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

NUCLEAR WASTE TECHNICAL REVIEW BOARD
FULL BOARD MEETING

SUBJECT: TOTAL SYSTEM PERFORMANCE ASSESSMENT-1995: OBJECTIVES AND APPROACH

PRESENTER: ROBERT W. ANDREWS

PRESENTER'S TITLE AND ORGANIZATION: MANAGER, PERFORMANCE ASSESSMENT AND MODELING
CRWMS M&O/INTERA
LAS VEGAS, NEVADA

TELEPHONE NUMBER: (702) 295-9354

ARLINGTON, VIRGINIA
OCTOBER 17-18, 1995

Outline

- Philosophy/general objectives of TSPA
- Major recommendations from TSPA-1993
- Important components of TSPA-1995
- Revised design and site-related assumptions
- Issues not addressed in TSPA-1995
- General approach in TSPA-1995
- Information flow in TSPA-1995

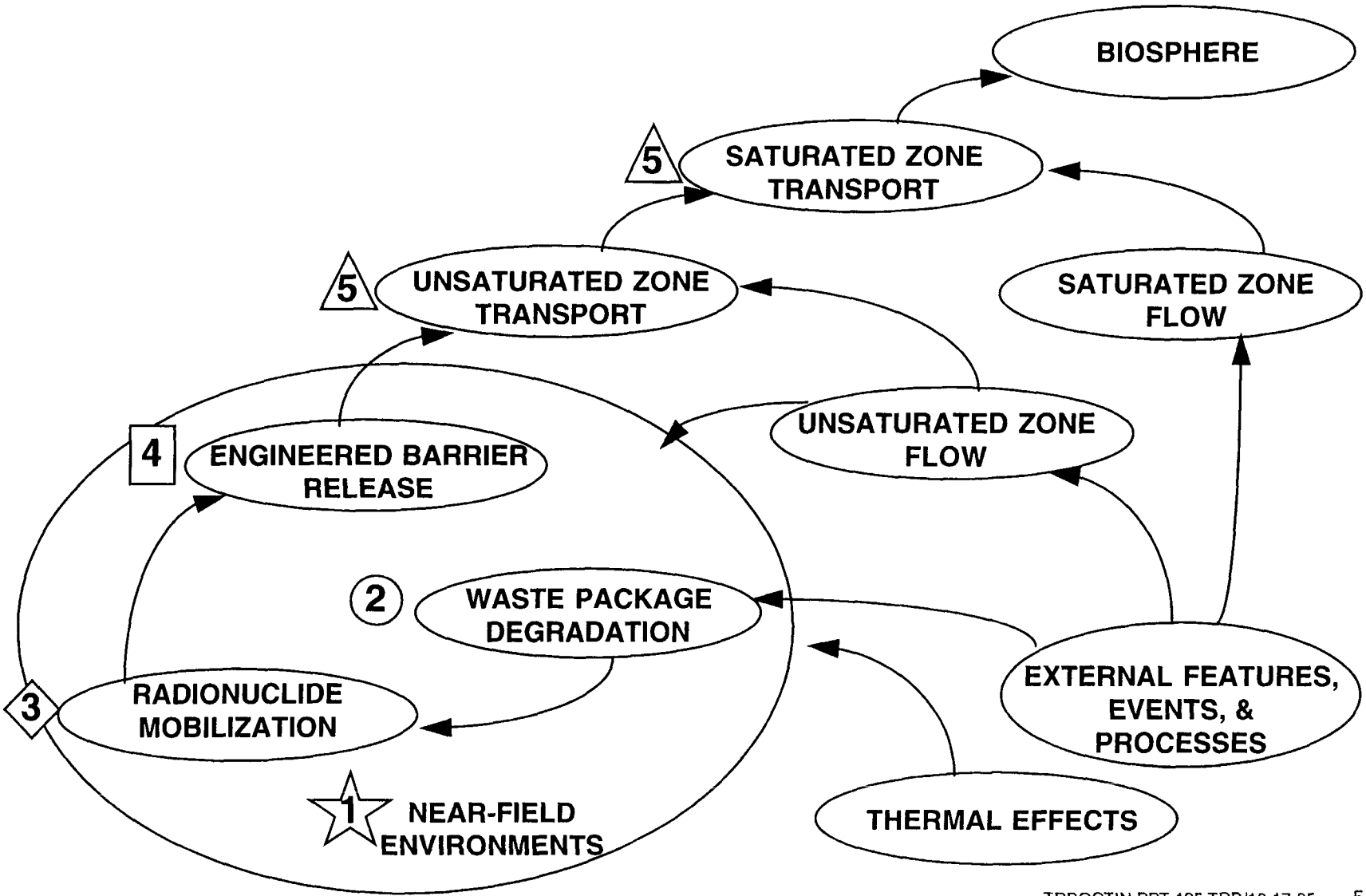
Philosophy/General Objectives

- Focus on components of waste isolation and containment determined by previous analyses to be significant to performance
- Incorporate all relevant processes that affect performance
- Be as "reasonably" "representative" as current information allows or "bounding" "conservative" where information is lacking
- Incorporate uncertainty and variability explicitly in the predictions of performance
- Evaluate the significance of current understanding and uncertainty on different post-closure performance measures
- Provide input to assist in prioritizing site characterization and design efforts

Major Recommendations from TSPA-1993

- Representativeness of drift-scale (near-field environment) processes needs to be enhanced
- Representativeness of waste package degradation models needs to be improved
- Alternative models of site-scale unsaturated zone flow and transport need to be investigated
- Most significant processes/models/parameters depends on time frame of analysis
  - waste package degradation
  - percolation flux
  - conceptual model of unsaturated zone flow
  - Np solubility

Important Components Included in TSPA-1995 Analyses



Significant Components Evaluated in TSPA-1995

- Alternative drift-scale thermo-hydrologic environments
- Alternative waste package degradation models in humid air and aqueous environments (includes degradation vs time)
- Localized percolation flux distribution intercepting repository drifts
- Alternative drift-scale aqueous transport models
- Unsaturated zone percolation flux distribution (and transport) between fractures and matrix

Revised Design-Related Assumptions in TSPA-1995

- Two areal mass loadings
  - low (25 MTU/acre)
  - high (83 MTU/acre)
- Four backfill alternatives
  - no backfill
  - backfill placed at 100 years; affects drift-scale thermal hydrology
  - backfill placed at 100 years; backfill and partially failed waste packages distribute flux such that no advection through waste package
  - backfill with capillary barrier placed at 100 years; no advection through EBS or through waste package
- Effects of humid air corrosion
- Effects of cathodic protection

Revised Site-Related Assumptions in TSPA-1995

- Incorporate initial estimates of spatially variable infiltration rates
- Evaluate two percolation flux distributions
  - low (values derived from vertical flow only from surface infiltration)
  - high (values derived from areally averaged surface infiltration)
- Allow possibility of fracture flow and transport in unsaturated zone
  - affects drift-scale and unsaturated zone flux
  - depends on percolation flux
- Modified radionuclide solubilities and retardation

Issues Not Addressed in TSPA-1995

- Potential effect of alternative container degradation modes
- Near-field thermal chemistry, thermal mechanics and other coupled processes
- Gaseous transport of C-14 in geosphere
- Saturated zone transport down-gradient from "accessible environment" at 5 kilometers
- Alternative biospheres
  - average member of critical group vs maximally exposed individual

Approach Used in TSPA-1995

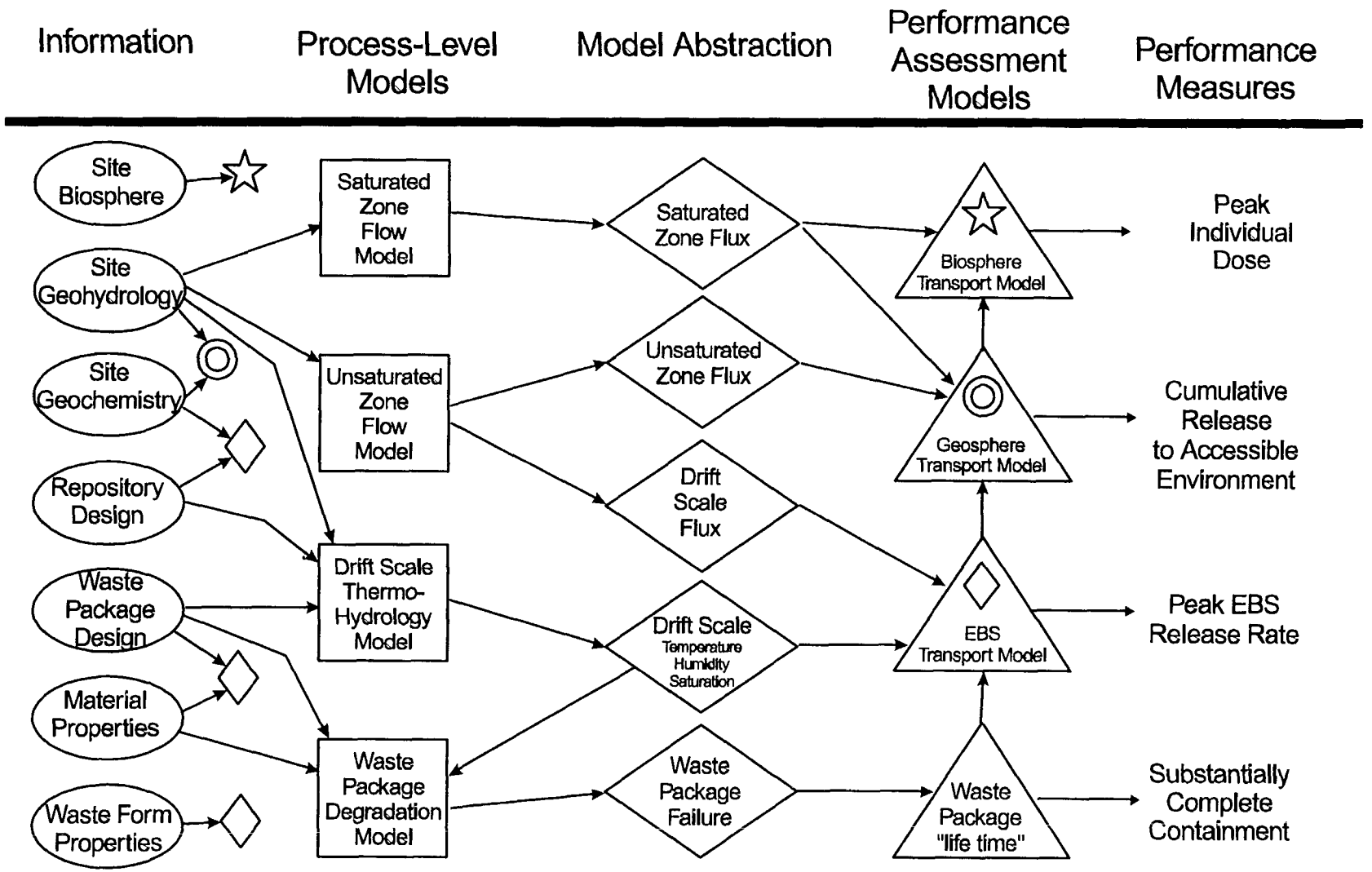
- Assimilate relevant site and design information
  - available process models
  - parameter distributions
- Develop process models, where needed
  - drift-scale thermal hydrology
  - humid air corrosion
  - unsaturated zone "non-equilibrium" fracture flow
- Conduct multiple deterministic or stochastic simulations with the process models
- Abstract appropriate response surfaces from the process model results
- Develop functional relationships between variables, where appropriate

Approach Used in TSPA-1995

(Continued)

- Input response surfaces, functional relationships and fixed parameters into Total System Performance Assessment model - RIP (Repository Integration Program)
- Conduct multiple realizations of performance using RIP
  - substantially complete containment
  - peak EBS release rate
  - cumulative release rate at the accessible environment for 10,000 years
  - maximally exposed individual dose at accessible environment for 10,000 and 1,000,000 years
- Conduct sensitivity analyses of alternative conceptual assumptions and designs
- Process the results to determine the most significant parameters for given conceptual assumptions and performance measures

TSPA-1995 Information Flow Diagram



Outline of TSPA-1995 Presentations

- Ambient unsaturated zone hydrology model and drift -scale thermal hydrology model and abstraction
- Waste package degradation model and abstraction, and waste package "failure" distribution results
- Radionuclide mobilization and EBS transport models and peak EBS release rate results
- Unsaturated and saturated zone transport model, geosphere release and peak dose results
- Volcanism effects and consequences
- Significance of predicted results and implications to site and design