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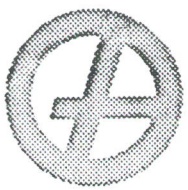
Presentation to

Nuclear Waste Technical Review Board

Risk and Performance Assessment Panel



May 21,1991

Scope

- An independent study to develop and recommend a detailed strategic plan of action for evaluation of the suitability of the Yucca Mountain site for a repository

Administered through DOE-Chicago and Argonne National Laboratory

- "..., it is recognised that safety assessments must form an integral part of repository development programmes at an early stage of research, and throughout the course of siting, design, construction, operation, and decommissioning and final sealing of radioactive waste disposal systems. Prior to licensing a particular site and repository design, safety assessments must proceed iteratively with disposal system siting and development, to determine if further information is needed and, if so, what type of information is needed."

Nuclear Energy Agency, Paris, 1991

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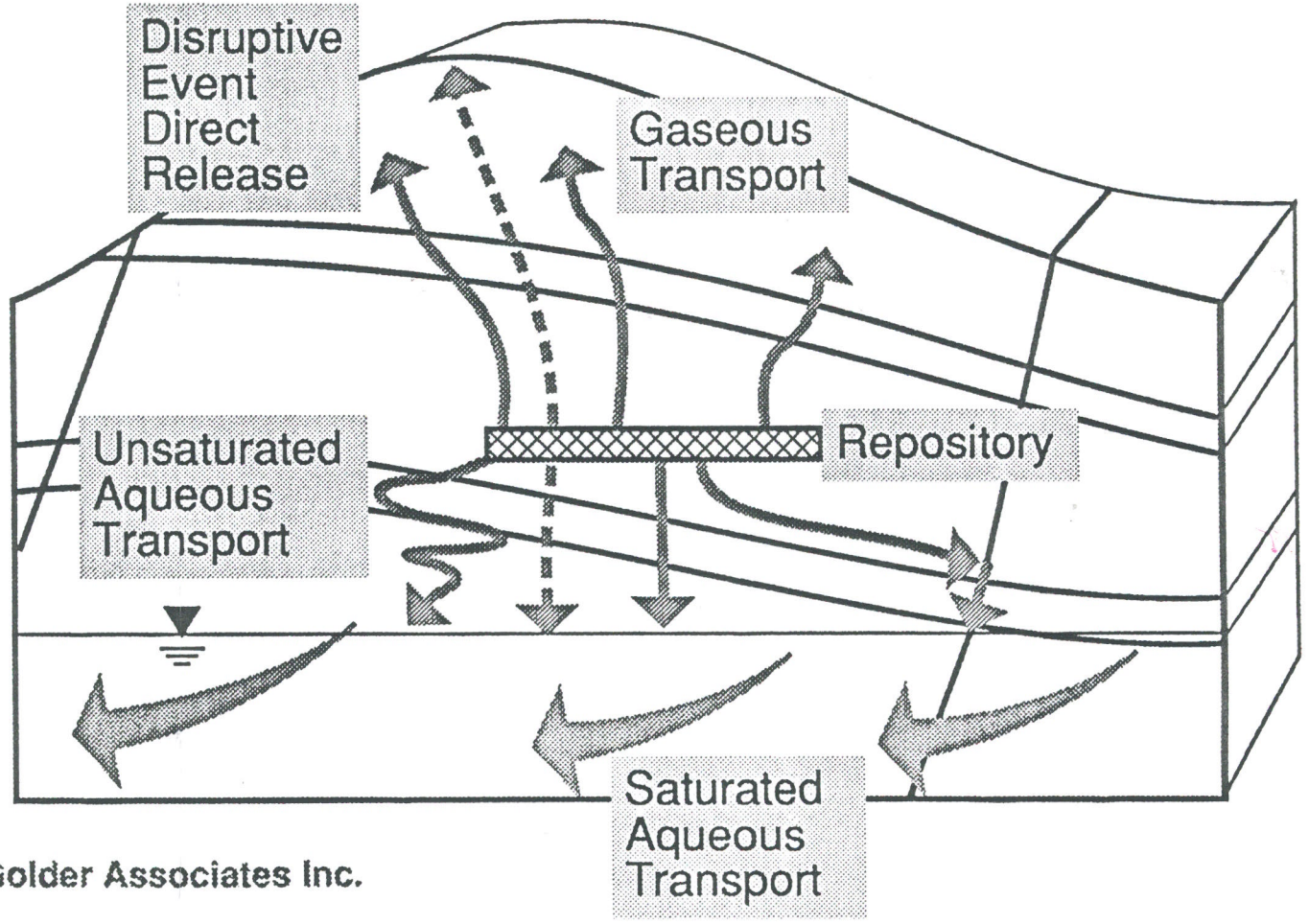
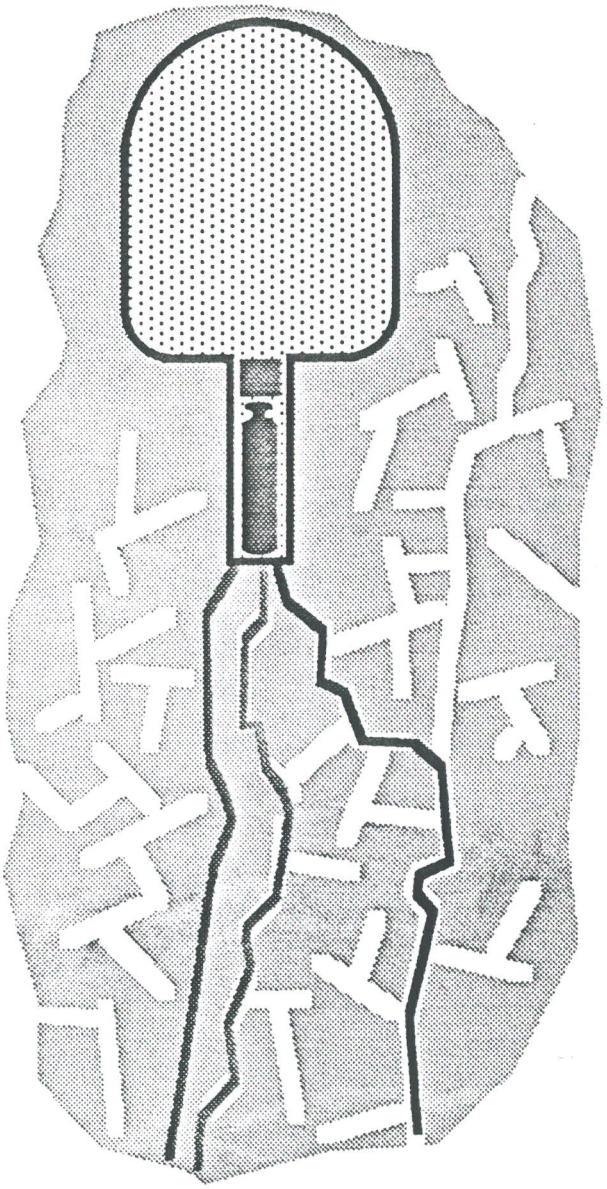
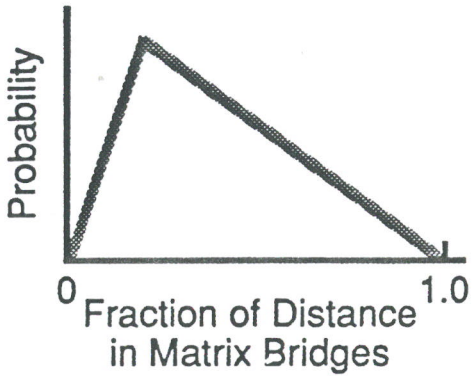
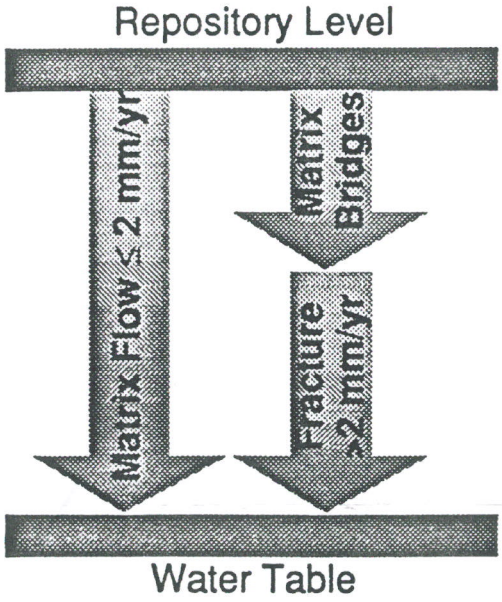
Transport Pathways Away From Repository Level



Illustrative Example
Unsaturated Zone Pathway







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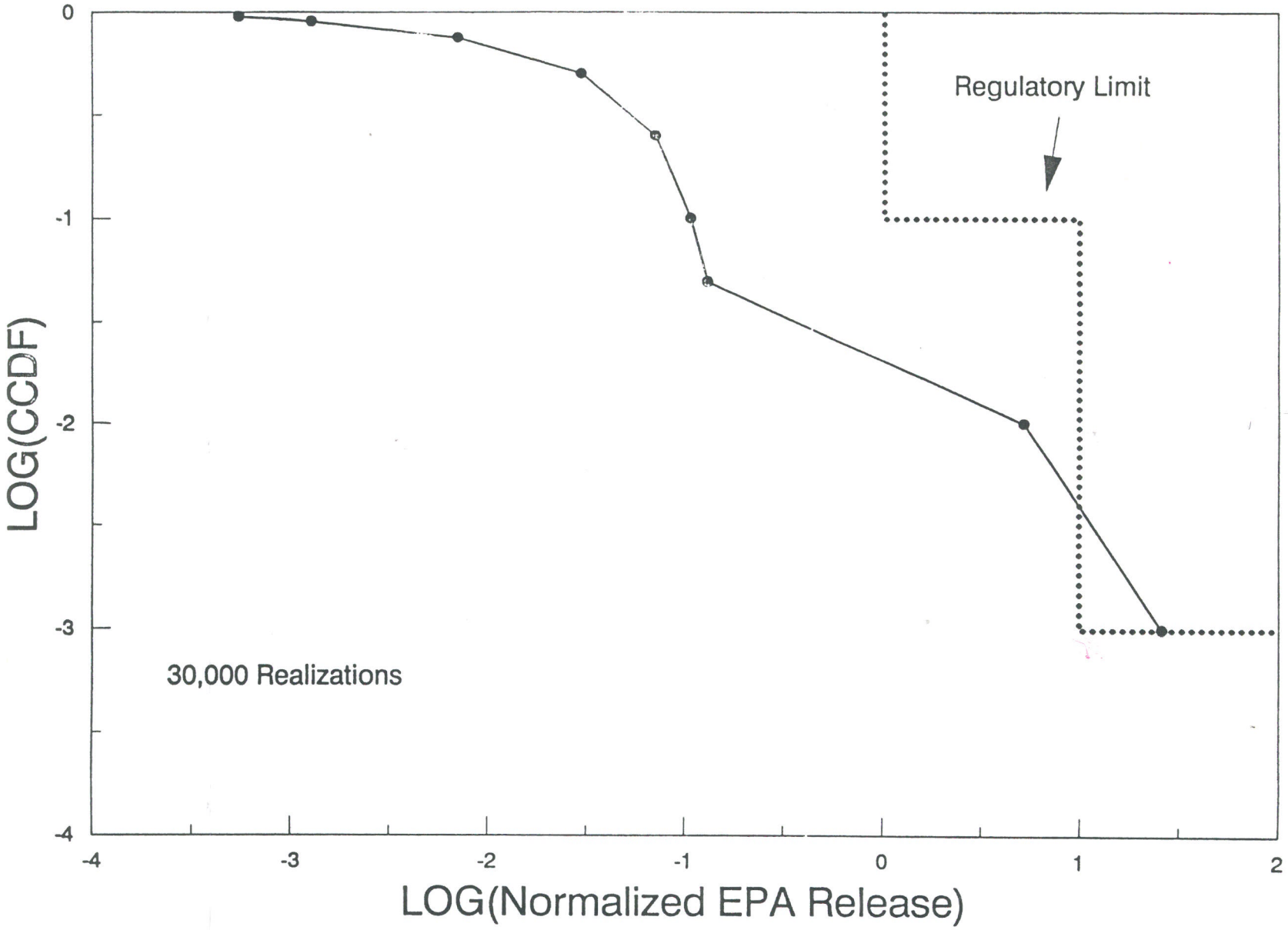
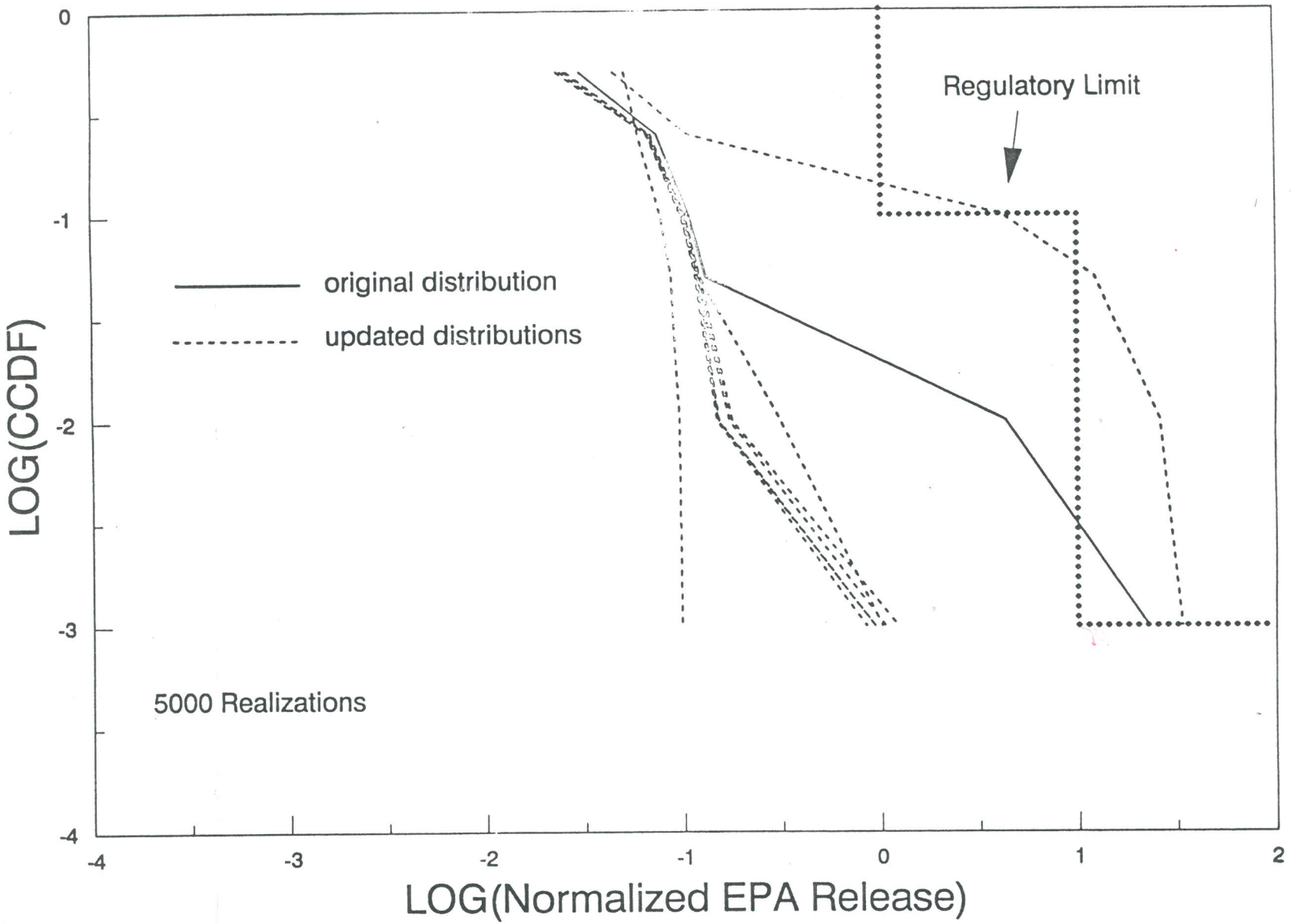
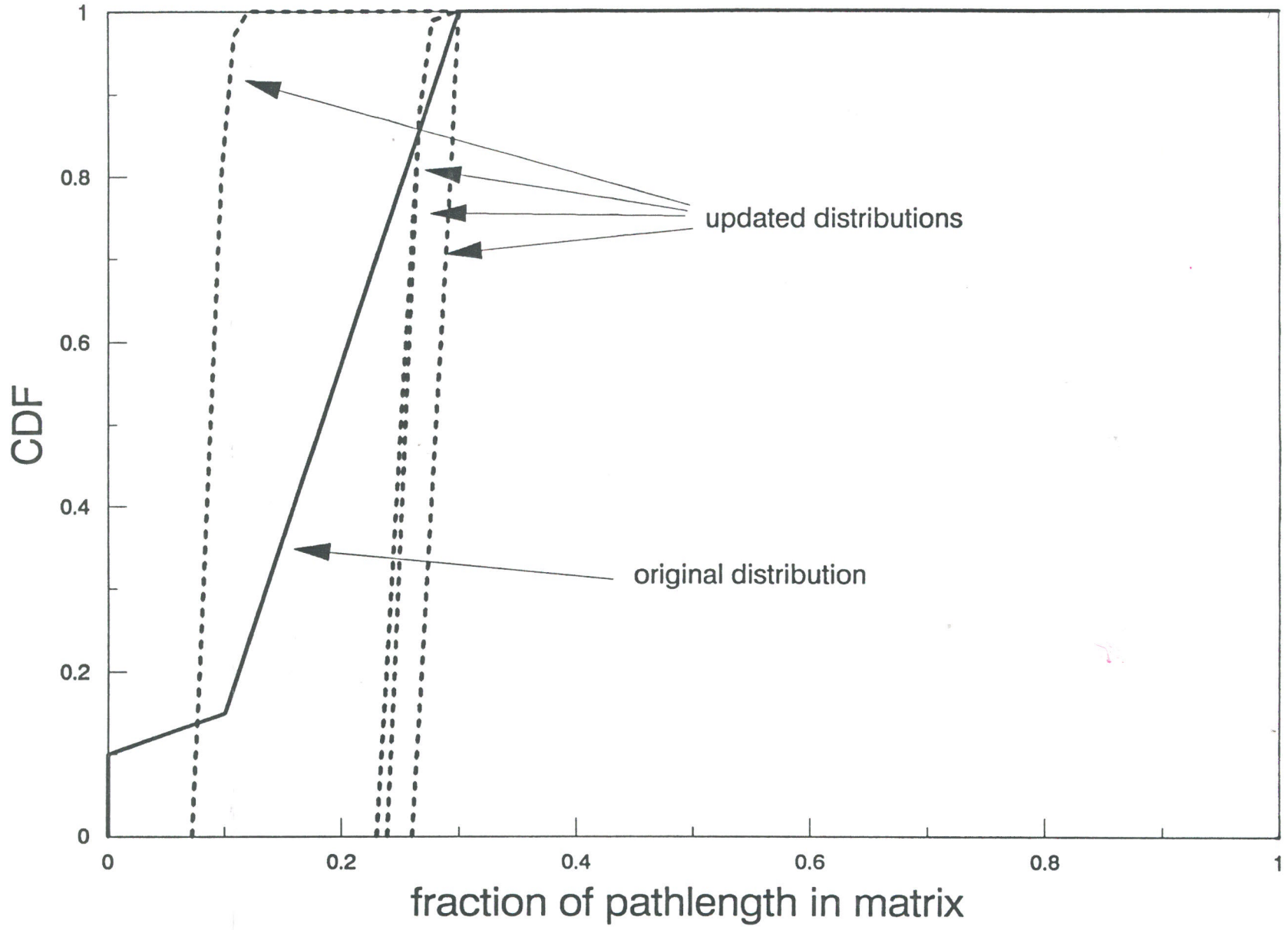
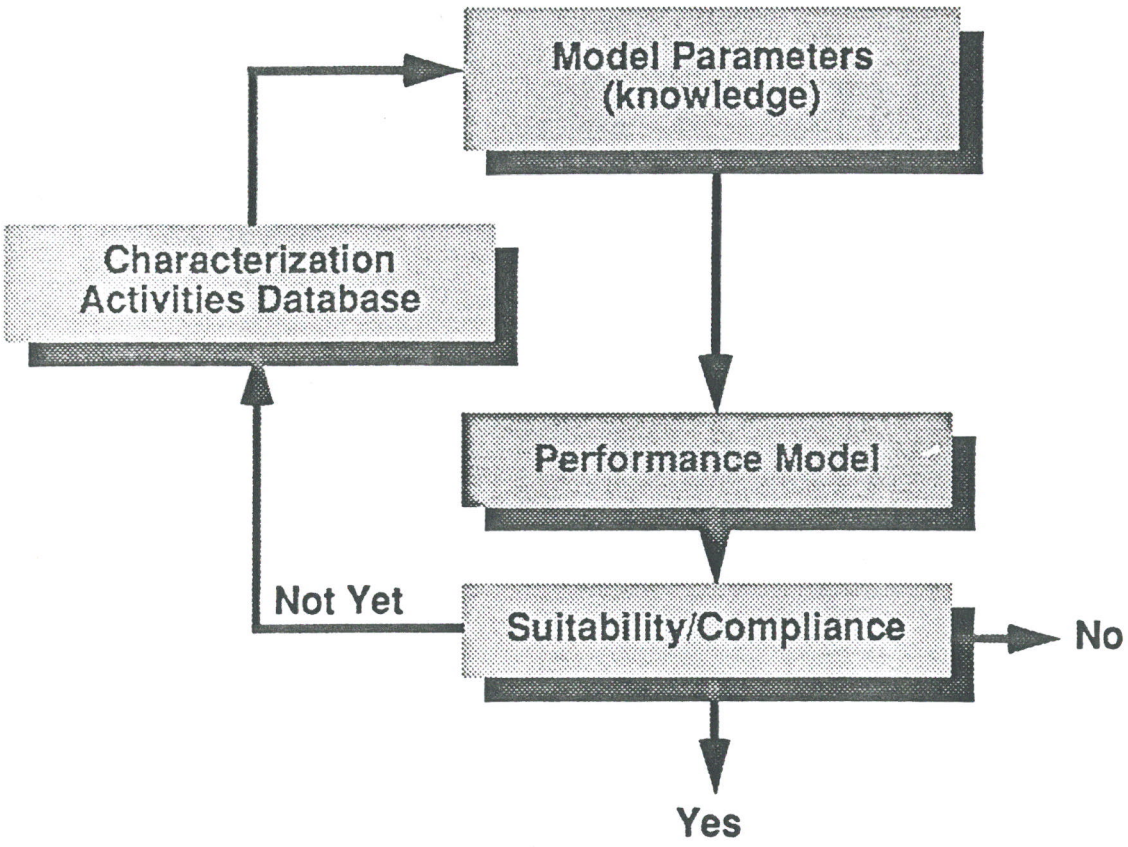

Regulatory Limit
30,000 Realizations
LOG(CCDF)
LOG(Normalized EPA Release)
0
-1
-2
-3
-4
-4
-3
-2
-1
0
1
2


Regulatory Limit
original distribution
updated distributions
5000 Realizations
LOG(CCDF)
LOG(Normalized EPA Release)
0
-1
-2
-3
-4
-4
-3
-2
-1
0
1
2

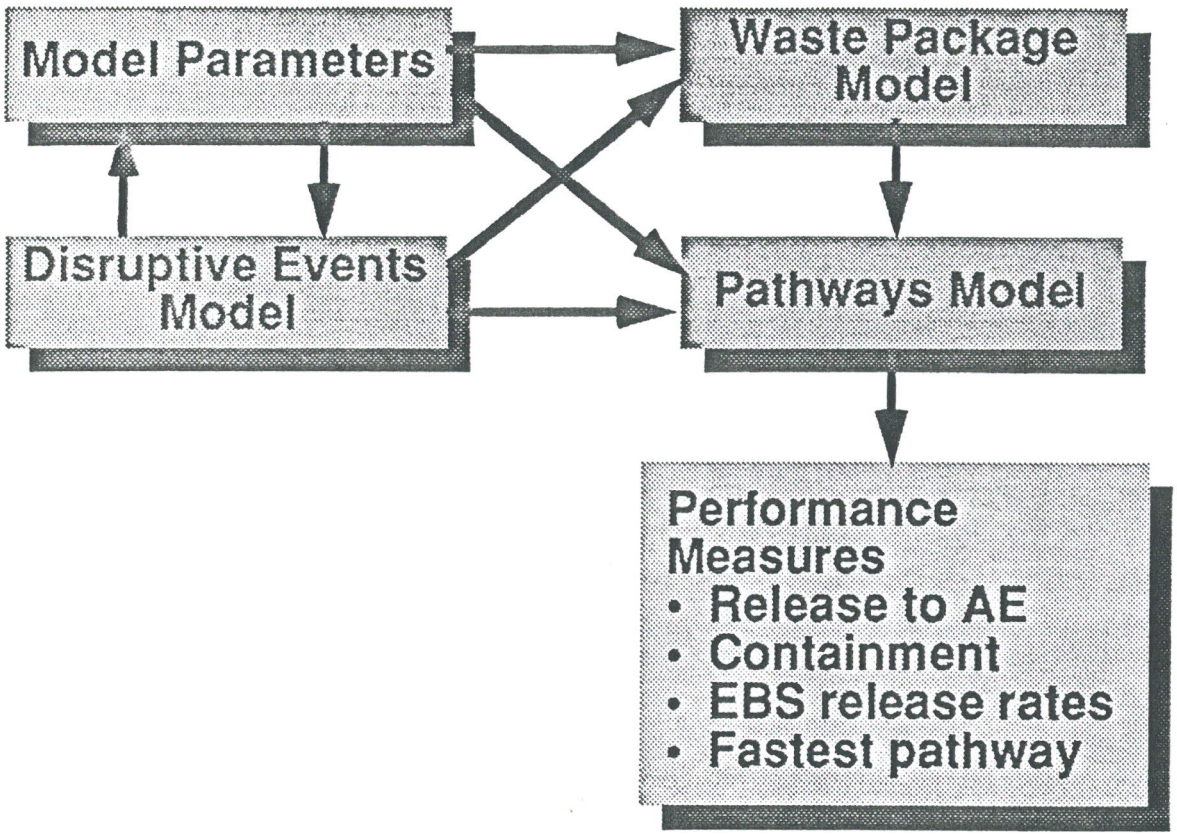

1
0.8
0.6
0.4
0.2
0
CDF
0
0.2
0.4
0.6
0.8
1
fraction of pathlength in matrix
updated distributions
original distribution

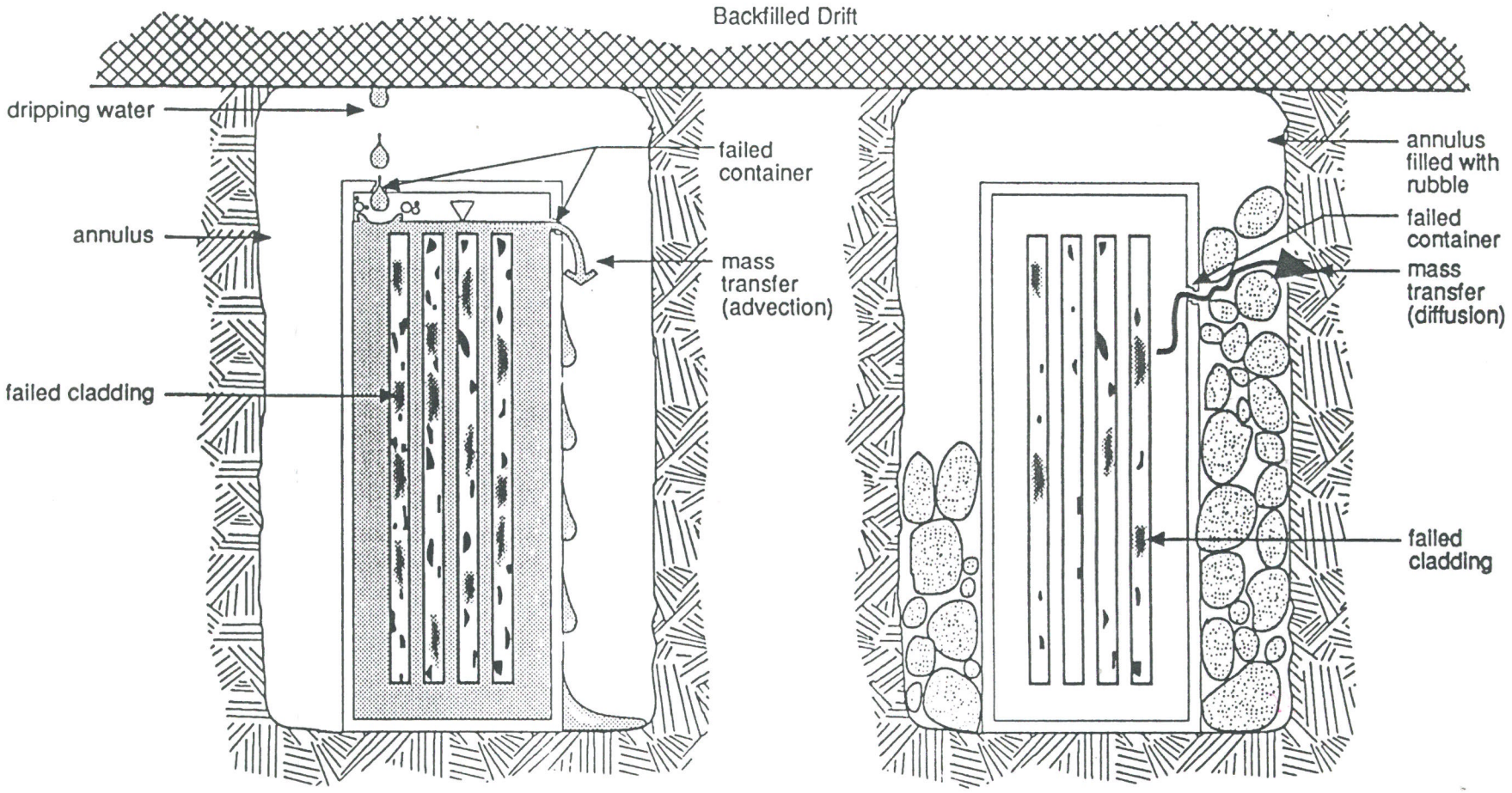
System Overview



1. Due to complexity, the performance model has to be greatly simplified.
2. Scientists will define the model, the model will define the parameters
3. Characterization activities do not directly measure model parameters

Performance Model





mass release rate = f(mass exposure, mass transfer)
mass exposure, mass transfer = f(environmental conditions)
environmental conditions ≡ moisture, temperature, chemistry...

FIGURE 1
WASTE PACKAGE SCHEMATIC
ARGONNE/MODEL DEVELOPMENT

PROJECT NO. 903-1371.203 DRAWING NO. 24909 DATE 5/14/91 DRAWN BY CB

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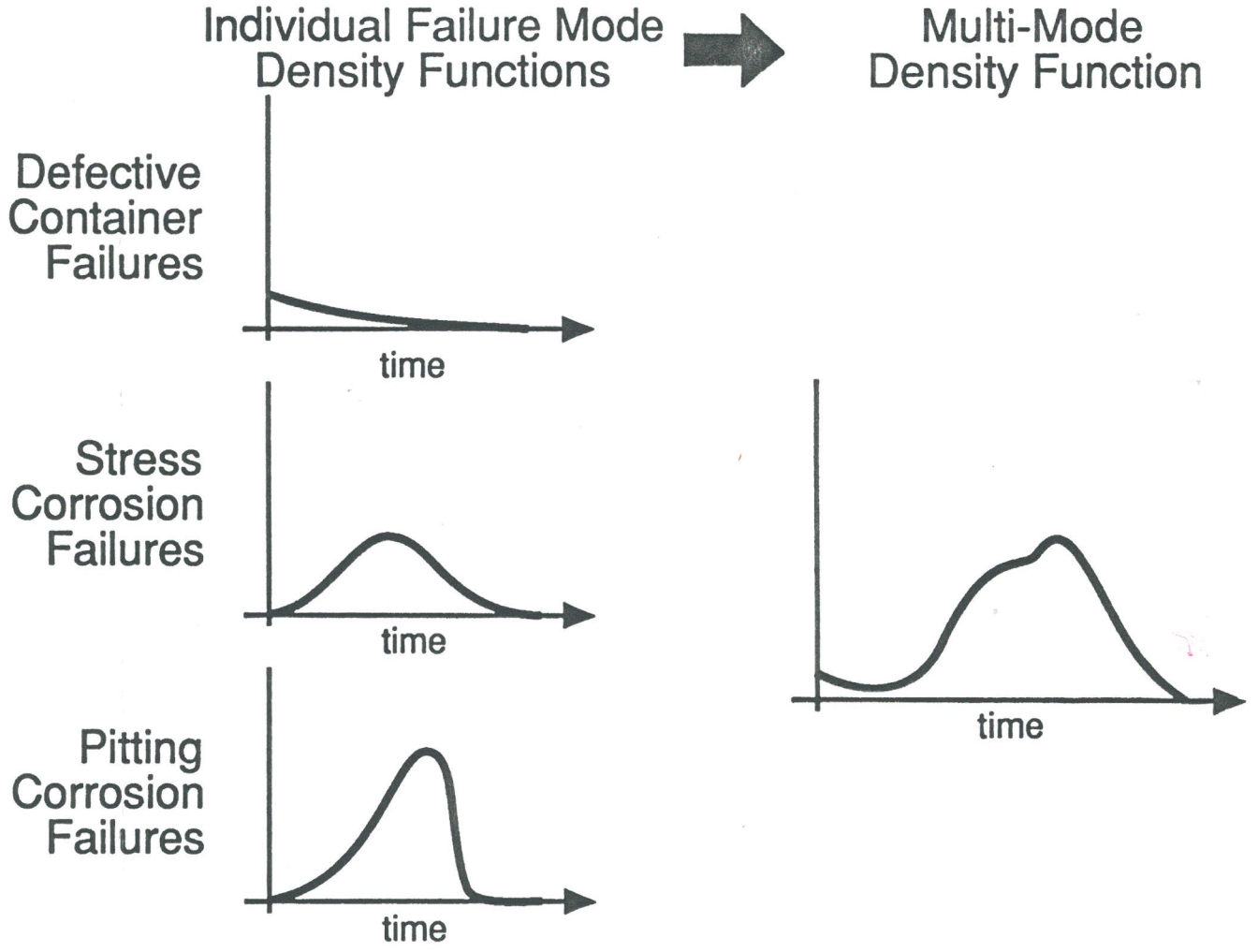
Waste Package Failure Modes



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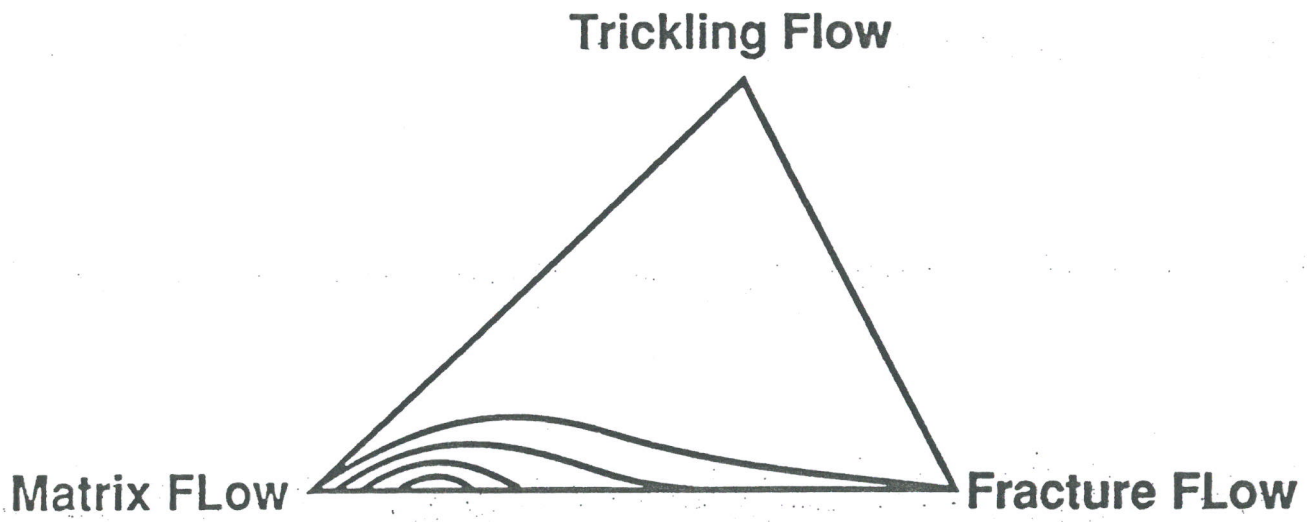
Pathways Model

- **Pathways are essentially one-dimensional (i.e.negligible nuclide gain or loss within a pathway)**
- **Processes represented: Advection, Diffusion, Retardation (sorption, matrix-diffusion)**
- **Multiple advective modes can exist within a pathway (e.g. matrix/fracture/trickling flow)**
- **Approach:**
  - Characterize each advective mode separately (velocity, retardation, etc.)
  - Evaluate distribution of nuclide distances traveled in each mode
  - Use a simple transport algorithm to simulate

Pathways



- Plot fraction net path length in each mode
- Contours represent distribution of individual paths within the pathway
- The distribution and the velocities change with net flux

Preliminary List of Disruptive Events

- **Volcanism**
  - extrusive strombolian
  - extrusive hydrovolcanic
  - intrusive (magma chamber)
- **Faulting**
  - primary faulting within repository
  - secondary faulting within repository
  - faulting outside repository
  - detachment
- **Climate**
  - precipitation change
  - evapotranspiration change
- **Human Intrusion**
  - drilling
  - resource mining
  - irrigation/flooding

Preliminary List of Disruptive Event Consequences

- Local disruption of some waste packages
- Water table change
- Change in infiltration rate
- Change in hydraulic gradient
- Direct release to AE or SZ

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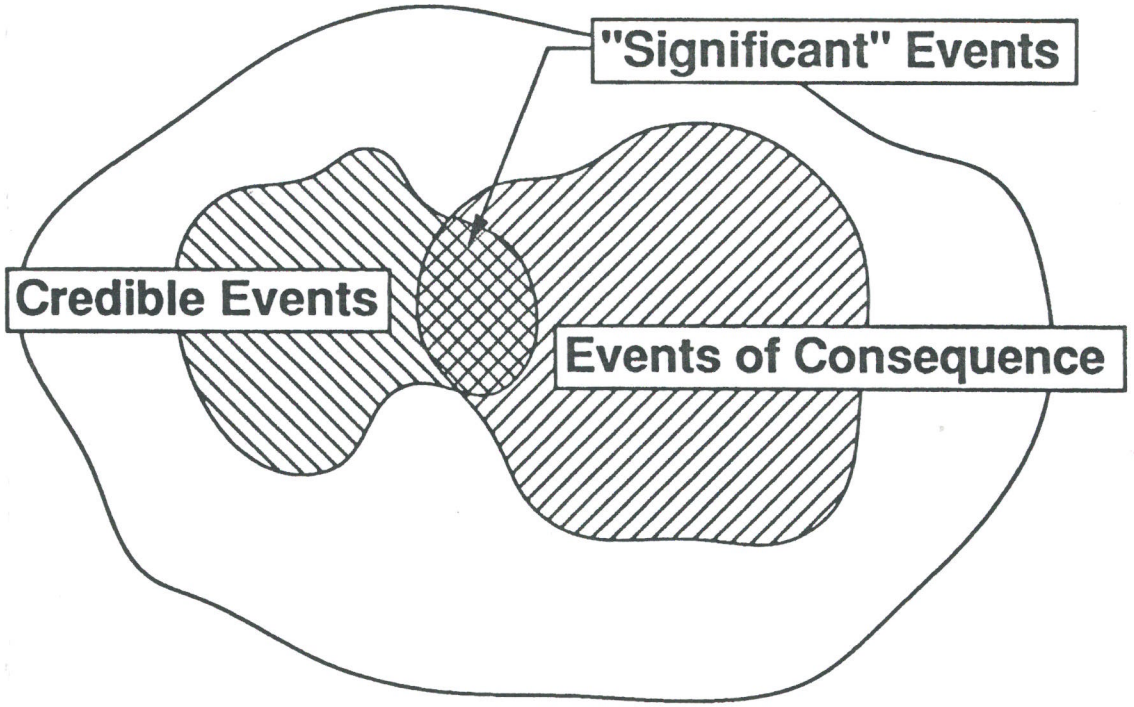
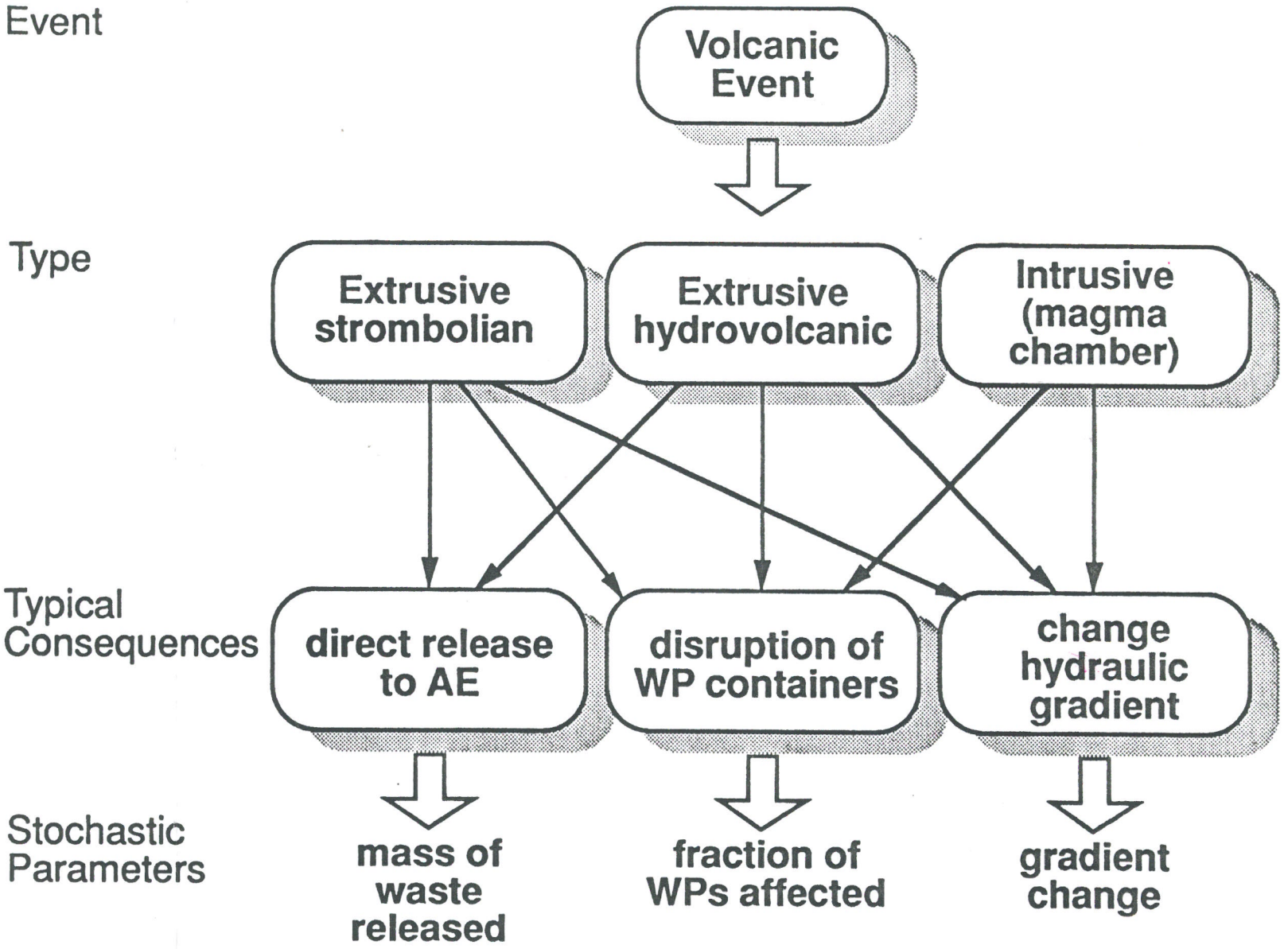
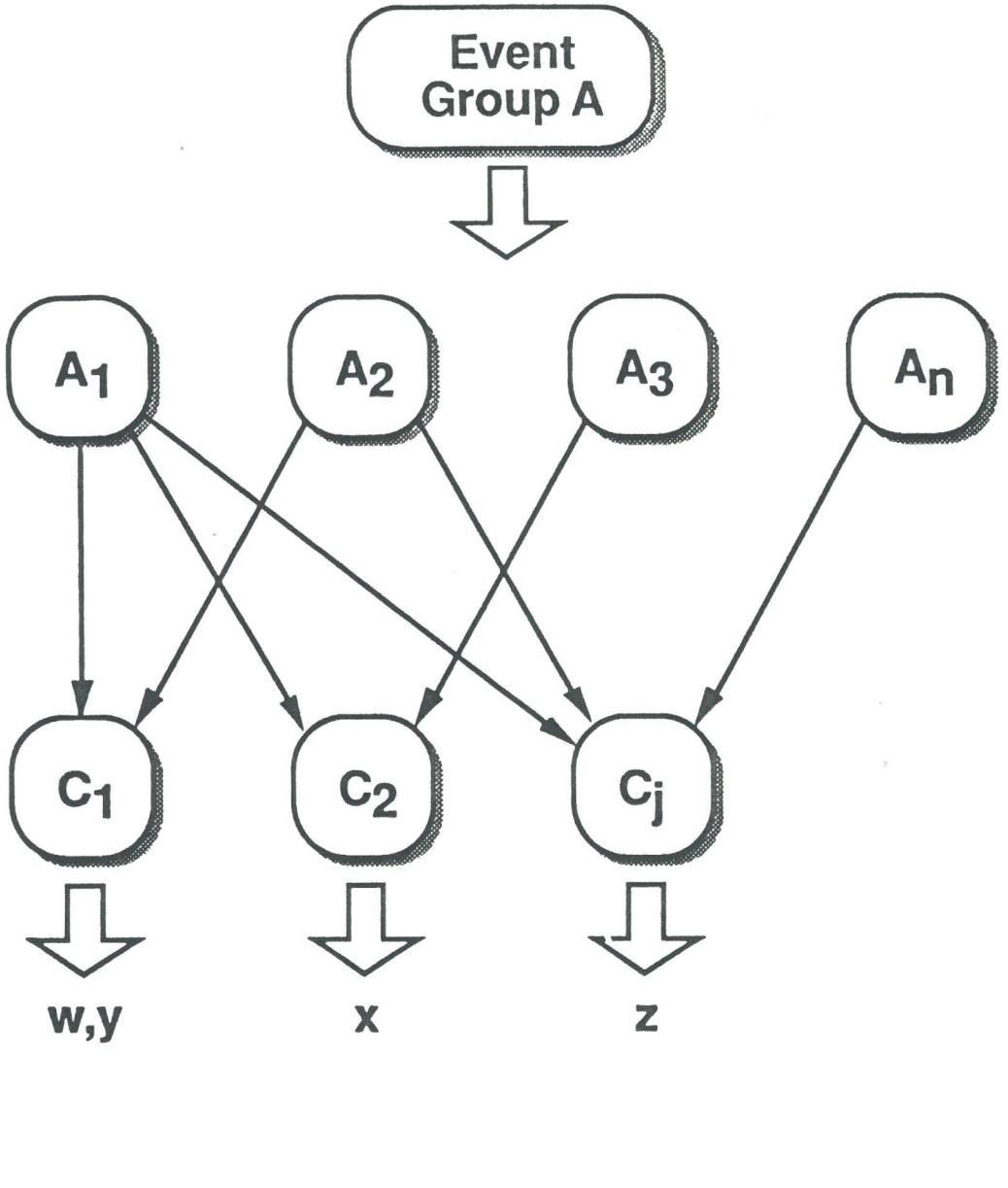
Set of All Conceivable Disruptive Events and Processes at Yucca Mountain




Event
Volcanic Event
Type
Extrusive strombolian
Extrusive hydrovolcanic
Intrusive (magma chamber)
Typical Consequences
direct release to AE
disruption of WP containers
change hydraulic gradient
Stochastic Parameters
mass of waste released
fraction of WPs affected
gradient change

Model Input

occurrence of significant disruptive event



P(A)

identification of event type given event occurrence

$\sum_{i=1}^{n} P(A_i|A) \geq 1$

(correlated)

consequences of event

$P(C_j|A_i)$

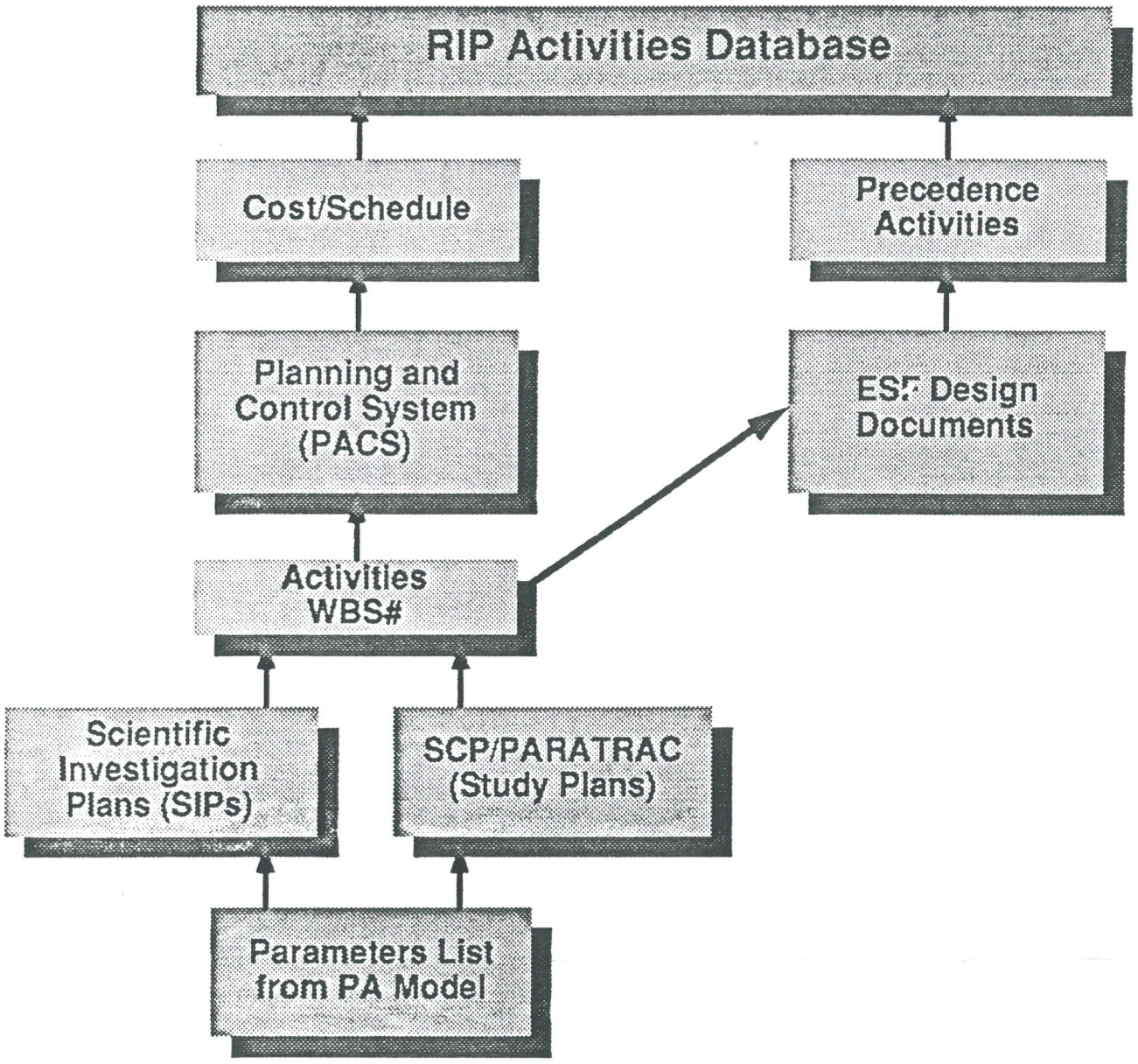
stochastic parameters describing consequence

w,y,x,z distributions

Information Sources for the RIP Activities Database

- **PARATRAC**
  - Relational data base to identify site characterization activities (from the SCP) that are associated with a given parameter. Associated cost and schedule information found via WBS#.
- **Scientific Investigation Plans (SIPs)**
  - Documents describing the scientific programs for investigating waste form alteration, waste package performance, etc. Associated cost and schedule information found via WBS#.
- **Planning and Control System (PACS)**
  - Cost schedule data base for Yucca Mountain Project activities (including waste package). Can be linked to information from PARATRAC and SIPs via a WBS#.
- **ESF Title 1 Design Docs.**
  - Establishes precedence activities for site characterization activities. Cost and schedule information for the precedence activities is retrieved form PACS.

Information Sources for the RIP Activities Database



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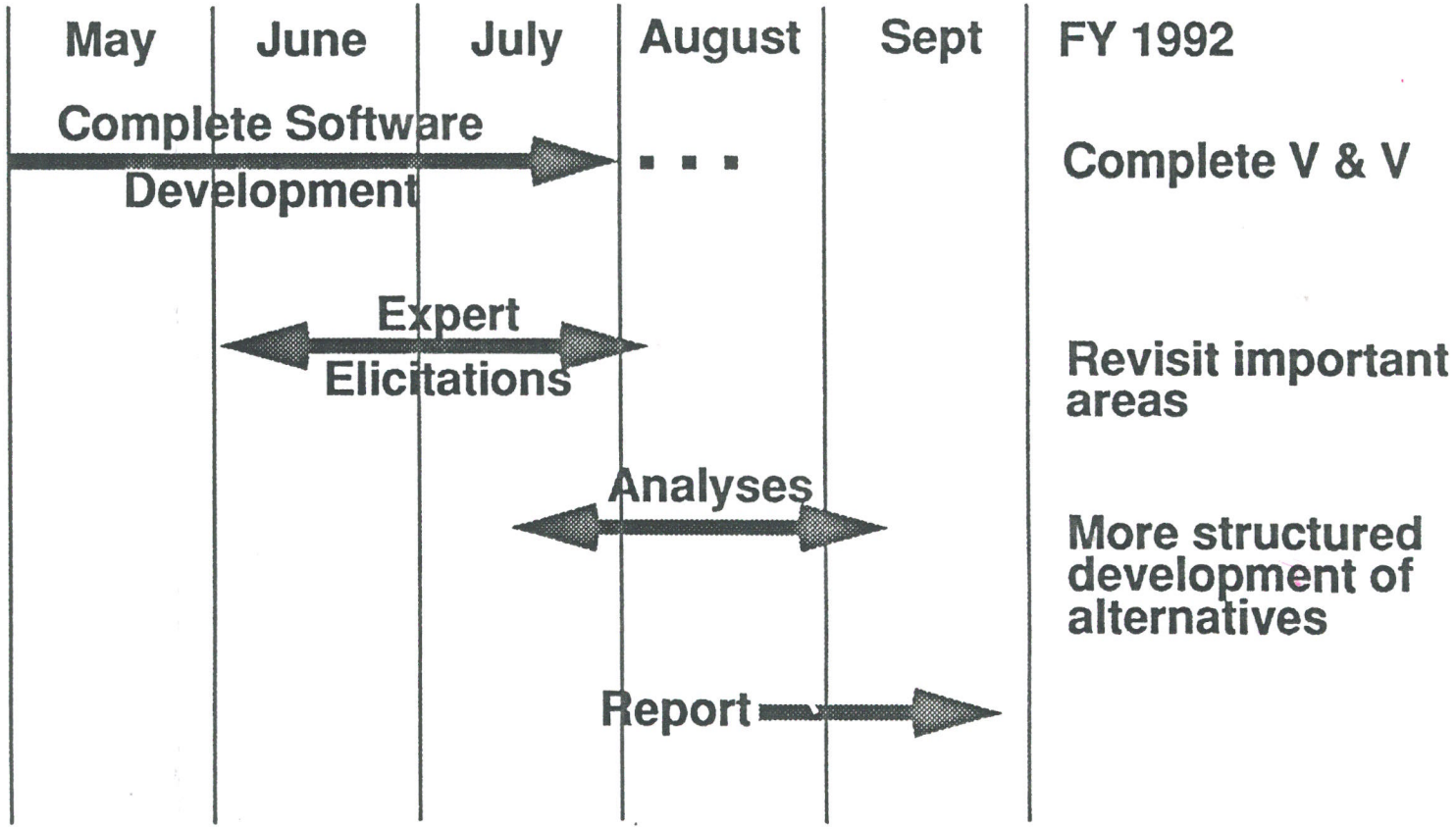
Schedule


May
June
July
August
Sept
FY 1992
Complete Software Development
. . .
Complete V & V
Expert Elicitations
Revisit important areas
Analyses
More structured development of alternatives
Report