Getting LNG Onto the Rails

By: Robert Fronczak
AVP Environment and Hazmat

Of: Association of American Railroads

For: Energy by Rail Conference

Date: October 27, 2016
Outline

- Current Status
- The Alaska Railroad Project
- The Need
- Other Cryogenic Liquids Transported by Tank Car
- What DOT Should Do?
- FRA testing
Current Status

• Methane refrigerated liquid (Liquefied Natural Gas – LNG) is not allowed in tank cars in the US
• A special permit (SP) is required to transport LNG by rail in the US
• The Alaska Railroad currently has a SP to transport LNG in tank trucks in an intermodal move
• There was never a demand to transport LNG by rail in the past
• LNG has been allowed in tank cars in Canada since July 2014
• Canadian Containers for Transport of Dangerous Goods by Rail standard TP14877 revised section 8.6.24 includes the specifications for the TC-113C120W and TC-113C140W class cars
The Alaska Railroad is the first railroad permitted to transport LNG by Rail
Alaska Railroad Project

- FRA granted approval in October 2015
  - Expires in December 2017
  - Three round trips per week
  - 12 tanks per train – 7,024 gallons per container
- Intermodal shipment from Port Mackenzie to Fairbanks (350 miles)
- First shipment occurred in October 2016
## LNG Engineering Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>LNG Tank Car Value</th>
<th>40-Foot LNG ISO Container</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inner tank material</td>
<td>ASTM A240 304L</td>
<td>ASME SA 240-304</td>
</tr>
<tr>
<td>Inner tank thickness</td>
<td>0.6 inch</td>
<td>0.264 inch</td>
</tr>
<tr>
<td>Outer tank material</td>
<td>AAR TC128B</td>
<td>ASTM A 572-60</td>
</tr>
<tr>
<td>Outer head thickness</td>
<td>0.5 inch</td>
<td>0.315 inch</td>
</tr>
<tr>
<td>Outer shell thickness</td>
<td>0.4375 inch</td>
<td>0.236 inch</td>
</tr>
<tr>
<td>Shell standoff</td>
<td>6 inches</td>
<td>4 inches</td>
</tr>
<tr>
<td>Head standoff</td>
<td>6 inches</td>
<td>6 inches</td>
</tr>
<tr>
<td>Inner tank diameter</td>
<td>104 inches</td>
<td>88 inches</td>
</tr>
<tr>
<td>Inner tank length</td>
<td>~900 inches</td>
<td>456 inches</td>
</tr>
<tr>
<td>Inner tank pressure</td>
<td>75 psi</td>
<td>70 -100 psi</td>
</tr>
<tr>
<td>Capacity</td>
<td>30,000 gallons</td>
<td>10,000 gallons</td>
</tr>
<tr>
<td>Outage</td>
<td>13%</td>
<td>13%</td>
</tr>
</tbody>
</table>
The Need

- There is a huge increase in the production of methane in the US as a result of fracking
- The price of natural gas is low
- Shippers are starting to pursue transportation of LNG by rail
- Car builders are receiving requests for quotes to build new cars to transport LNG
- There is a shortage of pipeline capacity in certain areas of the country
- As a result, the need to transport
Production in 2016 will be approximately 33.9 trillion cubic feet, or 44 percent higher than the 1990 to 2006 average.

(trillion cubic feet)

- Preliminary based on Jan-Sept data
- Source: Energy Information Administration
LNG as a Possible Fuel Source

- Railroads are exploring the use of LNG as a locomotive fuel
- Until infrastructure can be built, there will be a need to get LNG to railroad fueling points
- Tank car transportation is a good alternative to the movement of that LNG
  - Safe 99.997% of all hazardous materials reach destination without an accident-caused release
12,770 Other Cryogenic Liquids were Transported by Tank Car in 2015

<table>
<thead>
<tr>
<th>Proper Shipping Name</th>
<th>U.S. DOT Hazard Class</th>
<th>UN/NA Number</th>
<th>2015 US Tank Car Originations</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARBON DIOXIDE, REFRIGERATED LIQUID</td>
<td>2.2</td>
<td>UN2187</td>
<td>10,708</td>
</tr>
<tr>
<td>ARGON, REFRIGERATED LIQUID</td>
<td>2.2</td>
<td>UN1951</td>
<td>1,588</td>
</tr>
<tr>
<td>ETHYLENE, REFRIGERATED LIQUID</td>
<td>2.1</td>
<td>UN1038</td>
<td>356</td>
</tr>
<tr>
<td>HYDROGEN CHLORIDE, REFRIGERATED LIQUID</td>
<td>2.3</td>
<td>UN2186</td>
<td>118</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>12,770</td>
</tr>
</tbody>
</table>
Transportation of Ethylene Refrigerated Liquid

• Ethylene, refrigerated liquid has been shipped in rail tank cars for 50 years
• The properties of methane, refrigerated liquid are very similar to ethylene, refrigerated liquid (UN 1038, hazard class 2.1)
• The differences are minor:
  • Methane has a normal boiling point of –260F where ethylene’s is –160F
  • Methane weighs ~3.6 lbs/gal where ethylene weighs 4.7 lbs/gal.
  • Both products are lighter than air at ambient temperatures and thus any spilled or vented liquid or gas disperses in the air as soon as it warms up to ambient temperature
Other Cryogenic Materials Historically Transported by Rail

- Hydrogen refrigerated liquid and oxygen, refrigerated liquid
- Both commodities are currently authorized for transportation by tank car
- Hydrogen refrigerated liquid has a boiling point of -423°F and is classified as a flammable gas
- Oxygen refrigerated liquid has a boiling point of -297°F
- When DOT-113 tank cars were developed for the transportation of cryogenic liquids, there was no contemplated demand for the transportation of LNG, and as a result it was not included in the list of authorized commodities
What DOT Should Do?

• Authorize transportation of methane, refrigerated liquid in DOT-113C120W and DOT-113C140W tank cars
• These tank cars meet essentially the same requirements as tank cars used for ethylene, refrigerated liquid, and are essentially identical to the requirements for those cars
• Cars should be allowed for 286,000 pounds gross rail load (GRL) for the complete car
### 49 CFR §173.319(d)(2) Should Be Modified as Follows

2) Air, argon, helium, nitrogen, **methane** and oxygen, ethylene, and hydrogen (minimum 95 percent parahydrogen), cryogenic liquids must be loaded and shipped in accordance with the following table:

<table>
<thead>
<tr>
<th>Pressure Control Valve Setting or Relief Valve Setting</th>
<th>Maximum Set-to-discharge Pressure (psig)</th>
<th>Maximum permitted filling density (percent by weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ethylene</td>
<td>Ethylene</td>
</tr>
<tr>
<td>17</td>
<td></td>
<td>52.8</td>
</tr>
<tr>
<td>45</td>
<td></td>
<td>52.8</td>
</tr>
<tr>
<td>70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>75</td>
<td></td>
<td>51.1</td>
</tr>
<tr>
<td>Maximum pressure when offered for transportation</td>
<td>10 psig</td>
<td>10 psig</td>
</tr>
<tr>
<td>Design service temperature</td>
<td>Minus 260 °F</td>
<td>Minus 260 °F</td>
</tr>
<tr>
<td>Specification (see 180.507(b)(3)of this subchapter</td>
<td>113D60W</td>
<td>113C120W</td>
</tr>
<tr>
<td></td>
<td>113C60W</td>
<td></td>
</tr>
</tbody>
</table>

© ASSOCIATION OF AMERICAN RAILROADS
FRA is Planning Testing

- Step 1: Equipment Description
  - Gathered information in sufficient detail for evaluations
- Step 2: Accident scenarios
  - Four scenarios: head, shell top and bottom impacts
- Step 3: Analyze crashworthiness performance
  - Assess using extrapolation
  - Simplified engineering analysis
  - Detailed engineering analysis will be considered

Source: Presentation by Francisco Gonzales III at the October 19, 2016 Tank Car Committee Meeting
Questions

Robert E. Fronczak
Assistant Vice President Environment & Hazmat
Association of American Railroads
425 Third Street, S.W., Suite 1000
Washington, DC 20024
Phone: 202-639-2839
Email: RFronczak@aar.org