Working Group #5
LNG Facilities

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Attendance Breakdown

Approximate total attendance	29 persons
Federal Regulators	6 persons
State Regulators	0 persons
International Regulators	0 persons
Pipeline Industry/Service Providers	13 persons
Standard Developing Organizations	0 persons
Researchers	3 persons
Academics	0 persons
LNG Operators	7 persons

Top 5 Identified R&D Gaps

Gap #1 – No current industry guideline for periodic external and internal inspections of API 620 low temperature and cryogenic storage tanks. (General Knowledge)

Gap #2 – Validate cryogenic bolted joint model behavior by conducting bench testing and performing comparison. Evaluate the effectiveness of spring washers (also called Belleville washers). (General Knowledge)

Gap #3 – Evaluation of Full Containment Tank Design with External Steel Shell and development of performance criteria for external loading factors. (General Knowledge)

Gap #4 – Identify/Develop alternative performance based standards for control system testing. (General Knowledge)

Gap #5 – Develop guidelines for sound engineering practices of fire protection systems. (General Knowledge)

Associated Details
(Gap #1)

No current industry guideline for periodic external and internal inspections of API 620 low temperature and cryogenic tanks.

Creation and Dissemination of General Knowledge

a. Targets LNG operations
b. All existing LNG storage facilities
c. Leverage existing consensus standards, tank builders experience, data collected from previous internal inspections, summarize what inspections were conducted and the findings from those inspections. Use this information to develop industry guidance for inspection of low temperature storage tanks. Work with standards development organizations.
d. Targeting 12 – 18 months

Associated Details
(Gap #2)

Validate cryogenic bolted joint model behavior by conducting bench testing and performing comparison. Evaluate the effectiveness of spring washers (also called Belleville washers).

Creation and Dissemination of General Knowledge

a. Targets LNG operations
b. All existing base load and peak shaving facilities
c. Field application, measurement, and recording of strain gauge and thermocouple data for the purpose of validating numerical analysis.
d. Targeting 6 – 12 months

Associated Details
(Gap #3)

Evaluation of Full Containment Tank Design with External Steel Shell and development of performance criteria for external loading factors

Creation and Dissemination of General Knowledge

Recent editions of NFPA 59A permit full containment steel storage tanks, however 49CFR193 requires concrete for outer container for the full containment storage tanks.

a. Targets LNG operations
b. New LNG storage facilities
c. Determine external loads to consider blast, projectile, thermal, etc. as well as thermal shock for inner tank leak.
d. Targeting 18 – 24 months

Associated Details
(Gap #4)

Related to the prescriptive nature of 193.2619 Control System Testing (including RV's and Fire and Gas systems), identify performance based standards such as API 580, 581, etc. and their applicability/gaps with an end result of giving end users options.

Creation and Dissemination of General Knowledge

a. This general knowledge will target all LNG facilities in the US
b. This gap addresses regulatory requirements under 49 CFR Part 193. This research should identify available standards which identify performance based requirements for performing maintenance while achieving the same level of safety as the prescriptive based requirements.
c. This gap will address related consensus standards and will identify other alternative performance based standards which may be used by LNG facility operators to perform maintenance in lieu of prescriptive requirements.
d. This research will identify available performance based requirements for maintenance.
e. This research should be completed within 12-18 months.

Associated Details
(Gap #5)

Additional research on performance of fire protection systems, Develop guidelines for LNG sound engineering practices.

Creation and Dissemination of General Knowledge

a) LNG operations (import, export, peak shaving, small-scale, etc.)

b) Regulations require a fire protection evaluation, however, do not provide guidelines for how to conduct the evaluation or key parameters to define

c) NFPA 59A (primary), NFPA 13-15-24-750-2001, API 2218, UL 1709, ISO 12944 and 22899

d) Identify fire scenarios and fire protection options focusing on:

- Firewater coverage and demand
- Fire and gas detection
- Fire extinguishers
- Determining buildings benefiting from fire suppression systems (sprinkler hazard classification and special hazard systems)
- Performance considerations for fireproofing and low-temperature protection

e) This research should be completed in 18-24 months

Additional Identified Gaps

Day 1 Morning Session

- General Knowledge – Lack of documented, consistent industry guidance and approach to addressing potential LNG facilities cyber security threats. Out of scope for PHMSA, in scope for DHS.

GTI Presentation

- General Knowledge – Opportunity to use Transportation Technology Center (TTC) to validate hazard mitigation measures performance data that is currently available in the public domain. Potential bolt on PHMSA Research Project 847.

Honeywell Presentation

- Technology – Improve method for determining volumetric process leak through a combination of existing numerical methods and leveraging gas cloud imaging technology (Honeywell).
- General Knowledge – Opportunity to use gas cloud imaging technology (Honeywell) to field validate existing gas dispersion modelling behavior.

Additional Identified Gaps, cont'd

CB&I Presentation

- General Knowledge – No current industry guideline for periodic external and internal inspections of API 620 low temperature and cryogenic tanks.
- General Knowledge – Regulation inconsistency between NFPA 59A and 49CFR193 with respect to the use of full containment steel tanks for LNG storage. Perform evaluation to determine whether full containment tanks with steel outer tank is an acceptable design alternative based on external loading and siting risks.
- Establish performance criteria for external loading factors (blast, thermal, projectile, etc.) for single containment and full containment tanks with an outer steel shell.
- General Knowledge - Thin wall metallic liner (vapor barriers) in full containment tank systems with concrete outer tanks may leak product vapor in service. Need to develop comprehensive guidelines for thin wall liner design, details, installation and testing.
- General knowledge - Tank System Failure Rates shown in NFPA 59A Table 19.6.1 do not consider effects due to external hazards. No sufficient guidance for comprehensive risk assessment is currently provided.

Additional Identified Gaps, cont'd

Cheniere Presentation

- Lack of bolted joint standards in general facilities process services and cryogenic services. Perform gap analysis between ASME PCC-1, other cryogenic considerations, other available references to address the joint design, analysis, and joint make up training and qualification.
- Validate cryogenic bolted joint model behavior by conducting bench testing and performing comparison. Evaluate the effectiveness of spring washers (also called Belleville washers).

Stress Engineering Presentation

- Provide clarity to end users related to the process to use to demonstrate design and/or safety equivalency.
- Provide known low temperature transient scenarios identified in the presentation that impact (equipment and adjacent equipment) and include them in standard or guideline so they can be considered in risk analysis scenarios.

Additional Identified Gaps, cont'd

Blue Engineering Presentation

- Related to the prescriptive nature of 193.2619 Control System Testing (including RV's and F&G systems), identify performance based standards such as API 580, 581, etc. and their applicability/gaps with an end result of giving end users options.
- Additional research and testing to fully evaluate pipe-in-pipe materials of construction, process conditions, and failure scenarios.
- Perform cost and risk tradeoff evaluation of different impoundment sizes/designs and release durations.

Additional Topics Identified by Working Group

- LNG hoses: Collect leak, rupture rates, and test data. Develop best practice on transfer hose maintenance and replacement
- Additional research on performance of fire protection systems, Develop guidelines for LNG sound engineering practices.
- Develop detailed geotechnical guidelines.