Critical Infrastructures in Changing Times: 
Need for Resiliency

International Disaster and Risk Conference (IDRC)

Davos, Switzerland
30 May – 02 June 2010

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Deep Water Horizon – Before the Disaster
Multiple Redundancy
A supposedly “fail-safe” system

A “fail-safe” System Failed
Gulf of Mexico Oil Spill 2010

Nesting pelicans are seen landing on May 22 as oil washes ashore on an island that is home to hundreds of brown pelican nests as well as terns, gulls and roseate spoonbills in Barataria Bay.

http://www.huffingtonpost.com/2010/04/30/louisiana-oil-spill-2010_n_558287.html

40 million gallons of crude leaked as of 29 May 2010

Gulf of Mexico Oil Spill 2010

An oil-soaked bird against the side of the HOS, an Iron Horse supply vessel, at the site of the Deepwater Horizon oil spill on May 9.

http://www.huffingtonpost.com/2010/04/30/louisiana-oil-spill-2010_n_558287.html

20 million gallons spilled so far
BP’s Response

1000 ships and boats deployed
Cost: US 1 billion and counting

Haiti Earthquake

http://www.deepwaterhorizonresponse.com

http://afraraymond.files.wordpress.com/2010/02/haiti_big_image_984x12361.jpg

Haiti Earthquake

Infrastructure Recovery Is very difficult

Chengdu Earthquake - 2008

Not designed for Resiliency
Earthquake Kobe in Japan, Jan 1995

Magnitude = 7.2 Richter scale
More than 6,000 died
More than 40,000 injured
Estimated Damage = US$200 B

Source: Kathee Terry, NASA

Kobe Earthquake 1995

The most damage to the city was not because of the earthquake but the fires ignited due to gas leakage from the ruptured pipelines

Source: www.mines.utha.edu
Hurricane Katrina – Levees failed

Isabella Lander (L) and Arabella Christiansen climb on the 17th Street Canal levee which broke during Hurricane Katrina. Despite $22 million in repairs, the levee is leaking. Experts fear the levee could fail again in another large storm. (Mario Tama/Getty Images)

http://www.greatdreams.com/weather/new-orleans-levee.jpg

Hurricane Katrina in the US, Sept 2005

80% of the city is left under water with no power, no drinking water, telephone or food supply.

These damages could have been prevented if the levee condition could be monitored.

http://www.greatdreams.com/weather/new-orleans-levee.jpg

Critical infrastructures are vulnerable to unexpected failures

- Natural Hazards
  - Hurricanes
  - Earthquakes
  - Snow storms
  - Floods

- System Failures
  - Equipment Breakdown
  - Human error
  - Intentional events
Resilience Needs to be a part of the Design

“Resilient physical and social systems must be robust, redundant, resourceful, and capable of rapid response”

Local solutions can provide Resiliency

• For example, local supply of electricity where possible, can form the backbone of the overall supply network

• Solar and other distributed energy systems now make it possible
Conclusions

• Resilient systems will have higher initial cost in most cases

• Lack of service availability and restoration costs need to be studied

• Challenge: How safe is safe enough?

Thank you