

# Extreme Flood Frequency Analysis: Practicing Risk Analysis

Jery R. Stedinger  
Cornell University and USGS  
Member HFAWG  
sabbaticals USGS, USACE

# Estimating Flood Risk

B17B

PFHA (?)



**Empirical**

**Imagine**

Use observed  
Flood Data

Construct using  
regional flood,  
rainfall, climate,  
storm-track, &  
orographic data

T = 100 to 1000 comfortably

T = 10,000 to 1 million

# 2011 Japanese Nuclear Accident





# Japanese government and utility officials have repeatedly said that

“... that engineers could never have anticipated the magnitude 9.0 earthquake — by far the largest in Japanese history — that caused the sea bottom to shudder and generated the huge tsunami. “

“We can only work on precedent, and there was no precedent,” said Tsuneo Futami, a former Tokyo Electric nuclear engineer who was the director of Fukushima Daiichi in the late 1990s. “When I headed the plant, **the thought of a tsunami never crossed my mind.**”

“What we understand we can manage.  
What we do not imagine, we leave to fate.”

[http://www.nytimes.com/2011/03/27/world/asia/27nuke.html?\\_r=1&nl=todaysheadlines&emc=th2&pagewanted=print](http://www.nytimes.com/2011/03/27/world/asia/27nuke.html?_r=1&nl=todaysheadlines&emc=th2&pagewanted=print)

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# Protection against System Failure

Dr. Mattson, NRC Safety Expert (quoted NEWSWEEK 4/25/79)

"We saw failure modes the likes of which had never been analyzed."

Bignell, V., and J. Fortune, *Understanding Systems Failure*, Manchester University Press, 1984. , p. 10,

“Designers of nuclear plants or any piece of equipment for that matter can only give assurances that they have faced up to the known dangers. To cope with problems beyond these they depend upon general and detailed care being taken during the building, inspection and operation and maintenance of a system. In addition they rely upon the intelligence, training and wits of those who are present when the unexpected occurs.”

# Risk Analysis

Not sufficient just to meet a probability design target, or the most obvious natural hazards.

WE created the potential for disaster, so we must design for when standards are exceeded because the cost of a real failure is too great.

Fate is not responsible – we are.

Thoughtful Probabilistic Hazard Analysis  
is how we seek to understand that responsibility.