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Title of Presentation

HIGH-LEVEL NUCLEAR WASTE IMMOBILIZATION PROGRAM

Name	Department and Institution	Mailing Address
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Abstract

Existing high-level nuclear wastes in the United States are described along with current management techniques and long-term disposal options. All of the disposal options involve some type of immobilization operation to restrict radionuclide dispersion; the primary option is disposal of immobilized waste packages in deep (500-1000 meter) geological formations. Several immobilized waste forms currently under development are discussed, and form selection factors and regulatory criteria are identified.

Note - Attached presentation material extracted from previously approved manuscript DP-MS-79-2, U. S. Program for The Immobilization of High-Level Nuclear Wastes, by J. L. Crandall, presented to the American Nuclear Society Meeting in Atlanta, GA, June 3-8, 1979.

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HIGH-LEVEL WASTE IMMOBILIZATION PROGRAM

DISCUSSION TOPICS ARE:

- o DESCRIPTION OF RADIOACTIVE WASTES
- o DISPOSAL STRATEGY
- o WASTE FORM DEVELOPMENT
- o WASTE FORM SELECTION
- o REGULATORY ASPECTS
- o PROJECT SCHEDULES

TYPES OF NUCLEAR WASTES

- HIGH-LEVEL
- TRANSURANIC
- LOW-LEVEL
- AIRBORNE

TABLE 1

U.S. HIGH-LEVEL NUCLEAR WASTES

SOURCE	FORM	1978 QUANTITIES 10^6 GAL	1978 QUANTITIES 10^6 CURIES	1990 HIGH EST. 10^6 GAL	1990 HIGH EST. 10^6 CURIES	SOLIDIFICATION VOL. OF 1990 WASTES* (10^3 CU. FT.)
HANFORD PLANT	ALK. SALT/SLUDGE/ LIQUOR	50	190	65	230	660
	SEPARATED $^{90}Sr/Y$, $^{137}Cs/Ba$	-	350	-	425	
IDAHO CHEMICAL PROCESSING PLANT	ACID CALCINE	0.45	85	1.3	500	300
	ACID LIQUID	2.5		1.2		
SAVANNAH RIVER PLANT	ALK. SALT/SLUDGE/ LIQUOR	22	570	22	680	200
NUCLEAR FUEL SERVICES	ALK. SLUDGE/LIQUOR	0.6	64	0.6	48	7
	ACID LIQUOR	0.01	2.1	0.01	1.6	
POSSIBLE FUTURE LWR WASTE**	ACID LIQUOR	0.7	1,900	5.2	14,000***	460

*25% LOADING OF WASTE OXIDES IN WASTE FORM.
**NO PROCESSING OF SPENT FUELS FROM COMMERCIAL NUCLEAR POWER REACTORS IS CURRENTLY BEING PERFORMED IN THE U.S., AND OFFICIAL POLICY IS PRESENTLY TO STORE RATHER THAN PROCESS SPENT FUEL.
***AFTER AT LEAST 6 YEARS' AGING.

DEFENSE WASTE SITES
STATUS

HANFORD

- 50 MILLION GALLONS OF WASTE IN 168 CARBON STEEL TANKS
- 240 CAPSULES OF STRONTIUM AND CESIUM IN WATER BASIN

IDAHO

- WASTE STORED AS 400,000 GALLONS OF CALCINE POWDER IN 18 STAINLESS STEEL BINS
- NEW WASTE CALCINING FACILITY NEAR COMPLETION

SRP

- 23 MILLION GALLONS OF WASTE IN 33 CARBON STEEL TANKS
- WASTE RETRIEVAL DEMONSTRATED ON LARGE SCALE

OFFICE OF NUCLEAR ENERGY - WASTE (NEW)

DIRECTOR - SHELDON MEYERS

DEPUTY - RAYMOND G. RAMATOWSKI

DIVISION OF WASTE ISOLATION	DIVISION OF WASTE PRODUCTS	DIVISION OF FUEL STORAGE & TRANS.	STAFF DIVISIONS (BEING REORGANIZED)
COLIN A. HEATH	GOETZ K. OERTEL	MICHAEL J. LAWRENCE	BUDGET - D. B. LECLAIRE
REPOSITORY SITES	*WASTE HANDLING*	*SPENT FUEL STORAGE*	PLANNING - C. W. KUHLMAN
REPOSITORY R & D	*WASTE PROCESSING*	*TRANSPORTATION R & D*	STAFF - A. F. PERGE
INTERAGENCY COORD.	*DECOMMISSIONING*		WIPP - R. STEIN
	INTERIM STORAGE		NWCF - L. W. HARMON

DIVISION OF WASTE PRODUCTS
LEAD OFFICE ASSIGNMENTS

ASSIGNMENT	OPERATIONS OFFICE	CONTRACTOR
HIGH-LEVEL WASTE	SAVANNAH RIVER	DU PONT
TRANSURANIC WASTE	ALBUQUERQUE	ROCKY FLATS
LOW-LEVEL WASTE	IDAHO	EG & G PLUS ORNL
AIRBORNE WASTE	IDAHO	EXXON NUCLEAR
DECOMMISSIONING WASTE	RICHLAND	UNITED NUCLEAR
INTERIM WASTE MANAGEMENT	HEADQUARTERS	DWP

1/24/80 WMP-0-A
12109

NATIONAL LONG-TERM HIGH-LEVEL WASTE MANAGEMENT PROGRAM

OBJECTIVE	-	PROVIDE COORDINATED R & D AND OPERATIONAL PLANS FOR LONG-TERM MANAGEMENT OF RADIOACTIVE HIGH-LEVEL WASTE FROM PROCESSING SPENT NUCLEAR FUEL
OVERALL RESPONSIBILITY	-	HEADQUARTERS OFFICE OF NUCLEAR ENERGY - WASTE (NEW)
LEAD RESPONSIBILITY FOR PLANNING & IMPLEMENTATION	-	SAVANNAH RIVER OPERATIONS OFFICE
TECHNICAL ADVISOR	-	E. I. Du PONT, SAVANNAH RIVER LABORATORY

HLW MANAGEMENT LEAD OFFICE OBJECTIVES

DEVELOP THE TECHNOLOGY TO:

- REMOVE HLW FROM INTERIM STORAGE FOR PROCESSING
- PROCESS WASTE INTO IMMOBILIZATION FORM(S) FOR DISPOSAL
- PREPARE WASTE FORMS FOR SHIPMENT TO DISPOSAL SITE(S)

DEVELOP AND CHARACTERIZE OPTIMUM IMMOBILIZATION FORMS

- REFERENCE FORMS
- ADVANCED FORMS

CONSTRUCT AND OPERATE A LEAD FACILITY FOR PROCESSING DEFENSE HLW

COORDINATE A PROGRAM FOR IMMOBILIZING ALL U.S. HLW

CARRY OUT APPROPRIATE INTERNATIONAL ACTIVITIES

HIGH-LEVEL WASTE FORM DEVELOPMENT PROGRAM

THREE PART PLAN TO SELECT WASTE FORM CHOICES

- o DEVELOPMENT OF WASTE FORM PRODUCTION PROCESS
- o WASTE FORM CHARACTERIZATION
- o SELECTION OF PREFERRED ALTERNATIVES

UTILIZE SEVERAL LABORATORIES AND CONTRACTORS TO DO WORK ELEMENTS

PRIMARY HIGH-LEVEL WASTE FORMS

IN-PLACE SOLIDIFICATION FORMS

CONCRETE, RICH CLAY, POLYMERS

CONCRETE FORMS

NORMAL CONCRETE, POLYMER CONCRETE, HOT PRESSED CONCRETE

CALCINE FORMS

DIRECT CALCINES, PELLETIZED CALCINES

GLASS FORMS

BOROSILICATE GLASS, HIGH SILICA GLASS, PHOSPHATE GLASS

CERAMIC FORMS

SUPERCALCINES, SYNROC, MINERAL ION EXCHANGERS, OTHERS

MATRIX FORMS

METAL MATRIX WITH GLASS OR CERAMIC MARBLES
CERMETS
MULTIBARRIER AND COATED PARTICLE FORMS

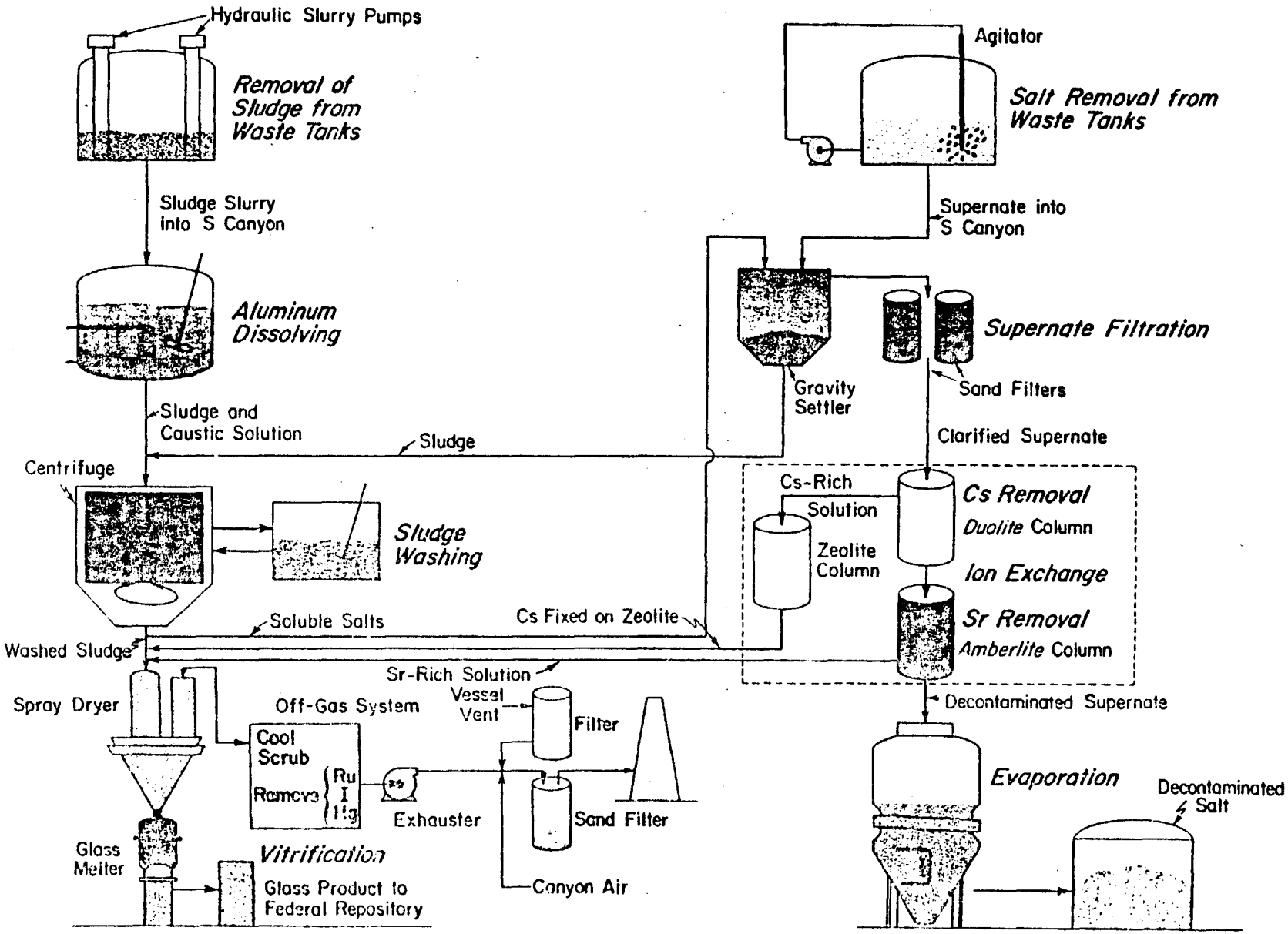


FIGURE 1.1 SRP Defense Waste Processing Reference Flowsheet

WASTE FORM DEVELOPERS

CONTRACTOR	WASTE FORMS
SAVANNAH RIVER LABORATORY	BOROSILICATE GLASS
ROCKWELL HANFORD	GLASS & CLAY CALCINE
EXXON NUCLEAR IDAHO CO	GLASS & CALCINES
PACIFIC NORTHWEST LABORATORY	GLASS, GLASS CERAMICS MATRICES & COATED PARTICLES
OAK RIDGE NATIONAL LABORATORY	CONCRETE, CERMET, & COATED PARTICLES
ARGONNE NATIONAL LABORATORY	SYNROC & METAL MATRICES
LAWRENCE LIVERMORE LABORATORY	SYNROC
SANDIA LABORATORIES	TITANATE ION EXCHANGER
ROCKWELL - PSU	TAILORED CERAMICS
CATHOLIC UNIVERSITY	POROUS GLASS MATRIX
NC STATE UNIVERSITY	SYNROC
UNIVERSITY OF FLORIDA	SURFACE REACTION - STUDIES

NARROWING WASTE FORM CHOICE

WASTE FORM DEVELOPERS

- o SPECIFIC FORM COMPOSITIONS
- o WASTE FORM PROPERTIES
- o MANUFACTURING REQUIREMENTS

DOE WASTE MATERIALS CHARACTERIZATION ORGANIZATION (MCC, MRB, IML)

- o APPROVED COMPARISON DATA BETWEEN WASTE FORMS

WASTE SITE

- o PARTICULAR SITE CONDITIONS
- o PARTICULAR SITE ENGINEERING ASSESSMENTS

DOE WASTE ACCEPTANCE CRITERIA

- o REGULATORY REQUIREMENTS (WHERE AVAILABLE)
- o WASTE SYSTEM REQUIREMENTS

FINAL DECISION ON FORMS FOR ENGINEERING DEVELOPMENT WILL BE MADE BY DOE

- o WILL USE REVIEW PANELS EXTENSIVELY
- o WILL RETAIN MANY OF CURRENT FORM DEVELOPERS AS ENGINEERING DEVELOPERS

HIGH-LEVEL WASTE IMMOBILIZATION FORMS SELECTION FACTORS

FORM	LEACHABILITY - MATCH TO REPOSITORY CONDITIONS
	DISPERSABILITY AND IMPACT RESISTANCE - TRANSPORT AND STORAGE
	VOLATILITY - MATCH TO TRANSPORTATION ACCIDENTS
	STABILITY - AGING RADIATION TRANSMUTATION
	SENSITIVITY TO WASTE LOADING AND COMPOSITION
	WASTE VOLUME LOADING
	DEVELOPMENT STATUS
PROCESS	PROCESS SAFETY - REMOTABILITY
	PROCESS SENSITIVITY - QA REQUIREMENTS
	FEED PREPARATION REQUIRED
	PROCESS WASTE GENERATION - OPERATING AND DECOMMISSIONING
	CAPITAL AND OPERATING COSTS
	APPLICABLE LARGE SCALE EXPERIENCE

CRITERIA DEVELOPMENT ROLES

EPA	-	OVERALL CRITERIA FOR WASTE ISOLATION
NRC	-	REGULATIONS FOR REPOSITORY LICENSING TO MEET EPA CRITERIA
ETW:P	-	WASTE FORM SPECIFICATIONS TO MEET REPOSITORY ACCEPTANCE REQUIREMENTS
ETW:F	-	WASTE FORM SPECIFICATIONS TO MEET HANDLING AND TRANSPORTATION REQUIREMENTS
ETW:I	-	ACCEPTANCE REQUIREMENTS FOR WASTE FORMS SO THAT REPOSITORY PERFORMANCE MEETS NRC REGULATIONS

DEVELOP CANDIDATE FORMS AND PROCESSES

- COMPLETE INITIAL EVALUATION OF WASTE FORMS AND PROCESSES AND ASSESSMENT OF APPLICABILITY TO DEFENSE SITES. FY-1981

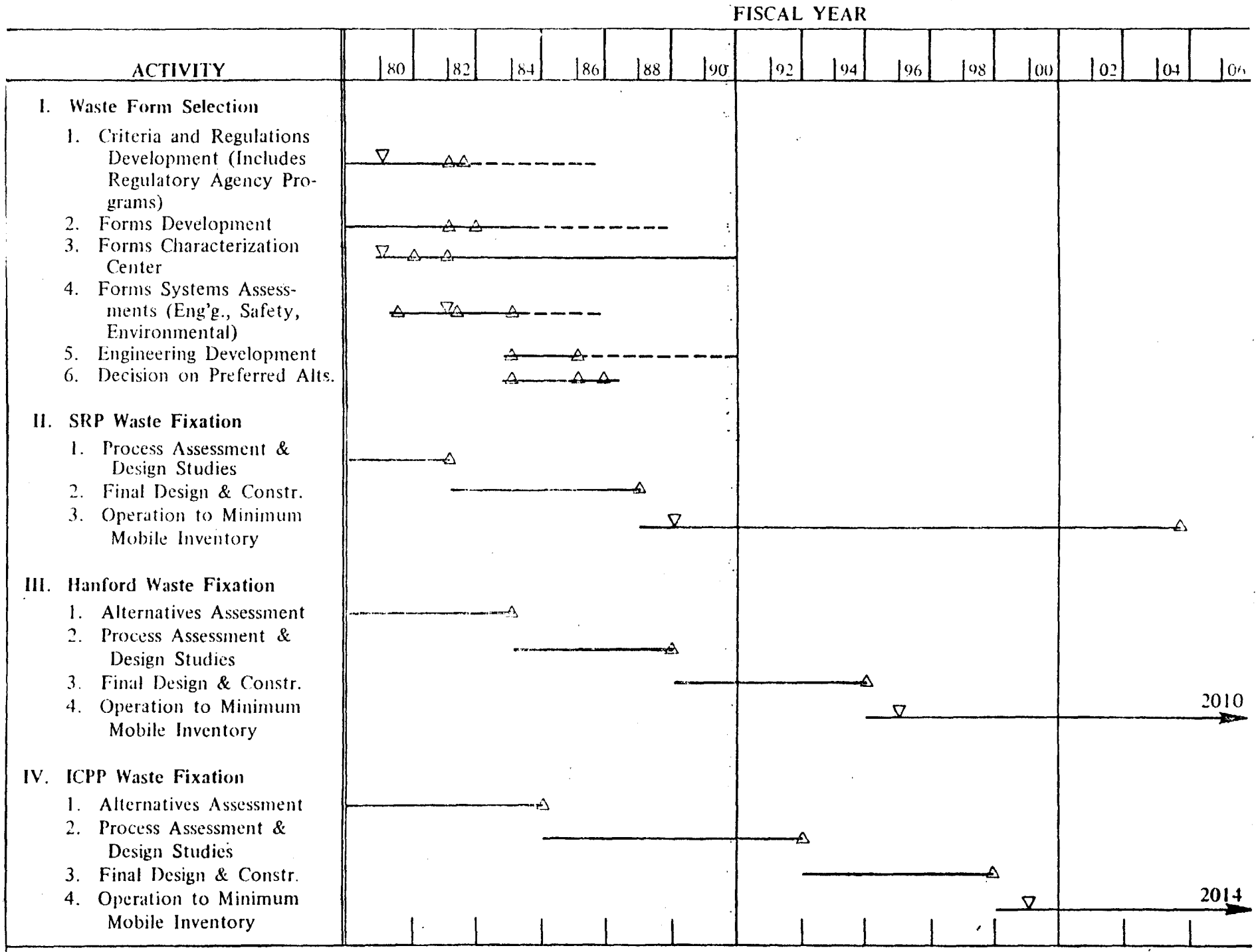
- COMPLETE DETAILED DEVELOPMENT AND EVALUATION OF TWO TO FOUR PROMISING FORMS. FY-1983

- BEGIN LARGE-SCALE DEVELOPMENT FOR ONE OR TWO SELECTED ALTERNATIVE FORMS AND PROCESSES. FY-1984

- ESTABLISH MATERIALS CHARACTERIZATION CENTER FY-1979

    - o PUBLISH COMPILATION OF WASTE FORM PROPERTIES - FY-1980
    - o UNIFORM TEST METHODS DEVELOPED - FY-1981
    - o DATA HANDBOOK STARTED - FY-1981

IMMOBILIZATION OF DOE HIGH-LEVEL WASTES



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ETW:I	-	ACCEPTANCE REQUIREMENTS FOR WASTE FORMS SO THAT REPOSITORY PERFORMANCE MEETS NRC REGULATIONS