

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

**PRESENTATION TO
THE NUCLEAR WASTE TECHNICAL REVIEW BOARD**

**SUBJECT: USING A GWTT MODEL TO
IDENTIFY INFORMATION NEEDS
FROM SITE CHARACTERIZATION**

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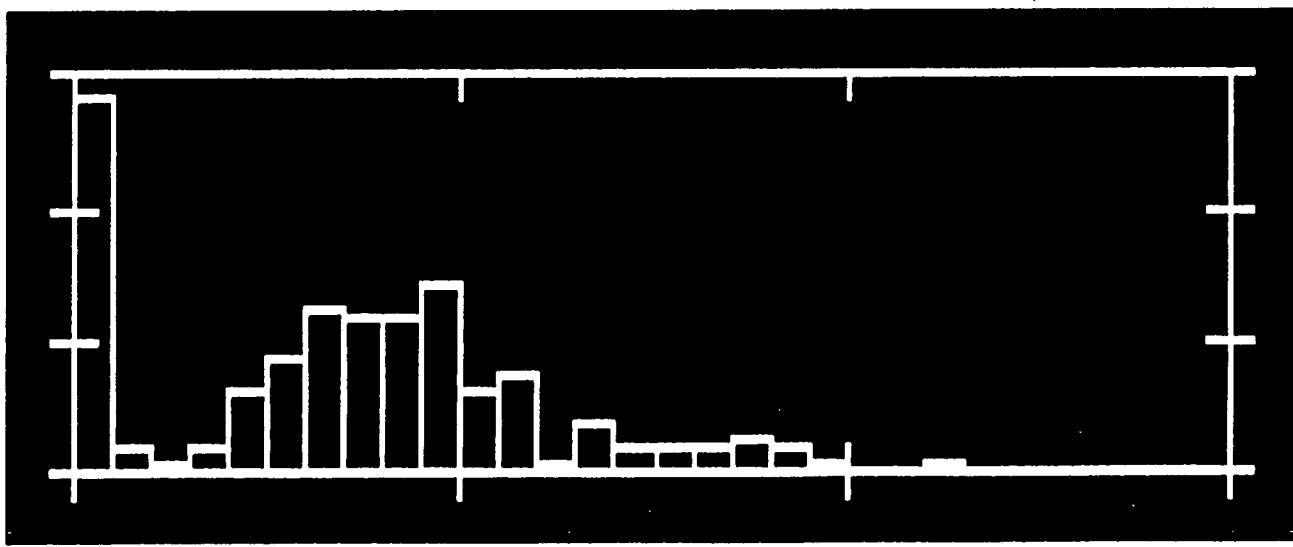
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What question do we ask when we run a PA model?

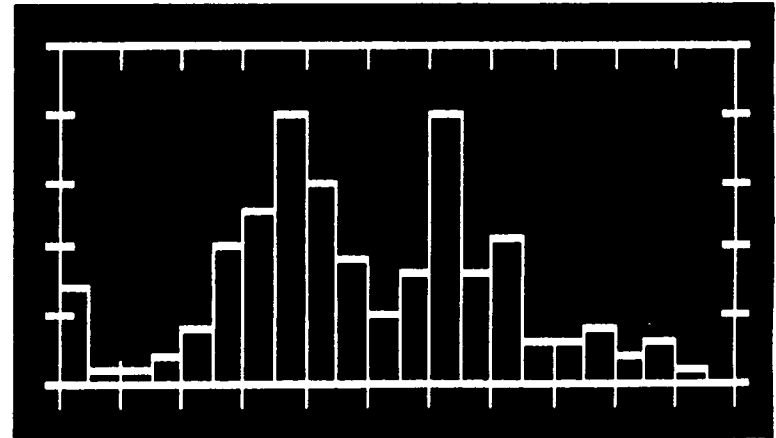
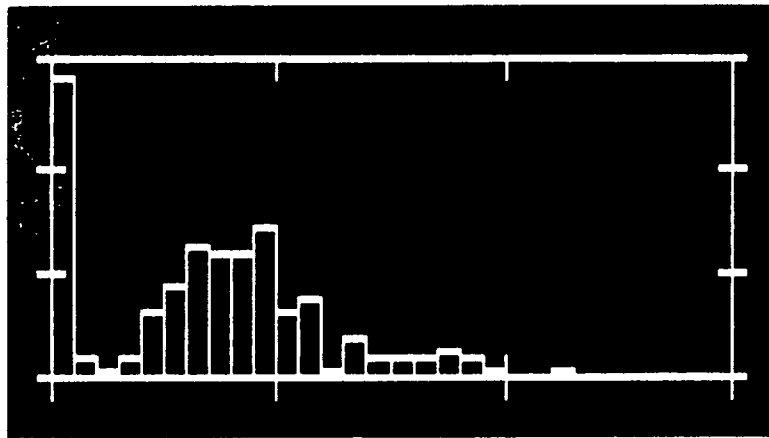
- Under what credible circumstances or conditions do we fail to meet a regulatory or technical criterion?



GWTT

Why ask the question?

- To identify what information, if obtained from a program of site characterization, is most likely to change our prediction.



Information

How do we ask the question?

- **Define uncertainty as Shannon's informational entropy.**

- ***What are the consequences of our ignorance?***

**a consequence is
a failure to meet a
regulatory criteria**

- ***What causes the failure?***

What do we mean by uncertainty?

- **Incomplete Information**
- **Lack of Confidence**
- **Incomplete State of Knowledge**
- **Multiple Choice**
- **Ignorance**
- **Entropy**
- **Murphy's Law**

Informational Entropy

*provides a
quantitative basis
for uncertainty*

What do we mean by uncertainty?

- Incomplete Information
- Lack of Confidence
- Incomplete State of Knowledge
- Multiple Choice
- Ignorance
- Entropy
- Murphy's Law

- A measure of a state of knowledge given a set of information
- A measure of confidence in a prediction

Does the adoption of, what we will now call, a Hypothesis Test Approach change the inputs of a performance assessment simulation?

Some Major Differences

OLD	NEW
some distributions assumed	no distributions assumed
statistics contain some inputs	statistics only first step
uncertain data deterministic	every input a distribution

Additional Differences Between 1990 and 1986 Simulations

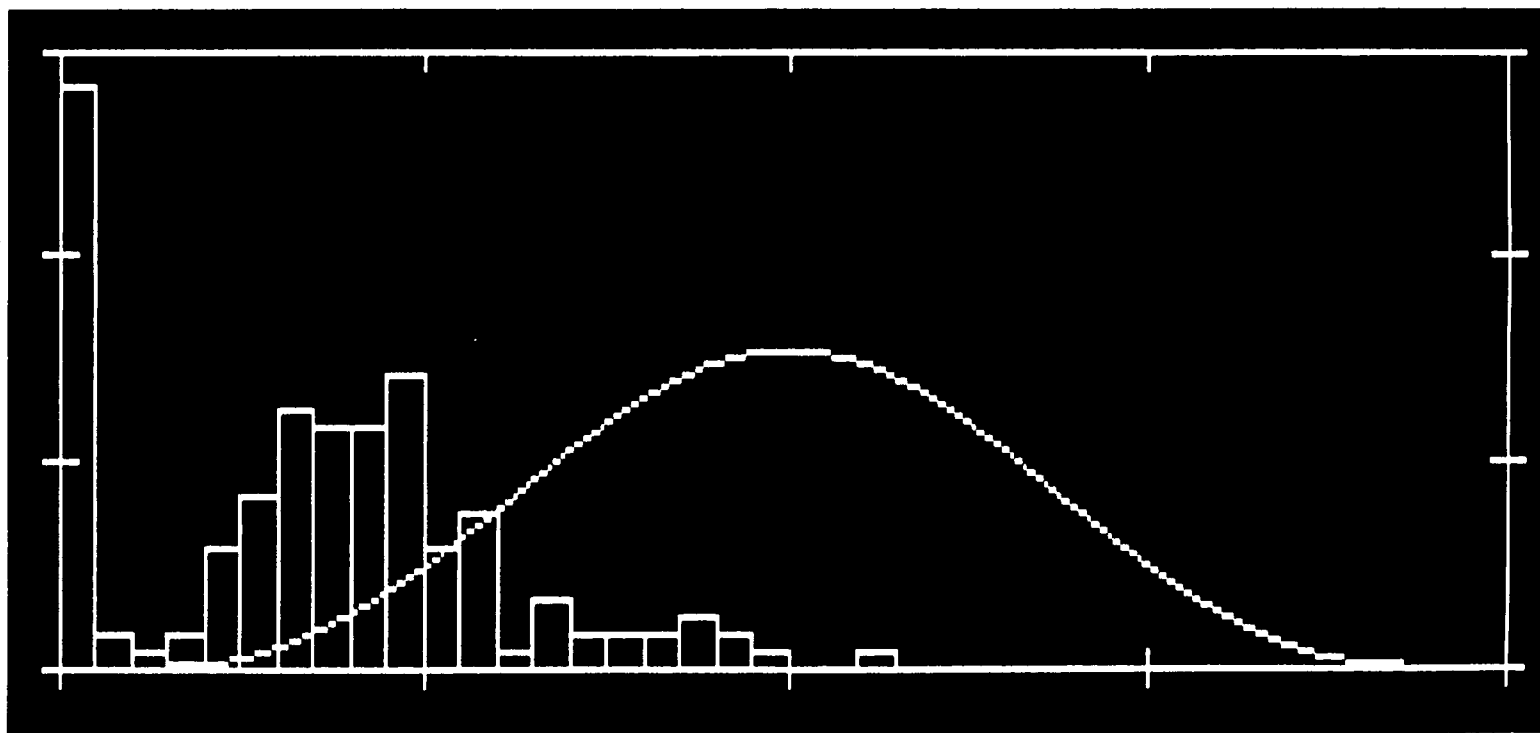
ASSUMPTION	1986	1990
Unit Gradient Domain Pressure Fracture/Matrix Philosophy	Assumed Thermal/Mech Unconstrained If...Then... Nominal	Consequence Hydrostratigraphy Must be ≤ 0.0 Composite Model Credible Failure

If this approach is taken, is there a material difference between an "old" performance assessment and a "new" performance assessment?

0.5 MM/YR, 1-D, Steady-State

	<u>1986</u>	<u>1990</u>
E [GWTT]	40,000 YRS.	16,000 YRS.
P [GWTT < 1,000]	0.000001%	20%

GWTT Predictions



0

40,000

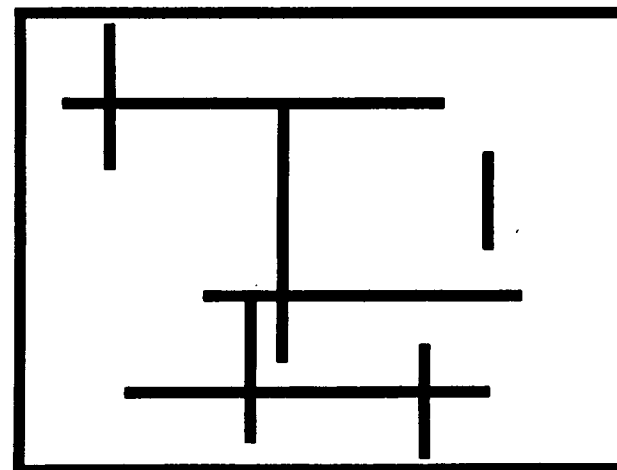
80,000

GWTT (Years)

Information Needs

- **The assumption of interconnected fracture pathways throughout the domain is the "root cause" of most failures.**

Given our current state of knowledge, how reasonable is this assumption?



DATA

What information would change our degree of belief in this assumption?

Assumption

- **Connectivity is a function of fracture density**
- **Density is a function of 2 pieces of information that can actually be obtained as data.**

frequency & orientation

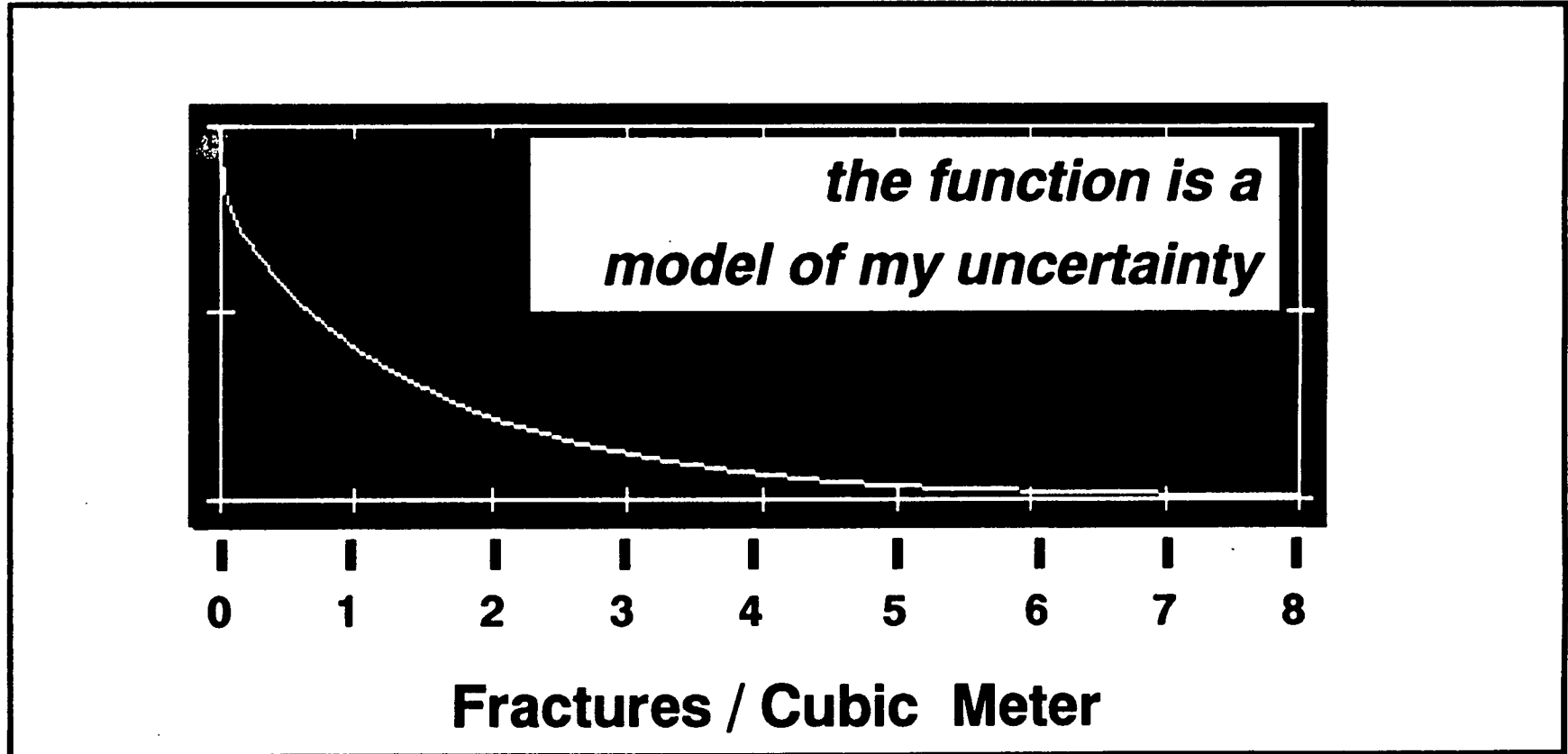
- **Connectivity can be related to the data through a test.**

The law of mythical numbers

**An expert opinion,
once referenced,
becomes fact despite
evidence to the
contrary.**

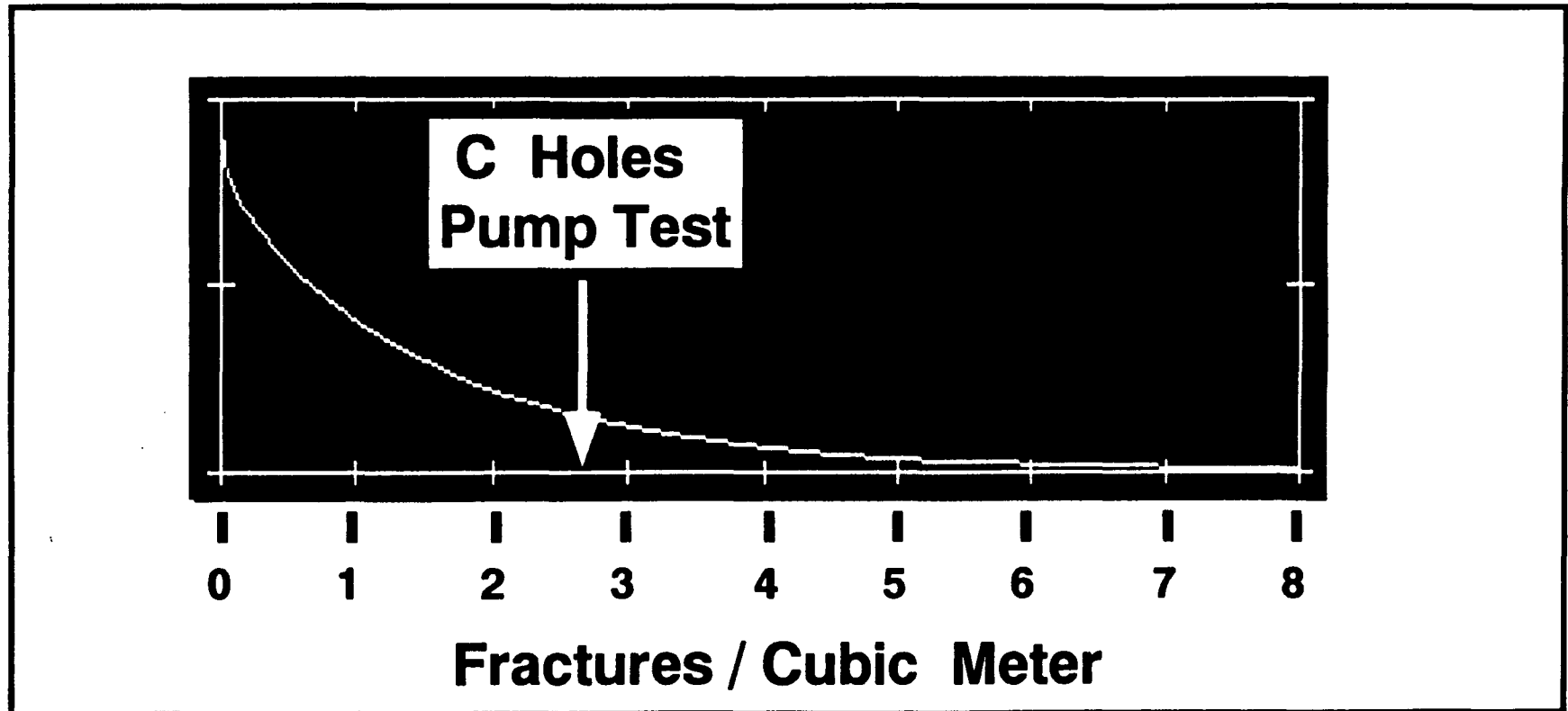
Singer, M., 1990. *The Vitality of Mythical Numbers*, in Judgment Under Uncertainty: Heuristics and Biases, Cambridge University Press.

Probability Model USW G-4 Calico Hills



- **Step 1 - How many fractures per cubic meter are likely given the currently available data?**

Probability Model USW G-4 Calico Hills



- **Step 2 - Relate the data to a test. Probability of connected fractures equals 18%.**

Headlines

- **Humidity rises above 10% in Washington, D.C.**
- **Dog bites man**
- **Project PI concludes GWTT criterion cannot be met with 100% certainty**

Summary

- **PA calculations do not carry a 1000 year warranty.**
- **Should provide a plausible basis for a current decision.**
- **Should identify and then use information to update the basis for the decision.**