Accidents, Incidents, Mistakes, and the Lessons Learned From Them

The (sometimes) volatile history of liquefied natural gas.

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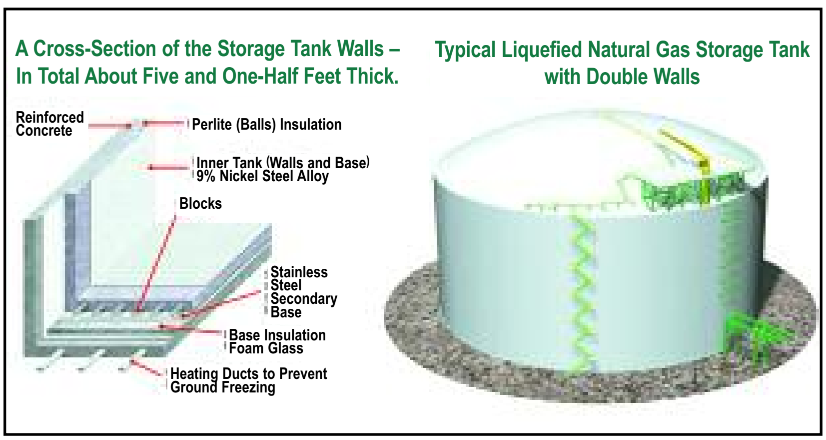

Figure 1: Modern LNG tanks are double walled, to contain any leakage.

The cooling of a gas to a liquid (liquefaction) dates back to the 19th century, when British chemist and physicist Michael Faraday experimented with liquefying gases, including natural gas.[1] In 1873 the first practical compressor refrigeration machine was built in Munich by German engineer Karl Von Linde.

Liquefied natural gas (LNG) compresses to a small fraction of its original volume (approximately 1/600) under liquefaction. With the amount of flammable material that LNG contains, it has the potential to be an extremely dangerous chemical, if handled improperly. The liquefaction of natural gas raised the possibility of its transportation to many destinations. In January 1959 *Methane Pioneer*, a converted World War II freighter containing five aluminum prismatic tanks, carried a liquefied natural gas cargo from Lake Charles, La., to Canvey Island, United Kingdom. This demonstrated that the transportation of large quantities of LNG safely across the ocean was possible.

The Cleveland Incident

In 1941 the first commercial LNG plant was built in Cleveland, Ohio. This plant ran without incident until 1944. That year, the plant expanded and added an additional LNG tank. This tank was added during World War II, when stainless steel alloys were scarce. Therefore, low-nickel alloy (3.5-percent nickel) was substituted in the construction of the tank. Low-nickel steel does not have the same properties as stainless steel, and, shortly after going into service, the tank failed.

At the time of failure, the tank had been filled to capacity, and the failure caused the contents of the entire tank to be emptied into the streets and sewers of the surrounding city. When the vapors from this spill ignited, the ensuing fire engulfed the nearby tanks and surrounding areas. Within 20 minutes of the initial release of LNG, a second spherical tank failed, due to the weakening from the fire. During the entire incident, 128 people were killed, 225 were injured, and 475 surrounding acres were directly impacted.

LNG Safety and Security

A local Federal Maritime Security Coordinator's perspective.

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Since September 11, 2001, liquefied natural gas (LNG) issues have typically been a weekly occurrence in the media. New applications for a facility, word of a new vessel under construction, the need for an increase in imports, or public concern over safety and security have all been frequent topics for discussion.

Soon after the attacks, the Captain of the Port (COTP) at the U.S. Coast Guard Marine Safety Office (MSO) Boston quickly assessed the status of shipping in the port of Boston and closed it to marine traffic. Ports were being closed across the United States.

For Boston, closing the port included ensuring that the LNG vessel at the Everett Distrigas Terminal in Everett, Mass., was departing as planned. The vessel had finished offloading and was planning on being outbound that morning. The company quickly ensured that the outbound transit commenced.

In the days following the attacks, MSO Boston settled into a command post mode and began working on how to resume commercial shipping while ensuring an adequate level of port security. With most ports across the nation reopening to commercial traffic a few days after 9/11, and with Boston having the luxury of a port security unit (PSU) arriving to complement its force, the command felt it had adequately reprioritized missions overnight and focused on port security. The one exception came when the State of Massachusetts, the City of Boston, and the City of Everett grew concerned with the next LNG arrival that was due into the Everett Terminal.

As the LNG carrier (LNGC) *Matthew* began its transit from Trinidad to Boston, the port security regime put in place in Boston was not enough to allay concerns. The Everett LNG import facility was located in a densely populated area, and vessels transiting to that facility passed through a restricted waterway that converged with waterfront businesses, residential communities, and Logan International Airport. The local fire chiefs of Everett, Chelsea, and Boston had unsuccessfully fought the siting decision for the facility in the 1970s when the plant went into operation. The safety concerns they had at that time were translated to security concerns and revisited with a new eye toward "malicious intent." The 30-year safety track record of LNG companies did not satisfy these concerns.

The Captain of the Port Order required the *LNGC Matthew* to supply: 1) a threat and vulnerability assessment, 2) a security plan, and 3) a consequence management plan. Complying with this order would take time, and the company diverted the vessel's cargo elsewhere while it worked on meeting the requirements of the COTP Order. This solution was only temporary, as it became clear that the region would need the gas supplied by this facility in the very near future. With winter approaching, options were limited to keep the supply of gas uninterrupted in the Northeast and Distrigas was a key supplier.

At this point, the date was late September 2001, and the *Matthew* was most likely the only ship in the U.S. being held out. Most ports were reopened, and the backlog of ships in the queue in places like New York

Approval of Shoreside LNG Terminals

The Coast Guard's role and its relationship with FERC for siting onshore or near-shore LNG terminals.

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The permitting and approval process for a shore-side liquefied natural gas (LNG) terminal can be both complicated and controversial and is a completely different process from that for an LNG deepwater port. For a shore-side LNG terminal, the Federal Energy Regulatory Commission (FERC) is the lead federal agency with approval authority over the siting, design, and operation of the terminal. This applies to LNG terminals built along the waterfront as well as those built beyond the shoreline but inside state waters. State waters typically extend three miles from shore, except in Texas and Florida where they extend three marine leagues (or about 10 miles) from shore.

Coast Guard and Georgia Department of Natural Resource boats patrol the east side of Elba Island on the Savannah River in front of the Southern LNG facility June 2004. The boats were enforcing a security zone on the river established for the G8 Summit. All recreational boating traffic was restricted; however, commercial traffic was allowed to move in and out of the port with some Coast Guard escorts. USCG photo by PA2 Dana Warr.

This article will focus on the Coast Guard's role and its relationship with FERC for the siting of onshore LNG terminals or near-shore LNG terminals that are located within state waters. An LNG terminal that is built offshore beyond state waters is subject to the Deepwater Port Act, and in this case the Department of Transportation (DOT) is the lead federal agency with approval authority over the license for a deepwater port. The authority to process deepwater port applications has been delegated by DOT to the Coast Guard and the Maritime Administration (MARAD), with the Coast Guard being responsible for evaluation of environmental impacts and approval of the siting, design, and operation of the deepwater port, among other things. Noting this dis-

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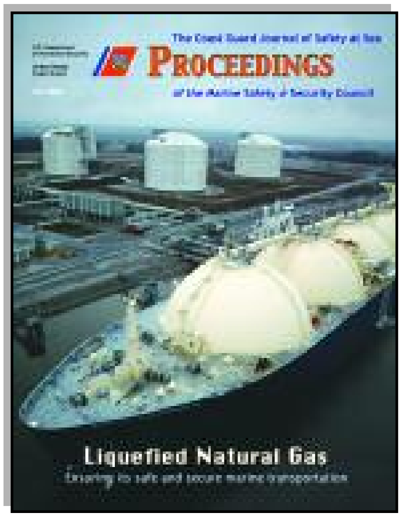

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PROCEEDINGS Magazine, Fall 2005

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