API 656 Storage Tank NATECH
Natech (Natural Hazard Triggered Technological Accidents)
Hurricane drives crude oil prices to record high
API SCAST Endorses New Publication

- First meeting held on 14 Feb 2020
- Taskgroup formed to author this publication
- PEMyers of PEMY Consulting and Earl Crochet of Kinder Morgan to co-chair this TG
- Tank owners/operators have interest in this project
- This project is needed given most of the world is not seriously considering how to deal with Natech, developing methods, guidelines and publications related to Natech
- By API acting now, this will head off other SDOs from issuing potential publications which would replace API publications and best practices
Natural hazard triggered technological accidents involving the releases of hazardous materials (hazmat) are known as Natechs.

A few:
- 1994 Milford Haven Storm in UK – flammable vapors release and lighting results in fire that causes 10% loss of UK refining capacity.
- 2005 Hurricane Katrina and Rita in US result in oil and gas releases including a tank that contaminated over 1800 homes and huge losses for the oil and gas industry.
- 2008 Wenchuan earthquake in China results in release of sulfuric acid and ammonia causing evacuation of 6000.
- 2011 Great East Japan Earthquake and Tsunami cause extensive damage to infrastructure.
- 2017 Hurricane Harvey causes sinking floating roofs and tanks sliding resulting in spills.
# Natech Initiators

<table>
<thead>
<tr>
<th>Classification</th>
<th>Risk management stages</th>
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</thead>
<tbody>
<tr>
<td>a) Geological hazards</td>
<td>• Accident analysis and return of experiences.</td>
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<tr>
<td>3. Tsunami</td>
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<tr>
<td>b) Hydrometeorological hazards</td>
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<tr>
<td>1. Storms</td>
<td></td>
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<td>2. Tropical cyclones</td>
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<td>(hurricanes/typhoons)</td>
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<tr>
<td>3. Tornadoes</td>
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<td>4. Floods</td>
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<td>5. Lightning</td>
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<td>6. Extreme temperatures</td>
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<tr>
<td>c) Multi hazard and cross cutting</td>
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</tbody>
</table>
Natech Categorization

1. Three groups
   - Geologic
   - Hydrometeorological
   - Multihazard

2. Geological
   - Earthquakes
   - Volcanos
   - Tsunamis
   - Landslides and related

3. Hydrometeorological
   - Storams
   - Tropical cyclones
   - Tornados
   - Wind
   - Flooding
   - Lightning
   - Extreme temperatures

4. Multihazard: Multiple effects and domino effects (e.g. Fukushima Daiichi 2011)
Development of parametric fragility curves for storage tanks: A Natach approach

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Source and Setting

- Natechs can be triggered by any kind and size of natural hazard event, it doesn’t need to be a major one.
- Natech risk exists everywhere, where hazardous-materials installations are located in natural hazard zones.
- Natechs risk expected to increase in the future due to more frequent natural hazards (e.g. climate change), industrial growth and increasing vulnerability of society (e.g. urbanisation, interconnectedness)
Exposure and Vulnerability

- **Simultaneous** releases from **multiple** sources over **wide areas**
- **Unavailability of lifelines** needed for accident **mitigation**
- **Competition** for **scarce resources**
- **Hazardous** releases **hampering emergency response**
- **Non-functional** or **inappropriate** civil **protection measures**
Natech Risk Assessment

- **Powerful** tool for identifying Natech hazards and estimating associated risk
- **Overlay** of natural hazard risk and industrial installations does **not** indicate Natech risk!
- Physical **damage** due to natural hazard impact and related hazardous consequences **should** be analysed
- The analysis should **consider**:
  - **Multiple and simultaneous** releases
  - **Damaged** safety barriers/systems
  - **Unavailable** support systems
  - **Unusual** environmental conditions
  - **Cascading** events (e.g. domino effects)
Steps in Natech Risk Assessment

1. Characterization of the natural hazard
2. Identification of critical equipment
3. Identification of damage severity and impact scenarios
4. Estimation of damage likelihood
5. Estimation of loss of containment and accident scenarios
6. Identification of credible combinations of events
7. Calculation of likelihood of each combination
8. Evaluation of consequences of each combination
9. Risk evaluation

Data need is **minimal** if natural hazard and industrial risk data are collected **considering** Natech risk!
Good Practices for Addressing Natech Risk

- European Union: **Seveso III Directive** explicitly addresses Natechs and requires installations to **identify** and **evaluate** Natech risks
- OECD: Natech addendum to the **guiding principles** for chemical accident prevention, preparedness and response contains Natech-specific amendments
- U.S.A.: California Accidental Release Prevention (CalARP) program calls for Natech **risk assessment** for earthquakes
- Japan: Laws on industrial safety and industrial disaster prevention requires **additional measures** to reduce Natech risks
Tools for Natech Risk Assessment

- **eNatech**: Natech accident database for systematic collection and analysis of global data (http://enatech.jrc.ec.europa.eu)

- **ARIPAR**: QRA for chemical facilities (module for earthquake impacts on single sites)

<table>
<thead>
<tr>
<th>Event</th>
<th>Standards</th>
<th>Damage Mechanisms</th>
<th>Value Added</th>
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</thead>
<tbody>
<tr>
<td>Flooding</td>
<td>ASCE7-16, FEMA</td>
<td>Sliding, piping -&gt; spills Wind dependency</td>
<td>Little current guidance Provide ballast requirements to prevent damage Priority: high</td>
</tr>
<tr>
<td>Rainfall</td>
<td>API 650, NOAH Precip Server, ASCE7-16</td>
<td>Damage, sunk floating roofs -&gt; spills Flooding dependency</td>
<td>Little current guidance Provide guidelines about floating roof drains, sizing, maintenance: Priority: high</td>
</tr>
<tr>
<td>Wind</td>
<td>ASCE7-16, FEMA</td>
<td>Sliding, buckling, overturning Flooding dependency</td>
<td>Little current guidance Guidelines about how flooding impacts potential wind damage Priority: high</td>
</tr>
<tr>
<td>Seismic</td>
<td>API 650, ASCE7-16</td>
<td>Sliding, buckling, overturning</td>
<td>Guidance well established Priority: low</td>
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</table>
| Snow  | API 650, ASCE7-16 | Floating roof sink  
Fixed roof damage  
Dome buckling; spills possible | Reasonable current guidance  
Limited to colder regions  
Priority: low                                                                                     |
| Ice   | API 650, ASCE7-16 | Damage, sunk floating  
Inoperability  
Damaged drains and piping; spills possible | Some guidance  
Limited to colder regions  
Priority: medium                                                                                       |
| Tsunami | ?               | Low probability  
Vulnerability limited to coastal | Little guidance  
Limited discussion at this point  
Priority: low until determined otherwise                                                                         |
| Other |                 |                                                                                 | Not yet discussed                                                                                                                  |
Next Steps

- Conf call to be scheduled before API Spring 2020 meeting in New Orleans
- 2.5 hr f2f meeting in New Orleans week of April 2020
- API welcomes participation by other members/organizations under the ANSI accredited SDO process
- Let me know if you are interested in participating