Remediation and Restoration of the Lac Mégantic, Quebec Oil Train Disaster

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Agenda

- Chronology of Lac Mégantic Derailment
- Summary of Environmental Impacts
- Emergency Response Activities and Timeline
- Post-emergency Remediation Activities
- Site Restoration Activities
- CTSB Summary of Disaster Causes
- Path Forward
Chronology (July 5 - 6, 2013)

- 72 Bakken crude oil tankers parked overnight 10 kilometers west of Lac-Mégantic
- Rail crew sets hydraulic and hand brakes, departs approximately 11:25 pm
- Fire reported in the parked train engine at 11:30 p.m.
- Nantes Fire brigade responds, train engine shut down, fire extinguished and depart scene at 12:00 a.m.
- Train begins rolling downhill towards Lac-Mégantic
- At 1:15 a.m. train derails in Lac-Mégantic
- 67 rail cars spill contents with subsequent explosions and fire
- ~150 responders from Quebec and US
- 47 fatalities
## Summary Table on Bakken Crude Oil Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Reported Values</th>
<th>Hazmat Transportation Regulatory Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flashpoint</td>
<td>Range: -59°C to 50°C</td>
<td>Bakken crude oils meet the criteria for Packing Group I, II, or III flammable liquids or as combustible liquids.</td>
</tr>
<tr>
<td>Initial Boiling Point</td>
<td>Range: 2.2°C to 66.9°C</td>
<td>Bakken crude oils with an initial boiling point of 35°C or less meet criteria for Packing Group I flammable liquids; others for Packing Group II or III flammable liquids or combustible liquids according to flashpoint.</td>
</tr>
<tr>
<td>Vapor Pressure at 50°C</td>
<td>Maximum: 16.72 psia</td>
<td>All Bakken crude oils have a vapor pressure below 43 psia at 50°C and must be transported as liquids.</td>
</tr>
<tr>
<td>Reid Vapor Pressure at 38°C</td>
<td>Maximum: 15.4 psia</td>
<td>Not used by the regulations; confirm the vapor pressure at 50°C is well below the above 43 psia limit and Bakken crude oils must be transported as liquids.</td>
</tr>
<tr>
<td>Rail tank car pressures on delivery</td>
<td>Maximum: 11.3 psig</td>
<td>Demonstrates that Bakken crude may be safely transported in DOT specification 111 tank cars.</td>
</tr>
<tr>
<td>Flammable gas content</td>
<td>Maximum: 12.0 liquid volume %</td>
<td>None: with the vapor pressures of all Bakken crudes oils examined not exceeding a vapor pressure of 43 psia at 50°C, all Bakken crude oils examined must be transported as liquids.</td>
</tr>
<tr>
<td>Hydrogen sulfide content in the vapor space</td>
<td>Most reported H₂S concentrations were below the OSHA STEL; one reported a maximum level of 23000 ppm</td>
<td>None when low values are experienced; additional hazard communication to warn of the presence of H₂S when inhalation hazard levels are encountered.</td>
</tr>
<tr>
<td>Corrosivity</td>
<td>NACE B+ or B++</td>
<td>Data and experience indicate that Bakken crude oil does not corrode steel at a rate of ¼ inch per year or more so that Bakken crude oil is not a corrosive liquid.</td>
</tr>
</tbody>
</table>
Summary of Environmental Impacts

• > 6,000,000 L spilled
• Rail corridor
• Zone Incendiée
  - Soils @ 0-3m over ~1 acre
  - TPH combustion residuals
  - LNAPL greater than C20
  - Non-combustible building foundations and structural steel
  - Groundwater impacts
• Lac Mégantic
  - LNAPL impacts to northern shoreline rip rap
  - Wharf at Municipal Marina destroyed
• Rivière Chaudière
  - LNAPL impacts to embankments and floodplain areas

“Zone Incendiée” immediately post disaster
Village of Lac Mégantic

- Multiple commercial and residential foundation/basement impacts
- Pont Agnès footers/foundation
- Storm sewer conveyances
Emergency Response: July - December 2013

- About 6,000,000 L petroleum crude oil was quickly released
- On-scene command ~150 firefighters were called to the scene
- Residents evacuated
- Storm sewers plugged/fires extinguished
- City downtown secured/power disconnected
- Groundwater recovery trenches/wells installed
- 136,000 MT impacted soil and other material, removed to soil storage area in 2013
- Debris stockpiled
- Interim commercial center constructed
- Subsurface impacts delineation
- Rail line re-established
Clean up Standard

- **Soil (Petroleum Hydrocarbons C10-C50)**
  - Level A: Background Levels (300 ppm)
  - Level B: Maximum acceptable limit for residential site (700 ppm)
  - Level C: Maximum acceptable limit for commercial site (3,500 ppm)
  - Level D: Maximum acceptable for disposal (10,000 ppm)
  - Site Remediation Objective: Level A for residential area and level B for the railroad zone

- **Water (Petroleum Hydrocarbons C10-C50)**
  - Surface water criteria: 3,500 ppb
  - Site Remediation Objective: 50% of 3,500 ppb and no free product
Post-Emergency Remediation

• Impacted soil removal – 135,000 MT
  - Zone Incendiée
  - Pont Agnès
  - Storm Sewers conveyances
  - Building foundations (pending)

• Activities of AECOM
  - Prime contractor
  - Program Manager role:
    • Bid specs/Contractor evaluation
    • Field work oversight
    • Reporting
  - Health and Safety
  - Supervision and coordination
  - Soil, Water, Air and Noise monitoring

Impacted soil being loaded for treatment/disposal; Lac Mégantic visible in background
Post Emergency Remediation

**Impacted soil stockpiles**
- Emergency 136,000 MT
- Post emergency 135,000 MT (ongoing)

**Impacted soil treatment - Phase 2**
- Soil Washing (not successful)
- Biological – 10,000 MT already treated on site, remain 199,000 MT to treat (contract ended in 2017)
- Landfill – 10,000 MT send to cover a former mine
Post Emergency Remediation

Groundwater/oil recovery and treatment

• Oil/water separator
• Carbon filtration
• 50,000,000 L treated water 2014 YTD
Post Emergency Remediation

Storm Sewer Conveyances

• Rue des Veterans (Phases 1 and 2)
• Rue Frontenac
• Clean fill re-used on site
Post Emergency Remediation

- Rivière Chaudière sediment removal (pending)
- Building demolition and foundation impacted soil removal (pending)
- Marina wharf replacement (pending)
- Innovative real-time perimeter air monitoring (first time implemented in Quebec)
CTSB Summary of Disaster Causes

• Fire in the locomotive

• Leaving trains unattended

• Braking force
  – Air brakes
  – Hand brakes

• Class 111 tank cars: Damage and construction
  – All 72 tanks cars were Class 111, lacked enhancements such as a jacket, a full head shield, and thermal protection

• Single-person crews

• Dangerous goods: Inadequate testing, monitoring, and transport
Path Forward

- 127,000 hours safe work - 2 incidents
- 135,000 MT impacted soil removed:
  - 23,000 MT of <A and A-B soil stockpile for reuse
  - 32,000 MT of >B soil disposed to a treatment facility
  - 75,000 MT soil >B sent to the treatment site (10,000 tm already treated)
  - 5,000 MT debris disposed
- 61,000 MT backfill
- 50,000,000 L impacted groundwater treated 2014 YTD
Thank You!

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