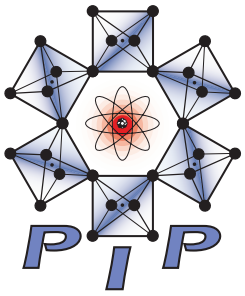
UCRL-ID-131072

Fissile Materials Disposition Program



Rough Order of Magnitude Cost Estimate for Immobilization of 18.2 MT of Plutonium Using Existing Facilities at Hanford

Alternatives 4A/8/10

Prepared by Bechtel for
Lawrence Livermore National Laboratory

June 1998

Plutonium Immobilization Project

Lawrence Livermore National Laboratory
Livermore, California 94550

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1.0 Introduction

The purpose of this Cost Estimate Report is to identify preliminary capital and operating costs for a facility to immobilize 18.2 metric tons (nominal) of plutonium as a ceramic in an existing facility, the Fuels and Materials Examination Facility (FMEF), at Hanford.

The technical engineering data used as the basis for this study is presented in the EIS Data Call Input Report, "Plutonium Immobilization Plant Using Ceramic in Existing Facilities at Hanford." The FMEF will require minimal facility modifications to accommodate the plutonium immobilization mission. Adequate space is available within the FMEF for installation of the immobilization process equipment. Facility HVAC, utility, and support systems exist to support the immobilization operations. Building modifications are primarily the removal of the SAF line (gloveboxes and support equipment) on the 70' level and building interior changes.

The facility design for a 50 metric ton plutonium throughput plant will be used for the 18.2 metric ton facility. Plutonium conversion operations will operate at the same design rate as the 50 metric ton facility over the 10 year operating period. Some of the process equipment will operate for a shorter period of time and fewer operators will be required. The assumptions, missions, design bases, facility and process descriptions, and accident analyses are the same. Therefore it is assumed that the capital cost for the 18.2 metric ton facility it is assumed identical to that of the 50 metric ton facility. However, the following operating costs will be less: consumable materials, equipment replacement and maintenance labor, employment requirements, and waste generation.

The Plutonium Immobilization Plant (PIP) will process 1.8 metric tons of plutonium materials per year. Plutonium from DOE sites is received and processed (physically and chemically) into an oxide form in the plutonium conversion portion of the plant. In the first stage immobilization process, the plutonium oxide is then incorporated into ceramic form by blending and weighing with ceramic precursor, binder and water. The mixture is dried, pressed into discs (pucks), sintered in a furnace, cooled, inspected and loaded into cans. The filled cans are then mounted on a rack inside a defense high level waste (HLW) canister. The canister will be transferred by truck to the planned Hanford waste vitrification plant to undergo a second stage immobilization, which fills the canister with radioactive HLW glass. A total of 17.3 metric tons of plutonium ceramic discs in 1,900 cans, loaded into 68 HLW canisters will be produced annually. The plant is operated for

10 years to process the entire 18.2 metric tons of plutonium metal and oxide to be immobilized.

The estimates were developed from preconceptual engineering data developed for the Environmental Impact Statement (EIS) Data Call Input Report and site visits, and utilized historical cost data from similar nuclear and industrial projects, as well as budget-level cost quotations where available. It should be noted that the estimates developed in this and subsequent reports for other alternatives are intended to provide a basis for comparison of significant cost differences between the alternatives and are not intended to yield project budget costs. Exceptions and/or additions to these assumptions and exclusions are noted. Accordingly, reconciliation between this estimate and previous estimates for similar options is inappropriate.

2.0 Management Summary

2.1 Costs

The cost analysis including capital, operating and maintenance, and decontamination and decommissioning costs for the Plutonium Immobilization Plant in an existing facility (FMEF) at Hanford are presented in this report. These costs are summarized in Table 1.

TABLE 1 Cost Summary
Plutonium Immobilization Plant in Existing Facilities at Hanford

Section	CATEGORY	Cost-($M)'97 $
4.1	Technology Development	excluded
4.2	Process Equipment	232
4.3	Process Facilities	79
4.4	Site Improvement and Support Facilities	7
4.5	Regulatory Compliance	excluded
	Total Phase I Facility Capital Costs	**318**
4.6	Operations and Maintenance (10 years)	350
4.7	Decontamination & Decommissioning	45
	Total Costs	**713**

The costs are presented in millions of fourth quarter 1997 dollars. The costs reflect a contingency of 40% for Process Equipment, Process Facility and Site Improvement and Support Facilities, and no contingency for Operation and Maintenance.

Facility capital costs include engineering, construction, equipment fabrication, initial spare parts, installation, certification and testing, and project management. The total costs do not include costs for technology development and regulatory compliance. The estimates of these costs will be covered in separate cost estimate reports. Also, costs for site qualification, site selection, oversight/ownership, fees, royalties, payments-in-lieu-of-taxes, and cost of capital are not included. Transportation costs are not included.

Costs for Process Equipment include estimates for major process equipment as shown in the equipment list for this option. Note the equipment list is based on the EIS Data Call Input Report and layouts. These costs were developed based on informal vendor quotes (where available), previous estimates for similar equipment, current estimating manuals, or estimates based on equipment weights, materials of construction and transportation to the site.

Section	CATEGORY	Cost-($M) '97 $
4.2	**Process Equipment**	**Total**
4.2.1	Engineering	40
4.2.2	Fabrication	90
4.2.3	Installation	88
4.2.4	Certification and Test	5
4.2.5	Project Management	9
4.2	**Total**	**232**

Cost for Process Facilities includes costs for structural modifications to the FMEF. These modifications are primarily the demolition and removal of the SAF line on the 70' level. This includes disassembly and removal of gloveboxes, support equipment, piping, ducts, conduit, and interior partition walls. No radioactive materials have been introduced into the FMEF, thus decontamination is not required. Other modifications include installing a doorway and opening in the Decon Cell shield wall and installing a material conveyor between the 42' and 70' levels. A mezzanine is constructed in the

Upper Process Cell on the 42' level and interior partition walls are constructed throughout.

These costs are based on preliminary estimates of building structural materials (e.g. concrete, rebar, etc.) and estimates of facility support equipment (such as building heating, ventilating and air conditioning; fire protection, electrical motor control centers, etc.). Pricing of these materials and systems was developed from historical data from previous estimates for similar equipment in similar service, from current estimating manuals, or by the use of historical factors developed for similar nuclear/industrial projects.

Section	CATEGORY	Cost-($M) '97 $
4.3	**Process Facilities**	**Total**
4.3.1	Engineering	14
4.3.2	Construction	60
4.3.3	Project Management	5
4.3	**Total**	**79**

The FMEF is an existing facility. Support systems such as HVAC (glovebox and building), utilities (compressed air, process gases, water, cooling water, etc.), and electrical power are existing and assumed to be adequate to support the PIP. Site Improvement and Support Facilities are existing. Costs for site improvements and plant utilities and services include only allowances for inspection, repair and upgrade as necessary of existing systems. All other support systems are existing.

Section	CATEGORY	Cost-($M) '97 $
4.4	**Site Improvement and Support Facilities**	**Total**
4.4.1	Engineering	1
4.4.2	Construction	5.5
4.4.3	Project Management	0.5
4.4	**Total**	**7**

Operations and maintenance costs include labor, materials, utility and waste management and disposal costs necessary to operate the facility at design

capacity for 10 years. Facility start-up cost is factored at 120% of the annual operation and maintenance labor cost.

Section	CATEGORY	Cost/yr-($M) '97 $
4.6	**Operation and Maintenance**	**Total**
4.6.1	All consumable materials	5
4.6.2	Utilities	1
4.6.3	Labor	24
4.6.4	Waste Management and Disposal	2
4.6	**Total cost per year**	**32**
	Facility Start-up	28
	Total for 10 years	**350**

Decontamination and decommissioning (D&D) costs are based on the assumption that a DOE M&O contractor or A/E will shut-down, decontaminate, and remove contaminated or other surplus equipment from the facility. The cost of D&D is assumed to be 10% of the facility capital costs for a similar facility (i.e., PIP in new construction at SRS) with an adjustment for FMEF building size.

Section	CATEGORY	Cost-($M) '97 $
4.7	**Decontamination & Decommissioning**	**45**

3.0 Assumptions and Exclusions

3.1 Assumptions

Major design assumptions are based on the technical engineering data developed during 1997 and used as the basis for the EIS Data Call Input Report. Capital cost equipment and facilities are therefore based on preliminary layout drawings found in the EIS Data Call Report and the equipment list developed for the EIS design. Operating costs are based on data tables in the EIS report. A number of cost estimate factors, for parametric analysis, were developed from meetings held between DOE, Lawrence Livermore National Laboratory, Fluor Daniel, Burns and Roe, and Bechtel.

3.2 Exclusions

The following major items have been excluded from the estimates:

- Cost of land
- R&D / technical development costs
- NEPA, licensing and permitting costs
- DNFSB / DOE oversight costs
- Revenues
- Transportation costs
- Escalation beyond the fourth quarter of FY 1997
- Regulatory compliance documentation
- M&O fees
- Payments-in-lieu-of-taxes to local communities
- Government fees to privately owned facilities
- Transportation or storage of plutonium forms and wastes out of facility (off-site)
- Existing FMEF and planned Hanford HLW vitrification facility
- Existing support and service facilities
- Waste management facilities

4.0 Cost Estimates

Cost estimates have been developed for Capital, O&M and D&D cost components.

4.1 Technology Development

The costs for research and development to support the Plutonium Immobilization Plant are not included in the scope of this cost estimate report. Estimates of costs to complete the research and development necessary before detailed design and engineering will be covered in a separate report.

4.2 Process Equipment

The process equipment cost estimate provides costs for the major process equipment as listed in the equipment list developed for the Plutonium Immobilization Plant using ceramic in existing facilities at Hanford. It also includes costs for process piping and instrumentation. Costs are based on vendor quotes (where available), historical costs of similar equipment in similar service, current estimating/pricing manuals or estimated costs per pound of equipment of the same complexity and materials of construction.

Factors are included for process equipment initial spares, distributable field costs, contractors bond, overhead and profit, construction and project management.

4.2.1 Engineering

An allowance of 25% of the total field costs for Architect/Engineering Title I and II design, engineering, and procurement support cost are included in this estimate. An additional 15% of Title I and II engineering cost is also included for Title III engineering and field verification.

4.2.2 Fabrication

Costs for fabrication includes costs for shop or field fabrication of process equipment, piping, or instrumentation.

4.2.3 Installation

Costs for the installation include the costs associated with field installation of process equipment utilizing the manual labor rates for Washington issued by Burns and Roe and a standard 40 hour work week. No productivity penalty factors have been applied for installation in FMEF.

4.2.4 Certification and Test

Costs for certification and test of process equipment are based on an allowance of 5% applied to the fabrication cost.

4.2.5 Project Management

Project management costs for the process equipment include all required project supervision and field management. It is assumed that the DOE will hire an Architect-Engineer (A/E) construction program manager to interact with the design A/E's, equipment vendors, and the construction contractor.

4.3 Process Facilities

The Process Facilities estimate includes all costs for the modifications to the FMEF and Fuel Assembly Area (FAA) wing. The cost of the HLW vitrification plant is not included.

The following subsections describe the major cost estimating assumptions and estimating bases:

4.3.1 Engineering

An allowance of 25% of the total field costs for Architect/Engineering Title I and II design, engineering, and procurement support cost are included in this estimate. An additional 15% of Title I and II engineering cost is also included for Title III engineering and field verification.

4.3.2 Construction

Construction costs for process facilities includes the costs associated with field installation of all bulk construction materials and support equipment associated with the process facility building utilizing manual labor rates for Washington issued by Burns and Roe, and a standard 40 hour work week.

4.3.3 Project Management

Project management costs for the process facilities include all required project supervision and field management. It is assumed that the DOE

will hire an A/E construction program manager to interact with the design A/E's, equipment vendors, and the construction contractor.

The major assumptions and cost estimate bases for the process facility are:

4.3.4 Process Building

Modifications to the existing FMEF include demolition and removal of interior concrete and metal stud partition walls, disassembly and removal of existing gloveboxes and equipment, construction of new interior partition walls, and new openings in existing concrete walls and floor slab.

Other Process Building material quantities including electrical components, instrumentation, lighting, etc. are quantified using preliminary takeoffs from the EIS Data Call Input Report. Costs for new support equipment and systems needed for the facility are based on the support equipment list priced using previous estimates for similar equipment or systems as a guide, current estimating manuals, or estimated costs based on equipment weights and materials of construction.

4.4 Site Improvement and Support Facilities

The site improvement and support facilities includes the costs of site improvements, utilities, services and support buildings. The costs for these items is minimal because most are already existing. An allowance for inspection, repair and upgrade as necessary of existing systems is included.

The following support buildings are existing: administration building, fire and medical station, cooling tower, entry control building, and sanitary and industrial waste treatment facilities.

Assumptions and estimate bases for site improvements and utilities are covered in Appendix A of this report.

4.4.1 Engineering

An allowance of 25% of the total field costs for Architect/Engineering Title I and II design, engineering, and procurement support cost are included in this estimate. An additional 15% of Title I and II engineering cost is also included for Title III engineering and field verification.

4.4.2 Construction

Construction costs for the site improvement and support facilities includes the costs associated with field labor, installation of all bulk construction materials and support equipment associated with each site improvement, utility, service or support facility building utilizing manual labor rates for Washington provided by Burns and Roe and a standard 40 hour work week .

4.4.3 Project Management

Project management costs for the process facilities includes all required project supervision and field management. It is assumed that the DOE will hire an A/E construction program manager to interact with the design A/E's, equipment vendors, and the construction contractor.

4.5 Regulatory Compliance

Permits, licensing and environmental documentation are not included in the scope of this cost estimate. Estimates of the costs of permits, licensing, and environmental documentation are covered in a separate cost estimation report.

4.6 Operations and Maintenance

The operations and maintenance (O&M) cost estimate for the Plutonium Immobilization Plant includes total annual costs for operating personnel wages, utilities, consumable, operation material and maintenance expenditures, and waste disposal. Total operations and maintenance estimates are based on immobilization of plutonium over a 10 year period.

4.6.1 Materials

Cost of consumable materials for process operations such as chemicals, ceramic precursor, binder and lubricant are based on costs found in "Chemical Marketing Prices Report" magazine**.** For additional cooling tower water system treatment chemicals, the cost estimate is based on a Nalco Chemical Company preliminary quotation. Cost for uranium dioxide (UO_2) is based on a quoted price of $53/kg from Cameco Corp. (Canada). Cost of product cans and canisters are based on pricing from Savannah River Site (DWPF). Operating material costs for 500 cu ft waste container boxes and 55-gallon drums are based on packaging costs from Burns and Roe. The cost for facilities and equipment maintenance is based on an allowance of 1/2% of the total equipment

capital cost plus 1% of the total facility operation and maintenance labor cost. The cost for major capital replacement is based on an allowance of 1% of facility equipment capital cost (excluding demolition costs).

4.6.2 Utilities

The cost for utilities and services, including materials, safety, environmental and security, are based on the current electricity, water usage, and telephone service cost at Hanford.

4.6.3 Labor

Operations cost for personnel is based on the facility operating manpower requirements described in the Plutonium Immobilization Plant Using Ceramic EIS Data Call Input Report. The rate for non-manual labor employee including updated burden rates are based on DOE wage rate for Washington. Wages for manual labor employee including updated fringe benefits are based on wage rates for Washington issued by Burns and Roe.

4.6.4 Waste Management and Disposal

Waste management and disposal costs are estimated based on waste disposal cost information supplied by Burns and Roe for treatment and disposal of transuranic waste. Disposal costs for hazardous, mixed and low level radwaste were based on information from Hanford.

4.7 Decontamination and Decommissioning

Decontamination and decommissioning (D&D) costs are based on the assumption that a DOE M&O contractor or A/E will shutdown, decontaminate, and remove contaminated and surplus equipment from the facility. The cost of D&D is assumed to be 10% of the facility capital costs for a similar facility (i.e., PIP in new construction at SRS) with an adjustment for FMEF building size.

Appendix A - Assumptions and Estimate Bases

A-1 Assumptions

Client	Lawrence Livermore National Laboratory
Project Location	400-Area, Hanford Site, Washington
Project Scope	The project consists of the comparison of capital and O&M costs for several facility options for plutonium immobilization.
Scope of Option	Design, procurement, construction and operating costs for a Plutonium Immobilization Plant using an existing facility (FMEF) located at Hanford.
Type of Estimate	Order of magnitude capital cost estimates
Purpose of Estimate	Compare the costs of several facility options and locations of the process plants for plutonium immobilization.
Pricing Level	Costs are at 4th quarter, 1997. Escalation is excluded.
Project Schedule	Estimate assumes a “normal” schedule without scheduled overtime. However, in areas of restriction and modifications, multiple shifts of working schedule will be applied as required.

A-2 Existing Construction Estimate Bases

I. Capital Costs Estimate

Scope Definition

Scope of the work is based on site visits, drawings, sketches, flow diagrams and equipment lists presented in the EIS Data Call Input Report, Plutonium Immobilization Plant Using Ceramic in Existing Facilities at Hanford.

- Modifications to the existing FMEF Building were based on six FMEF layout plans, one FAA layout plan, and four marked-up drawings of FMEF for demolition.

- Process equipment was defined by the equipment list, EIS Data Call Report, flow diagrams, and Hanford Site support.

- Mechanical/HVAC were defined by a newly developed flow diagram, equipment list and layout sketches.

- Electrical/Instrument Control were based on newly developed single line diagram and equipment list.

Site Improvement & Utilities

The following were made as the bases of the cost estimate for site improvements and utilities:

- The site consists of a modified FMEF. The majority of the process equipment is installed on the 42' and 70' levels of FMEF.

Yard piping

This system is existing. Minimal allowance was provided for small modifications or improvements.

Yard electrical

This system is existing. Minimal allowance was provided for small modifications or improvements.

Pricing

Equipment Pricing:

Equipment was priced based on the description, capacity or size in the equipment list, with reference to previous estimates for similar facilities, in-house historical data bases, and current published information as available.

Glove Box Pricing:

All glove boxes are constructed of stainless steel, double-wall (water-wall) and lined with 1/4" lead on all sides, top and bottom, and include a support stand. The number of windows, glove ports, and electrical/utility penetrations were estimated for each glove box.

The glove boxes are fabricated at the vendor's shop and shipped to the site. The glove boxes will be delivered to a staging area, where equipment and controls will be installed in the glove boxes. The fitted glove boxes will be moved to the installation location in FMEF, installed and tested.

Bulk Materials Pricing:

Bulk materials were priced based on current estimating experience or recent publications of cost data such as Means and Richardson's estimating manuals.

Labor

Wages for manual labor employee including updated fringe benefits are based on wage rates for Washington issued by Burns and Roe.

Performance Factors:

The following adjustment factor was applied to the work performed inside the FMEF building

Location Factor (1.18) - Increase is due to the work performed located inside FMEF. This factor was only applied to the demolition work estimate.

Washington State Sales Tax

Washington State Sales Tax of 8% is included in material costs.

Distributable (General Conditions), Overhead and Profit Costs

Distributable costs, which include the temporary construction facilities, construction equipment, tools, personnel, field office costs and other distributable support costs are included to cover the distributable material costs, support and non-manual labor costs, contractor's overhead and profit.

Business and Occupational Tax

A tax rate of 0.471% is applied to equipment, materials, labor and subcontract costs.

Contractor's Bond

Contractor's bond is included.

Construction Management

Construction management costs, including the construction manager's overhead and profit, was included.

Engineering and Other Design Services

Engineering and other design services costs include functions such as project control, engineering, documentation, quality control, procurement, and support services. These costs were factored at 20% of the field costs.

Project Management

Project management costs are included.

Escalation

Escalation is excluded. Costs are at fourth quarter 1997 level.

Contingency

Contingency is included as follows:

Existing Facility, sole occupancy	40%

Exclusions

The following major items have been excluded from the estimates:

- Cost of land
- R&D/technical development costs
- NEPA, licensing and permitting costs
- DNFSB/DOE oversight costs
- Revenues
- Transportation costs
- Escalation beyond the fourth quarter of FY 1997
- Regulatory compliance documentation
- M&O fees
- Payments-in-lieu-of-taxes to local communities
- Government fees to privately-owned facilities
- Transportation or storage of plutonium forms and wastes out of facility (off-site)
- Existing FMEF and FAA buildings, and the planned HLW vitrification plant
- Existing of support and service facilities
- Waste management facilities