U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

U.S. NUCLEAR WASTE TECHNICAL REVIEW BOARD

SUBJECT: PATH TO AN INTEGRATED TSPA-VA

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ARLINGTON, VA
OCTOBER 9, 1996
Outline

- Total System Performance Assessment-Viability Assessment (TSPA-VA) approach
- The abstraction process
- The role of the TSPA-VA peer review
- The role of planned and proposed expert elicitations
Planning of TSPA-VA

- Past and current sensitivity analyses to evaluate alternative conceptual models in cooperation with the Site Investigations Program are preparatory to TSPA-VA.

- The objective is to ensure that TSPA-VA captures the process-level modeling being performed by the site, engineering, and environmental functions of the Project.

- External experts are to be involved
  - Through focused expert elicitations
  - Through a comprehensive peer review
A TSPA-VA Plan was Completed

- Defines overall approach, roles, and responsibilities
- Discusses method of ensuring that the most representative process models are abstracted into TSPA-VA
- Presents for each process model to be abstracted:
  - Current status of abstraction
  - NRC’s treatment in IPA-2 or recent communication
  - Relevant uncertainties
  - Sources of information
  - Expected output from abstraction process
  - Key personnel
  - Schedule
Approach to TSPA-VA

• Form abstraction and testing teams of process model development and performance assessment staff to ensure proper testing and use of models and appropriate bounding of uncertainties

• Supplement in-house expertise with expert elicitation to quantify uncertainty in process models

• Focus TSPA analyses on key attributes consistent with previous TSPA experience, the Waste Containment and Isolation Strategy and the NRC’s key technical issues
Schedule of TSPA-VA

Process Model Abstraction Workshops 10/96 - 3/97

Process Model Sensitivity Analyses 1/97 - 10/97


TSPA-VA "Reference Case" Analysis 11/97 - 1/98

TSPA-VA Sensitivity Analysis 1/98 - 4/98

TSPA-VA Documentation 4/98 - 8/98

TSPA-VA Peer Review 1/97 - 3/99
Model Abstractions for Total System Performance Assessment

- TSPA results need to properly reflect results from highly detailed and computationally intensive site and engineered system process models.

- It is neither efficient nor reasonable to incorporate all the complexity inherent in each of the process models in a probabilistic TSPA calculation.

- Abstracted models are employed as surrogates for comprehensive process models, maintaining the essential elements of the process model, including key interdependencies.
Process Model Abstraction/Testing Activities

- Waste form degradation
- Waste form mobilization
- Waste package degradation
- Near field environment
- Thermo-hydrology
- Unsaturated zone flow
- Saturated zone flow and transport
- Unsaturated zone transport
- Biosphere
- Disruptive FEP’s (volcanism, tectonism, criticality)
TSPA - VA Teams

• TSPA Core Team (TCT)
  – Composition: TSPA analysts and management
  – Objectives:
    » to ensure utility of results for use in TSPA
    » to integrate results from all abstraction testing activities

• Abstraction Core Team (ACT)
  – Composition: performance assessment subsystem modeler(s), TCT representative, site/design representative(s)
  – Objective: to plan and manage abstraction/testing activity
Workscope for Abstraction/Testing Activities

• Preparation and planning (ACT)
  1. Expand and summarize current information
  2. Develop information on current abstraction of process
  3. Select workshop participants and disseminate information from 1 and 2
  4. Plan and schedule workshop
  5. Synthesize comments and suggestions generated by 3
Workscope for Abstraction/Testing Activities
(continued)

• Workshop
  – Present current TSPA representation of process (TCT)
  – Present current state of process information (ACT)
  – Develop and prioritize list of analyses to refine and enhance TSPA model
  – Select analyses, schedule activity, define resources

• Conduct analyses
# Key TSPA-VA Model Abstractions

<table>
<thead>
<tr>
<th>Process Model</th>
<th>Key Output in Abstraction</th>
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<tbody>
<tr>
<td>Unsaturated zone hydrology</td>
<td>Percolation/seepage flux</td>
</tr>
<tr>
<td>Thermal hydrology</td>
<td>Humidity, temperature</td>
</tr>
<tr>
<td>Waste package degradation</td>
<td>Containment time</td>
</tr>
<tr>
<td>Radionuclide mobilization</td>
<td>Solubility, diffusive/advective flux</td>
</tr>
</tbody>
</table>
## Components of TSPA-VA

<table>
<thead>
<tr>
<th>Process Model</th>
<th>Key Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsaturated zone transport</td>
<td>Advective velocity distribution</td>
</tr>
<tr>
<td>Saturated zone hydrology</td>
<td>Dilution</td>
</tr>
<tr>
<td>Biosphere</td>
<td>Dose conversion factors</td>
</tr>
<tr>
<td>Disruptive features/events</td>
<td>Probability, effects</td>
</tr>
</tbody>
</table>

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Proposed Work Flow Diagram for Abstraction/Testing Activities

1. TSPA Core Team
2. Abstraction Core Team
3. Site/Design
4. Plan Activity
5. Conduct Workshop
6. Document Workshop
7. Conduct Analyses
8. Site/Design
9. Interim Status
10. TSPA Peer Review Team
11. Complete Analyses
12. Abstraction Core Team
13. Synthesize Results for TSPA
14. Document Analyses for TSPA-VA
Proposed Workshop Dates

• Waste form degradation 03/03/97 - 03/06/97
• Waste form mobilization 03/03/97 - 03/06/97
• Waste package degradation 12/2/96 - 12/4/96
• Near field environment 03/7/97 - 03/11/97
• Thermo-hydrology 12/18/96 - 12/20/96
• Unsaturated zone flow 12/16/96 - 12/18/96
• Saturated zone flow and transport 11/18/96 - 11/20/96
• Unsaturated zone transport 03/05/97 - 03/07/97
• Biosphere 06/02/97 - 06/04/97
• Disruptive FEP's (volcanism, tectonism, criticality) 12/09/96 - 12/11/96
TSPA Peer Review

The approach for and input to the TSPA-VA will be reviewed in depth using a combination of expert elicitation and peer review to provide guidance for the development of the TSPA-LA.
Key Phases of TSPA Peer Review

• Orientation (10/96 - 6/97)
  – Convene peer review panel; introduce Program

• Scenario and process models (10/97 - 6/98)
  – Review site and design process models

• Model abstraction (1/98 - 6/98)
  – Review abstraction process into PA models

• TSPA peer review (6/98 - 3/99)
  – Review TSPA-VA; prepare guidance for TSPA-LA
TSPA Peer Review Schedule

<table>
<thead>
<tr>
<th>FY 1997</th>
<th>FY 1998</th>
<th>FY 1999</th>
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<tbody>
<tr>
<td>Orientation</td>
<td></td>
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<tr>
<td>Abstraction</td>
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<tr>
<td>Scenarios &amp; Process Models</td>
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<tr>
<td>VIABILITY ASSESSMENT</td>
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</tr>
<tr>
<td>Peer Review</td>
<td>TSPA-LA Recommendations</td>
<td></td>
</tr>
</tbody>
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Preliminary Activities

• Convene peer review panel
  – Letter request to various professional organizations for nominations of qualified candidates for the peer review panel
  – Technical specialities needed and the requirements for the peer review will be defined in the letter
  – DOE will select peer reviewers from the list of nominations, considering expertise, interest, and availability

• Let contracts for panel members

• Peer review panel chairperson develops a peer review plan in accordance with DOE procedures
Orientation Phase

• After the peer review plan has been approved, DOE will brief the peer review panel on TSPA 1991, 1993, 1995, and subsequent modeling activities.

• The peer reviewers will review these modeling activities in detail and make preliminary observations on the modeling plans, documentation of approach, and assumptions for TSPA-VA.
Scenario and Process Model Phase

- PA with site and design process modelers will introduce scenarios and process models used to describe features, events, and processes.

- Panel will review current state of process modeling.

- Panel will issue interim letter report with impressions on the TSPA-VA and recommendations for the TSPA-LA (6/98).
Abstraction Phase

- PA and process modelers will present updated process-level models, as available, for TSPA-VA development
- Panel will review these models and the abstraction process that converts these models into PA input
- Panel will issue interim letter report with impressions on the TSPA-VA and recommendations for the TSPA-LA (6/98)
TSPA Peer Review Phase

- Panel will begin formal peer review slightly ahead of VA; will issue interim letter report with VA (8/98)

- Peer review will continue after VA and will conclude with final report with recommendations for the TSPA-LA (3/99)

- Results of peer review will be incorporated as guidance for development of TSPA-LA
Expert Elicitation for TSPA-VA

• Purpose
  - To quantify and document the uncertainties in process models to strengthen TSPA-VA
  - To focus on process models that are very significant to total system performance
Concept

• Small scale focused elicitation
  - Approximately six-month duration

• Panels will have five to six experts
  - will include Project experts and experts external to the Project

• Will follow the nine-step process outlined in the NRC’s Branch Technical Position on the use of expert elicitation
Approach

• Complete the first elicitation
  – Unsaturated zone process model

• Propose additional process models for elicitations
  – Waste package degradation
  – Drift-scale thermohydrology
  – Waste form dissolution
  – Saturated zone hydrology
Unsaturated Zone Expert Elicitation

• Analyze the spatial and temporal distribution of percolation flux

• Focus on
  – Infiltration
  – Methods to characterize unsaturated fractured rock
  – Analysis and numerical modeling of fluid flow in variably saturated rock
  – Data and modeling uncertainties and their quantification
Unsaturated Zone Elicitation Schedule

Oct  | Nov  | Dec  | Jan  | Feb  | Mar  | Apr  | May  |

Planning/Select Experts

Workshops

Data Needs

Models/Interpretations

Feedback

Data Compilation/Dissemination

Elicitations

Documentation

Final Report

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Status

- An implementation plan was developed to define the objectives of the unsaturated zone expert elicitation, the panel selection criteria, and the process to be followed.

- Letters requesting nominations for the expert panel were distributed.

- Panel selection will begin in October.
## Proposed Expert Judgment Schedule

<table>
<thead>
<tr>
<th>FY 97</th>
<th>FY 98</th>
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<tbody>
<tr>
<td>Unsaturated Zone</td>
<td>Waste Package Degradation</td>
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<tr>
<td>Waste Form Dissolution</td>
<td>Thermal/Hydrology</td>
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<tr>
<td>Saturated Zone Hydrology</td>
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<tr>
<td>Viability Assessment</td>
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