

## **Appendix R**

### **Major LNG Incidents**

## Major LNG Incidents Involving LNG Release

Incident Date	Ship/Facility Name	Location	Ship Status	Injuries/Fatalities	Ship/Property Damage	LNG Spill/ Release	Incident Summary
October 1944	East Ohio Gas LNG Tank	Cleveland	NA	128 deaths	NA	NA	Tank failure and no earthen berm. Vapor cloud formed and filled the surrounding streets and storm sewer system. Natural gas in the
1964 and 1965	Methane Progress	Arzew, Algeria	Loading (1964); Shortly after leaving port (1965)	None	None		In 1964, a lightning strike to the forward vent riser of the Methane Progress ignited vapor which was being routinely vented through the venting system at the time. A similar occurrence also occurred in early 1965. Both times, the flame was quickly extinguished by
1965		Canvey Island, UK	Transfer operation	1 injury; serious burn		Yes	During LNG transfer, an error resulted in the release of LNG. The release became ignited, causing one
May 1965	Jules Verne	Arzew, Algeria	Loading	No	Yes	Yes	Overflowing of a cargo tank. Resulted in a tank cover and
1965	Methane Princess		Disconnecting after discharge	No	Yes	Yes	Valve leakage. Deck fractures.
1969		Portland, Oregon	Under construction	NA	Yes	Yes	An explosion occurred in an LNG tank under construction. No LNG had ever been introduced into the tank. The cause of the accident was the accidental removal of blinds from natural gas pipelines which were connected to the tank. This led to the flow of natural gas into the tank while it was being constructed.

<b>Incident Date</b>	<b>Ship/Facility Name</b>	<b>Location</b>	<b>Ship Status</b>	<b>Injuries/Fatalities</b>	<b>Ship/Property Damage</b>	<b>LNG Spill/ Release</b>	<b>Incident Summary</b>
1971	LNG ship Ezzo Brega, La Spezia LNG Import Terminal	La Spezia, Italy	Unloading LNG into the storage tank	NA	Yes	Yes	First documented LNG “rollover” incident, where two differing temperatures and densities of LNG mix. Tank developed a sudden increase in pressure, causing LNG vapor to discharge safely from the tank safety valves and vents. Tank roof slightly damaged. No ignition.
January 1972	Montreal East	Montreal, Canada	Defrosting operations	NA	NA	NA	During defrosting, a back flow of natural gas from the compressor to the nitrogen valve when the valve remained unclosed caused over-pressurization of the compressor. This led to a leak and subsequent ignition.
February 1973		Staten Island, New York	Repair on empty storage tank	Yes-37 fatalities.	Yes	No	While repairing the interior of an empty storage tank, a fire started. The increase in pressure inside the tank occurred so quickly that the concrete dome collapsed down inside the tank. 37 construction workers inside the tank were killed.
1973		Canvey Island, UK	NA	No	Yes	Yes	Glass breakage. Small amount of LNG spilled upon a puddle of rainwater, and the resulting flameless vapor explosion, called a rapid phase transition (RPT), caused the loud “booms.” No injuries resulted.
1974	Methane Progress		In port	No	Yes	No	Touched bottom at Arzew.

<b>Incident Date</b>	<b>Ship/Facility Name</b>	<b>Location</b>	<b>Ship Status</b>	<b>Injuries/Fatalities</b>	<b>Ship/Property Damage</b>	<b>LNG Spill/ Release</b>	<b>Incident Summary</b>
July 1974	Massachusetts Barge	Massachusetts	Loading	NA	NA	Yes	40 gallons of LNG leaked during loading, as a result of a power failure and the resulting automatic closure of the safety valves. The leak resulted in several fractures to
1975	Philadelphia Gas Works		NA	No	Yes	NA	Not caused by LNG. An iso-pentane intermediate heat transfer fluid leak caught fire and burned the entire vaporizer area.
1977	Arzew	Algeria	NA	1 worker frozen to death	NA	Yes	Aluminum valve failure on contact with cryogenic temperatures. Wrong aluminum alloy on replacement valve. LNG was released, but no vapor
September 1977	LNG Aquarius	Boatang, Indonesia	Loading	No	No	Yes	During filling, LNG overflowed through the vent mast. Possible cause was difficulties in the liquid level gauge system.
1979	Columbia Gas LNG Terminal	Cove Point, Maryland	NA	1 killed 1 seriously injured	Yes	Yes	LNG leaked through the LNG pump electrical penetration seal and entered the substation. A circuit breaker ignited the natural gas-air mixture, resulting in an explosion.
April 1979	Mostefa Ben-Boulaid Ship		Unloading	No	Yes	Yes	Valve leakage. Deck fractures.

<b>Incident Date</b>	<b>Ship/Facility Name</b>	<b>Location</b>	<b>Ship Status</b>	<b>Injuries/Fatalities</b>	<b>Ship/Property Damage</b>	<b>LNG Spill/ Release</b>	<b>Incident Summary</b>
April 1979	Pollenger Ship		Unloading	No	Yes	Yes	Valve leakage. Tank cover plate fractures.
1979	El Paso Paul Kayser Ship		At sea	No	Yes	No	Stranded. Severe damage to bottom, ballast tanks, motor was water damaged, bottom of containment system set up.
1980	LNG Libra		At sea	No	Yes	No	Shaft moved against rudder. Tail shaft fractured.
1980	LNG Taurus		In port	No	Yes	No	Stranded. Ballast tanks all flooded and listing. Extensive bottom damage.
1984	Melrose		At sea	No	Yes	No	Fire in engine room. No structural damage sustained – limited to engine room.

<b>Incident Date</b>	<b>Ship/Facility Name</b>	<b>Location</b>	<b>Ship Status</b>	<b>Injuries/Fatalities</b>	<b>Ship/Property Damage</b>	<b>LNG Spill/ Release</b>	<b>Incident Summary</b>
1985	Gradinia	In port	In port	No	Not reported	No	Steering gear failure. No details of damage reported.
1985	Isabella	Unloading	Unloading	No	Yes	Yes	Cargo valve failure. Cargo overflow. Deck fractures.
1989	Tellier	Loading	Loading	No	Yes	Yes	Broke moorings. Hull and deck fractures.
1990	Bachir Chihani	At sea	At sea	No	Yes	No	Sustained structural cracks allegedly stressing and fatigue in inner hull.
1993	Indonesian Liquefaction facility	Indonesia	NA	No	NA	NA	LNG leak from open run-down line during a pipe modification project. LNG entered an underground concrete storm sewer system and underwent a rapid vapor expansion that over pressured and ruptured the sewer pipes. Storm sewer system substantially damaged.

<b>Incident Date</b>	<b>Ship/Facility Name</b>	<b>Location</b>	<b>Ship Status</b>	<b>Injuries/Fatalities</b>	<b>Ship/Property Damage</b>	<b>LNG Spill/ Release</b>	<b>Incident Summary</b>
2002	LNG ship Norman Lady	East of the Strait of Gibraltar	At sea	No	Yes	No	Collision with a U.S. Navy nuclear-powered attack submarine, the U.S.S Oklahoma City. In ballast condition. Ship suffered a leakage of seawater into the double bottom dry tank area.
2004	Skikda	Algeria	NA	27 killed 72 injured (the casualties are mainly due to the blast, few casualties due to fire)	Yes	NA	A leak in the hydrocarbon refrigerant system formed a vapor cloud that was drawn into the inlet of a steam boiler. The increased fuel to the boiler caused rapidly rising pressure within a steam drum. The rapidly rising pressure exceeded the capacity of the boiler's safety valve and the steam drum ruptured. The boiler rupture was close enough to the gas leak to ignite the vapor cloud and produce an explosion due the confined nature of the gas leak and an ensuing fireball. The fire took eight hours to extinguish. The explosions and fire destroyed a portion to the LNG plant and caused 27 deaths, and injury to 72 more.

Incident Date	Ship/Facility Name	Location	Ship Status	Injuries/Fatalities	Ship/Property Damage	LNG Spill/ Release	Incident Summary
2006	Train 2 Facility	Port Fortin, Trinidad, Caracas	No	1 Injury	Yes	No	Atlantic LNG reported that an accident occurred at its Train 2 facility at Point Fortin, Trinidad when a temporary eight inch isolation plug was blown by built-up pressure. The Train 2 facility had been shut down due to the detection of a gas release from a two-inch pipeline. The release of natural gas was brought under control, and personnel returned. While the company was carrying out repairs the plug blew injuring one worker. It had been filled with inert gas to facilitate repairs.
2009	South Hook LNG Terminal	UK	NA	No	No	Yes	A maximum of ten litres of LNG was spilled and “immediately vaporized”, because of the unintended activation of the emergency shutdown system, which caused powered emergency release couplings to separate, discharging LNG.
2010	Montoir de Bretagne terminal	France	Unloading	No	Yes	No	The incident occurred when liquid passed into the gas take-off line during discharge operations. The damage sustained extended to part of the ship's manifold and its feed lines.
2010	Withnell Bay facility	Australia	Loading	No	Yes	Yes	The ship suffered cryogenic burns when 2,000 to 4,000 litres of LNG were spilt.

Incident Date	Ship/Facility Name	Location	Ship Status	Injuries/Fatalities	Ship/Property Damage	LNG Spill/ Release	Incident Summary
2011	Yung An LNG Terminal	Taiwan	Unloading	No	Yes	Yes	The vessel's master decided to suspend the discharge and move the ship off the berth but the problems were eventually rectified and the vessel returned to complete the discharge of its cargo.
2011	Pyeongtaek LNG terminal	South Korea	Unloading	No	Yes	Yes	The ship disconnected from the berth after what was described as a very small leak of LNG was reported around the top of one emergency release coupler shortly after a scheduled overhaul of the unloading arms had been completed. Seals and ball valves were replaced on the unloading arms and discharge recommended using the remaining two arms.
2015	Al Orai	Off Zeebrugge, Belgium	At Sea	1 Injury	Yes		Al Orai involved in a collision with the Dutch freighter, Flinterstar. Flinterstar sank with all survivors rescued and one injury. The Al Orai suffered a slight gash and there was some water ingress, however, the vessel was able to return to port with the assistance of a tug.

## Sources:

Center for Energy Economics 2006, Shipwrecklog.com, "Atlantic LNG Trinidad Train 2 accident injures employee," November 2006, <http://www.oilandgasinternational.com/default.aspx>.

Center for Energy Economics 2012, Shipwrecklog.com, "LNG Safety and Security," June, 2012, [http://www.beg.utexas.edu/energyecon/LNG\\_Safety\\_and\\_Security\\_Update\\_2012.pdf](http://www.beg.utexas.edu/energyecon/LNG_Safety_and_Security_Update_2012.pdf)