PHMSA Public Workshop on Liquefied Natural Gas (LNG) Regulations

May 18-19, 2016

U.S. Department of Transportation, 1200 New Jersey Avenue, SE. Washington, DC

Meeting Notes

Day 1 Wednesday, May 18, 2016				
Time	**Topic**	**Organization**	**Presenter**	**Notes**
8:30 -9:00	Welcome, US DOT PHMSA ; Welcome and workshop overview PHMSA's LNG regulatory agenda. Office of Pipeline Safety Perspective.	PHMSA OPS	Alan Mayberry, Deputy Associate Administrator for Policy and Programs, Office of Pipeline Safety Kenneth Lee, Director, Engineering & Research Division, Office of Pipeline Safety	Alan Mayberry introduces the workshop. The topic of revising and updating 49 CFR 193 is important to PHMSA. The goal of the workshop is to seek solutions for the various stakeholders involved. This meeting is for public input to be collected and placed on the docket for the purpose of future changes to the regulation. Provided a DOT Overview. Mission: Safe transportation of hazardous materials. Vision: Most innovative transportation agency in the world. Underlying principles involve understanding and safely managing risks, with the codes as the minimum, and focus on performance otherwise. Purpose of workshop: Listen about concerns and new developments, then communicate lessons learned and plans for update. Plans for update include this public meeting, review of standards incorporated by reference, consideration of new types of facilities and scale of LNG industry, with evaluation of incidents and facility aging, ending in a notice of proposed rulemaking. Kenneth Lee introduced LNG research projects: Failure rates review and analysis; exclusion zone calculations. Other workshop input can be given at a public forum in the fall.
9:00 -9:20	National Association of Pipeline Safety Regulators (NAPSR) Perspective; State regulator perspective emphasis on existing peak-	NAPSR	Robert Schaefgen, Inspector, Delaware Public Service Commission	Delaware's peakshaver facility introduced, with statistics given. Provided details regarding the items that are checked during an inspection, including normal operations, startup/shutdown, cool down, equipment replacement or repair, and upgrades.

	shavers. Inspection findings.			
9:20 -9:50	National Fire Protection Association (NFPA) 59A Committee Perspective; Overview of substantive changes since 2001 edition. Discuss path for PHMSA adoption of newer editions of NFPA 59A.	NFPA 59A Committee	Jay Jablonski, Vice President/ General Manager, HSB Professional Loss Control; NFPA 59A Committee Chair	Provided background of NFPA 59A standard, as well as the intent of the standard, and some of the applicability issues of the standard. Provided the basis of the NFPA committee including technical committees, balance, and member interests. Changes to NFPA 59A since 2001 version: Reorganization of chapters and addition of annex materials; Referenced standards updated; Revised definitions including component/facility/plant (consistent with 49 CFR 193) and LNG storage container descriptions; revision of siting criteria and modeling requirements; New considerations for storage tanks and piping systems; Performance-based siting (Chapter 15) added. Ideally, agreement will exist that the 2019 version can be adopted by, or incorporated into, 49 CFR 193, with the help and input of industry and regulatory agencies. Introduced some future concerns, including referenced standards, 'other' hazards, natural hazards frequency, and small-scale siting issues. Public input for next version (2019) ends in January 2017, with first draft published in September 2017. Encouraged pubic and workshop attendees to comment and contribute. Q: Cecile Scofield; Should a new facility be using the newer (2013) version of NFPA 59A instead of the 2001? A: This is a regulatory issue. The facility follows the regulatory adopted code. Q: Eric Swentzer, Fullbright; There are concerns for moving from a prescriptive siting to a performance-based (risk) assessments? A: Comparison of risk is difficult to communicate to public due to perception. There is a continuing problem with voluntary vs. involuntary risk. This perhaps could be handled within NFPA 59A with annex material giving explanatory material. Q: Jenny Mandel, EnergyWire Reporter; Please talk about previous 59A additions vs. current activities and adoption of newer standards? A: The NFPA 59A committee is involved with PHMSA and other regulatory agencies, and wants to improve these relationships for more collaboration. There have been improved relationships and communications within the last few years. This meeting is another example of that.

				Q: Terrence Wells, Lloyd's Register; With the increase in marine LNG activity, do you expect any related effects on the NFPA 59A standard for FLNG, FSLFSU, SRU facilities and onshore facilities? A: Currently NFPA 59A does not apply to offshore, but no new developments are known at this time for marine applications. Q: Unknown person; Any interest in NFPA to develop liquid fueling standards? A: NFPA 59A does not address vehicle side of LNG, but due to interest and growth, something probably will be developed. Q: Cecile Scofield; DOE is granting export license to small-scale facilities not jurisdictional under FERC or CFR 193 – what is being done about it? A: This is a regulatory issue. If NFPA 59A is followed, it could meet the regulatory requirements.
9:50 - 10:10	Public Perspective; Discuss risk based siting and provide the public's concerns about LNG safety.	Pipeline Safety Trust	Professor Sara Gosman, Vice President, PST Board of Directors	The basis of siting for LNG plants falls into three categories: (1) Precautionary – protecting the public from harm, especially catastrophic events. Errs on the side of overprotection, partially due to lack of failure rate data. (2) Probabilistic risk assessment – protect public from unacceptable risks, leaves catastrophic events as acceptable. (3) Public consent – community-driven approach to regulation; protect the public against risks that the community finds unacceptable. Introduces variant risks and varied perceptions into the siting of the plant. Community is likely to demand more safety measures and communication of risk to develop trust. There are three types of regulations: (1) Prescriptive – requirements that specify a particular action or restriction; siting may include ownership or distance issues. (2) Performance – specifications for achieving a level, requires review and acceptance. (3) Other – Planning and analysis requirements, information disclosure, liability and insurance requirements, etc. Public participation comes in three varieties: (1) Standards-setting organizations, where public has the opportunity to provide input; however , limited due to lack of records and requirement to respond, and lack of public on committee. (2) Regulatory hearings and comment periods (3) Robust and early partnership with public – Early and deep involvement of public. **Current framework:** Precautionary, with more emphasis on hazards, conservative assumptions that make exclusion zones larger, but there is lingering uncertainty regarding absolute safety. Methodology is prescribed. There is public participation in FERC process, but often comes late due to the rule set. No similar process for PHMSA facilities.

				Advantage: Errs on side of caution (safety over cost); tailored to the specific plant. *Disadvantage*: Does not engage public in risk decisions. **Risk-based**: Uses Quantitative Risk Assessment (QRA) to protect against intolerable risks; is based on protocols; addresses individual and societal risks. Performance method, with a prescriptive method for quantification. Is not clear how the public is involved. *Advantages*: Flexibility for integrating mitigation options. *Disadvantages*: Dependent on correct analysis and data; difficult to enforce. **Development**: Create a process that is open, honest, builds trust and partnerships. **Third way**: A careful process to be established with public to define acceptable risk; broaden requirements for liability and bonding to cover risk; engage public as partner.
10:25 - 10:45	Emergency Responder Perspective; Gain an understanding of the emergency responder's concerns about LNG safety and preparedness for response from trainer.	Gas Technology Institute (GTI)	Margaret Kaigh Doyle, GTI Senior Manager, LNG	Introduced the LNG value chain with stakeholders: Regulators, USCG, first responders, and operators. GTI is looking to PHMSA to provide update of 49 CFR 193 to incorporate small-scale LNG; hopefully a model for other agencies. Small-scale LNG is a booming industry with many new stakeholders. There is a wide spectrum where regulations need to catch up. 49 CFR 193 needs to adapt to a changing industry. Needs to be investment in training many people. USCG has made efforts to address small-scale LNG on the marine side, with several policy letters. There is a need for training of fire fighters, hospital cryogenic burn units, etc.; provide training that is easy and affordable, often online. GTI now offering several training systems, including instructor-led and online, for LNG issues.
10:45 - 11:15	AGA's Supplemental Gas Committee (SGC) LNG Industry Perspective - Management of Older LNG Plants, Engagement in the Standards Making Process; Managing operations,	American Gas Association (AGA)	Kevin Ritz, Sr. Engineering Technical Specialist, Baltimore Gas and Electric (BGE)	*Purpose*: To maintain safety and operational capabilities of aging LNG facilities. LNG facilities are compliant with regulations, including many Incorporated by Reference (IBR) standards. LNG facilities are generally well-designed and built, with properly trained and effective employees. Managing older facilities outside of the requirements of the regulations, through asset, maintenance, risk, and operational management plans. There are important considerations include data and information gathering for aging components; consideration of how components fail; prioritization of maintenance and replacement activities. *Challenges*: Incorporated by Reference (IBR) of outdated

	maintenance and modernization of older plants to CFR 49 CFR Part 193. AGA SGC's engagement in the standards development process; efforts to promote incorporation by reference (IBR) of later standard editions.			standards, incorporation of aging issues into 49 CFR 193. A properly maintained plant can be expected to have a long operational life, and the LNG industry has an excellent record in safety and maintaining standards of quality.
11:15 - 11:45	Large Scale LNG Operator Perspective; Cheniere began exporting LNG this year. Discuss challenges of large scale plants face related to with regulation under CFR 49 Part 193.	Cheniere Energy	Pat Outtrim, Vice President Government Affairs, Cheniere Energy	LNG is one the most heavily regulated industries in the US, but reflects the commitment of all the people involved in the industry, including multiple regulatory agencies. LNG is a mature industry, with an exemplary safety record. There has been a step change in industry with onshore regas terminals (vs. peakshavers), and the second step change with export facilities. Future expected to include 65 mpta by 2020 (will be one of the top 3 manufactures of LNG in world). World market has matured from limited scope, take-or-pay contracts to a global trade with LNG emerging as an independent commodity. Regulatory challenges: 49 CFR 193 IBRs 9 standards NFPA 59A references 61 other standards. The delay in regulatory change delays incorporation of safety improvements, in design, construction, and operational issues. Regulations have served the industry well, but don't reflect many industry best practices. • Need to update to most current industry standards • Reflect best practice in risk-based approaches • OSHA PSM serves as a good model and could be applied to LNG plants
1:00 -1:30	Small Scale LNG Industry Operator Perspective; Information on how the industry is evolving and	Fortress Investment Group	Brannen McElmurray, Managing Director, Fortress Investment Group	Brannen McElmurray was unable to attend.

	the challenges small scale LNG operators face related to the regulation under CFR 49 Part 193.			
1:30 -2:30	LNG Technology Panel Perspectives; Technologies incorporated since the 2001 edition of NFPA 59A (membrane and concrete tanks, and vacuum jacketed pipe).	Industry	Greg Denton, Business Development Manager, GTT North America - membrane tanks Alan Hatfield, VP -LNG Technical Services, Braemar Engineering -Concrete Tanks Matt Martineau, Principal Project Engineer at Chart Inc., Vacuum jacketed pipe/other technologies	Greg Denton provided GTT overview via corporate video. Corporate video contained information about membrane tank technology with comparison to 9% Ni steel technologies. Has a similar risk profile as full containment tanks. Has been included in most international standards (EN 1473, CSA Z276, NFPA 59A, ACI 376, EN 14620, KS B 4963). Q: William James, Florida ; Central Florida has a sinkhole problem – have engineers considered what would happen if one developed under an LNG storage tank? A: Greg Denton; Any tank that is built would require a proper geotechnical study. Comment by Aziz Bamik, GTT; Commented on membrane tanks that remained intact after Fukishima earthquake: Although the associated piping was damaged, they were returned to service afterward. Alan Hatfield Introduced various LNG storage tank types. Explained the various design spills required for LNG storage tanks and siting requirements associated with each. History of double containment storage tank at EcoElectrica (1996), with FERC concerns at the time. These concerns were addressed and subsequently mitigated. A similar case now exists with full concrete tanks; many of the concerns have been encapsulated within American Concrete Institute's ACI 376. Q: Jerry Havens, University of Arkansas; A worst case scenario for full containment (FC) tanks is the tank top fire (TTF) combined with high winds; If a full tank is on fire and burns for at least a day, how does the tank withstand that exposure? A: Alan Hatfield; The modeling assumes the tank top is gone, but I'm not sure how scenario occurs. However, the flame lifts due to need for mixing with air, so the thermal radiation on concrete is the scenario. Q: William James, Florida; Assuming that tanks are digitally monitored, is the industry aware that the technology exists to disable these electronics from remote location? A: Alan Hatfield; Yes, tanks are heavily instrumented. However, tanks can sit for long periods of time without electronic systems – the primary systems, including relief valves, are mechanical. In

				addition, the tanks are designed and sized for such conditions. Matt Martineau presented the background of Chart and its involvement in the LNG industry. Detailed some of the gaps in LNG storage tank standards, primarily due to shop-built tanks (and specifically the ASME BPV Code shortcomings of 49 CFR 193). Q: Cecile Scofield; Could you please define what is a small-scale LNG liquefaction facility that is not FERC or PHMSA regulated? A: Matt Martineau; NFPA 59A Chapter 13 addresses small-scale facilities without calling them that (so there is not a specific definition, but Chapter 13 classifies by storage volume, 100,000 gal. per tank or less, with no more than 270,000 gal. on-site). The regulatory guidelines would then apply to what is legally jurisdictional. Q: Harry Kytomaa, Exponent; Do you provide continuous vacuum jacketing or segments, and is the pipe monitored for vacuum leaks and/or designed to contain leaks? A: Matt Martineau; For most applications, vacuum jacketing is manufactured in segments and installed for insulation only, and is not monitored. Some installations are designed for containment (providing a stainless steel outer pipe) as well as relief protection. The ability to monitor the vacuum space is possible.
2:45 -3:15	PSE Marine Bunkering/Peak Shaving Project; Discuss the challenges of locating and designing a small scale LNG plant for marine bunkering at shipping terminal.	Puget Sound Energy (PSE)	Jim Hogan, Consulting Project Manager, PSE	Provided background on Tacoma LNG project – one of the few (and only of newer) projects to act as a peakshaver as well as a vehicle fuel facility. Environmental, economic, and resource supply issues drive the need for the project, especially the coastal Emission Control Areas (ECAs). TOTE marine found need to use LNG-powered vessels, so PSE is planning on supplying them, and other customers. The project includes 800 feet of buried LNG pipeline, which is not covered in 49 CFR 193, but is in newer versions of NFPA 59A. This required a special permit from PHMSA. *Challenges*: Port location, geo-technical issues. Due to the many ways the marine industry differs from the LNG industry, there are conflicts between PHMSA and USCG, often due to regulatory lag (old codes that reference old standards). *Lessons learned*: Regulators are supportive; long-term relationships are important. Regulators and public must be added to process (collaborate with all stakeholders) Q: Bob Cam; ABS Consulting; Are the heavies removal a requirement of your clients? A: Jim Hogan; No, even with pipeline quality gas, there are some heavies in gas that must be removed for liquefaction.

3:15 -3:30	US DOT PHMSA Office of Hazardous Materials LNG Update; Hazmat LNG regulations. Update on LNG research.	PHMSA OHMS	Lad Falat, Director, Engineering & Research Division, Office of Hazardous Materials Safety	Office of Hazardous Materials Safety (OHMS) regulates transportation of LNG in commerce, but not stationary LNG, LNG as a fuel, or large marine transport (USCG). OHMS works in partnership with other federal agencies. Air transportation of LNG is prohibited. Rail transport of LNG is currently prohibited, but being formulated by DOT; Federal Railroad Administration (FRA) does give special permits for iso-containers and tender cars. Approximately 28,000 LNG tank trailers are in service, with only 10 highway incidents over last 15 years, with no fires or explosions. OHMS looking into predicting product flows to understand LNG transportation needs. R&D path forward includes LNG transport topics: FRA for portable and rail cars, overall commodity flow investigations
3:30 -4:15	Open Discussion; Open discussion to gain input from public, industry, emergency responders. Webcast audience can email or Tweet their questions.	PHMSA	Facilitated by PHMSA Staff	Q: Alex Edmuston, Cosmodyne; Compliance with older codes is problematic, especially with regard to vendors and ASME BVPC issues. Have you addressed this? A: Kenneth Lee, PHMSA; Yes, look at PHMSA's LNG FAQ, which provides a safety equivalency guideline for this issue. Q: Alex Edmuston, Cosmodyne; Which vessels have to comply with ASME requirements in an LNG plant (e.g., lube oil cooler vessel)? A: Buddy Secor, PHMSA; That is not the intent of our efforts on this topic. Refer to the FAQ, and contact PHMSA if you have further questions. Q: Web participant; Regarding earlier discussion with Jay Jablonski about NFPA developing liquid fueling standards, NFPA 52 addresses vehicular fueling and you can also refer to NFPA 30A for this issue. Q: Ted Gleichman, Center for Sustainable Economy; Why has PHMSA not incorporated newer versions of NFPA 59A? Is this a function of federal staffing and budget cuts, or are there other issues? Is the 2016 version significantly advanced in terms of public safety? A: Kenneth Lee; In 2009, PHMSA found problems with newer additions regarding general safety concerns; the work has stalled since then. Industry interest greatly increased since then, and PHMSA is now working diligently to review and incorporate the latest industry standards as necessary. We have been in contact with NFPA and are diligently working on evaluating the incorporation of the latest version of NFPA 59A. Q: Mark Medi, UPRC; OHMS looked at LNG rail shipment, but industry already shipping in refrigerated (113) tank cars. Is

				there something specific that makes LNG dramatically different, perhaps a fuel use issue? A: Lad Valat, OHMS; I can't speak directly to that, but I'm aware that it has been determined that LNG is not appropriate for refrigerated (113) tank cars. The issue is being evaluated by FRA. Q: Web participant; How will PHMSA address the use of buried LNG tanks when they are used for vehicular fueling, with the boil-off gas being directed to the local distribution system? A: Kenneth Lee, PHMSA; Answer on this is deferred until more research can be done. Q: Cecile Scofield, Florida; PHMSA changed from Source5 modeling in 2010 to other methods (based on public safety), and at the time FERC deferred approval for some facilities due to this ruling. Why is it acceptable for an LNG plant in Florida to be designed to NFPA 59A-2001 when NFPA 59A-2013 is out there and better, due to the risk-based siting provisions? A: Julie Halliday, PHMSA; Prescriptive and risk-based (or performance) standards are different, and performance based siting is not necessarily better than the existing prescriptive standards. Q: Terrence Wells, Lloyd's Register; Is there a path forward for re-development of regulation? A: Kenneth Lee; There exist strict government rules for new regulation development, beginning with this workshop, and will include public comment periods in the future, notices of proposed rulemaking, requiring many months (years) to address comments and be revised, with other governmental agency reviews including a cost-benefit analysis. Q: Web participant; Can we expect to see standardized of exclusion zones for ASME tanks in the new version? A: Kenneth Lee, PHMSA; This will be one of the things we are considering in re-development of the code. A: Julie Halliday, PHMSA; There is a recognition of smaller scale LNG facilities in Chapter 13 of NFPA 59A, and that is under review for inclusion into 49 CFR 193. Q: Nino Nicotra, Bechtel; The system we have now is now safe enough when evaluated by QRA in terms of risk to the public. Will you in the future account for tolerable risk to the public? And is there anything for risk to workers to be included? A: Julie Halliday, PHMSA; This issue will be considered, and may be covered by PSM. You can send in comments to this workshop. Public risk tolerability involves public perception and

				understanding, and will be incorporated in some of our future work. Q: Jenni Mandel, Energy Wire; To what extent will changes considered for CFR 193 apply to existing plants or will facilities that are under the FERC filing system be exempt from the new rules once they file with FERC? A: Kenneth Lee, PHMSA; It is too early to say where rulemaking process will go, or what will be covered. The cost-benefit analysis (with the current regulation as a benchmark) will include evaluation of application to older facilities. A: Alan Mayberry, PHMSA; The rulemaking process covers the retro-activity and a policy will be developed to address this through the rule-making process. Q: Bill Blake, Eagle LNG; Is the rulemaking going to be a mix of NFPA 59A versions or whole adoption of some versions? A: Kenneth Lee: Incorporation can be done by section or by whole (e.g., 2001 and some sections of 2006). The work going forward may include any combination.
4:15 -4:30	US DOT PHMSA Closing Remarks -Day 1; Summarize key points and provide information for next day's meeting.	PHMSA OPS	Buddy Secor, Supervisory Engineer, Engineering & Research, Office of Pipeline Safety	Meeting Statistics: 160 attendees in the room 200 attendees online 360 attendees total
Day 2 Thursday, May 19, 2016				
8:30- 8:45	Welcome Day 2; LNG Incident Reports; Discuss reported incidents since 2011, year reporting requirements began.	PHMSA OPS	Kenneth Lee, Director, Engineering & Research Division, Office of Pipeline Safety	Reviewed the definitions and criteria for incident reporting at LNG plants. LNG incident reporting has been required since January 1, 2011. There have been nine reported LNG incidents since 2011, with one on-site fatality (contractor) and one on-site injury (employee). Percentages of LNG facilities entering service by decade: 10% 1960-69 61% 1970-79 4% 1980-89 10% 1990-99 10% 2000-09 4% 2010-2016
8:45 -9:15	Williams Plymouth LNG	Williams Company	Von Studer, Williams	Mr. Studer introduced the Williams peakshaver facility located in S.E. Washington State. The plant was built in 1975 and

	Incident & Reconstruction; Williams presentation about the incident, investigation, redesign/reconstruction and lessons learned.		Plymouth Plant Manager	expanded in 1979. The facility experienced an incident on March 31, 2014. Incident summary: During start-up of the regen heater, starting of the regen compressor introduced different gas paths and an explosion resulted. Shrapnel from the explosion punctured the outer shell of adjacent LNG storage Tank 1 with no inner tank penetration. Perlite insulation leaking from the puncture was, at first, thought to be LNG leakage but was not. Shrapnel also damaged boil-off piping and produced a fire whose flames extended 20 to 30 feet into the air. A small ½" fitting at base of LNG tank was damaged due to shrapnel, resulting in small amount of LNG leakage (the only leakage of LNG during incident). A piece of 1" pipe was sheared off and a 10" gas compression pipe was punctured, both resulting in gas leakage. Due to location of the LNG facility, communication with the state of Oregon was required. The facility is located near the Columbia river which is on the border between Oregon and Washington State. Evidence preservation is crucial to investigation. Regulatory response was swift and thorough. Williams Involved PHMSA, Washington Utilities and Transportation Commission, FERC, and others. 3D reconstruction of the exploded adsorber pieces was performed and had one piece missing. The one piece that was missing (after it was recovered) turned out to be the piece that struck and punctured the outer shell of the LNG tank. Metallurgical analysis showed no weakness in failed adsorber vessel. Plant readings showed ~1774 psi pressure at inlet (~800 psi differential) of D-20A adsorber. Purge and pack blowdown procedure did not fully remove air from the system. The root cause was found to be lack of removal of air from the system; this, combined with heated gas from salt bath heater and heat of compression, resulted in an auto-ignition. LNG Tank investigation (aluminum alloy inner) showed pristine tank condition internally and externally – nothing was found that required repair (beyond incident damage). Public communication was initiated shortly after incident and continued through investigation.

				Q: Alex Edmuston, Cosmodyne; In the tank that was damaged, was there concern that the release of Boil-Off Gas (BOG) could have resulted in a larger incident? A: Von Studer; Once area was safe, a temp patch was installed, allowing venting through discretionary vents. The release was elevated and was methane, so gas rose upon release. Q: Alex Edmuston, Cosmodyne; Would the risk of penetrating the outer tank be less if the outer was constructed with concrete? A: Von Studer; Yes, concrete would have protected better, but the outer in this case did provide some protection also. Q: Unknown Person; Any consideration of nitrogen purge instead of natural gas purge? A: Von Studer; Yes, sometimes purges are done with nitrogen. However, nitrogen in a mole sieve may not be as effective for purging as natural gas. Q: Unknown Person; How full was the storage tank? A: Von Studer; 60-70 foot level in tank. Were able to transfer 98% of tank T1 contents to tank T2. Q: Terrence Wells, Lloyd's Register; Fire triangle – did you do a congestion analysis within system? A: Von Studer; I'm not familiar with a congestion analysis. Q: Terrence Wells, Lloyd's Register; Design criteria for pressurized vessels startup? A: Von Studer; 1774 psi may have fallen within 2.5 factor of vessel design, but that was only data available and pressure may have been greater. Q: Terrence Wells, Lloyd's Register; Do you use additional gas detection during purges now? Q: Terrence Wells, Lloyd's Register; Do you have gas detection in your purge zones? A: Von Studer; We do use additional gas detection to monitor oxygen levels during purges. Q: Terrence Wells, Lloyd's Register; PSSR (Pre-Startup Safety Review) process in place? Q: Terrence Wells, Lloyd's Register; Do you have a MOC process? A: Von Studer; Yes, we have management of change. Q: Terrence Wells, Lloyd's Register; Were all vessels checked for rating under applicable codes. A: Von Studer; Yes, all vessels were checked, double checked, and

				triple checked. Q: Cecile Scofield, Florida; What was the difference between the LNG liquid height and the breach? A: Von Studer; Breach on outer tank was below the inner tank liquid level, but only dimpled the inner tank's 1" thick liner. Q: Kim Wilson, USCG; How long did it take to conduct the entire investigation? A: Von Studer; A lot longer than Williams would have liked. 6 months from beginning until information came back. Had to involve all relevant parties. Comment, Graham Atkinson, HSL; Investigated a fatality auto ignition incident recently; a congestion study was not necessary as the ignition was within the piping.
9:15-9:35	Incident Response to Williams Incident; Fire Chief to discuss incidence response and lessons learned.	Washington State, Benton County	Chief Lonnie Click, Fire Chief, Benton County Fire Protection District #1	Initial dispatch informed about number of employees and basic nature of the plant, and explosion/fire. Emergency preparedness includes tri-county area and SE Washington all-hazard incident management team. Employees evacuated immediately – only 5 minor injuries (treat and release). One residence evacuated immediately due to proximity to facility. Closed highway, river (barge traffic), railway, and temporary flight restriction for local air traffic. Established 2 mile evacuation radius. The town of Plymouth was evacuated (approx. 200 people). Communication systems established and proper flow of information established; chain of command established; developed incident response objectives. BNSF was involved due to dented rail. Oregon town across river was involved but Oregon officials chose to not evacuate. Local law enforcement jurisdictions are involved for potential criminal investigation. Gas monitors were placed. NOAA provided area weather forecasts. Two hours into response, initial entry was made, entry personnel were uneasy. After entry was made, it was determined that the electronic controlled safety system was destroyed. Subsequent entries were made to perform manual isolations and then observe the fires. Transitioned to stable incident was achieved in 2.5 days. Lesson learned: Relationship with Williams crucial. Communication between various agencies. Over-extension of resources. Increased emphasis on Local Emergency Planning Committees (LEPC) plant training and familiarity, including

				incident exercises. Q: Web participant; CFR 193/NFPA 59A requires development of relationships with LEPC, so how can LEPC improve relationship with plants? A: Lonnie Click; LEPCs need to be aggressive in relationship building prior to incidents, using all local resources to engage with plants. Q: Eric Swentzer, Fullbright; Describe the response complexity levels and what resources are available for various levels? A: Lonnie Click; Initial attack is type 4 or 5 in first 12-24 hours. As incident complexity changes and need arises, moves to type 3 or higher. Plans are developed for type 2 or 1 if needed. Potential duration of incident is important determination (type 1 team costs $1million/day). Response was type 3 and escalation to type 2 or 1 was delayed until stabilization was determined. Q: Mark Medi, UPRC rail hazmat; What prompted the 2 mile radius? How long was evacuation? 1st entry team went in at about 90 minutes and backed out – How long before right team assembled? A: Lonnie Click; The DOT hazmat rulebook was started. A large leak was assumed. Evacuated residents were allowed back in next day. Within 60 minutes, 35-40 Firefighters were on scene. Williams personnel were there to help, but conditions unknown. Prep and planning for entries done, and crew swaps were done same day. Other resources were available from state if initial response not completed within 72 hours. Q: Ted Gleichman, Center for Sustainable Economy; Could you speak to how your education on LNG issues evolved during the incident? How do tanks this old fare in earthquakes? A: Lonnie Click; The conversation about LNG upon arrival was to view LNG as a flammable gas. Having had flammable gas training, viewed LNG as just a state that the flammable gas is in. As a responder, looks to professionals for answers. Seismic issues are somewhat understood. Facility held up well in catastrophic explosion, so should be OK in earthquake event. NFPA 472 covers response activities and responder responsibilities.
9:35 - 10:15	Vapor Cloud Explosion Historical Incidents; Present research on major vapor cloud explosion	Health & Safety Laboratory (HSL) UK	Dr. Graham Atkinson, Principal Scientist Fluid Dynamics Team,	This project sought to understand how vapor clouds develop, when they become severe, and what makes them severe. Motivation: Four major vapor cloud explosions, each occurred in the open at “simple” plants- “Open Vapor Cloud Explosions (Open VCEs).” Not a methane event- unlikely for such an explosion to occur. Other materials (refrigerants) at LNG facilities are of

	incidents to improve understanding of vapor cloud development and explosion mechanism in order to more reliably assess risk of VCE at large scale LNG plants.		Major Hazards Unit, HSL UK	interest. Incidents reviewed: LPG (14), LNG (1), Gasoline (6), Other (3). How do centered vapor clouds form? Average cloud radius 200-600m. Lesson from Venezuela: Rare still-atmospheric conditions lead to large vapor clouds. What was weather like during these incidents? Most indicate no wind with some exceptions. Two types of incidents: First are small releases over long periods propagated by gravity and later ignited, second is large release rates immediately ignited. Nil-wind vapor clouds travel in a laminar regime and allow for little air mixture- explosion is largely homogenous throughout. What happens in a severe VCE? Consistently see explosions that are equally severe throughout. Over pressures of at least 1 bar seen in experiments. No gasoline clouds were found to burn as a flash fire- all were severe explosions. What kind of explosions occurred and what caused them to transition from a flash fire? Signature of a detonation: Steel poles or posts with continuous bending (15-20 Bars). Severe (episodic) deflagrations (2-5 bars); these are of recent interest. These do not leave continuously curved objects. Fixborough likely resulted from flash fire transitions from pulsing episodes. Transition area was not highly congested. Patricia Outtrim, Cheniere; Clarification; Not LNG spills, small releases. Q: Patricia Outtrim, Cheniere; Did any of these facilities have emergency shutdown systems or gas detection systems? A: Graham Atkinson; Only a few, and for those that did, they were not completely functional. Q: Patricia Outtrim, Cheniere; If they had emergency shutdown gas detection systems, would you have had these types of clouds? A: Graham Atkinson; Not as large. Q: Patricia Outtrim, Cheniere; Can this occur at an LNG facility with detection? A: Graham Atkinson; This shows how important detection and shutdown are. No, this cannot happen at an LNG facility if such a release is detected and acted upon. Q: Harry Kytomaa, Exponent; Point-leak rates are really evaporation from the liquids? Q: Harry Kytomaa, Exponent; The source which forms the vapors is important; Buncefield leak was from vents at the roof and dispersed by structures; from a risk analysis standpoint, what happens if there is a spill at this flow rate without mixing, what would be the consequences? A: Graham Atkinson; Experimental studies show that material projected into space or running down the side of the tank

				produces similar vaporization rates. Q: Bill Fowler, Jordan Cove; Describe what happened in Algeria? A: Graham Atkinson; We have had difficulty accessing information. There appears to have been a large leak of mixed refrigerants. Flow of heavy combustible gas cloud grew to 40-50m and was ingested into a boiler system, violent explosion resulted. Clarification; Julie Halliday PHMSA; The scenarios presented here by Dr. Atkinson are looking at large releases of heavy hydrocarbons. These are not likely to occur at peak shaving facilities. This is the preliminary part of this project, looking at the accident history, and has not evaluated the safety and mitigation measures present at LNG plants.
10:30 - 10:55	Vapor Dispersion MEP Update; Describe the recent revisions to the LNG vapor dispersion Model Evaluation Protocol (MEP), the update of the National Fire Protection Association's database of test data, and new procedure review of new editions of previously approved models.	Health & Safety Laboratory (HSL) UK	Dr. Simon Gant, Principal Scientist, Fluid Dynamics Team, Mathematical Sciences Unit, HSL UK	This project involves evaluating alternative dispersion models. Background- timeline; Protocol in 2007, database in 2008-2010; 2011 – Degadis 2.1, PHAST v6.6/6.7, and FLACS v9.1r2 dispersion models examined and approved by FERC & PHMSA. What is the NFPA database? Spreadsheet with 33 experiments, including wind tunnels, measurements, what was being measured. The update hopes to include new features in the database, correct errors, and offer more extensive documentation and guidance. Maximum arc-wise concentrations: Gas source and plume, look at maximum concentration downwind on an arc. Additional data from existing experiments have been added to the database. Errors in experimental data (geometry Ba-Hamburg) have been identified and corrected. Deliverables: Excel spreadsheet, V12, e.g., Burro 3; Database Guide (Final NFPA Database V12 to be issued at end of Aug 2016). Future work: Focus on spills at import facilities, export terminals flashing jets, and spills of condensates.
10:55 - 11:25	DOT; PHMSA; R&D Project: Comparison of Exclusion Zone Calculations and Vapor Dispersion Modeling Tools; Present preliminary findings from the R&D project comparing	CH-IV International	Phil Suter, LNG Consultant, CH-IV International	Vapor dispersion zones are required to be established per 49 CFR 193 in accordance with NFPA 59A, 2001, quantitative means for single source accidental leakage sources. CH-IV will follow same process project developers are required to follow to calculate "single accidental leakage sources." Task 1: Design Basis and Plot plans, facility layout for a generic site. Description of facilities. Task 2: Define Failure Criteria. Task 3: Single Accidental Leakage Source Determination. Task 4 (current step): Vapor Dispersion Results (Unmitigated). Sensitivity models will then be examined- roughness and wind speed varied. Mitigation- duration and obstacles examined. Task 5: Final Report. This tool might be very valuable for LNG

	exclusion zones produced by various dispersion codes using the FERC failure rate table for single accident leak sources (SALS).			applicants who do not have P&IDs yet. Questions held until later.
11:25 - 11:50	Quantitative Risk Analysis (QRA); Discuss QRA for siting and NFPA 59A Chapter 15's QRA.	Quest Consultants	Jeff Marx, Senior Engineer, Quest Consultants	Risk and risk-based siting were discussed in previous talks. PHMSA is currently considering risk-based design. What is siting? Design, location, and construction of an LNG facility such that the public is protected. 49 CFR 193 Subpart B IBR NFPA 59A 2001 defines siting, and exclusion zones. What is a QRA- Quantitative Risk Analysis? QRA implies a numerical, comprehensive evaluation. Risk is combination of probability, consequences, and vulnerabilities. Risk in the context of LNG siting is risk to the public. Why do risk based siting? Congress is examining this issue, there is a need to adapt to changing LNG industry, and there have been requests from operators. QRA uses internationally accepted methodology for site location studies and other evaluations, and provides compliance with corporate and/or regulatory standards. A QRA would capture all hazards at the LNG plant. QRA benefits: Considers all possible release sources; LNG, refrigerants, natural gas, etc. Other benefits such as size, local variations. How could this be implemented? Develop regulatory language. Capture the requirements of 49 CFR 193 and NFPA 59A. NFPA 59A 2016 Chapter 15? Possibly. NFPA 59A Hazard Identification needs to be more comprehensive. Frequency Analysis- only 12 failures listed. Consequence Analysis- release behavior. Inconsistent set of hazard endpoints (burns, fatalities, damage). Risk mapping- considerations of uncertainty are ill-defined. May not even belong in this chapter. Discusses risks to onsite/offsite personnel and property. NFPA 59A does a good job introducing QRA. Needs to improve hazard identification, failure frequency (needs database), consistent endpoints, define scope to only be offsite persons.
1:00-1:20	Risk Based Siting for Small Scale LNG; Discuss what risk based approach to siting might entail.	DNV GL	Cheryl Stahl, Senior Principal Consultant, Environment & Navigation, DNV GL	Prescribed exclusion zones: Easy to regulate and enforce, but may not be applicable to all facilities; not transparent. Consequence based exclusion zones: Better, but not transparent and may create mitigation response that is not necessary QRA: Comprehensive, but difficult to regulate. Ideal solution: open & transparent, taking into account risk-based and technology factors. Four factors:

				Exposure: captures potential outrage, societal, and escalation issues Overlapping Industrial: ignition probability and neighborhood issues Inventory/Flow Rate: factors specific to facility Technological controls: demonstrable comparison to industrial technologies and changes Result is risk-based exclusion zones for various facility sizes; no specific knowledge for users, although they are developed with high level of expertise.
1:20 -1:50	Process Safety Management at LNG Plants; Present how process safety has evolved since the original peak shavers were built in the 1970s and what gaps may exist today.	AcuTech	David Moore, President & CEO, AcuTech	PSM is a management system instead of a specification, so it tends to fill in the gaps between specifications. PSM is regarded as a good practice in the industry overall. Effectively it is an industry strategy that has been codified, but it is greatly unchanged since 1992. Fundamentally sound PSM system: Comprehensive and involved – stakeholders, employees, etc. LNG industry based on many PSM concepts. CFR Part 193 provides coverage so that LNG plants are not jurisdictional under PSM (29 CFR 1910.119). What's changing? Best practice is 2007 CCPS book with 20 elements (risk-based PSM). Differences: PSM is performance, CFR 193 is prescriptive. (Change would be integration, not substitution) Siting requirements in CFR 193 are the most dramatic difference – not required for PSM. PSM written for wide varieties of facilities, unlike LNG industry. Recommend: Strict mapping of PSM against PSM and other best practices. Some things better in CFR 193, some better in PSM.
1:50- 2:30	Process Safety Management Program at Marine Export Terminal; Describe process safety management at Cameron.	Cameron LNG	Jamie Gray, Project Manager, Cameron LNG	Introduction to Cameron LNG. Cameron has implemented (effectively) the 14 elements of PSM. PSI, PHA, MOC fully implemented. Mechanical integrity is an integral part of their program. PSM valuable tool for LNG industry. Q**:** Mike Khayata, PHMSA**;** For NDT of welds, what was the level of review at your facility? A: Jamie Gray; Many different levels of service, comply with ASME requirements. Some instances of 100% NDE, exceeds ASME.
2:45 -3:45	Open Discussion; Open discussion to gain input from public, industry, emergency responders.	PHMSA	Facilitated by PHMSA Staff	Q: Web participant; Isn't LNG a combination of other hydrocarbons? Would vapor fences increase the chances of VCE? A: Graham Atkinson, HSL; Purpose of vapor fences is to mitigate hazards; vapor fences prevent transport of vapor to a neighborhood, but can increase depth of vapor cloud and so could make a VCE more severe.

	Webcast audience can email or Tweet their questions.			Comment from Harry Kytomaa, Exponent; Led an investigation of Skikda event. In train with incident, no working gas detection, awaiting renovation. Air intake for boiler was low to ground, resulting in ingestion of flammable vapors. In renovated trains or other modern LNG plants, that wouldn't happen. Q: Web participant; Risk in Chapter 15 of NFPA 59A: Does the committee intend to provide guidance define on how the tolerable risk region is to be met? Would it consider adopting guidance from the UK? Will the cost of injury be defined? How does PHMSA deal with ALARP? A: Jay Jablonski; The 59A committee is open to input and will consider input from the public; new language in standard will be put to public for comment. A: Julie Halliday, PHMSA; No defined plans, just ideas being evaluated and gathering feedback. Q: Arthur Ransome, CH-IV International; Potential changes in Model Evaluation Protocol (MEP) - Will the existing tools be subject to the new MEP, and will all modeling be on hold? A: Julie Halliday; The proposed changes are not significant. Approved models are approved for use. Q: Cecile Scofield; What is a small scale LNG facility? Someone needs to define this. Commentary: Julie Halliday, PHMSA; Siting jurisdiction is local or FERC. CFR 193 doesn't really control plant location. There are many agencies that have jurisdiction. Risk is applied in many areas – high level hazards, siting, operationally with layers of protection. Q: Phil Suter, CH-IV International**;** Comments submitted regarding workshop or other? Steps for updating CFR 193 – how can people remain involved? A: Julie Halliday; Comments used in development of NPRM, comments addressed in preamble. A: Kenneth Lee; public can stay engaged through docket for this issue. Once rulemaking is started, everything stays public on the docket. All comments are wanted and welcome. Q: Nino Nicotra, Bechtel; Is there a protocol for submittal of questions? Should they be submitted all in one, or broken into topics? A: Alan Mayberry, PHMSA; Instructions are on the website, with links for this topic.

3:45 -4:00	US DOT PHMSA Closing Remarks -Day 2; Summarize key points and discuss next steps.	PHMSA OPS	Alan Mayberry, Deputy Associate Administrator for Policy and Programs, Office of Pipeline Safety	Closing Comments from Alan Mayberry; Workshop important to PHMSA, schedule is uncertain. Probably a multi-year process, and some initial steps are desirable for IBR of standards such as NFPA 59A. Next public meeting is R&D forum in October 2, 2016.