Composition of DG-trains to prevent a hot BLEVE

11th Meeting working group on tank on vehicle technology

19 May 2010
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Introduction

- Risk of transport of dangerous goods
  - Individual risk
  - Societal risk

- Calculation using (Dutch) guidelines

- Substances:
  - Liquefied flammable gas (A)
  - Toxic gas (B2/B3)
  - Toxic liquid (D3/D4)
  - Flammable liquid (C3)
Relevant incident scenarios

a. Toxic gas
   - short duration: 50 tons
   - continuous: 30 min.
   - small pool

b. Toxic liquid
   - large pool

c. Flammable liquid
   - pool fire

d. Liquefied flammable gas
   - short duration: 50 tons
   - continuous: 30 min.
Short duration LFG-scenarios

Possible effects
1. Flash fire or explosion
2. BLEVE (direct ignition)
3. Hot BLEVE (ignition caused by scenario c)
Hot BLEVE

Conditions:
- Train with LFG and LF
- Tank-wagons with LFG and LF next to each other
- Not enough time for effective measures
- Trains with only LFG are excluded
Effect of a BLEVE

<table>
<thead>
<tr>
<th></th>
<th>Hot BLEVE</th>
<th>Cold BLEVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% Fatalities</td>
<td>200 meter</td>
<td>140 meter</td>
</tr>
<tr>
<td>1% Fatalities</td>
<td>450 meter</td>
<td>380 meter</td>
</tr>
</tbody>
</table>

Area in which:

- 100% Fatalities hot vs. cold $\approx 2!$ (higher societal risk)

- 1% Fatalities hot vs. cold $\approx 1,4!$
Influence of a hot BLEVE on risk level

- Basic rail network
- Risk vs. spatial planning
- Societal risk is caused by LFG, especially a hot BLEVE
- SR far beyond the acceptable risk on certain tracks
Transportation routes of LFG with origin Sloehaven
Transportation routes of LFG with origin Kijfhoek
Transportation routes of LFG with origin Antwerpen
Transportation routes of LFG with origin Germany
Large influence of a hot BLEVE on the societal risk

- Pressure to reduce the risk

- Commitment of parties involved to compose trains hot BLEVE proof (HBP)

- Initiative by ministries and transport sector
Realization hot BLEVE proof transportation goals

<table>
<thead>
<tr>
<th>Measure</th>
<th>HBP minimal</th>
<th>HBP medium</th>
<th>HBP maximal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. HBP containers</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>NL</td>
<td>0%</td>
<td>80%</td>
<td>100%</td>
</tr>
<tr>
<td>Abroad</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. HBP composing at Kijfhoek</td>
<td>50%</td>
<td>80%</td>
<td>100%</td>
</tr>
<tr>
<td>3. HBP composing at location of origin</td>
<td>50%</td>
<td>90%</td>
<td>100%</td>
</tr>
<tr>
<td>4. Rerouting over the Betuweroute</td>
<td></td>
<td>Not relevant</td>
<td></td>
</tr>
<tr>
<td>5. International aspects/agreement</td>
<td>0%</td>
<td>50%</td>
<td>100%</td>
</tr>
</tbody>
</table>
## Results societal risk

<table>
<thead>
<tr>
<th>Number of kilometers</th>
<th>HBP minimal</th>
<th>HBP medium</th>
<th>HBP maximal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 &lt; SR &lt; 3</td>
<td>98</td>
<td>74</td>
<td>48</td>
</tr>
<tr>
<td>3 &lt; SR &lt; 10</td>
<td>69</td>
<td>46</td>
<td>27</td>
</tr>
<tr>
<td>SR &gt; 10 x acceptable</td>
<td>40</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Total SR &gt; 1</td>
<td>207</td>
<td>128</td>
<td>76</td>
</tr>
</tbody>
</table>
Conclusion

• Hot BLEVE proof transport reduces the societal risk significantly

• Contribution of transport from abroad is also important for risk reduction and realization of the basic rail network
Questions

Therefore: Please share your view with us on the topic of composing trains hot Bleve proof
• feasibility
• experience