Process Safety Management Program at CLNG

US DOT PHMSA Office of Pipeline Safety LNG Workshop



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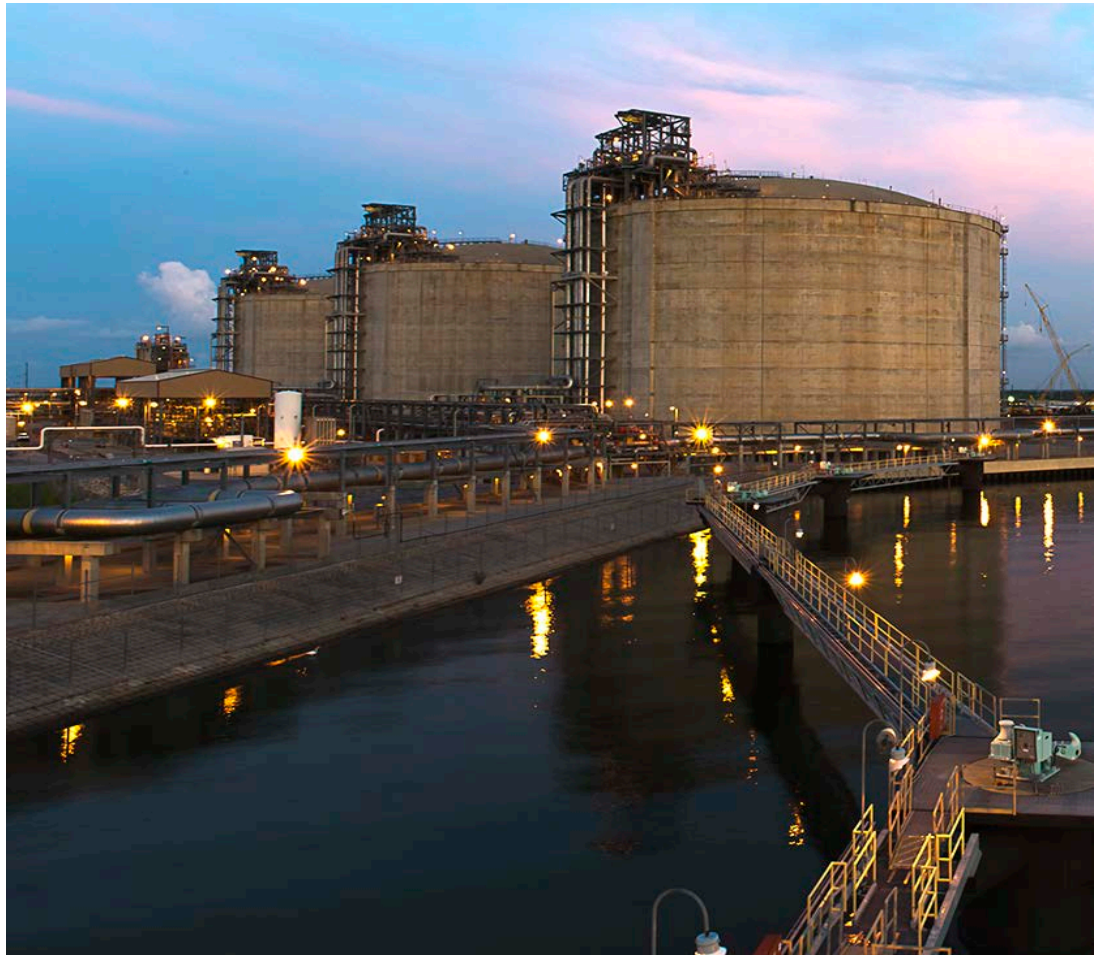
Agenda

- Introduction to Cameron LNG
- Process Safety Management
- Cameron LNG Example PSM Elements
  - Process Safety Information
  - Process Hazard Analysis
  - Management of Change
  - Mechanical Integrity
- Conclusion

Introduction to Cameron LNG

- Liquefied Natural Gas (LNG) terminal near the Gulf of Mexico, in Hackberry, Louisiana
- Adding natural gas liquefaction and export facilities to the existing regasification terminal
- Once the liquefaction project is completed, the terminal will:
  - liquefy domestically-produced natural gas for export
  - import LNG and re-gasify it for delivery to domestic markets, or
  - re-export foreign-sourced LNG



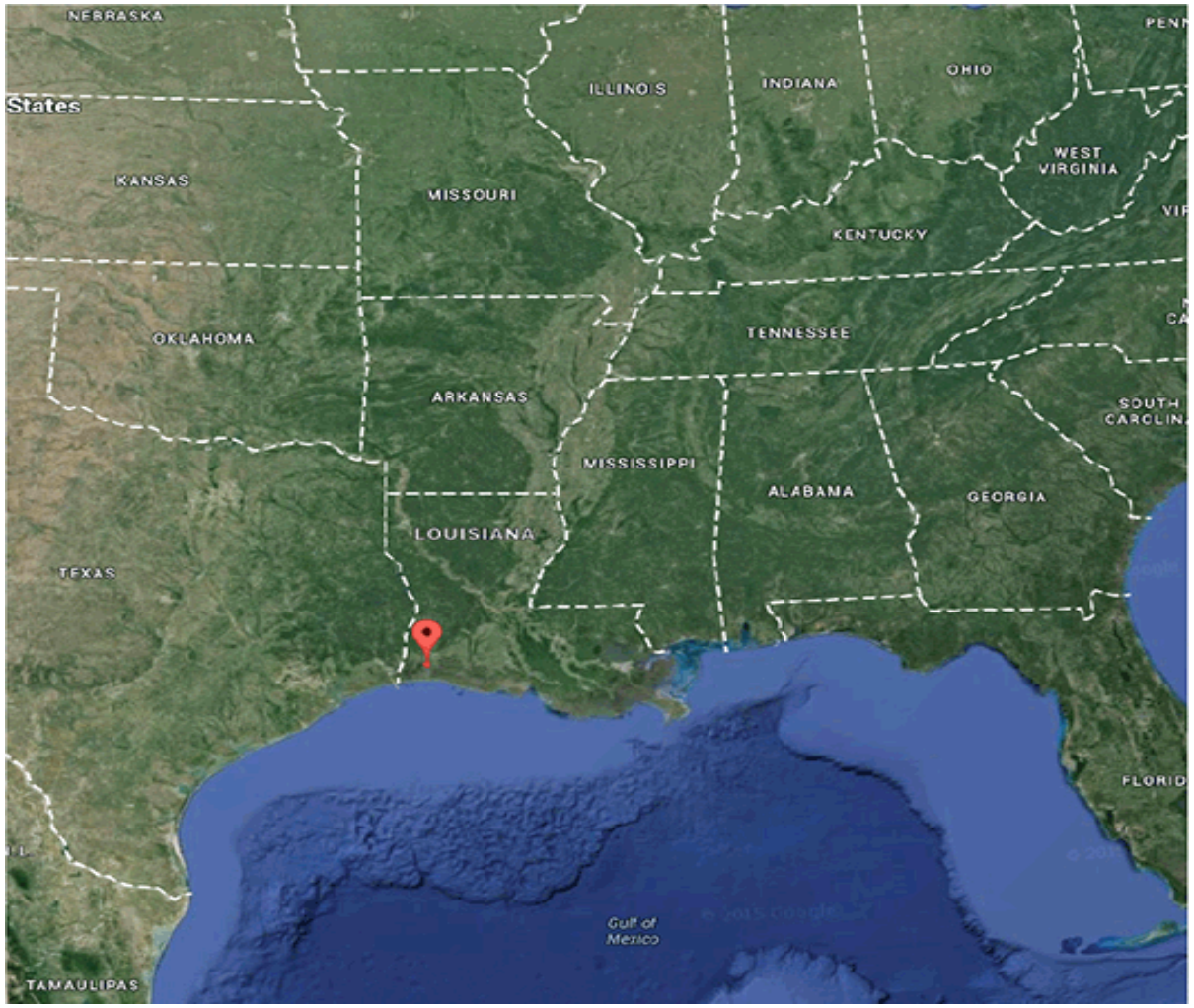
Introduction to Cameron LNG Experienced Partners

- Sempra developed the first LNG receipt terminal on the west coast of North America, Energía Costa Azul, in Mexico and a second terminal, Cameron LNG, in Louisiana near the Gulf of Mexico. Sempra LNG is also active in the sale and purchase of LNG worldwide
- ENGIE (formerly named GDF SUEZ) is the largest LNG importer in Europe. Its LNG portfolio, sourced from six countries, is the third largest in the world. It operates 17 LNG ships and has a significant presence in regasification terminals globally
- Mitsui has a significant global LNG portfolio and strong relationships with major LNG buyers spanning more than 40 years. The company holds equity interests in LNG production facilities that operate in seven countries
- Mitsubishi is a highly experienced LNG developer and investor and has a significant global LNG portfolio and strong relationships with major LNG buyers
- NYK is one of the largest shipping companies in the world. It operates 846 major ocean vessels, as well as fleets of planes, trains, and trucks, including 28 LNG ships

Introduction to Cameron LNG

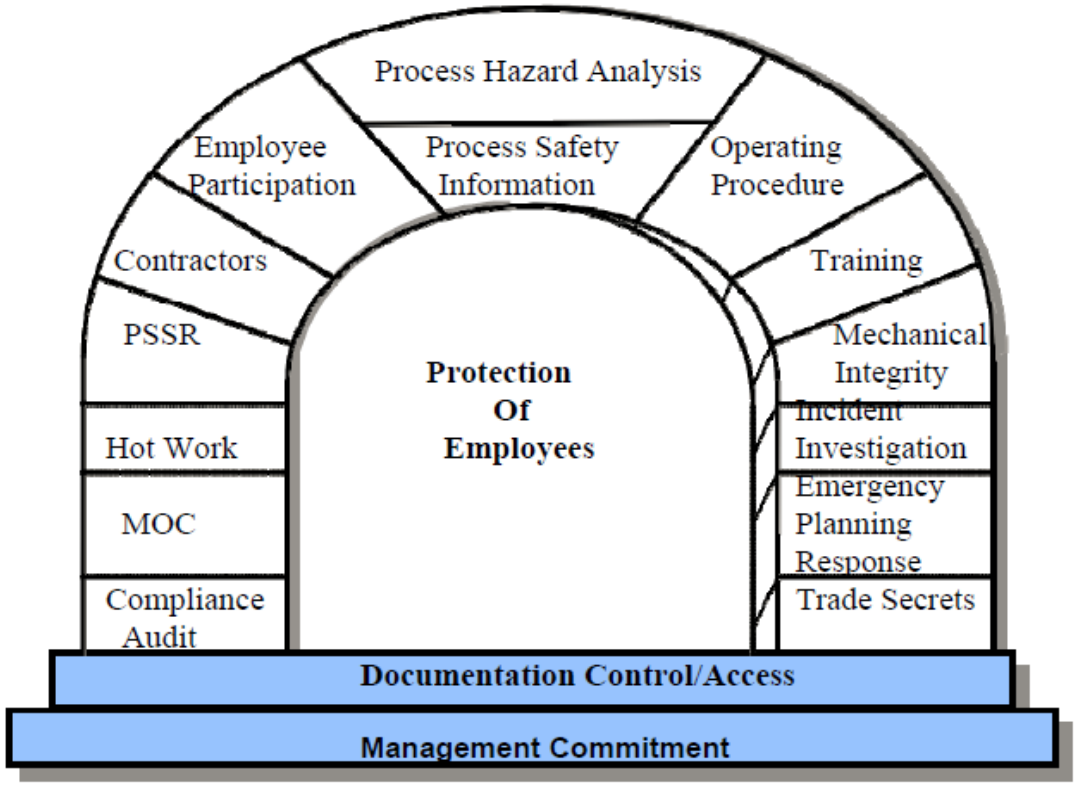
- Located along the Calcasieu Ship Channel that connects to the Gulf of Mexico
- Site is 18 miles from Gulf of Mexico and 36 miles from major interstate gas pipelines

Facts	Regasification Facilities	Liquefaction Facilities
Commercial operations	July 2009	Train 1, 2 and 3 in 2018
Capacity	1.80 bcfd vaporization	13.5 mtpa liquefaction
Employees	62 personnel	An additional 140 personnel
Marine berths	2 berths suitable for Q-Flex sized (217,000 m^3) LNG ships	
LNG storage tanks	3 full containment tanks each at 160,000 m^3	
Power supply	Purchased from Entergy (electric utility)	



Process Safety Management

- Process Safety Management (PSM)
  - A set of inter-related approaches to manage hazards associated with the process industries
  - Intended to reduce the frequency and severity of incidents resulting from releases of chemicals and other energy sources
  - Composed of organizational and operational procedures, design guidance, audit programs, and a host of other methods
  - Implemented by OSHA in 29 CFR 1910.119 in 1992
- PSM program is divided into 14 elements



Process Safety Management

- OSHA does not enforce the PSM standards in 29 CFR 1910.119 on LNG facilities
- Cameron LNG recognizes the value of the PSM elements and has incorporated many into the facility's design and operation
- Cameron LNG Regasification terminal has operated for 9 years and over 1 million man hours without a lost time accident or loss of containment

Process Safety Information

- Complete and accurate written information concerning process chemicals, process technology, and process equipment is essential to an effective PSM program and to a process hazard analysis
  - Process Chemicals
    - Cameron LNG has a Safety Data Sheet (SDS) approval process that requires review by safety, environmental, and technical personnel
  - Process Technology
    - A block flow diagram has been developed
    - Process technology information (safe upper and lower limits for such items as temperatures, pressures, flows or compositions, etc.) are documented in design basis and other documents
  - Process Equipment
    - All technical design documents (PFD, P&ID's, HMB, data sheets, electrical classification, relief system design, safety system, etc.) are available via the document management system

Process Hazard Analysis

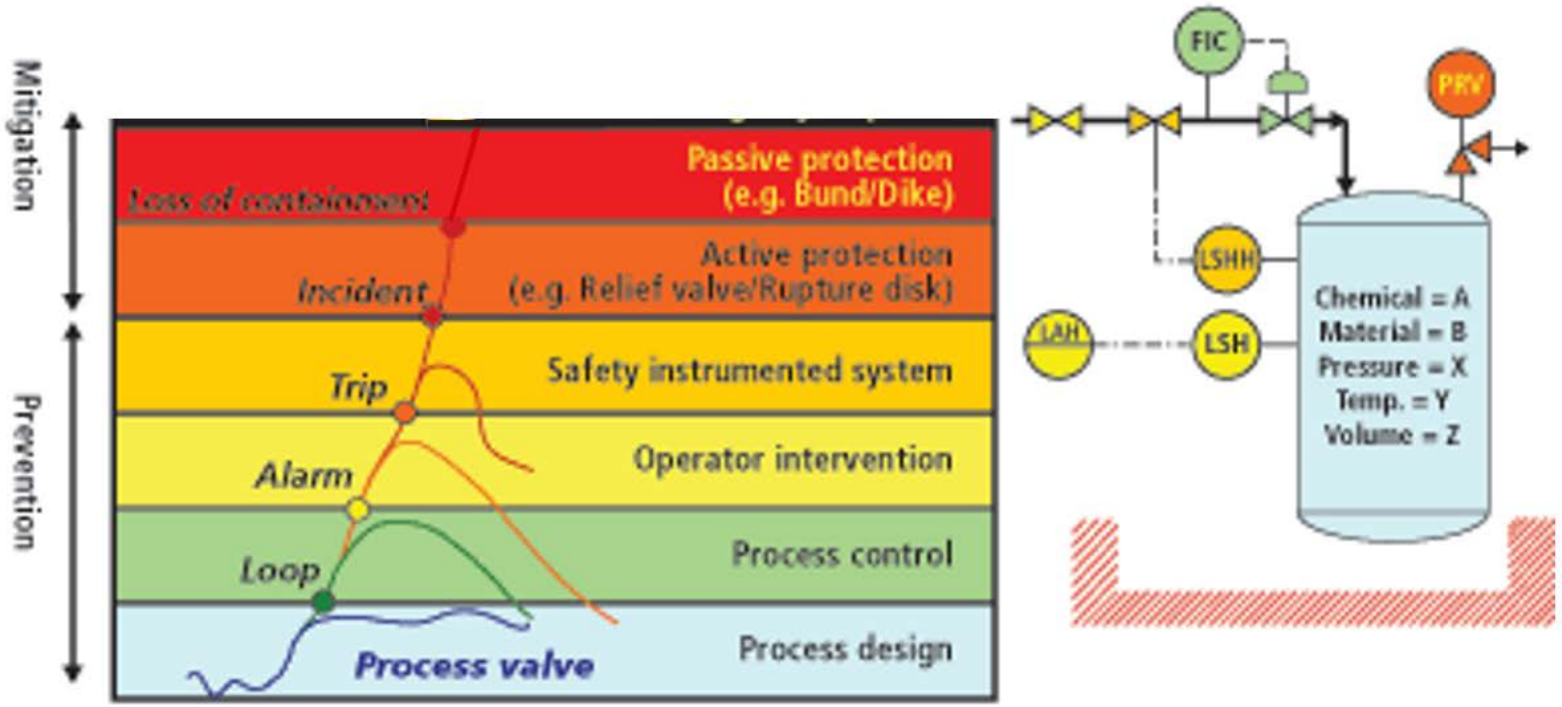
- A process hazard analysis (PHA) is an organized and systematic effort to identify and analyze the significance of potential hazards associated with the processing or handling of highly hazardous chemicals
- Cameron LNG conducted a Hazard and Operability Study (HAZOP)
  - Required Process Safety Information (P&ID, Cause & Effect, PFD, design basis, etc.) was issued for review prior to the workshop
- HAZOP Participants
  - Facilitated by a team of 3rd party specialists
  - Participants were selected from different disciplines including Process, Mechanical, Instrumentation & Control, Operations & Maintenance, Commissioning & Start Up, Process Safety, etc.
- HAZOP Results
  - Over 1000 recommendations
  - All recommendations have been closed out and incorporated into the facility's design

Management of Change (MOC)

- Written procedures to manage changes (except for "replacements in kind") to process chemicals, technology, equipment, and procedures; and, changes to facilities that affect a covered process
- Cameron LNG's Management of Change Process
  - Evaluate and control modifications to facility design, operation and organization before implementation
  - Ensure no new hazards are introduced or that existing hazards to the environment, the community, employees or facilities are not unknowingly increased
  - Cameron LNG uses a 3rd party software to track planned changes through checklists, analyses and approvals to ensure preparedness to implement any operational or organizational change

Mechanical Integrity

- Mechanical Integrity programs are used to assure that equipment used to process, store, or handle highly hazardous chemicals are designed, constructed, installed and maintained to minimize the risk of releases of such chemicals
- Design - Layers of Protection:



Mechanical Integrity

- Construction and Installation –
  - Pressure vessel and heat exchanger fabricated, inspected, tested, and certified in accordance with ASME Boiler and Pressure Vessel Code Section VIII (ASME Code)
  - Inspection and auditing of manufactures during fabrication
  - Non Destructive Examination (NDE)
    - NDE per project specification and ASME Code
    - NDE including but not limited to the following:
      - Visual examination
      - Radiography examination
      - Ultrasonic examination
      - Dye penetrant examination
      - Magnetic particle examination
      - Hydrostatic testing

Mechanical Integrity

- Maintenance - Asset Integrity Management System:
  - Identification of and monitoring of all safety critical elements
  - Inspection and Operations & Maintenance standards and philosophies
  - Asset specific HSE cases or Safety Management Plans
  - Monitor equipment throughout life cycle with NDE such as visual inspection, UT thickness readings, and others techniques
  - Audit and verification to assure that integrity is managed as intended
  - Statutory requirements

Conclusion

- PSM elements are valuable tools proven to enhance the safety of process facilities
- Cameron LNG implemented a number of these elements in the facility's design and operation
- Future revisions of 49 CFR 193 should account for the enhanced safety provided by incorporating these elements and reference appropriately updated codes and standards