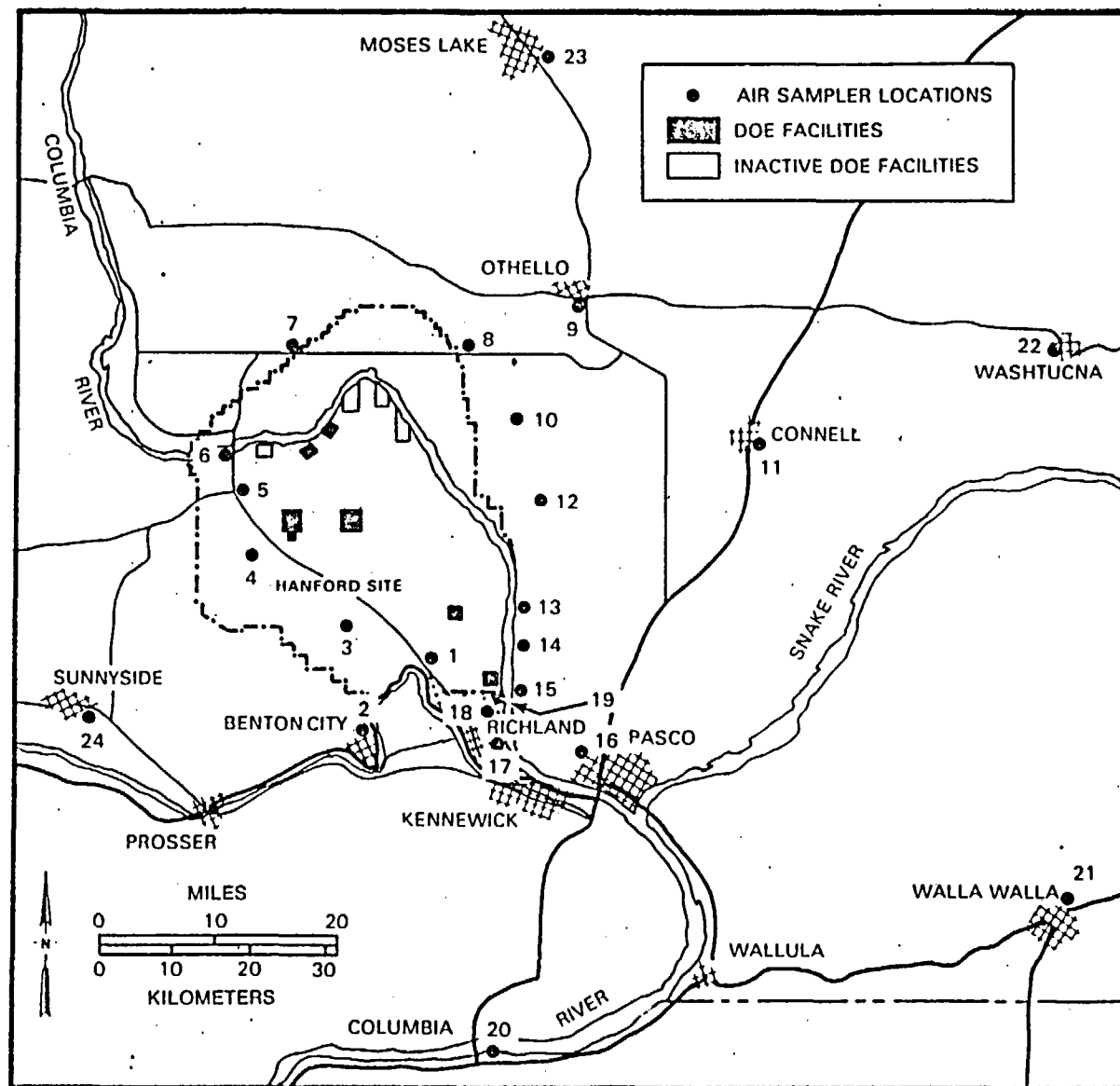
- **MAXIMUM TRITIUM CONCENTRATIONS UP TO 850 PCi/ML ARE BELOW THE CONCENTRATION GUIDE OF 3,000 PCi/ML**
- **GROSS BETA RADIOACTIVITY HAS BEEN DECREASING FOR SEVERAL YEARS AND IS NOW AT INSIGNIFICANT LEVEL IN MOST OF THE AQUIFER. SOME SMALL AREAS OF HIGHER LEVELS NEAR 200 AREAS AND 100 N AREA**



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EPA STAFF SITE VISIT

WASTE DESCRIPTION  
AND SITES  
AIR SAMPLING  
LOCATIONS







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**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES  
AIRBORNE RADIOACTIVITY IN THE  
HANFORD ENVIRONS FOR 1982**

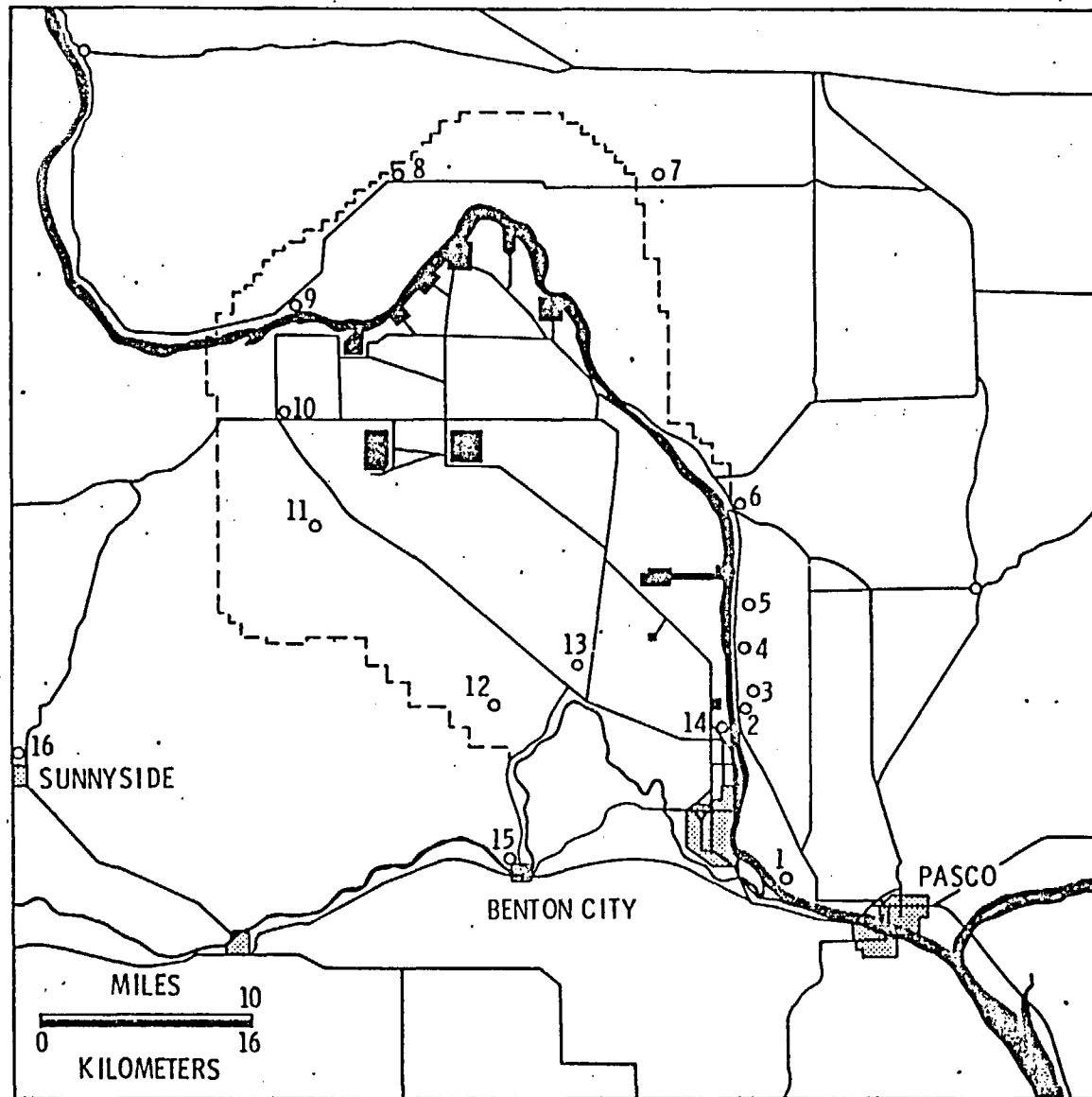
- **GROSS BETA CONCENTRATIONS RANGE FROM 0.011 pCi/M3 TO 0.076 pCi/M3 AT PERIMETER STATIONS**
- **CONCENTRATION GUIDE LIMIT FOR GROSS BETA ACTIVITY IN AIR IS 0.2 pCi/M3**
- **GROSS ALPHA CONCENTRATIONS RANGE FROM 0.00033 pCi/M3 TO 0.0053 pCi/M3 AT PERIMETER STATIONS**
- **CONCENTRATION GUIDE LIMIT FOR GROSS ALPHA ACTIVITY IN AIR IS 0.2 pCi/M3**



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EPA STAFF SITE VISIT

WASTE DESCRIPTION  
AND SITES  
SOIL AND  
VEGETATION  
SAMPLING  
LOCATIONS





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HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES  
RADIONUCLIDES IN SOIL AT HANFORD**

- **LARGEST REPORTED CONCENTRATION OF  $^{90}\text{Sr}$ -0.36 pCi/G AT ALE**
- **LARGEST REPORTED CONCENTRATION OF  $^{137}\text{Cs}$ -1.26 pCi/G AT PROSSER BARRICADE**
- **LARGEST REPORTED CONCENTRATION OF  $^{239, 240}\text{Pu}$ -0.037 pCi/G AT PROSSER BARRICADE**
- **LARGEST REPORTED CONCENTRATION OF U-0.80 pCi/G AT TAYLOR-FLATS #2**



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**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES  
RADIONUCLIDES IN VEGETATION  
AT HANFORD**

- **LARGEST REPORTED CONCENTRATION OF  $^{90}\text{Sr}$ -0.063 pCi/G AT TAYLOR FLATS #2**
- **LARGEST REPORTED CONCENTRATION OF  $^{137}\text{Cs}$ -0.093 pCi/G AT VERNITA BRIDGE**
- **LARGEST REPORTED CONCENTRATION OF  $^{239, 240}\text{Pu}$ -0.0038 pCi/G AT WAHLUKE #2**
- **LARGEST REPORTED CONCENTRATION OF U-0.041 pCi/G AT BYERS LANDING**

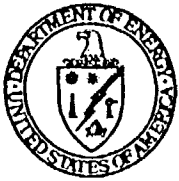


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**HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES**  
**RADIATION DOSE COMMITMENTS TO PUBLIC**  
**FROM 1982 HANFORD OPERATIONS**

- **WHOLE BODY DOSE OF 0.1 MAN-REM TO MAXIMUM INDIVIDUAL VERSUS RADIATION PROTECTION STANDARD OF 500 MAN-REM**
- **LARGEST ORGAN DOSE WAS 0.4 MAN-REM TO BONE VERSUS RADIATION PROTECTION STANDARD OF 1500 MAN-REM**
- **RANGE FROM 3 MAN-REM TO 7 MAN-REM TO POPULATION VERSUS BACKGROUND RADIATION DOSE OF 34,000 MAN-REM**

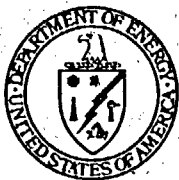


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HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

**WASTE DESCRIPTION AND SITES  
RADIATION DOSE COMMITMENTS TO PUBLIC  
FROM 1982 HANFORD OPERATIONS**

**POPULATION RECEIVED 3-7 MAN-REM VERSUS NATURAL  
BACKGROUND OF 34,000 MAN-REM**



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HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

## **CONTENTS**

**SECTION 1 - DEFENSE WASTE MANAGEMENT PLAN**

**SECTION 2 - WASTE DESCRIPTION AND SITES**

**SECTION 3 - REFERENCE DISPOSAL PLAN AND ALTERNATIVES**

**SECTION 4 - APPLICATION OF PROPOSED 40 CFR 191 TO IN-PLACE  
STABILIZATION**

**SECTION 5 - HANFORD DEFENSE WASTE EIS AND APPROACH TO  
PERFORMANCE ASSESSMENT**

**SECTION 6 - ISSUES AND CONCERNS**



**DOE-RL  
HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

**REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
HANFORD WASTE MANAGEMENT  
PROGRAM MISSIONS**

- **MANAGE EXISTING AND FUTURE WASTES TO ENSURE SAFE STORAGE UNTIL FINAL DISPOSAL**
- **MAINTAIN WASTE MANAGEMENT FLEXIBILITY TO SUPPORT POSSIBLE FUTURE PROGRAMS**
- **PROVIDE SAFE AND COST EFFECTIVE FINAL DISPOSAL PROGRAMS FOR EXISTING AND FUTURE WASTES**





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HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

**REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
HANFORD WASTE MANAGEMENT PROGRAM  
PRODUCT**

- **SAFE INTERIM WASTE STORAGE**
- **FINAL WASTE DISPOSAL**
- **TECHNOLOGY DEVELOPMENT**



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HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

**REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
BASIS DEVELOPMENT**

- **FOR EARLY PLANNING, REGULATIONS WERE NOT DEVELOPED, BUT A GENERAL BASIS COULD BE USED:**
  - **DISPOSE OF THE WASTE WITH A SUFFICIENT DEGREE OF LONG-TERM SAFETY**
- **EARLY PLANNING AND DESIGN FOCUSED ON RETRIEVAL FOR REPOSITORY DISPOSAL DUE TO:**
  - **PERCEIVED HAZARD**
  - **NATIONAL ACADEMY OF SCIENCES 1978 REPORT WHICH EXPRESSED CONCERNS ABOUT AIRBORNE TRANSPORT AFTER INTRUSION AS WELL AS LONG-RANGE GROUNDWATER TRANSPORT**
  - **GENERAL DIRECTION OF NATIONAL PLANNING**



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**EPA STAFF SITE VISIT**

**REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
BASIS DEVELOPMENT (CONT)**

- **PRELIMINARY RETRIEVAL DESIGNS INDICATED HIGH COST AND SUBSTANTIAL OCCUPATIONAL HAZARD, DUE TO NEED FOR WASTE HANDLING**
- **DURING THE SAME TIME FRAME, IMPACT ASSESSMENTS FOR IN-PLACE STABILIZATION INDICATED:**
  - **GROUNDWATER IMPACTS LOW**
  - **INTRUSION IMPACTS LOW**
  - **NUCLIDE CONTENT LOW**
  - **NUCLIDE CONCENTRATIONS IN SOME TANKS MAY BE BELOW THE DEVELOPING DEFINITION OF HIGH-LEVEL WASTE**
  - **POPULATION RISK LOW**
- **THUS THE CONCEPT OF IN-PLACE STABILIZATION BEGAN TO RECEIVE SERIOUS CONSIDERATION, WITH ADDED BASES:**
  - **COST/RISK/BENEFIT BALANCING**
  - **MEET APPLICABLE STANDARDS**



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HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

**REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
BASIS DEVELOPMENT (CONT)**

- **GROUNDWATER TRANSPORT IMPACT**
  - LEAK FROM 241-T-106 TANK PENETRATED LESS THAN HALF THE DISTANCE TO GROUNDWATER AND STABILIZED THERE
  - DIRECT DISCHARGE TO 216-B-5 REVERSE WELL CAUSED TRANSPORT OF LONG-LIVED NUCLIDES ONLY A FEW METERS (Pu-239 BELOW 0.01 nCi/g AT 12 METERS AWAY)
  - TRANSPORT MODELING PREDICTED ESSENTIALLY NO TRANSPORT THROUGH VADOSE ZONE TO GROUNDWATER UNLESS DRIVING FORCE ADDED (INCREASED RAINFALL OR IRRIGATION)
  - EVEN WITH DRIVING FORCE, ADDED IMPACT OF RIVER WATER USE PREDICTED TO BE ONLY A FEW HEALTH EFFECTS OVER SEVERAL THOUSAND YEARS
- **THUS GROUNDWATER IMPACT OF IN-PLACE STABILIZATION EXPECTED TO BE ACCEPTABLE**



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**EPA STAFF SITE VISIT**

**REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
BASIS DEVELOPMENT (CONT)**

- **INTRUDER SCENARIOS (HYPOTHETICAL):**
  - **DRINKING WATER WELL 400 METERS AWAY FROM 200-EAST, CLIMATE CHANGE ASSUMED TO PROVIDE DRIVING FORCE**
    - **INDIVIDUAL DOSE LESS THAN 1 REM.**
  - **EXCAVATION SCENARIO FOR TRANSURANIC LIQUID SITE**
    - **INDIVIDUAL 70-YEAR DOSE COMMITMENT OF 4 REM.**
  - **DRILLING SCENARIO INTO TRANSURANIC CONCENTRATION OF 10,000 nCi/g**
    - **INDIVIDUAL MAXIMUM ANNUAL DOSE OF 0.5 REM.**
- **THUS INDIVIDUAL EXPOSURES FROM INTRUSION WERE LOW**



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HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

**REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
BASIS DEVELOPMENT (CONT)**

- **NUCLIDE CONTENT**

- ACTINIDE CONTENT 8,000 TIMES LESS THAN THAT OF COMMERCIAL SPENT FUEL TO YEAR 2000. FISSION PRODUCT CONTENT 70 TIMES LESS
- THUS LESSER DEGREE OF CONTAINMENT THAN THAT CONSIDERED FOR COMMERCIAL WASTE COULD PROVIDE ADEQUATE SAFETY FOR DEFENSE WASTE

- **NUCLIDE CONCENTRATIONS**

- HALF OR MORE OF THE SINGLE-SHELL TANKS MAY NOT BE HIGH-LEVEL WASTE BASED ON TABLE I OF 40 CFR 191



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**EPA STAFF SITE VISIT**

**REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
BASIS DEVELOPMENT (CONT)**

- **DEVELOPING STANDARD**

- **EARLY BASIS FOR 40 CFR 191 WAS 1,000 HEALTH EFFECTS OVER 10,000 YEARS FOR A REFERENCE REPOSITORY**
- **PRELIMINARY HANFORD RISK ASSESSMENTS INDICATED THAT IN-PLACE STABILIZATION COULD MEET SUCH A STANDARD ON HEALTH EFFECTS**



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**EPA STAFF SITE VISIT**

**REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
BASIS DEVELOPMENT (CONT)**

- **BASED ON THE RELATIVELY LOW IMPACTS AND OTHER INFORMATION ABOVE, THE REFERENCE PLAN WAS CHOSEN TO BE MOSTLY IN-PLACE STABILIZATION WITH THE BASIS SUMMARIZED HERE:**
  - SUFFICIENT DEGREE OF LONG-TERM SAFETY
  - COST/RISK/BENEFIT BALANCING OF IMPACTS OF OPERATIONAL AND POST-DISPOSAL PHASES
  - MEET APPLICABLE STANDARDS AND REGULATIONS
- **BASIC CONCEPT OF REFERENCE PLAN**
  - RETRIEVE MATERIAL IF "READILY" RETRIEVABLE (HYDRAULIC RETRIEVAL FOR TANKS) OR "READILY ACCESSIBLE" (STORED TRU) OR HIGH HAZARD LEVEL (CAPSULES)
  - STABILIZE ALL OTHER WASTE IN PLACE IF ADEQUATE SAFETY CAN BE SHOWN AND REGULATIONS CAN BE MET





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HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

**REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
IMPACT COMPARISON**

<b>ALTERNATIVE</b>	<b>OPERATIONAL PERIOD COST/HEALTH IMPACT</b>	<b>POST-DISPOSAL (10,000 YEARS) HEALTH IMPACT</b>
<b>IN-PLACE STABILIZATION</b>	<b>LOW/VERY LOW</b>	<b>LOW</b>
<b>GEOLOGIC REPOSITORY</b>	<b>HIGH/LOW</b>	<b>LOW</b>



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**EPA STAFF SITE VISIT**

**REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
PREVIOUS RESULTS FOR TANKS AND CAPSULES  
(RHO-LD-139, 1980)**

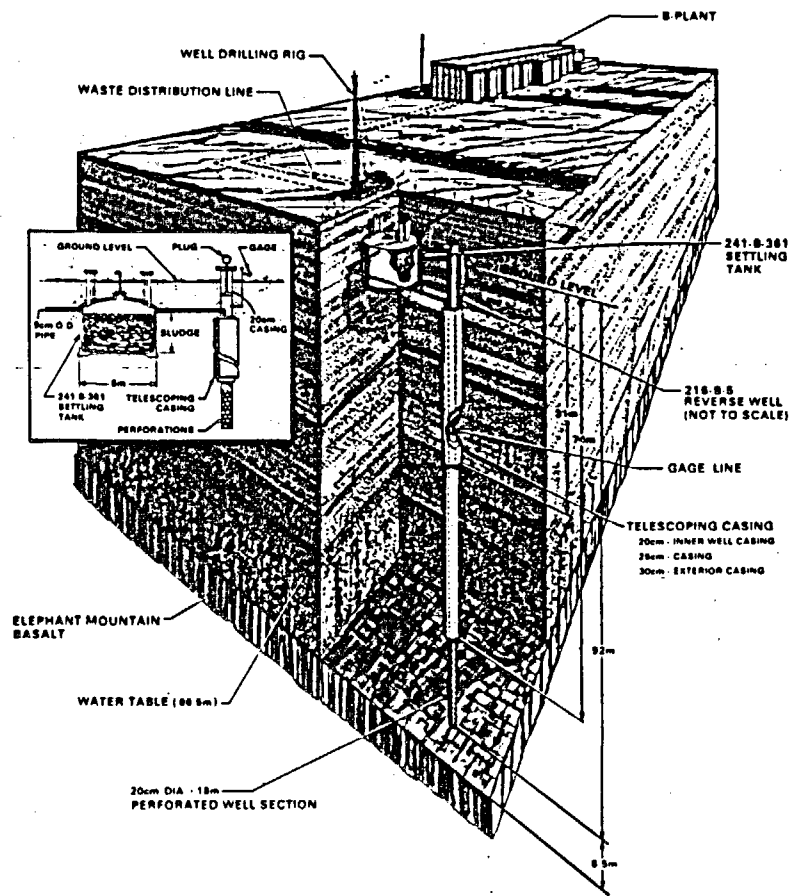
<b>ALTERNATIVES</b>	<b>OPERATION PERIOD IMPACTS</b>	<b>POST-DISPOSAL SEVERE ACCIDENT IMPACTS (10,000 YEARS)</b>
<b>IN-PLACE STABILIZATION: (CAPSULES TO REPOSITORY)</b>	<b>ROUTINE OCCUPATIONAL EXPOSURE:</b> LESS THAN 700 MAN REM.  <b>INDUSTRIAL ACCIDENTS:</b> LESS THAN 1 HEALTH EFFECT  <b>ROUTINE POPULATION EXPOSURE:</b> LESS THAN 4 MAN REM.  <b>COSTS:</b> LESS THAN 0.7 BILLION	<b>GLACIAL FLOODING:</b>  <b>LESS THAN 30 HEALTH EFFECTS</b>
<b>RETRIEVE TO REPOSITORY:</b>	<b>ROUTINE OCCUPATIONAL EXPOSURE:</b> LESS THAN 7,000 MAN REM.  <b>INDUSTRIAL ACCIDENTS:</b> LESS THAN 12 HEALTH EFFECTS  <b>ROUTINE POPULATION EXPOSURE:</b> LESS THAN 270 MAN REM.  <b>COSTS:</b> LESS THAN 6 BILLION	<b>SOLUTION MINING:</b>  <b>LESS THAN 30 HEALTH EFFECTS</b>



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EPA STAFF SITE VISIT

REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
216-B-5 REVERSE WELL DISPOSAL SYSTEM

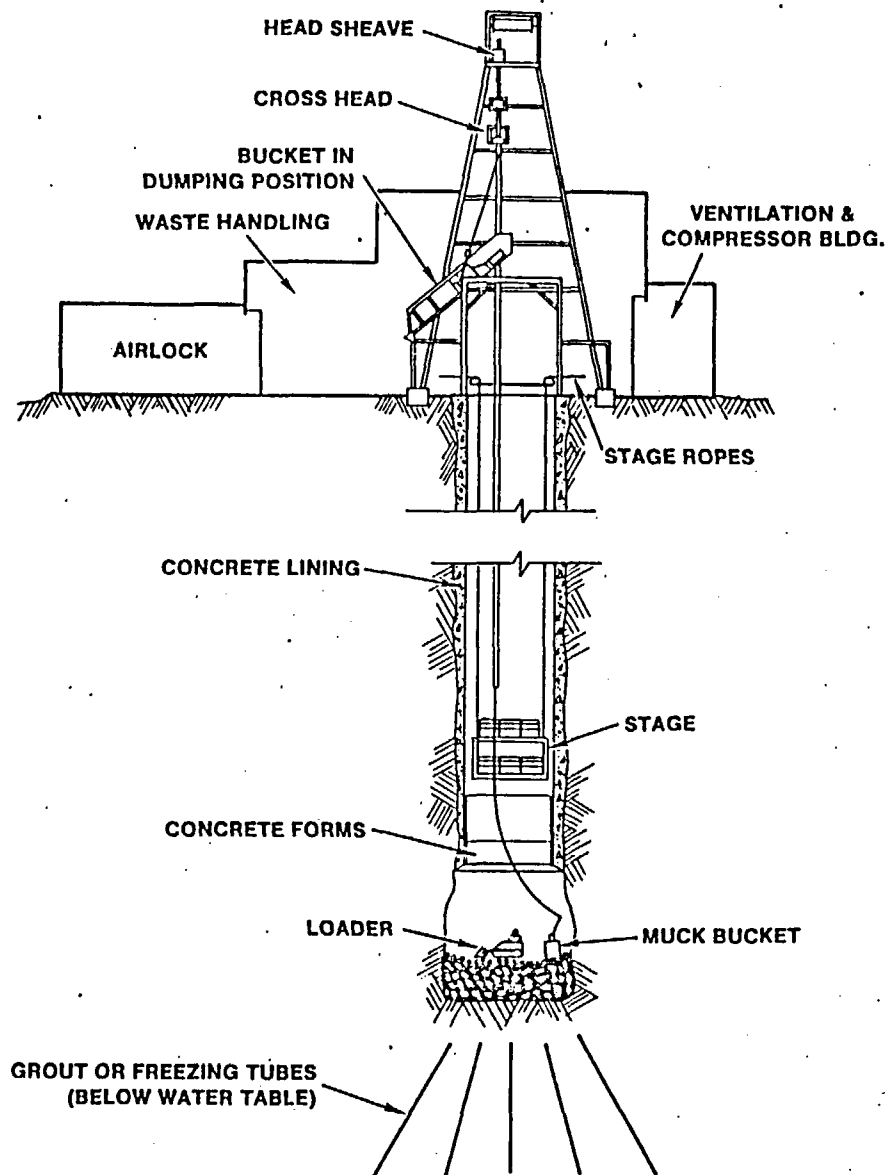




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EPA STAFF SITE VISIT

REFERENCE DISPOSAL PLAN  
AND ALTERNATIVES  
**SHAFT MINING OPERATION  
FOR DEEP REVERSE WELL**  
SIDE VIEW





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EPA STAFF SITE VISIT

REFERENCE DISPOSAL PLAN  
AND ALTERNATIVES

PROTOTYPE WASTE  
RETRIEVAL SYSTEM

STANDBY  
GENERATOR  
TRAILER

WASTE  
RETRIEVER

IN-TANK TV VIEWING &  
LIGHTING UNIT

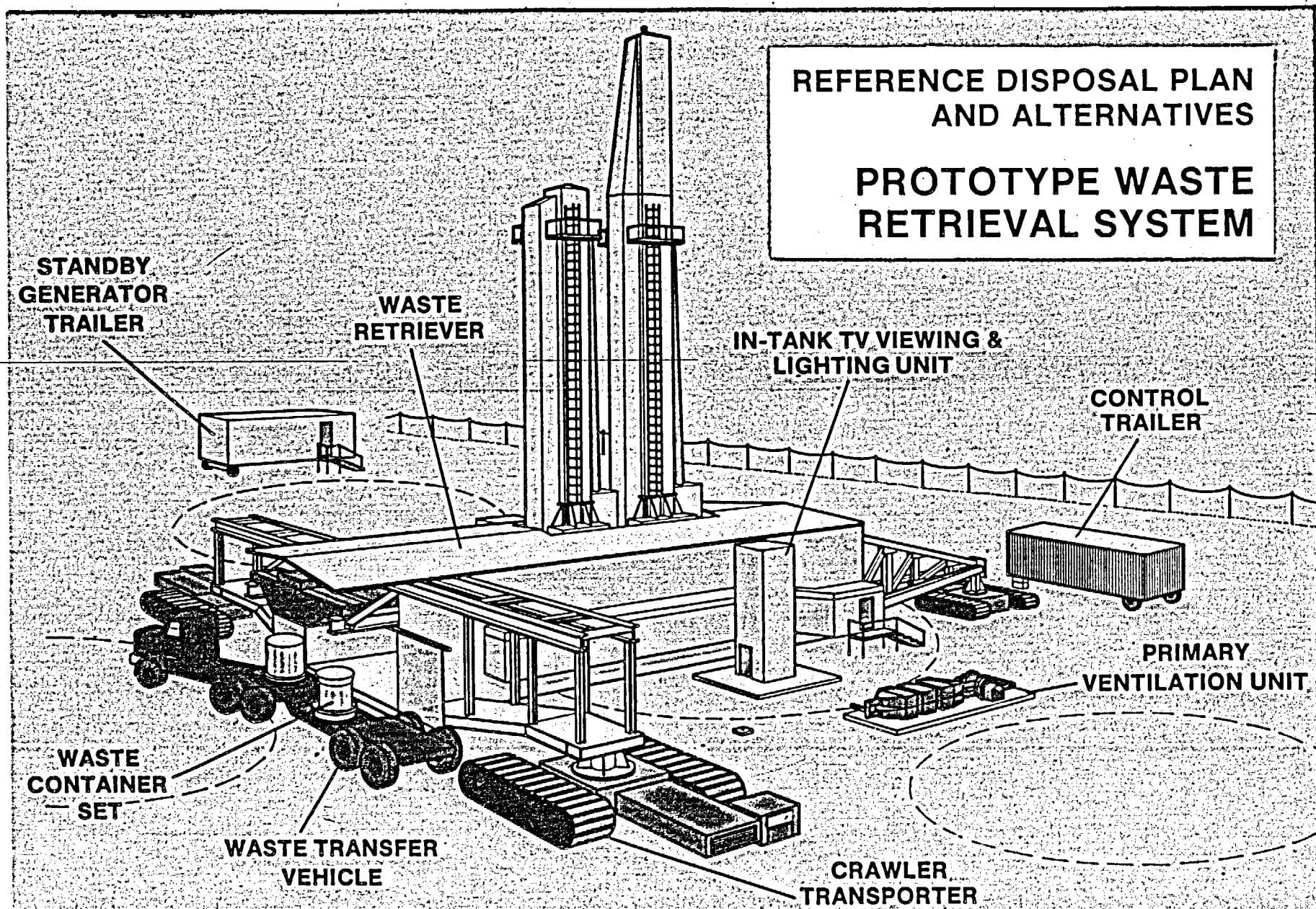
CONTROL  
TRAILER

PRIMARY  
VENTILATION UNIT

WASTE  
CONTAINER  
SET

WASTE TRANSFER  
VEHICLE

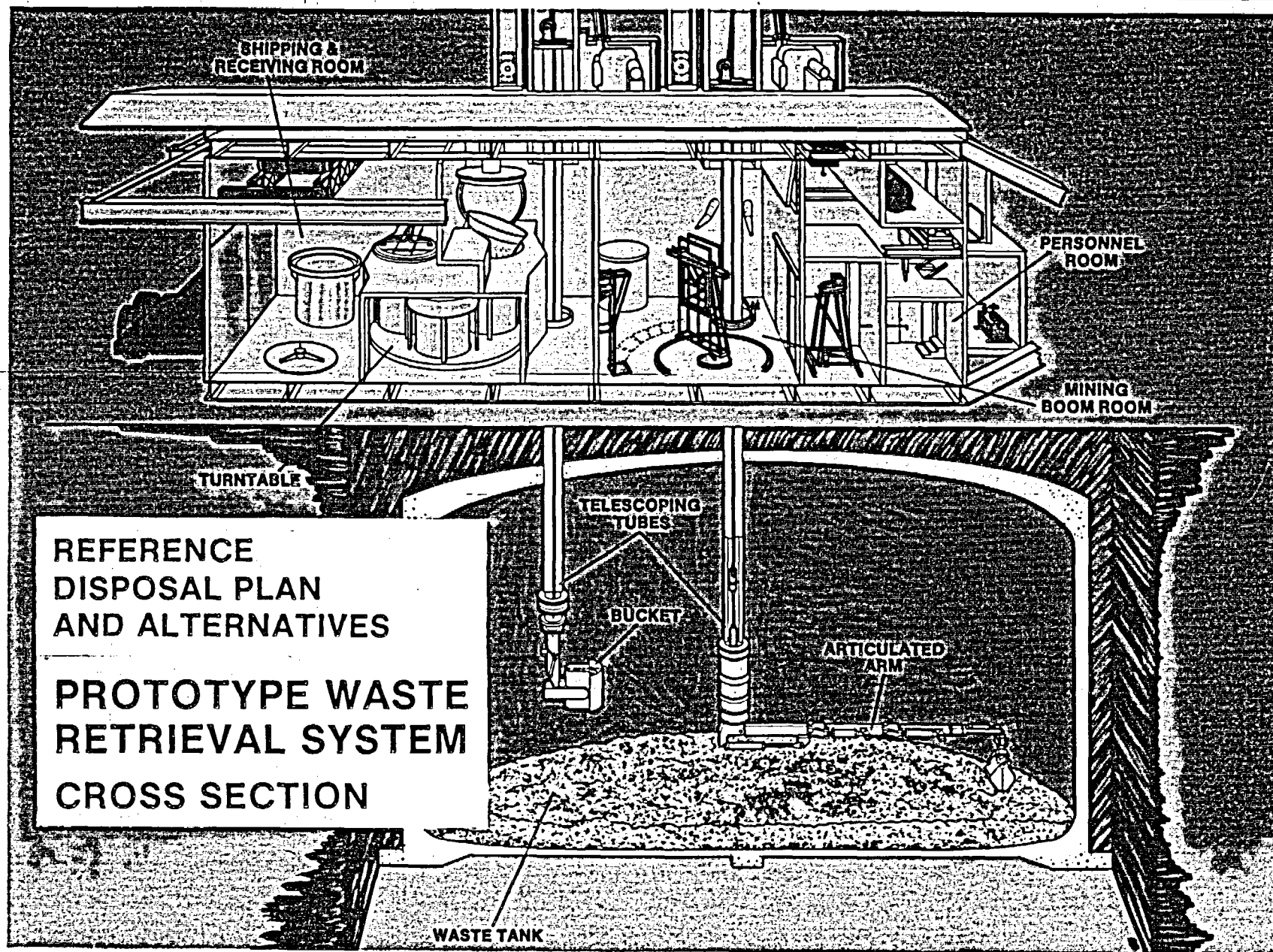
CRAWLER  
TRANSPORTER





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EPA STAFF SITE VISIT

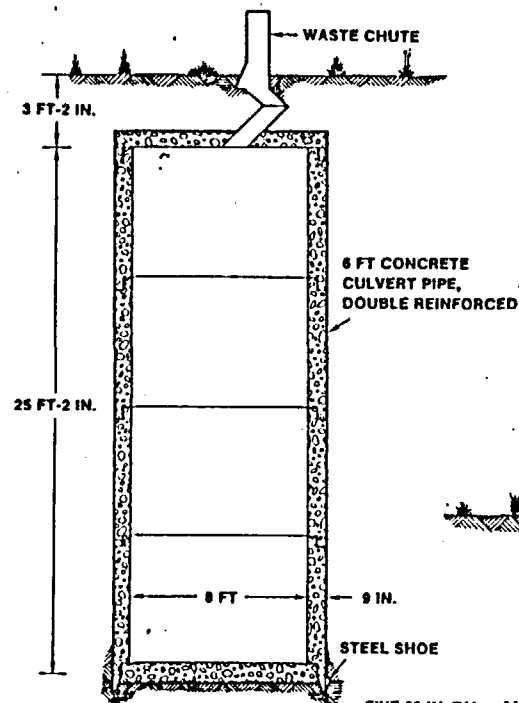




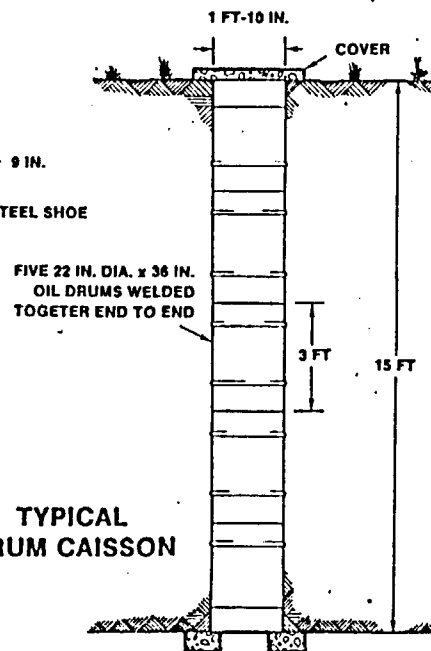
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HANFORD DEFENSE WASTE DISPOSAL PROGRAM

EPA STAFF SITE VISIT

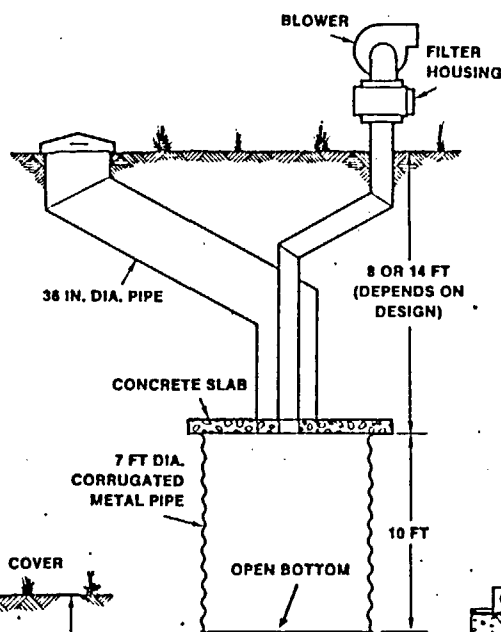
## CAISSON TYPES



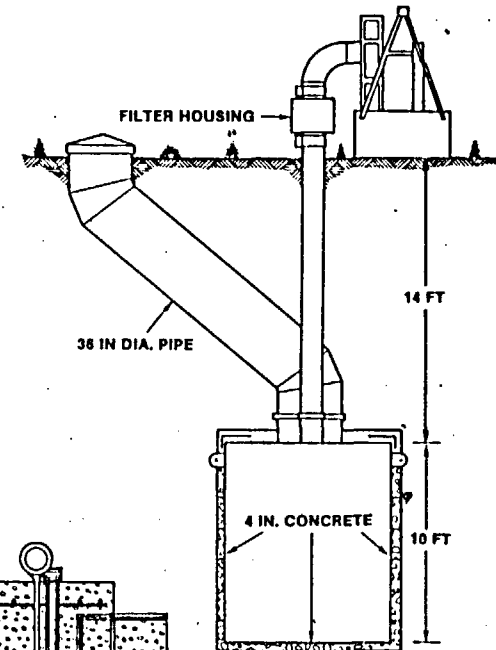
218-E-7 LAB  
WASTE VAULT  
(CONCRETE TYPE)



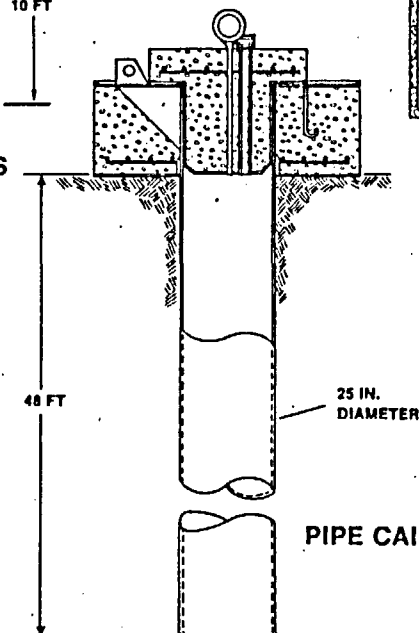
TYPICAL  
DRUM CAISSON



SOLID WASTE  
BURIAL CAISSONS  
(PRE-1970)



ALPHA CAISSON  
TRU STORAGE  
(POST 1970)



PIPE CAISSON

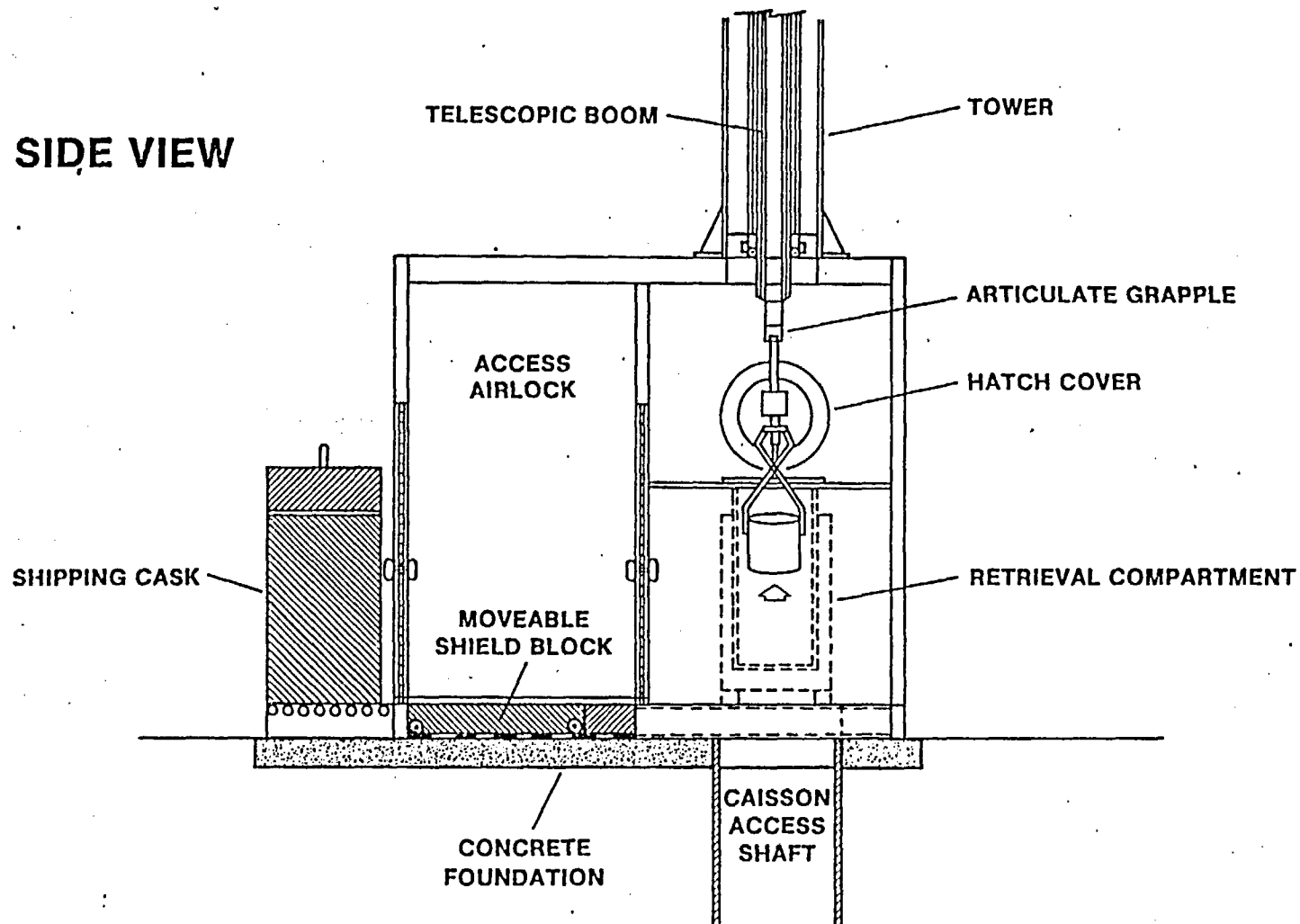


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EPA STAFF SITE VISIT

REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
**CAISSON RECOVERY BUILDING**

**SIDE VIEW**



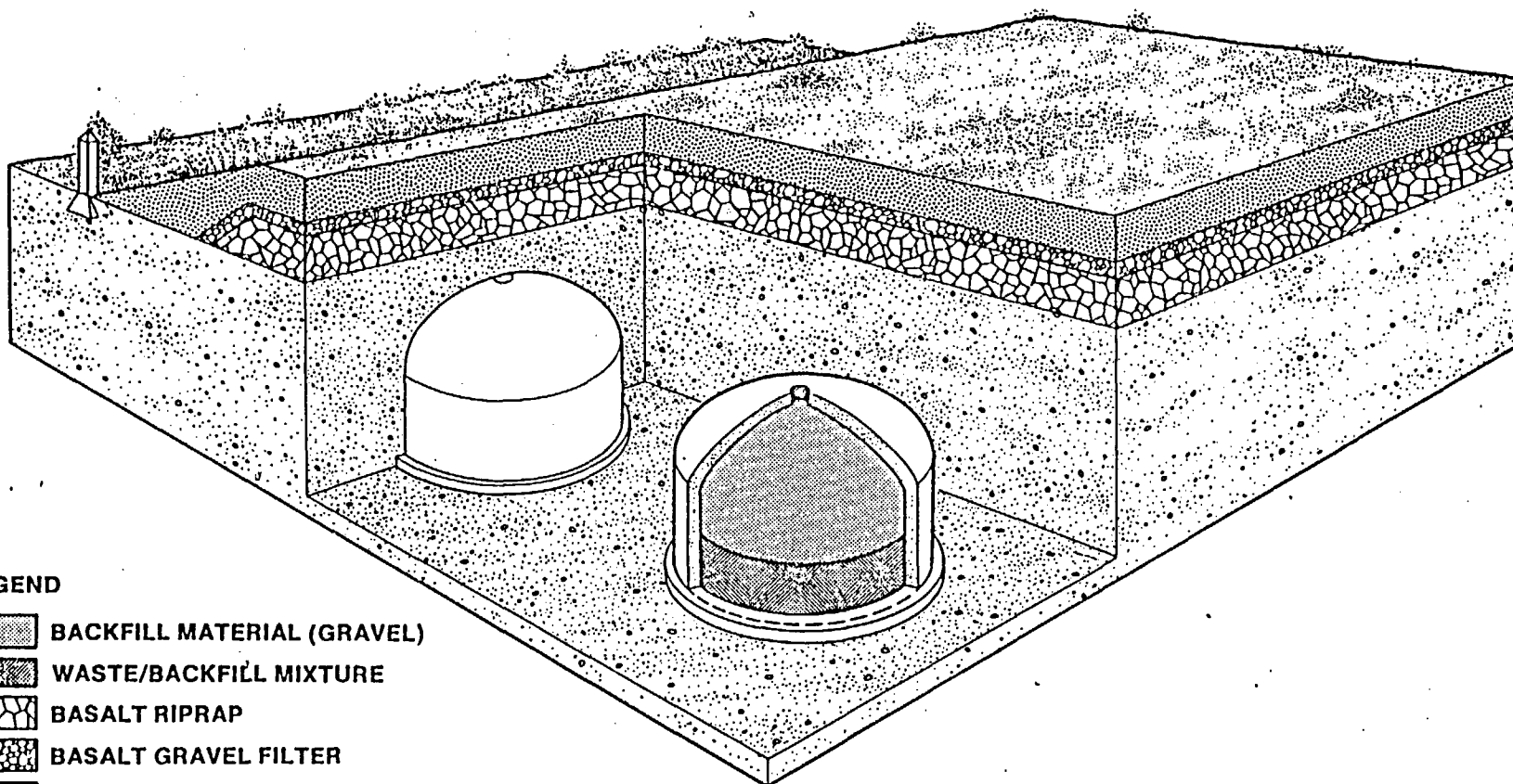




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EPA STAFF SITE VISIT

REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
IN-PLACE STABILIZATION OF HANFORD WASTE SITES  
SINGLE-SHELL TANKS



LEGEND

- BACKFILL MATERIAL (GRAVEL)
- WASTE/BACKFILL MIXTURE
- BASALT RIPRAP
- BASALT GRAVEL FILTER
- SOIL



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EPA STAFF SITE VISIT

REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
IN-PLACE STABILIZATION OF HANFORD WASTE SITES  
COST COMPARISONS\*  
SINGLE-SHELL TANKS

<u>ALTERNATIVE</u>	<u>TOTAL COSTS (10<sup>6</sup>)</u>
• IN-PLACE STABILIZATION (149 SINGLE-SHELL TANKS)	\$ 400
• MECHANICAL RECOVERY, PROCESSING AND ONSITE GEOLOGIC DISPOSAL	\$ 8,500

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TRANSURANIC WASTES

• IN-PLACE STABILIZATION	\$ 45
• RECOVERY, PROCESSING (PRE-1970) AND SHIPMENT TO REPOSITORY	\$ 600

\*ROUGH ORDER ESTIMATES

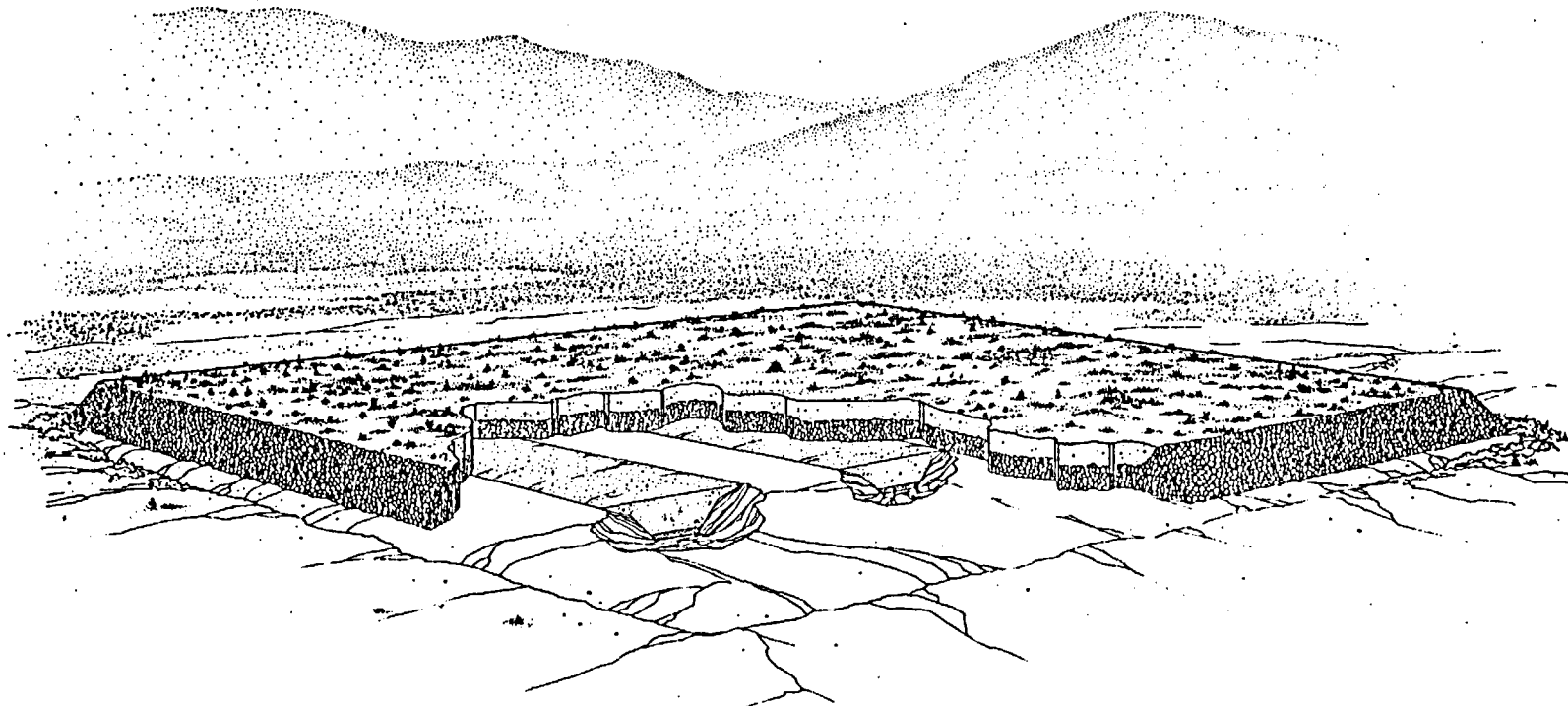


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HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

**REFERENCE DISPOSAL PLAN AND ALTERNATIVES**

**DISPOSAL BLOCK CONTAINING  
CRIBS AND TRENCHES**





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EPA STAFF SITE VISIT

REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
HANFORD WASTE SITES IN-PLACE STABILIZATION COST

TRU CONTAMINATED SOIL SITE (PRE-1970)  
EXAMPLE COST ANALYSIS FOR SPECIFIC SITE  
216-Z-12 CRIB

IN-PLACE STABILIZATION

INCLUDES:

- SITE PREPARATION
- SURFACE BARRIER
- SURFACE AND SUBSURFACE MARKERS
- MONITORING PROGRAM (5 YEARS)

TOTAL COSTS (10<sup>6</sup>)

\$1.8

RECOVERY

INCLUDES ONLY RECOVERY -  
DOES NOT INCLUDE  
PROCESSING, TRANSPORT  
OR WIPP DISPOSAL

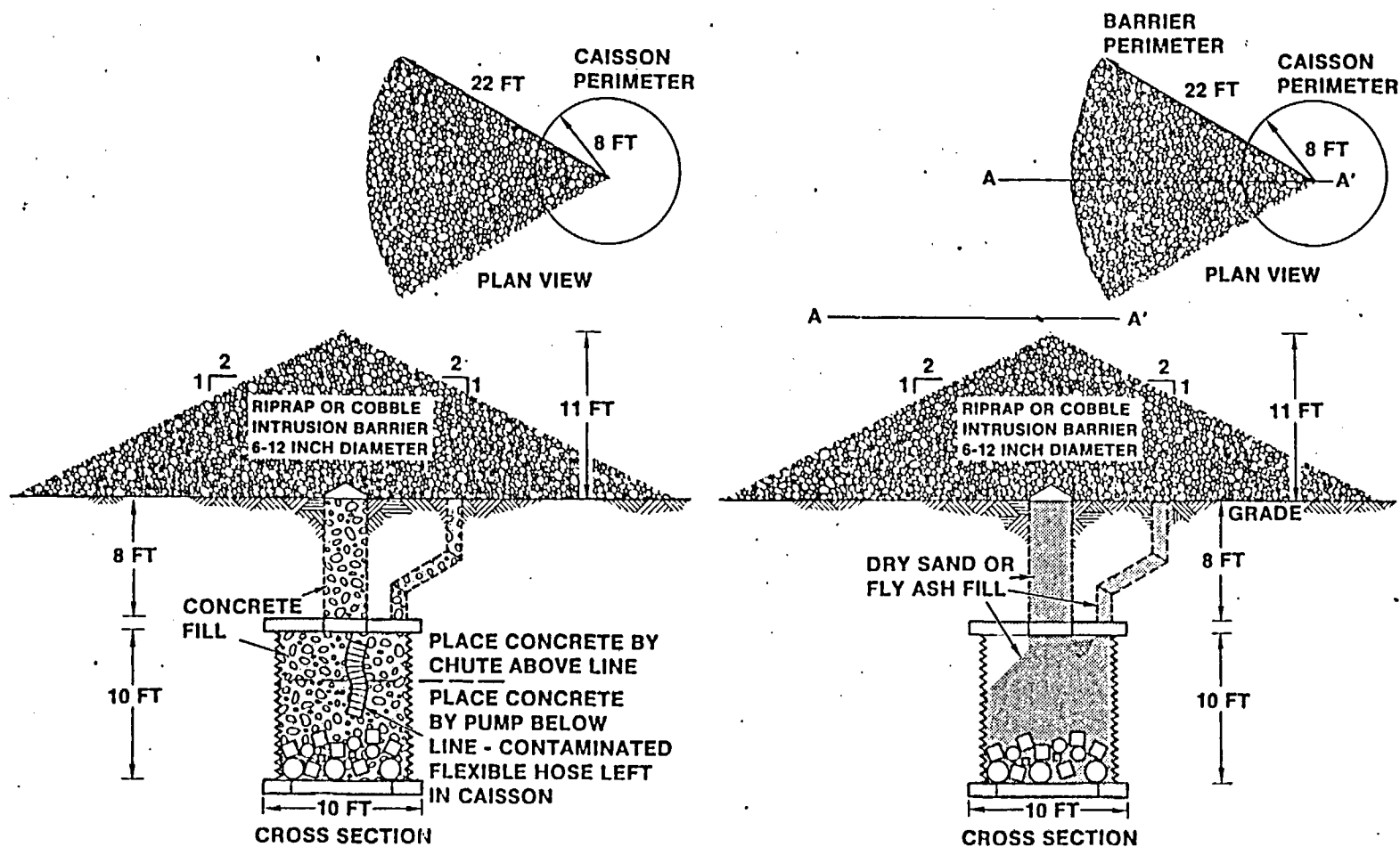
\$11.0



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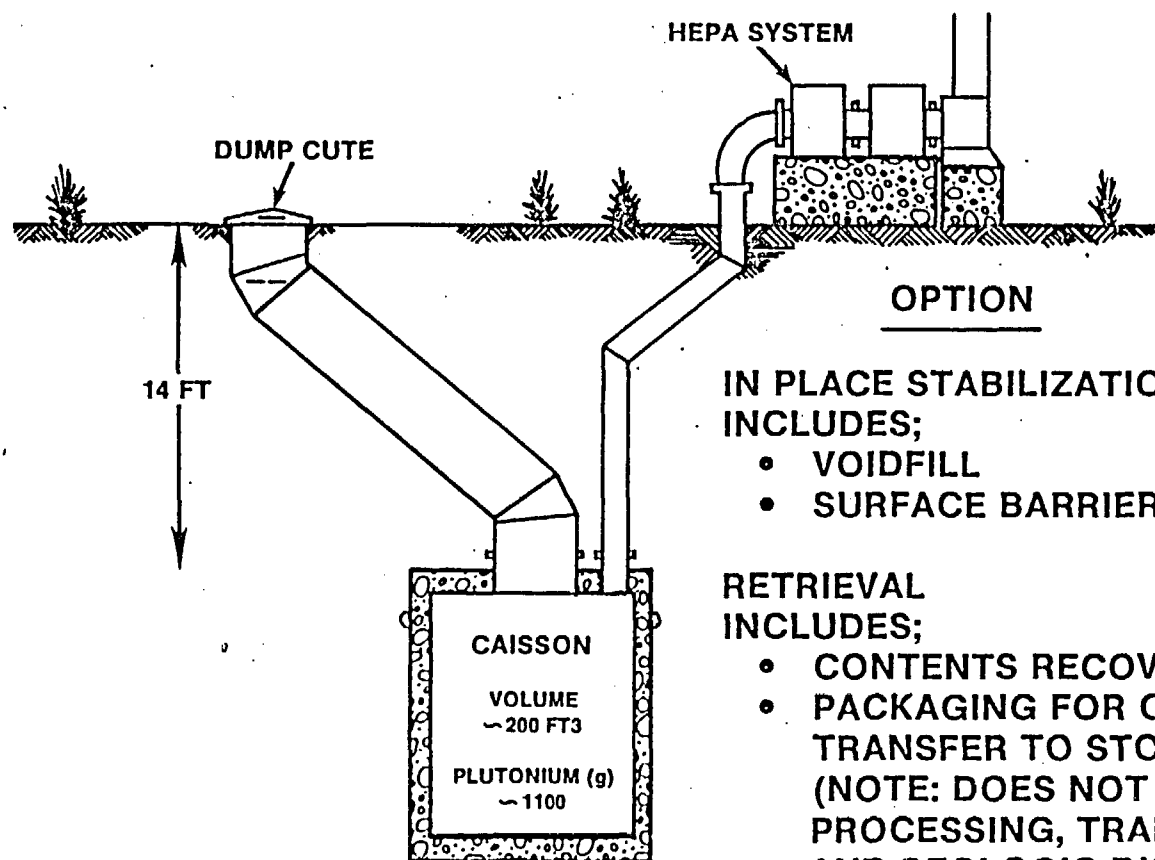
EPA STAFF SITE VISIT

REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
**TRU IN-PLACE STABILIZATION METHODS**





REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
**TRU CAISSON MANAGEMENT COSTS**



OPTION	COST (\$000)
IN PLACE STABILIZATION INCLUDES; <ul style="list-style-type: none"><li>• VOIDFILL</li><li>• SURFACE BARRIER</li></ul>	24-72
RETRIEVAL INCLUDES; <ul style="list-style-type: none"><li>• CONTENTS RECOVERY</li><li>• PACKAGING FOR ON-SITE TRANSFER TO STORAGE (NOTE: DOES NOT INCLUDE PROCESSING, TRANSPORT AND GEOLOGIC DISPOSAL</li></ul>	2500-6100



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**EPA STAFF SITE VISIT**

**REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
HANFORD WASTE MANAGEMENT STRATEGY**

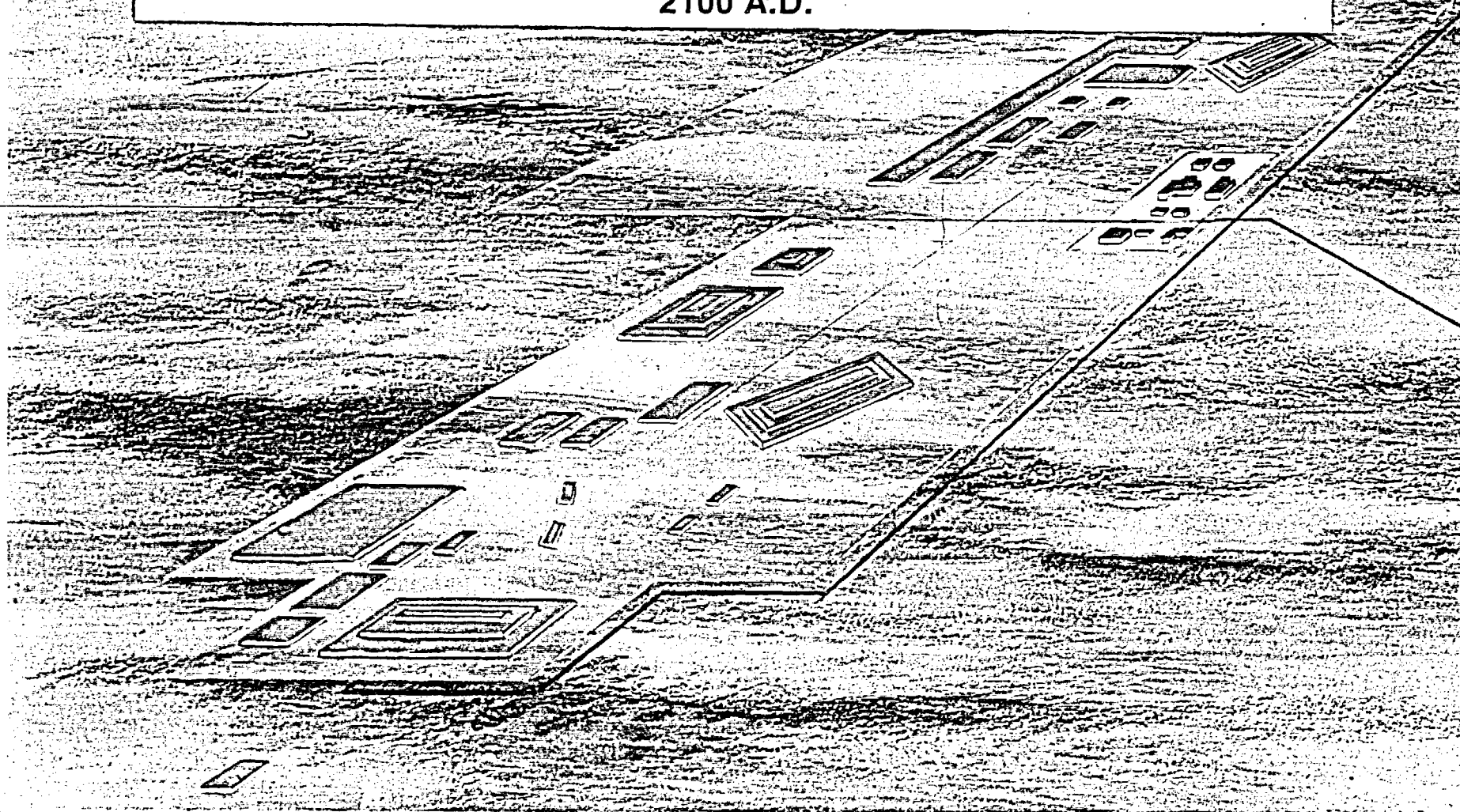
- **IN-PLACE STABILIZE AS MUCH EXISTING WASTE AS POSSIBLE IN A SAFE, COST-EFFECTIVE MANNER**
- **BREAK WITH PAST PRACTICES BY PREPARING FUTURE WASTES TO:**
  - **STOP PERPETUATION OF STORAGE MODES**
  - **MOVE TO MEET FINAL DISPOSAL REQUIREMENTS**
  - **MEET EMERGING REGULATORY CRITERIA**
  - **SATISFY PUBLIC CONCERNS**



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EPA STAFF SITE VISIT

REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
IN-PLACE STABILIZATION OF HANFORD WASTE SITES  
DISPOSED 200 WEST AREA  
2100 A.D.



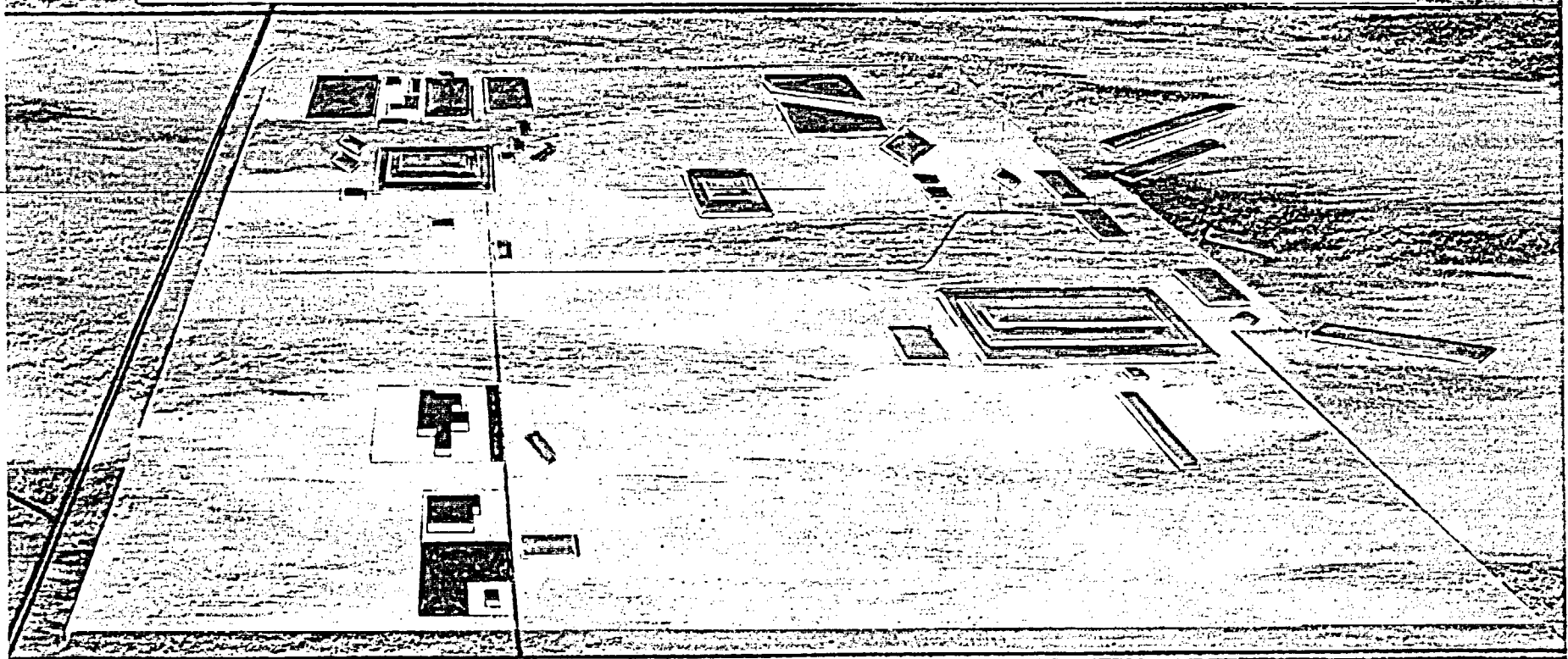




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EPA STAFF SITE VISIT

REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
IN-PLACE STABILIZATION OF HANFORD WASTE SITES  
DISPOSED 200 EAST AREA  
2100 A.D.

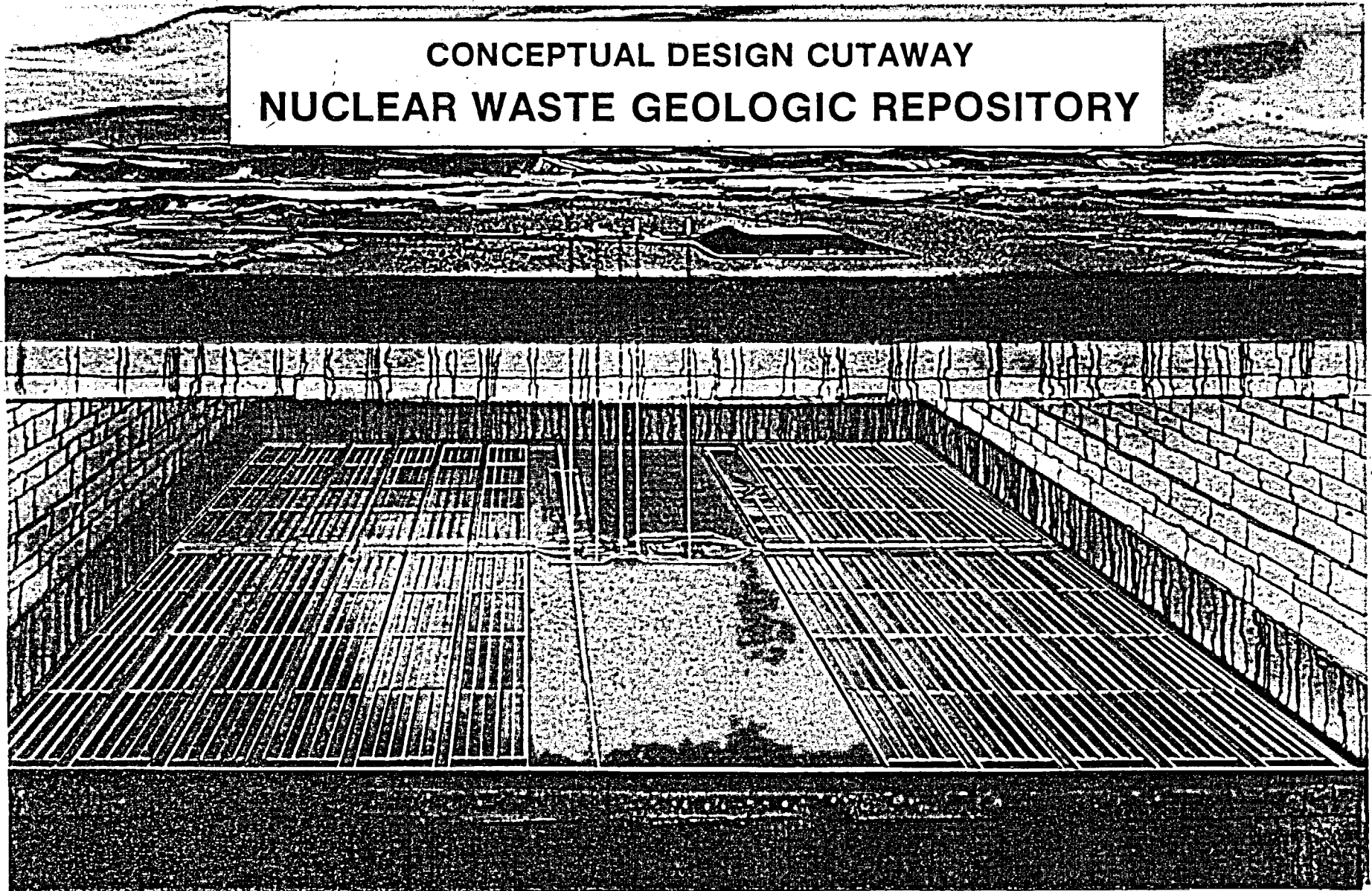




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EPA STAFF SITE VISIT

CONCEPTUAL DESIGN CUTAWAY  
NUCLEAR WASTE GEOLOGIC REPOSITORY

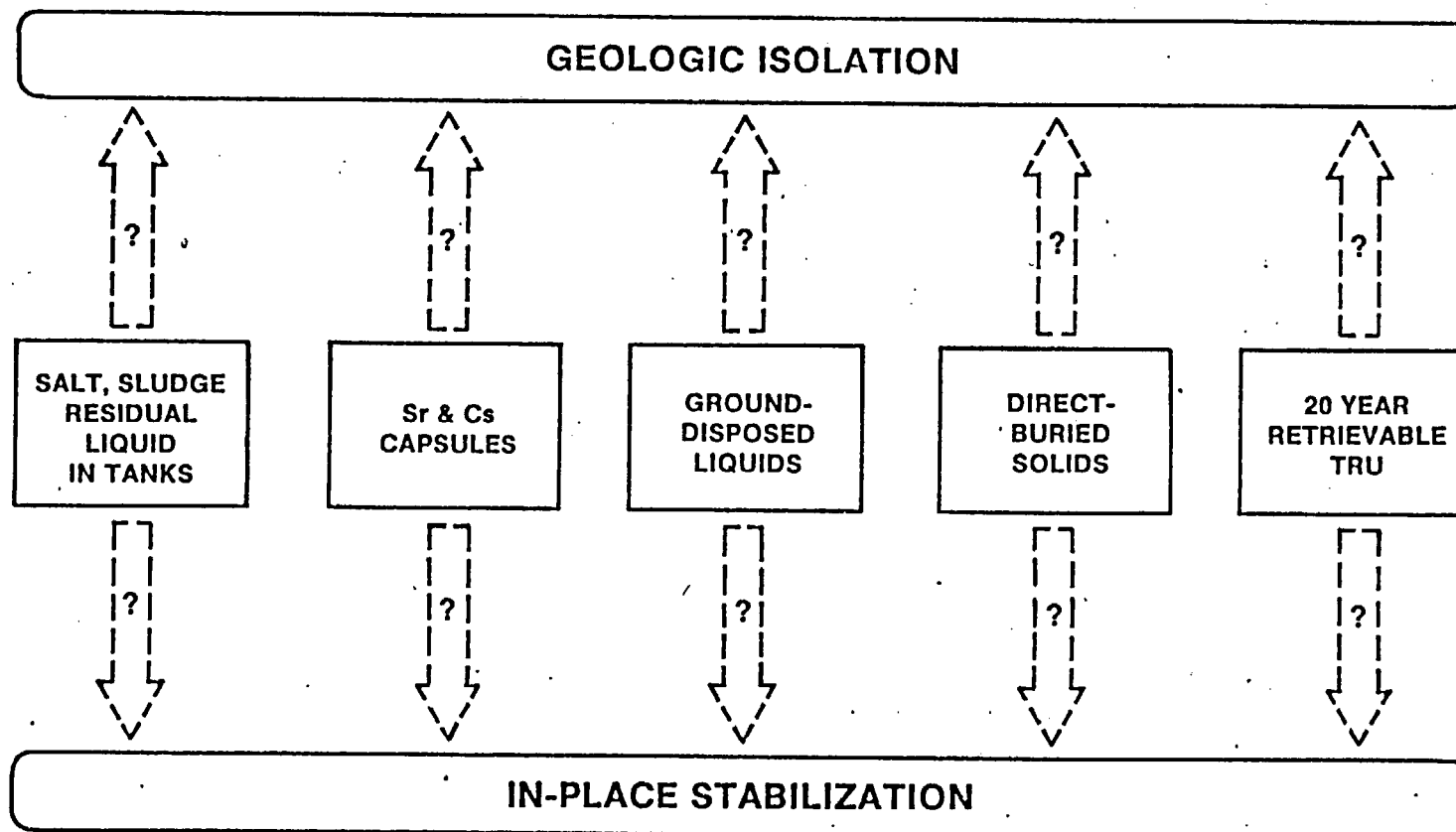




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EPA STAFF SITE VISIT

REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
EIS DECISIONS



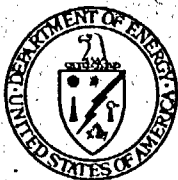


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**EPA STAFF SITE VISIT**

**REFERENCE DISPOSAL PLAN AND ALTERNATIVES  
HANFORD WASTE MANAGEMENT  
REFERENCE OPTION**

- **IN-PLACE STABILIZATION OF SINGLE-SHELL TANKS**
- **IN-PLACE STABILIZATION: PRE-1970 LIQUID AND SOLID DISPOSAL SITES**
- **SEND Cs & Sr CAPSULES TO REPOSITORY**
- **SEND PUREX WASTE TO IMMOBILIZATION FACILITY AND REPOSITORY**
- **RECOVER POST-1970 STORED TRU AND SEND TO A REPOSITORY**
- **SEND FUTURE TRU WASTES TO A REPOSITORY**
- **NON HIGH-LEVEL WASTES IN DOUBLE-SHELL TANKS WILL BE GROUTED FOR SHALLOW LAND BURIAL**
- **HIGH-LEVEL WASTE IN DOUBLE-SHELL TANKS WILL BE RETRIEVED, IMMOBILIZED AND SENT TO A REPOSITORY**



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HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

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STABILIZATION**

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**SECTION 6 - ISSUES AND CONCERNS**



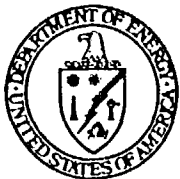
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HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

**APPLICATION OF PROPOSED 40 CFR 191  
TO IN-PLACE STABILIZATION**

**40 CFR 191 DOES NOT APPLY TO THE FOLLOWING  
HANFORD WASTE:**

- **DISPOSED WASTE**
- **DOUBLE-SHELL TANK WASTE BELOW TABLE I**
- **SINGLE-SHELL TANK WASTE BELOW TABLE I**



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**EPA STAFF SITE VISIT**

**APPLICATION OF PROPOSED 40 CFR 191  
TO IN-PLACE STABILIZATION**

**40 CFR 191 APPLIES (AS WRITTEN) TO THE FOLLOWING  
HANFORD WASTE:**

- **WASTE PLANNED FOR REPOSITORY DISPOSAL**
  - EXISTING DOUBLE-SHELL TANK WASTE ABOVE TABLE I
  - CESIUM AND STRONTIUM CAPSULES
  - STORED TRANSURANIC WASTE
  - FUTURE HIGH-LEVEL WASTE
  - FUTURE TRANSURANIC WASTE
- **WASTE PLANNED FOR IN-PLACE STABILIZATION**
  - SINGLE-SHELL TANK WASTE ABOVE TABLE I (UP TO 70 TANKS)



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HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

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**EPA STAFF SITE VISIT**

**HANFORD DEFENSE WASTE  
ENVIRONMENTAL IMPACT STATEMENT  
AND APPROACH  
TO PERFORMANCE ASSESSMENT**

- **OVERVIEW OF EIS**
- **APPROACH TO DISPOSAL PERFORMANCE ASSESSMENT**
- **BALANCING IMPACTS AMONG ALTERNATIVES**



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HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

**HANFORD DEFENSE WASTE EIS  
AND APPROACH TO PERFORMANCE ASSESSMENT**

**OVERVIEW OF EIS**

- **PURPOSE**
- **SCHEDULE**
- **SCOPE**
  - **WASTES**
  - **ALTERNATIVES**
  - **ENVIRONMENTAL ISSUES**



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HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

**HANFORD DEFENSE WASTE EIS  
AND APPROACH TO PERFORMANCE ASSESSMENT**

**PURPOSE**

**TO PROVIDE ENVIRONMENTAL INPUT INTO THE DECISION  
PROCESS FOR DISPOSAL OF CERTAIN RADIOACTIVE  
DEFENSE WASTES AT HANFORD**



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**EPA STAFF SITE VISIT**

**HANFORD DEFENSE WASTE EIS  
AND APPROACH TO PERFORMANCE ASSESSMENT**

**SCHEDULE**

<b>NOI PUBLISHED</b>	<b>APRIL 1, 1983</b>
<b>COMMENT PERIOD ON NOI ENDS</b>	<b>MAY 1, 1983</b>
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<b>ISSUE DEIS TO PUBLIC</b>	<b>NOVEMBER 30, 1984</b>
<b>ISSUE FEIS TO PUBLIC</b>	<b>AUGUST 1, 1985</b>
<b>RECORD OF DECISION</b>	<b>SEPTEMBER 15, 1985</b>



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**RESULTS FROM PUBLICATION OF NOI**

- **18 PUBLIC COMMENT LETTERS RECEIVED BY CLOSE OF COMMENT PERIOD, MAY 2, 1983**
- **COMMENTS RANGED FROM REQUESTS FOR ADDITIONAL INFORMATION THROUGH THOSE EMOTIONALLY CRITICAL TO THOSE CONSTRUCTIVE**



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**SCOPE OF WASTES INCLUDED**

- **TANK WASTE**
- **Sr AND Cs CAPSULES**
- **PRE-1970 TRU SOLID WASTE BURIAL GROUNDS**
- **STORED TRU SOLID WASTES**
- **TRU CONTAMINATED SOIL SITES**
- **NEW WASTE**



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**NEW WASTE**

**HIGH-LEVEL WASTE TO BE GENERATED THROUGH 1996  
FROM PROCESSING N REACTOR FUEL (ACTUAL PLUS 10%  
CONTINGENCY). SHIPPINGPORT FUEL AND FFTF  
CORES I-IV**



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WASTES NOT COVERED BY THIS EIS**

- **LOW-LEVEL WASTE DISPOSAL (COVERED BY ERDA-1538)**
- **DECONTAMINATION AND DECOMMISSIONING OF  
SHUTDOWN NUCLEAR FACILITIES (WILL BE COVERED  
SEPARATELY)**





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**SCOPE OF ALTERNATIVES**

- **REPOSITORY DISPOSAL**
- **IN-PLACE DISPOSAL**
- **NO DISPOSAL ACTION (CONTINUE STORAGE)**
- **REFERENCE ALTERNATIVE (COMBINATION DISPOSAL)**



**HANFORD DEFENSE WASTE EIS  
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**REPOSITORY DISPOSAL**

- **RETRIEVE, PROCESS, PACKAGE, TRANSPORT AND  
EMPLACE WASTES IN DEEP GEOLOGIC REPOSITORIES  
(ON OR OFF-SITE, DEDICATED OR COMINGLED WITH  
COMMERCIAL)**



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**IN-PLACE STABILIZATION WITH  
ENGINEERED BARRIERS DISPOSAL ALTERNATIVES**

• **DESIGN CONCEPTS:**

- **DISPOSE WASTES IN-PLACE WITH ENGINEERED BARRIERS  
DESIGNED TO PRECLUDE RESUSPENSION/INHALATION AND  
DEEP-ROOT-CROP EXPOSURE PATHWAYS TO MAN AND TO  
PRECLUDE FARMING, DWELLING OR OTHER USES BY MAN  
OF AREAS OVER OR NEAR WASTE DISPOSAL SITE**



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**HANFORD DEFENSE WASTE EIS  
AND APPROACH TO PERFORMANCE ASSESSMENT  
BASIS FOR CONSIDERATION OF IN-PLACE  
STABILIZATION OF CERTAIN DEFENSE WASTES ON THE  
200 AREA PLATEAU OF THE HANFORD SITE**

- PAST DISCHARGES OF PLUTONIUM TO THE GROUNDWATER HAVE NOT RESULTED IN RADIOLOGICAL CONSEQUENCES (Section 4)
- PREVIOUS TANK LEAKS HAVE NOT RESULTED IN RADIONUCLIDE MOVEMENT TO THE BIOSPHERE (Section 4)
- PRELIMINARY RADIOLOGICAL CONSEQUENCE MODELING, EVEN USING CONSERVATIVE ASSUMPTIONS, HAS NOT TO DATE DISCLOSED A POTENTIAL FOR SIGNIFICANT RADIOLOGICAL CONSEQUENCES (Section 4)
- CONSIDERATION OF THE SITE SPECIFIC CHARACTERISTICS (GEOLOGICAL, SEISMIC, HYDROLOGICAL, CLIMATOLOGICAL, ETC.) OF THE HANFORD 200 AREA PLATEAU INDICATES A LACK OF RADIONUCLIDE TRANSPORT.
- CONSIDERATION OF REASONABLY POSTULATED NATURAL EVENTS (WIND EROSION, FLOODING, SEISMIC ACTIVITY, ETC.) THAT COULD IMPACT IN-PLACE STABILIZED WASTE SITES INDICATES THAT THE IMPACTS MAY BE INSIGNIFICANT OR NONEXISTENT
- CONSIDERATION OF REASONABLY POSTULATED MAN-INDUCED EVENTS THAT COULD IMPACT IN-PLACE STABILIZED WASTE SITES SEEMS TO INDICATE SMALL RADIOLOGICAL CONSEQUENCES



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**NO DISPOSAL ACTION**

- **CONTINUE TO MANAGE WASTES**
- **REMOVE INTERSTITIAL TANK LIQUID TO  $\sim$  50,000 GAL.**
- **FILL TANKS WITH SUITABLE MATERIAL AS NEEDED TO PRECLUDE DOME COLLAPSE**
- **PROVIDE NEAR SURFACE CAISSONS FOR DRY STORAGE OF Sr AND Cs CAPSULES**
- **MONITOR AND MAINTAIN WASTE SITES FOR 300 YEARS - FOLLOWED BY NO CONTROLS IN PERIOD 300 - 10,000 YEARS**



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**REFERENCE ALTERNATIVE**

- **REPOSITORY DISPOSAL**
  - TREATED AND IMMOBILIZED DOUBLE-SHELL TANK HIGH-LEVEL WASTE
  - STORED TRU SOLID WASTES (ASSUMING AVAILABILITY OF WIPP)
  - DIRECT NEUTRALIZED WASTE (1984 - 1990 PROCESSING)
  - GLASSIFIED PUREX ACID WASTE AFTER 1990
  - Sr AND Cs CAPSULES
- **DISPOSE IN PLACE WITH ENGINEERED BARRIERS**
  - SINGLE-SHELL TANK WASTE
  - TRU CONTAMINATED SOIL SITES
  - PRE-1970 TRU SOLID WASTE BURIAL GROUNDS



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**ENVIRONMENTAL ANALYSIS FOR A GIVEN  
WASTE CATEGORY AND DISPOSAL ALTERNATIVE**

- **DETERMINE IMPACTS RELATED TO:**
  - **DISPOSAL FACILITY CONSTRUCTION**
  - **PLANNED WASTE RETRIEVAL AND/OR DISPOSAL OPERATIONS**
  - **TRANSPORTATION**
  - **POSTULATED ACCIDENTS**

**(REPEATED FOR EACH WASTE CLASS AND DISPOSAL  
ALTERNATIVE - SUMMED BY DISPOSAL ALTERNATIVE)**



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**SCOPE OF ENVIRONMENTAL ANALYSIS**

WASTE TYPES \ ALTERNATIVES	REPOSITORY DISPOSAL	IN SITU STABILIZATION	CONTINUED STORAGE
• TANK WASTE (INCLUDES NEW WASTE)			
SST			
DST			
• CAPSULES			
• TRU CONTAMINATED SOIL SITES			
• PRE-1970 TRU SOLID WASTE BURIAL GROUNDS			
• RETRIEVABLE STORED TRU			

REFERENCE DISPOSAL







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**SCOPE OF ENVIRONMENTAL ISSUES**

- **RADIOLOGICAL IMPACTS**
  - **WORKERS DURING DISPOSAL (OPERATIONAL) PERIOD**
  - **PUBLIC DURING DISPOSAL PERIOD**
    - **WITHIN 50 MILES OF SITE**
    - **DOWN STREAM COLUMBIA RIVER TO OCEAN**
  - **PUBLIC DURING POST DISPOSAL PERIOD**



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**SCOPE OF ENVIRONMENTAL ISSUES (CONT)**

- **ECOLOGICAL IMPACTS OF CONSTRUCTION AND OPERATION**
- **SOCIOECONOMIC (INCLUDING CULTURAL) IMPACTS**
- **RESOURCE COMMITMENTS (MANPOWER, ENERGY RESOURCES, MATERIALS)**



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**SCOPE OF ENVIRONMENTAL ISSUES (CONT)**

- **POTENTIAL IMPACTS ASSOCIATED WITH:**
  - **CHEMICAL HAZARDS OF WASTE**
  - **TRANSPORTATION**



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**RADIOLOGICAL AND NON-RADIOLOGICAL IMPACTS  
RELATED TO POSTULATED ACCIDENTS AND OTHER  
UNPLANNED EVENTS**

- **DISPOSAL OPERATIONS**
  - CONSTRUCTION
  - OPERATIONS
  - TRANSPORTATION
- **POST-DISPOSAL SYSTEM PERFORMANCE**



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**EXAMPLES OF DISPOSAL OPERATIONS ACCIDENTS  
TO BE CONSIDERED**

- INADVERTENT EXHUMATION
- HIGH-LEVEL WASTE TANK BUMPED
- PROCESS MISHAP DURING PACKAGING
- TRUCK OR RAIL ACCIDENTS
- CANISTER OR DRUM DROP (REPOSITORY SHAFT)
- CAPSULE RUPTURE DURING TRANSFER
- PIPE BREAKS
- SPILLS AND LEAKS



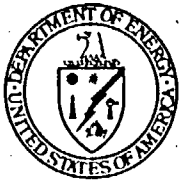
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**SCOPE OF POST-CLOSURE EVENTS CONSIDERED  
FOR PERFORMANCE ASSESSMENT**

- WIND EROSION
- FLOODING
- METEORITE IMPACT
- DOMESTIC WELL DRILLING
- DAM CONSTRUCTION
- VOLCANISM
- EARTHQUAKES
- CLIMATE CHANGE
- CRITICALITY
- DRILLING
- EXCAVATION
- AIRPLANE CRASHES



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**APPROACH TO DISPOSAL SYSTEM  
PERFORMANCE ASSESSMENT**

**"PERFORMANCE ASSESSMENT" (40 CFR 191) AN ANALYSIS  
WHICH IDENTIFIES EVENTS AND PROCESSES WHICH  
MIGHT AFFECT THE DISPOSAL SYSTEM, EXAMINES THEIR  
EFFECTS UPON ITS BARRIERS AND ESTIMATES THE  
PROBABILITIES AND CONSEQUENCES OF THE EVENTS**



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**APPROACH TO PERFORMANCE ASSESSMENT**

- **DISPOSAL IN A DEEP GEOLOGIC REPOSITORY**
  - WILL MEET ALL APPLICABLE CRITERIA AND STANDARDS FOR NRC LICENSING OF REPOSITORY
- **DISPOSAL AT HANFORD BY IN-PLACE STABILIZATION WITH ENGINEERED BARRIERS**





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**HANFORD DEFENSE WASTE EIS  
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**IN-PLACE STABILIZATION AT HANFORD - WHAT IS IT?**

- **LEAVE THE WASTE IN PLACE**
- **STABILIZE THE WASTE**
  - **IF WASTE IS ALREADY ADEQUATELY STABILIZED, THEN TAKE NO ADDITIONAL ACTION**
  - **IF ADDITIONAL ACTION REQUIRED, DRY TO NEAR SOLID FORM, OR**
  - **GROUT, OR**
  - **MIX WITH STABILIZING CHEMICALS, OR**
  - **GLASSIFY IN PLACE (IN-SITU VITRIFICATION), OR OTHERS**
- **THEN**
  - **COVER WITH SUBSTANTIAL ENGINEERED BARRIERS, MONUMENT AND RECORD**



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**HANFORD WASTE FOR WHICH DISPOSAL  
WITH IN-PLACE STABILIZATION AND ENGINEERED  
BARRIERS IS CONSIDERED IN THIS PRESENTATION**

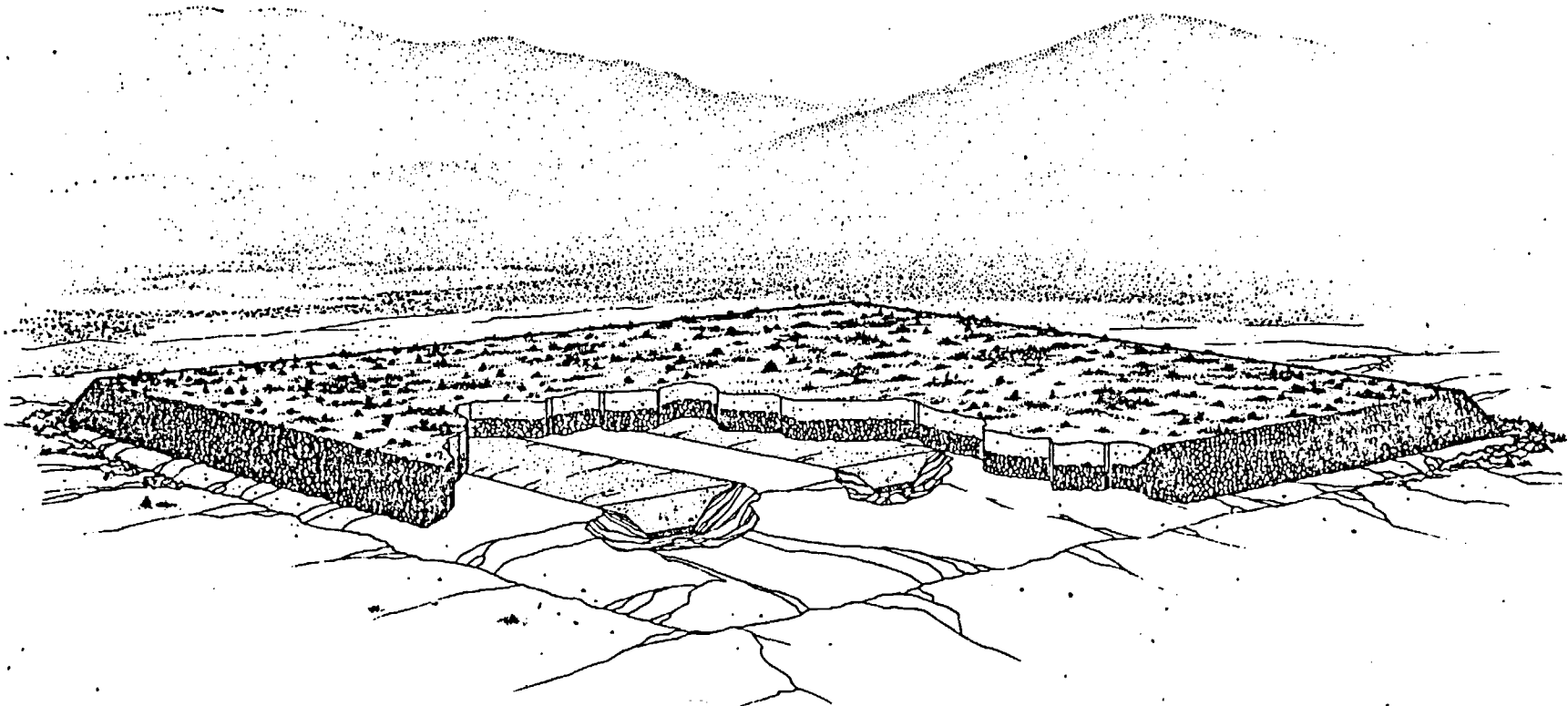
- **SINGLE-SHELL TANK WASTE**
- **TRU CONTAMINATED SOIL SITES**
- **PRE 1970 WASTE BURIAL GROUNDS**



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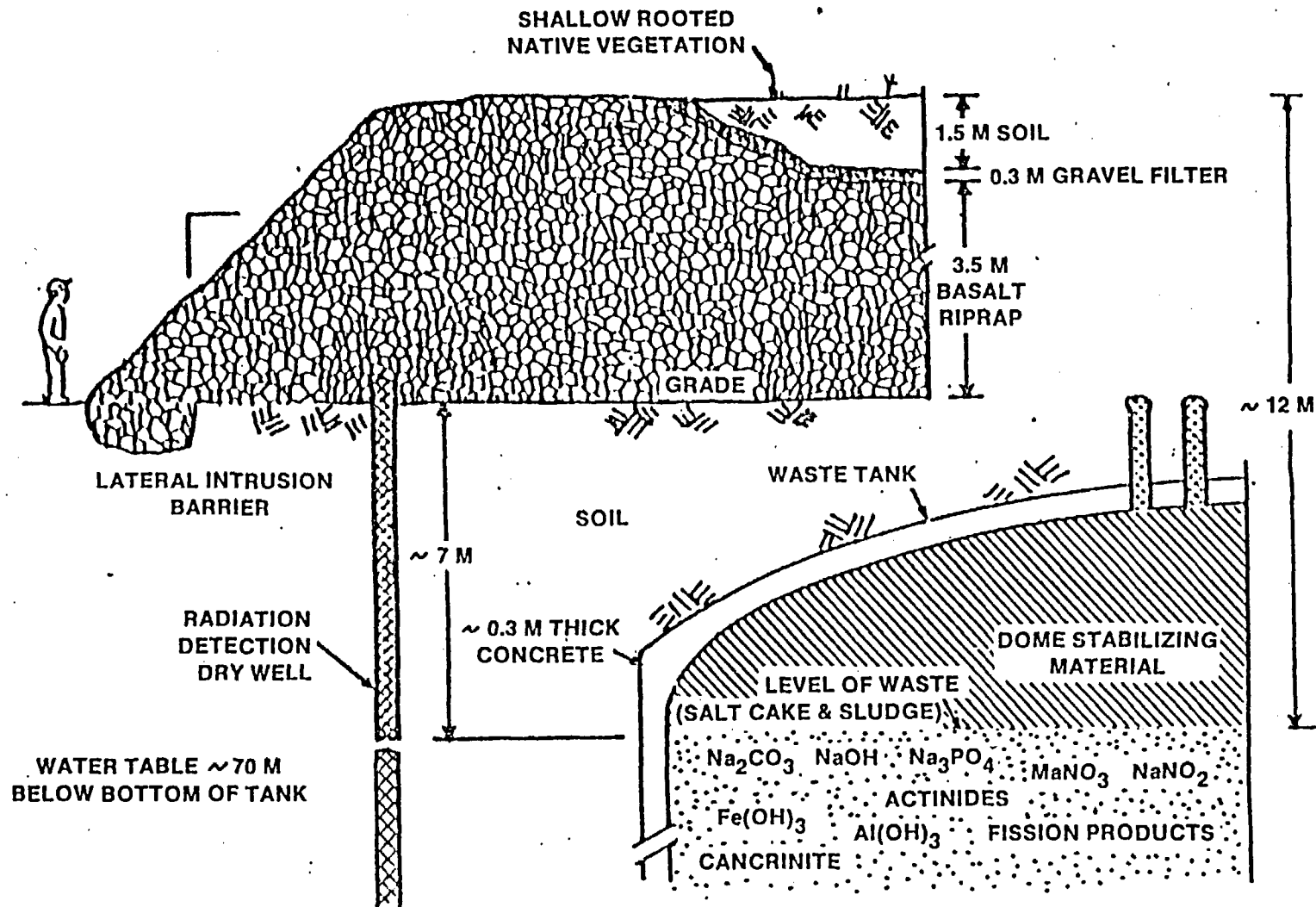
**HANFORD DEFENSE WASTE EIS  
AND APPROACH TO PERFORMANCE ASSESSMENT  
ENGINEERED BARRIER OVER IN-PLACE STABILIZED  
TRU CONTAMINATED SOIL SITES  
AND TRU BURIAL GROUNDS**





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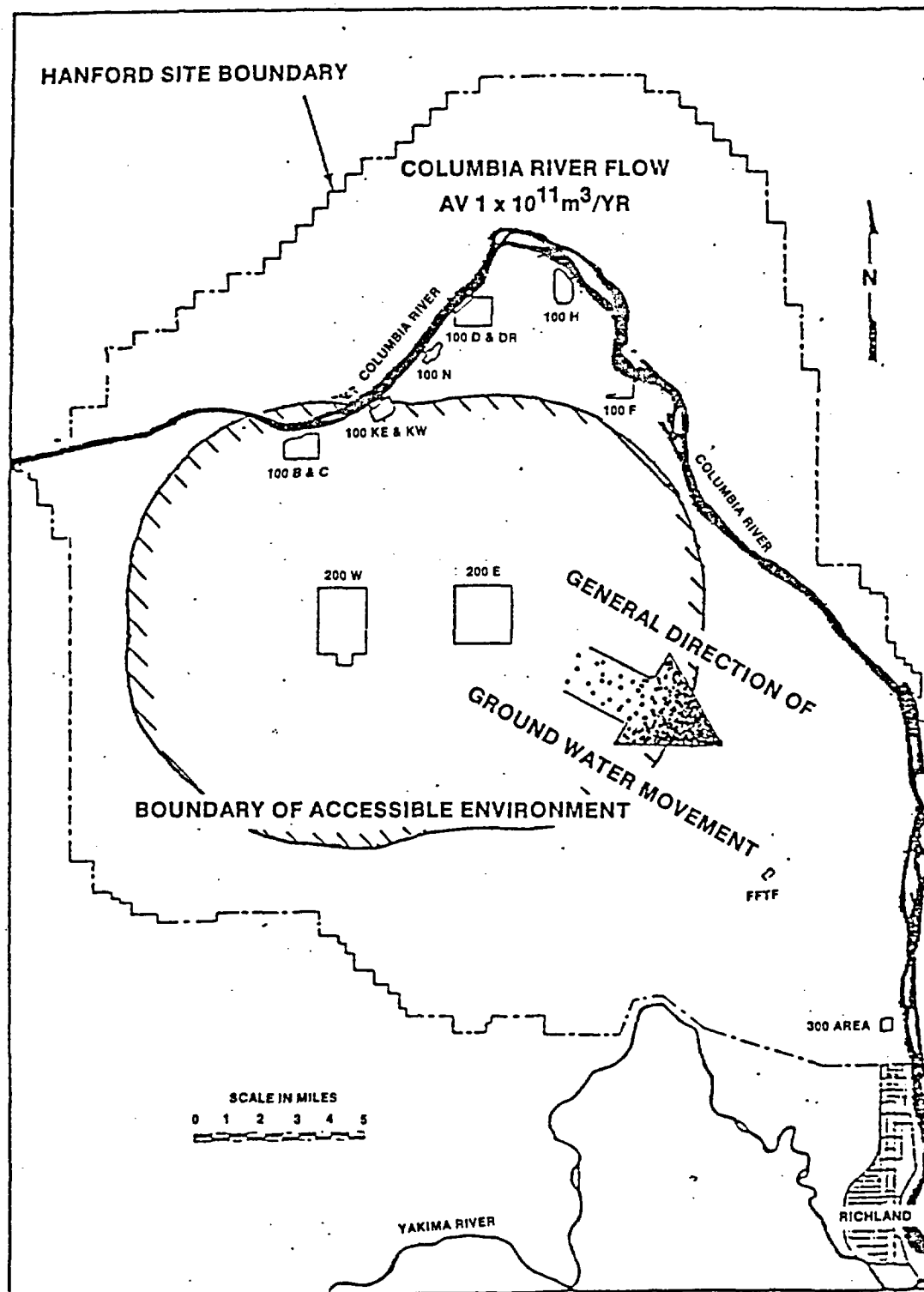


DETAILS OF AN EXAMPLE ENGINEERED BARRIER  
OVER IN PLACE STABILIZED TANK WASTE

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ACCESSIBLE ENVIRONMENT 200 E & W



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**POSTULATED EVENTS THAT MIGHT AFFECT THE  
PERFORMANCE OF THE IN-PLACE STABILIZATION  
DISPOSAL SYSTEM**

- **WIND EROSION**
- **FLOODS**
- **CLIMATE CHANGE/IRRIGATION**
- **ICE AGE**
- **METEORITES**
- **VOLCANISM**
- **EARTHQUAKES**



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**EVENT: REMOVAL OF WASTE BY WIND EROSION**

**EXPECTATION: WITH RIPRAP AND ROCK ARMORING, HIGHLY  
IMPROBABLE, IF NOT IMPOSSIBLE**



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**EVENT: REMOVAL OF WASTES BY FLOODING**

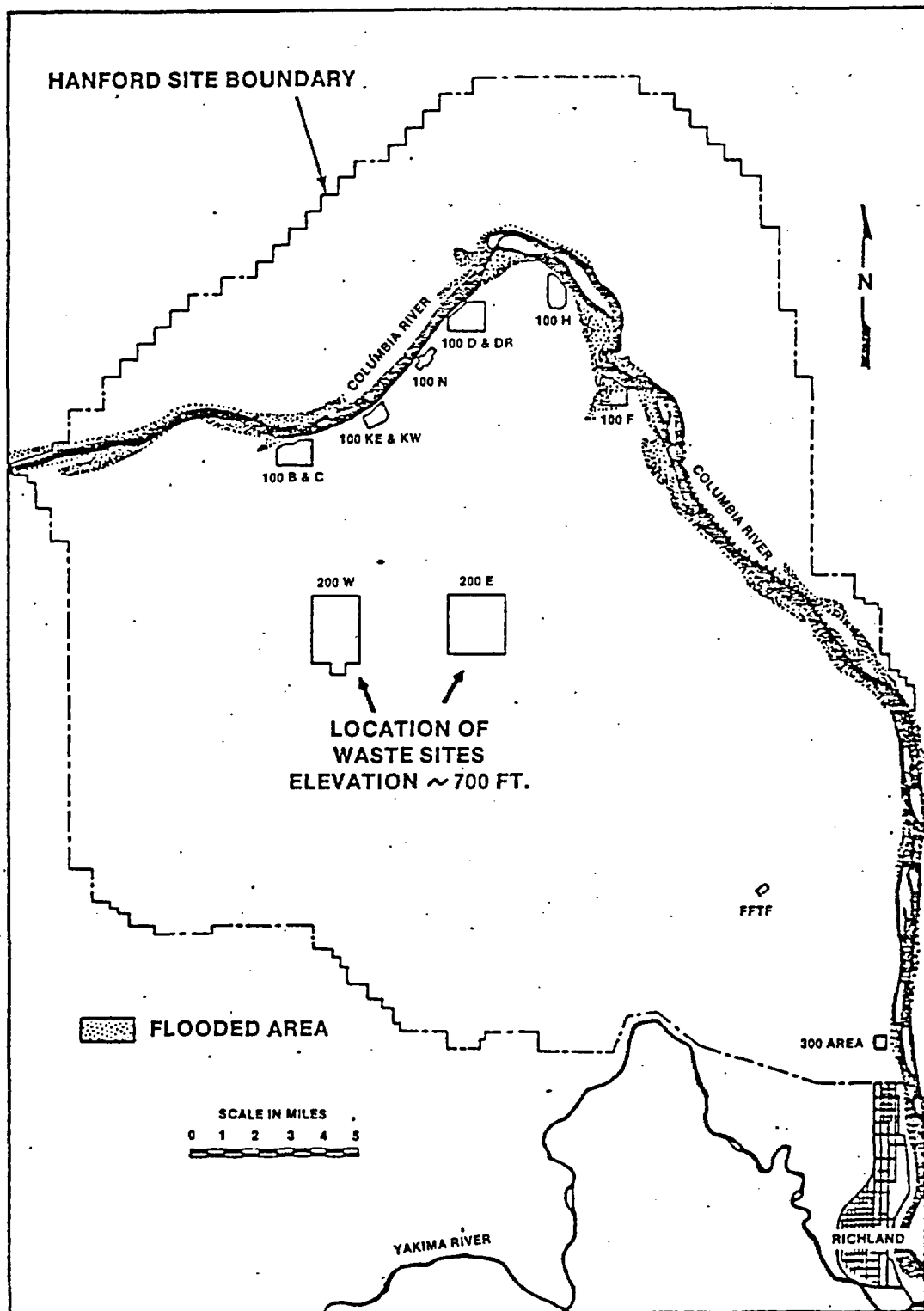
**EXPECTATION: REMOVAL NOT LIKELY - ONLY GLACIAL  
FLOODING WOULD REACH WASTE SITES ON  
200 AREA PLATEAU**



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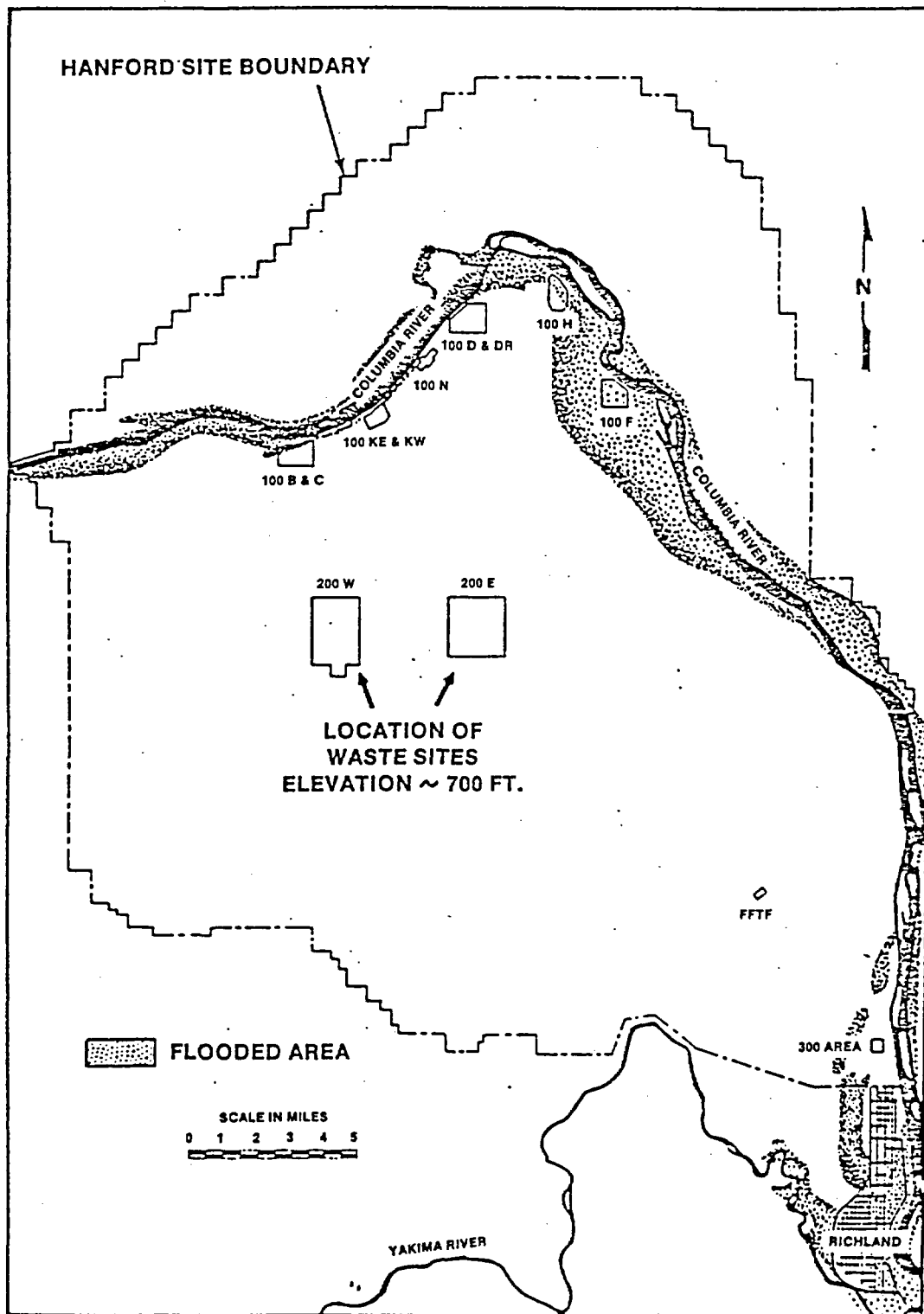
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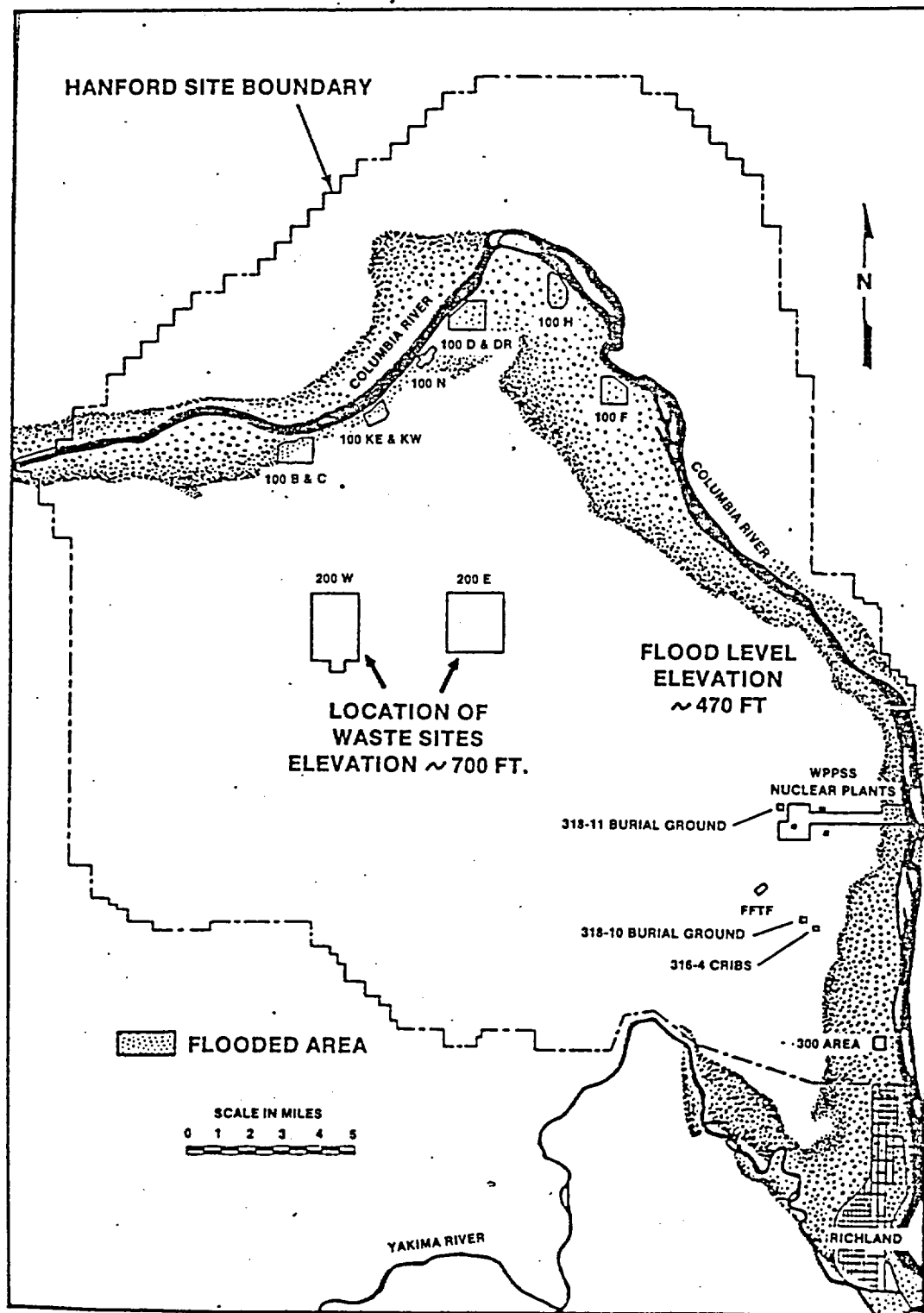
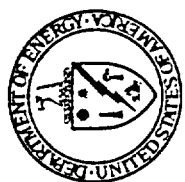
HIGHEST FLOOD ON RECORD (1894)  
800,000 CFS

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PROBABLE MAXIMUM FLOOD  
1,440,000 CFS



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FLOOD RESULTING FROM A 25 PERCENT BREACH  
OF GRAND COULEE DAM  
5,280,000 CFS



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**EVENT: LEACHING TO GROUNDWATER FOLLOWING  
PRECIPITATION - PRESENT CLIMATE**

**RESULT: THERE IS INADEQUATE PRECIPITATION TO FORM  
A DRIVING FORCE TO TAKE RADIONUCLIDES  
TO ACCESSIBLE ENVIRONMENT**



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**EVENT: RETURN OF ICE AGE ANTICIPATED TO BEGIN  
15 THOUSAND YEARS A.P.**

- BY ABOUT 45,000 YRS A.P. ICE SHEETS WOULD BE  
LARGE ENOUGH TO INFLUENCE SITE STABILITY  
INDIRECTLY (FLOODS FROM DAMMED UP ICE MELT)**
- FIRST LARGE FLOOD WOULD LIKELY ENTRAIN  
HANFORD SEDIMENTS AND ALL WASTES**
- P (EVENT SCENARIO) 0.25 - 0.75**

**RADIOLOGICAL CONSEQUENCES: NONE EXPECTED: CONCENTRATION OF  
LONG LIVED NUCLIDES (Pu-239) IN SOILS  
INSIGNIFICANT (< 0.1 NCi/g), NO  
AGRICULTURE OR HABITATION UNTIL RETURN  
OF HOSPITABLE CLIMATE**



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**EVENT: METEORITES**

**EXPECTATION: NO IMPACT, HOWEVER IF LARGE METEORITE  
STRIKES TANK WASTE DISPOSAL SITE 2 TO 20  
RADIATION INDUCED HEALTH EFFECTS MIGHT  
RESULT**



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**EVENT: VOLCANISM**

**EXPECTATION: HANFORD IS 140 MILES DUE EAST OF  
MOUNT ST. HELENS; NEARBY EXPLOSIVE  
ACTIVITY IS NOT ANTICIPATED**

**LAST LAVA FLOW ABOUT 8 MILLION YEARS AGO  
(IF FLOWS WERE TO FOLLOW PATTERN, NEXT  
FLOW IS ABOUT 4 MILLION YEARS OVERDUE--IT  
IS SUSPECTED THAT FISSURES AND TECTONIC  
PRESSURES HAVE MOVED ELSEWHERE)**

**REGARDLESS, ADDITIONAL FLOWS WOULD  
FURTHER ISOLATE WASTES**



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**EVENT: EARTHQUAKES?**

**RESULT: NO AFFECT ON WASTES EXPECTED --  
EARTHQUAKE ITSELF PROVIDES NO  
TRANSPORT FORCE**

**DAMMING OF COLUMBIA RIVER BY LANDSLIDE  
RESULTING FROM EARTHQUAKE FOLLOWED BY  
SUDDEN RELEASE OF VERY LARGE FLOOD IS  
NOT, AT THIS STAGE OF OUR ANALYSIS,  
BELIEVED CREDIBLE**





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**SEPTEMBER 1983**

**EPA STAFF SITE VISIT**

**HANFORD DEFENSE WASTE EIS  
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**MAN-INDUCED AND/OR HIGHLY IMPROBABLE, BUT  
NOT IMPOSSIBLE EVENTS LEADING TO THE  
POTENTIAL RELEASE OF HANFORD WASTE  
RADIONUCLIDES TO ACCESSIBLE ENVIRONMENT**

- **HUMAN INTRUSION**
- **IRRIGATION/INCREASE IN PRECIPITATION**



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**HIGHLY IMPROBABLE BUT NOT IMPOSSIBLE EVENTS  
LEADING TO RELEASE OF HANFORD WASTE  
NUCLIDES TO ACCESSIBLE ENVIRONMENT**

**EVENT: ANNUAL PRECIPITATION INCREASES TO 60 CM/YR**

**EXCESS WATER MOVES DOWNWARD, PENETRATES  
WASTE ZONE, LEACHES RADIONUCLIDES FROM  
WASTE, MOVES TO GROUNDWATER FROM WHICH  
CONTAMINATED WELL WATER COULD BE DRAWN  
OR VIA WHICH RADIONUCLIDES REACH THE  
COLUMBIA RIVER**

**(SCENARIO BEGINS 300 YEARS AFTER DISPOSAL)**



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**PRECIPITATION/IRRIGATION EVENT (CONT)**

**RESULT: RADIOLOGICAL CONSEQUENCES OF "CLIMATE  
CHANGE" EVENT ON IN-PLACE STABILIZED WASTES  
WITH ENGINEERED BARRIERS**

**LIFETIME DOSE TO MAXIMUM INDIVIDUAL -  
0.02 REM**

**COLLECTIVE DOSE TO POPULATION OVER  
10,000 YEARS -  $9 \times 10^4$  MAN-REM**

**(COLLECTIVE DOSE TO POPULATION OVER 10,000 YEARS  
FROM NATURAL BACKGROUND -  $2 \times 10^9$  MAN-REM)**



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**SEPTEMBER, 1983**

**EPA STAFF SITE VISIT**

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**ADVERSE IMPACTS RELATED TO IN-PLACE  
STABILIZATION WITH ENGINEERED BARRIERS FROM:**

- |                        |  |
|------------------------|--|
| <b>WIND EROSION</b>    | <b>- NONE</b>  |
| <b>FLOODS</b>          | <b>- NONE</b>  |
| <b>CLIMATE CHANGE</b>  | <b>- AT MOST 20HE/10K YEARS</b>  |
| <b>METEORITES</b>      | <b>- AT MOST 20HE/10K YEARS</b>  |
| <b>VOLCANISM</b>       | <b>- NONE</b>  |
| <b>ICE AGE FLOODS</b>  | <b>- DESTROYS DISPOSAL SYSTEM BUT HAS NO ADVERSE<br/>RADIOLOGICAL CONSEQUENCES</b>                             |
| <b>EARTHQUAKES</b>     | <b>- NONE</b>  |
| <b>HUMAN INTRUSION</b> | <b>- BARRIERS DESIGNED TO PRECLUDE INTRUSION--<br/>ON "WHAT IF" BASIS, 4HE OR LESS FROM DRILLING<br/>EVENT</b> |



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**PRELIMINARY FINDINGS**

**THE APPROACH TO PERFORMANCE ASSESSMENT TAKEN  
FOR IN-PLACE STABILIZATION SUGGESTS THAT THIS  
DISPOSAL METHOD WOULD:**

- **PROVIDE ADEQUATE PROTECTION OF HEALTH AND SAFETY OF  
THE PUBLIC OVER 10,000 YRS OR LONGER, AND**
- **RESULT IN MUCH LESS THAN 1,000 HEALTH EFFECTS OVER  
10,000 YEARS (EPA BASIS FOR DEVELOPING STANDARD)**



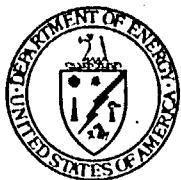
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HANFORD DEFENSE WASTE DISPOSAL PROGRAM**

**EPA STAFF SITE VISIT**

**HANFORD DEFENSE WASTE EIS  
AND APPROACH TO PERFORMANCE ASSESSMENT**

**BACK TO THE EIS**

- **LONG-TERM PERFORMANCE OF DISPOSAL ALTERNATIVES IS AN ESSENTIAL PART OF THE HANFORD DEFENSE WASTE EIS**
- **IMPACTS OF PRE DISPOSAL ACTIVITIES SUCH AS THOSE ASSOCIATED WITH WASTE RETRIEVAL, PACKAGING, TRANSPORT AND WASTE FACILITY CONSTRUCTION ARE ALSO ESSENTIAL IN ESTABLISHING A COMPLETE ASSESSMENT OF ENVIRONMENTAL IMPACTS ASSOCIATED WITH DISPOSAL OF RADIOACTIVE WASTE AT HANFORD**



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**BALANCING OF IMPACTS - AN EXAMPLE**  
(BASED ON RHO-LD-139, 1980)

REPOSITORY DISPOSAL OF  
SINGLE-SHELL TANK WASTE

IN-PLACE STABILIZATION OF  
SINGLE-SHELL TANK WASTE

EXPECTATION OF  
LONG TERM  
PERFORMANCE

LESS THAN 30 HE  
OVER 10,000 YRS

LESS THAN 30 HE  
OVER 10,000 YRS

POPULATION  
EXPOSURE  
DURING OPERATIONS

< 270 MAN-REM

< 4 MAN-REM

OCCUPATIONAL  
EXPOSURE

< 7,000 MAN-REM  
TO RETRIEVE 200,000 M<sup>3</sup>  
OF WASTE

< 700 MAN-REM

INDUSTRIAL  
ACCIDENTS

~ 12 FATALITIES  
PRINCIPALLY TO  
REPOSITORY MINERS

NO MORE THAN 1

COST (APPROX)  
MILLIONS OF \$

~ 6,000

~ 700



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**CONCLUSIONS**

- **EITHER REPOSITORY DISPOSAL OR DISPOSAL BY STABILIZING IN-PLACE WITH ENGINEERED BARRIERS WOULD PROVIDE ADEQUATE PROTECTION OF PUBLIC HEALTH AND SAFETY**
- **REPOSITORY DISPOSAL WOULD COMMIT MORE RESOURCES AND HAS A GREATER POTENTIAL FOR INDUSTRIAL TYPE FATALITIES DURING THE OPERATIONAL PERIOD**
- **REFINED ANALYSES, FOR OPERATIONAL IMPACTS AND LONG-TERM DISPOSAL SYSTEM PERFORMANCE IMPACTS WILL BE NEEDED FOR EACH OF THE 4 DISPOSAL ALTERNATIVES TO ESTABLISH AN APPROPRIATE ENVIRONMENTAL BASIS FOR FUTURE DECISIONS ON DISPOSAL OF HANFORD DEFENSE WASTE**





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**SECTION 4 - APPLICATION OF PROPOSED 40 CFR 191 TO IN-PLACE  
STABILIZATION**

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## **ISSUES OF CONCERN**

- **BACKGROUND**
  - PROPOSED RULE WAS DEVELOPED BASED EXCLUSIVELY ON REPOSITORY RELEASE CALCULATIONS
- **PROBLEM**
  - APPLICABILITY TO IN-PLACE STABILIZATION OF OLD WASTE NOT CLEAR
- **RESULTS**
  - AMENDMENTS FOCUSED ON IN-PLACE STABILIZATION ARE DIFFICULT TO INCORPORATE INTO 40 CFR 191 AND SUPPORT DOCUMENTS
  - IN-PLACE STABILIZATION MAY BE PRECLUDED BY THE PROPOSED RULE



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## ISSUES AND CONCERNS CONCERNS FOR IN-PLACE STABILIZATION

- PROPOSED RELEASE LIMITS PRECLUDE CONSIDERATION OF OPERATIONAL IMPACTS AND OVERALL HEALTH EFFECTS
- IN-PLACE STABILIZATION MAY BE PRECLUDED BY LACK OF RECOGNITION IN SUPPORTING DOCUMENTS
- WHAT IS "ACCESSIBLE ENVIRONMENT" - PARTICULARLY "SURFACE"
- "AT LEAST AS MUCH PROTECTION" AS REPOSITORY IMPOSES UNREASONABLE CONSTRAINTS
- APPLICATION OF TABLE II TO A NON REPOSITORY DISPOSAL SYSTEM
  - WHAT IS A "DISPOSAL SYSTEM"?
  - SEVERAL SITES? THE TOTAL SITE?
- METHOD OF AVERAGING TO DETERMINE WHAT WASTES ARE "HIGH LEVEL"



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