PLUTONIUM IMMOBILIZATION
OVERVIEW FOR THE US NWTRB

THE OFFICE OF FISSILE MATERIALS
DISPOSITION

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Immobilization Topics

- Background on plutonium disposition program
- Progress since January 1996 briefing to NWTRB
- Immobilization project overview
- Immobilized form
  - description
  - development
  - characterization
Disposition Program Background

- "Excess fissile materials pose a clear and present danger to national and international security" [1/94 NAS report]
- Permanent fissile materials disposition office established, reporting to DOE Under Secretary [P.L. 103-337, 10/94]
- "I believe that the dual-track approach for eliminating excess U.S. weapons plutonium stockpiles best serves our arms reduction and nonproliferation goals" [President Clinton, 2/97]

Surplus Plutonium

<table>
<thead>
<tr>
<th>Location</th>
<th>Amount (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hanford</td>
<td>11.6</td>
</tr>
<tr>
<td>Idaho</td>
<td>4.2</td>
</tr>
<tr>
<td>Rocky Flats</td>
<td>11.8</td>
</tr>
<tr>
<td>Los Alamos</td>
<td>1.8</td>
</tr>
<tr>
<td>Pantex</td>
<td>21.3</td>
</tr>
<tr>
<td>Savannah River</td>
<td>1.9</td>
</tr>
<tr>
<td>Other Sites</td>
<td>0.2</td>
</tr>
<tr>
<td>Total</td>
<td>52.5</td>
</tr>
</tbody>
</table>

* This total includes ~ 7 MT of irradiated fuel
Progress Since 1/96 TRB Briefing

Office of Fissile Materials Disposition

- Hybrid approach for plutonium disposition [MOX fuel in existing reactors and Pu immobilization] picked in 1/97 record of decision (ROD) and based on:
  - environmental analyses [DOE/EIS-0229]
  - technical, cost and schedule considerations [DOE/MD-0003]
  - nonproliferation analyses [DOE/NN-0007]
- Can-in-canister at Savannah River Site announced as preferred immobilization approach in 5/97 [notice of intent to prepare tiered EIS]

Hybrid Approach

Office of Fissile Materials Disposition

Dismantle Nuclear Weapons

Store Nuclear Material Components

Convert Nuclear Material Components & Prepare Materials

Mixed Oxide Fuel for Burning in Existing Reactors

Immobilization in Glass or Ceramic

Spent Nuclear Fuel

Vitrified High Level Waste Canister

Geologic Repository
Immobilization Project Objectives

- Project goal: Develop and deploy can-in-canister immobilization by 2005
- Immobilized form that:
  - Meets the spent fuel "standard"
  - Qualifies for repository acceptance
  - Can effectively incorporate Pu, U, and neutron absorbers as well as expected impurities
- Immobilization process that:
  - Meets ES&H and S&S requirements
  - Is sufficiently flexible to attain quality products while accommodating available Pu feeds
- Facility concept that is cost effective and flexible

Can-in-canister Immobilization approach
Immobilization assumptions

- Plan on immobilizing 50 MT Pu [pending decision in '98 on split of material to MOX and CIC] in ~10 years.
- Incoming material will be unclassified and stabilized: metals, oxides, unirradiated reactor fuel.
- HLW canisters are available for plutonium mission
  - ~ 175 canisters/year [if 50MT in 10 years]
  - > 100 r/hr 30 years after fabrication
- Immobilized Pu/HLW canisters will go to the federal waste management system [once “qualified” by meeting all applicable acceptance criteria]

Immobilization Project
Immobilization Technology Selection

FY97 R & D Program

1. Form Development
   - Pu, U solubilities
   - Impurity tolerance
   - Therm stability
2. Characterization
   - Durability in Repository
   - Rad effects
3. Fabrication Process
   - Proc. Parameters
   - Flowsheet
   - Scale ability
4. Preconceptual Engineering Study
5. Proliferation Resistance

Office of Fissile Materials Disposition

Criteria & Metrics

Development of Selection Criteria

Presentation to Technical Evaluation Panel

Experimental & Engineering Data

TEP Evaluation versus Criteria Metrics

7/28-8/22

7/28-30

7/28-8/29

Peer Review

Draft TEP Report

Draft Recommendation

5/18-21

RR

Recommendation to DOE:
- LLNL Recomd. Report
- TEP Report
- PRP Ltr. Report

R&D for Form Downselect

Forms developed to handle expected impurities in feed materials
- approximately 90 glass and 30 ceramic samples with plutonium produced and tested

Flowsheets/layouts developed and key process equipment evaluated

Focus on ceramics as immobilized form based on
- both glass and ceramics have the potential to meet mission objectives
- ceramics offer small to moderate advantages in proliferation resistance, potential worker dose, and cost effectiveness
Savannah River Site

- Preferred site for plutonium immobilization
  - Leverage off operational Defense Waste Processing Facility
  - Backup site is Hanford due to planned HLW vitrification plant
- Potential to leverage off planned Actinide Packaging and Storage Facility by expanding storage.
- Involved with LLNL in developing the immobilization technology
- Early demonstration of the can-in-canister technology is planned at SRS.

Immobilization Project Organization

- DOE-MD
  - LLNL R&D Lead
  - Technical Program Integration
  - Plant Project
    - AE TBD
- DOE-EM
  - Stabilized Pu HLW Program
- DOE-OCRWM
- ANSTO
  - Ceramic R&D
- LLNL
  - Ceramic R&D Process/equip.
  - RD&T with Pu
  - Special equip.
  - design/dev.
  - Tech. transfer
  - Project support
- ANL
- PNNL
- WSRC
  - Special equip.
  - design/dev.
  - Integrated hot demonstration
  - Pre & conceptual eng. studies
  - Project support
  - Operations