Biosphere Process Model Assumptions, Comparison to VA, and Sensitivities

Presented to:
Nuclear Waste Technical Review Board

Presented by:
John F. Schmitt
Manager, Biosphere Analysis Section
Civilian Radioactive Waste Management System
Management and Operating Contractor

August 2, 2000
# Biosphere Inputs to TSPA-SR

- **Process Model Factors Affecting Radionuclide Transport Away from Engineered Barriers**

<table>
<thead>
<tr>
<th>Key Attributes of Performance</th>
<th>Process Model Factor</th>
<th>TSPA-SR Input Parameters</th>
</tr>
</thead>
</table>
| Transport Away from the Engineered Barrier System | UZ Radionuclide Transport | - Fracture aperture and spacing in different units  
- Flow fields for different infiltration scenarios and climate states  
- $K_d$ for all elements included in TSPA  
- Matrix diffusion coefficients – $f$ (isotopes, units)  
- $K_c$ and/or kinetic colloid parameters for Pu, Am, Th etc.  
- Colloid filtration factor |
| | SZ Radionuclide Transport | - Breakthrough curves – $f$ (radionuclide, region)  
- Climate change flux multiplication factor  
- Capture zones and release locations within each zone  
- Flow fields  
- Flowing interval spacing  
- Effective porosity for all units except the volcanic units  
- Dispersivity (longitudinal, horizontal transverse, vertical transverse)  
- Boundary definition of the alluvium  
- $K_d$ for isotopes included in TSPA  
- Flowing interval porosity  
- Matrix porosity  
- Effective diffusion coefficient  
- $K_c$ colloid parameters  
- Colloid filtration factor |
| Wellhead dilution | Annual groundwater usage |
| Biosphere Dose Conversion Factor | Biosphere dose conversion factor – $f$ (radionuclide, irrigation time) |
Biosphere Inputs to TSPA-SR

- Process Model Factors for Disruptive Events Scenario

<table>
<thead>
<tr>
<th>Key Attributes of Performance</th>
<th>Process Model Factor</th>
<th>TSPA-SR Input Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effects of Potentially Disruptive Processes and Events</td>
<td>Seismic Activity</td>
<td>• Probability of seismicity/structural deformation</td>
</tr>
<tr>
<td></td>
<td>Volcanic Direct Release</td>
<td>• Annual probability of igneous intrusion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Atmospheric transport parameters</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Probability that an intrusion will result in one or more eruptive vents</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Number of vents through the waste</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Wind direction factor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Wind speed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Biosphere dose conversion factors - f (radionuclide)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Factor to account for radionuclide removal from soil</td>
</tr>
<tr>
<td></td>
<td>Intrusive Indirect Release</td>
<td>• Annual probability of igneous intrusion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Number of Waste Packages damaged by intrusion (for groundwater transport source term)</td>
</tr>
</tbody>
</table>
Key Biosphere Assumptions and Their Bases

- Biosphere work is performed to comply with DOE Guidance, and proposed EPA and NRC regulations
- These documents provide substantial biosphere definition
Key Biosphere Assumptions and Their Bases
(Continued)

- Critical receptor and environment are partially prescribed in proposed regulations
  - NRC: “...to limit speculation by specifying the assumptions to be used...”
  - EPA: “…speculation concerning some characteristics of the future should not be the focus of the compliance determination…”
Key Biosphere Assumptions and Their Bases
(Continued)

• Values representing the behaviors and characteristics of the receptor of interest are developed based upon demographic survey information for Amargosa Valley residents
  – EPA and NRC specify the Amargosa Valley location, and use of current diet and life style for compliance demonstration
Key Biosphere Assumptions and Their Bases
(Continued)

• Post-closure assessment for nominal case assumes potential contamination to the reference Biosphere is from groundwater via water well
  – No other significant release pathways for licensed material are identified in other process models
Key Biosphere Assumptions and Their Bases
(Continued)

- Volcanic eruptive scenario assumes exposure during volcanic event, and increased dust concentrations in air afterwards
  - Reasonably conservative approach
Principal Biosphere Differences - VA to PMR

- Critical receptor
  - VA: rural residential farmer in Amargosa Valley
  - PMR: average member of the critical group located in Amargosa Valley, and RMEI

- Food ingestion
  - VA: rural resident: assumes 50% of diet is locally grown food
  - PMR: AMCG, RMEI: based on survey results for people who eat locally grown food and have a garden
Principal Biosphere Differences - VA to PMR
(Continued)

- Radionuclide buildup in soil and soil removal
  - VA: not included
  - PMR: modeled and incorporated

- Annual rainfall
  - VA: calculated for current rainfall, and for 2x and 3x more
  - PMR: current rainfall
Biosphere Related Sensitivity Tests

- **Nominal case sensitivity analysis results**
  - ingestion accounts for essentially all of the Biosphere Dose Conversion Factors (BDCF)
  - drinking water, followed by leafy vegetables
  - inhalation and external exposure are not significant

- **Volcanic eruptive scenario sensitivity results**
  - soil ingestion and inhalation dominate for most radionuclides
Biosphere BDCF Sensitivity

- **Degraded Barrier**
  - 95th %tile BDCFs for all radionuclides

- **Enhanced Barrier**
  - 5th %tile BDCFs for all radionuclides
Preliminary Biosphere BDCF Sensitivity Analysis

This information was prepared for the 8/00 NWTRB meeting for illustrative purposes only and is subject to revision; not appropriate for assessing regulatory compliance.