

Implementability
of the
EPA High-Level Waste
Standards

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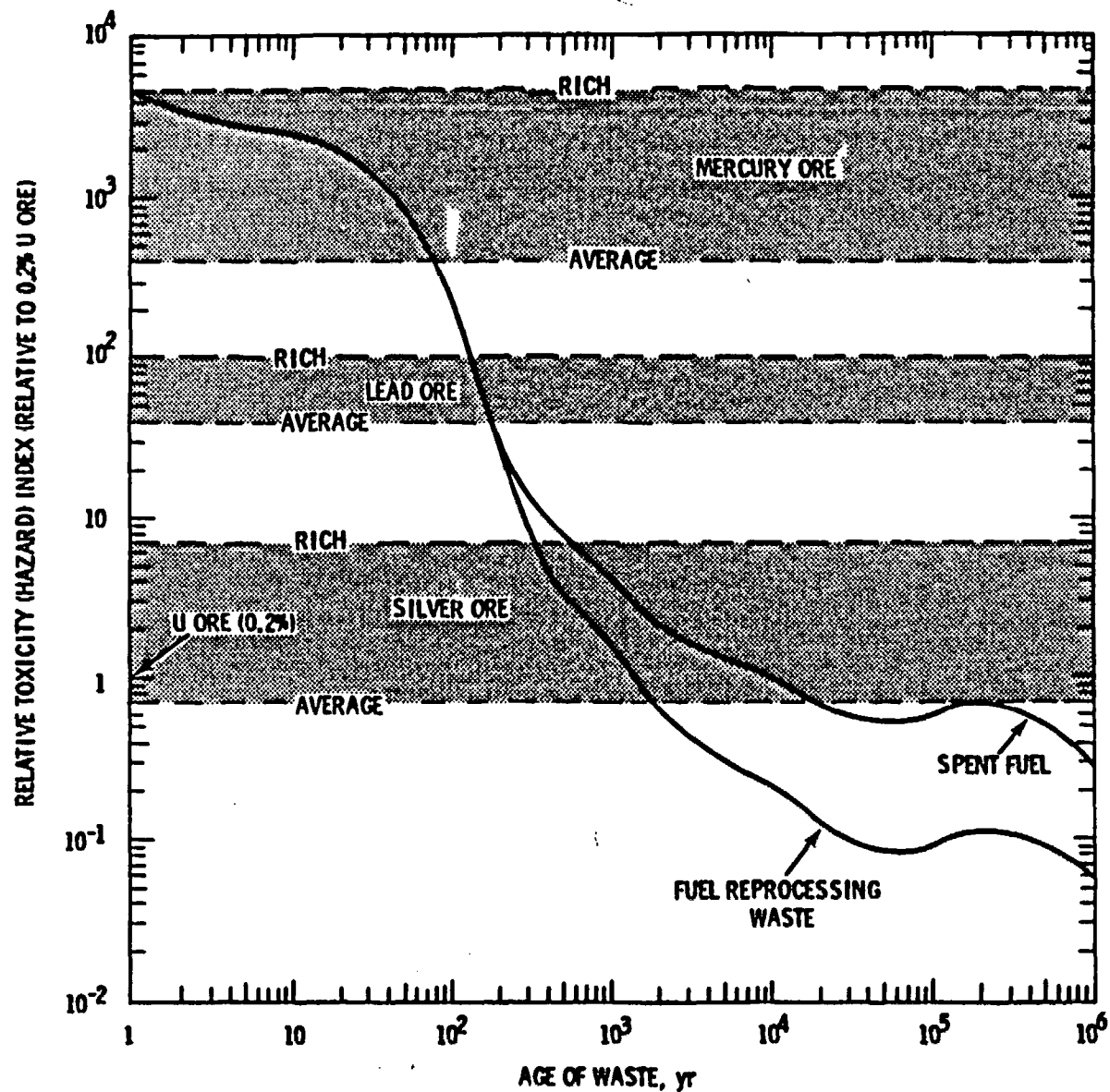
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Purpose of Briefing

1. Explain basis for Staff's views that a probabilistic EPA HLW Standard can be implemented in an NRC licensing review
2. Present example for estimating likelihood of volcanic eruption through a repository at Yucca Mountain, Nevada
3. Describe the possible use of rulemaking in implementing the Standard
4. Determine the position NRC Staff will take as EPA prepares to reissue its standards

What is Adequate Isolation of HLW?

1. Radiotoxicity of HLW persists for very long time
2. U.S. regulatory framework uses a maximum 10,000 year reference period and requires consideration of a range of events
 - Cumulative release over 10,000 years
 - Individual dose for 1,000 years
 - Groundwater protection for 1,000 years
3. IAEA is developing an international standard limiting the risk to the maximum individual, with no time limit. Existing European standards are consistent with this approach



Toxicity of Spent Fuel and Reprocessing Waste from Uranium-Plutonium Recycle Relative to 0.2% Uranium Ore Necessary to Produce 1 MT of Reactor Fuel

EPA HLW Standards - Chronology

About 1978 to 1982	EPA circulates working drafts which include a probabilistic cumulative release limit
Dec. 1982	EPA Promulgates proposed standards (40CFR191)
May, 1983	NRC submits formal comments to EPA
Aug. 1985	SECY-85-272 informs Commission of EPA resolution of NRC comments
Sept. 1985	EPA issues Final Standards
July 1987	U.S. Court of Appeals vacates final standards

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EPA HLW Standards - Requirements

Containment Requirement

- Limits total activity released
over 10,000 years
- Stated probabilistically

Individual Protection Requirement

Groundwater Protection Requirement

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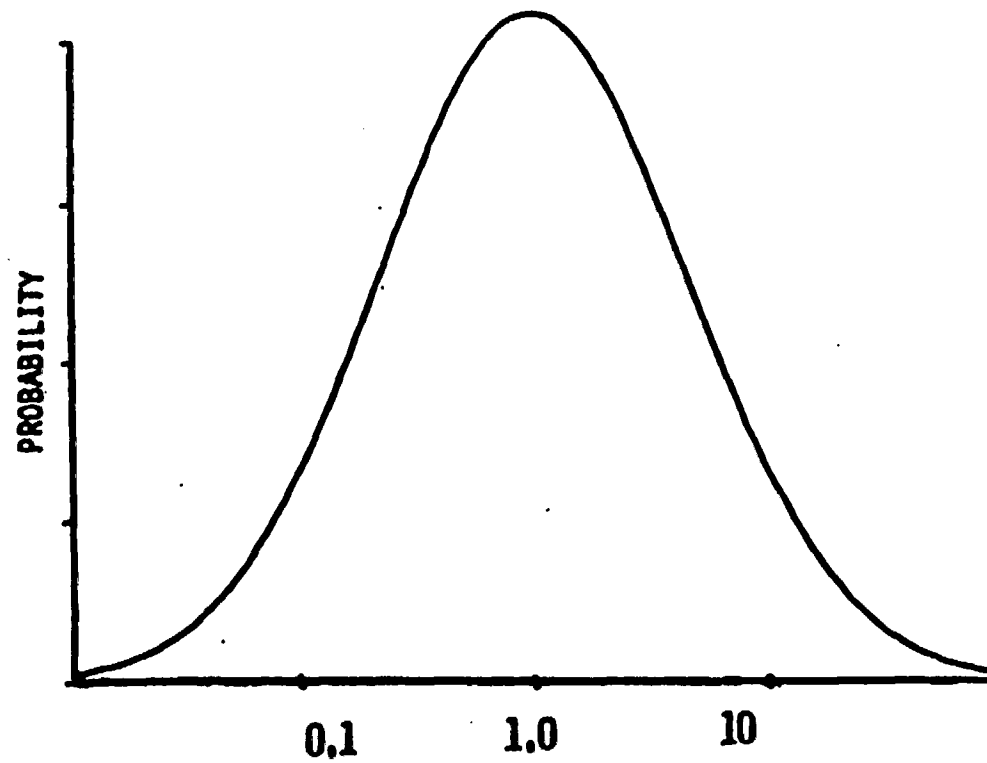
EPA CONTAINMENT REQUIREMENT

<u>RADIONUCLIDE</u>	<u>RELEASE LIMIT (CURIES)</u> <u>OVER 10,000 YEARS</u> <u>PER 1000 MTHM OF WASTE</u>
C-14 or I-129	100
Tc-99	10,000
Th-230 or 232	10
Any other alpha-emitter	100
Any other beta-emitter	1,000

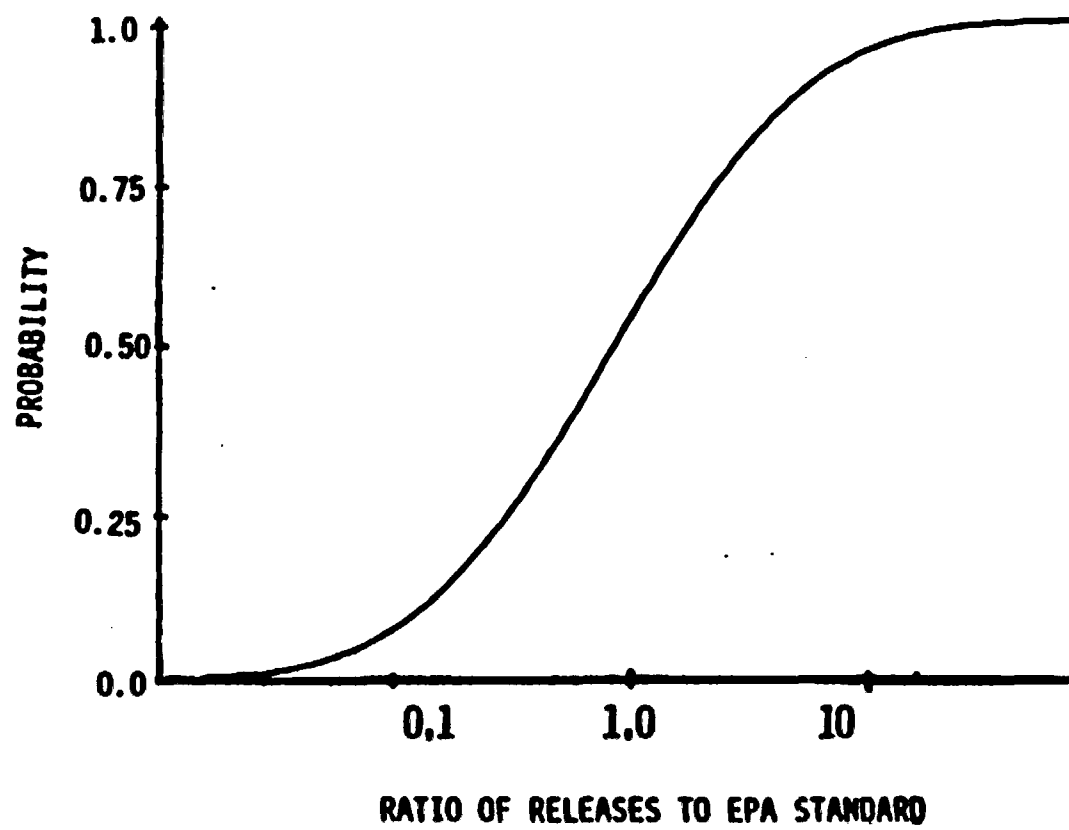
SUM-OF-FRACTIONS RULE: IF MORE THAN ONE NUCLIDE IS RELEASED, THE ACTIVITY OF EACH IS TO BE DIVIDED BY ITS RELEASE LIMIT, AND THE FRACTIONS ARE TO BE SUMMED.

PROBABILISTIC NATURE: RELEASES MORE LIKELY THAN 1/10 IN 10,000 YEARS SHALL NOT EXCEED THE RELEASE LIMIT ABOVE.

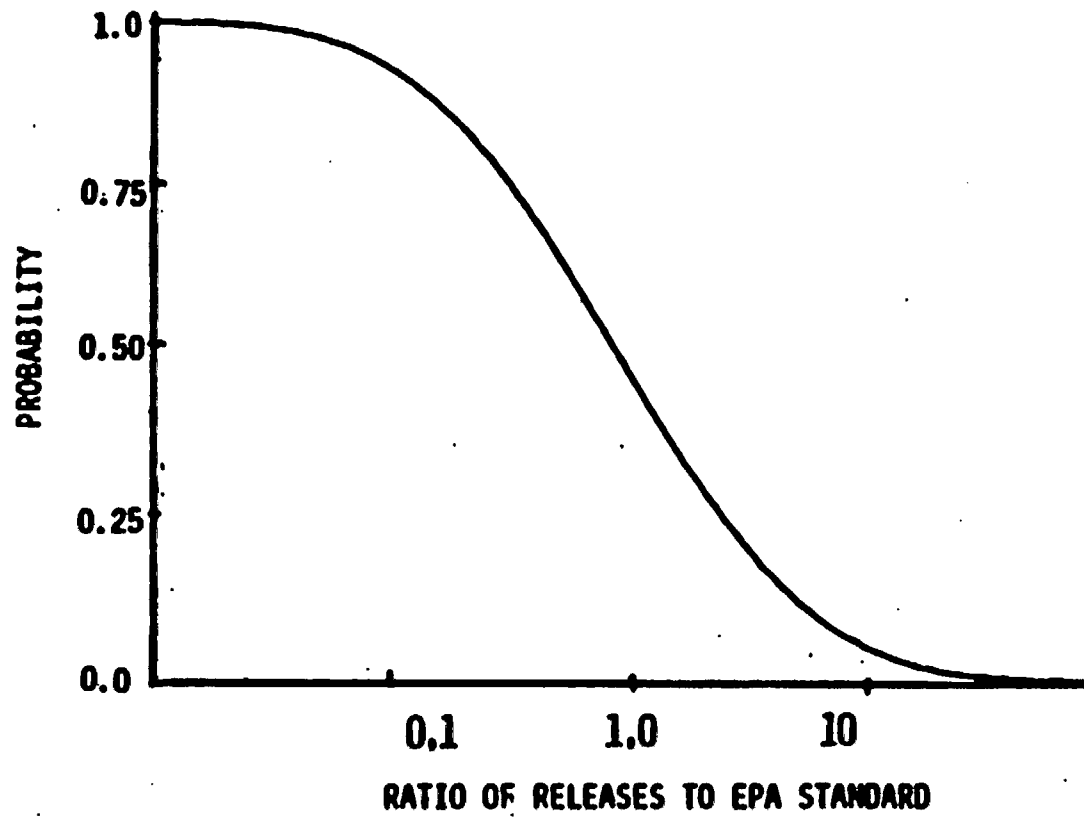
RELEASES MORE LIKELY THAN 1/1000 IN 10,000 YEARS SHALL NOT EXCEED TEN TIMES THIS RELEASE LIMIT.



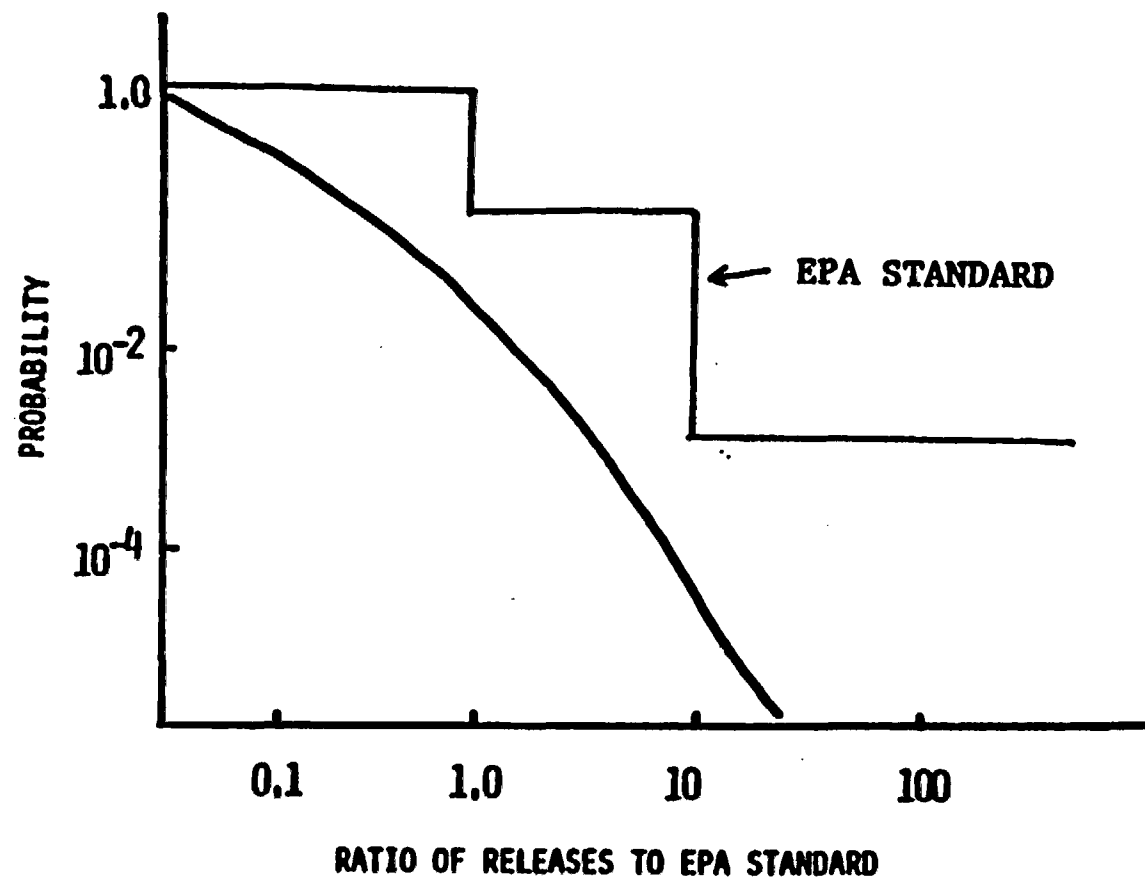
RATIO OF RELEASES TO EPA STANDARD
Example of a Probability Density Function



Example of a Cumulative Distribution Function



Example of a Complementary Cumulative Distribution Function.



Issues for License Review

- Regardless of the form of EPA's Standard, a licensing review must consider over a sufficient time frame:
 1. What can go wrong with a repository?
 2. What are the consequences if this happens?
 3. How likely is it to happen?
- Questions #1 and #2 must be addressed even though they are technically complex and require projection of future conditions
- Until 1985, the NRC staff argued that Question #3 should be answered qualitatively, and that a requirement for numerical probability estimates would be unworkable in NRC's licensing review process

Sandia Analysis

Sandia National Laboratories (SNL) did analyses in support of NRC's comments on the proposed EPA HLW Standards (NUREG/CR-3235):

- Analyses evaluated only scenario consequences; no attempt was made to estimate scenario probabilities
- SNL analyses suggested that a good repository could comply with EPA's Standards

NRC Comments and EPA Resolution

NRC Comments on proposed standards stated:

"The numerical probabilities in [the proposed standards] would require a degree of precision which is unlikely to be achievable in evaluating a real waste disposal system"

EPA added the following wording to the Final Standards (Suggested by the NRC staff and virtually identical to the wording in 10CFR60.101):

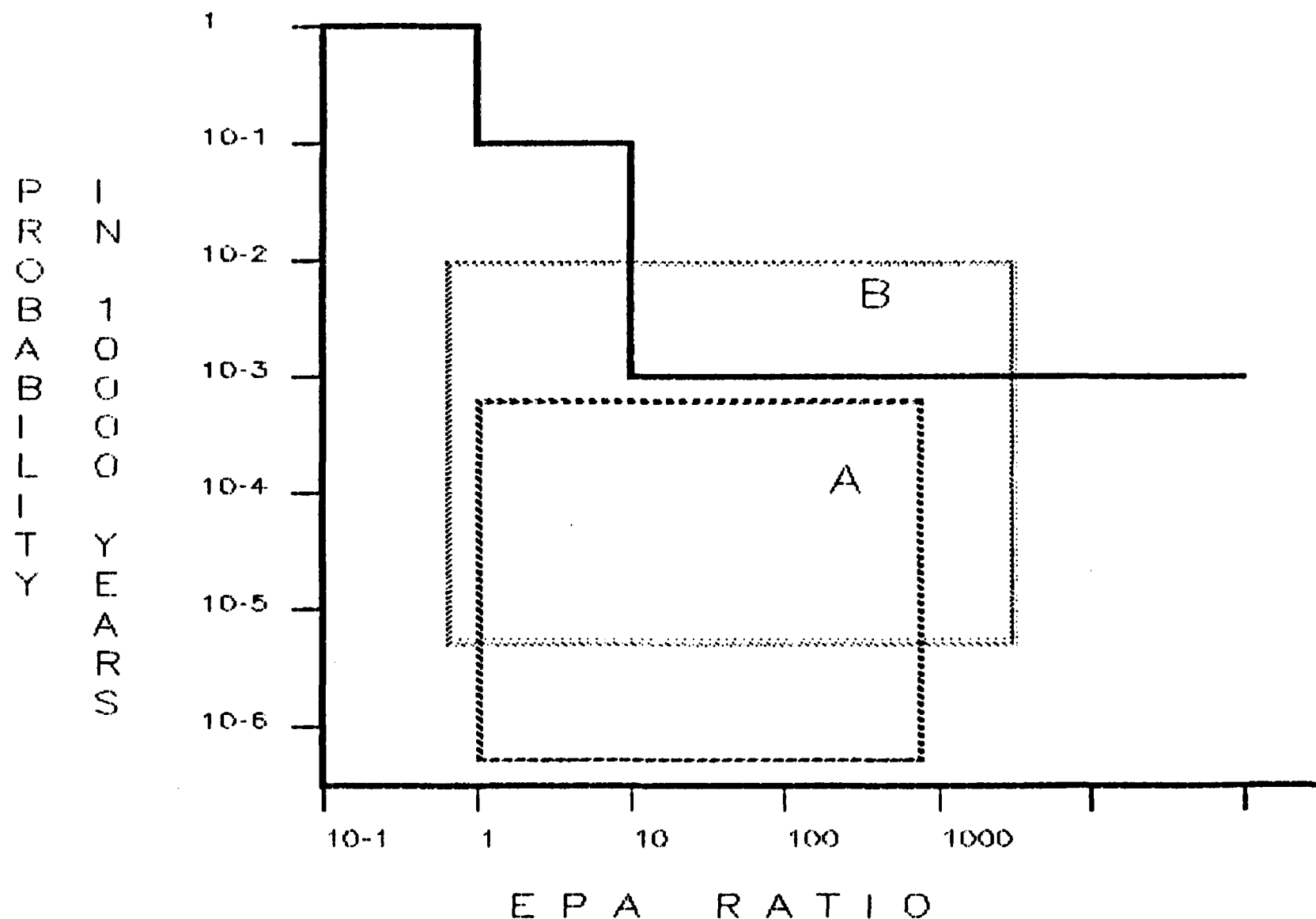
"Performance assessments need not provide complete assurance that the requirements of 191.13(a) will be met. Because of long time period involved and the nature of the events and processes of interest, there will inevitably be substantial uncertainties in projecting disposal system performance. Proof of the future performance of a disposal system is not to be had in the ordinary sense of the word in situations that deal with much shorter time frames. Instead, what is required is a reasonable expectation, on the basis of the record before the implementing agency, that compliance with 191.13(a) will be achieved."

NRC Acceptance of Final Standards

NRC Staff agreed that the EPA standards would be implementable with the added wording because:

1. The new wording recognizes the qualitative nature of a "Reasonable Assurance" finding, even if numerical probabilities are involved
2. Most numerical probability estimates will not be controversial in a licensing review; (e.g., when consequences are much lower than regulatory limits, or when probabilities are obviously very high or low)
3. Probability estimates of physical phenomena will be developed using models of the underlying processes; thus, the Staff will review these estimates in the same way it reviews the consequence modeling.
4. If a numerical probability estimate cannot be developed when needed, it is more likely the fault of the repository site than of the EPA Standard

ALTERNATE CONCEPTUAL MODELS ON VOLCANISM PLOTTED IN CCDF SPACE

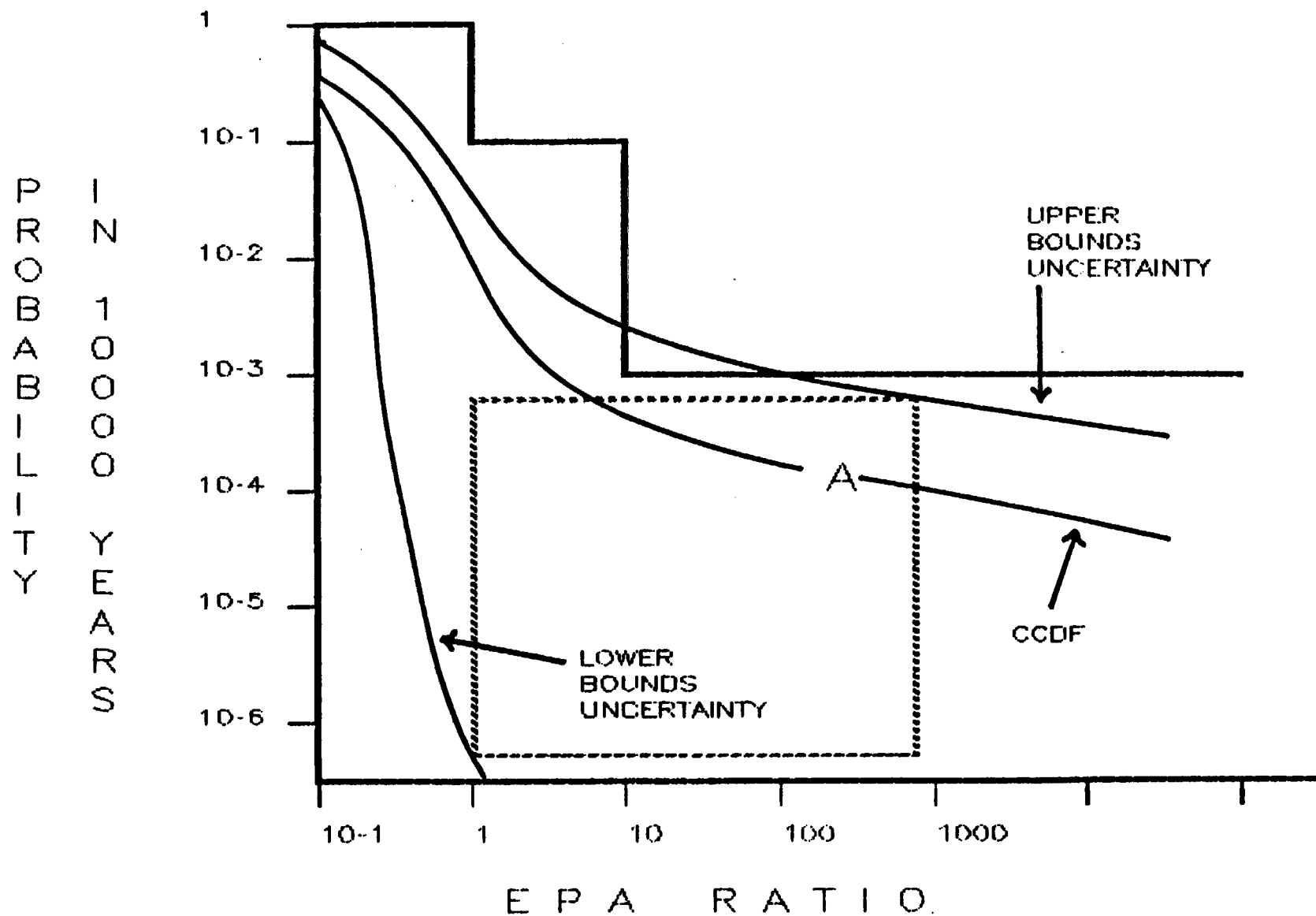


A = BEST ESTIMATE FOR CONCEPTUAL MODEL A
 B = BEST ESTIMATE FOR CONCEPTUAL MODEL B
 ----- MODEL A BOUNDS
 MODEL B BOUNDS

MODEL A
 MONOCYCLIC
 END OF CYCLE
 TOPOGRAPHY HELPS CONTROL
 SURFACE STRUCTURE IMPORTANT

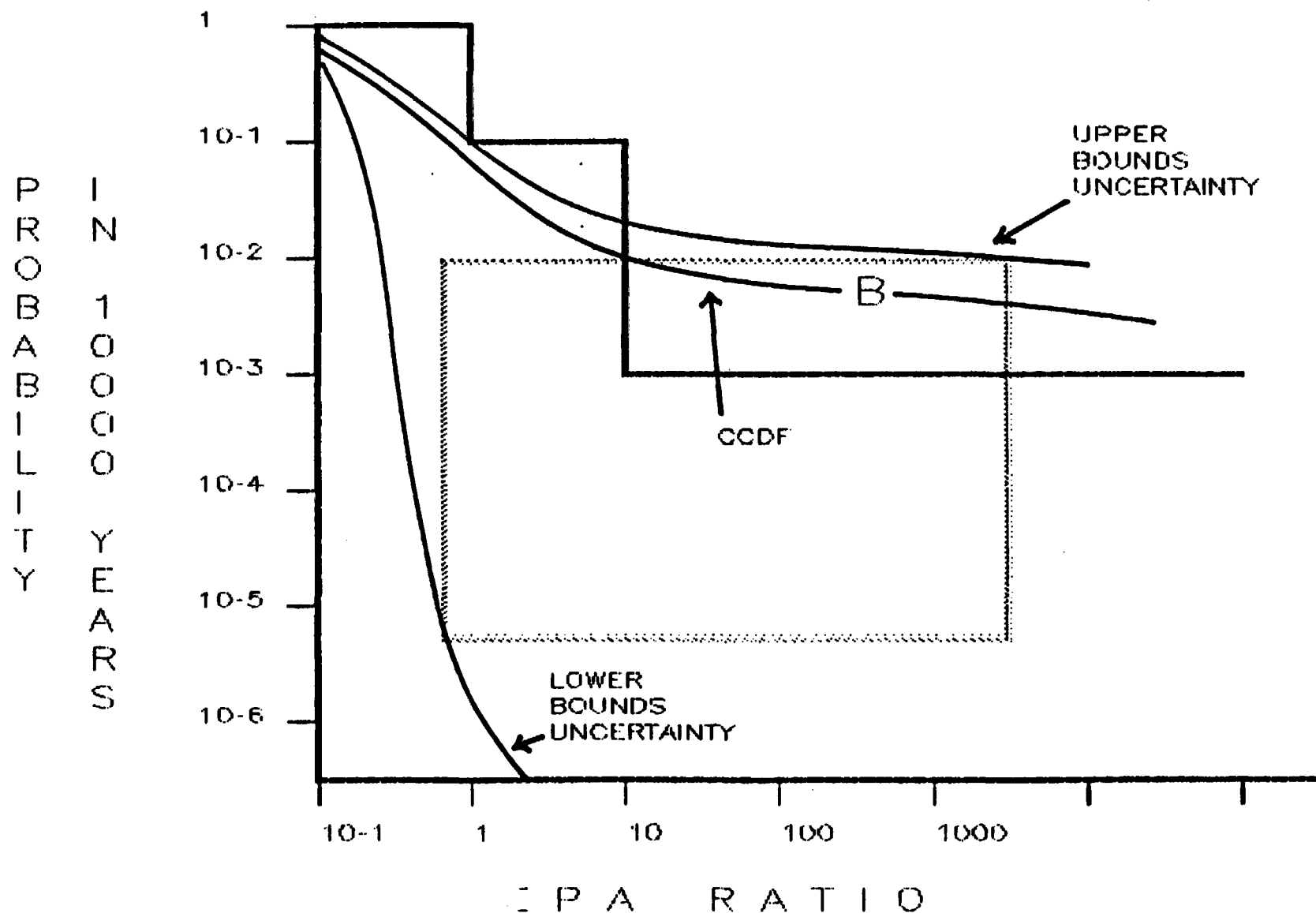
MODEL B
 POLYCYCLIC
 MID CYCLE
 TOPOGRAPHY NO EFFECT
 SURFACE STRUCTURE NO EFFECT

POSSIBLE CCDF WITH "UNCERTAINTY" BOUNDS FOR MODEL A

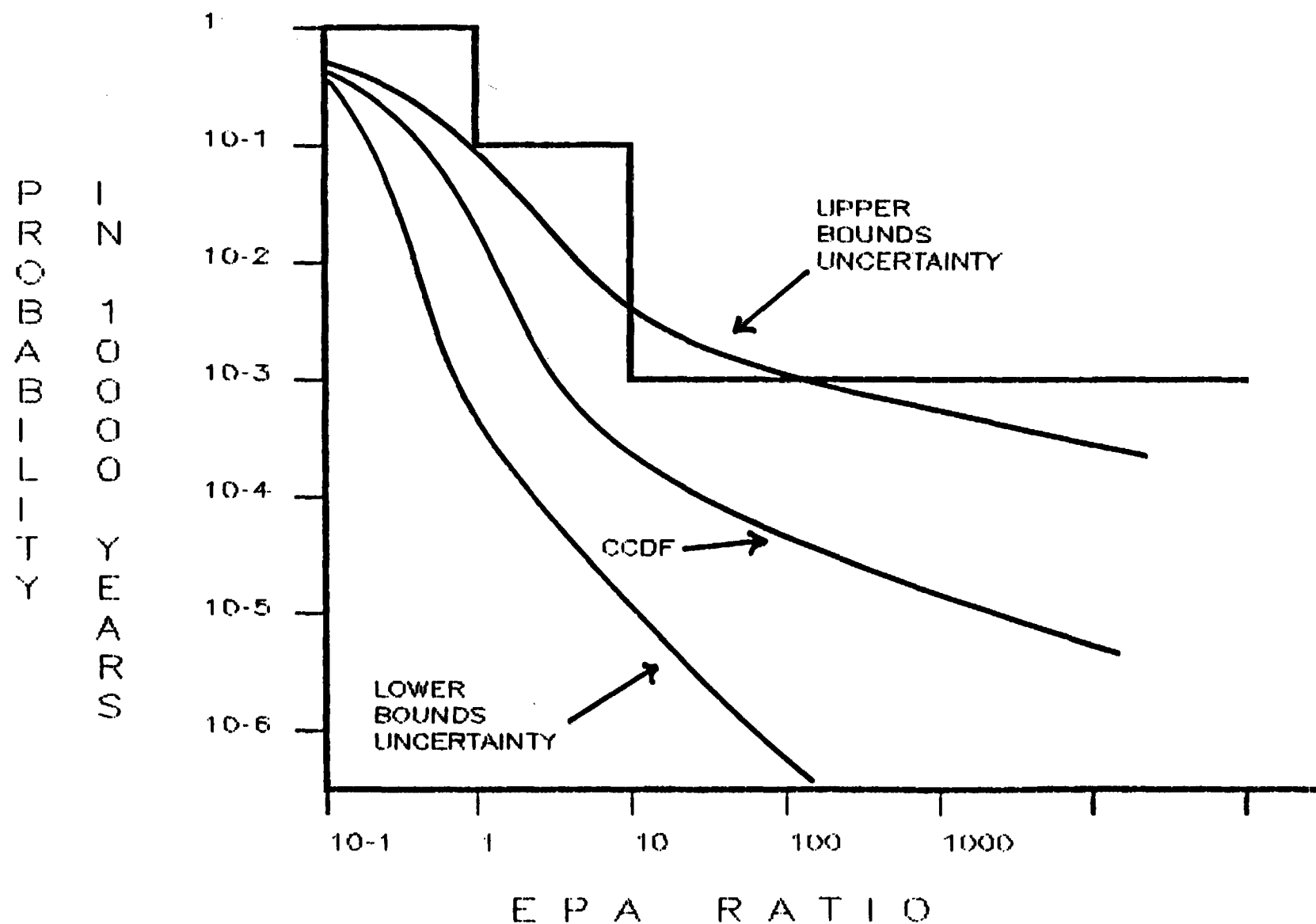


A = BEST ESTIMATE FOR CONCEPTUAL MODEL A
 MODEL A BOUNDS
 CCDF = COMPLEMENTARY CUMULATIVE DISTRIBUTION FUNCTION

POSSIBLE CCDF WITH "UNCERTAINTY" BOUNDS FOR MODEL B



B = BEST ESTIMATE FOR CONCEPTUAL MODEL B
 MODEL B BOUNDS
 CCDF = COMPLEMENTARY CUMULATIVE DISTRIBUTION FUNCTION

EXPECTED CHARACTER OF CCDF AT LICENSING

CCDF = COMPLEMENTARY CUMULATIVE DISTRIBUTION FUNCTION

Potential use of Rulemaking

Staff is beginning to scope a rulemaking addressing implementation of the EPA Standard. Issues to be addressed might include:

1. Generic elimination of consideration of certain fanciful events such as repository disruption by meteorite strike or nuclear explosion
2. Site-specific elimination of additional events at Yucca Mountain
3. Specification (either generic or site-specific) of acceptable models for determining probabilities of natural events
4. Further restrictions on consideration of human-initiated disruptions

Summary

NRC Staff recognizes that the likelihood of potentially disruptive events will need to be assessed in a licensing review regardless of the form of the EPA standards. A numerical requirement for probabilities may make this assessment somewhat more difficult, but does not prevent implementation of the EPA Standards.