US DOT
Pipeline and Hazardous Materials Safety Administration
Office of Pipeline Safety
R&D Forum

LNG Working Group #5

PHMSA PERSPECTIVE
LNG RESEARCH DRIVERS

PIPES 2016 Sec. 27 National Security

Section 27 of the PIPES 2016 Act also amended Section 60103(a) of title 49, United States Code, to include consideration of national security in deciding on the location of new LNG facilities.

(a)Location Standards.—The Secretary of Transportation shall prescribe minimum safety standards for deciding on the location of a new liquefied natural gas pipeline facility. In prescribing a standard, the Secretary shall consider the—

(1) kind and use of the facility;

(2) existing and projected population and demographic characteristics of the location;

(3) existing and proposed land use near the location;

(4) natural physical aspects of the location;

(5) medical, law enforcement, and fire prevention capabilities near the location that can cope with a risk caused by the facility;

(6) need to encourage remote siting; and

(7) national security.

PIPES 2016 Section 27

SEC. 27. STANDARDS FOR CERTAIN LIQUEFIED NATURAL GAS PIPELINE FACILITIES

- Update to Minimum Safety Standards.--The Secretary of Transportation shall **review and update** the minimum safety standards prescribed pursuant to section 60103 of title 49, United States Code, for permanent, **small scale** liquefied natural gas pipeline facilities.

Update to IBR Standards

- The National Technology Transfer and Advancement Act of 1995 directs Federal agencies to use voluntary consensus standards instead of government developed voluntary technical standards, when applicable.
- PHMSA regularly reviews updates to currently referenced consensus standards as well as new editions to ensure that the content remains consistent with the intent of the pipeline safety regulations.
- PHMSA has the responsibility to ensure public safety and will only adopt those portions of standards into the Federal regulations that meet the agency's directive(s) to ensure the best interests of public safety are served.
- Last update was in 2010.
- NFPA 59A Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)"
- ASME BPVC "Rules for Construction of Pressure Vessels"
- ASCE/SEI 7, "Minimum Design Loads for Buildings and Other Structures"

Technical Evaluation NFPA 59A 2016

- **Concrete LNG tanks** – new std. ACI 376
- **Membrane LNG tanks**
- **Pipe in pipe** – (full containment vs. insulation only; defining design spill and impoundment requirements)
- **Underground pipe** (separation and corrosion control/monitoring)
- **ASME BPVC 2015**
  - **Hydrostatic pressure test/design factors**
  - **Cold stretching**
- **New standards IBR** (e.g. API 625, ALPEMA)
- **Seismic requirements and return periods of natural hazards**
- **Chapter 13 for small-scale?**
- **Chapter 15 Risk based siting?**
- **Toxic hazards not addressed**

NFPA 59A issues not addressed from 2006 IBR

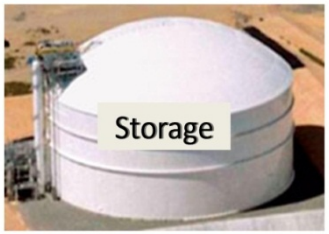
- *Reconcile differences relating to dispersion analyses for vapor releases from process and safety equipment; containers with liquid penetrations at grade; design spill cases for full and double containment containers; standards for impoundment sizing for snow accumulation, severe weather, emergency depressurization, and fuel bunkering.*
- Design spill
  - Single Accident Leak Sources (SALS)
  - Design spill for full or double containment containers with concrete secondary containers

LNG Supply Chain

Start—Natural Gas

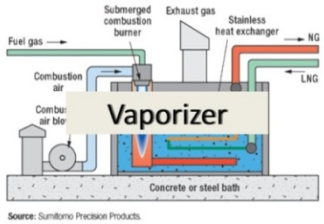
Liquefaction

Storage



Today's LNG Plant—Export, Transportation Fuel, & Transport

LNG 1960 through Mid-2000s—Peak Shaving & Import



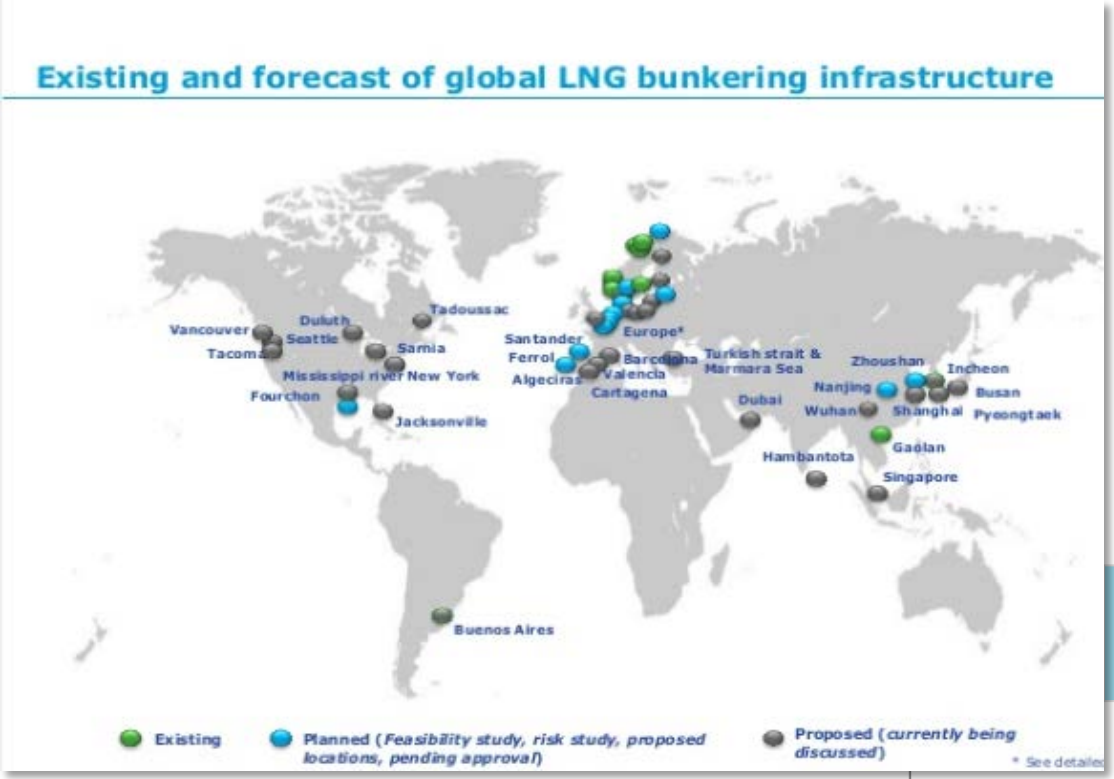
Marine Bunkering Driver

EPA Emission Control Areas (ECA)

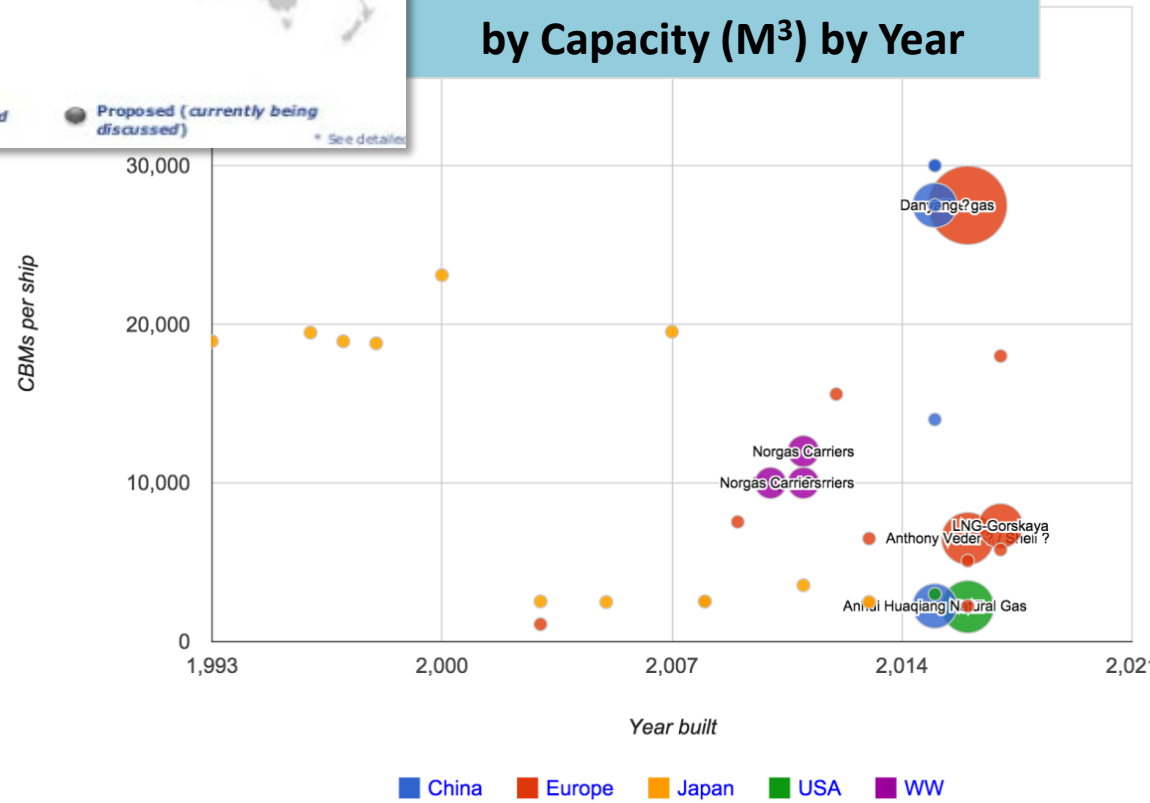
- 2010 the Environmental Protection Agency (EPA) adopts Annex VI from the International Maritime Organization (IMO) to the International Convention for the Prevention of Pollution from Ships (MARPOL)
- Engine and fuel sulfur limits in ECA (200 miles from the coast)
- Added requirements for internal waters (Michigan River, Great Lakes)
- LNG < expensive than EPA-compliant fuel
- More stringent requirements in 2020 (just upheld by IMO)

Bunkering Forecast

Infrastructure & Vessels



Number of Small LNG Vessels by Capacity (M^3) by Year



U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration

Nine Incidents Since 2011* (120 Plants)

Near Misses—NRC Reports

NATIONAL RESPONSE CENTER 1-800-424-8802
GOVERNMENT USE ONLYGOVERNMENT USE ONLY***
Information released to a third party shall comply with any applicable federal and/or state Freedom of Information and Privacy Laws

Incident Report # 1142551

INCIDENT DESCRIPTION

*Report taken by: MST3 ANNALIESE ENNIS at 12:03 on 11-MAR-16
Incident Type: VESSEL
Incident Cause: EQUIPMENT FAILURE

INCIDENT LOCATION
DISTRIGAS TERMINAL County: MIDDLESEX
18 ROVER ST
City: EVERETT State: MA

RELEASED MATERIAL(S)
CHRIS Code: LNG Official Material Name: LIQUEFIED NATURAL GAS
Also Known As:
Qty Released: 5 GALLON(S)

DESCRIPTION OF INCIDENT
AT 0540 THERE WAS A RELEASE OF LIQUEFIED NATURAL GAS INTO THE ATMOSPHERE FROM A TANK VESSEL DUE TO A FAULTY TRANSFER ARM. THE VALVE CONNECTED TO THE STRIPPING PUMP FAILED.

Incident Causes:

- Inadequate purging (2)
- Back-up generator (2)
- PLC board failure
- Regulator failure on portable vaporizer
- Weld failure in heat exchanger
- Overpressure due to gasket failure
- 1 Fatality and 1 Injury; $80M property damage

**Incident reporting required since 2011*

Plymouth, WA—Williams
March 2014

- Loss of emergency systems & control room
- Emergency response
- Operator Qualification
- Start-up procedures
- Brittle properties of adsorber
- Washington Utilities and Transportation Commission (WUTC) request for PHMSA to issue advisory bulletin and update regulations
- One injury; $80M property damage

The systems installed at the Plymouth facilities did not quickly stop the production of LNG vapors (e.g., isolation valves don't work when damaged).

PGW—Philadelphia, PA

June 2015

A contract employee was killed when two metal caps burst off their fittings due to an explosion experienced within the silencer unit of a contractor's vacuum truck during removal of a molecular sieve in an absorber vessel.

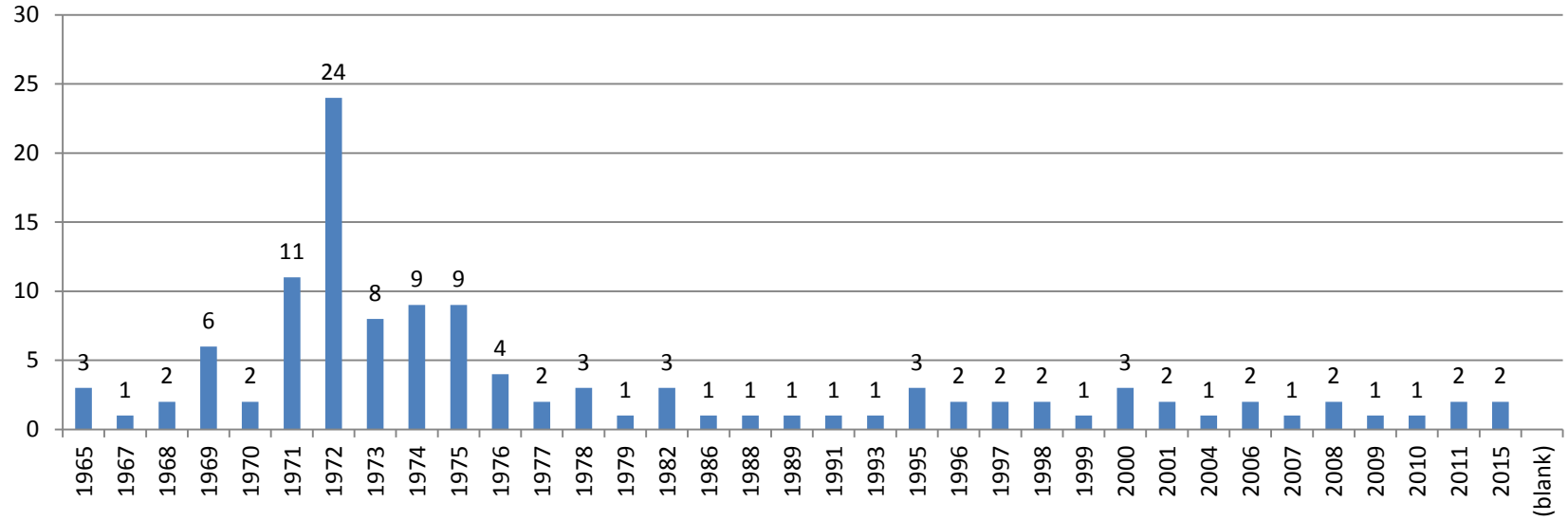
PHMSA Annual Report

PART C – LEAKS IN PAST YEAR	Record the number of leaks resulting in a release detected and repaired, by location and cause. (NOTE: Careful review of the instructions is required.)			
	Leaks			Totals
Cause	Plant Piping and Equipment	Storage Tank	Other Location	
External Corrosion	2	0	0	*2*
Internal Corrosion	0	0	0	*0*
Natural Force Damage	0	0	0	*0*
Excavation Damage	0	0	0	*0*
Other Outside Force Damage	0	0	0	*0*
In-plant Piping or Weld ONLY (*For these types of failures*) — Construction, Installation, or Fabrication-related	0	2	0	*2*
In-plant Piping or Weld ONLY (*For these types of failures*) — Original Manufacturing related	1	0	0	*1*
Low Temperature Embrittlement	0	0	0	*0*
Equipment Failure	8	0	0	*8*
Incorrect Operation	1	0	1	*2*
Other Causes	4	0	0	*4*
Totals	*16*	*2*	*1*	*19*

PART D – OTHER EVENTS	Record the number of Events. (NOTE: Careful review of the instructions is required.)
TYPE	Number of Events
Rollover	0
Security Breach	1
ESD Actuations not reported as Incidents	
- Activated by false signal	21
- Activated by maintenance or other non- emergency event	103
Insulation Degradation	0
Other Types	5
Totals	*130*

Age of LNG Facilities—State & PHMSA

Number of LNG Facilities Entering Service by Year

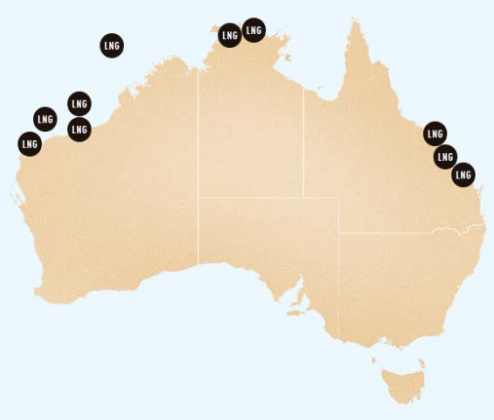


Addressing Risk

- Commissioning (new plants)
- Vapor cloud explosions (export terminals)
- Transfer operations (high frequency at LNG fuel plants)
- Cooling/warming (thermal cycling—due to years in service)
- Replacing equipment (purging—due to aging plants)
- Others?

Australia: LNG Production Restarted at NWS
May 2015

The North West Shelf project in Australia reportedly restarted production at its Karatha gas plant. The Woodside-operated facility was shut down on May 5, 2015, due to an **electrical issue that caused the loss of power supply**.



LNG WORLD NEWS
The industry's LNG news terminal

HOME NEWS BY TOPIC REGIONAL NEWS EVENTS SUBSCRIBE

ABOUT CONTACT REPORT YOUR NEWS ADVERTISING

LNG production restarted at NWS

North West Shelf project in Australia reportedly restarted production at its Karatha **gas plant on May 11.**

The Woodside-operated facility was shut down on May 5 due to an electrical issue that caused the loss of power supply.

Two cargoes have already been loaded at the facility since the restart. Woodside Rogers

Australia: Chevron Restarting Gorgon LNG Export Facility After Mechanical Issues

May 2016

Chevron is gearing up to restart operations at its Gorgon LNG export facility in Western Australia. Chevron told Reuters that start-up activities are underway at Gorgon's Train 1, and the company plans to safely restart production in the "coming weeks." Exports from Gorgon were temporarily halted in early April 2016 due to **mechanical issues with the propane refrigerant circuit on Train 1**.

Outages at Norway's LNG Plant Deter Export Shipments
June 2013

A lack of reliability in Norway's **outage-prone liquefied natural gas export plant** is preventing deliveries to Asia this year, one of its owners said—the latest sign of disillusionment with the project. Europe's only LNG-producing plant has been **beset by technical faults** since it opened in 2007, partly due to its construction.

The plant was assembled outside of Norway and transported to its present location on a barge, which required a **compact design resulting in the extension of time necessary for repairs**. In February 2013, a **gas leak** led to a 2-month halt in production, and on May 28, 2013, the plant shut down again due to a **short circuit in the electrical unit** of one of the cooling processors. It restarted this week.

PHMSA LNG R&D Projects

- **OPS R&D Projects Supporting Mandates**
  - GTI - Review and consider refinements the Failure Rate Table (establishes design selection criteria for Design Spills into impounding areas at LNG facilities serving only vaporization, process or LNG transfer areas)
  - CHIV – Comparison of Exclusion Zone Calculations and Vapor Dispersion Modeling Tools
  - ORNL - ASME BPVC compare 1992 with 2015
  - ORNL (Quest) – Review of potential methods for risk-based siting (small-scale focus)
  - ORNL (Quest) – Review Chapter 13 for potential small scale siting
  - Sandia - Evaluation of FDS for approval to radiant heat flux and vapor dispersion (interagency agreement between PHMSA and DOE)
  - HSL – VCE Historical Accidents
- **Future Engineering Studies**
  - Phase 2 of Vapor Cloud Explosion
  - Review of Part 193 for management of process hazards (e.g. PSM, AIChE CCPS Risk Based Process, ACC Responsible Care, API RP 750 Management of Process Hazards)

LNG R&D Projects – Other than OPS

- **National Exposure Research Laboratory at EPA** - overlays contours on maps to show exposure to pollutants from road traffic and port emissions to look at impacts of potential new developments. https://www.cmascenter.org/c-tools/ (could show potential impacts from accidental releases at LNG installations)
- **TNO -** Small scale program in NL
  - Safety of transfer hoses
  - Design of transfer systems
  - Safety of storage tanks
  - **Small scale LNG projects in its initiation phase**
  - Hoses (Bunker hose shape and loads, Qualification of ESD systems_
  - Tanks (Heat load on tanks)
  - Others (Online measuring methane slip, Custody transfer system)
- **MKOPSC & HSL** – Will present later
- **R&D Program Need** -Database of LNG R&D in the US and abroad

HazMAT

LNG Risks Associated With Small Scale Facilities – Volpe Center
A transportation study on the impacts associated with new and emerging LNG facilities that involve non-pipeline transport. Identify the LNG transport risk parameters associated with each facility, and information as to whether each new/emerging LNG facility is currently covered under the existing hazardous materials regulations. (in progress)

LNG Tank Cars – TBD
Project is to gain an understanding of the structural performance of LNG tank cars used as fuel tenders and LNG commodity transport vessels. The FRA and PHMSA are interested in understanding the structural performance of LNG container packaging used in rail transportation under various accident loading scenarios.