Overview of NaTECH: Natural Hazard Triggering Technological Disasters

June 9, 2016

Nancy E. Kinner
UNH-Co-Director
Coastal Response Research Center

Meeting Goal

• Natural disasters often trigger technological disasters = NaTECH
  • Example = Oil and chemical spills resulting from hurricane
• Result = Stafford Act + OPA ‘90
  • Complicates response
• Widespread impacts to industry, commerce, communities and natural resources in coastal zone
  • Mississippi/Alabama coast has experienced NaTECH events
• Increase awareness, understanding and coordination among participating stakeholder groups and agencies for NaTECH
Meeting Objectives

- Bring together a diverse group stakeholders potentially impacted or involved in response to NaTECH events
  - Scenario = Major storm impacts Mobile + causes major oil spill
- Increase regional preparedness by identifying potential strategies for improved response, enhanced resilience, and quicker recovery when NaTECH events occur
- Recommendations for how to achieve this

- Natural Hazards:
  - Earthquakes
  - Floods
  - Lightening Strikes
  - Hurricanes
  - Tsunamis
  - Landslides

- Technological Disasters
  - Oil Spills
  - Chemical Spills
  - Power Outages
  - Loss of Drinking Water
  - Loss of Wastewater Treatment
  - Solid Waste Accumulation
NaTECH History

• Late 1900s and early 2000s
  • World Conference on Disaster Reduction
• Leaders on NaTECH = European Union and Japan
• U.S. Lead = California
  • Northridge Earthquake 1994
• Turkey Kocaeli Earthquake 1999
  • 21 releases
  • Air, water and soil impacts

Approaches

• Laws and regulations
• Chemical storage on higher ground
• Anti-flotation mitigation for storage tanks in flood zones
• Seismic risk assessments for spill prevention
• Databases of NaTECH incidents and lessons learned
• Hazard mapping
• Land use planning
U.S. Examples

- EPA Risk Management Plans for Chemical Facilities
  - Little NaTECH focus required
- CalARP: California Accidental Release Prevention Program
  - Earthquake related releases risk assessment

Domino Effects

- Cascading events
- Missing in much planning
- Current FEMA -led “Cascadia Rising” exercise has earthquake to tsunami to technological failures focus
  - June 7-10
  - Pacific Northwest
### Key Factors in Addressing NaTECH Events

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazardous materials</td>
<td>Previous identification and detection of sites that handle hazardous materials; chemical type and toxicity, release type and quantity, and knowledge of appropriate first aid and clean up procedures and evacuation measures by both individuals (residents affected) and emergency workers (from local fire departments and industry), and their level of preparedness.</td>
</tr>
<tr>
<td>Human resources</td>
<td>Number of emergency workers available; skills and competencies level.</td>
</tr>
<tr>
<td>Communications</td>
<td>Warning systems and activation procedures; communication means such as telephones, radios, pagers, and alarm systems.</td>
</tr>
<tr>
<td>Transportation</td>
<td>Availability of resources such as vehicles and drivers, identification of transportation and evacuation routes, etc.</td>
</tr>
<tr>
<td>Fire services</td>
<td>Detection and suppression of fires and/or hazardous material releases, mobilization of personnel, equipment and supplies to support debris clearance, evacuation, and search and rescue operations.</td>
</tr>
</tbody>
</table>
Factors are not different from any emergency response. Key is multiple, concurrent responses when considering these factors. Integrated Risk Management
New Research/Advances
Mostly Europe and Japan
Funding Opportunities

NATECH Accident Database

Recent major natural disasters, such as the 2002 summer floods in Europe or Hurricanes Katrina and Rita in the United States in 2005, highlighted the emergence of a new type of risk that manifests itself when the natural and technological worlds collide. The impact of a natural disaster on a facility storing or processing chemical substances can result in the release of hazardous materials with possibly severe off-site consequences through toxic-release, fire or explosion scenarios. Accidents initiated by a natural hazard or disaster which result in the release of hazardous materials are commonly referred to as Natech or na-tech accidents. This includes releases from fixed chemical installations and spills from oil and gas pipelines.
Electronic Regional Risk Atlas (ERRA)

Integrated Risk Management
BowTie Approach

We extended the existing framework in two ways.

(Extended) Natech risk analysis framework

Natural hazards
Industrial facilities
Physical damages
Chemical releases
Human and ecological effects

Mechanical models
Fragility curves
Economic damages
Supply chain effects

Fires and explosions
CGE models
(Extended) Natech risk analysis framework

We extended the existing framework in two ways:

1. Natural hazards
   - Mechanical models
2. Industrial facilities
   - Fragility curves
3. Physical damages

Chemical releases

Fires and explosions

Human and ecological effects

Economic damages

Supply chain effects

Damage to Industrial Facilities

fragility curves

e.g. Spectral Intensity
### Table

<table>
<thead>
<tr>
<th></th>
<th>$10^{-5}$</th>
<th>$10^{-4}$</th>
<th>$10^{-3}$</th>
<th>$10^{-2}$</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disastrous</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Acc 1</td>
</tr>
<tr>
<td>Catastrophic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Acc 2</td>
</tr>
<tr>
<td>Significant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serious</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Diagram

(Extended) Natech risk analysis framework

- **Natural hazards**
  - Mechanical models
- **Industrial facilities**
  - Fragility curves
- **Physical damages**
- **Chemical releases**
- **Fires and explosions**
- **Economic damages**
  - CGE models
- **Supply chain effects**

*We extended the existing framework in two ways.*
How can the indirect damage be evaluated?

- A Computable General Equilibrium (CGE) model is a comprehensive economy-wide simulation model based on microeconomic theory and an existing input-output table.
Comparison with Actual Data

- We compared the simulation results for industrial production with the actual data.
- The following results are still preliminary. We need to further research on the modeling.