Update on Yucca Mountain Activities

Presented to:
Nuclear Waste Technical Review Board

Presented by:
Dr. J. Russell Dyer
Acting Project Manager
U.S. Department of Energy
Yucca Mountain Site Characterization Office
Las Vegas, Nevada

January 20-21, 1997
Agenda

• Project Plans for FY98
  – Managing the Viability Assessment
  – Components of the Viability Assessment
  – Design and scientific testing
  – Core science activities

• Near-Term Key Events
Managing the Viability Assessment

- Background
- Program documentation
- Summary schedule for completion of the VA
- VA management teams
- VA management groups

The Program’s principal objectives for the Yucca Mountain Project for 1998 are to:
- Prepare the VA and supporting documentation
- Prepare groundwork for completing the LA
- Continue site investigations and design activities leading to resolution of technical issues including the NRC’s KTIs
The VA will provide a basis for making an informed assessment of the feasibility to proceed with the process of licensing and constructing a repository at Yucca Mountain based on a current understanding of:

- A preliminary design concept
- System performance
- A plan leading to LA
- Cost to develop and operate a repository
## Summary Schedule for Completion of the Viability Assessment

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<th>Year</th>
<th>Month</th>
<th>Event Description</th>
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<tr>
<td>1998</td>
<td>July</td>
<td>VA Design to YMSCO (L-3)</td>
<td>6/30/98</td>
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<td>YMSCO Accepts VA Design (L-2)</td>
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<td>TSPA-VA to YMSCO (L-3)</td>
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<td>YMSCO Accepts TSPA-VA (L-2)</td>
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<td>License Application Plan to YMSCO (L-3)</td>
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<td>YMSCO Accepts LA Plan (L-2)</td>
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<td>Cost Estimate to YMSCO (L-3)</td>
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<td>YMSCO Accepts Cost Estimate (L-2)</td>
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<td>September</td>
<td>YMSCO Accepts Viability Assessment (L-2)</td>
<td>8/28/98</td>
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<td>October</td>
<td>OCRWM Accepts Viability Assessment (L-1)</td>
<td>9/4/98</td>
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<td>Secretary submits VA to Congress (L-0)</td>
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Managing the Viability Assessment (VA)

- Overall responsibility for the VA lies with the YMSCO
- Major policy issues are the responsibility of RW-1
- Management groups have been chartered to ensure that:
  - Timely decisions are made on key VA issues and policies
  - Decisions and policies are adequately documented
  - Decisions are immediately communicated to line and VA product managers
VA Management Teams

- Management Teams specified in the Charter have been assembled and are operational, they consist of:
  - Program Review Group (PRG)
  - Viability Assessment Integration Group (VAIG) and subgroups
    - VA (Product) Teams
    - VA External Parties Information and Outreach Working Group
## VA Management Groups

### PROGRAM REVIEW GROUP

| Chairman:   | L. Barrett |
| Members:    | R. Dyer, D. Shelor, S. Brocoum, R. Strickler, C. Metzger |
| Secretary:  | L. Desell |

### VA INTEGRATION GROUP

| Chairman:   | S. Brocoum |
| Secretary:  | D. Royer |
Management Groups Supporting VAIG

VA INTEGRATION GROUP

DOE VA (PRODUCT) TEAM
- Team Leader: T. Sullivan
- Design: D. Kane
- TSPA: M. Tynan
- LA Plan: C. Hanlon
- Cost Estimate: M. Brodsky

VA EXTERNAL PARTIES INFORMATION AND OUTREACH WORKING GROUP
- Chair: R. Craun
- Vice Chair: S. Smith

M&O PRODUCT TEAM
- Team Leader: J. King
- Design: B. Stanley
- TSPA: R. Andrews
- LA Plan: J. Weaver
- Cost Estimate: D. Morag
Mined Geologic Disposal System - Viability Assessment Design

- Performance driven design
- Design evolving from today through LA
- Priorities for FY98 and VA are those systems with no regulatory precedence:
  - Engineered barrier system
  - Ground control
  - Subsurface ventilation
  - Waste emplacement and retrieval
  - Performance confirmation
MGDS Consulting Board

- An independent, multi-disciplinary panel of eight experts which provide feedback on the repository and waste package design
- The board's members serve on one or two sub-boards:
  - Waste Package and Subsurface Facility Sub-Board
  - Sub-Surface Repository Sub-Board
FY 1998 meetings between the board and M&O design team: December 17-19, 1997, March 25-27, 1998 (planned), and June 24-26, 1998 (planned)

Recent board comments relevant to VA:
- Move quickly to finalize design criteria, performance goals, and assumptions for VA
- Plan to construct the perimeter drift, main ventilation drift, and ramps prior to any emplacement drifts
## MGDS VA Design Product Development Status

### FY 1997

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- Waste Quantity Study - 4/97
- Retrievability Study - 4/97
- WP Closure Methods - 8/97
- EBS Materials Selection - 8/97
- Criticality Technical Report, Rev 1 - 9/97
- MGDS Design Phase I - 9/97
- VA Design Management Plan - 11/97
- Con-Ops Update - 7/98
- Criticality Topical Report - 8/98
- MGDS VA Design Development - 6/98

### FY 1998

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- Design Documentation to TSPA VA - 3/98
- VA Design Issue Resolution - 5/98
- MGDS VA Design Product Delivered - 6/98
- MGDS VA Design Acceptance - 8/98

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Total System Performance Assessment for Viability Assessment

- Priorities in implementing FY 1998 plans:
  - Computer model development, documentation, and acceptance remains on schedule
  - Uniform database of traceable model input used by all computer modelers
  - All computer models and input data move towards acceptable quality assurance (QA) pedigree
  - Multiple lines of evidence used to provide “reality check” for modeling where possible
Note: Objective of the TSPA-VA Peer Review is to provide formal, independent evaluation and critique of TSPA-VA for CRWMS M&O in order that the TSPA-LA process and presentation can be improved

- Care required in overinterpretation of sensitivity results when varying levels of conservatism/realism are included in the models
- Recommends investigating methods to explicitly test subsystem models
- Although impressed with use of expert elicitation, concerned that this process could be misused - it is not a substitute for data
Summary of Findings from TSPA
Peer Review Panel - Second Interim
Report 12 Dec 1997

(Continued)

- Key elements of safety case should be presented in a framework including supporting models, underlying physical/chemical principles, conformance with available data, experience in comparable systems, and sensitivity analyses

- Further attention is needed to interpretation of environmental tracers

- Steps should be taken to assess the uncertainties in and range of validity for equivalent continuum fracture-matrix models
Summary of Findings from TSPA Peer Review Panel - Second Interim Report 12 Dec 1997
(Continued)

- Impact of thermochemical and thermohydrologic changes on repository performance should be investigated
- Support the selection of the most corrosion resistant metals, recognizing that realistic data are required
Summary of Findings from TSPA Peer Review Panel - Second Interim Report 12 Dec 1997

(Continued)

- More data on water chemistry are required to refine and validate existing models
- Better descriptions of transport from the EBS are required
- An analysis of backfill should be included in the TSPA-VA
- Mechanistic models of waste form degradation would provide a stronger basis than response surfaces
- Volcanism may be able to be screened out on the basis of the low probability of occurrence
The consequences of criticality may be so low as to make it unimportant.

NTS data on colloidal transport should be carefully analyzed to determine their applicability to TSPA.

The conservatism underlying EPA and NRC dose conversion factors should be understood, quantified in a cursory sense and their implications discussed.
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<td>TSPA Peer Review 3rd Interim Report - 8/98</td>
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<td>Prelim UZ Transport Chapter - 1/98</td>
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<td>Prelim UZ Flow Chapter - 1/98</td>
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<td>Prelim WP Degradation Chapter - 1/98</td>
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<td>TSPA-VA Base Case Results - 1/98</td>
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<td>Prelim Thermal/Hydro Chapter - 2/98</td>
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<td>Prelim Biosphere Chapter - 2/98</td>
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<td>Near-Field Models Acceptance - 4/98</td>
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<td>TSPA-VA Management Plan - 5/98</td>
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<td>Draft TSPA-VA Document - 6/98</td>
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<td>Final TSPA-VA Document - 8/98</td>
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<td>TSPA-VA Product Delivery - 8/98</td>
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<td>TSPA-VA VA Acceptance - 8/98</td>
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License Application Plan

• Provides a link between the Viability Assessment and the License Application

• Identifies work to be performed to complete the License Application
  – Describes additional tests supporting the repository safety strategy
  – Describes remaining design work
  – Describes planned TSPA Analyses
  – Describes the performance confirmation program

• Includes cost of that additional work
License Application Plan

(Continued)

- Also describes other work necessary to support the License Application Submittal
  - Site Recommendation
  - Environmental Impact Statement and Environmental Compliance
  - Licensing
  - Field Construction and Operation

- Provides summary schedule to develop major products supporting the site recommendation and License Application Submittal
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<td>Prepare draft LA Plan 2/2/98 - 5/1/98</td>
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<td>Incorporate &amp; confirm resolutions 5/20/98 - 6/2/98</td>
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<td>Issue LA Plan to YMP 7/1/98</td>
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<td>LA Plan Accepted - 8/98</td>
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MGDS-VA Cost Estimate

- Consists of the following repository life cycle phases:
  - Development and evaluation
  - Engineering and construction
  - Emplacement operations
  - Caretaker operations
  - Closure and decommissioning

- Report will be reviewed and approved in accordance with MGDS-VA Cost Estimate Management Plan
- An independent review of cost-estimate will be performed
  - Foster Wheeler Environmental
  - Phased review to be completed in July 1998
MGDS-VA Cost Estimate
Elements Excluded

- Historical MGDS D&E costs (prior to 1998)
  - Site characterization, prior design activities
- License application plan cost (10/98 - 3/02)
- Program costs
  - Waste acceptance
  - Storage
  - National transportation (Regional Servicing Contractor (RSC) concept)
  - Other Program costs
MGDS Cost Estimate Product Development Status

FY 1997

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Cost Estimate Management Plan - 10/97
Final Estimate for VA - 7/98
Support External Review - 7/98
Prepare Final Cost Documentation - 4/98
Review VA Cost Estimate - 7/98

FY 1998

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MGDS Cost Estimate Product Delivery - 8/98
MGDS Cost Estimate Acceptance - 8/98
FY98 Plans -
Design and Scientific Testing
Performance Attributes of a Repository

- Limited water contacting waste packages
- Design containment - long waste package lifetime
- Slow rate of radionuclide release
- Concentration reduction of radionuclides during transport
## Hypotheses Evaluated in the Viability Assessment

### Limited Water Contacting Waste Packages
- Percolation flux at repository depth can be bounded
- Seepage into drifts is a fraction of percolation flux
- Thermally induced changes in seepage can be bounded
- Seepage that contacts waste packages can be limited

### Long Waste Package Lifetime
- Heat reduces relative humidity at waste package surface
- Slow corrosion at low relative humidity
- Protection of inner barrier by the outer barrier
- Engineered enhancements extend the period of containment of the inner barrier

### Slow Rate of Radionuclide Release
- Containment time sufficient to prevent oxidation of spent fuel
- Amount of water that contacts waste can be limited
- Release rate of soluble radionuclides controlled by slow waste form dissolution
- Release rate of actinides dominated by solubility limits rather than colloidal stability

### Concentration Reduction of Radionuclides During Transport
- Physical properties of barriers reduce concentrations during transport
- Chemical properties of barriers reduce concentrations during transport
- Contaminants in lower volume flow in unsaturated zone will be diluted by higher volume flow in the saturated zone
## Design and Scientific Testing Programs

### Limited Water Contacting Waste Packages
- Test in-situ conditions in Alcove 7 (ongoing)
- Fracture flow and seepage testing in ESF niches (9/98)
- Monitor drift-scale thermal test (Ongoing)

### Design Containment/Long Waste Package Lifetime
- Complete preliminary waste package designs to accommodate commercial spent nuclear fuel (Conceptual designs for HLW Glass, DOE Spent Nuclear Fuel and Plutonium)
- Waste package containment barrier corrosion tests
- Galvanic protection tests
- Waste package containment preliminary degradation process models
- Engineered Materials Characteristics Report (12/98)

### Slow Rate of Radionuclide Release
- Spent fuel degradation (oxidation and dissolution) tests and preliminary process models
- Borosilicate glass waste form degradation tests and preliminary process models
- Colloid stability testing
- Waste Form Characteristics Report (12/98)
- Disposal Criticality Analysis Methodology Topical Report (10/98)

### Concentration Reduction of Radionuclides During Transport
- Complete Site Description document (8/98)
- Report: Geomechanics of Rock Mass (10/98)
- Begin Busted Butte UZ Transport Test
- Continue C-Wells Saturated Zone Flow and Transport Test
- Conduct Colloid Mobilization Studies
- Drilling and Testing in SD-6
Update on Data Collection Activities

- Drilling and sampling
- Construction of testing facilities
- Peer review
Core Science Activities

- Drilling and Sampling on Location
  - WT-24
  - WT-17 and WT-3
  - SD-6
  - C-Well Complex
  - Alcoves 3 & 4
  - Alcove 6
  - Niche studies
ALCOVES
1 - UPPER TIVA CANYON ALCOVE
2 - BOW RIDGE FAULT ALCOVE
3 - UPPER PAINTBRUSH TUFF CONTACT ALCOVE
4 - LOWER PAINTBRUSH TUFF CONTACT ALCOVE
5 - THERMAL TEST FACILITY
6 - NORTHERN GHOST DANCE FAULT ALCOVE
7 - SOUTHERN GHOST DANCE FAULT ALCOVE
Purpose of the Pump tests at WT-24

- Evaluate steep hydraulic gradient north of the proposed repository block
- Determine whether the observed water level represents local perched water or regional water table.

Status of work:

- Hydraulic pumping test complete 01/12/98
- Preliminary evaluation of drawdown data indicate a very low permeability zone that may be perched water
- Hole is being deepened to investigate lower zones that may represent the regional water table
WT-17 and WT-3

- **Purpose**
  - Water level measurements
  - Water chemistry sampling

- **Status of work**
  - Wells are being cleaned
  - New equipment will be installed
Purpose of drilling at SD-6

- Obtain additional stratigraphic information on the western side of the repository block
- Obtain hydrologic information on the west side of the proposed repository block
- Compare with predicted stratigraphy from Integrated Site Model

Status of work

- Drilling has progressed to 1150 feet below land surface (in Topopah Spring lower lithophysal rock unit)
- Drilling on hold - pipe stuck in hole
C-Well Complex

- **Purpose of C-wells testing**
  - Perform tracer tests to evaluate flow and transport characteristics in the saturated zone

- **Status of work**
  - Tracer testing in Bullfrog unit is complete
  - Installing new equipment
  - Next pump test will be conducted in the Prow Pass unit starting in February or March
Alcove 3 & 4

• Purpose
  – Testing and sampling to examine changes in:
    • Water geochemistry
    • Degree of saturation

• Status of work
  – Began coring downward in Alcove 3 to a depth of 9 meters
  – Plan on coring upward from Alcove 4
Alcove 6

• Purpose
  – Evaluation of North Ghost Dance Fault as potential fast-path location through Yucca Mountain

• Status of work
  – USGS continues pneumatic 3-d permeability testing
  – Drilling new hole for fracture-matrix interactions study
Niche Studies

• Purpose
  - Examine changes in moisture content in the repository horizon with differing geologic conditions
  - Examine effects of construction on permeability

• Status of work
  - Niche 1 - sealed for USGS testing
  - Niche 2 - excavated; LBNL conducting dye injection testing
  - Niche 3 - boreholes drilled into the area for permeability testing
Construction of Test Facilities

- Busted Butte facility
- Cross Drift predictive reports
UZ Transport Test at Busted Butte

- Purpose of the Busted Butte test
  - Validate lab data on radionuclide migration
  - Validate conceptual UZ flow and transport models
  - Reduce uncertainty in the transport of key radionuclides (Tc, I, Np and colloidal Pu)
Status of the UZ Transport Test at Busted Butte

- The pad and high wall construction for the test tunnel was completed in late December 1997.
- Drill and blast of the underground test tunnel 1998, ~48 meters of tunnel has been excavated.
- The contact between the Calico Hills and Topopah Springs units was encountered on January 13, 1998 at 43.2 meters into the excavation drift.
Enhanced Characterization of the Repository Block

Southern Test Complex

Waste Ramp
Development Access Ramp

Cross Over Alcove

Emplacement Drifts
West Main
Exhaust Main

Crest Alcove
Solitario Canyon Fault Alcove

Single Heater Test Located in Lower Lithophysal Zone

Emplacement Drifts
West Main
Exhaust Main

Crest Alcove
Solitario Canyon Fault Alcove

Borehole WT-24
Emplacement Exhaust Shaft

Borehole SD-13
Cross Over Alcove

Borehole SD-6

Borehole SD-11

Expansion Area

Scale is approximate

Feet

2000 ft
4000 ft

500 m
1000 m

Meters
Cross Drift Hydrologic Predictive Report

- Use existing data and modeling capabilities to predict in advance of drift excavation in situ:
  - Hydrologic properties and conditions
  - Microbiologic populations
  - Fast-path related secondary mineralization
  - Isotope geochemistry, including Cl-36, O, U, and Sr

- Predictions will be made along the Cross Drift alignment for subsequent comparison with underground measurements and observations
Cross Drift Geotechnical Predictive Report

- Developed in accordance with the industry standard “Geotechnical Baseline Reports for Underground Construction” published by the ASCE
- Focus is to predict underground conditions relevant to tunnel construction within the zone of excavation such as:
  - Spatial distribution of the rock formations
  - Rock mass properties related to ground support including faults, fracture zones, key blocks, and rock strength
  - Rock mass properties for TBM performance predictions
  - Groundwater conditions that would influence tunneling
  - Hazardous minerals
Peer Review
Objective: provide an independent evaluation of the use of Chlorine-36 to influence conceptual models of percolation flux through Yucca Mountain, particularly with respect to:

- Sampling, analytical and data interpretations used for Chlorine-36 and other environmental isotopes
- Adequacy of Chlorine-36 data integration with relevant site characteristics to predict groundwater flux at the potential repository horizon

Status of work: panel members were provided with technical presentations and a tour of the site (01/16/98)
Near Term Key Events

Look Ahead

January 98 - April 98
Viability Assessment Major Milestones
January 98 - April 98

- Preliminary UZ Transport (TSPA-VA Chapter) - 1/98
- Preliminary Waste Package Degradation (TSPA-VA Chapter) - 1/98
- Preliminary UZ Flow (TSPA-VA Chapter) - 1/98
- Present TSPA-VA Base Case Results - 1/98
- Prepare Revised Draft License Application Plan - 1/98
- Prepare Final Cost Documentation (MGDS Cost Estimate) - 1/98
- Resolution of all 20 VA Design Issues - 1/98-5/98
- Complete Design Information Documentation in Support of TSPA-VA - 3/98
Closing Remarks

- We have less than 178 working days to complete the components of the Viability Assessment.
- Focus will be in the good science and engineering that provide the foundation for those products.
- Goal is to assemble more than 15 years of information into a coherent repository concept, which will help guide the completion of site characterization.