Working Group 5
LNG Safety

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Attendance Breakdown

Approximate total attendance	33
Federal Regulators	3
LNG Industry	11
Standard Developing Organizations	1
Researchers	6
Industry Associations	3
Service Providers	9

Top Identified R&D Gaps

Gap #1 – (Standards/General Knowledge)Control System Testing Frequency

Gap #2 – (General Knowledge) Comparison of Process Safety Management (PSM), American Petroleum Institute (API) Consensus Standard, NFPA Standards, and Prescriptive Regulatory Requirements.

Gap #3 – (General Knowledge) Consistent Methodologies for Quantitative Risk Assessment (QRA)

Gap #4 – (General Knowledge) Model Evaluation Protocols for LNG Hazard Models

Gap #5 – (General Knowledge) Efficacy and Treatment of Hazard Mitigation Measures.

Associated Details
(Gap #1)

Control System Testing Frequency

Background: 49CFR193.2619 prescribes testing intervals for control systems of durations which can be overly conservative and may have unintended negative consequences. Of principal concern are safety relief valves which are required to be tested every calendar year not to exceed 15 months. Results would optimize testing frequency, minimize risks, and achieve harmonization.

The Scope of Work of this research should seek input from operating facilities of multiple types (i.e. peak shaving, import terminal, export terminal) and include consideration of risks associated with:

- Impact of potential material and equipment degradation
- Impact of worker safety and potential human error
- Comparison to other relevant codes and standards including NFPA 59 and NFPA 59A, National Board Inspection Code, and API Recommended Practices.

Associated Details
(Gap #2)

Comparison of Process Safety Management (PSM), American Petroleum Institute (API) Consensus Standard, NFPA, and Prescriptive Regulatory Requirements

Directions: CFR 49 Part 193 was first promulgated in 1980. Since that time safety management systems have greatly advanced. This project is to review the current requirements and practices to propose a path forward to incorporate critical safety advances. The scope of work of this research should include:
- A review of voluntary standards such as:
    - API 1173
    - OSHA CFR 29 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 59A, and other codes.
- Identify and prioritize gaps to be mitigated and decide how they should be addressed.

Associated Details
(Gap #3)

Consistent Methodologies for Quantitative Risk Assessment (QRA)

Directions: Currently, regulations are prescriptive in nature. Industry has expressed desire to move towards a risk-based approach for evaluating potential impacts to life and property. Develop a standard methodology for performing QRAs:

- Research study must present QRA to stakeholders such that they understand the general process, significance of results, and interpretation or application of results
- Develop a guideline for consistent QRA methodology which includes definitions, acceptable sources of data:
- Consequence/QRA modeling tools which are appropriate
- Determine endpoints to be used for evaluating hazards
- Active or passive mitigation, and if it should be accounted for
- Operator response, and if it should be accounted for
- Identify sensitivity analyses/parametric studies that should be considered in the QRA
- Identify and define appropriate risk assessment outputs – Societal Risk, Individual Risk
- Use the developed methodology to establish a benchmark risk profile for representative facilities, including: (1) export and (2) peakshaving.

Associated Details
(Gap #4)

Model Evaluation Protocols for LNG Hazard Models

Directions: At present, vapor dispersion models are approved for use in siting studies, using a model evaluation protocol (MEP) administered by the NFPA. However, there does not exist an MEP for the source models that provide critical inputs to these dispersion models. This includes both LNG pool evaporation models, flashing jet source models [both cryogenic and pressure-liquefied], and releases of condensates. In addition, there are no MEPs for fire or explosion models. The purpose of this research project will be to develop new MEPs for source models and fire and explosion models relevant for LNG siting studies. Scope of Work would include, but not be limited to:

- Evaluation of relevant experimental data sets
- Gap analysis for where new experiments are needed
- Collaboration with other international agencies confronted with these questions
- Recommendations to PHMSA on interpretation and application of the findings to regulatory process.

Associated Details
(Gap #5)

Efficacy and Treatment of Hazard Mitigation Measures

Active and passive hazard mitigation measures can be used to effectively reduce the hazards associated with vapor dispersion and thermal radiation associated with LNG releases, but some measures are not currently recognized under the prescriptive measures defined in 49CFR193.

The Scope of Work of this research should identify and evaluate the effects of implementing mitigating measures such as: Water curtains; High Expansion Foam; Insulating Polymer Concrete; Insulating floating foam blocks; Minimizing release durations (e.g. control systems enhancements). The research should leverage available information and minimal physical testing is anticipated under this research. The analysis technique shall include evaluating each of the above, both individually and in select combinations, and shall consider how these measures may impact the calculation of vapor dispersion and thermal radiation for at least two example representative, conceptual LNG facility sites.