YUCCA
MOUNTAIN
PROJECT

Studies

Saturated Zone Flow and Transport Conceptual Model and Parameter Issues Affecting Total System Performance Assessment

Presented to:
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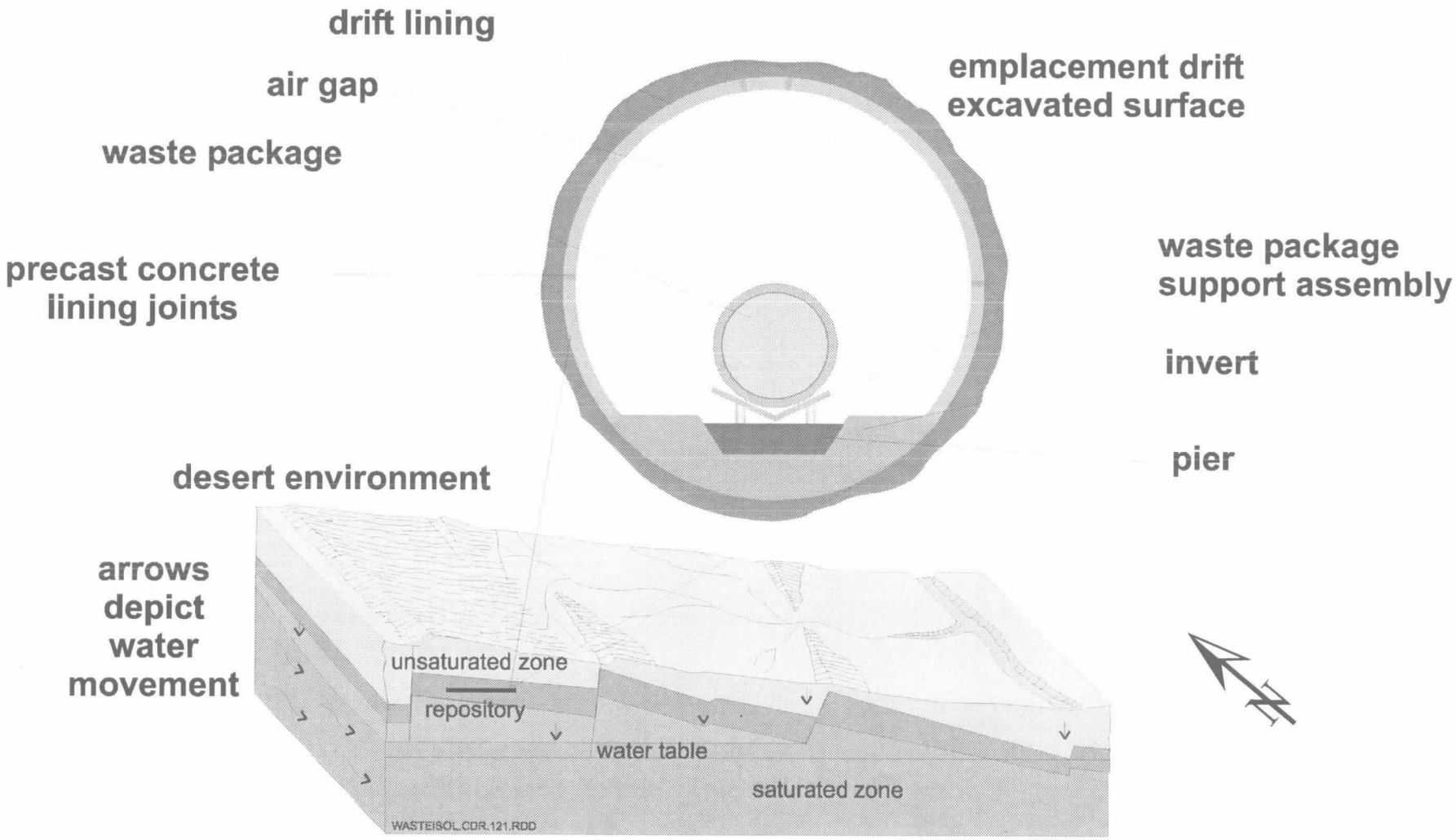
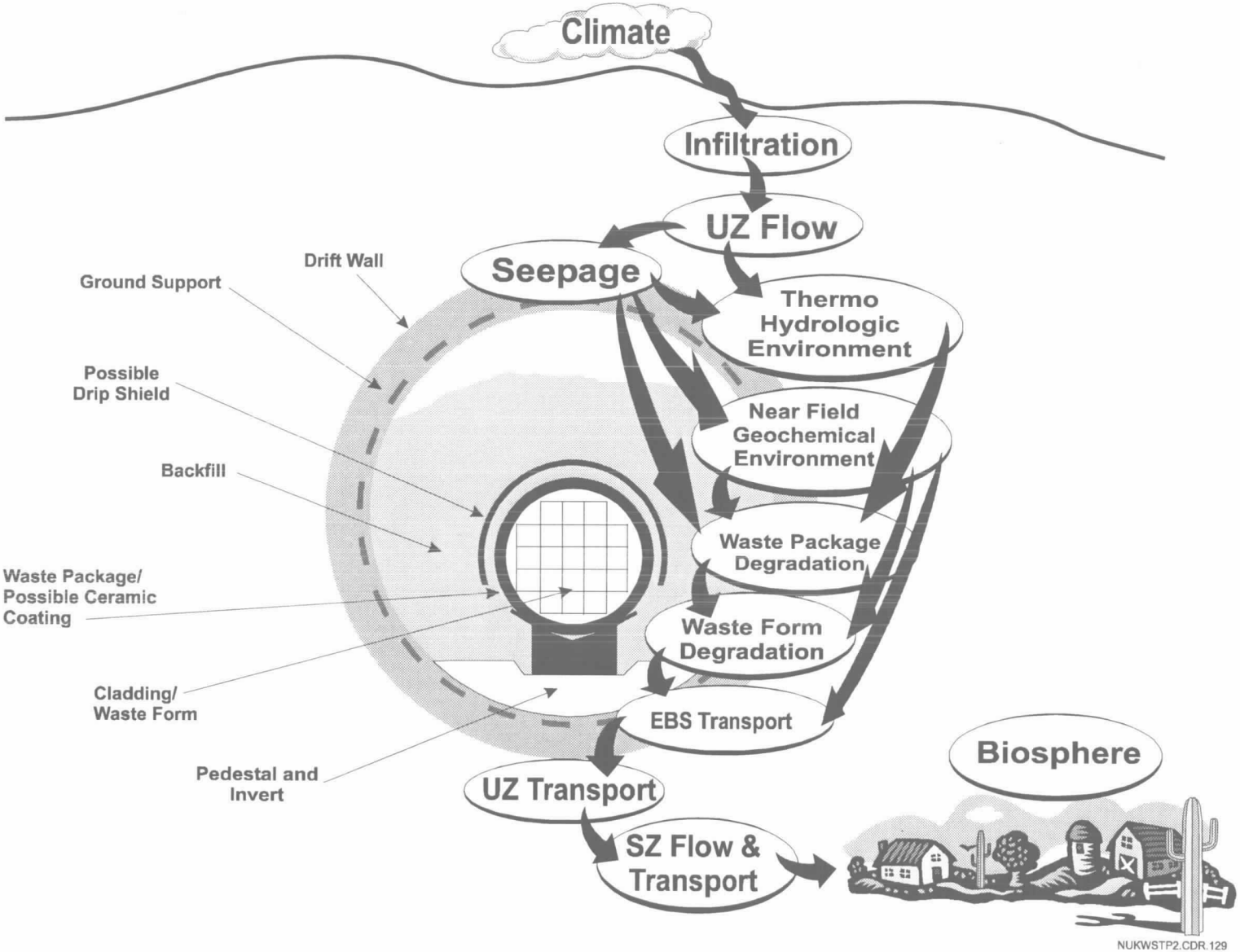
Outline

- Role of natural system in performance assessment
- Key information required from saturated zone flow and transport model
- Major groupings of saturated zone flow and transport model uncertainties
- Key issues addressed by the saturated zone expert elicitation

Waste Isolation



Components of Total System Performance Assessment



Role of Natural System in Repository Safety Strategy

- Provides controlled environment within which behavior of engineered components can be evaluated
- Provides remoteness from variability in surficial processes
- Provides remoteness from biosphere
- Provides reduction (by dispersion, dilution, retardation) and delay in arrival of any released radionuclides from engineered components

Key Information Required from Saturated Zone Flow and Transport Model for TSPA

- Given a release of radionuclide y from the unsaturated zone, what is the time of arrival and concentration of that radionuclide when it reaches potential ground-water withdrawal wells located x km downgradient
  - y is determined by source term, EBS release and UZ transport characteristics
    - highly soluble, unretarded species (e.g., I, C, Tc, Se)
    - slightly soluble, slight retardation species (e.g., Np, U, Pa)
    - partially stable and filtered colloidal particles (e.g., Pu)
  - x is determined by regulatory requirements which are currently not fixed
    - 20 km is current measure of performance
    - other distances (5, 30 ?50 km) used in sensitivity analyses
    - evaluate the maximum concentration vs time at the given distance without considering the probability that a given withdrawal well intercepts the maximum concentration
  - releases from the unsaturated zone are spatially and temporally variable
  - concentrations in the saturated zone are spatially and temporally variable
  - concentrations at the well head may be further diluted by mixing in the withdrawal well

Major Groupings of Saturated Zone Flow and Transport Model Uncertainties

(derived from Workshop on SZ Flow and Transport Model Abstraction/Testing - April 1997)

- **Conceptual models of SZ Hydrogeology**
  - large-scale (> km) channelization features
  - hydrologic and mineralogic characteristics of faults
  - channelization caused by heterogeneous hydrostratigraphic zones
  - connectivity of fracture networks at intermediate scales (10's - 100's m)
- **Conceptual models of SZ ground-water flow**
  - distribution and magnitude of regional discharge
  - distribution and magnitude of regional recharge
  - distribution and magnitude of vertical flow downgradient from repository
  - alternative conceptual models of the large hydraulic gradient

Major Groupings of Saturated Zone Flow and Transport Model Uncertainties

(continued)

- Conceptual models of SZ radionuclide transport
  - relevant range of longitudinal and transverse dispersivity
  - approximating the effects of matrix diffusion using an effective fracture porosity
  - relevant range of matrix and fracture sorption coefficients
- Coupling of SZ flow and transport model to other TSPA components
  - effects of climate change on groudwater flux, water table elevations and discharge locations
  - coupling of SZ transport with UZ transport
  - potential effects of thermal and chemical alterations on SZ flow and transport
  - range of scenarios used to simulate withdrawal from wells

Abstraction/Testing Activities Resulting from Prioritization of Key Uncertainties

- Sensitivity study on uncertainty in site-scale SZ transport parameters and models (Robinson et al., 1997)
- Coupling of UZ and SZ transport models (Robinson and Arnold, 1998, in preparation)
- Effects of large-scale channelization on effective transport properties (Arnold et al., 1997)
- Determination of effective field-scale transport parameters using C-wells testing results (Umari, Turin, Reimus et al. 1997)
- Past, present and future saturated zone fluxes (D'Agnese et al., 1997)
- Geologic structure and processes affecting flow channelization (Cohen et al., 1997)

Key Issues Addressed by the Saturated Zone Expert Elicitation

- Conceptual model of ground-water flow
- Conceptual model of the large hydraulic gradient
- Magnitude and direction of ground-water flow
- Influence of climate change on ground-water flow
- Conceptual models of saturated zone transport, especially solute dilution, dispersion and effective fracture density
- Applicability and range of sorption coefficients in the tuffaceous rocks and alluvium
- Potential changes in ground-water flow due to repository-induced thermal processes or disruptive events
- Possible influence of colloidal transport of radionuclides