The Cost of Inadequate Protection

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Topics

- The meaning of "100 year protection"

- Comparison to building codes, etc.

- Risk-based capital

- The cost of capital

- Annual loss cost

What Does "100-Year Protection" Mean?

- Does not mean a 100 year guarantee

- Probability of failure in one year = 1 / 100 = 1%

- Equivalent to a 39.4% probability of failure over 50 years

    - $1 - (1 - 0.01)^{50} = 39.4\%$

    No failure in 1 year

    No failure in 50 years

    At least 1 failure in 50 years

39.4% in 50 Years

- Assumes 1% probability in each of the 50 years

- There is evidence that the probability of extreme flooding is increasing

  – Increase in mean sea level

  – Increased hurricane activity in the Gulf of Mexico

- See RMS's report "Flood Risk in New Orleans – Implications for Future Management and Insurability"

 – http://www.rms.com/Publications/NO_FloodRisk.pdf

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Building Code Guidelines for CA Earthquake

- **Three dimensions**

  - Performance state

    - Fully operational

    - Operational

    - Life safe

    - Near collapse

  - Occupancy

    - Safety-critical facilities

    - Essential / hazardous facilities

    - Basic facilities

  - Frequency of event

    - Described in probabilistic terms

Frequency Dimension

Earthquake Classification	Probability of Occurrence	Annual Probability	Probability as Fraction
Frequent	50% in 30 years	2.3%	1 / 43.8
Occassional	50% in 50 years	1.4%	1 / 72.6
Rare	10% in 50 years	0.21%	1 / 475
Very Rare	10% in 100 years	0.11%	1 / 950

Performance versus Frequency
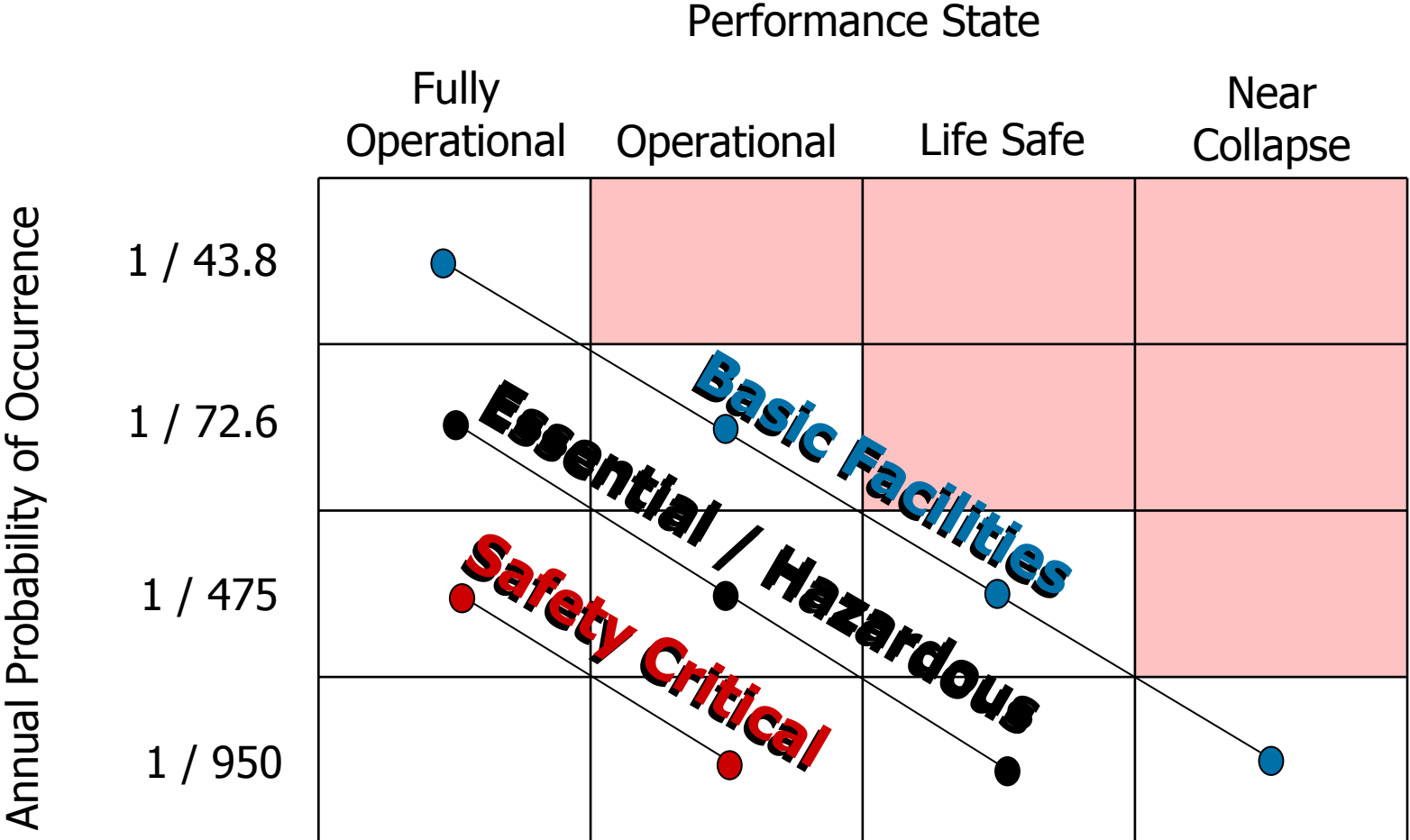
Corporate Bond Default Probabilities

Standard & Poor's Rating	1-Year Default Probability	
AAA	0.01%	
AA	0.03%	
A	0.11%	Investment grade
BBB	0.30%	
BB	0.81%	
B	2.21%	
CCC	6.00%	Junk
CC	11.68%	
C	16.29%	

Risk-Based Capital Catastrophe Component

- National Association of Insurance Commissioners (NAIC)

  - 1/250 exceedance probability (EP)

- A.M. Best

  - 1/100 EP for windstorm

  - 1/250 EP for earthquake

- Standard & Poor's

  - 1/250 EP

- Moody's

  - Considers both the 1/100 and 1/250 EPs

- Fitch

  - 1/100 tail value at risk (TVaR)

Required Capital

- Assume $100 billion economic loss if the levees fail

- At 1/100 EP protection level

  – All 5 of the above mentioned RBC models would require at least $100 billion in reserve

- At 1/475 EP protection level

  – None of the RBC models would require at least $100 billion in reserve

Annual Cost of $100 Billion of Capital

Interest Rate	Annual Cost
3%	$3 billion
4%	$4 billion
5%	$5 billion
6%	$6 billion
7%	$7 billion

Annual Loss Cost

- Assume cost of failure = $100 billion

- Expected cost of failure in a year

  = $100 billion * probability of failure

Protection Level	Annual Loss Cost ($ million)
1/100	1,000
1/200	500
1/500	200
1/1,000	100
1/10,000	10

Summary

- The cost of inadequate protection includes both the annual loss cost and the cost of capital.

- For a 1/100 protection level, the annual cost can be from $4 billion to $8 billion, depending on the interest rate

- This cost needs to be included in the analysis of the cost of building the levees to different protection levels.