Performance Assessment Demonstration: Overview

Presentation to:
Panel on Risk & Performance Analysis
U.S. Nuclear Waste Technical Review Board

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OUTLINE

- Purpose
- Scope
- Work Performed
- Tentative Results
- Needs for Modeling Improvements

PURPOSE OF THIS EFFORT

- Demonstrate Staff Capability
- Evaluate Existing Analytical Tools (Methods and Codes)
- Insight into Methodological Needs
- Insight into Site Characterization

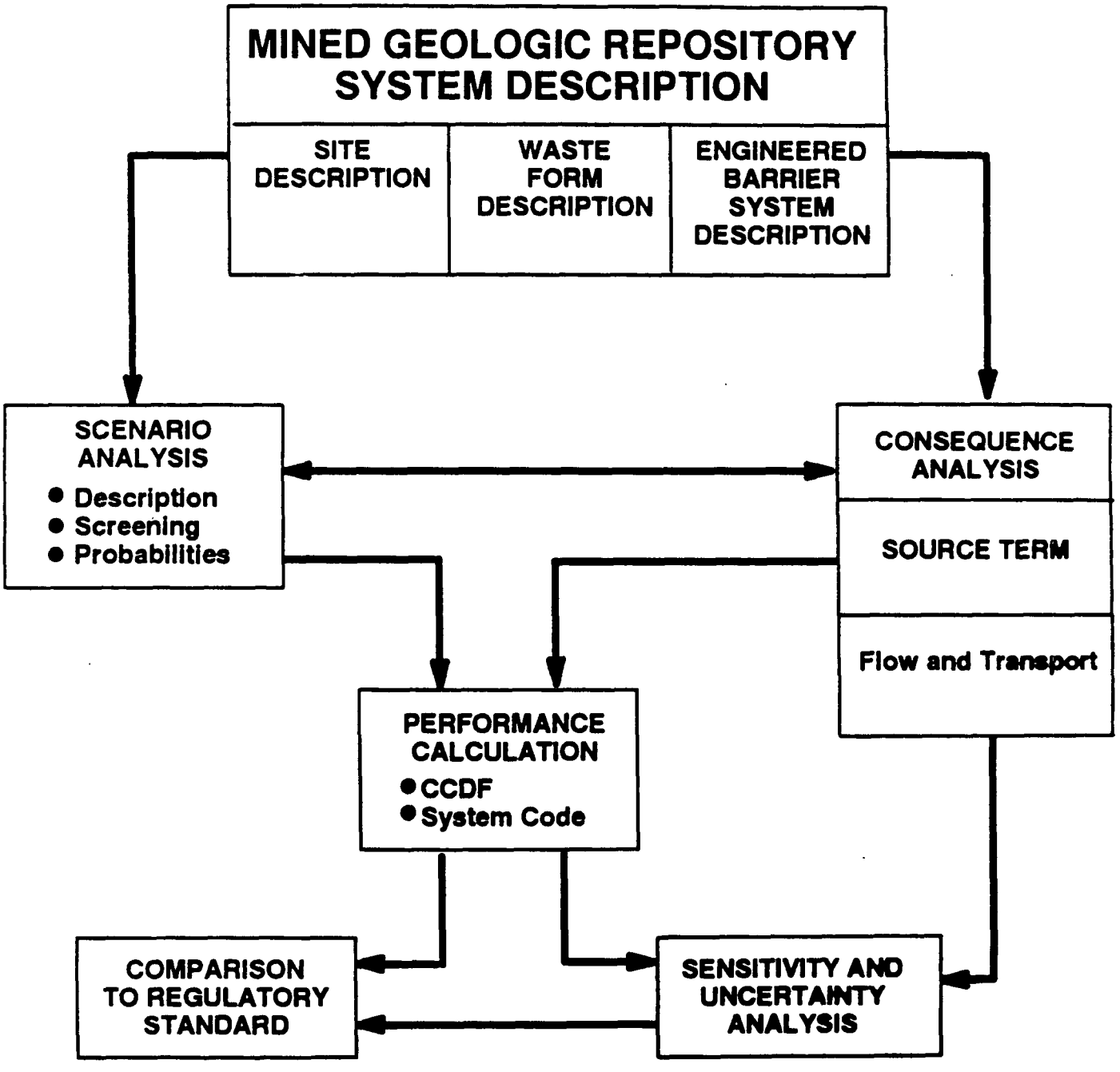
SCOPE OF THIS EFFORT

- Perform a Preliminary Analysis
- Use Currently Available Tools, if Practicable
- Take Advantage of Limited Site Data
- Fit Analysis into Available Time and Resources
- Step Through as Many Components of the Methodology as Possible, but Reduce the Depth
- Focus Analysis on EPA Containment Standard

SOME IMPORTANT CAVEATS

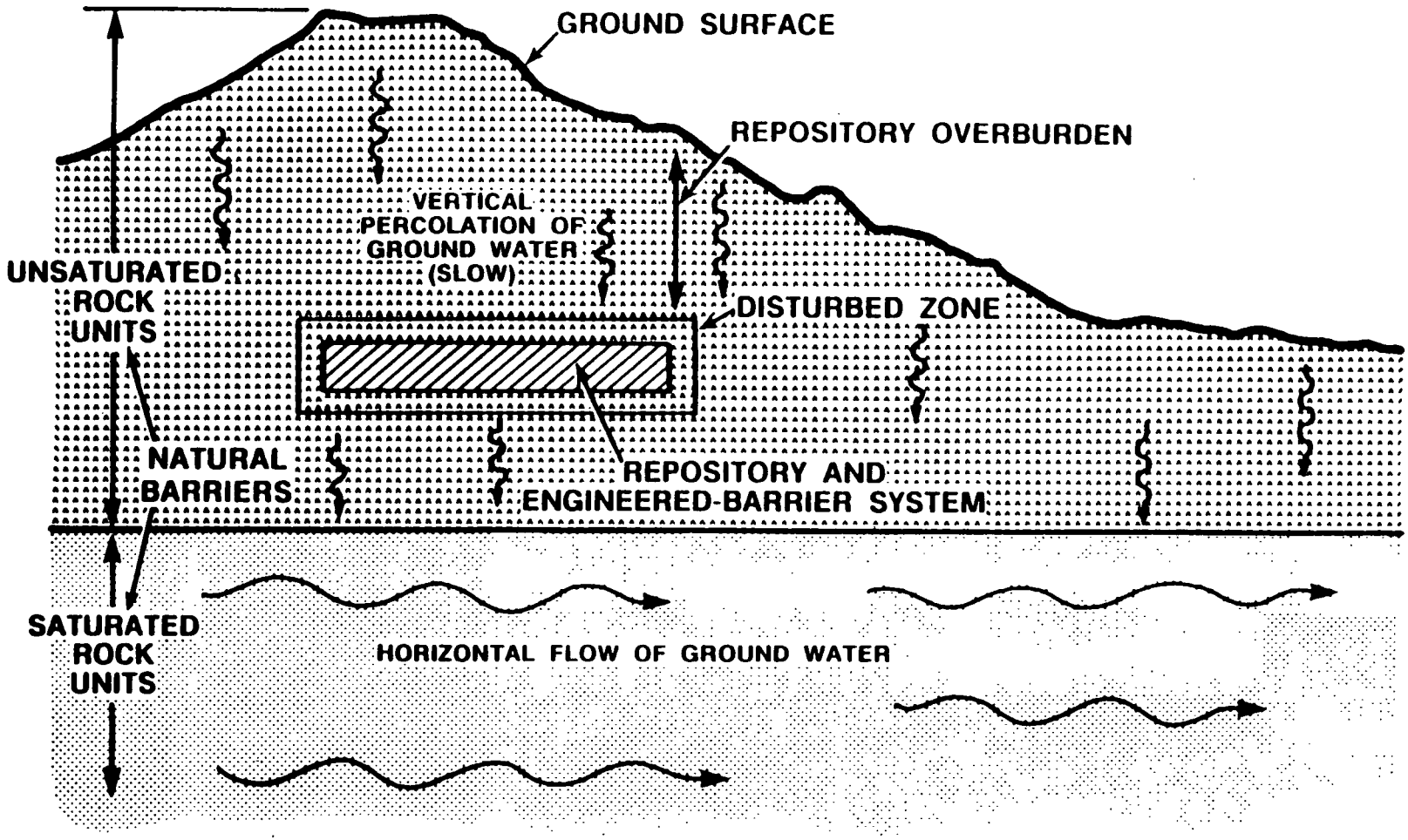
1. Numerical Results Do Not Represent A Repository at Yucca Mountain
2. Large Uncertainties
3. Limited Set of Scenario Classes
4. Rudimentary Waste Package Failure Model
5. Indirect Modeling of Some Aspects of Unsaturated Flow and Transport

COMPONENTS OF TOTAL SYSTEM PERFORMANCE ASSESSMENT

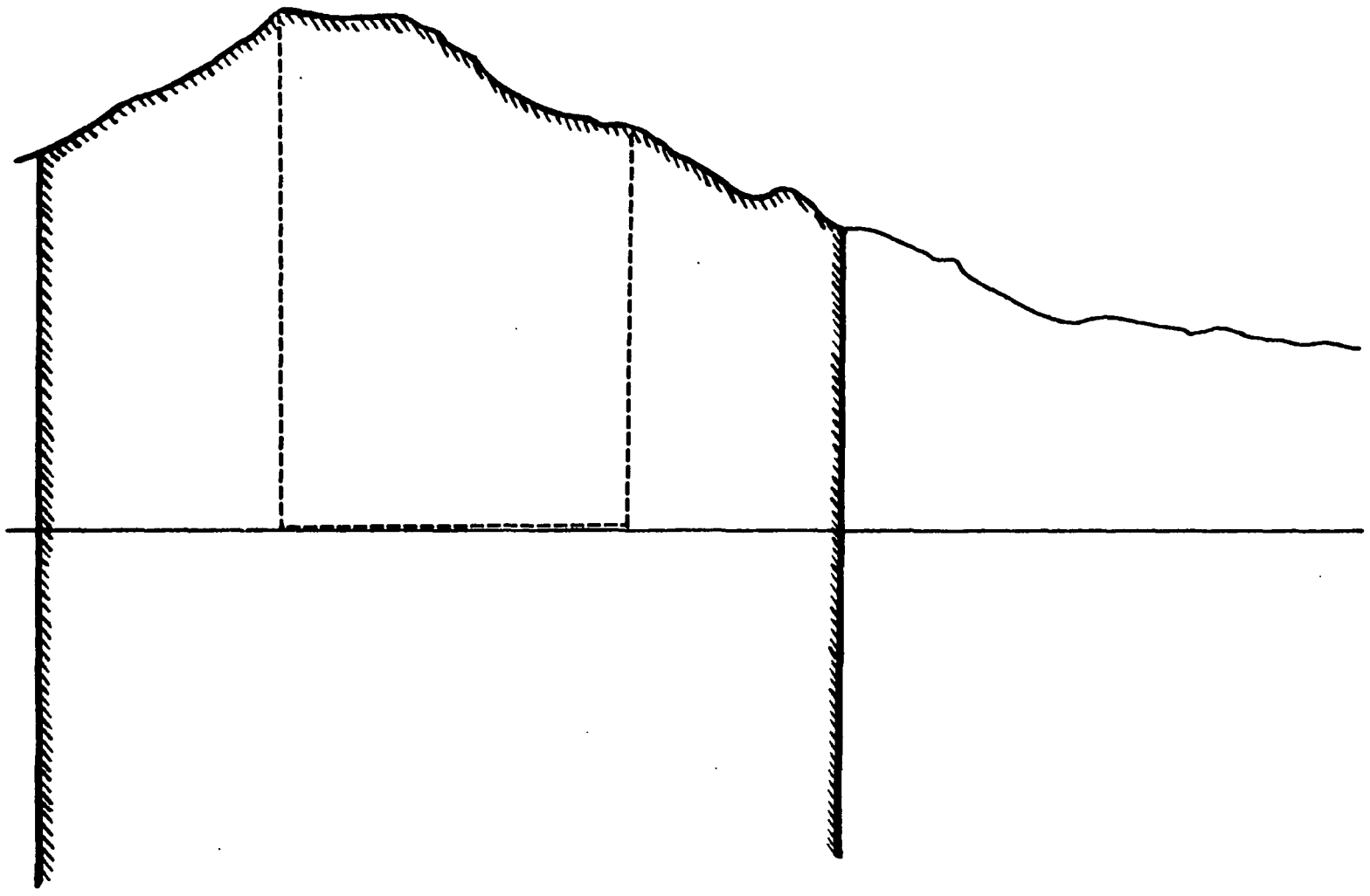


PERFORMANCE ASSESSMENT UNCERTAINTY

- Future States of Nature
- Model
- Data / Parameter



(After DOE, 1988)



--- Calculational Release Boundary for this study

Accessible Environment Boundary

DETERMINATION OF SCENARIO PROBABILITIES FROM THE PROBABILITIES OF FUNDAMENTAL EVENTS

	$\overline{P}$ 0.9	$\overline{P}$ 0.1
$\overline{D}$ 2.3×10^{-7}	Scenario class # 0 Probability $= 2.0 \times 10^{-7}$	Scenario class # 1 Probability $= 2.3 \times 10^{-8}$
D ~ 1.0	Scenario class # 2 Probability ~ 0.9	Scenario class # 3 Probability ~ 0.1

$\overline{P}$ is not pluvial — $\overline{D}$ is no drilling

P is pluvial — D is drilling

Scenario class # 0 is no drilling, not pluvial
Scenario class # 1 is no drilling, with pluvial
Scenario class # 2 is drilling, not pluvial
Scenario class # 3 is drilling and pluvial

Note: Probability combinations assume that fundamental events have independent probabilities of occurrence; this is not a general restriction.

PATHWAYS

- Liquid Pathways
- Gas Pathways (Carbon-14)
- Direct Release (Human intrusion)

LIQUID PATHWAY SCENARIOS

1) Base Case

- Infiltration rate (0.1 - 5.0 mm/yr)

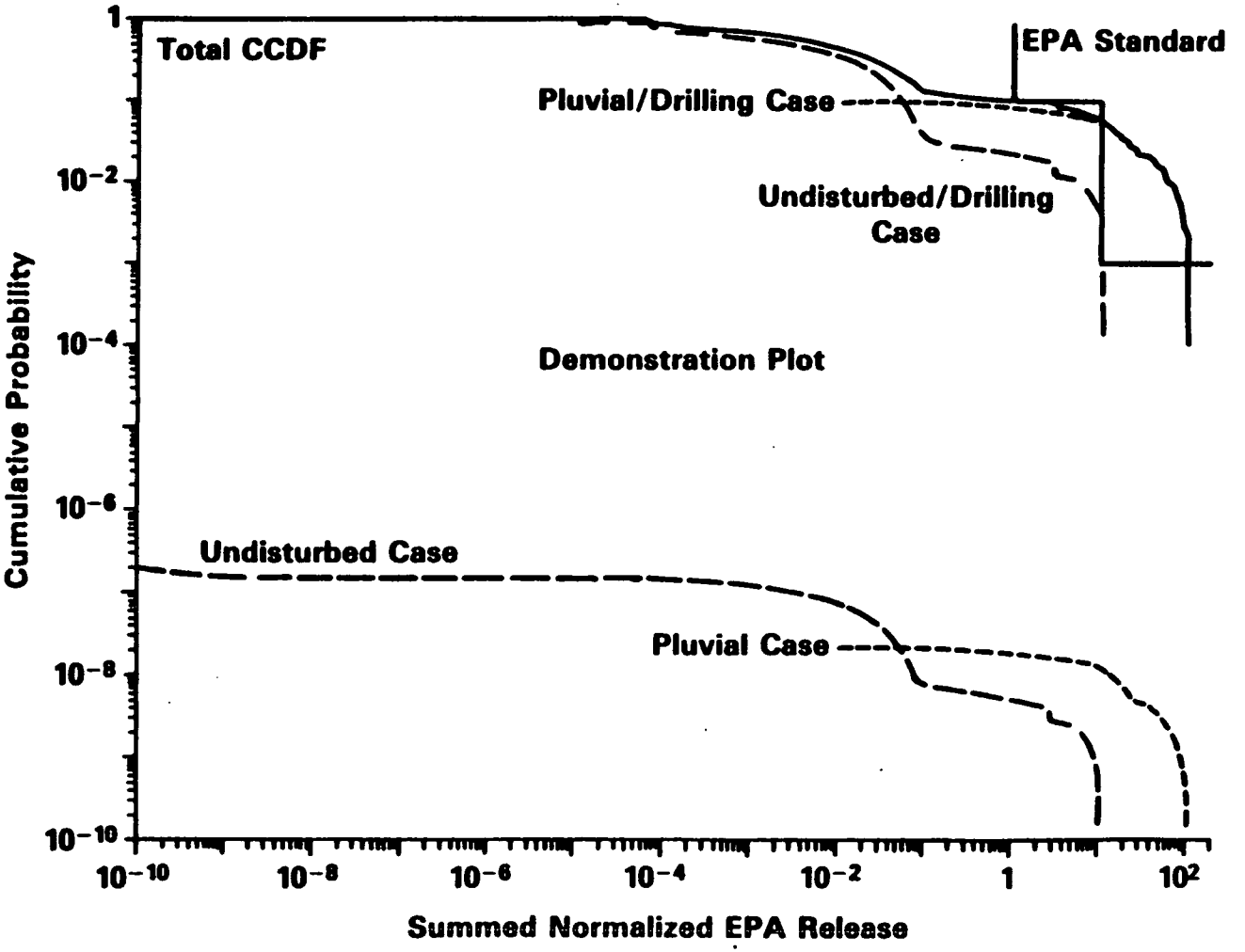
2) Pluvial Case

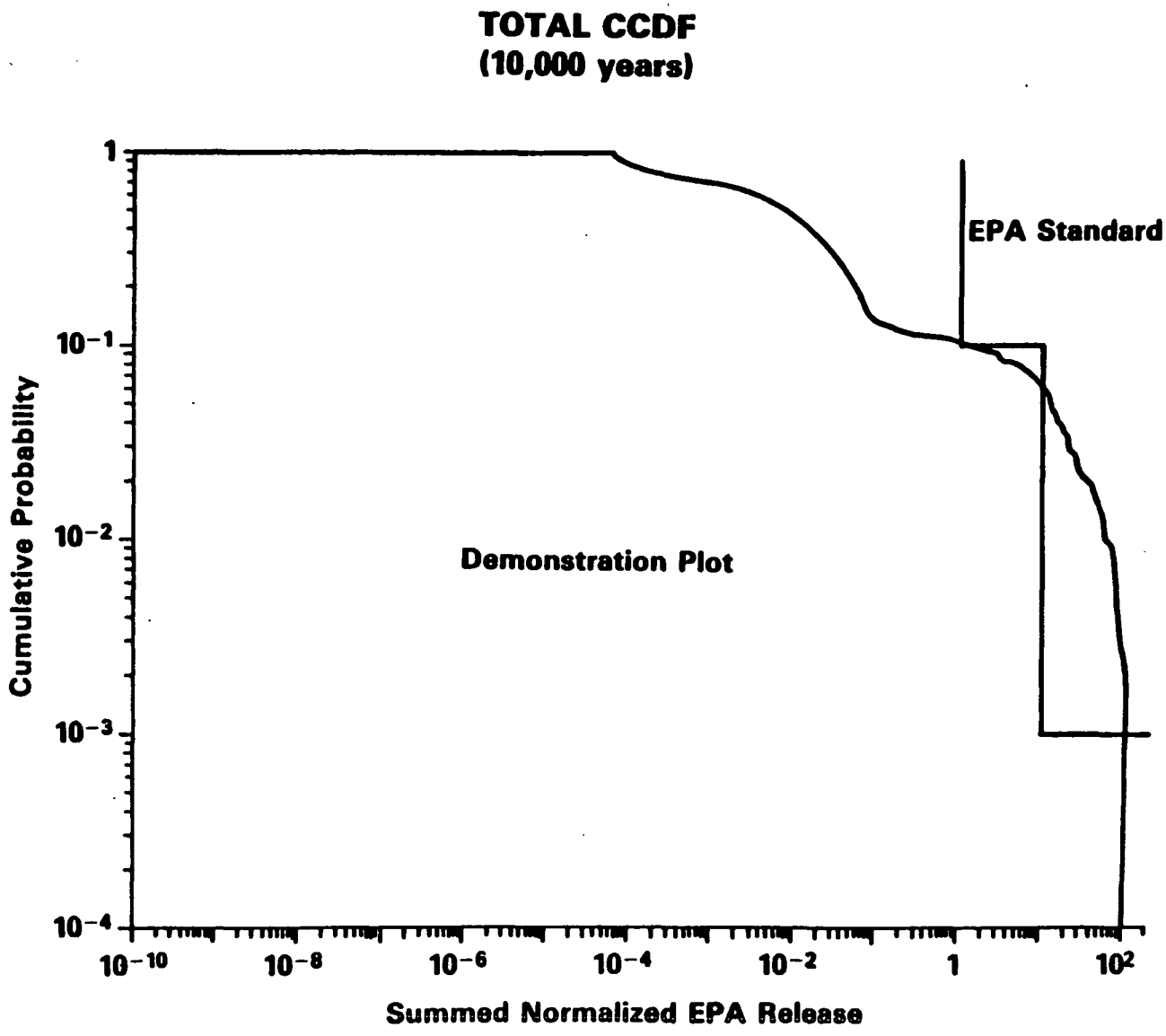
- Infiltration rate (5.0 - 10.0 mm/yr)
- Water table raised 100 meters

Parameters Sampled for Each Scenario Class

Parameter	Distribution	Subset
EBS Lifetime	Normal	
Uranium Solubility	Uniform	
Dispersivity	Normal	
Infiltration Rate	Uniform	Base Case, Pluvial
Water Contact Fract.	Uniform	
Matrix Porosity	Uniform	Each Hydrologic Unit
Log Saturated Cond.	Uniform	Each Hydrologic Unit
Std. Dev. Log K	Uniform	Each Hydrologic Unit
Retardation Coeff.	Uniform	Each Radionuclide
Solubilities	Uniform	Each Radionuclide
Correlation Length	Uniform	

TOTAL CCDF
(10,000 years)




TOTAL CCDF
(10,000 years)
1
10^{-1}
10^{-2}
10^{-3}
10^{-4}
Cumulative Probability
EPA Standard
Demonstration Plot
10^{-10}
10^{-8}
10^{-6}
10^{-4}
10^{-2}
1
10^{2}
Summed Normalized EPA Release

AUXILIARY ANALYSES

Purpose: Evaluation of assumptions, preprocessing of raw data and independent analyses

Analyses Performed:

1) Gaseous Release of Carbon-14
2) Testing Statistical Convergence
3) Analysis of Hydrologic Data
4) Two-dimensional Flow Model