[16]

KEY TECHNICAL ISSUE (KTI) RADIONUCLIDE TRANSPORT (RT)

RT TEAM

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NRC/DOE TECHNICAL EXCHANGE
PRE-LICENSING ISSUE RESOLUTION STATUS
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Radionuclide Transport Subissues

Current Status

- Subissue 1: Radionuclide Transport through Porous Rock -Open
- Subissue 2: Radionuclide Transport through Alluvium -Open
- Subissue 3: Radionuclide Transport through Fractured Rock -Open
- Subissue 4: Nuclear Criticality in the Far Field -Closed Pending Confirmation
- All four subissues are related to:
  - RSS Principal Factors: Transport through UZ and SZ
  - NRC Abstractions: Radionuclide Transport in the UZ and SZ

Subissues 1 & 2: Radionuclide Transport through Porous Rock/Alluvium

- Background
  - ▶ In developing acceptance criteria, the staff assumed DOE would use one or more of the following model abstractions for retardation in PA:
    - – 1) Kd = 0. No interaction
    - – 2) Constant Kd approach
    - – 3) Process models (i.e., more complex models where sorption is a function of additional parameters)

Format of Remaining Viewgraphs

- Model Abstraction
  - ▶ Information Need
    - – Reason for Information Need
      - – Example of data gap or status of effort

Subissues 1 & 2: Radionuclide Transport through Porous Rock/Alluvium

Status: Open

- For $K_d = 0$ approach (Model Acceptable)

Additional Data and/or Analysis needed by LA

- Provide information on effective porosity
  - Affects travel time to critical group; could affect performance if radionuclides reach critical group before 10,000 years
    - Flowpaths through alluvium have yet to be characterized.
- Demonstrate $K_d = 0$ assumption doesn't underestimate dose
  - Certain special conditions can lead to radionuclide flux that exceeds flux when $K_d = 0$ is assumed.
    - Irreversible sorption of radionuclides on mobile particulates and colloids, e.g., Pu migration from Benham event?

Subissues 1 & 2: Radionuclide Transport through Porous Rock/Alluvium

Status: Open

- For constant K_d approach (Model Acceptable)

Additional Data and/or Analysis needed by LA

- Provide information to demonstrate appropriate values of parameters are used in equation, $R_f = 1 + (\rho/n)K_d$
  - Sorption characterization is incomplete
    - Of the 21 Key Radionuclides identified in the RSS (Rev 3), 5 untested using site-specific materials (Pd, Sm, Pb, Ac, & Cm)
    - Ground-water chemistries unbounded for 4 other Key Radionuclides (Se, Pa, Ni, U)
    - Plutonium experiments failed to reach steady state

Subissues 1 & 2: Radionuclide Transport through Porous Rock/Alluvium

Status: Open

- For constant K_d approach (Model Acceptable)

Additional Data and/or Analysis needed by LA

- Provide information to demonstrate appropriate values of parameters are used in equation, $R_f = 1 + (\rho/n)K_d$
  - Transport characterization is incomplete
    - Flow-through column tests have been performed involving only 4 radionuclides (Se, Tc, Np, & Pu)
    - Colloids, evident in batch sorption tests, could affect breakthrough curves in dynamic system (e.g., Th, Sn, & Nb)
    - Batch sorption tests at initial radionuclide concentrations that exceed solubility limits make K_d's suspect (e.g., U, Np)
    - Plutonium elution is a function of flowrate, inconsistent with constant K_d approach.

Subissues 1 & 2: Radionuclide Transport through Porous Rock/Alluvium

Status: Open

- For constant K_d approach (Model Acceptable)

Additional Data and/or Analysis needed by LA

- Provide information to demonstrate that flowpath acts as a single continuum porous medium.
  - Preferential pathways can bypass potential sorbing material along the flowpath
  - The abstraction that allows the use of Kd's determined in static tests for predicting retardation under dynamic conditions requires the medium be porous.
    - Flowpaths through alluvium have yet to be characterized.
    - Calico Hills nonwelded vitric is being tested in Busted Butte.

Subissue 3: Radionuclide Transport through Fractured Rock

Status: Open

- For $K_d = 0$ approach (Model Acceptable)

Additional Data and/or Analysis needed by LA

- Provide information on effective porosity
  - Same as for transport through porous rock/alluvium
- Demonstrate $K_d = 0$ assumption doesn't underestimate dose
  - Same as for transport through porous rock/alluvium
- Justify the length of flowpath to which these fracture transport conditions apply.
  - Affects travel time to critical group; could affect performance if radionuclides reach critical group before 10,000 years
    - The length of flow path in the fractured rock has yet to be established (e.g., the contact between the tuff aquifer and alluvium, valley fill is uncertain).

Subissue 3: Radionuclide Transport through Fractured Rock

Status: Open

- For retardation/attenuation approach (Model Acceptable)

Additional Data and/or Analysis needed by LA

- Demonstrate capability to predict breakthrough curves of reactive, non-reactive, and colloidal tracers.
  - The estimation of transport through fractured rock is relatively untested.
    - C-hole reactive tracer tests are the only field tests demonstrating transport in the SZ at YM, and thus take on added importance.
    - The C-hole breakthrough curves (concentration and travel time) could not be quantitatively predicted using laboratory experiments alone or in concert with hydraulic pump tests.

Subissue 3: Radionuclide Transport through Fractured Rock

Status: Open

- For retardation/attenuation approach (Model Acceptable)

Additional Data and/or Analysis needed by LA

- Demonstrate nonradioactive tracers used in field tests are appropriate homologues for radioelements.
  - Processes affecting tracers and radionuclides should be the same.
    - Excavated blocks from Busted Butte to be tested at AECL
- Justify the length of flowpath to which these fracture transport conditions apply.
  - Same as for transport through porous rock/alluvium

Subissue 4: Nuclear Criticality in the Far Field

Status: Closed Pending Confirmation

- Need for additional analysis
  - Provide technical basis for exclusion of criticality in the far-field environment FEP