Locomotive Alternative Fuels and Cryogenic Commodity Transportation
(Projects and Regulations)

Mark A. Maday
Staff Director
Hazardous Materials Division
Office of Technical Oversight, FRA

RAIL
Moving America Forward

U.S. Department of Transportation
Federal Railroad Administration

Topics

- FRA projects on use of cryogenic fuel in locomotives
- Feasibility of use of hydrogen as a locomotive fuel.- An example
- FRA approvals for shipment of cryogenic fuel on rail
- Current Regulations and their limitations
- Safety Issues and concerns

FRA Alternative Fuels Team

Motive, Power, and Equipment

- Gary Fairbanks, Staff Director
- Steve Clay, MP&E Specialist

Hazardous Materials Division

- Mark Maday, Staff Director
- Phani Raj, General Engineer

Railroad Policy & Development

- Melissa Shurland, General Engineer
- Francisco Gonzalez III, Hazmat Specialist

LNG Usage on Rail

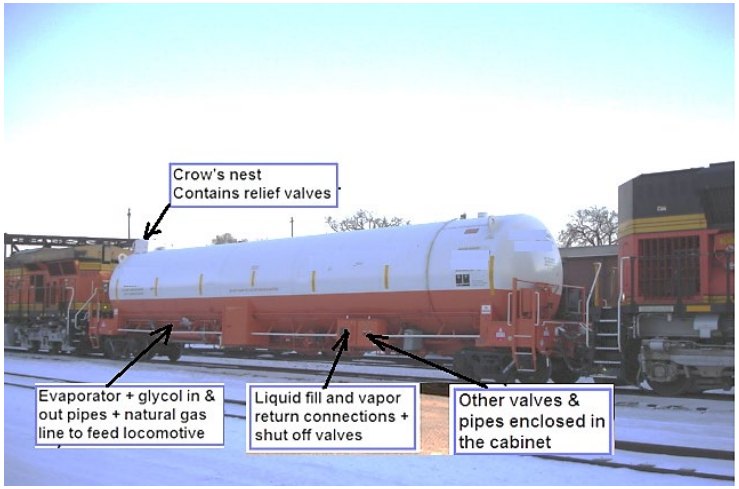
- LNG pilot projects, for use as a locomotive fuel
  - CN tested the concept in Canada; BNSF tested over several routes and weather conditions in the US; and UP conducted static tests only. All three programs have been terminated.
  - Florida East Coast Railway (FECR) is testing the feasibility on its Jacksonville – Miami route.
- LNG is being moved as a commodity on rail
  - FECR is moving LNG in UN-T75 portable tanks in well cars between Hialeah (Miami) and Port Everglades.
  - Alaska Railroad [AKRR] had moved a few test shipments in UN-T75 portable tanks between Anchorage and Fairbanks, AK.

LNG Pilot Test Program by CN

A tender car fueling two, duel fuel locomotives

Portable LNG Tank Tender in a Train

Types of LNG tender cars



Tank car type tender car
(similar in design to DOT 113C120W)

Portable (ISO) tank tender

Alternative Fuels Program Approvals

- Program requires approval by Associate Administrator Railroad Safety (Aug 2013 Letter)
- Program responsibility of Host railroad
- Pilot Program - Expect multi-year program
- Standards – Developed by Industry (AAR) initially
- Rulemaking – Most likely last step in process

A Technical Assessment
Hydrogen as a locomotive fuel

Example: A commuter train (600 T) serves a 100 km O-D pair with average speed of 100 km/hr, with 10 trips/day. How much H_2 is needed and what are the on-board CH_2 storage requirements?

- Total H2 gas required/day = 425 kg
- Assumed storage pressure = 250 barg = 3600 psig
- Max gas storage density (at 20 ^oC) = 20 kg/m^3 = 1.25 Lb/cft
- Assumed size of composite tank = 1 m (dia) x 15 m (length)
- Nominal volume of each tank = 8.5 m^3 = 300 cft.
- Weight of each tank = 2.5 T = 5,500 lbs.
- # of tanks needed for 10 trip service = 3

Transport of Hydrogen by Rail (Commercial Transport)

- Hydrogen authorized for transport in DOT-113 tank cars
  - No DOT-113's for Hydrogen currently available
  - Car design subject to Association of American Railroads Tank Car Committee approval
- Hydrogen is authorized in UN-T75's
  - Requires FRA approval per 49 CFR 174.63

ISO Tanks on a Flat Rail Car

FRA Policies & Guidelines for LNG shipments on rail

- FRA has developed a guidance document related to the details required in an application for approval to transport LNG in Portable Tanks. [*"Guidance for preparing an application under 49 CFR § 174.63 for Special Approval by the FRA to transport Liquefied Natural Gas (LNG) in portable Tanks."*]
- RR must convince FRA that the proposed shipments are safe (Safety & risk analysis, train controls, track integrity, speed restrictions, tank protection, etc.).
- FRA requires the RRs to work with and provide information and other assistance to communities & emergency responders along rail corridors.

FRA's Major Safety Concerns

- Crashworthiness of portable tanks and tank cars for these duties have not been tested under field conditions.
- The performance of these double walled tanks when subject to an engulfing fire is not completely tested or understood .
- The reliabilities and performance of valves, gaskets and other appurtenances used in cryogenic environments and subject to the fatigue and vibration environment of railroad are not known.
- Performance of shut off valves and devices under crash scenarios is not known.
- Risks of shipments (of Flammable & cryogenic liquids) of multiple containers in unit trains vs. manifest trains are not known.

Thank you!!
Questions & Discussion