Transportation Research Board 92nd Annual Meeting
January 13-17, 2012 Washington D.C.

Session 830: Is Natural Gas an Outpost or a Detour on the Road to Clean Energy?

Part 1: Life-Cycle Emissions of Natural Gas Vehicles – Advantages, Disadvantages, and Uncertainties

Best Practices to Avoid Liquefied Natural Gas Fueling Station Venting Losses

James Wegrzyn – Brookhaven National Laboratory
Charles Powars – St. Croix Research

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LNG fueling station venting losses can be associated with...

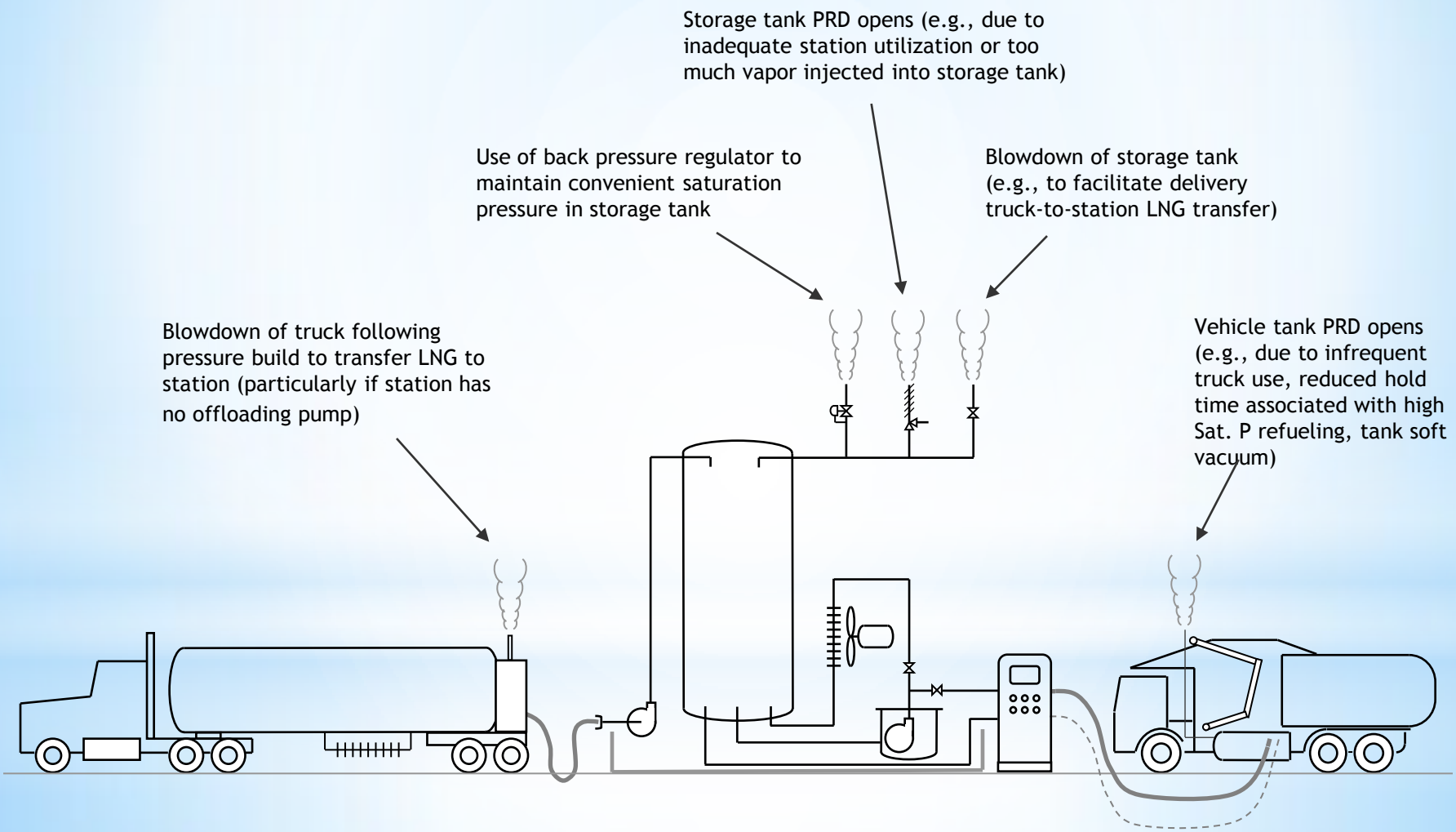
Tank truck delivery of LNG to the station

LNG fueling station management

LNG vehicle fueling and operation

These intermittent venting losses are different from (and usually larger than) continuous "leaks"

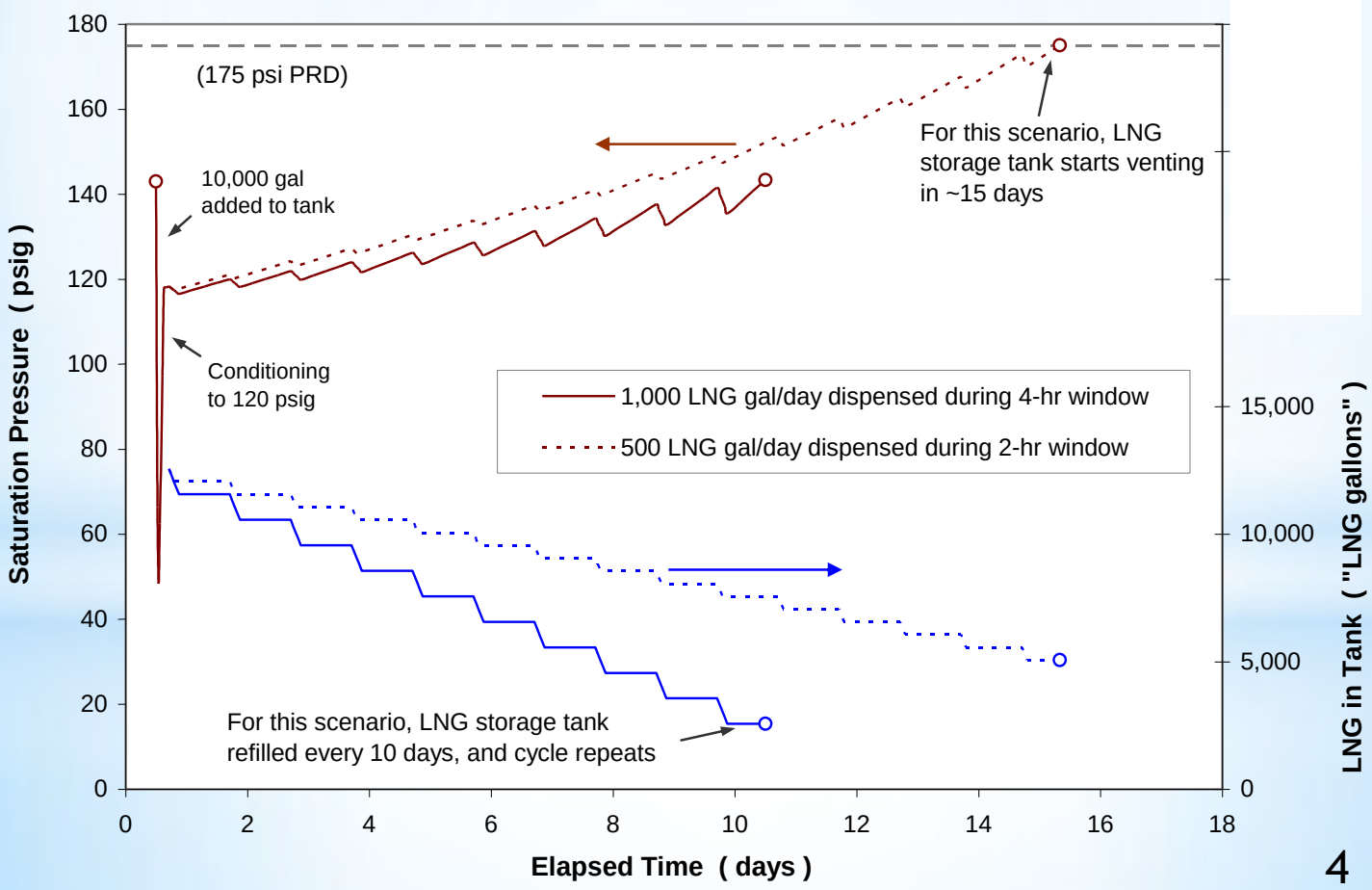
Example practices producing LNG station venting



LNG: "Use it or lose it"

The main requirement to avoid venting is adequate station utilization

Example: Station with 15,000-gallon storage
1,000 gal/day dispensed → no tank venting
500 gal/day dispensed → pressure reaches PRD → venting



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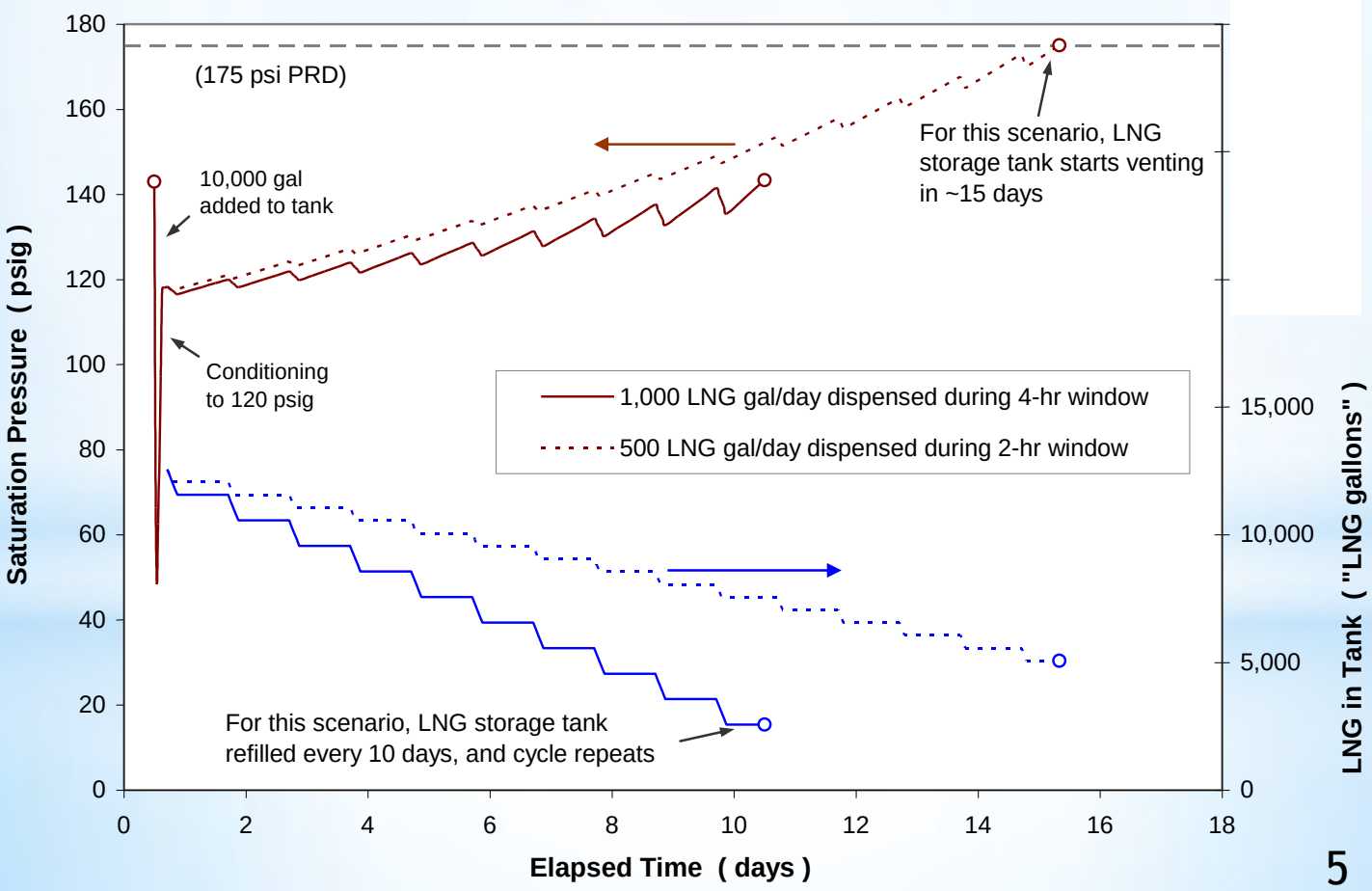
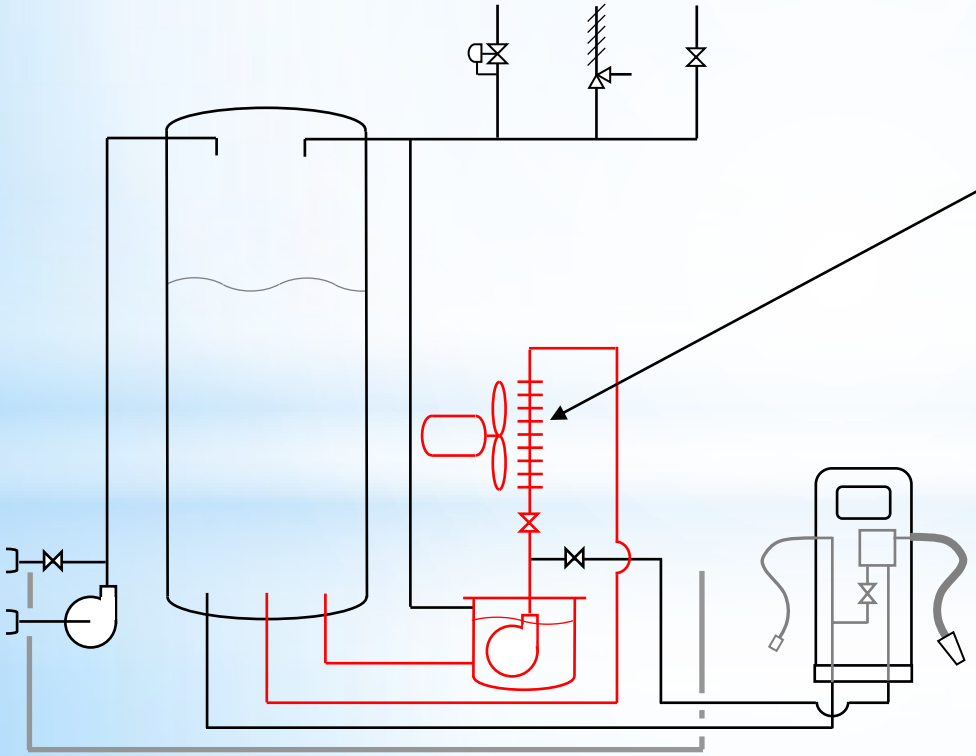


Stations "condition" the LNG to increase its saturation pressure for no-pump vehicle fuel systems

(which reduces density,
decreases hold time,
and increases venting likelihood)

Conditioning circuit heat exchangers,

Natural draft | Forced draft



A few stations can dispense both "grades" of LNG

Clean Energy Port of LA & LB station

"Blue" LNG – Low saturation pressure & higher density for vehicles with pumps

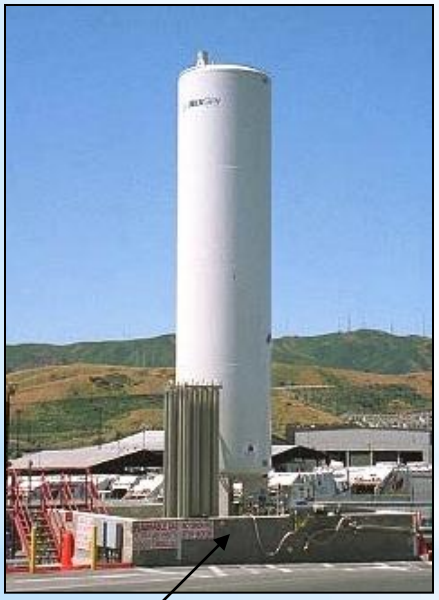
"Green" LNG – Higher saturation pressure & lower density for vehicles without pumps

LNG pump priming often involves vapor venting

The challenge: Pumping a saturated fluid

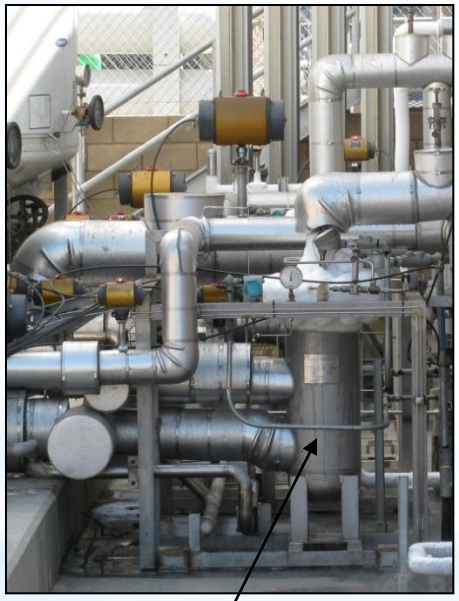
Solutions:

Elevating LNG tank increases NPSH to pump



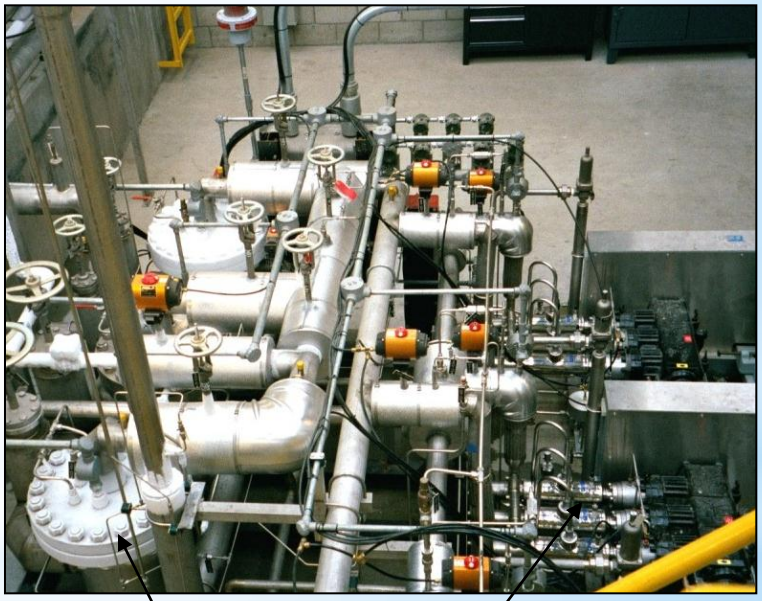
Pump under tank will still produce substantial vapor unless submerged in sump

Sump-submerged centrifugal pump for LNG fueling



Centrifugal pump in vacuum-jacketed LNG sump

Sump-submerged centrifugal pump serves as an reciprocating pump inducer for L/CNG fueling



Centrifuga l pumps in VJ sumps

High-pressure reciprocating pumps

Practices that can cause LNG station venting

- Condition LNG to unnecessarily high saturation pressure (reduces station and vehicle tank hold times)
- Use back-pressure regulator "auto-vent" to maintain station tank at a conveniently constant pressure
- Atmospheric release of vapor that is sometimes offloaded from vehicle tank to reduce pressure and enable refueling
- Vent some vapor from station tank to reduce pressure for convenient refilling from LNG tank truck
- Vent vapor associated with priming of pump that transfers LNG from tank truck to station tank
- Vent vapor from tank truck following pressure-build to transfer LNG to station tank

Strategies for reliquefying or otherwise utilizing LNG station vent gas have been tried or considered...

Reliquefaction of boil-off vapor
Utilize boil-off vapor for on-the-fly LNG fuel conditioning
Flaring of boil-off vapor
Sell boil-off vapor to local natural gas utility
Utilize boil-off vapor to supply facility natural gas requirements
Use boil-off vapor to generate electric power to be sold to electric utility
Use boil-off vapor to generate electric power for on-site utilization
Compress boil-off vapor for use for CNG vehicle fueling

...but very few of these are used at current stations.

For more information and/or electronic copies of the two reports

1) Best Practices to Avoid Liquefied Natural Gas Fueling Station Venting Losses

2) Analysis of Temperature and Pressure Changes in Liquefied Natural Gas (LNG) Cryogenic Tanks

Email the request to **jimtheweg@bnl.gov**

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