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

# NUCLEAR WASTE TECHNICAL REVIEW BOARD
# FULL BOARD MEETING

## SUBJECT: PERFORMANCE ASSESSMENT FOR THE REVISED PROGRAM


## PRESENTER: DR. ABRAHAM VAN LUIK

**PRESENTER'S TITLE AND ORGANIZATION:** TEAM LEADER, TECHNICAL SYNTHESIS TEAM
LAS VEGAS, NEVADA

**TELEPHONE NUMBER:** (702) 794-1424


**AUSTIN, TEXAS**
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# Outline

- Key Performance Assessment Activities in 1996
- Planning for the Total System Performance Assessment-Viability Assessment (TSPA-VA)
- PISA Chapter 8: Total System Performance Assessment
- Augmentation of the TSPA-VA for the License Application
- Performance Confirmation

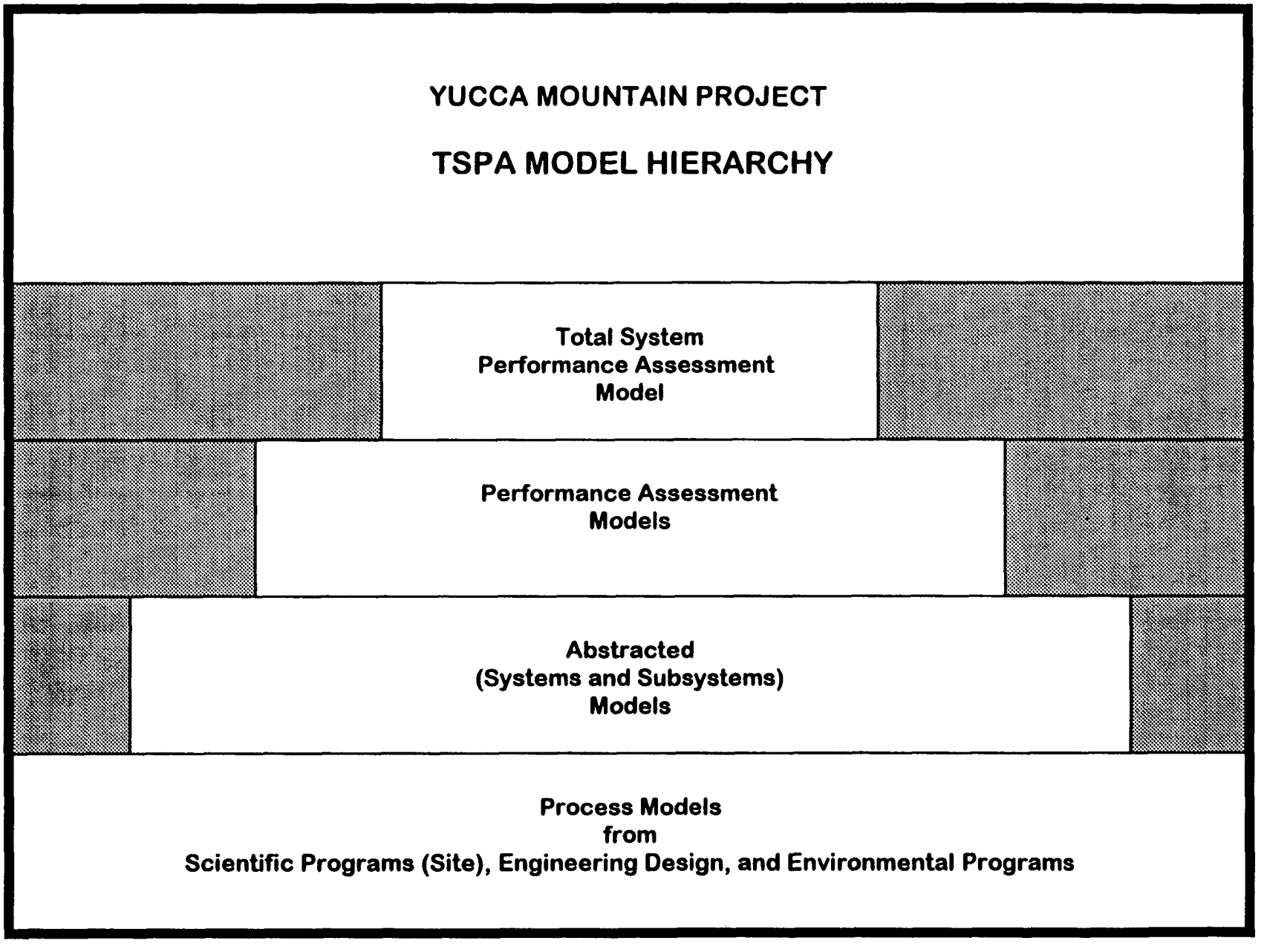
# Key Performance Assessment Activities in 1996

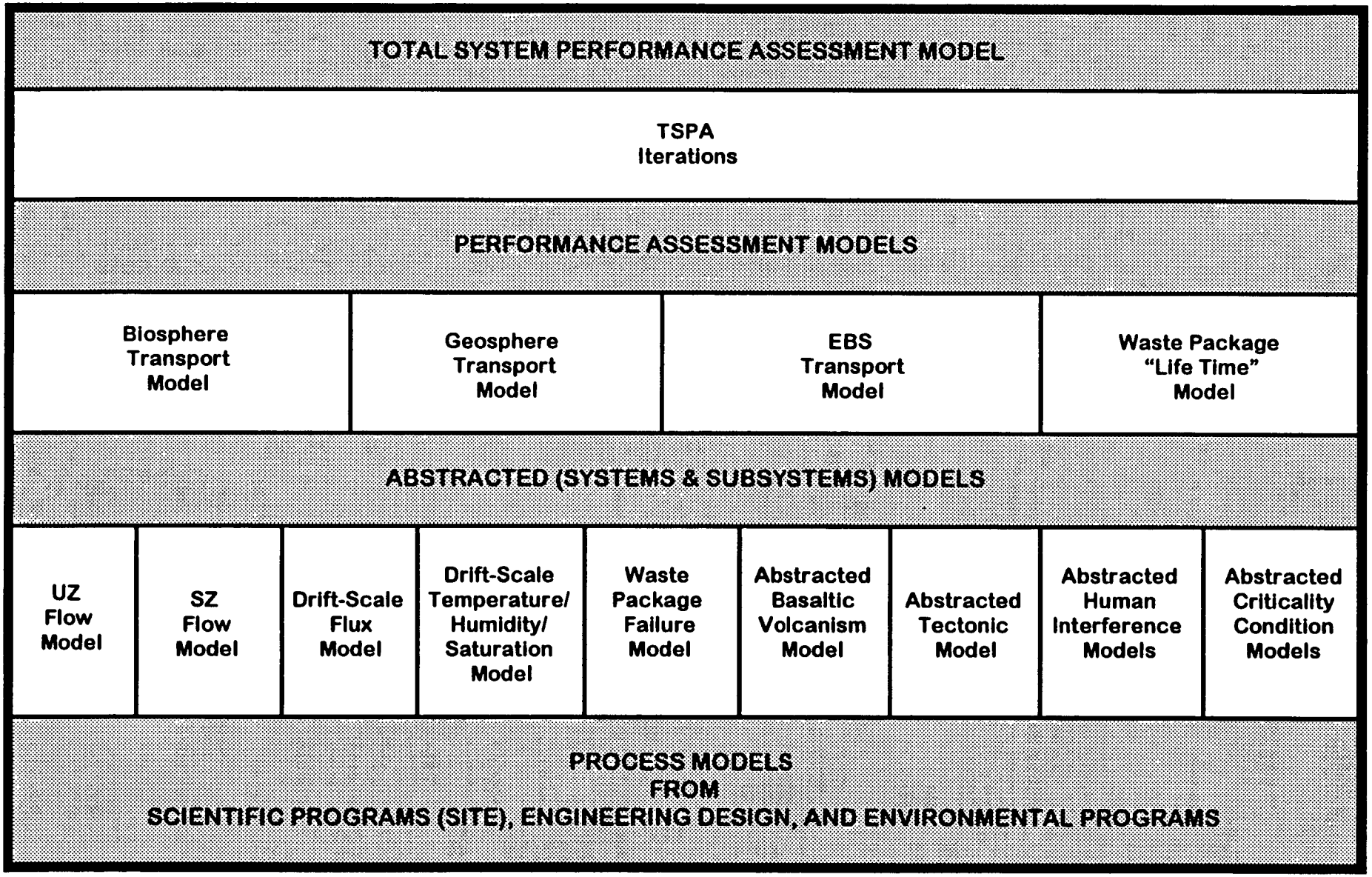
- Performance assessment will complete additional sensitivity analyses to improve its evaluation of various components of the natural and engineered barriers. These analyses will be used to
  - Refine the strategy for evaluating waste containment and isolation
  - Identify site and design-related information required for performance assessments for the Viability Assessment and License Application
- In support of engineering design activities, performance assessment will
  - Continue analyzing hydrological and thermal effects of waste-generated heat on the waste package and engineered system
  - Use improved data to refine models of waste package material degradation and waste dissolution

# Planning for the Total System Performance Assessment-Viability Assessment (TSPA-VA)

YUCCA MOUNTAIN PROJECT

# TSPA MODEL HIERARCHY




TOTAL SYSTEM PERFORMANCE ASSESSMENT MODEL
TSPA
Iterations
PERFORMANCE ASSESSMENT MODELS
Biosphere Transport Model
Geosphere Transport Model
EBS Transport Model
Waste Package "Life Time" Model
ABSTRACTED (SYSTEMS & SUBSYSTEMS) MODELS
UZ Flow Model
SZ Flow Model
Drift-Scale Flux Model
Drift-Scale Temperature/ Humidity/ Saturation Model
Waste Package Failure Model
Abstracted Basaltic Volcanism Model
Abstracted Tectonic Model
Abstracted Human Interference Models
Abstracted Criticality Condition Models
PROCESS MODELS
FROM
SCIENTIFIC PROGRAMS (SITE), ENGINEERING DESIGN, AND ENVIRONMENTAL PROGRAMS

| PROCESS MODELS FROM SCIENTIFIC PROGRAMS (SITE), ENGINEERING DESIGN, AND ENVIRONMENTAL PROGRAMS | | | | | | |
|---|---|---|---|---|---|---|
| | | Waste Package/ EBS Models | | | Potentially Disruptive Features, Events, and Processes Models | |
| Natural System Models | Near Field Environments Models | Waste Package Degradation Models | Waste Form Alteration/ Dissolution Models | Waste Package/ EBS Release Models | Basaltic Volcanism Models | Tectonics Models |
| Geologic (3-D) Framework Models<br><br>UZ Gaseous Flow Models<br><br>UZ Aqueous Flow Models<br><br>UZ Gaseous Transport Models<br><br>UZ Aqueous Transport Models<br><br>SZ Flow Models<br><br>SZ Transport Models<br><br>Climate Change Models<br><br>Biosphere Models | Repository-Scale T-H Environment Models<br><br>Drift-Scale T-H Environment Model<br><br>Repository-Scale T-C Environment Models<br><br>Drift-Scale T-C Environment Models<br><br>Effect of Man-Made Materials on T-C Environment Models<br><br>Effect of Colloid Formation on T-C Environment Models | Corrosion-Resistant Barrier Degradation Models<br><br>Corrosion-Allowance Barrier Degradation Models<br><br>Cladding Degradation Models<br><br>Galvanic Protection Models | Waste Package T-H Environment Models<br><br>Waste Form Alteration Models<br><br>Waste Form Dissolution Models | Waste Package Advective/ Diffusive Transport Models<br><br>EBS Advective/ Diffusive Transport Models<br><br>EBS Colloidal Transport Models | Recurrence Models<br><br>Direct Effects Models<br><br>Indirect Effects Models | Recurrence Models<br><br>Direct Effects Models<br><br>Indirect Effects Models |

# Model Abstraction is to be Performed by Working Groups

- Working groups are being organized to perform the abstraction analyses
- Working groups are to be composed of performance assessment modelers and process modelers (site, engineering, and biosphere)
- Performance assessment modelers and process modelers jointly will perform model abstraction, testing, and sensitivity analyses
- Process modeler involvement will ensure that performance assessment use of process models is correct

# Status of Working Groups

- Planning is in progress to define the Abstraction Working Groups
  - Membership
  - Resource commitment
- To date, the Performance Assessment organization has
  - Defined working groups needed to ensure the right mix of expertise for each subject area
  - Performed detailed work-planning for the TSPA-VA

# TSPA Planning Activities for the Viability Assessment

- Work will focus on major improvements to TSPA components for unsaturated zone and saturated zone flow and transport
- Seven major modeling topics were identified, and detailed plans were developed for the Working Groups to address
  - Unsaturated Zone Flow
  - Saturated Zone Flow
  - Thermal-Hydrologic-Mechanical Coupling
  - Transport
  - Backfill
  - Climate
  - Biosphere
  - EBS Performance Analyses

# The Performance Assessment Program Defined a Series of Modeling Topics and "Issues"

- The following have been defined for each issue:
  - Data needs and sources
  - TSPA implementation
  - Sensitivity studies
  - Status

# The Objective in Defining Topics and Issues Was to Plan the TSPA-VA

- The purpose of identifying topics and issues was to define the TSPA-VA and the work needed to accomplish that system analysis

- The Working Groups will review and revise this preparatory work, as appropriate, and feed any data needs requiring further work back to the site and design programs

- An example list of issues developed for one topic is presented in the following viewgraph

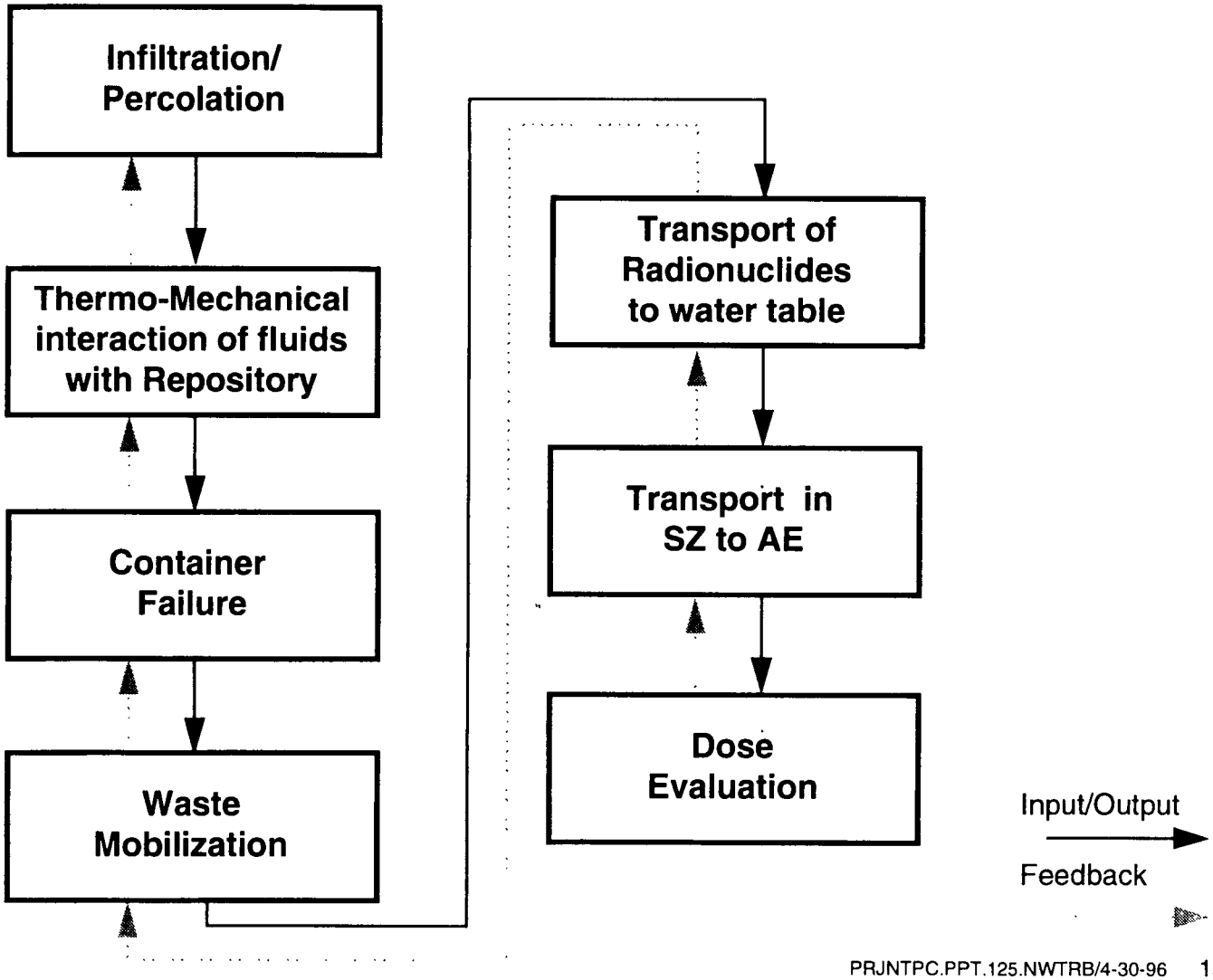
# Example:
# UZ Flow Modeling Sensitive Issues

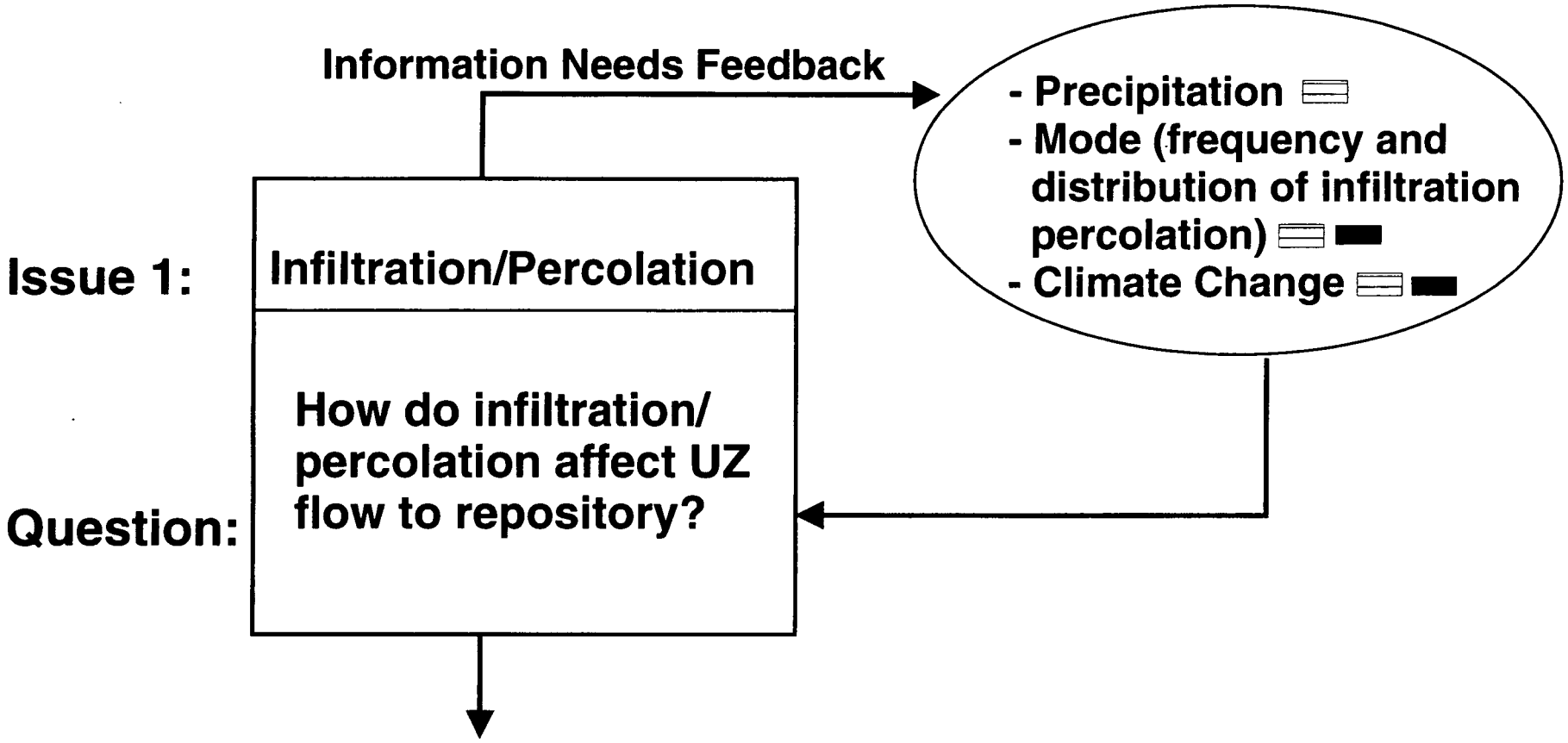
- Fracture-matrix coupling
- Fracture hydraulic properties
- Lateral diversion of water above the repository
- Episodicity (infiltration of pulses versus steady-state infiltration)
- Infiltration/percolation rate
- Heterogeneity and scaling

# The Identified "TSPA Implementation" Activities Are Being Organized and Planned for Efficiency

- A modeling flow hierarchy with seven components has been constructed
- A reduced set of modeling applications is planned that draws on results of process-level modeling to provide abstracted subsystem-level input to each of these components
- The flow hierarchy, its components, and the process-level feeds to be abstracted for each component are illustrated on the next six viewgraphs

# Working Groups' Modeling Flow Scenario to Control Interfaces



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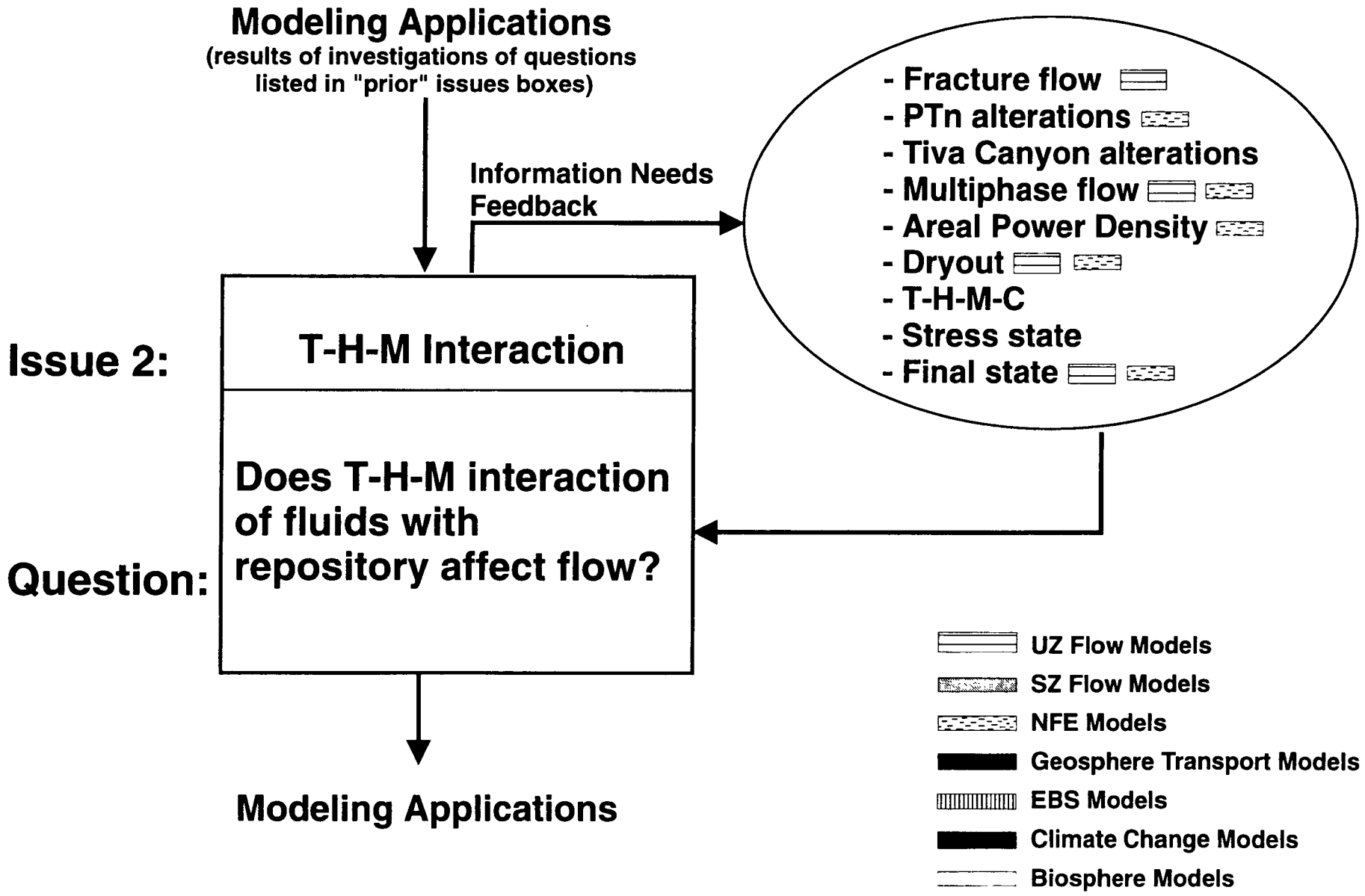
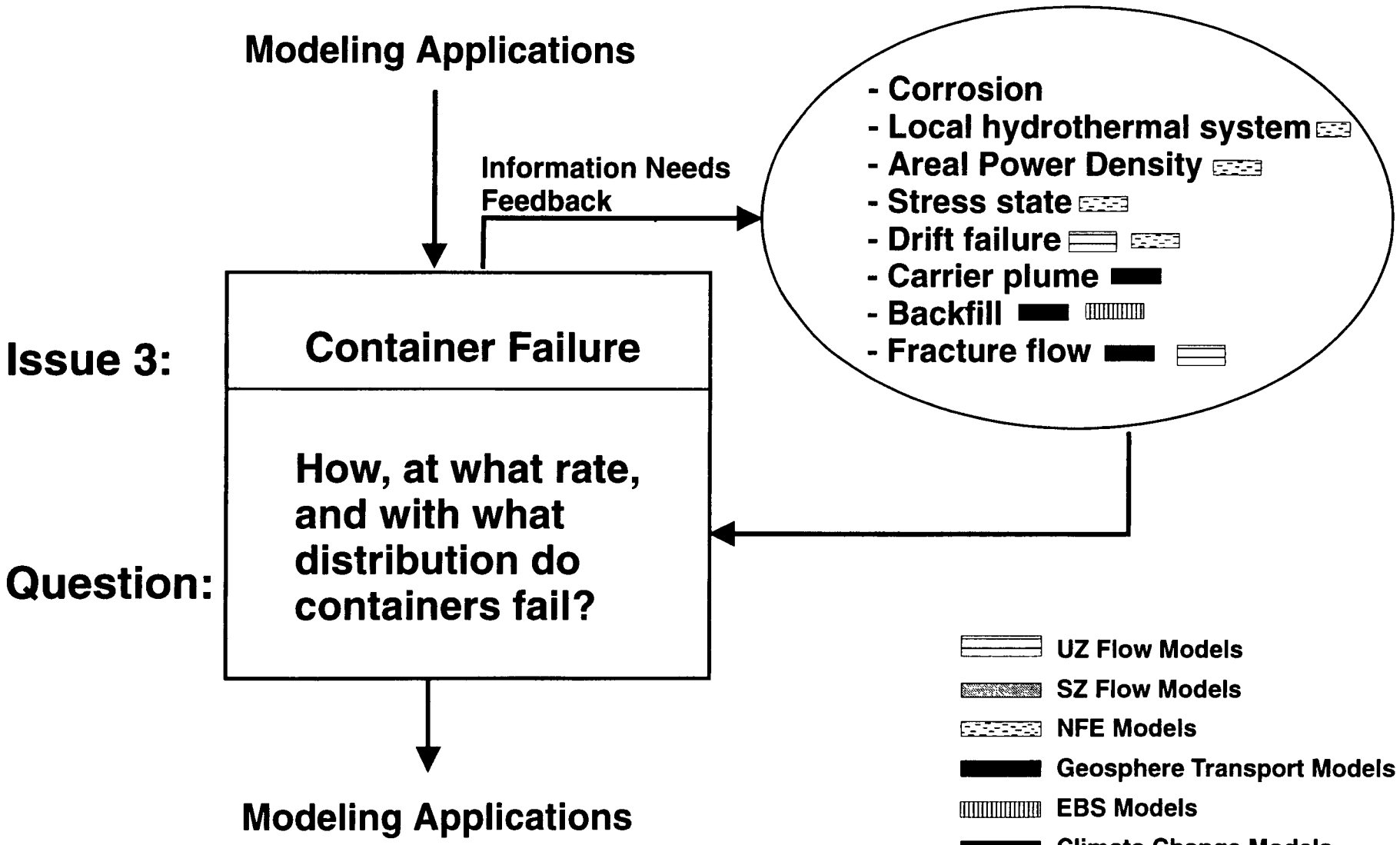

Modeling Applications
(results of investigations of questions listed in "prior" issues boxes)
Information Needs Feedback
- Fracture flow
- PTn alterations
- Tiva Canyon alterations
- Multiphase flow
- Areal Power Density
- Dryout
- T-H-M-C
- Stress state
- Final state
Issue 2:
T-H-M Interaction
Question:
Does T-H-M interaction of fluids with repository affect flow?
Modeling Applications
UZ Flow Models
SZ Flow Models
NFE Models
Geosphere Transport Models
EBS Models
Climate Change Models
Biosphere Models

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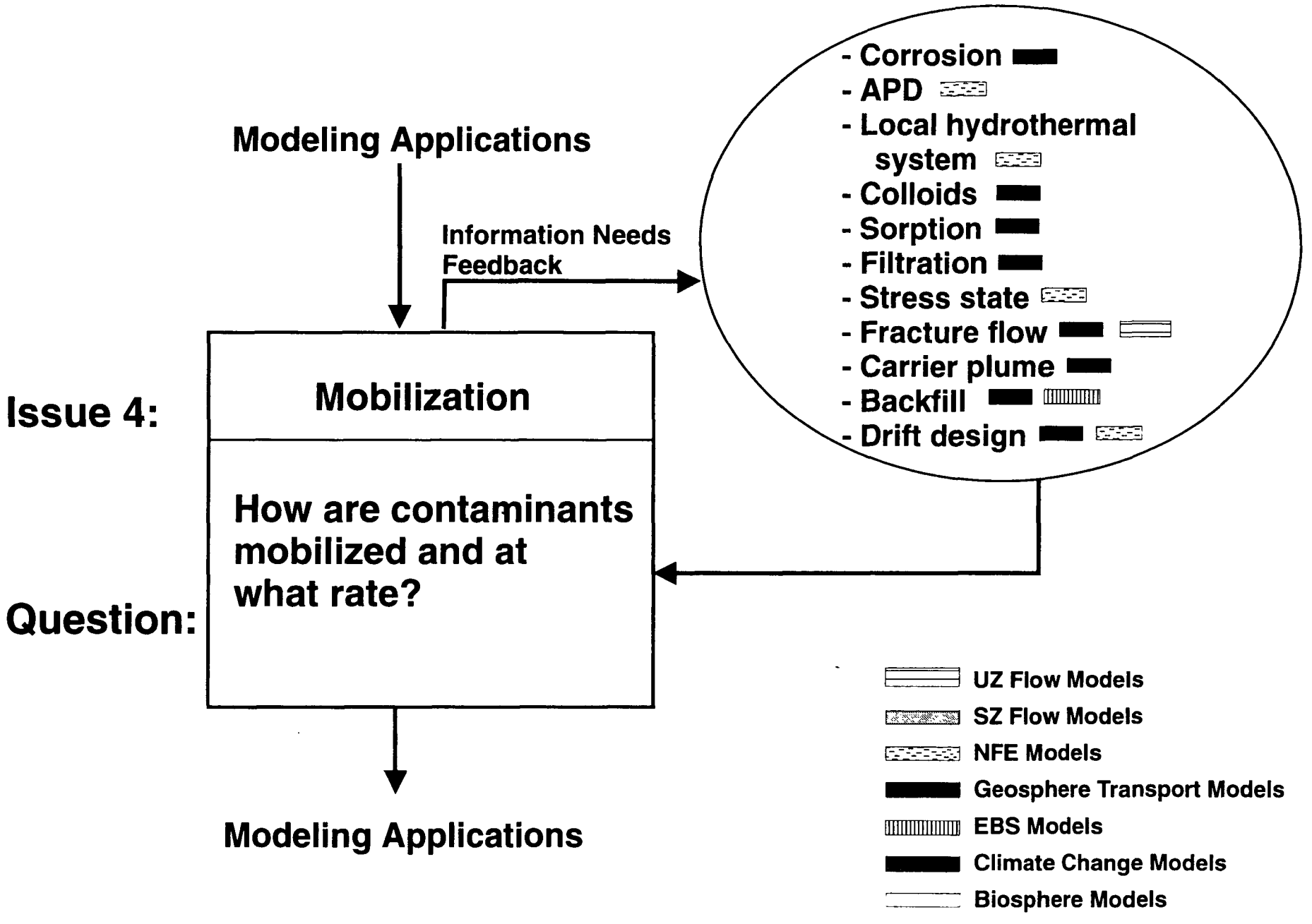
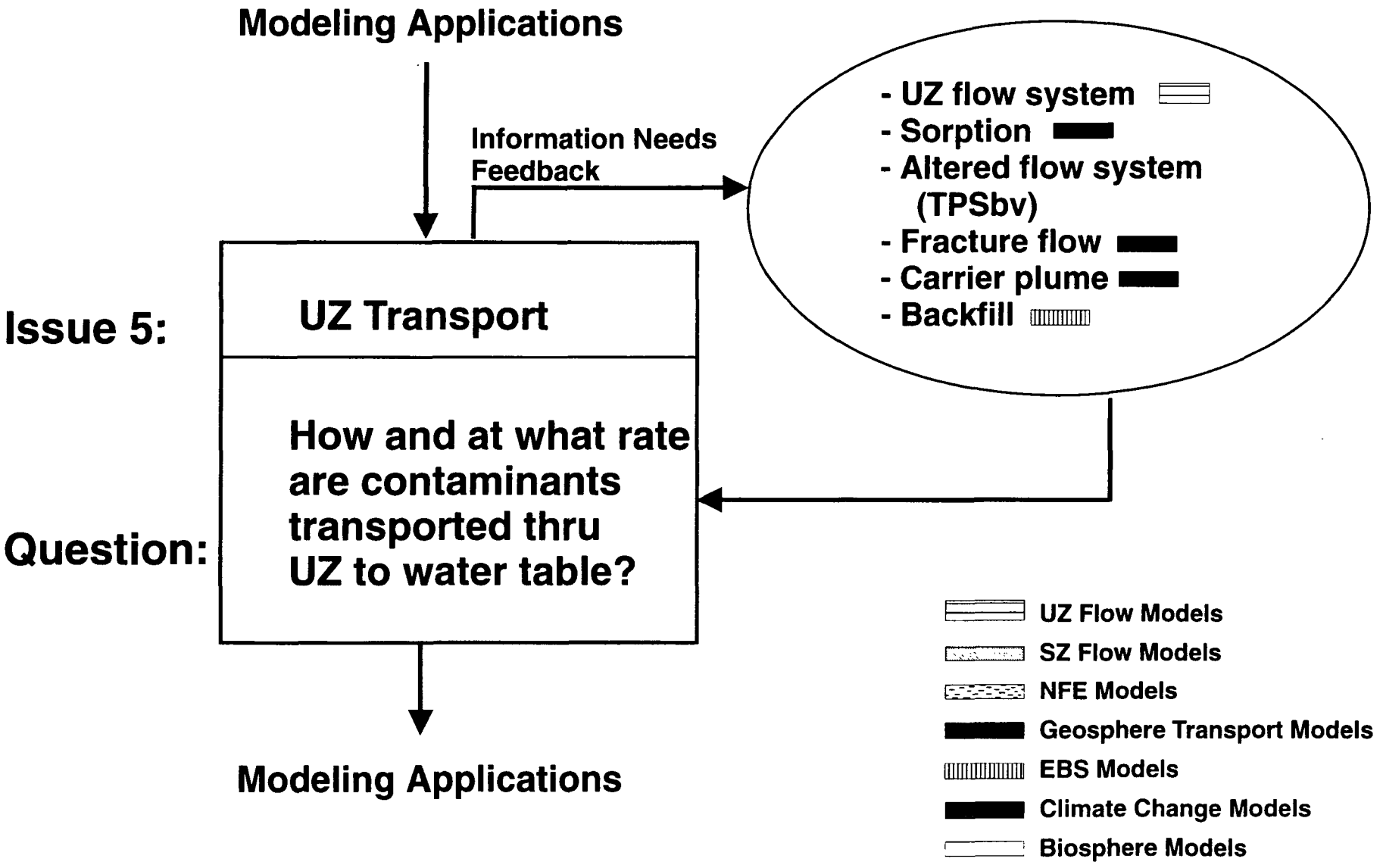

Modeling Applications
Information Needs Feedback
- Corrosion
- APD
- Local hydrothermal system
- Colloids
- Sorption
- Filtration
- Stress state
- Fracture flow
- Carrier plume
- Backfill
- Drift design
Issue 4:
Mobilization
Question:
How are contaminants mobilized and at what rate?
Modeling Applications
UZ Flow Models
SZ Flow Models
NFE Models
Geosphere Transport Models
EBS Models
Climate Change Models
Biosphere Models

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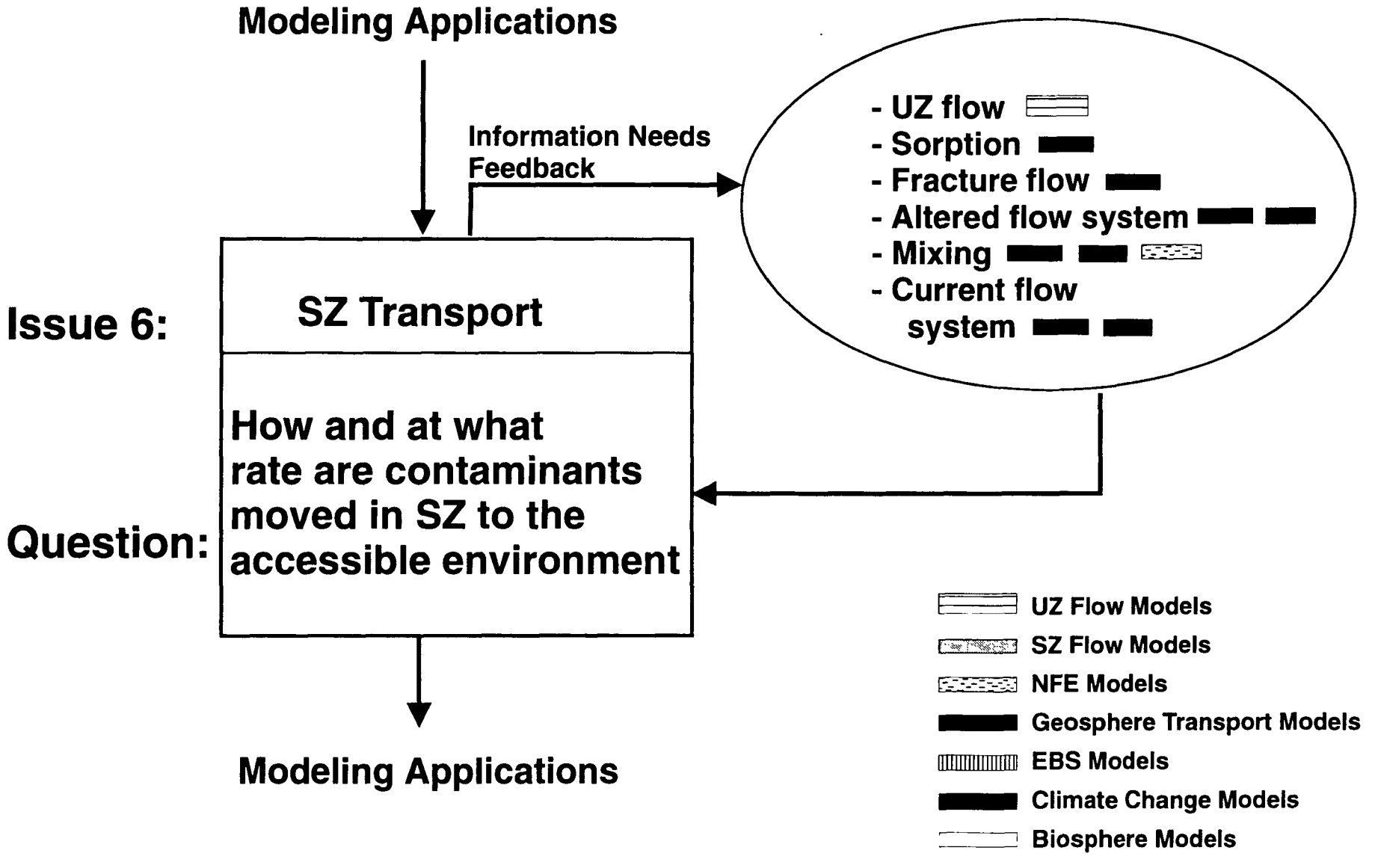
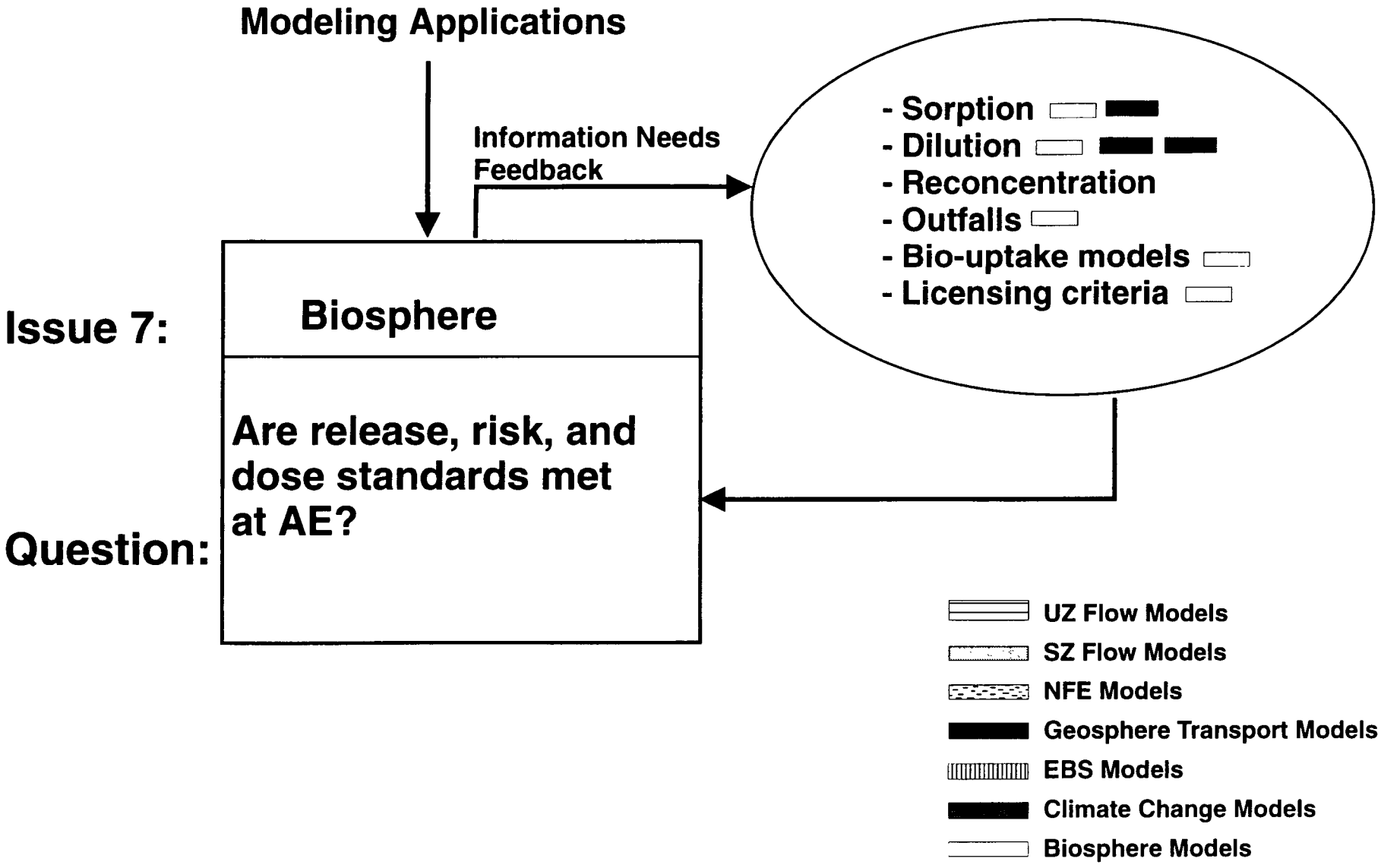

Modeling Applications
Information Needs
Feedback
- UZ flow
- Sorption
- Fracture flow
- Altered flow system
- Mixing
- Current flow system
Issue 6:
SZ Transport
Question:
How and at what rate are contaminants moved in SZ to the accessible environment
Modeling Applications
UZ Flow Models
SZ Flow Models
NFE Models
Geosphere Transport Models
EBS Models
Climate Change Models
Biosphere Models

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# PISA Chapter 8
# Total System Performance Assessment

- An annotated outline, with five sections, is in preparation
  - Introduction
  - System and subsystem descriptions
  - Evaluation of undisturbed performance
  - Evaluation of potentially disturbed performance
  - Synthesis, summary, and conclusions

# Augmentation of the TSPA-VA for the License Application

# Performance Assessment Work Between the TSPA-VA and the LA

- Addressing peer review comments on the TSPA-VA
- Incorporating new data and process-level modeling results through sensitivity studies
- Refining evaluations of alternative models
- Adding to the documentation to ensure that a complete, reviewable package is created for the regulator

# Performance Confirmation

# Performance Assessment Work for the Performance Confirmation Program

- It is expected that scientific, engineering, and environmental work continues
  - to evaluate the potential repository
  - to assist in the preparation of the License Application and its updates to receive waste and close the repository
- Performance Assessment is a full participant in the current Confirmation Concepts Study

# A Performance Confirmation Concepts Study is in Progress

- It is a systems engineering task under WBS 1.2.1.5
  - Started 10/2/95
  - Draft report due 8/30/96
  - DOE acceptance review due 9/30/96
- Performance Confirmation Study will provide technical bases for performance confirmation requirements
  - FY96 focus is on supporting repository and engineered barrier system design
  - Customer focus will be broadened in FY97
- Provide a Draft Performance Confirmation Plan
  - Presenting an overview of the performance confirmation approach