Mined Geologic Disposal System
Viability Assessment Cost Estimate Plan

Presented to:
Nuclear Waste Technical Review Board

Presented by:
Mitchell G. Brodsky
General Engineer
U.S. Department of Energy
Yucca Mountain Site Characterization Office
Las Vegas, Nevada

June 25-26, 1997
Outline

• Why we are doing the MGDS VA cost estimate
• Components of the estimate
• Estimating approach
• Cost control process and review plans
• Example draft estimate
• Key milestones on path to final MGDS VA cost estimate
• Issues and challenges
VA Cost Estimate Requirement

• MGDS-VA cost estimate required by the Energy and Water Development Appropriation Bill, 1997 (became law 9/30/97) H.R.3816

Nuclear Waste Disposal Fund

“.....That no later than September 30, 1998, the Secretary shall provide to the President and to the Congress a viability assessment of the Yucca Mountain site. The viability assessment shall include:

(1) the preliminary design concept for the critical elements for the repository and waste package;

(2) a total system performance assessment, based upon the design concept and the scientific data and analysis available by September 30, 1998, describing the probable behavior of the repository in the Yucca Mountain geological setting relative to the overall system performance standards;

(3) a plan and cost estimate for the remaining work required to complete a license application; and

(4) an estimate of the costs to construct and operate the repository in accordance with the design concept.”
Program/Project Cost Estimates - Usage

- MGDS-VA cost estimate
  - Provides the cost of a reference repository design
  - Used as input into Program cost estimates
  - Supports project trade and optimization studies

- Program cost estimates are used to
  - Determine waste fund fee adequacy
  - Determine defense funding required
  - Compare available funding with anticipated near-term costs
  - Determine Program economic viability
  - Perform Program trade and optimization studies
MGDS VA Cost Estimate Time Phases

98 MGDS-VA Cost Estimate

- D&E* 02-10
- Pre-Emplacement Construction 05-10
- Emplacement Ops. 10-33
- Caretaker Operations 34-59
- Closure and Decommissioning 60-66

98 Program Cost Estimate

- D&E* 83-10
- Pre-Emplacement Construction 05-10
- Emplacement Ops. 10-41
- Caretaker Operations 42-59
- Closure and Decommissioning 60-70

* Development and Evaluation
Elements Excluded From MGDS Estimate

- Historical MGDS D&E costs (prior to 1998)
  - Site characterization, prior design activities
- License application cost (10/98 - 3/02)
- Program costs
  - Waste acceptance
  - Storage
  - National transportation (Regional Servicing Agent (RSA) concept)
  - Other Program costs (NRC, NWTRB, misc.)
Elements Included in MGDS Estimate

- MGDS development and evaluation (D&E)
- Surface facilities
- Subsurface facilities
- Disposal containers
- Performance confirmation
- Nevada transportation
Development and Evaluation: Cost Estimating Approach

- Multi-year project plan approach
  - Includes design activities, management, institutional, Payment Equal To Taxes (PETT), and planning for performance confirmation and Nevada transportation construction activities
  - Expansion of the planning horizon from historical five-year planning to include activities through 2010
Surface Facilities: Cost Estimating Approach

- Radiological facilities
  - Design-based bottoms-up
  - Equipment--commercial database and quotes
  - Manpower--manpower studies, means database and site unique factors
  - Closure and decommissioning--factoring

- Balance of plant
  - Capital costs--scaling (MRS design/cost base)
  - Operation costs--manpower studies based
  - Closure and decommissioning--factoring
Subsurface Facilities: Cost Estimating Approach

- Design layout based excavation modeling
  - Efficiency based progress
    - Tunnel Boring Machine (TBM) primary method
    - Road headers/other excavation used
  - Ground support--bottoms-up
- Manpower based on crew assignment and schedules
  - Crew costs based manpower studies, crew efficiency considerations and NTS labor agreement rate bases
- Materials and equipment based on industrial reference databases
  - Dataquest
  - Western Mining Engineering
  - US Army Corps of Engineers
Disposal Containers: Cost Estimating Approach

- **Unit costs**
  - Design-based quantity takeoffs
  - Material costs based on supplier quotes
  - Other contributors include
    - Nye County sales tax
    - Factors for transport, project management
    - Contingency

- **Disposal container quantities**
  - Waste stream based
Performance Confirmation - Cost Estimating Approach

• Capital costs
  – Facilities estimated by Surface--capacity factoring; and Subsurface--bottoms-up
  – Boreholes scaled from historical local database

• Operations
  – Based on scaling and factoring
  – Data analysis, new studies, and scaling from historical local database
Nevada Transportation: Cost Estimating Approach

• Until such time that the transportation mode/route is selected, the following assumptions are made for cost estimating purposes
  – Assumes a government-owned and Regional Service Agency (RSA) operated rail line from a main railroad line to the repository
  – Route assumed to be the average of five rail route alternatives in EIS studies (in review)
Cost Control Process

Controlling Documents

- Documented Assumptions (HQ, YMSCO)
- M&O Cost Estimating Guide
- Cost Estimating, Analysis, and Standardization (DOE Order 5700.2D)
- DOE Cost Guide Volume 6, 11/94

References:
- Estimating Databases
- Selected Studies

Cost Activity

- Cost Estimate Review Process M&O/DOE
- Cost Estimate Document

Cost Integration Process

Project Cost Estimating Process

OR

Cost Trend Assessment

Design Outputs

- Design Inputs
- Design Activity (Preliminary)
- RDD

Technical Data for Cost Estimates
Assessing Accuracy and Risk

- Developing a plan for assessing risk of the overall estimate

- Current estimating guide and industry experience provides for a range of contingency levels, based upon design maturity, that which are applied to elements of the estimate
MGDS VA Estimate Reviews

- Yucca Mountain Project (YMP)
  - Multi-year planning January - February 1998
  - MGDS estimate April 1998 and July 1998

- External Review Team
  - Review completed segments and submit feedback at end of segment review
    » Assumption segment - October 1997
    » Disposal container segment - January 1998
    » D&E (multi-year segment) - February 1998
    » Repository and remaining elements - April 1998
    » Draft Final report - June 1998
Yucca Mountain is the Largest Element of Total System Life Cycle Costs

Relationships of Major Elements of Total Life Cycle Costs (Based on 1997 Program Cost Estimate)

- Payment Equal to Taxes (PETT) and Benefits (2%)
- Waste Acceptance, Storage, and Transportation Development and Evaluation and Operations (12%)
- Program Management and Other Development and Evaluation (13%)
- Mined Geologic Disposal System Development and Evaluation and Operations (73%)

Assumptions:
- Disposal of total requirement in a single repository.
- Emplacement 2010-2041.
- Closure 50 years after start of emplacement.
- No centralized interim storage.
- Disposal in large waste packages.
- Rail and truck transport (13 truck sites).
Repository Cost Drivers

70,000 MTU repository (scaled from 97 PCE)

- Development and Evaluation (2002-10)
  - $1,800 M (12%)
- Nevada Transportation
  - $750 M (5%)
- Performance Confirmation
  - $800 M (5%)
- Surface Facilities
  - $3,900 M (25%)
- Waste Package
  - Fabrication
  - $4,500 M (29%)
- Subsurface Facilities
  - $3,700 M (24%)

Total = $15,450 M FY 97 Dollars

The MGDS estimate is presently in work, the data presented herein is result of a scaling effort to be replaced by the cost estimate of the RDD Rev. 0

Assumptions:
- Disposal of 70,000 MTU in Yucca Mountain repository.
- Emplacement 2010-2033.
- Closure 50 years after start of emplacement.
- No centralized interim storage.
- Disposal in large waste packages.
- Rail and truck transport (13 truck sites).
Key Milestones

- Cost Analysis Report - VA assumptions  
  - 9/30/97
- Disposal container design freeze - 9/30/97
- Bin 3 freeze - 9/30/97
- Final design freeze (non-Bin 3) 2/10/98
- VA Document due - 8/28/98
Challenges

- Reconcile external review comments
- Incorporate late design changes which have a significant impact on the cost estimate
- Integrate design and related costs details from design segments
Backup Charts
98 MGDS Cost Products

- Post LA (02 - 10)
- LA Cost (98 - 02)
- Historical Costs

MGDS-VA 70K MTU

- MGDS input to 98 PCE* ~100K MTU

Other:
- Performance Confir.
  Transportation
- Surface Capital & OPS costs
- Subsurface Capital & OPS
- Waste Pkg. Unit Costs

Systems Engineering / Integration

* Program Cost Estimate
Total System Life Cycle Costs (Existing Estimate)

Major Elements of Total Life Cycle Costs
Billions of constant 1997 dollars

- Payment Equal to Taxes (PETT) and Benefits
- Waste Acceptance, Storage, and Transportation Development and Evaluation and Operations
- Program Management and Other Development and Evaluation
- Mined Geologic Disposal System Development and Evaluation and Operations

Total System Cost
$32.8 Billion (97$s)

Assumptions:
- Disposal of total requirement in a single repository.
- Emplacement 2010-2041.
- Closure 50 years after start of emplacement.
- No centralized interim storage.
- Disposal in large waste packages.
- Rail and truck transport (13 truck sites).
## Major Difference Between 95 TSLCC and 97 PCE

<table>
<thead>
<tr>
<th>Item</th>
<th>95 TSLCC</th>
<th>97 PCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste stream</td>
<td>SNF &amp; DHLW</td>
<td>SNF, DHLW &amp; DOE SNF</td>
</tr>
<tr>
<td>Mass Thermal Loading</td>
<td>100 MTU/acre</td>
<td>83 MTU/acre</td>
</tr>
<tr>
<td>Tunnel ground support</td>
<td>(minimal) Mesh &amp; rock bolts</td>
<td>Concrete liner</td>
</tr>
<tr>
<td>Emplacement drift Diameter</td>
<td>5 meters</td>
<td>5.5 meters</td>
</tr>
</tbody>
</table>