Crude by Rail

Bob Greco, API
NCSL Task Force on Energy Supply
December 9, 2014
American Petroleum Institute

- National Trade Association formed in 1919
- Only U.S. association representing entire value chain of the oil and natural gas industry: exploration, production, pipelines, refining, marketing and transportation
- More than 600 member companies
- State Petroleum Councils in 33 States
U.S. Energy Revolution

Shale Resources, Lower 48 States

Current and prospective resources and basins in the continental US
U.S. crude oil production
million barrels per day

History

2012

Projections

U.S. maximum production level of
9.6 million barrels per day in 1970

Tight oil

Lower 48 offshore

Alaska

Other lower 48 onshore

Source: EIA, Annual Energy Outlook 2014 Early Release
Williston Basin Crude Oil Transport

2013

- Rail Export: 62%
- Pipeline Export: 33%
- Tesoro Refinery: 4%
- Trucked to Canadian Pipeline Export: 1%

2014

- Rail Export: 66%
- Pipeline Export: 27%
- Tesoro Refinery: 6%
- Trucked to Canadian Pipeline Export: 1%

Source: North Dakota Pipeline Authority
Growth of Crude by Rail

Growth of Crude by Rail Carloads

Originated Carloads on Class I Railroads (1,000’s)

Note: 409,000 ethanol movements in 2011

Sources: AAR & RSI Presentations to NTSB, April 2014
Oil & Gas Industry Improvements to Rail Safety: CPC-1232 Tank Car Design

- **Top fittings housings** prevent the top valves from damage in a derailment.
- Loading and unloading facilities use a **manway** to inspect cars, obtain samples, gauge volume, and for cleaning.
- The **tank shell** holds the product and thicker tank material improves puncture resistance.
- **Reclosing pressure relief devices (PRD)** reduce the pressure inside the car and act as a thermal protection system in case of a derailment and fire.
- **Tank jackets** protect the insulation from weather.
- **Bottom outlet valves** are used to unload cars and drain liquid when the car is cleaned.
- **Protective skids and enhanced handle design** protect the bottom outlet valve in the case of a derailment.

**½” Head Shield Full-Height**
Sustained Tank Car Supply: Critical for continued production & economic growth

• Bakken production could reach over 2 million bpd by 2020
  – ~25% of U.S. Production, 13% of U.S. consumption
• Rail movements to grow 40% over 2013 levels by 2015
• Western Canadian rail growth: ~12,000 additional railcars in the next 12 months
• U.S. requires additional rail cars AND all modes of transportation, including pipeline, rail and barge, to supply the energy our country needs
  – sustain crude oil production forecasts
  – reduce dependence on imported foreign crude oil
  – support globally competitive refining industry
# Classification Process

<table>
<thead>
<tr>
<th>Hazard Classes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>Explosives</td>
</tr>
<tr>
<td>Class 2</td>
<td>Gases</td>
</tr>
<tr>
<td>Class 3</td>
<td>Flammable and Combustible Liquids</td>
</tr>
<tr>
<td>Class 4</td>
<td>Flammable Solids; Spontaneously Combustibles; Dangerous when Wet</td>
</tr>
<tr>
<td>Class 5</td>
<td>Oxidizers/Organic Peroxides</td>
</tr>
<tr>
<td>Class 6</td>
<td>Toxics; Infectious Substances</td>
</tr>
<tr>
<td>Class 7</td>
<td>Radioactives</td>
</tr>
<tr>
<td>Class 8</td>
<td>Corrosives</td>
</tr>
<tr>
<td>Class 9</td>
<td>Miscellaneous</td>
</tr>
</tbody>
</table>
## Classification Process

<table>
<thead>
<tr>
<th>Packing Group</th>
<th>Flash Point</th>
<th>Initial Boiling Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>&lt;=95°F</td>
<td>&lt;=95°F</td>
</tr>
<tr>
<td>II</td>
<td>&lt;73°F</td>
<td>&gt;95°F</td>
</tr>
<tr>
<td>III</td>
<td>73°F-140°F</td>
<td>&gt;95°F</td>
</tr>
</tbody>
</table>
API: Holistic Approach to Safety

Focus on holistic and systematic approach to safety improvements: Prevention, Mitigation, and Response

• Solutions must be data-driven with measurable improvements to safety without creating new risks or inadvertently shifting the risks to other businesses or operations

• Collaboration is needed among government, shippers, owners/lessors, railroads, and tank car builders
Industry Action

• New API standard (RP3000) for classifying, loading/unloading, and transporting crude oil to ensure it is moved safely
  – Assessment of physical properties of crude oil in transportation

• API, NDPC, AFPM have all studied the physical properties of crude oil
  – Bakken crude is similar to other light, crude oils
  – Vapor pressure by itself is not an indicator of volatility
DOT Statements

• Timothy Butters, PHMSA -- “Bakken crude oil’s gas content, flash point, boiling point, and vapor pressure are not outside the norm for light crude oils.”*

• FRA noted in its study that vapor pressure was not an effective metric when considering real world accident conditions.

* PHMSA’s Deputy Administrator, Tim Butters, testified on Sept. 9th before the Subcommittees on Energy and Oversight, Committee on Science, Space, and Technology
Questions Answered by Research on Bakken Crude

- **Is Bakken crude different than other light crudes?**
  - No, research shows that Bakken is not materially different than other light crudes

- **Is Bakken crude more volatile than other light crudes?**
  - No, the average initial boiling point, flash point, and RVP of Bakken are similar to other light crude oils

- **What indicators are we assessing?**
  - Flash point, vapor pressure, IBP, API Gravity, light ends composition, others

- **Is Bakken crude compatible with our current rail cars?**
  - Yes, Bakken crude is currently packaged in railcars designed to carry flammable liquids at a design pressure of 100 psi
DOT Proposed Rail Safety Rule

- Proposed rule published July 23
  - Advance Notice (ANPRM) on emergency response
  - 3800+ comments submitted by Sept 30 (deadline)
- Concerns
  - Overestimated retrofit capacity
  - Underestimated size of fleet
- Final rule: March 2015?
API/AAR Joint Comments

• New Tank Cars
  – ½” shell with jacket, thermal blanket, full height head shields, pressure relief device, bottom-handle outlet protection, & top fittings protection

• Existing Non-Jacketed cars (DOT-111 (7/16”) and CPC-1232 (½”))
  – Same as New Car spec (less shell thickness)
  – After retrofit – 21,000 ½” cars meeting New Car Spec

• Existing jacketed cars (7/16”) get BOV and PRD -- thermal blankets not needed

• Prioritize cars in crude oil and ethanol: most of the unit train service for flammable liquids

• Retrofit schedule must account for shop capacity and must be reviewed
API/AAR Recommendation: Safety-Driven

• Improved puncture and spill resistance
  – University of Illinois: conditional probability of release (CPR) for cars involved in accidents - uses over 40 years of data
• Avoidance of a tank car thermal rupture
  – Predicts the time to failure for a tank car involved in a pool or torch fire - Analysis of Fire Effects on Tank Cars (AFFTAC) modeling
Improving Response

- Oil and rail industry emergency response professionals are partnering to share expertise around crude oil spills and fires.

- Optimized positioning of assets, resources and personnel facilitates quick, effective response to rail incidents involving crude oil.

- Oil and rail industry experts are working with multiple stakeholders to develop training and exercises for first responders.
Conclusion

• Crude-by-rail: necessary for a robust oil/gas infrastructure
  – enhances economic growth, supports jobs, and is good for the country
• The industry is using state-of-the-art tank cars and is committed to further improvements
• API and AAR: significant progress on collaborative approaches
• DOT should take a holistic approach to safety and finalize a rule grounded in science and data
Bob Greco
Group Director, Downstream & Industry Operations
202-682-8167

greco@api.org
Background slides
Figure 4. U.S. crude oil and lease condensate proved reserves, production, and imports, 1981-2013

# Crude Oil and Ethanol Tank Car Fleet*

<table>
<thead>
<tr>
<th>Car Type (CPR Value)</th>
<th>Number as of 2013</th>
<th>2014 orders</th>
<th>2015 orders</th>
<th>Crude Total</th>
<th>Ethanol Total</th>
<th>Ethanol and Crude Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPC-1232 J (4.57%)</td>
<td>7,685</td>
<td>13,647</td>
<td>9,730</td>
<td>31,062</td>
<td>23</td>
<td>31,085</td>
</tr>
<tr>
<td>CPC-1232 NJ (10.3%)</td>
<td>11,364</td>
<td>7,481</td>
<td>1,180</td>
<td>20,025</td>
<td>751</td>
<td>20,776</td>
</tr>
<tr>
<td>Legacy-111 J (8.5%)</td>
<td>6,524</td>
<td></td>
<td></td>
<td>6,524</td>
<td>88</td>
<td>6,612</td>
</tr>
<tr>
<td>Legacy-111 NJ (19.55%)</td>
<td>22,930</td>
<td></td>
<td>22,930</td>
<td></td>
<td>26,983</td>
<td>49,913</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total</td>
<td>80,541</td>
<td>27,845 108,386*</td>
</tr>
</tbody>
</table>

* Note: Excludes 38,000 tank cars in Other Flammables service.

* AAR data of existing cars. RSI data shows committed tank car orders that are contracted to be built for a specific design and will be completed by the end of 2015.
Proposed Retrofit Schedule

API (Crude and Ethanol)
- Ramp up: 2Q-4Q
- Legacy DOT-111 NJ
- CPC-1232 NJ
- Legacy DOT-111 J
  - Review Standards for Applicability to All Flammable Liquids

PHMSA (Crude, Ethanol All Flammable Liquids)
- PG 1: 3Q
- PG 2: 3Q
- PG 3: 3Q
U.S. Rail Safety Statistics

69% of rail accidents are caused by operational errors and track failures

Accidents Resulting in Hazardous Materials Release

2012 U.S. Rail Accidents

- Human Factors: 31.0%
- Equipment: 16.2%
- Misc: 11.9%
- Track: 37.8%

1 FRA Office of Safety Analysis
## Industry Action - Comparison of Crude Oil Data Sets

<table>
<thead>
<tr>
<th></th>
<th>API Other Crudes*</th>
<th>API Bakken*</th>
<th>AFPM</th>
<th>NDPC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vapor Pressure PSI</strong></td>
<td>Avg 7.24 Min 1.43 Max 11.46</td>
<td>Avg 11.81 Min 3.60 Max 15.37</td>
<td>8 - 12 0.8 15.4</td>
<td>11.7 8.9 14.4</td>
</tr>
<tr>
<td>(ASTM D6377)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sulfur Wt %</strong></td>
<td>Avg 0.14 Min 0.01 Max 0.64</td>
<td>Avg 0.1 Min 0.02 Max 0.25</td>
<td>Not reported</td>
<td>0.14</td>
</tr>
<tr>
<td>(D4294)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>API Gravity</strong></td>
<td>Avg 40.36 Min 34.40 Max 46.9</td>
<td>Avg 42.66 Min 38.60 Max 47.07</td>
<td>&gt;37</td>
<td>41 36.7 46.3</td>
</tr>
<tr>
<td>(D5002)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Initial Boiling Point</strong></td>
<td>Avg 101.94 (PGII) Min 83.40 (PG I) Max 182.80 (PGII)</td>
<td>Avg 91.96 (PG I) Min 79.10 (PG I) Max 150.80 (PG II)</td>
<td>69.6 (PG I) 36.0 (PG I) 152.4 (PG II)</td>
<td>99.6 (PG II) 91.9 (PG I) 107.2 (PG II)</td>
</tr>
<tr>
<td>(D86) °F</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* API’s analysis of over 200 samples submitted to PHMSA
ANSI/API RP 3000, Classifying and Loading of Crude Oil into Rail Tank Cars, Sept 2014

- Hazardous Materials Regulations cover all hazardous materials, RP 3000 provides guidance specifically for crude oil
- For rail transportation only
- Includes loading, does not cover offloading of crude oil
- PHMSA encouraged to incorporate API RP 3000 by reference into new DOT regulations
- Consideration will be given to revisiting the standard if new DOT regulations contain different requirements
- Developing training for RP 3000
Safety: Improvements in Fleet Safety for the Crude Oil and Ethanol Cars

- Current Fleet
- Retrofitting DOT-111 NJ cars
- Retrofitting CPC-1232 NJ cars
- Retrofitting DOT-111 J cars
- Modified and New Fleet
Safety: Fleet Survivability in a Pool Fire Increased for Crude Oil and Ethanol Cars

Survivability in a pool fire (in minutes)
API/AAR Joint Industry Work Groups

CEO Engagement

Prevention
- Training
- Technology
- Safety Management/Culture
- Standards

Mitigation*
- Classification & Testing
- Tank Car Design

Response
- Training
- Planning

*Includes tank car mfrs & leaseholders