

MASTER

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NUCLEAR WASTE MANAGEMENT - A PERSPECTIVE

**Presentation for
AMERICAN NUCLEAR SOCIETY
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**PRESENTATION ASSUMES CERTAIN QUESTIONS
CONCERNING RADIOACTIVE WASTE MANAGEMENT**

- 1. WHAT IS THE SCOPE OF OUR PROBLEMS WITH
NUCLEAR WASTES?**
- 2. HOW HARMFUL ARE PRESENT INVENTORIES OF
WASTE? FUTURE INVENTORIES?**
- 3. WHAT IS BEING DONE (AND CAN BE DONE) TO
SOLVE OUR WASTE MANAGEMENT PROBLEMS?**

CLASSIFICATION OF WASTES

HIGH-LEVEL WASTE:

HIGH-LEVEL WASTE IS THE ONLY WASTE TYPE DEFINED IN A FEDERAL REGULATION (10 CFR 50, APPENDIX F):

"WASTE FROM FIRST CYCLE SOLVENT EXTRACTION OR WASTES FROM SUBSEQUENT CYCLES FROM FUEL REPROCESSING"

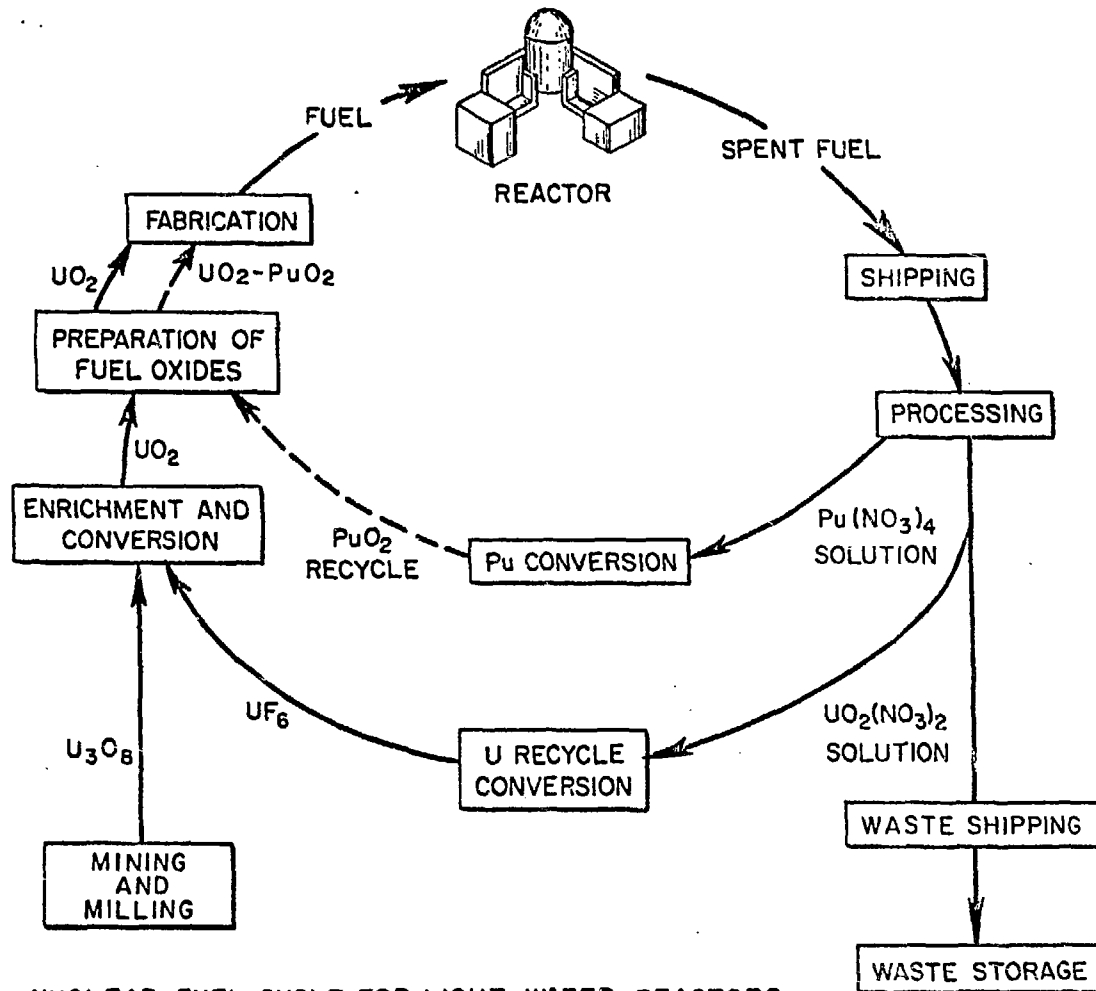
LOW-LEVEL SOLID WASTE:

TRANSURANIUM (TRU): CONTAINS GREATER THAN 10 nCi OF TRANSURANIC LONG-LIVED ALPHA ACTIVE MATERIALS PER GRAM OF WASTE; EITHER HIGH OR LOW LEVELS OF BETA-GAMMA ACTIVITY (ATOMIC NUMBERS GREATER THAN 92); APPLIES ONLY TO DOE WASTES AT PRESENT

NON-TRANSURANIUM (TRU): CONTAINS LESS THAN 10 nCi OF TRU MATERIALS PER GRAM OF WASTE

LOW-LEVEL LIQUID WASTE:

ALL LIQUID WASTES OTHER THAN HIGH-LEVEL LIQUID WASTES

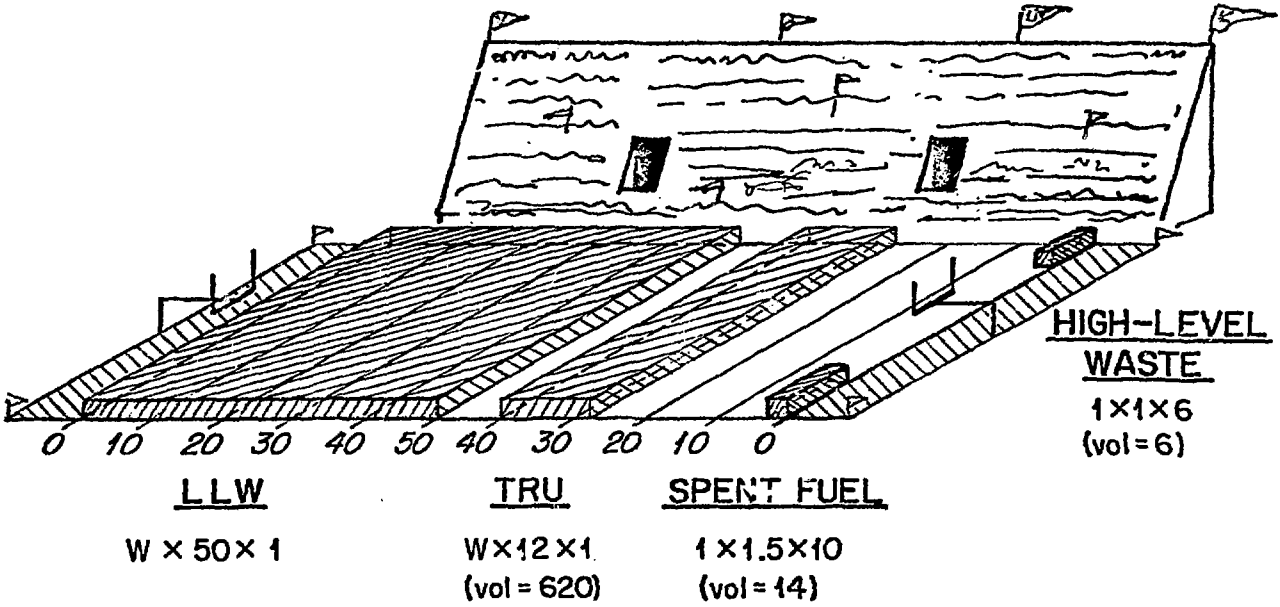


NUCLEAR FUEL CYCLE FOR LIGHT WATER REACTORS

FUEL CYCLE FOR ONE LARGE NUCLEAR POWER PLANT
GENERATES SMALL QUANTITY OF HLW,
BUT LARGER QUANTITIES OF TRU AND LLW

<u>CATEGORY</u>	<u>VOLUME (CUBIC METER)</u>	<u>NUMBER OF SHIPMENTS</u>
SPENT FUEL	14	11
HLW (AS SOLID)	6	4
TRU	620	83
LLW	2,500	190
ORE TAILINGS	42,000	--

THE WASTE FROM A REACTOR IN ONE YEAR WOULD PARTIALLY COVER A FOOTBALL FIELD



THE LARGE INVENTORIES OF WASTE DERIVE PRIMARILY
FROM DEFENSE PROGRAMS

HIGH-LEVEL WASTE (HLW), cubic meters

Commercial	2,300
Defense	270,000

TRANSURANIC WASTE (TRU), contained TRU, kilograms

Commercial	123
Defense	1100

SPENT FUEL DISCHARGED FROM COMMERCIAL REACTORS

2300 metric tons of heavy metal (MTHM)

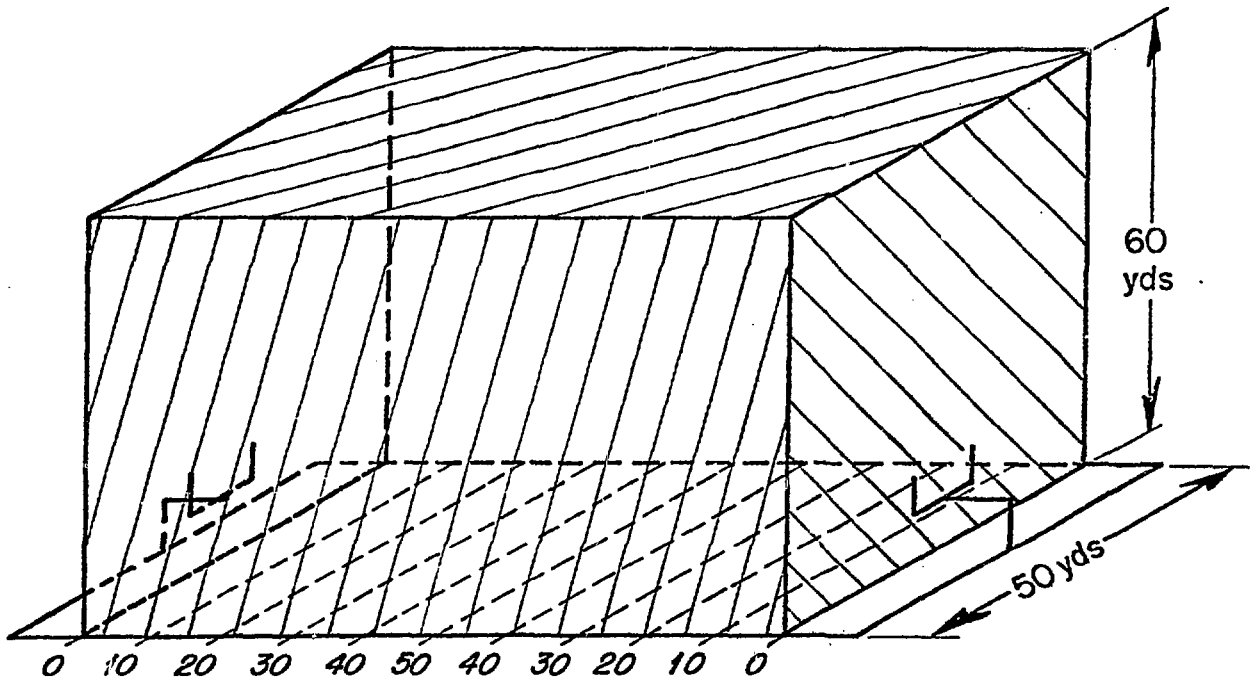
LOW-LEVEL WASTE (LLW), cubic meters, buried

Commercial	425,000
Defense	1,440,000

URANIUM MILL TAILINGS

140 million metric tons

INVENTORY OF HLW WOULD COVER A FOOTBALL FIELD
APPROX. 60 yds DEEP



VOLUME = ~ 300,000 cu yds

COMMERCIAL WASTES ARE INCREASING
BECAUSE OF DIVERSE NUCLEAR ACTIVITIES

- HIGH-LEVEL WASTE: •DEPENDS ON PERMITTING COMMERCIAL RECYCLE
- TRU WASTE: •SMALL R & D (INSTITUTIONAL) SOURCES
•LARGE AMOUNTS DEPEND ON COMMERCIAL RECYCLE
- SPENT FUEL: •AMOUNT DEPENDS ON WHETHER RECYCLE IS PERMITTED
- LOW-LEVEL WASTE: •INCREASING MEDICAL
•OPERATING REACTORS
•RESEARCH APPLICATIONS
•INDUSTRIAL APPLICATIONS
•DECOMMISSIONING

PRESENT PRACTICE RELIES PRIMARILY ON
INTERIM STORAGE AND SHALLOW LAND BURIAL

HLW: LIQUID AND SLUDGES IN TANKS

TRU: IN CONTAINERS IN STORAGE FACILITIES

LLW: IN SHALLOW LAND BURIAL (ALSO
HYDROFRACTURE AT ORNL)

DOE HEADQUARTERS WASTE MANAGEMENT ORGANIZATION

NUCLEAR ENERGY

Assistant Secretary - GEORGE CUNNINGHAM

Principal Deputy Assistant Secretary - JOHN CRAWFORD

Deputy Assistant Secretary for Nuclear Waste Management - SHELDON MEYERS

Waste Isolation Division - C. A. HEATH

Waste Products Division - G. OERTEL

Fuel Storage & Transfer Division - M. LAWRENCE

Deputy Assistant Secretary for Naval Reactors - ADM. H. G. RICKOVER

Deputy Assistant Secretary for Nuclear Reactor Programs - ROBERT FERGUSON

Director, Plans & Evaluation - S. BREWER

Director, Resource Management - D. LECLAIRE


**NATIONAL PROGRAM CONCERNS ARE DERIVED FROM PROBLEMS
FROM THE PAST AND THE FUTURE**

PAST

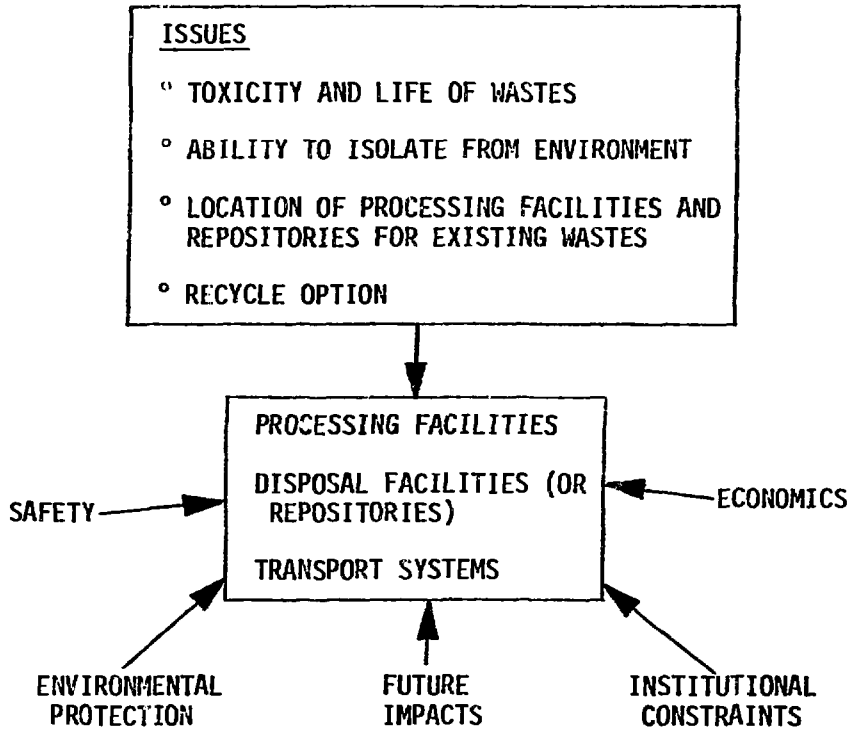
- DEFENSE WASTES
- R & D WASTES
- COMMERCIAL WASTES

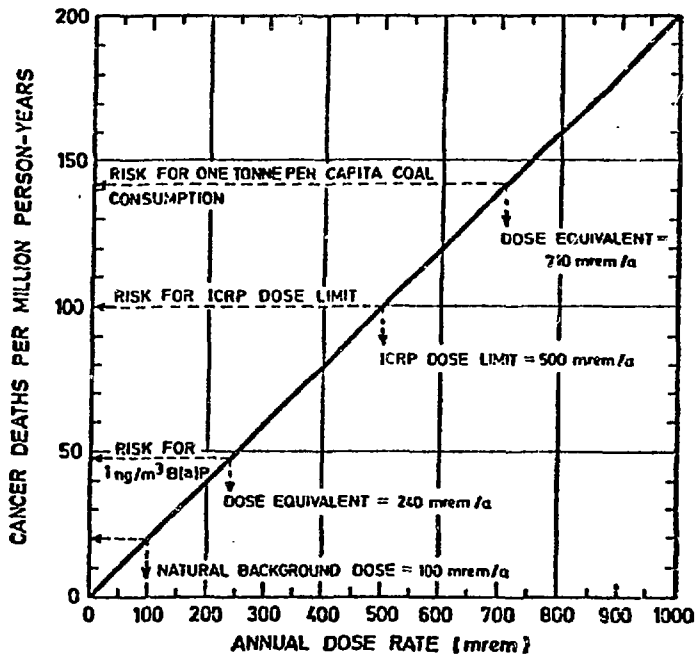
FUTURE

- DEFENSE WASTES
- COMMERCIAL WASTES

- 
- IMPROVEMENT OF PRACTICE
 - FIXATION OF WASTES
 - PERMANENT REPOSITORIES

ISSUES WITH ALL WASTE TYPES INVOLVE
SOCIAL AND TECHNICAL SECTORS

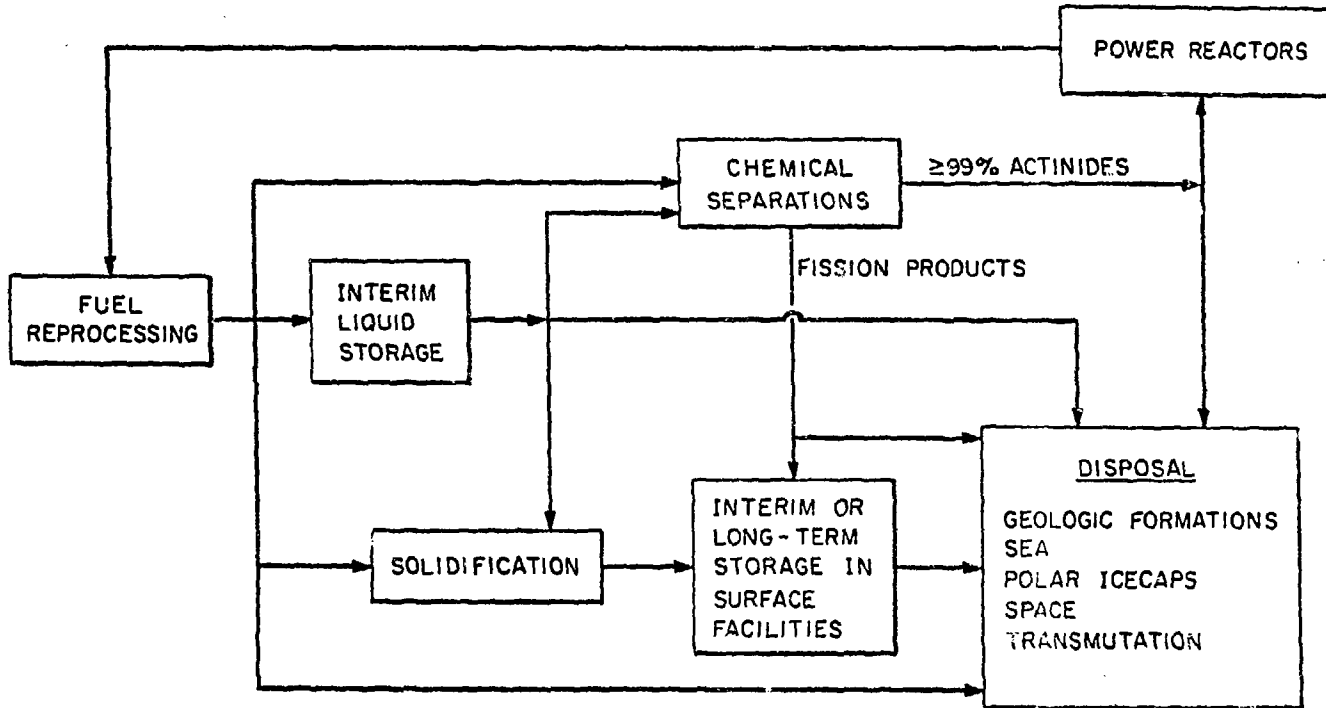




CANCER RISK PER YEAR

BONE CANCER (ORNL WASTES)	1 OUT OF 7.6 MILLION
CANCER DEATH (129 mrem/yr*)	1 OUT OF 155,000
U.S. CANCER DEATH RATE (1971)	1 OUT OF 627

***129 mrem/yr is background at Oak Ridge.**

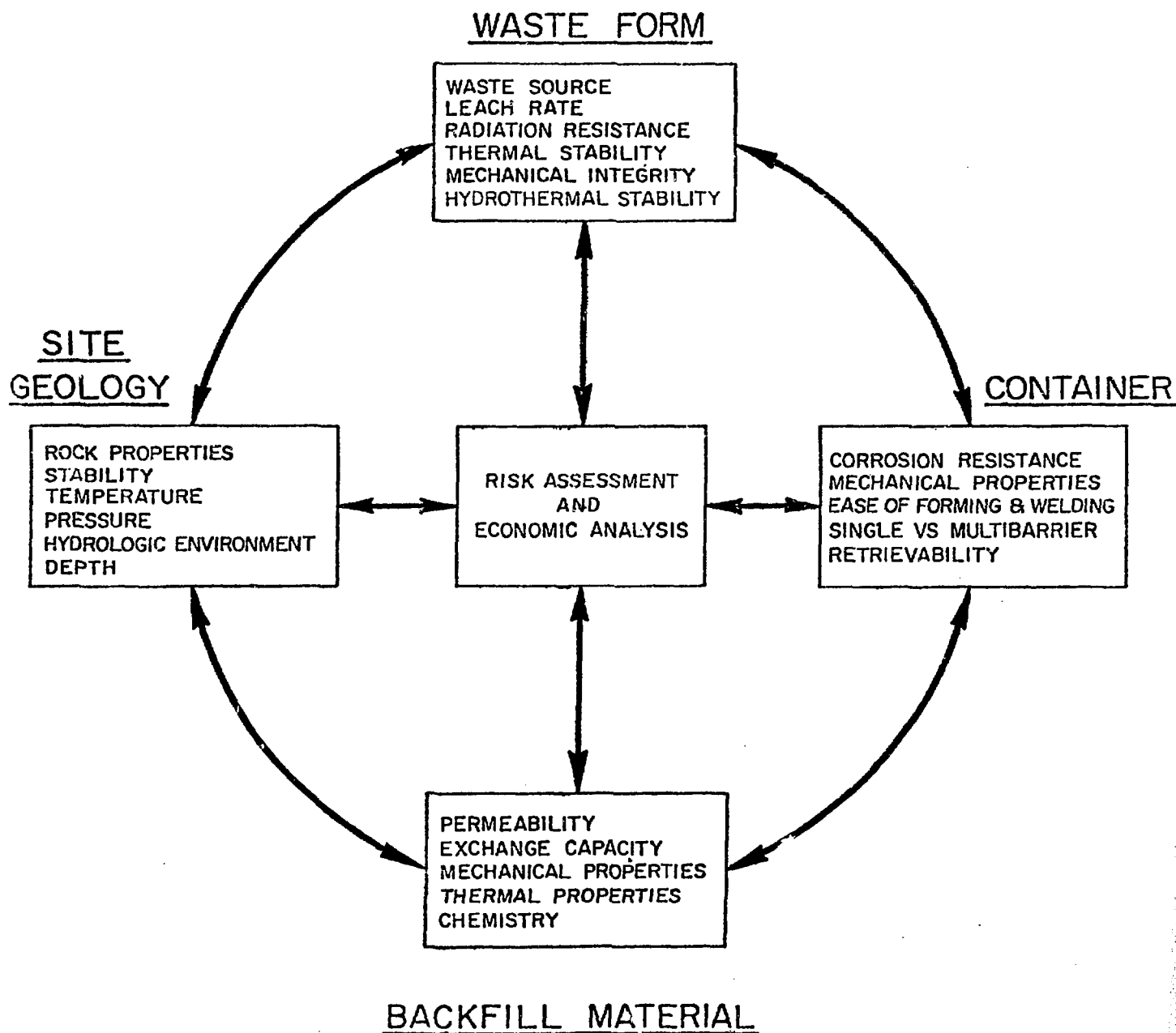


Options for Management of High-Level Wastes.

MANY ALTERNATIVE WASTE FORMS ARE BEING INVESTIGATED

<u>WASTE FORMS</u>	<u>OTHER VARIABLES</u>
• CALCINE	• RADWASTE
• SUPERCALCINES	— LIQUID VS SLUDGE
• CONCRETES	— COMPOSITION (Zr,Al,Fe)
• CERMETS	— AGE
• CERAMIC MATRIX	• PROCESS
• COATINGS	— PERCENT RADWASTE IN WASTE FORM
• PYROCERAM	— FORMING METHOD
• ZEOLITES	— TEMPERATURE
• SYNROC	— SIZE
• OTHERS	• CONTAINMENT
	• GEOLOGICAL

MANY FACTORS ARE INVOLVED IN THE SELECTION OF ALTERNATIVE WASTE FORMS



POSSIBILITIES FOR LONG-TERM STORAGE AND DISPOSAL

- ISOLATION ON EARTH

 - STORAGE AS LIQUIDS IN TANKS

 - STORAGE AS SOLIDS IN CONCRETE STRUCTURES

 - DISPOSAL AS SOLIDS IN CRYSTALLINE ROCKS

 - DISPOSAL AS SOLIDS IN SHALES AND CLAYSTONES

 - DISPOSAL AS SOLIDS IN SALT FORMATIONS

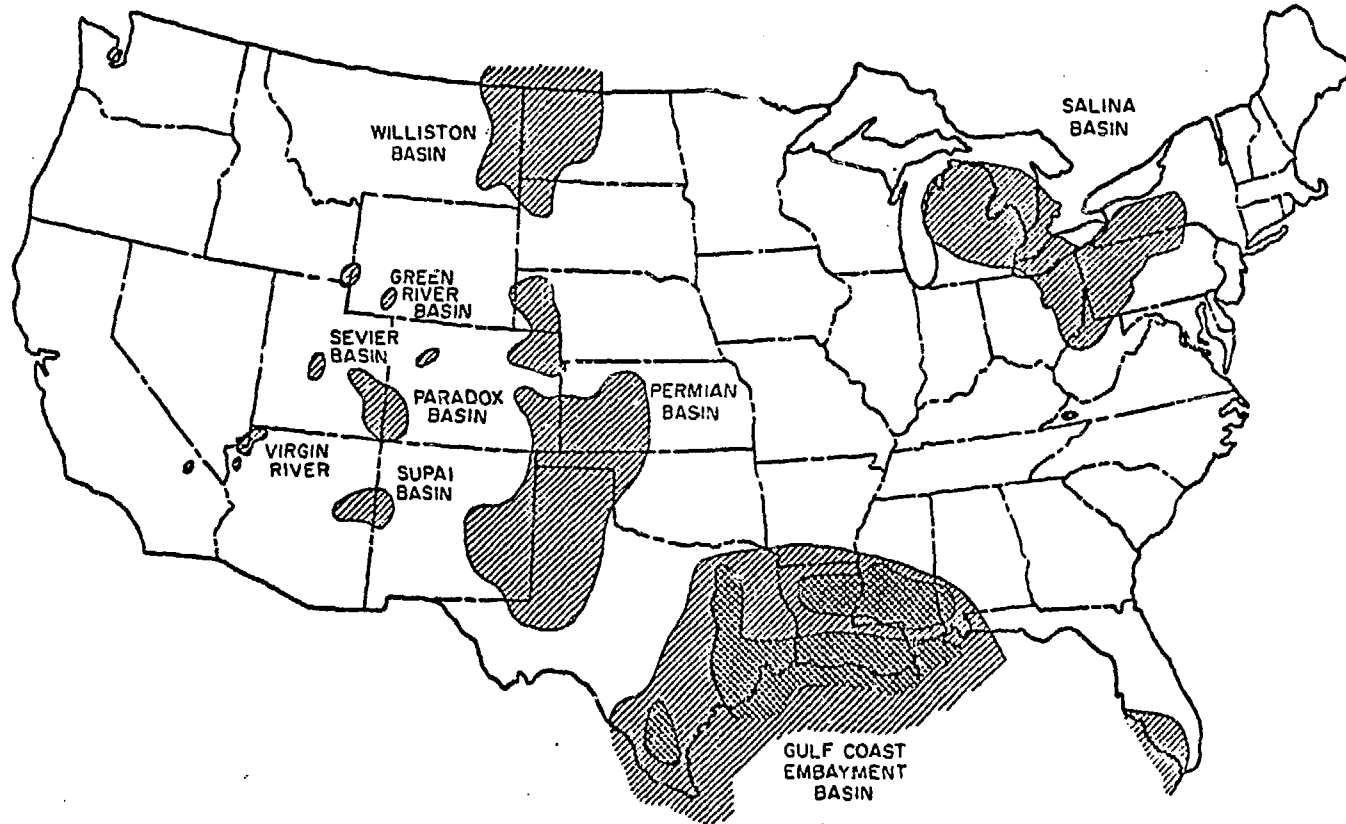
 - DISPOSAL AT GREAT DEPTHS UNDERGROUND

 - DISPOSAL AT SEA (SEA BED)

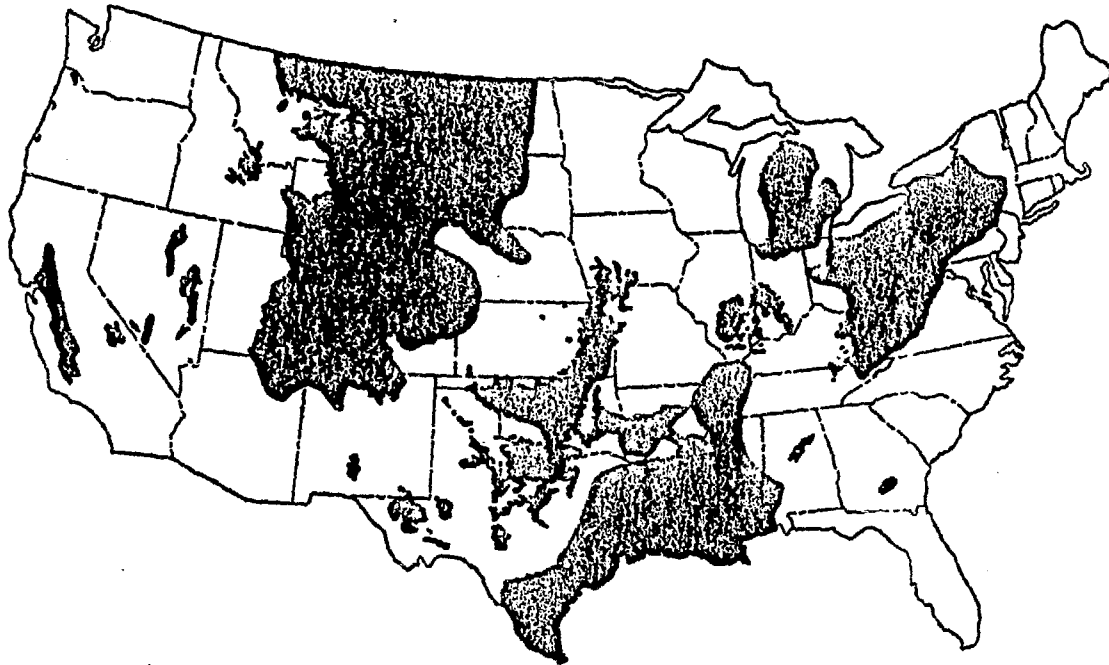
 - DISPOSAL WITHIN POLAR ICE CAPS

- TRANSMUTATION TO NONRADIOACTIVE SPECIES

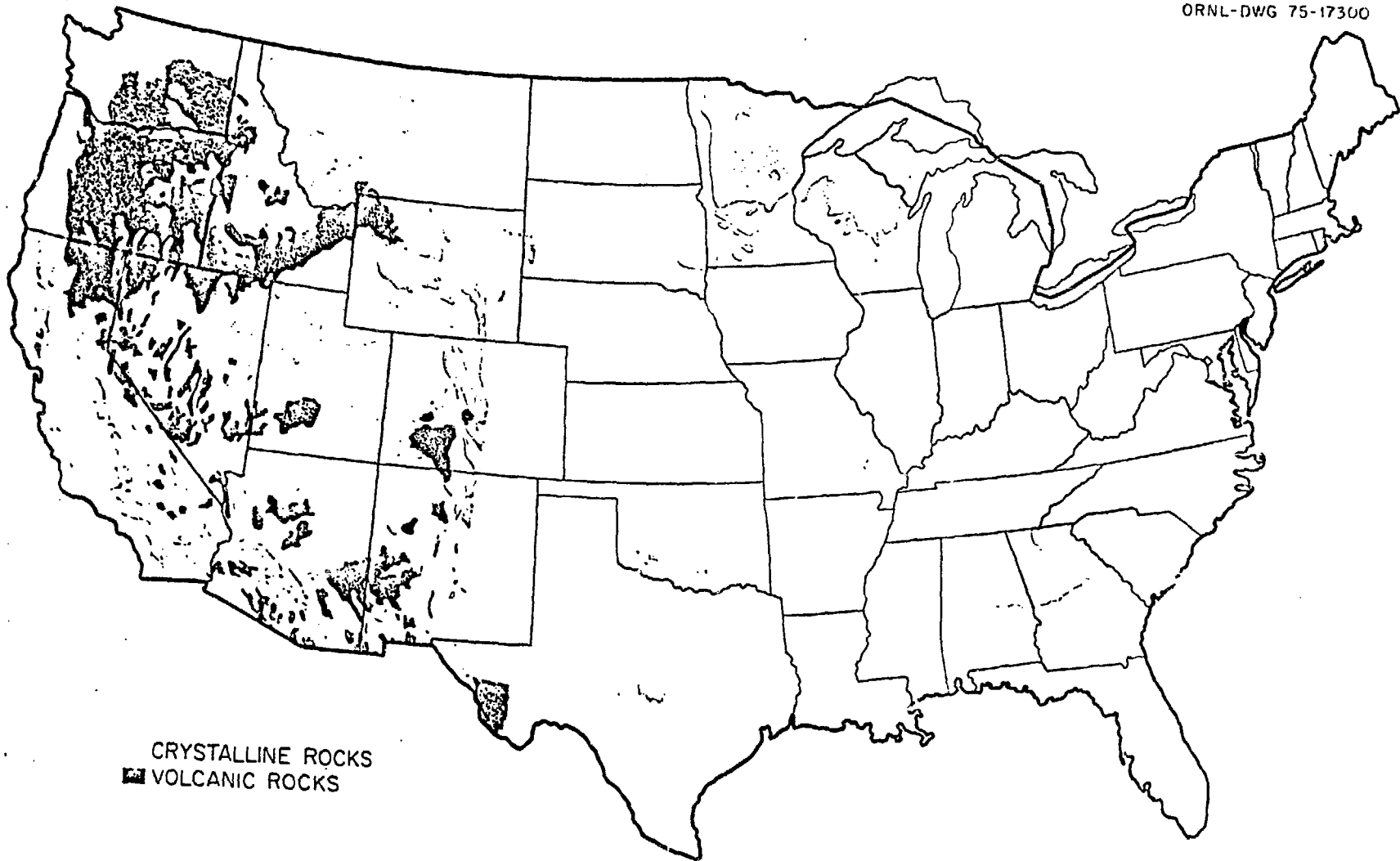
- DISPOSAL INTO OUTER SPACE



ORNL-DWG 74-1641



Thick Bodies of Shale, Mudstone, and Claystone in the U.S.

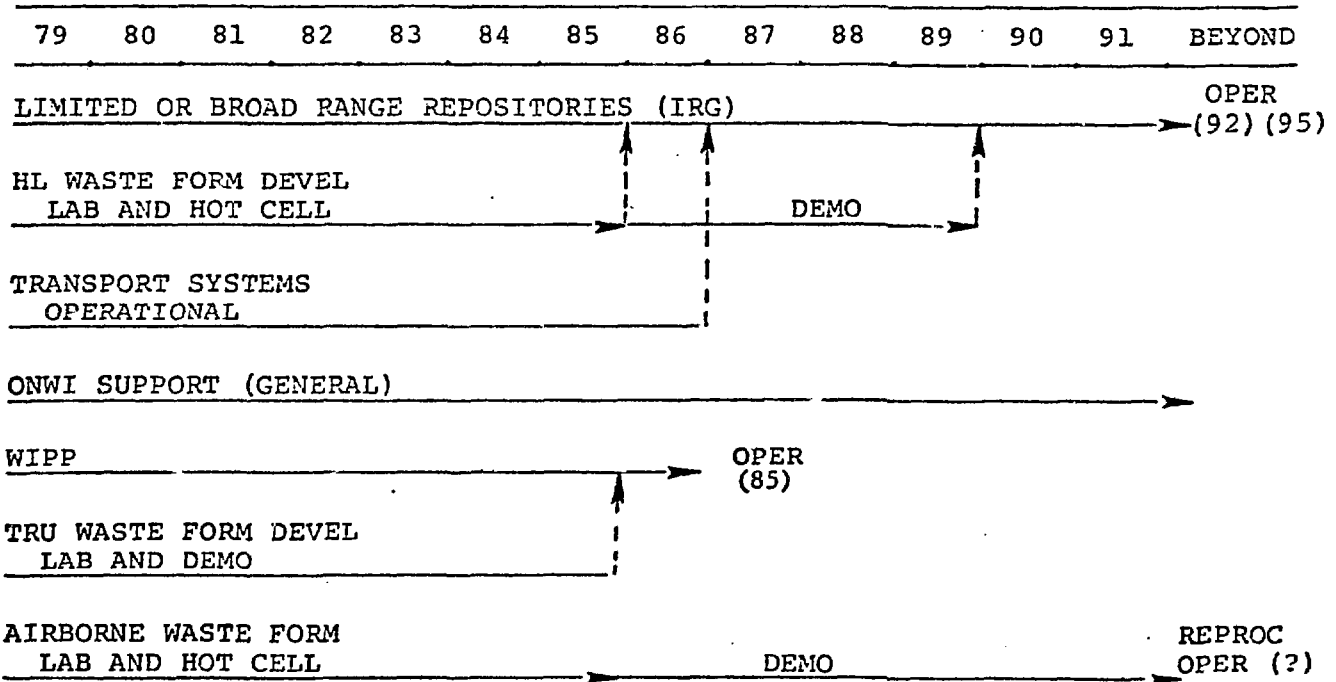


CRYSTALLINE ROCKS
■ VOLCANIC ROCKS

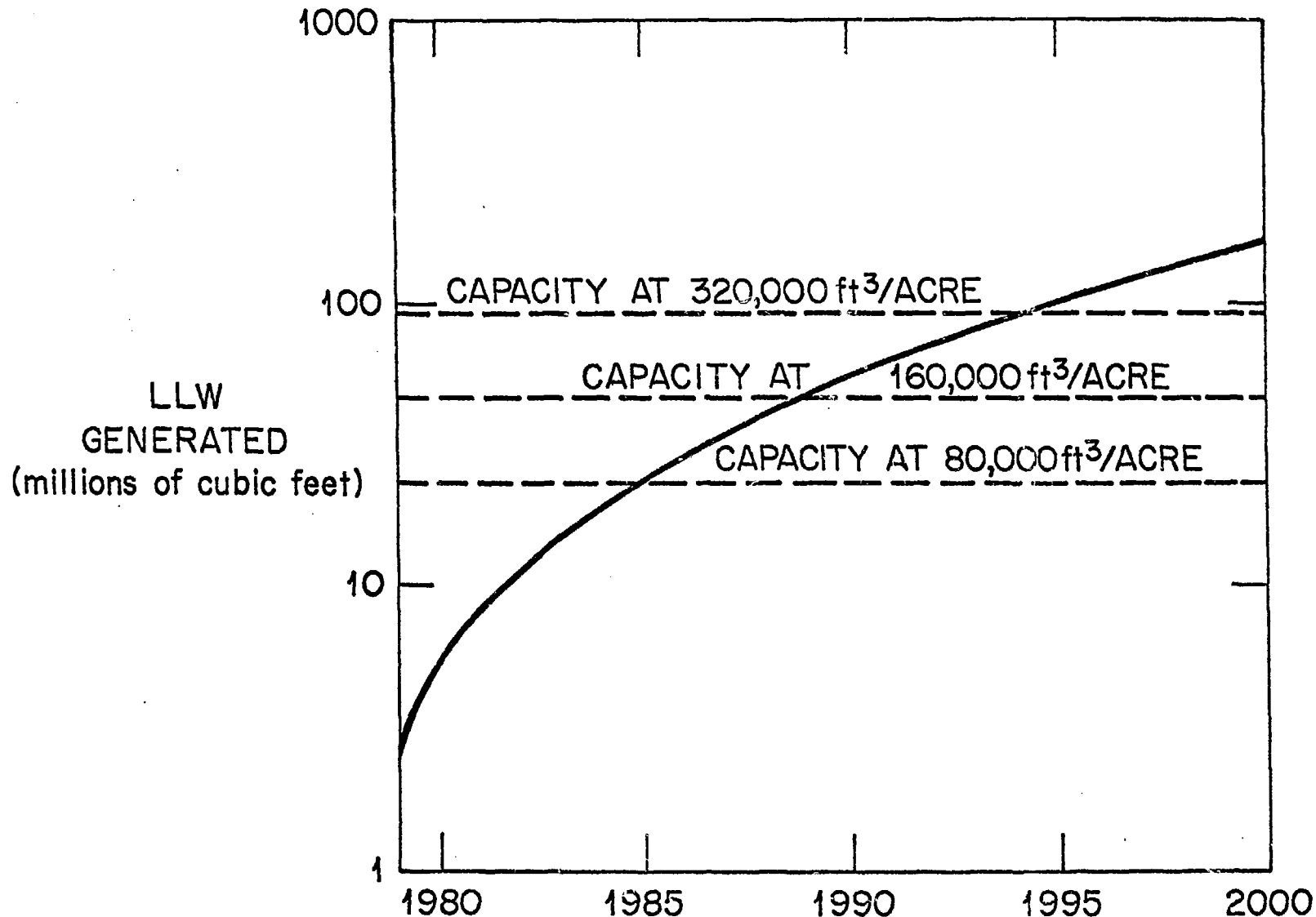
Crystalline and Volcanic Rocks in the U.S.

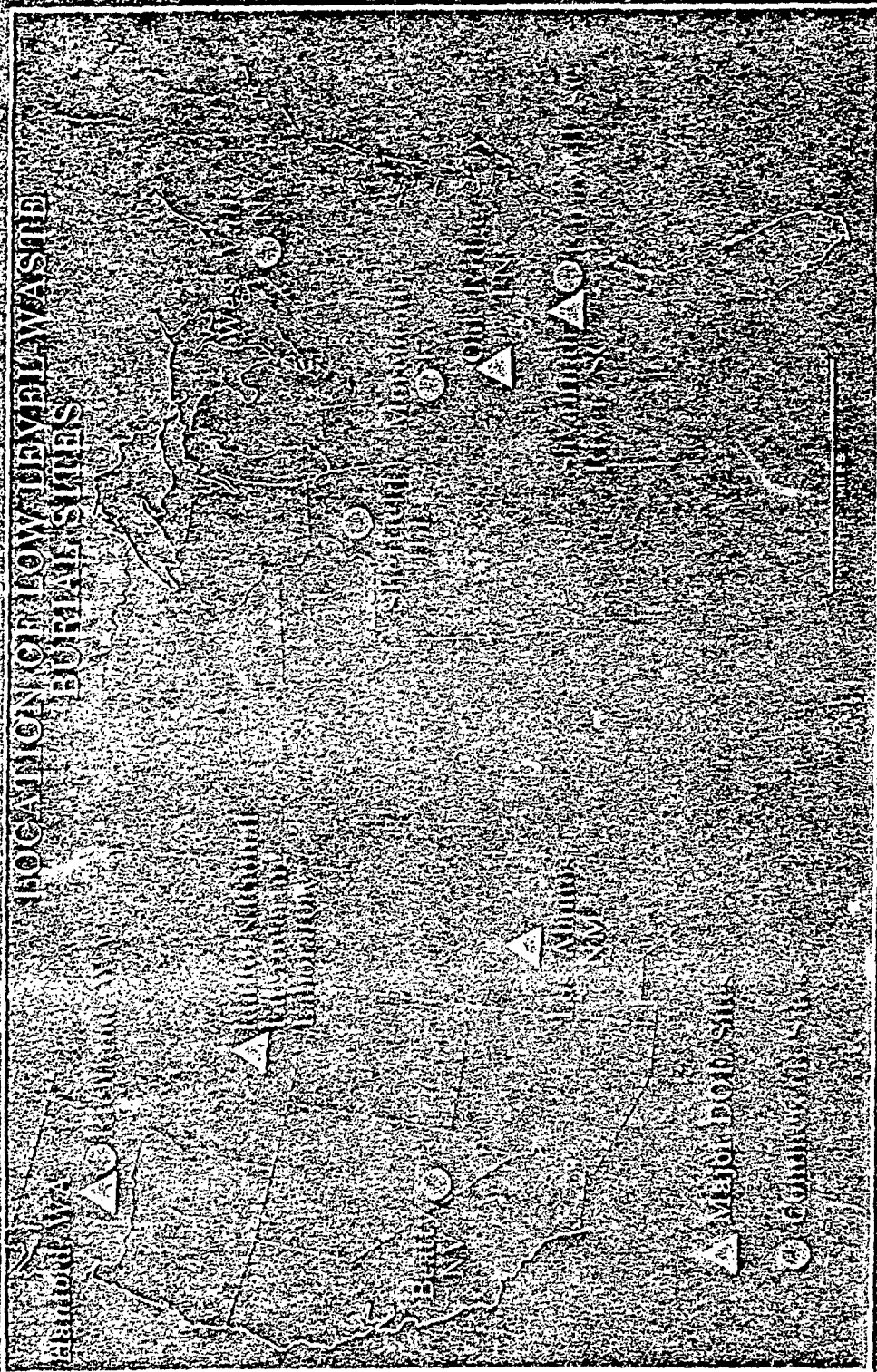
SCHEDULES FOR WASTE PROGRAMS ARE DEPENDENT ON UNCERTAINTIES
IN TIMING FOR REPOSITORIES AND REPROCESSING

CALENDAR YEAR



CAPACITY FOR DISPOSAL OF LLW COULD BECOME A CRITICAL PROBLEM IN THE NEAR FUTURE





**PROBLEM IN LOW-LEVEL WASTE IS TO DEAL WITH THE
INHERITED PROBLEMS AND PLAN FOR FUTURE**

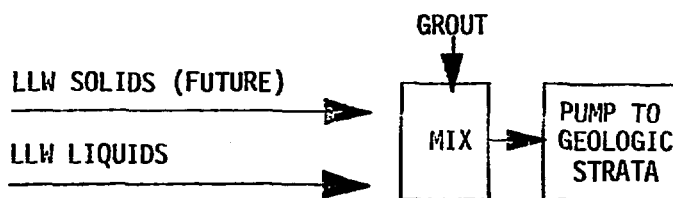
BURIAL GROUNDS - STABILIZE TO PREVENT LEAKAGE

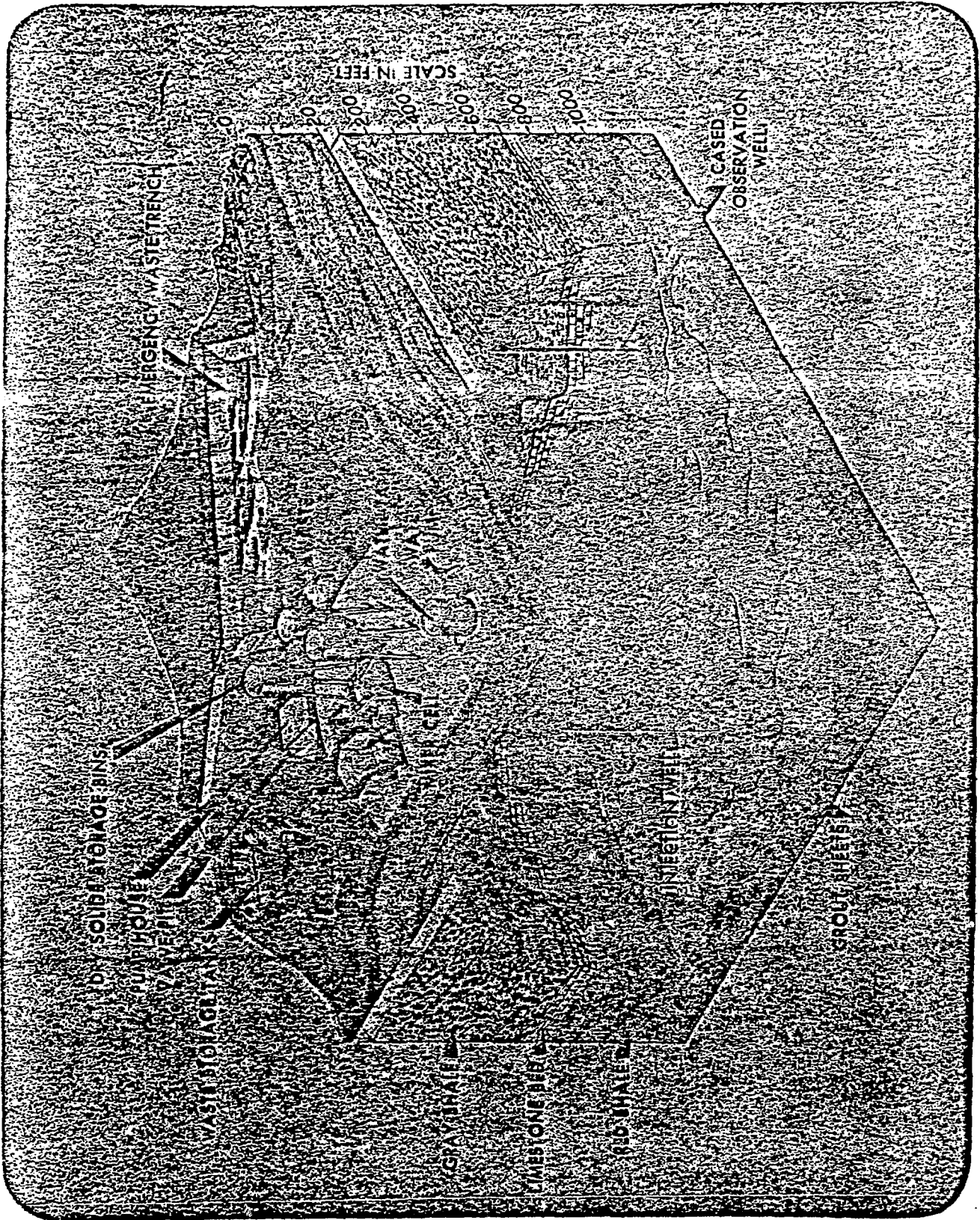
- IMPROVE PACKAGING
- IMPROVE MONITORING

ALTERNATIVES - REDUCTION OF VOLUME

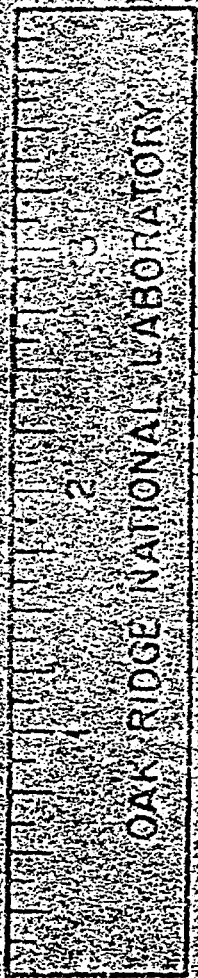
- BETTER DISPOSAL SITES AND
METHODS

**HYDROFRACTURE IS THE ONLY OPERATIONAL ALTERNATIVE
TO BURIAL GROUNDS AND RETRIEVABLE STORAGE**





EXISTING HYDROFRACTURE SCHEMATIC



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CORE SAMPLE FROM DISPOSAL ZONE SHOWING GROUT SHEETS

OTHER PROBLEMS NEED TO BE ATTACKED

- 1. DECONTAMINATION AND DECOMMISSIONING AND RESULTANT WASTES**
 - (a) OLD MANHATTAN ENGINEERING DISTRICT SITES**
 - (b) PRODUCTION FACILITIES**
 - (c) R & D FACILITIES**
 - (d) REACTORS**
- 2. MILL TAILINGS**
- 3. REDUCTION OF GASEOUS EFFLUENTS (FOR REPROCESSING)**
- 4. TRANSPORTATION**

INSTITUTIONAL ISSUES

- **PROLIFERATION OF STATE AND LOCAL LAWS**
- **NEED FOR A FEDERAL TRANSPORT SYSTEM**
- **ACCIDENT RESPONSE PREPAREDNESS**
- **PUBLIC INFORMATION**

NECESSARY POLICY DECISIONS

- WHAT IS ACCEPTABLE RISK
- METHODOLOGY FOR ESTABLISHING RADIATION AND SAFETY STANDARDS
- SECURITY REQUIRED FOR WASTE SHIPMENTS
- WASTE ACCEPTANCE CRITERIA FOR DISPOSAL
- ADEQUACY OF GEOLOGIC FORMATIONS FOR PERMANENT WASTE DISPOSAL
- GOVERNMENT-SUPPORTED AFR'S

WHAT NEEDS TO BE DONE?
TECHNICAL

FOR WASTES

1. PROCESS TECHNOLOGY

APPLY PROCESSING AND SOLIDIFICATION
METHODS (DEVELOP SOME)

2. EITHER:

(a) BUILD ENGINEERING SURFACE STORAGE
FACILITIES, OR

(b) USE GEOLOGIC REPOSITORIES

FOR SPENT FUEL

1. CONSTRUCT STORAGE FACILITIES

FOR WASTE AND SPENT FUEL

1. IMPROVE TRANSPORTATION SYSTEM

WHAT IS BEING DONE?

DOE

PROCESSING AND WASTE FORM IMPROVEMENTS

HLW
TRU
LLW
AIRBORNE

REMEDIAL ACTION

BURIAL GROUNDS
DECONTAMINATION-
DECOMMISSIONING

REPOSITORIES

WIDE RANGE OF
GEOLOGIC MEDIA
SPENT FUEL STORAGE

TRANSPORTATION

IMPROVED HARDWARE
AND LOGISTICS

EPA, NRC

CRITERIA/REGULATIONS

ENGINEERS AND SCIENTISTS BELIEVE THE TECHNOLOGY
IS AVAILABLE FOR ALMOST ANY ALTERNATIVE

1. PROCESS TECHNOLOGY IS IN AN ADVANCED STATE
2. GEOLOGIC REPOSITORIES ARE FEASIBLE (RETRIEVABLE,
IF NECESSARY)
3. ENGINEERED STORAGE FACILITIES ARE FEASIBLE
4. TRANSPORT SYSTEMS CAN BE PLACED ON A MORE
ORGANIZED BASIS

SO - WHAT'S THE PROBLEM?

NONE OF THESE EXIST!

- 1. MUST HAVE FINANCIAL INCENTIVES UP FRONT
FOR ACCEPTANCE**
- 2. MUST HAVE CRITERIA AND STANDARDS DEVELOPED
BY REGULATORS**
- 3. MUST HAVE COURAGEOUS DECISIONS FROM THE
POLITICAL ARENA**
- 4. MUST HAVE DEMONSTRATIONS TO GAIN PUBLIC
CONFIDENCE**

WHAT CAN YOU DO?

1. DEMAND DEMONSTRATIONS OF WELL CONCEIVED FACILITIES
2. DEMAND LEGISLATIVE CHANGES WHICH WILL CONTRIBUTE TO PUBLIC ACCEPTANCE