Overview of Current PHMSA LNG Research Projects Related to PSM, QRAs, and Hazard Mitigation Measures

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PHMSA Pipeline Safety Research & Development Forum

Working Group #5 – LNG Facilities

Feb. 19, 2020

Discussion Topics

Some Active PHMSA-funded LNG Research Projects

- PHMSA RP #732: Performance Gap Comparison of Process Safety Management Consensus Standards and Regulatory Requirements for LNG Facilities
- PHMSA RP #847: Evaluation of the Efficacy and Treatment of Hazard Mitigation Measures for LNG Facilities
- PHMSA RP #731: Consistency Review of Methodologies for Quantitative Risk Assessment

A Past PHMSA-funded LNG Research Project

- PHMSA RP #642: Statistical Review and Gap Analysis of LNG Failure Rate Table

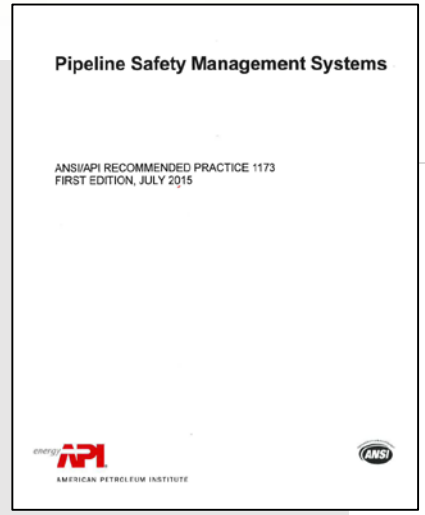
PHMSA Research Project #732: Performance Gap Comparison of Process Safety Management Consensus Standards and Regulatory Requirements for LNG Facilities

- $295,529 project | 21 month duration
- End Date: April 30, 2020
- Objective:
  - Evaluate consensus standards, best practices, and regulatory requirements for process safety management (PSM) to help PHMSA achieve its safety goals, assess risk, and to improve public health and safety
  - Support PHMSA's strategy to update regulatory requirements for safety management systems (e.g. revisions to 49CFR193 or other)
- Tech. Advisory Panel: OSHA, FERC, + industry
- Project Team: gti BLUE

Context:

Federal Code US49CFR193:

- Established in 1980, before significant PSM developments
- LNG facilities are specifically excluded from 29CFR1910.119



Notable PSM Developments:

- 1992: OSHA 29CFR1910.119 (PSM)
- 2007: AIChE CCPS Risk-Based PSM
- 2012: CSChE PSM Standards
- 2015: API RP 1193 Pipeline Safety Mgmt. Sys.
- 2017: CSA Z767-17 PSM

Project public webpage: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=732

Background: PHMSA's Research Solicitation July 2017

General Knowledge/Standards – **Performance Gap Comparison of Process Safety Management Consensus Standards and Regulatory Requirements**

PHMSA promulgated regulations setting federal safety standards for LNG facilities in 1980 at 49 C.F.R. Part 193 (PHMSA LNG regulations). Since that time, safety management systems have greatly advanced. This project should review the current requirements and practices to propose a path forward to incorporate critical safety advances. The scope of research should include:

- Review voluntary standards such as:
  - API RP 1173; and,
  - Occupational Safety and Health Administration 29 CFR Part 1910.119;
- Survey industry safety management systems to gain an understanding of existing practices;
- Determine the goals;
- Perform gap analysis between desired state and CFR Part 193, NFPA Standard 59A (2001), "Standard for the Production, Storage, and Handling of Liquefied Natural Gas" (NFPA 59A) and other codes; and
- Identify and prioritize gaps to be mitigated and decide how they should be addressed.

The results are anticipated to support the strategy to update regulatory requirements for safety management systems, which have greatly advanced since PHMSA LNG regulations were first promulgated in 1980. The timeline for such a solution should be 1-2 years.

Reviewed Literature and Regulatory Requirements

- Investigated primary regulations, standards and voluntary recommended practices
- Considered supplementary topical standards, references and regulations
- Compared requirements and voluntary practices in matrix format
- Reviewed 150+ topics to identify potential gaps or differences

Compared these primary regulations, voluntary standards and recommended practices:

i. 49CFR193
ii. 29CFR1910.119 (OSHA PSM)
iii. ANSI/API RP 1173 (2015)
iv. NFPA 59A, Standards for the Production, Storage, and Handling of LNG (2001 and 2019)
v. And 40CFR68 (EPA RMP)

Supplementary leading standards and practices considered included:

i. CCPS/AIChE “Guidelines for Risk Based Process Safety”
ii. Canadian Society for Chemical Engineering PSM-related guidelines
iii. International Association of Oil & Gas Producers’ related guidelines
iv. CSA-Z767-17 Process Safety Management
v. UKSI No. 483 Control of Major Accident Hazards

Current Project Status

- Surveying nine operators of LNG facilities to gather input - - a balance of LNG Terminals and LNG Peak Shaving Plants/Small Scale Facilities
- Preparing summary documents/other content for inclusion in Final Report
- Some of the topics that have had greater discussion by the TAP include:
  - Interest by some operators in an increased use of a RAGAGEP-based approach vs. a primarily prescriptive approach in 49CFR193 to ensure Mechanical Integrity
  - Process Hazard Analysis practices and requirements
  - Management of Change-related practices and requirements
  - Potential operator's procedure(s) to manage its own process safety
  - Potential opportunities to enhance employee participation in PSM-related activities
  - Potential additional coordination with external emergency response agencies

PHMSA Research Project #847: Evaluation of the Efficacy and Treatment of Hazard Mitigation Measures for LNG Facilities

- $319,707 project | 16 month duration | End Date 1/31/21
- Objective: Develop a standardized, consistent, robust, and detailed methodology that
  - utilizes the thermal radiation and vapor dispersion computational models that are currently-approved by US DOT PHMSA, and
  - calculates thermal radiation and vapor dispersion distances arising from the use of hazard mitigation measures that are commonly employed at LNG facilities but are not currently recognized under 49CFR193.
- Leverage hazard mitigation effectiveness assessments and data in public domain
- Apply a sensitivity analysis to inform the development of the methodology
- Project Team: gti BLUE

Project public webpage: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=847

Will Evaluate the Five Topics in PHMSA's Research Solicitation, Plus Perhaps One Additional Measure

PHMSA Research Announcement #693JK3191RA01 (**emphasis added**)

Liquefied Natural Gas

(General Knowledge) **Evaluate Efficacy and Treatment of Hazard Mitigation Measures**

Active and passive hazard mitigation measures may effectively reduce the hazards associated with vapor dispersion and thermal radiation associated with LNG releases, but some measures are not currently recognized under Part 193 regulations. This project must identify and evaluate the effects of implementing mitigating measures such as **water curtains**, **high expansion foam**, **insulating polymer concrete**, **insulating floating foam blocks**, and **minimizing release durations** (e.g. control systems enhancements). The research should significantly leverage available information and previous studies. PHMSA anticipates minimal physical testing. The analysis technique shall include evaluating each of the above measures, both individually and in select combinations, and shall consider how these measures may impact the calculation of vapor dispersion and thermal radiation for existing and conceptual LNG facility sites (large-scale, peak shavers, mid-scale, small-scale, etc.) using a risk-based approach to siting. PHMSA seeks results in 12-18 months.

PHMSA Research Project #731: Consistency Review of Methodologies for Quantitative Risk Assessment (of LNG Facilities)

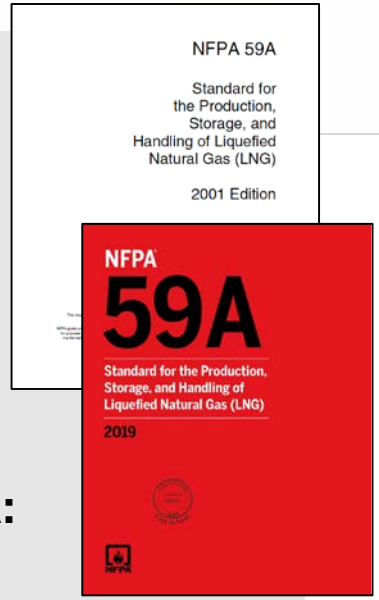
- $858,587 project | 24 month duration
- Objective:
  - Develop methodology and guideline to establish consistency, guidance, knowledge, and best practices to perform QRAs of LNG facilities
  - Demonstrate QRA methodology on two representative generic LNG facilities (peak shaving and export)
  - Identify for PHMSA's consideration potential clarifications to the 2019 edition of NFPA 59A
- Technical Advisory Panel: FERC + industry
- Project Team:

gti C-FER Technologies BLUE INL

Context:

Federal Code US49CFR193:

- Currently incorporates 2001 (and 2006) editions of NFPA 59A
- May be revised to incorporate 2019 or future edition



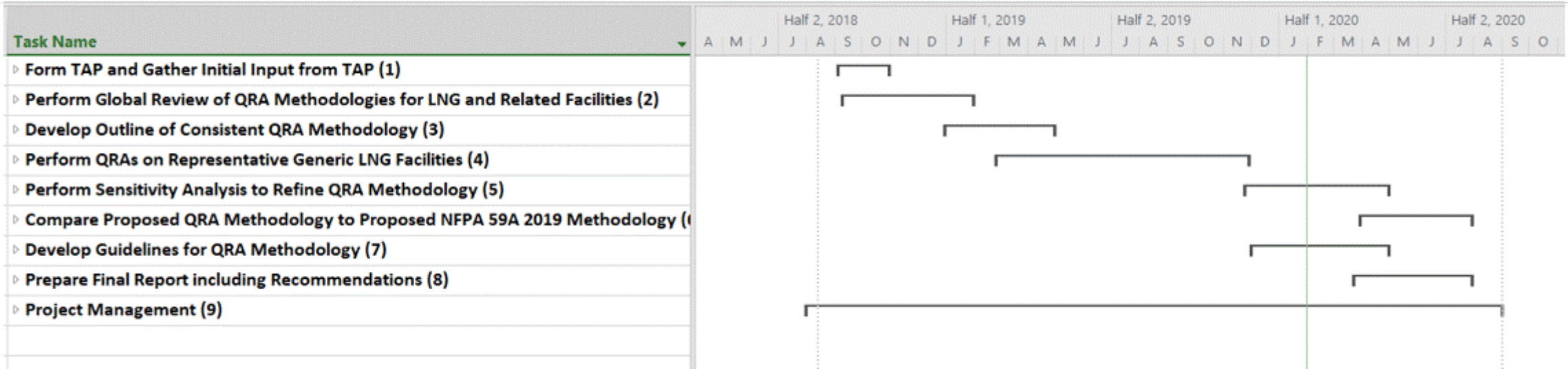
QRA-related content in NFPA 59A:

- 2001 and 2006: None
- 2009: Appendix E created (as suppl. info.)
- 2013: Chapter 15 created
- 2016: Chapter 15 retained
- 2019: Chapter 19 substantially expanded

Project public webpage: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=731

Project Overview, Tasks and Schedule

- As provided in the public version of Sixth Quarterly Report:



- "Perform QRAs on Representative Generic LNG Facilities" include for:
  - Export Terminal
  - Peak Shaving Facility

Past PHMSA Research Project #642: Statistical Review and Gap Analysis of LNG Failure Rate Table

- Final Report available at: https://primis.phmsa.dot.gov/matrix/FilGet.rdm?fil=11074
- Summary:
  - Statistically reviewed and analyzed gaps in the data underlying and relevant to PHMSA's LNG Failure Rate Table.
  - Made recommendations regarding potential changes to the Table, the baseline threshold failure rate criterion, and future research to generate new data or analysis
- Quote (p. 121): "Significant gaps in available failure rate data exist in almost every category of the current FRT. Those categories with some of the largest apparent gaps include:
  - Cryogenic/LNG piping
  - Cryogenic/LNG valves, expansion joints and gaskets
  - Cryogenic/LNG transfer arms and hoses
  - Cryogenic/LNG atmospheric storage containers
  - Cryogenic/LNG pressure vessels "

Project public webpage: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=642

Potential Future LNG Research: New Data Collection or Assessment of LNG Equipment Failure Rates

Quote Excerpt from PHMSA RP #642 Final Report

- "PHMSA and FERC should consider funding research to conduct a new survey of LNG facilities in the US, in order to update and expand upon the most recent survey study completed in 1981 ("GRI FRD '81"). The U.S. is in a unique position since many LNG facilities are older facilities built in the 1960s and 1970s. A new survey can potentially leverage this historical basis that represents a significant number of operational hours. …
- "PHMSA and FERC should consider supporting the coordination of any new industry-government consortium efforts to create a national database of information related to the in-service performance of LNG piping and components. This effort can build upon the experience of the Plastic Pipe Database Consortium (PPDC), but should incorporate appropriately-defined nomenclature and should report both incidents and total populations as well as age, type and other relevant details defined by the consortium."

Ref: Page 125 of PHMSA RP 642 Final Report: https://primis.phmsa.dot.gov/matrix/FilGet.rdm?fil=11074

Questions / Discussion