Chemical Accident Prevention and Preparedness in China

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The CPI in China

- The chemical process industry (CPI) in China has been the pillar industry
- By the end of 2008, China’s total sizable petrochemical enterprises had reached 28,515
- In 2011, the gross industrial output value was US $1.8 trillion
  - 23.9% of China’s GDP
- The CPI has presented a significant safety risk to human lives and the environment
More than 300 Chemical Safety Related Laws/Standards in the last decade (Partial List)

<table>
<thead>
<tr>
<th>Year</th>
<th>Law Title</th>
<th>Standard/Regulations</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>Law on the Prevention and Control of Atmospheric Pollution</td>
<td>Identification Standard of Major Hazard installations</td>
</tr>
<tr>
<td>2001</td>
<td>Law on Prevention and Control of Occupational Diseases</td>
<td></td>
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<tr>
<td>2002</td>
<td>Work Safety Law</td>
<td>Measures for the Administration of Registration of Hazardous Chemicals</td>
</tr>
<tr>
<td>2003</td>
<td>Law on Road Traffic Safety</td>
<td>Safety Regulations for Dangerous Chemical Goods</td>
</tr>
<tr>
<td>2004</td>
<td>Technical guidelines for environmental risk assessment on projects</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>Code for design of fire-dike in storage tank farm</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Guidelines for enterprises to develop emergency response plan for work place accidents</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>Law on Emergency Responses</td>
<td>Production Safety Accident Report and Investigation &amp; Treatment Regulations</td>
</tr>
<tr>
<td>2008</td>
<td>Guideline of safety management system implementation for petrochemical corporation</td>
<td>Fire prevention code of petro chemical enterprise design</td>
</tr>
<tr>
<td>2009</td>
<td>Identification Standard of Major Hazard installations (Revised)</td>
<td>General Norms for Safety Standardization of Hazardous Chemical Enterprises.</td>
</tr>
<tr>
<td>2010</td>
<td>Guidelines for process safety management of petrochemical corporations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Safety Regulations for Dangerous Chemical Goods (Revised)</td>
<td></td>
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</tbody>
</table>
Emergency Response Plan

Law on Emergency Response was promulgated in 2007

Every chemical company has prepared an emergency response plan

Emergency response command centers have been built in many large chemical companies/parks

Emergency response drills start to get normalized
Key Supervision Lists

➔ First Hazardous Chemical Technology List of Key Supervision
  ➔ Issued on June 20th, 2009
  ➔ 15 types of chemical processes
      ➔ Phosgene related chemical processes
      ➔ Chlorination processes
      ➔ Nitration processes
      ➔ .......

➔ First Hazardous Chemicals List of Key Supervision
  ➔ Issued on June 21st, 2011
  ➔ 60 chemicals such as chlorine, ammonia, LPG, hydrosulfide, Hydrogen, phosgene
  ➔ .......

➔ Facilities covered by these two categories should be equipped with automatic control systems, emergency shutdown systems (ESD) and leakage monitoring and alarming systems

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During the last 15 years, 35 national chemical industrial parks (CIPs), 189 provincial CIPs, and more than 1,000 county level CIPs have been built up.

30% of chemical companies in China are now located in these CIPs.
UNEP’s APELL Pilot Project in ZhangJiaGang Chemical Industrial Park, 2010
Statistics of Chemical Accidents

![Bar chart showing the number of fatalities and chemical accidents from 2004 to 2011. The chart indicates a general decrease in both categories from 2004 to 2011.](chart.png)
### Environmental accidents reported to MEP (2005-2011)

<table>
<thead>
<tr>
<th>Number</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Production</td>
<td>23</td>
<td>58</td>
<td>39</td>
<td>57</td>
<td>63</td>
<td>69</td>
<td>54</td>
<td>363</td>
</tr>
<tr>
<td>Chemical Transportation</td>
<td>24</td>
<td>32</td>
<td>28</td>
<td>25</td>
<td>52</td>
<td>28</td>
<td>15</td>
<td>204</td>
</tr>
<tr>
<td>Illegal discharge</td>
<td>14</td>
<td>22</td>
<td>14</td>
<td>23</td>
<td>23</td>
<td>17</td>
<td>19</td>
<td>132</td>
</tr>
<tr>
<td>Natural Disaster</td>
<td>5</td>
<td>12</td>
<td>17</td>
<td>42</td>
<td>6</td>
<td>82</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>10</td>
<td>30</td>
<td>29</td>
<td>13</td>
<td>33</td>
<td>12</td>
<td></td>
<td>127</td>
</tr>
</tbody>
</table>

Total: 908
Safety Situations Still Severe

- Even though the total number of chemical accidents decreased, the number of the severe accidents and the death toll rose about 30% and 27.3% respectively in 2010.
- The number of major environmental emergencies increased 120% in 2011.
One explanation from SAWS

- Increased production capacity in a single facility leads to higher safety risk
- Once an accident occurs, it will evolve into a major accident
What are our learned lessons?

- Over-emphasized
  - Occupational safety and industry hygiene
  - Emergency Response

- Overlooked process safety
  - Folk adage---“They have money to buy coffin, but no money to buy medicine”
  - No process safety regulations or standards until 2008
  - Few people in the CPI know process safety well
  - Many top management people don’t know how to manage process safety

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Another Repeated Accident

- 2012/2/28, an explosion occurred at Keer Chemical Company in Hebei Province
- 25 died, 4 missing, 46 injured
Accident Analysis

→ Direct cause

- Heat transfer fluid leaking under the #1 reactor caught fire
- The product Guanidine Nitrate and the unreacted raw material Ammonium Nitrate inside the reactor were locally heated
- The local heating resulted in dramatic decomposition of the above two chemicals, which leaded to explosion

→ Indirect Causes

- Unreasonable facility siting
- The degree of production automation was low
- Poor management of change (MOC)
  - The operating temperature of the heat transfer fluid was changed from 210 °C to 255 °C
  - No process hazard analysis was done for this change
- The education of the employees was not sufficient.
  - Most of them only got middle school degrees
First PSM Standard of China, 2010

30 years behind European Seveso Directive I
18 years behind the U.S.A. OSHA PSM standard
15 years behind the Korean PSM standard

AQ
中华人民共和国安全生产行业标准
AQ/T 3034-2010

化工企业工艺安全管理实施导则
Guidelines for process safety management
of petrochemical corporations

2012/10/16
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Implementation Guideline for Hazard Identification and Mitigation in Hazardous Chemical Enterprises

Released on August 7th, 2012 by SAWS

2.2.5 Periodical HAZOP analysis has to be performed in the hazardous chemical enterprises that are covered by the above two categories or have major hazard installations

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3.2.3 HAZOP has to be performed once every five years at least
On December 6, 2006, “Environment Impact Assessment (EIA) Public Hearing on BASF-Yangzi Company's Planning in 11th '5-Year' Period" was held in the Nanjing Chemical Industrial Park, attended by leaders from local agencies, officials from the Park, representatives of local residents.

BASF introduced the expansion plan during the 11th "5-Year" Period, then elucidated on its environmental protection plan to ensure the minimum impact to the environment as well as the safety of the plants.
Big construction projects in the chemical industry have to go through Public Hearings in Environmental Administrative Permission
Conclusions

- We believe that the chemical accident prevention and awareness will be further enhanced with the economic development of China.
- People’s right to know will be strengthened with the continued national Reform and Opening-up policy.
- However, the trend of major chemical accident occurrence will take long to reverse.
  - Lack of process safety experts
  - Lack of advanced safety culture
Thank you very much!