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Liquefied Natural Gas (LNG) Infrastructure Security: Background and Issues for Congress

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Liquefied Natural Gas (LNG) Infrastructure Security: Background and Issues for Congress

Summary

Liquefied natural gas (LNG) is a hazardous fuel frequently shipped in massive tankers from overseas to U.S. ports. LNG is also manufactured domestically and is often stored near population centers. Because LNG infrastructure is highly visible and easily identified, it can be vulnerable to terrorist attack. Since September 11, 2001, the U.S. LNG industry and federal agencies have put new measures in place to protect LNG infrastructure and respond to the possibility of terrorism. Nonetheless, public concerns about LNG risks continue to raise questions about LNG security. While LNG has historically made up a small part of U.S. natural gas supplies, rising gas prices and the possibility of domestic shortages are sharply increasing LNG demand. Faced with this growth in demand and public concerns, Congress is examining the adequacy of federal LNG security initiatives.

LNG infrastructure consists primarily of tankers, import terminals, and inland storage plants. There are six active U.S. terminals and proposals for over 20 others. Potentially catastrophic events could arise from a serious accident or attack on such facilities, such as pool or vapor cloud fires. But LNG has an exemplary safety record for the last 40 years, and no LNG tanker or land-based facility has been attacked by terrorists. Experts debate the likelihood and possible impacts from LNG attacks, but recent studies have concluded that such risks, while significant, are not as serious as is popularly believed.

Several federal agencies oversee the security of LNG infrastructure. The Coast Guard has lead responsibility for LNG shipping and marine terminal security, and has issued new maritime security rules under the Maritime Transportation Security Act of 2002 (P.L. 107-295). The Office of Pipeline Safety (OPS) and the Transportation Security Administration (TSA) both have security authority for LNG storage plants within gas utilities, as well as some security authority for LNG marine terminals. The Federal Energy Regulatory Commission (FERC) approves the siting, with some security oversight, of on-shore LNG marine terminals and certain utility LNG plants. According to the agencies, they are aware of one another's authorities and intend to cooperate, but there are questions about the appropriate division of responsibility.

Federal initiatives to secure LNG are still evolving, but a variety of industry and agency representatives suggest that these initiatives are reducing the vulnerability of LNG to terrorism. As Congress continues its oversight of LNG, it may decide to examine the public costs and resource requirements of LNG security, especially in light of dramatically increasing LNG imports. In particular, Congress may consider whether future LNG security requirements will be adequately funded, whether these requirements will be appropriately balanced against evolving risks, and whether the LNG industry is carrying an appropriate share of the security burden. Congress may also consider whether there is an effective division of responsibilities among federal agencies with a role in LNG security to minimize the possibility of regulatory confusion and balance agency missions with capabilities. Congress may also review the security implications of moving LNG terminals offshore. This report will not be updated.

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Liquefied Natural Gas (LNG) Infrastructure Security: Background and Issues for Congress

Introduction

Liquefied natural gas (LNG) facilities are receiving a great deal of public attention due to their increasingly important role in the nation's energy infrastructure and their potential vulnerability to terrorist attack. LNG has long been important to U.S. natural gas markets, although energy economics and public perceptions about LNG risks have limited the industry's growth. Concerns about rising natural gas prices and the possibility of domestic gas shortages have recently been driving up demand for LNG imports. But LNG is a hazardous[1] liquid transported and stored in large quantities. In light of the terror attacks of September 11, 2001, Congress is concerned about the security of existing LNG infrastructure and the security implications of a major increase in LNG imports to the United States.[2]

This report provides an overview of recent industry and federal activities related to LNG security. The report describes U.S. LNG infrastructure, the industry's safety record and security risks, and the industry's security initiatives since September 11, 2001. It summarizes recent changes in federal LNG and maritime security law and related changes in the security roles of federal agencies. The report discusses several policy concerns related to federal LNG security efforts: 1) public costs of marine security, 2) overlapping federal security jurisdiction, and 3) security implications of building offshore LNG facilities.

Scope and Limitations

This report focuses on industry and federal activities in LNG infrastructure security. The report includes limited discussion of state and local agency activities as they relate to federal efforts, but does not address the full range of state and local issues of potential interest to policy makers. The report also focuses on shipping, marine terminals and land-based storage facilities within gas utilities; it does not address LNG trucking, special purpose LNG facilities, or LNG-fueled vehicles.

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[1] 49 CFR 172.101. *List of Hazardous Materials.* Office of Hazardous Materials Safety, Department of Transportation.

[2] U.S. Representative Edward Markey (MA), House Committee on Homeland Security, Remarks at Hearing on First Responders. Washington, DC. July 17, 2003.
See also: "Coast Guard, Mikulski Clear Plan to Reactivate Cove Point LNG Plant." *Inside FERC.* Washington, DC. January 6, 2003. p5.

Background

What is LNG?

When natural gas is cooled to temperatures below minus 260°F it condenses into *liquefied* natural gas, or "LNG."[3] As a liquid, natural gas occupies only 1/600th the volume of its gaseous state, so it is stored more effectively in a limited space and is more readily transported by ship or truck. A single tanker ship, for example, can carry huge quantities of LNG–enough to supply the daily energy needs of over 10 million homes.[4] When LNG is warmed it "regasifies" and can be used for the same purposes as conventional natural gas such as heating, cooking and power generation.

In 2002, LNG imports to the United States originated primarily in Trinidad (66%), Qatar (15%), and Algeria (12%). The remaining 7% of U.S. LNG imports came from Nigeria, Oman, Malaysia, and Brunei.[5] Australia, Indonesia, and the United Arab Emirates were also LNG exporters in 2002. In addition to importing LNG to the lower 48 states, the United States also exports Alaskan LNG to Japan.

Expectations for U.S. LNG Growth

The United States has used LNG commercially since the1940s. Initially, LNG facilities stored domestically produced natural gas to supplement pipeline supplies during times of high gas demand. In the 1970's LNG imports began to supplement domestic production. Due primarily to low domestic gas prices, LNG imports have been relatively small–accounting for only 1% of total U.S. gas consumption in 2002.[6] In countries with limited domestic gas supplies, however, LNG imports have grown dramatically since the early 1970's. Japan, for example, imports 97% of its natural gas supply as LNG (over 11 times as much LNG as the United States in 2001).[7] South Korea, France, Spain, and Taiwan also import large amounts of LNG.

Natural gas demand has accelerated in the U.S. over the last several years due to environmental concerns about other energy sources, growth in natural gas-fired electricity generation, and historically low gas prices. Supply has not been able to keep up with demand, however, so gas prices have recently become high and volatile. As Figure 1 shows, U.S. natural gas prices at the wellhead have been fluctuating

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[3]Natural gas typically consists of at least 80% methane, although LNG is usually over 90% methane. It may also contain other hydrocarbon gases (e.g., propane) and nitrogen.

[4]Behr, Peter. "Higher Gas Price Sets Stage for LNG." *Washington Post*. Washington, D.C. July 5, 2003. pD10.

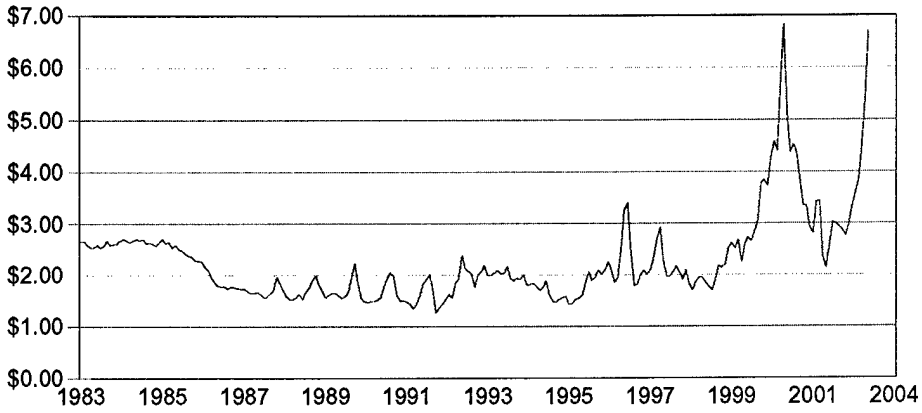
[5]Energy Information Administration (EIA). *Natural Gas Monthly*. Washington, DC. May, 2003. p11.

[6]Park, Gary. "List of Planned LNG Ventures Grows." *Petroleum News*. Haines, AK. June 29, 2003.

[7]Energy Information Administration (EIA). "World LNG Imports by Origin, 2001." Washington, DC. October 17, 2002.

between approximately $2.00/Mcf and peaks of nearly $7.00/Mcf since 1999.[8] International prices for LNG have fallen substantially at the same time because of increased supplies and lower production and transportation costs, making LNG more competitive with domestic natural gas.[9]

Figure 1: U.S. Natural Gas Wellhead Price ($/Mcf)



Source: Energy Information Administration

In recent testimony before the House Energy and Commerce Committee, the Federal Reserve Chairman, Alan Greenspan, called for a sharp increase in LNG imports to help avert a potential barrier to the U.S. economic recovery. According to Mr. Greenspan's testimony

> "...notable cost reductions for both liquefaction and transportation of LNG... and high gas prices projected in the American distant futures market have made us a potential very large importer... Access to world natural gas supplies will require a major expansion of LNG terminal import capacity."[10]

If current natural gas trends continue, industry analysts predict that LNG imports could increase to 5% of total U.S. gas supply by 2007, and could rise even further thereafter as new import facilities are built.[11]

Overview of U.S. LNG Infrastructure

The physical infrastructure of LNG consists of interconnected transportation and storage facilities, each with distinct physical characteristics affecting operational risks

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[8]Mcf = 1000 cubic feet

[9]Sen, Colleen Taylor. "LNG Poised to Consolidate its Place in Global Trade." *Oil & Gas Journal.* June 23, 200. p73.

[10]Greenspan, Alan, Chairman, U.S. Federal Reserve Board. "Natural Gas Supply and Demand Issues." Testimony before the House Energy and Commerce Committee. June 10, 2003.

[11]Park, Gary. "List of Planned LNG Ventures Grows." *Petroleum News.* June 29, 2003.

and security needs. This overview focuses on the three major elements of this infrastructure: tanker ships, marine terminals, and storage facilities.

LNG Tanker Ships

LNG is transported to the United States in very large, specially designed tanker ships. LNG tankers are double hulled, containing several massive refrigerated tanks, each sealed and insulated to maintain safe LNG temperature and prevent leakage during transit. There are currently 142 tankers in service around the world, with a combined cargo capacity of over 16 million cubic meters of LNG, equivalent to over five times the average daily U.S. natural gas consumption in 2001. Another 55 tankers with 7.6 million cubic meters of capacity are on order.[12] Two LNG tankers are owned by Marathon Oil, a U.S. company; the rest are foreign-owned.

LNG Marine Terminals

LNG tankers unload their cargo at dedicated marine terminals which store and regasify the LNG for distribution to domestic markets. These terminals consist of docks, LNG handling equipment, storage tanks, and interconnections to regional gas transmission pipelines. There are six active U.S. LNG terminals:

- **Everett, Massachusetts.** The Everett terminal is located across the Mystic River from Boston; tankers must pass through Boston harbor to reach it. The first LNG import facility in the country, the Everett terminal began service in 1971. According to Tractebel, the Belgian company which owns the terminal, it "serves most of the gas utilities in New England and key power producers" altogether meeting "between 15-20% of New England's annual gas demand."[13] The terminal received 48 LNG shipments in 2002.[14] According to Tractebel, the terminal plans to increase LNG shipments to approximately 60 per year, in part to supply newly constructed electric power plants nearby.[15]

- **Lake Charles, Louisiana.** The Lake Charles terminal is located approximately nine miles southwest of the city of Lake Charles near the Gulf of Mexico. The newest and largest LNG import facility in the country, the terminal began service in 1981 and is owned by CMS Energy.[16] The terminal received 44 LNG

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[12]LNG OneWorld. Internet home page. Drewry Shipping Consultants, Ltd. and Maritime Content, Ltd. London. July 16, 2001.

[13]Tractebel. "New LNG Vessel to Serve Tractebel's Atlantic Basin Customers." Press release. Brussells, Belgium. June 17, 2003.

[14]Sen, Colleen Taylor. June 23, 200. p79.

[15]Goodison, Donna and Crittenden, Jules. "Harbor Cargo Hazard Surging." *Boston Herald.* June 22, 2003. p1.

[16]Panhandle Energy (CMS Energy Corp.). "Trunkline LNG Lake Charles Terminal." Internet web page. Houston. July 16,2003.

shipments in 2002.[17] Under pending expansion plans, the terminal could receive up to 175 shipments per year by 2006.[18]

- **Cove Point, Maryland**. Cove Point is located on the Chesapeake Bay 60 miles southeast of Washington, DC, and five miles south of the Calvert Cliffs nuclear power plant. The Cove Point terminal, owned by Dominion Corporation, began service in 1978 but closed in 1980 because low domestic gas prices made imports uneconomic. In 1995, the terminal reopened to liquefy, store and distribute domestic natural gas in the Mid-Atlantic.[19] In July, 2003, the terminal reopened for LNG imports. Dominion expects the terminal to receive approximately 30 LNG shipments in 2003.[20] Under current expansion plans, the terminal could receive up to 90 shipments per year by 2004.[21]

- **Elba Island, Georgia.** The Elba Island terminal, owned by El Paso Corporation, is located on a marsh island approximately five miles down the Savannah River from Savannah, Georgia and ten miles from the Atlantic coast. Like Cove Point, the Elba Island terminal began service in 1978 and closed in 1980, but reopened in late 2001.[22] The terminal received 13 LNG shipments in 2002.[23] Under pending expansion plans the terminal could increase shipments to approximately 118 per year by 2006.[24]

- **Peñuelas, Puerto Rico.** The Peñuelas terminal, located on the southern coast of Puerto Rico, began service in 2002. The terminal is dedicated to fueling an electric generation plant which supplies 20% of Puerto Rico's power.[25] Both the terminal and power plant are owned by EcoElectrica, a joint venture of Edison Mission Energy and Gas Natural, a Spanish company. The terminal received 14 LNG shipments in 2002.[26]

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[17]BG Group. *International Operations*. Internet web page. Berkshire, U.K. July 17, 2003.

[18]*Federal Register*. Vol 67 No34. February 20, 2002. p7684.

[19]Dominion Corp. "History of Cove Point." Internet web page. Richmond, VA. July 17, 2003.

[20]Jowdy, Madeline. "Cove Point Nears July Start." *Natural Gas Week*. Energy Intelligence Group, Inc. June 27, 200.

[21]*Federal Register*. Vol 66 No 7. February 23, 2001. p11287.

[22]Energy Information Administration (EIA). "U.S. LNG Markets and Uses." Office of Oil and Gas. Washington, D.C. January, 2003. p3.

[23]Anonymous. "Total U.S. Imports Slightly Up and LNG Imports Down in 2002, Says DOE." *Foster Natural Gas Report*. May 8, 2003. p16.

[24]*Federal Register*. Vol 67 No181. September 18, 2002. p58784.

[25]Anonymous. "Gas Natural Acquires Enron's 50% Stake in 540-MW Gas Plant in Puerto Rico." *Platt's Global Power Report*. McGraw-Hill. July 10, 2003. p11.

[26]Smedley, Mark. "Spain's Gas Natural Buys Enron Stake in Puerto Rican LNG Venture." *International Oil Daily*. Energy Intelligence Group, Inc. London. June 24, 2003.

- **Kenai, Alaska.** Built in 1969, this is the oldest LNG marine terminal in the United States and the only one built for export (to Japan). The Kenai terminal, owned by Phillips Petroleum and Marathon Oil, is located in Nikiski near the Cook Inlet gas fields. Since 1969 the terminal has exported an average of approximately 34 LNG shipments each year.[27]

In addition to these active terminals, developers have proposed up to 20 new LNG marine terminals to serve the U.S. market. Seven of these proposals are well-advanced with pending federal approvals (for the terminal or associated pipelines). Table 1 lists summary information for these proposals.[28]

Table 1: LNG Terminals with Pending Federal Approvals

Project Name	Location	Developer	Key Features
Cameron LNG	Hackberry, LA	Sempra	Converted on shore liquid petroleum gas terminal
Port Pelican	Port Pelican, LA	ChevronTexaco	Offshore
Calypso	Bahamas	Tractebel	Offshore, pipeline to Florida
Ocean Express	Bahamas	AES	Offshore, pipeline to Florida
Energy Bridge	Gulf of Mexico	El Paso Global	New offshore concept
Freeport LNG	Freeport, TX	Cheniere	On shore
Cabrillo Port	Ventura, CA	BHP Billiton	Offshore

Additional LNG import terminals have been proposed for sites in Massachusetts, New Jersey, Florida, Texas, and California. Terminals to serve U.S. markets have also been proposed in Mexico and New Brunswick, Canada.

Several proposed LNG terminals, such as the Energy Bridge project, would be located entirely offshore, connected to land only by underwater pipelines. These offshore terminal designs seek to avoid community opposition and permitting obstacles which have delayed or prevented the construction of new on-shore LNG terminal facilities.[29] Because offshore terminals would be located far from land, they also would present fewer security risks than land-based LNG terminals. Offshore terminals do present environmental concerns, however, since they would use seawater for regasification. Such a process would cool the waters in the vicinity of the terminal with potential impacts on the local ecosystem due to the lower water

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[27]Marathon Oil Corporation. *2002 Annual Report.* Houston. March 10, 2003. p18.

[28]Sen, Colleen Taylor. p80.

[29]Zeus Development Corp. "Six New Offshore Terminal Designs May Expedite LNG Deliveries." Latin Petroleum Analytics. Houston, TX. June 11, 2003.

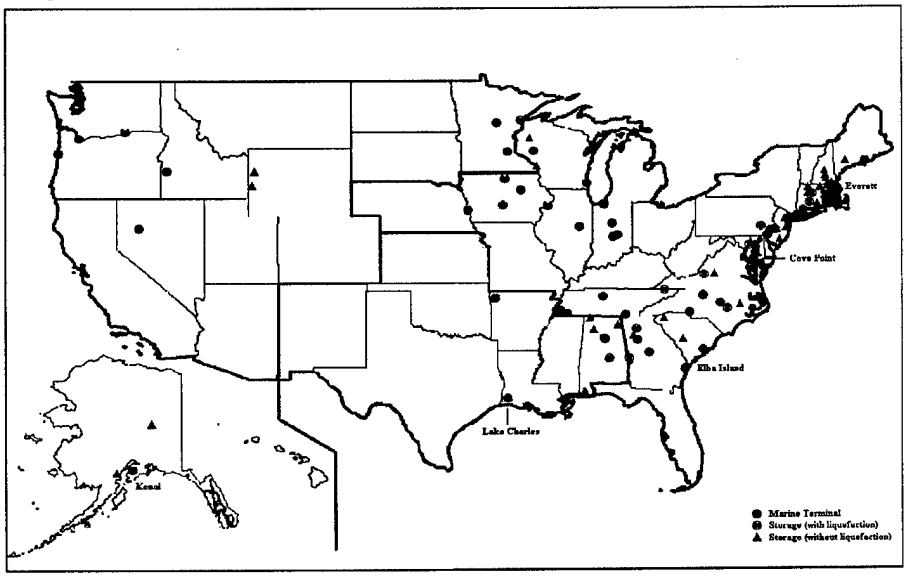
temperatures. No offshore LNG terminals have been built yet, so they may also need to overcome technical challenges associated with their floating designs.[30]

LNG Peak Shaving Plants

Many gas distribution utilities rely on "peak shaving" LNG plants to supplement pipeline gas supplies during periods of peak demand during winter cold snaps. The LNG is stored in large refrigerated tanks integrated with the local gas pipeline network. The largest facilities usually liquefy natural gas drawn directly from the interstate pipeline grid, although many smaller facilities without such liquefaction capabilities receive LNG by truck. LNG tanks are generally surrounded by containment impoundments which limit the spread of an LNG spill and the potential size of a resulting vapor cloud.[31] LNG peak shaving plants are often located near the populations they serve, although many are in remote areas away from people.

According to the Energy Information Administration (EIA) there are 96 active LNG storage facilities in the United States distributed among approximately 55 utilities.[32] These facilities are mostly in the Northeast where pipeline capacity and underground gas storage have historically been constrained. Figure 2 shows the locations of U.S. LNG storage facilities within utilities and marine terminals.[33]

Figure 2: LNG Storage Sites in Utilities and Marine Terminals



Source: Energy Information Administration

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[30]Shook, Barbara. "Environmental, Safety, Security Issues Add to Cost of Offshore LNG." *Oil Daily*. Energy Intelligence Group. August 5, 2003.

[31]California Energy Commission (CEC). *Liquefied Natural Gas in California: History, Risks and Siting*. No.700-03-005. Sacramento, CA. p5.

[32]Gaul, Damien and Young, Lillian. Energy Information Administration (EIA). "U.S. LNG Markets and Uses." Washington, DC. January, 2003. pp1,11.

[33]Figure 2 excludes seven small sites associated with vehicular fuel or niche applications.

LNG Risks and Vulnerabilities

The risks associated with LNG infrastructure in the United States have been debated for decades. A prominent accident at one of the nation's first commercial LNG facilities in 1944 initiated public fears and misperceptions about LNG hazards which persist today. In this accident, the "Cleveland Disaster," an LNG spill from an improperly designed storage tank caused a fire that killed 128 people.[34] While this accident continues to serve as a reminder of the hazards of LNG, technology improvements since the 1940's have made LNG facilities much safer. Serious risks remain, however, since LNG is inherently volatile and is usually stored in large quantities. Because LNG infrastructure is highly visible and easily identified, it is vulnerable to terrorist attack.

Physical Hazards of LNG

Natural gas is combustible, so an uncontrolled release of LNG poses a serious hazard of explosion or fire. LNG also poses hazards because it is so cold. Experts have identified several potentially catastrophic events that could arise from an LNG release. The likelihood and severity of these events have been the subject of considerable research and testing. While open questions remain about the impacts of specific hazards in an actual accident, there appears to be consensus as to what are the greatest LNG hazards.

- **Pool fires.** If LNG spills near an ignition source, the evaporating gas in a combustible gas-air concentration will burn above the LNG pool.[35] The resulting "pool fire" would spread as the LNG pool expanded away from its source and continued evaporating. Such pool fires are intense, burning far more hotly and rapidly than oil or gasoline fires.[36] They cannot be extinguished–all the LNG must be consumed before they go out. Because LNG pool fires are so hot, their thermal radiation may injure people and damage property a considerable distance from the fire itself.[37] Many experts agree that a pool fire, especially on water due to thermal effects, is the most serious LNG hazard.[38]

- **Flammable vapor clouds**. If LNG spills but does not immediately ignite, the evaporating natural gas will form a vapor cloud that may drift some distance from the spill site. If the cloud subsequently encounters an ignition source, those portions of the cloud with a combustible gas-air concentration will burn. Because only a fraction of such a cloud would have a combustible gas-air

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[34]Bureau of Mines (BOM). *Report on the Investigation of the Fire at the Liquefaction, Storage, and Regasification Plant of the East Ohio Gas Co., Cleveland, Ohio, October 20, 1944.* February, 1946.

[35]Methane, the main component of LNG, burns in gas-to-air ratios between 5% and 15%.

[36]Havens, Jerry. "Ready to Blow?" *Bulletin of the Atomic Scientists*. July/August 2003. p17.

[37]Fay, James A. "Spills and Fires from LNG and Oil Tankers in Boston Harbor." Working paper. MIT. Dept. of Mechanical Engineering. Cambridge, MA. March 26, 2003.

[38]Havens. 2003. p17.

concentration, the cloud would not likely explode all at once, but the fire could still cause considerable damage.[39] An LNG vapor cloud fire would gradually burn its way back to the LNG spill where the vapors originated and would continue to burn as a pool fire.[40] If an LNG tank failed due to a collision or terror attack, experts believe the failure event itself would likely ignite the LNG pool before a large vapor cloud could form.[41] Consequently, they conclude that large vapor cloud fires are less likely than instantaneous pool fires.

- **Flameless explosion**. If LNG spills on water, it could theoretically heat up and regasify almost instantly in a "flameless explosion" (also called a "rapid phase transition"). While the effects of tanker-scale spills have not been studied extensively, Shell Corporation experiments with smaller LNG spills in 1980 did not cause flameless explosions. Based on a review of these experiments, a U.S. national laboratory concluded that "transitions caused by mixing of LNG and water are not violent."[42] Even if there were a flameless explosion of LNG, experts believe the hazard zones around such an event "would not be as large as either vapor cloud or pool fire hazard zones."[43]

In addition to these catastrophic hazards, an LNG spill poses hazards on a smaller scale. An LNG vapor cloud is not toxic, but could cause asphyxiation by displacing breathable air.[44] Such clouds rise in air as they warm, however, diminishing the threat to people on the ground. Alternatively, extremely cold LNG could injure people or damage equipment through direct contact.[45] The extent of such contact would likely be limited, however, as a major spill would likely result in a more serious fire. The environmental damage associated with an LNG spill would be confined to fire and freezing impacts near the spill since LNG dissipates completely and leaves no residue (as crude oil does).[46]

Safety Record of LNG

The LNG industry has had an impressive safety record over the last 40 years. Since international commercial LNG shipping began in 1959, for example, tankers have carried over 33,000 LNG shipments without a serious accident at sea or in

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[39]West, H.H. and Mannan, M.S. "LNG Safety Practices and Regulations." Prepared for the American Institute of Chemical Engineering Conference on Natural Gas Utilization and LNG Transportation. Houston, TX. April, 2001. p2.

[40]Quillen, Douglas. ChevronTexaco Corp. "LNG Safety Myths and Legends." Presentation to the Natural Gas Technology Conference. Houston, TX. May 14-15, 2002. p18.

[41]Havens. 2003. p17.

[42]Siu, Nathan et al. *Qualitative Risk Assessment for an LNG Refueling Station and Review of Relevant Safety Issues*. Idaho National Engineering Laboratory. INEEL/EXT-97-00827 rev2. Idaho Falls, ID. February, 1998. p71.

[43]Havens. 2003. p17.

[44]Siu. 1998. p62.

[45]Siu. 1998. p63.

[46]Quillen. 2002. p28.

port.[47] Insurance records and industry sources show that there were approximately 30 LNG tanker safety incidents (e.g. leaks, groundings or collisions) through 2002. Of these incidents, 12 involved small LNG spills which caused some freezing damage but did not ignite. Two incidents caused small vapor vent fires which were quickly extinguished.[48]

The favorable safety record of LNG tankers is largely due to their double-hulled design. LNG carriers are less prone to accidental spills than typical crude oil, fuel, and chemical tankers because they are inherently more robust.[49] LNG tankers also carry radar and global positioning systems alerting operators to traffic hazards. Automatic distress systems and beacons send out signals if a tanker is in trouble. Cargo safety systems include instruments that can shut operations if they deviate from normal parameters. LNG tankers also have gas and fire detection systems.[50]

Land based LNG facilities also have had a favorable safety record in recent decades. There are approximately 40 LNG marine terminals and more than 150 peak-shaving plants worldwide. Since the 1944 Cleveland fire, there have been 10 serious accidents at these facilities directly related to LNG. Two of these accidents caused fatalities of facility workers–one death at Arzew, Algeria in 1977, and another death at Cove Point, Maryland, in 1979. Another three accidents at worldwide LNG plants caused fatalities, but these were construction or maintenance accidents in which LNG was not present.[51] According to one marine terminal operator, exhaustive tests have shown that safety dikes would contain the LNG from a ruptured storage tank, and would limit the effects of any fire to the terminal grounds.[52]

LNG Security Risks

LNG tankers and land-based facilities are vulnerable to terrorism. Tankers may be physically attacked in a variety of ways to destroy their cargo–or commandeered for use as weapons against coastal targets. Land-based LNG facilities may also be physically attacked with explosives or through other means. Alternatively, computer control systems may be "cyber-attacked," or both physical and cyber attack may happen at the same time. Some LNG facilities may also be indirectly disrupted by other types of terror strikes, such as attacks on regional electricity grids or communications networks, which could in turn affect dependent LNG control and

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[47]Delano, Fisoye et al. "Introduction to LNG." University of Houston Law Center, Institute for Energy, Law and Enterprise. Houston, TX. January, 2003. p23.

[48]CH-IV International. *Safety History of International LNG Operations, Revision 2.* TD-02109. Millersville, MD. November, 2002. pp13-17.

[49]Juckett, Don. U.S. Department of Energy (DOE). "Properties of LNG." LNG Workshop. Solomons, MD. February 12, 2002.

[50]Petroplus International, N.V. "Energy for Wales: LNG Frequently Asked Questions." Internet home page. Amsterdam, Netherlands. August 4, 2003.

[51]CH-IV International. pp6-12.

[52]Hager, George. "Risks of Liquefied Natural Gas Minimal." *USA Today.* May 31, 2002.

safety systems.[53] Since LNG is fuel for power plants, heating, military bases, and other uses, disruption of LNG shipping or storage poses additional "downstream" risks, especially in more dependent regions like New England.

No LNG tanker or land-based LNG facility has been attacked by terrorists. However, similar natural gas and oil facilities have been favored terror targets internationally. For example, over the past two years, gas and oil pipelines have been attacked in at least half a dozen countries.[54] In June 2002, Moroccan authorities foiled an Al-Qaeda plot to attack U.S. and British warships, and possibly commercial vessels, in the Straits of Gibraltar.[55] LNG tankers from Algeria en route to the United States pass through the same waters. In October 2002, the French oil tanker *Limberg* was attacked off the Yemeni coast by a bomb-laden boat.[56] In the United States, federal warnings about Al Qaeda threats since September 11, 2001 have repeatedly mentioned energy infrastructure.[57] In June of 2003, for example, U.S. intelligence agencies warned about possible Al Qaeda attacks on energy facilities in Texas.[58]

The potential hazard from terror attacks on LNG tankers continues to be debated among experts. One recent study of tankers serving the Everett LNG terminal assessed the impact of 1) a hand-held missile attack on the external hull, and 2) a bomb attack from a small boat next to the hull (similar to the *Limberg* attack). The study found that "loss of containment may occur through shock mechanisms caused by small amounts of explosive."[59] The study concluded that "a deliberate attack on an LNG carrier can result in a ... threat to both the ship, its crew and members of the public."[60] However, the study also found the risk of a public catastrophe to be small. For example, the study found that the LNG pool hazard would be less than that for a gasoline or liquefied petroleum gas (LPG) pool.[61] The study also concluded that a vaporized LNG explosion would be unlikely because a missile or bomb presents

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[53]Skolnik, Sam. "Local Sites Potential Targets for Cyberterror." *Seattle Post-Intelligencer*. Seattle, WA. Sept. 2, 2002.

[54]Parfomak, Paul W., Congressional Research Service (CRS). *Pipeline Security*. RL31990. Washington, DC. July 8, 2003. pp4-5. See this report for specific examples.

[55]Sawer, Patrick. "Terror Plot to Blow Up Navy Warships is Foiled." *The Evening Standard*. London. June 11, 2002. p4.

[56]Anonymous. "Ships as Terrorist Targets." *American Shipper*. November, 2002. p.59.

[57]Federal Bureau of Investigation (FBI). *The Terrorist Threat Confronting the United States*. Statement of Dale L. Watson, Exec. Dir. for Counterterrorism and Counterintelligence before the Senate Select Committee on Intelligence. Washington, DC. February 6, 2002.

[58]Hedges, Michael. "Terrorists Possibly Targeting Texas." *Houston Chronicle*. Houston. June 24, 2003.

[59]Waryas, Edward. Lloyd's Register America's, Inc. "Major Disaster Planning: Understanding and Managing Your Risk." Presented to the Fourth National Harbor Safety Committee Conference. Galveston, TX. March 4, 2002. p11

[60]Waryas, Edward. March 4, 2002. p24.

[61]Waryas. Edward. March 4,2002. p14. The study calculated that a fire from 1 LNG cargo tank with a 1 m^2 hole would cause a pool fire 25 meters across and would burn for 1 hour.

multiple ignition sources.[62] Other experts have calculated that an LNG fire under "worst case" conditions could be much more hazardous to waterfront facilities.[63] Impact estimates for LNG tanker attacks are largely based on engineering models, however, each with its own input assumptions–so it is difficult to assert definitively how dangerous a real attack would be.

Recent LNG Security Initiatives

Operators of LNG infrastructure had security programs in place prior to September 11, 2001, but these programs mostly focused on personnel safety and preventing vandalism. The terror attacks of September 11 focused attention on the vulnerability of LNG infrastructure to different threats, such as systematic attacks on LNG facilities by foreign terrorists. Consequently, both government and industry have taken new initiatives to secure LNG infrastructure in response to new threats.

Several federal agencies oversee the security of LNG infrastructure. The Coast Guard has lead responsibility for LNG shipping and marine terminal security. The Department of Transportation's Office of Pipeline Safety and the Department of Homeland Security's Transportation Security Administration have security authority for peak-shaving plants within gas utilities, as well as some security authority for LNG marine terminals. FERC has siting approval responsibility, with some security oversight, for land-based LNG marine terminals and certain peak-shaving plants. (Overlapping security authorities among federal agencies are further discussed later in this report.) In addition to federal agencies, state and local authorities, like police and fire departments, also help to secure LNG.

Coast Guard Maritime Security Activities

The Coast Guard is the lead federal agency for U.S. maritime security, including port security. Among other duties, the Coast Guard tracks, boards, and inspects commercial ships approaching U.S. waters. A senior Coast Guard officer in each port oversees the security and safety of vessels, waterways, and many shore facilities in his geographic area.[64] The Coast Guard derives its security responsibilities under the Ports and Waterways Safety Act of 1972 (P.L. 92-340) and the Maritime Transportation Security Act of 2002 (P.L. 107-295). New maritime security regulations mandated by P.L.107-295 are discussed below. Under P.L.107-295 the Coast Guard also has siting approval authority for offshore LNG terminals.

Shortly after September 11, 2001, the Coast Guard began to systematically prioritize protection of ships and facilities, including those handling LNG, based on vulnerability assessments and the potential consequences of security incidents. The

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[62]Waryas. Edward. March 4,2002. p12.

[63]Fay, James A. March 26, 2003.

[64]Frittelli, John F., Congressional Research Service (CRS). *Port and Maritime Security.* RL31733. Washington, DC. May 20, 2003. p10. See this report for more information about maritime and port security.

Coast Guard evaluated the overall susceptibility of marine targets, their use to transport terrorists or terror materials, and their use as potential weapons. In particular, the Coast Guard evaluated the vulnerability of tankers to "a boat loaded with explosives" or "being commandeered and intentionally damaged."[65] While the assessments focused on Coast Guard jurisdictional vessels and facilities, some scenarios involved other vital port infrastructure like bridges, channels, and tunnels.[66] The Coast Guard used these assessments in augmenting security of key maritime assets and in developing the agency's new maritime security standards.

The Coast Guard began increasing LNG tanker and port security immediately after September 11, 2001. For example, the Coast Guard suspended LNG shipments to Everett for several weeks after the terror attacks to conduct a security review and revise security plans.[67] The Coast Guard also worked with state, environmental and police marine units to establish 24-hour patrols in Boston harbor.[68] In July 2002, the Coast Guard imposed a 1,000-yard security zone around the Kenai LNG terminal–and subsequently imposed similar zones around other U.S. LNG terminals.[69] The Coast Guard also reassessed security at the Cove Point terminal before allowing LNG shipments to resume there for the first time since 1980.[70]

The most heavily secured LNG shipments are those bound for the Everett terminal because they pass through Boston harbor. The Coast Guard has had numerous security provisions in place for these shipments, including:

- Inspection of security and tanker loading at the port of origin in Trinidad.
- Occasional on-board escort to Boston by Coast Guard "sea marshals."
- 96-hour advanced notice of arrival of an LNG tanker.
- Advance notification of local police, fire, and emergency agencies, as well as the Federal Aviation Administration and the U.S. Navy.
- Boarding of the LNG tanker for inspection prior to entering Boston harbor.
- Harbor escort by armed patrol boats, cutters, or auxiliary vessels.
- Enforcement of a security zone closed to other vessels two miles ahead and one mile to each side of the LNG tanker.
- Suspension of overflights by commercial aircraft at Logan airport.
- Additional security measures that cannot be disclosed publicly.[71]

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[65]68FR126. July 1, 2003. p39244

[66]68FR126. July 1, 2003. p39246

[67]McElhenny, John. "Coast Guard Lifts Ban of Natural Gas Tankers in Boston Harbor." Associated Press. October 16, 2001.

[68]Crittenden, Jules. "Vigilance: Holiday Puts Spotlight on Harbor Security." *Boston Herald.* Boston, MA. June 30, 2002. p1.

[69]Anonymous. "LNG Security in Boston to Be Permanent." *Platt's Oilgram News.* New York, NY. August 1, 2002.

[70]Anonymous. "Coast Guard, Mikulski Clear Plan to Reactivate Cove Point LNG Plant." *Platt's Inside FERC.* Washington, DC. January 6, 2003. p5.

[71]Greenway, H.D.S. "Is it Safe?" *The Boston Globe Magazine.* Boston, MA. July, 27, 2003.

According to the Coast Guard, many of these security provisions are in place for the other U.S. LNG terminals as well, depending upon local assessments of security risk and the unique characteristics of each marine area.[72] Similar security measures would also likely be put in place for new on-shore LNG terminals.[73]

On July 1, 2003, the Coast Guard issued interim rules to implement the new security requirements mandated by P.L. 107-295. Among other provisions, the interim rules establish Coast Guard port officers as maritime security coordinators and set requirements for maritime area security plans and committees (68 FR 126, p39284). The rules require certain owners or operators of marine assets to designate security officers, perform security assessments, develop and implement security plans, and comply with maritime security alert levels. The vessel rules apply to all LNG tankers entering U.S. ports (68 FR 126, p39284). Facility rules apply to all land-based U.S. LNG terminals (68 FR 126, p39315) or proposed offshore LNG terminals (68 FR 126, p39338). Finally, new rules require certain vessels, including LNG tankers, to carry an automatic identification system (68 CFR 126, 39353).

The new marine security rules require that security plans for U.S. ships and facilities be prepared by December 31, 2003, and approved by July 1, 2004. Foreign vessels must have security plans by July 1, 2004. The Coast Guard will review and approve security plans for U.S. ships and facilities, but the agency intends to rely on countries of origin to approve the plans of foreign vessels. The Coast Guard will also verify that foreign vessels have security plans through on-board inspections in U.S. waters. The Coast Guard expects to review approximately 5,000 security plans before the July 1, 2004, deadline. Coast Guard officials are developing security plan review guidelines to help ensure speed and consistency of these reviews.[74]

The Coast Guard has also led the International Maritime Organization (IMO) in developing maritime security standards outside U.S. jurisdiction.[75] These new standards, the International Ship and Port Facility Security Code (ISPS Code) contain detailed mandatory security requirements for governments, port authorities and shipping companies, as well as recommended guidelines for meeting those requirements. The ISPS Code is intended to provide a standardized, consistent framework for governments to evaluate risk and to "offset changes in threat with changes in vulnerability."[76] The Coast Guard considers the new ISPS Code "to reflect the current industry, public and agency concerns."[77]

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[72]U.S. Coast Guard, Port Security Directorate. Personal communication. August 12, 2003.

[73]Associated Press. "Experts: Exxon Mobil's Proposed LNG Terminal Safe for Residents." AP Wire. August 20, 2003.

[74]U.S. Coast Guard, Port Security Directorate. Personal communication. August 12, 2003.

[75]68FR126. July 1, 2003. p39241.

[76]International Maritime Organization (IMO). "IMO Adopts Comprehensive Maritime Security Measures." Press release. London. December 17, 2002.

[77]68FR126. July 1, 2003. p39241

Federal Pipeline Safety and Security Agencies

The Office of Pipeline Safety (OPS) within the Department of Transportation has statutory authority to regulate the safety and security of LNG peak-shaving plants under the Natural Gas Pipeline Safety Act of 1968 (P.L. 90-481). The OPS security regulations for LNG peak-shaving facilities are found in 49 CFR 193, *Liquefied Natural Gas Facilities: Federal Safety Standards* (Subpart J-Security). These regulations govern security procedures, protective enclosures, communications, monitoring, lighting, power sources, and warning signs. Federal LNG *safety* regulations (33 CFR 127) and National Fire Protection Association standards for LNG also include provisions addressing security, such as requirements for monitoring facilities and preparing emergency response plans.[78] According to the OPS, the agency continues to enforce the LNG security regulations in 49 CFR 193 as part of its broader safety mission.[79]

The Pipelines Branch of the Transportation Security Administration (TSA) is the lead federal authority for the security of the interstate gas pipeline network under the Natural Gas Pipeline Safety Act of 1968 (P.L. 90-481). This security authority was transferred to TSA from the Transportation Department's Office of Pipeline Safety (OPS) under the Aviation and Transportation Security Act of 2001(P.L. 107-71). The TSA has also asserted its security authority over land-based LNG facilities that are considered an integral part of the interstate pipeline network.[80] The TSA has been cooperating with OPS on pipeline and LNG security oversight to avoid confusion as to which agency is in charge of security and what requirements may be in force.[81]

According to TSA officials, the agency oversees pipelines and land-based LNG as the "national transportation security manager."[82] In this capacity, the TSA expects pipeline and jurisdictional LNG facility operators to prepare security plans based on the OPS/industry consensus security guidance circulated in 2002. In 2003 the TSA intends to visit the largest 25-30 pipeline operators, including some with LNG plants, to review their security plans. Because all land-based LNG plants may not be considered "nationally critical," however, TSA does not plan to inspect all plants. TSA ultimately intends to issue formal security regulations to move beyond voluntary guidelines, but it is not clear if and when TSA will actually issue such regulations.[83]

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[78]National Fire Protection Association (NFPA). *Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)*. NFPA 59A. Quincy, MA.

[79]Office of Pipeline Safety (OPS). Personal communication. August 22, 2003.

[80]TSA. Personal communication. August 18, 2003.

[81]TSA. Personal communication. May 28, 2003.

[82]TSA. Personal communication. May 28, 2003.

[83]TSA. Personal communication. May 22, 2003.

Federal Energy Regulatory Commission (FERC) Oversight

The FERC is responsible for permitting new land-based LNG facilities, and for ensuring the safe operation of these facilities through subsequent inspections.[84] The initial permitting process requires approval of safety and security provisions in facility design, such as hazard detectors, security cameras, and vapor cloud exclusion zones. Every two years, FERC staff inspect LNG facilities to monitor the condition of the physical plant and inspect changes from the originally approved facility design or operations.[85] The FERC derives its LNG siting authority under the Natural Gas Act of 1938 (15 USC 717). The agency has jurisdiction over all existing LNG marine terminals and 15 peak-shaving plants involved in interstate gas trade.[86]

In response to public concern about LNG plant security since September 11, 2001, FERC has emphasized the importance of security at LNG facilities. According to the commission, FERC staff played key roles at inter-agency technical conferences regarding security at the Everett and Cove Point LNG terminals. As part of its biennial inspection program, FERC also inspected 11 jurisdictional LNG sites "placing increased emphasis on plant security measures and improvements."[87] According FERC staff, the commission has added a security chapter to its LNG site inspection manuals which consolidates previous requirements and adds new ones.[88]

Industry Initiatives for Land-Based LNG Security

After the September 11 attacks, gas infrastructure operators, many with LNG facilities, immediately increased security against the newly perceived terrorist threat. The operators strengthened emergency plans; increased liaison with law enforcement; increased monitoring of visitors and vehicles on utility property; increased employee security awareness; and deployed more security guards.[89] In cooperation with the OPS, the Interstate Natural Gas Association of America (INGAA) formed a task force to develop and oversee industry-wide security standards "for critical onshore and offshore pipelines and related facilities, as well as liquefied natural gas (LNG) facilities."[90] The task force also included representatives from the Department of Energy (DOE), the American Gas Association (AGA), and non-member pipeline

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[84]U.S. Code of Federal Regulations. 18 CFR 157.

[85]Foley, Richard. Federal Energy Regulatory Commission (FERC), Office of Energy Projects. "Liquefied Natural Gas Imports." Slide presentation. January, 2003. p17.

[86]FERC. Personal communication. August 13, 2003.

[87]Federal Energy Regulatory Commission (FERC). *2002 Annual Report.* Washington, DC. p21.

[88]FERC. Personal communication. August 13, 2003.

[89]American Gas Association (AGA) *Natural Gas Distribution Industry Critical Infrastructure Security.* 2002. and AGA. *Natural Gas Infrastructure Security–Frequently Asked Questions.* April 30, 2003.

[90]Haener, William J., CMS Energy Corp. Testimony on behalf of the Interstate Natural Gas Association of America (INGAA) before the House Transportation and Infrastructure Subcommittee on Highways and Transit. February 13, 2002. p4.

operators. With the endorsement of the OPS, the INGAA task force issued security guidelines for natural gas infrastructure, including LNG facilities, in September 2002.[91] The task force also worked with federal agencies, including Homeland Security, on a common government threat notification system.[92]

Key Policy Issues in LNG Security

Government and industry have taken significant steps to secure the nation's LNG infrastructure. But continued progress in implementing and sustaining LNG security faces several challenges. As discussed in detail in the following sections, agency officials are concerned about the public costs of LNG security, and the growth in those costs as LNG imports increase. Several federal agencies have jurisdiction of certain aspects of LNG security. While these agencies have cooperated in the past on safety regulation, facility operators are concerned that overlapping jurisdictions in LNG security may lead to regulatory confusion or redundancy. Finally, the recent trend to build new LNG marine terminals offshore may have security benefits for U.S. seacoasts, but may increase the vulnerability of the terminals themselves.

Public Costs of LNG Marine Security

Some policymakers are concerned about the public cost and sustainability of securing LNG shipments. Overall cost data for LNG security are unavailable, but estimates have been made for Everett shipments. The Coast Guard Program Office estimates that it currently costs the Coast Guard approximately $40,000 to $50,000 to "shepherd" an LNG tanker through a delivery to the Everett terminal, depending on the duration of the delivery, the nature of the security escort, and other factors.[93] State and local authorities also incur costs for overtime police, fire and security personnel overseeing LNG tanker deliveries. The state of Massachusetts and the cities of Boston and Chelsea estimated they spent a combined $37,500 to safeguard the first LNG shipment to Everett after September 11, 2001.[94] Based on these figures, the public cost of security for an LNG tanker shipment to Everett is on the order of $80,000, excluding costs incurred by the terminal owner.

Marine security costs at other LNG terminals could be lower than for Everett because they are farther from dense populations and may face fewer vulnerabilities. But these terminals expect more shipments. Altogether, the six active U.S. LNG terminals, including Everett, expect to have enough capacity for approximately 490 shipments per year by 2006. Currently proposed on-shore LNG terminals operating at capacity would more than double this number of shipments over the next decade

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[91]Interstate Natural Gas Association of America (INGAA) et al. *Security Guidelines Natural Gas Industry Transmission and Distribution*. Washington, DC. September 6, 2002.

[92]Haener, William J., February 13, 2002. p4.

[93]U.S. Coast Guard, Program Office. Personal communication. August 12, 2003. This estimate is based on boat, staff and administrative costs for an assumed 20-hour mission.

[94]McElhenny, John. "State Says LNG Tanker Security Cost $20,500." Associated Press. November 2, 2001. p1.

to over 1,000 per year.[95] Assuming an average security cost only half that for Everett, or $25,000 per shipment, annual costs to the public for marine LNG security would reach $25 million.

LNG security is not a line item in the DHS Appropriations Bill for 2004 (H.R. 2555); it will be funded from the Coast Guard's general maritime security budget. According to Coast Guard officials, the service's LNG security expenditures are not all incremental, since they are part of the Coast Guard's general mission to protect the nation's waters and coasts. Nonetheless, Coast Guard staff acknowledge that resources dedicated to securing maritime LNG might be otherwise deployed for boating safety, search and rescue, drug interdiction, or other security missions.[96] State and local agency costs *are* largely incremental, as they are mostly overtime labor charges for law enforcement and emergency personnel. These local resources could also be deployed in other public service or conserved altogether, especially in communities with tight budgets.[97]

Few, if any, interested parties have suggested that current levels of maritime LNG security ought to be reduced in the short term. Furthermore, the public costs of LNG security may decline as federally mandated security systems and plans are implemented. For example, new security technology, more specific threat intelligence, and changing threat assessments may all help to lower LNG security costs in the future. Nonetheless, the potential increase in security costs from growing U.S. LNG shipments may warrant a review of these costs and associated recovery mechanisms. Massachusetts state and municipal officials, for example, have argued that their increased LNG security costs should be paid by the Everett terminal owner.[98] The idea is similar to proposals that would impose additional fees on nuclear plant owners to offset the costs of increased federal government security services.[99] Other experts have suggested that LNG companies should potentially be required to contract private security to perform duties currently done by government agencies.[100] Some LNG companies have resisted such suggestions, reasoning that the millions of dollars in federal, state, and local taxes they pay should cover public law enforcement and emergency services.[101] Others have expressed a willingness to pay for "excess" security if it exceeds the level of security agency service ordinarily commensurate with corporate tax payments.[102]

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[95]Energy Information Administration (EIA). January, 2003. p7.

[96]U.S. Coast Guard, Port Security Directorate. Personal communication. August 12, 2003.

[97]McElhenny, John. November 2, 2001. p1.

[98]McElhenny, John. November 2, 2001. p1.

[99]U.S. Senate, Committee on Environment and Public Works. Report 107-3335. *Nuclear Security Act of 2002.* November 12, 2002. p17. This legislation was not passed.

[100]Daughdrill, William. H., Ecology and Environment, Inc. Lancaster, NY. Personal communication. August 7, 2003.

[101]McElhenny, John. November 2, 2001. p1.

[102]Dominion Resources, Corporate Security. Personal communication. Richmond, VA. August 19, 2003.

Federal Security Jurisdictional Issues

LNG facility owners have not reported problems with conflicting jurisdiction among federal security authorities, but they are concerned such problems might arise in the future. As noted earlier in this report, the Coast Guard, TSA, and FERC all have potentially overlapping security jurisdiction over certain facilities at onshore LNG terminals. For example, FERC's biennial LNG site visits explicitly include security inspections, and TSA oversees on-site pipeline security–but the Coast Guard asserts lead security authority over the entire terminal in its new maritime security regulations.[103] Under current authority, both the Coast Guard and TSA could both require their own facility security assessments for pipelines and LNG storage at LNG marine terminals. Among oil refiners, with marine terminals similar to those in LNG and also regulated by TSA and the Coast Guard, confusion is emerging over which federal agency has jurisdiction over certain security rules.[104] LNG peak-shaving plant operators reportedly have expressed similar concerns about potentially overlapping OPS and TSA security rules for their facilities.[105]

According to Coast Guard officials, the agency intends to avoid redundant LNG security regulations if facility requirements are covered under the existing regulations of other federal agencies.[106] Likewise, FERC staff expect to cooperate with other agencies that may have overlapping LNG security authority to ensure coverage and avoid redundancy.[107] The OPS, TSA, and FERC have been engaged in ongoing roundtable discussions with gas industry associations to address such regulatory concerns as they emerge.[108] But some LNG operators believe that cooperative efforts among these security agencies to clarify jurisdiction may not be sufficient. In the case of overlapping *safety* regulation for LNG terminals, for example, the DOT and the Coast Guard signed a memorandum of understanding delineating their responsibilities.[109] The DOT also signed an LNG safety memorandum with the FERC.[110] If overlapping LNG security oversight ultimately creates confusion or

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[103]U.S. Coast Guard, Port Security Directorate. Personal communication. August 12, 2003.

[104]Anonymous. "Industry Trends." *Oil and Gas Journal.* August 11, 2003. p7.

[105]Dominion Resources. Personal communication. August 21, 2003.

[106]U.S. Coast Guard, Port Security Directorate. August 12, 2003.

[107]Federal Energy Regulatory Commission (FERC), Office of Energy Projects. Personal communication. August 12, 2003.

[108]AGA. Personal communication. June 11, 2003.

[109]"Memorandum of Understanding Between the United States Coast Guard and the Research and Special Programs Administration for Regulation of Waterfront Liquefied Natural Gas Facilities." Washington, DC. May 9, 1986.

[110]"Memorandum of Understanding Between the Department of Transportation and the Federal Energy Regulatory Commission Regarding Liquefied Natural Gas Transportation Facilities." Washington, DC. April 16, 1985.

inefficiency, in the words of one LNG terminal operator, "maybe good, clean MOUs would help."[111]

Security Implications of Offshore LNG Facilities

Offshore oil and gas facilities have not been frequent terror targets, but they have been attacked in the past during wartime and in territorial disputes.[112] Since September 11, 2001, international concern about terrorist attacks on these platforms has grown.[113] Some experts believe terrorist attacks against offshore platforms have been on the rise recently in countries with a history of terror activity like Nigeria, Colombia and Indonesia–although many of these attacks may be economically, rather than politically, motivated.[114]

The current LNG industry movement to build new marine terminals offshore may reduce terrorism risks to ports and coastal communities, but may increase the risks to the terminals themselves. Because offshore oil and gas facilities are remote, isolated, and often lightly manned, some experts believe they are more vulnerable to terror attacks than land-based facilities.[115] Disruption of any single offshore LNG terminal would not likely have a great impact on U.S. natural gas supplies, but if several new offshore terminals were attacked in the future, the effects on natural gas availability and prices could have serious consequences for U.S. energy markets.

The LNG Security Challenge in Perspective

U.S. LNG facilities are high-profile terrorist targets, but compared to similar targets like oil refineries, fuels pipelines, and hazardous cargo vessels, LNG facilities are few in number. For example, based on data from the U.S. Office of Hazardous Materials Safety, 1,000 LNG tanker shipments would account for less than 1% of total annual U.S. shipments of hazardous marine cargo such as ammonia, crude oil, liquefied petroleum gases, and other volatile chemicals.[116] Many of these hazardous cargoes represent less of a risk than LNG, but many are just as dangerous and pass through the same waters as LNG.

Concerns about the security of U.S. LNG has received a great deal of public attention since September 11 due, in part, to heavy media coverage and the scrutiny of prominent politicians. But the LNG industry has a favorable safety record and currently reports no specific terrorist threats. Furthermore, LNG facility operators

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[111]Dominion Resources. Personal communication. August 21, 2003.

[112]George, Dev. "Piracy on Increase, Presents Threat to Offshore Structures, Vessels." *Offshore*. October, 1993. P25.

[113]McKenzie, Steve. "Submarine Terror Fear for North Sea Oil Rigs." *Scottish Sunday Mail*. August 10, 2003.

[114]Adams, Neal. "Terrorism in the Offshore Oil Field." *Underwater*. March/April 2003.

[115]Daughdrill. August 7, 2003.

[116]Office of Hazardous Materials Safety, Department of Transportation. *Hazardous Materials Shipments*. Washington, DC. October, 1998. Table 2. p2.

generally acknowledge that protecting their assets is in their best financial interest. Federal and regional authorities have been helping. Consequently, many experts believe that concerns about terrorist threats to LNG may be overstated and should not impede increased LNG imports. The head of the University of Houston's LNG policy research consortium made recent remarks along these lines:

> "Speaking very broadly, from all the information we have, we believe LNG can be used safely in the United States. Generally, we don't see LNG as likely or credible terrorist targets."[117]

LNG tankers, terminals and peak shaving plants are all being protected today. While the LNG industry continues to face challenges securing its infrastructure against terrorism, many analysts believe that more urgent security challenges lie elsewhere.

Conclusions

The U.S. LNG industry is growing quickly. While rising LNG imports may offer economic benefits, they also pose risks. LNG is inherently hazardous and its infrastructure is potentially attractive to terrorists. Both lawmakers and the general public are concerned about these risks. But the LNG industry has a long history of safe operations and has taken steps to secure its assets against terrorist attack. Recent studies have also shown that the potential hazard to the public of an LNG attack, while significant, is not as serious as is popularly believed. Federal, state and local governments have also put in place security measures intended to safeguard LNG against newly perceived terrorist threats. These measures are evolving, but a variety of industry and agency representatives suggest that these federal initiatives are reducing substantially the vulnerability of U.S. LNG to terrorism.

As Congress continues its oversight of LNG, policy makers may decide to examine the public costs and resource requirements of LNG security, especially in light of dramatically increasing LNG imports. In particular, Congress may consider whether future LNG security requirements will be appropriately funded, whether these requirements will be balanced against evolving risks, and whether the LNG industry is carrying its fair share of the security burden. Congress may also act to ensure that there is a clear division of responsibilities among federal agencies with a role in LNG security in an effort to minimize the possibility of regulatory confusion and balance agency missions with capabilities. Finally, Congress may initiate action to better understand the security implications of new LNG terminals offshore.

In addition to these specific issues, Congress might consider how the various elements of U.S. LNG security activity fit together in the nation's overall strategy to protect critical infrastructure. For example, it has been argued that maintaining high levels of security around LNG tankers may be of limited benefit if other hazardous marine cargoes are less well-protected. Likewise, costly "blanket" investments in LNG security might be avoided if more refined terror threat information were available to focus security spending on a narrower set of infrastructure

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[117]Behr, Peter. July 5, 2003. pD10.

vulnerabilities. U.S. LNG security requires coordination among many groups: international treaty organizations, federal agencies, state and local agencies, trade associations and LNG infrastructure operators. Reviewing how these groups work together to achieve common security goals could be an oversight challenge for Congress.