
Legal and Practical Concerns of Towing and Salvage Operations Relating to LNG Vessels

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SYNOPSIS: This paper will discuss the regulatory environment of LNG Shipping, the casualty history of LNG Shipping, and the legal and practical concerns which must be taken into consideration by those providing towing and/or salvage assistance to LNG vessels.

INTRODUCTION

"Just as the 19th century was shaped by coal and the 20th century by oil, people in the energy industry say, this century will belong to natural gas.

"International energy companies...and governments in gas-rich countries are aggressively championing the creation of a global market for natural gas...promoting the fuel as more plentiful and less polluting than oil and needed to sustain economic growth."

S. Romero, "Demand for Natural Gas Brings Big Import Plans, and Objections", *The New York Times*, June 15, 2005.

In his December 27, 2005 letter written "By direction of the Commandant [of the U.S. Coast-Guard]", Captain L.W. Thomas denied a request made by the City of Fall River, Massachusetts that the Coast Guard establish thermal and vapour dispersion exclusion zones for marine spills of liquefied natural gas (LNG) in part because,

"[t]he letters opposing establishment of exclusion zone requirements cite the proven safety record of the LNG industry, the robust safety features designed into LNG ships, and the effective safety and security procedures that have been established by regulation and industry best practices and guidelines. The safety record for the LNG industry shows no major marine incidents in nearly 40 years of service involving more than 40,000 cargo deliveries, and this includes regular LNG ship transits at ports with densely populated urban areas such as Boston, MA, and Tokyo, Japan."

In fact, there have been very few LNG vessel casualties of any sort publicly reported, and a bare handful of the sort to which salvors are called to respond. Consequently, there is little empirical data to draw upon when advising salvors and tug operators how to best protect their own interests while protecting and preserving the interests of their customers when called upon to respond to a LNG vessel casualty. The perceived risks associated with LNG may, in these circumstances, suggest the need for expansive protection written into response contracts. However, such protection in salvage contracts may adversely impact the salvors' awards, while actually protecting salvors from risks far less substantial than the perception. This paper will explore some of these risks and discuss ways of addressing them. In this

process, we will necessarily draw from lessons learned in dealing with casualties involving other than LNG vessels.

Whatever may be said at present will be subject to correction when greater experience with LNG vessel casualties has taught new lessons. Despite the favourable safety record of the industry up to the present, such greater experience will likely be forthcoming with increasing frequency as a consequence of the enormous expansion of the numbers and frequency of LNG shipments by sea to meet the growing energy needs of both the industrialized and the developing nations.

THE PRODUCT

Natural gas must be cooled to a temperature below -260 degrees Fahrenheit (-162.2 degrees Celsius) to become a liquid, in the process reducing its volume to 1/600 of that in its vapour state. As with other fuels, it is the vapour that burns, and the vapour/air mixture for natural gas will only burn when between the concentration limits of 5% and 15%.²

Natural gas consists primarily of methane, which is lighter than air. Liquid petroleum gas (LPG) consists primarily of propane and butane, which are heavier than air in their gaseous state. Whereas methane is cooled to make LNG, propane and butane are compressed to make LPG. Consequently, the most feared hazards of LNG and LPG may be very different, or at least the two products may react very differently in similar situations, despite similar public perceptions of risks. If LPG escapes from a storage tank (or a vessel) it will vaporise, but its vapour will remain close to the surface and dissipate largely by spreading horizontally. Escaping LNG will also vaporise, but its dissipation will be in a vertical plume along with such horizontal expansion as may result from the spread of the liquid or denser vapours still in the process of vaporisation.³

Many of the flammable vapours that come-off petroleum products which are liquid at atmospheric pressure and normal ambient temperatures, e.g. gasoline or crude oil, are also heavier than air and may therefore pose greater risks in some situations than natural gas.

GROWTH INDUSTRY

In the United States, LNG shipments represented 1% of gas consumption in 2000, but this increased to 3% by 2004. This was in part due to reductions in the pipeline sources relied

on from domestic production and from Mexico and Canada, but was also due to increased consumption.⁴ We do not have data for other countries, but would expect there to have been commensurate increases in LNG imports and consumption, and in some major cases, perhaps much greater increases.

The increasing demand for energy, combined with fewer known sources of oil, has made natural gas the crown prince of fossil fuels, with 2025 set as the year when natural gas will likely be the leading fossil fuel in the world.⁵ The relatively clean burning nature of natural gas also promotes demand for the product as an eco-friendly fuel in the era of concern for air pollution, acid rain, and other 'curses' of the industrialised age. There is also the advantage of cost.

"A typical barrel of oil commands roughly \$50 on the world market today [June 15, 2005], while 6,000 cubic feet of natural gas, its energy equivalent, is much less expensive. Even delivered from a pivotal Middle Eastern country like Qatar, it would probably cost \$18 to \$24, according to Bernard J. Picchi, a senior energy analyst with Foresight Research Solutions in New York."⁶

PRODUCTION AND MOVEMENT

Natural gas is found in most of the same places as oil e.g. Qatar, Iran, Russia, Angola, Yemen, and Algeria. The US is the largest consumer, and China and India have become rapidly growing markets.⁷ At present, there are seventeen terminals world-wide where LNG is liquefied and pumped onto LNG vessels, and forty terminals where it is pumped ashore into storage tanks from which it is vaporised and pipelined to end users.⁸ There are at present approximately 181 LNG carriers with a combined capacity in excess of 21 million m³ that operate between these terminals, and approximately 115 additional LNG carriers with combined capacity of more than 17 million m³ under construction or being planned.⁹ There are about 2 dozen outstanding applications for construction of new LNG discharge facilities in the U.S., and probably many more elsewhere in the world.

LNG tankers are double-hulled, and the LNG is stored either in double membrane containment systems made of special materials and located within the ship's inner hull, or in three-quarter inch (19-20mm) thick steel spherical tanks. In a membrane containment system, a secondary containment system surrounds the primary container. The insulation space between the two has sensing equipment to detect even the smallest presence of methane, possibly indicating a leak. In spherical tank vessels, the thick-walled tanks form a single containment, but these are considerably stronger than double membrane tanks. Most vessels currently under construction are of the double membrane tank design. Both types of LNG vessels have emergency shut down systems that activate when they identify potential safety problems.¹⁰

THE DANGERS

It is the particular nature of their cargoes and the construction of LNG vessels to accommodate those cargoes which give rise to the special concerns of responding salvors and tug operators. Otherwise, and in many cases despite that uniqueness, the responses will or should be much the same as for other tank vessels laden with energy producing cargoes.

Although LNG is reduced in volume by refrigeration, it stays at atmospheric pressure during shipment. As a liquid, it

weighs slightly less than half a similar volume of water. Therefore, if LNG is spilled, it will float and warm up through contact with air and water, and return to its gaseous state. As it vaporises, a vapour cloud resembling ground fog will form. Because of its low temperature, this cloud is initially heavier than air, but as it warms, it becomes lighter and will rise as it is lifted by the air, and it will be carried away by wind. LNG is nonetheless a hazardous material. The primary safety concerns for the potential consequences of a spill are attributed to (1) the cryogenic temperature, (2) its dispersion characteristics, and (3) the flammability of the LNG.¹¹

(1) Cryogenic Temperature

In contact with surrounding materials, LNG can cause injury, such as severe freeze burns, or damage, such as cracking of certain metals, i.e. mild steel decks and other vessel structural members.

(2) Dispersion Characteristics

LNG is not poisonous, but a cloud of vaporized natural gas could cause asphyxiation by displacing air and consequently the oxygen. Depending on cloud density, it may also spread horizontally increasing the risk of contact with an ignition source.

(3) Flammability

LNG is non-flammable, but its vapour is flammable in the right mixture with air. If the concentration of methane is less than 5%, it is too lean to burn. If the concentration of methane is greater than 15%, it is too rich, and the insufficiency of oxygen will prevent it from burning. Between those limits, it will burn.¹²

To burn, natural gas must also encounter an ignition source when within the flammable range. Otherwise, the vapour cloud will simply dissipate into the atmosphere. If the vapour cloud catches fire, it may constitute an enormous heat source. The vapour cloud can 'back burn' to the floating LNG. The quickly evaporating natural gas immediately above the pool of spilled liquid may create a "burning pool", and this can result in extensive damage to life and property.¹³

PROBLEMS TO ADDRESS¹⁴

As with any vessel casualty involving any cargo, there will be no imaginable limit to the problems which may at one time or another have to be addressed with respect to LNG vessel casualties. Surely, no effort will be made in this paper to be exhaustive. On the other hand, some of the problems unique to gas carriers, if not just to LNG vessels, seem fairly obvious. Of course, it is the nature of the cargo that makes handling a LNG vessel casualty different from handling others. Preventing that cargo from escaping its hull containment system, dealing with breaks in such systems and the resulting leaks, and safely handling the LNG, will be foremost in the minds of those responding. I shall briefly discuss some of those situations.

Situation: Hull opening permits sea water access into the cargo tank containment void space.

It is dangerous for sea water to penetrate the cargo tank insulation barrier and make contact with the cargo tank walls. This may result in the water freezing against the tank, and the consequential expansion due to the formation of ice may cause structural weakening which must be taken into account along with the other stresses imposed on the hull by

the means of response and the weakened condition of the hull resulting from the damage in the first place.

Sea water making contact with the cargo tanks will also result in heat transfer to the cargo causing additional "boil-off" gas in the cargo tanks. Usually, the cargo tank relief valves will lift so the gas can escape into the atmosphere unless the main propulsion machinery or auxiliary boilers can keep up with burning the excess gas, preventing relief valve lifting.

Situation: A cargo tank has been damaged and LNG is leaking.

Rapid vaporation of the LNG can be expected from its release into sea water and/or the atmosphere. If the gas ignites, there will be rapid burning which would accelerate the vaporation. Because natural gas is lighter than air, especially during burning, the flames and gases will tend to rise rather than spread horizontally. However, the natural gas at low temperatures closer to the escaping liquid pool may be heavier than air and will likely spread horizontally along the sides of the ship and across the surface of the water.

LNG vessels are typically equipped with high capacity sprinkler systems which can be used to extinguish flames. If there is no risk of ignition, it is probably safest to permit the LNG to vaporize and dissipate into the atmosphere until the breached tank is empty.

Another consideration with respect to breached cargo tanks is the damage which may be caused by the very cold temperature of the LNG coming in contact with the surrounding mild steel of the vessel. The surrounding steel should have sea water sprayed onto it to prevent it from becoming brittle because mild steel will shatter at LNG temperatures.

It is unlikely that any port would permit entry of a LNG carrier with its hull breached and gas leaking. It is also unlikely that a ship to ship transfer of cargo would be permitted until that type of leak has been stopped.

Situation: There is a leak in the cargo system; i.e. deck piping, 'boil-off' piping to the engine room, etc.

The crew/responders must determine the cause of the leak and try to isolate the line or vent it to the atmosphere. It is unlikely a LNG terminal will permit a vessel with a leaking gas line into port. If the leak cannot be isolated, the vessel will likely have to discharge all or part of her cargo to another vessel until the leak has been isolated and blocked, or the LNG supply to the leak has been exhausted.

Situation: The circumstances (e.g. grounding) of the LNG vessel require transfer of her cargo ship to ship.

- (a) Owners/responders must locate an available vessel(s) with sufficient capacity to receive the cargo.
- (b) Proper transfer hoses by type, diameters, flange compatibility, and lengths must be verified. Also, proper vapour (equalising) hoses must be available and connected during cargo transfer. The latter permit the gases generated in the receiving vessel's cargo tanks to return to the discharging vessel's tanks rather than be released into the atmosphere during transfer operations. The gases returned to the discharging vessel can then be blown out of the damaged vessel after completion of cargo operations to enable entry into the cargo tanks for inspection and repair.

- (c) Weather conditions must be suitable for the vessels to up to one another.
- (d) Fendering must be arranged and mooring compatibility must be verified before the receiving vessel is hired and sent to the site of transfer.
- (e) Owners/responders must provide protection from the wind and sea for the vessels to moor to each other if it is a grounding, or, in other situations, get both vessels to a site suitable for the STS operations.
- (f) Owners/responders must protect quality of the product. The receiving LNG carrier will likely have some cargo in her tanks to keep them cool while in ballast condition. Before transferring from one vessel to another with tanks which are already cool, a quality analysis of the gas in the receiving vessel should be carried out to assess the extent of contamination, if any, to be expected.
- (g) If the receiving vessel does not have any LNG in her tanks, time for cool down must be allowed because her tanks could be too warm for direct transfer. The receiving vessel will in that case receive some of the new cargo and direct it into her tanks through cooling nozzles to first cool the cargo tank surfaces before receiving the full flow of LNG.
- (h) Ballast tank/draft considerations must be taken into account. The normal discharge of LNG cargo requires that the vessel's ballast tanks be filled to maintain a constant draft of the vessel. If the ballast tanks of the damaged vessel are damaged, then damage control, longitudinal strength, hull shear stresses, and stability calculations will have to be performed before commencing cargo transfer.

Situation: Considerations for repairs:

- (a) LNG cargo tank and cargo system materials are special and require special repair procedures.
- (b) Cargo system piping, valves, and attachments are usually constructed of stainless steel. Repairs to these components require the availability of these materials and the expertise to weld and otherwise work with them. Planning amongst the owners, responders, and the repair facilities is required.
- (c) Cargo tanks are constructed of a variety of special materials, and these will require special availability and repair expertise.

EXPERIENCE WITH CASUALTIES

Insofar as we have been able to learn, all accidents to date involving LNG with a fatal outcome have occurred in the land based handling of the product.¹⁵ Major ship incidents involving LNG carriers include the El Paso Paul Kayser (1979) and the LNG Taurus (1979) groundings. There have also been several minor collisions, groundings, and other casualties, including the Norman Lady (2000) that was struck on the bottom by a submarine coming to the surface, but proceeded to port on her own, and the LNG Libra (1979), which suffered a tail shaft failure and had to be towed. None of these casualties has involved death or serious injury resulting from the peculiar nature of LNG.

El Paso Paul Kayser (1979)

El Paso Paul Kayser was a double membrane tanker of 125,000 m³ (approx. 165,000 cubic yards). She was en route from Algeria to the U.S. when she ran onto rocks at 19 knots and grounded in the Straits of Gibraltar in June 1979. She incurred heavy bottom damage over the entire length of

her cargo spaces, as well as flooding of the starboard double-bottom and wing ballast tanks, but there was no penetration of her membrane tanks and no cargo leakage. Salvors refloated the vessel and towed her to safe anchorage where the LNG was transferred to a sister vessel. No LNG was spilled.¹⁶

LNG Taurus (1979)

LNG Taurus is a LNG tanker of about the same size as **EI Paso Paul Kayser**, but of spherical cargo tank design. She ran aground in the Japanese port of Tobata at a speed of 12 knots when she swerved out of the channel to avoid a collision and struck a reef. The ship's bottom suffered extensive damage, but no cargo was lost in the accident. She was refloated by lightering to another vessel.¹⁷

LNG Libra (1979)

LNG Libra suffered a tail shaft failure and had to be towed into a position at sea off the Philippines where she performed a ship to ship (STS) transfer of her cargo, so she could proceed under two to a shipyard for repairs.¹⁸

Gaz Fountain (1984)

Gaz Fountain was a LPG carrier, not a LNG carrier. We mention it and the Selco Salvage response because this example may be of interest in connection with LNG vessel casualty responses under similar circumstances. **Gaz Fountain** was hit by three missiles while in the Persian Gulf during the Iran Iraq war. She burned with flames reportedly going 200m into the air. Her crew abandoned ship and Selco responded with water cannons and spray, extinguished the fire, then put a gasketed patch over the hole to ease the escape of gas under pressure and towed her to safety.¹⁹

EMPHASIS ON SAFETY

The shipping of LNG is surrounded by extensive safety and security measures. For example, the U.S. Coast Guard has issued regulations forbidding other vessels from operating close to LNG vessels in transit or docked at terminals. All LNG vessels in international service must comply with the major maritime treaties sponsored by the International Maritime Organization (IMO), such as the International Convention for the Safety of Life at Sea (the SOLAS Convention), and the International Convention for the Prevention of Pollution from Ships (the MARPOL Convention). LNG vessels must also comply with the IMO sponsored International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (the IGC Code). As with most such international mandates, the IGC Code is comprehensive in the breadth of its applicability, while leaving details to designers, builders, operators, and classification societies.

THE SANDIA REPORT²⁰

Because of the increased demand for LNG in the US, the US Department of Energy (DOE), Office of Fossil Energy commissioned the Sandia National Laboratories to analyse the potential threats of LNG. The Sandia Report has been prime source for some of the details relied upon for this paper. The key conclusions of the Sandia Report are that the risks from an accidental LNG spill, such as from collisions and groundings, are small and manageable with the safety policies and practices in place and applicable at the time the research for the report was done, and the most significant impact to public health and safety would likely result from close contact to LNG fires.²¹

THE ABS REPORT²²

For the same reasons, and also in 2004, the US Federal Energy Regulatory Commission (FERC) commissioned the American Bureau of Shipping to analyze the consequences of LNG marine spills on water and to prepare a report on that and other components of a complex study. The ABS Report along with the Sandia Report appear to be accepted as authoritative by all the US regulatory agencies involved in LNG transport.

INTENTIONAL BREACHES (TERRORISM)

It must be considered that salvors and tug operators will be called to respond to casualties resulting from hostile actions against or sabotage of LNG vessels. In this respect, many of the same principles apply as in the case of accidental breach, technically, operationally, and commercially. There will, however, be another layer of governmental authority involved because of the true criminal nature²³ of the acts causing the incident. The presence of criminal investigators on scene will inevitably impede the efforts of the responders, and this must be anticipated and taken into account when contracting.

TUG AND SALVAGE RESPONSE

It is reasonable to expect that over time LNG carriers will suffer all the same types of casualties that befall other vessels. There have already been breakdowns at sea, vessel strandings, and minor collisions. However, our research has revealed no cases, so far, involving major breaches of cargo compartments. Nonetheless, it should be expected such incidents will occur, and that they may very well occur in geographic areas where they may be most difficult to handle.

It is also reasonable to expect that response readiness will require tug and salvage operators to be prepared for all such casualties with the unique feature of the vessel's cargo in mind. Technical readiness will be essential, of course, as will operational readiness. For both of those, however, the response operator will be able to place some reliance for assistance on the staff of the vessel operator, and in most cases also on the crew of the vessel. Some decision-making will also be pre-empted by the intervention of governmental authorities. All such persons will have the same end result in mind – remedying the problem as promptly as may reasonably be done.

Response readiness also requires commercial readiness, and the responder who hopes to realise a fair profit while subjecting his own company and resources to minimal risks will not likely find much help from the operators of the casualty. Indeed, it will be in the interest of the latter to do as much as they can to transfer all the risks, financial and otherwise, from themselves to the responder, and to do so at the least possible cost to themselves and their insurers.

That means tough decisions will have to be made up front, at the time of the call for assistance. Will the responder once more stand by the age old position of being there to assist in solving the casualty operator's problems, but not there to make such problems his own? Will he be led, wittingly or not, into taking more responsibility than might be expected of him for other type vessels? Will he give up a potentially very generous award in order to avoid even the usual risks because of the perception of much greater risks arising from the LNG cargo? Will this additional caution result in an unnecessary financial penalty when considered by the court or arbitrator who hears the claim and makes the award? What will be the governmental intervention in what is done?

THE CONTRACT

Salvage, by definition, is done on a "no cure, no pay" basis. Salvage contracting will often employ the same "no cure, no pay" principle for determining the salvor's award.²⁴ Such contracts provide minimal direction on how the salvage operation is to be performed. Instead, the contract will leave that very much to the requirements of the situation as determined by the salvor. The contract will focus instead on commercial provisions after identifying the interests and terms.²⁵ Similarly, The International Convention on Salvage, 1989 (the 1989 Convention) provides minimal direction to the salvor, but instead lays out broad requirements such as acting to prevent pollution, using best endeavours on behalf of the salvaged interests, and defining how the reward for his performance will be determined.

Typical salvage contracts, and even the 1989 Convention, have evolved from a perception of salvage quite different from what the perception may be in the case of LNG vessel salvage. The major difference between LNG vessel salvage and salvage of other types of vessels is the perception of the risk to which the salvors are exposed. The real risk certainly include cryogenic burns and damage, vast fires, heat, and suffocation, in addition to all the traditional perils that the sea and the situation would pose to all vessels. The unusual aspect of LNG vessel salvage is, of course, the risk associated with the cargo. On board fires have always been a risk faced by salvors, but such risks are quite different when coming from a burning pool of LNG which may radiate lethal heat for a distance greater than two miles.²⁶

Salvors can generally be prepared for perils of the sea, but their lack of experience with LNG casualties may leave them ill-prepared for the potentially extreme risks they may face as a result of the unique features of LNG and the vessels built to transport it. In such circumstances, the concept of "no cure, no pay" may be less attractive than it would be for other type casualties. The salvor may then prefer a different, even if less remunerative, type of contract. There are of course other ways in which salvors can protect themselves in some respects, insuring that the economic risks are covered by the casualty vessel's interests. For example, the salvor could include and invoke SCOPIC²⁷ if operating under an LOF 2000 contract, or a SCOPIC equivalent if operating under a different form of "no cure, no pay" contract. That will ensure reimbursement of expenses, including the cost for equipment lost during the salvage operation, and at least some minimum award independent to a large degree on the measure of success.

However, before the salvor agrees to such an alternative solution, he must consider the implications and effect in the event of a successful salvage operation. This may be particularly crucial with respect to the salvage award. To the extent the salvor protects himself contractually from the risks associated with LNG vessel salvage, he will be "penalised" in the award because he will have removed one or more of the most important factors in Article 13 of the 1989 Convention for determining his award.

The specific concern in this regard will be the number of Article 13 criteria that are taken out of consideration when determining the award because the salvor protects himself from those risks. That could include "the salvaged value of the vessel and other property" if the salvor and vessel owner stipulate to a fixed value, irrespective of the value of whatever is eventually saved. Further, and more typically, the salvor may want to ensure compensation for his time and reimbursement for his expenses. To the extent he does not risk losses for those, that protection will also diminish the

award. Further, the risk of incurring third party liability, and other risks run by the salvors or their equipment, could be a major factor in determining the award unless the salvor protects himself from these risks in his contract.

In essence, any protective language the salvor writes into his contract will affect his final award. The salvor must always be mindful that salvage awards are not an exact science and any award fixed with such protective language will most certainly not be as great as an award fixed without such language. Even under LOF 2000 employing SCOPIC, the salvor will at a minimum risk giving up 25% of what might be a very generous award indeed.²⁸ Moreover, the greater and more generous the award, the greater his sacrifice will be for having protected himself from the risks.

On the other hand, if the salvor does not attempt to protect himself from those risks, but accepts them, the factors employed by Article 13 whether under an LOF 2000 or other contract, suggest a generous award especially enhanced by him taking those risks. That is, the salvor accepting the risks to his own personnel and equipment, as well as the risks to the casualty vessel and to his own finances (i.e. his risk of failure) will, combined with his showing of extraordinary skill and effort (which is necessarily involved in a successful LNG vessel salvage), to be highly valued in fixing his award.

In fact, many will argue that the perception of risks is far greater than the actual risk when dealing with LNG vessels.²⁹ If that is so, and if that public perception is also a perception of the court or the arbitrator, then it may be the salvor is taking substantially less risk than that for which he will be rewarded upon successful completion of the salvage operation.

CONCLUSION

Salvage is a risky business. Despite the safety record of LNG carriage by sea, there are certainly special risks associated with responding to casualties involving LNG vessels. These are all the usual perils, plus those resulting from the nature of the cargo.

Salvage responders rarely have the time once the emergency arises to assess every aspect of the casualty and tailor their response contract to a particular form that will enable the most equitable sharing of the risks. In the case of a LNG vessel casualty, it is likely the time to do so will be even shorter because of public and official demands for prompt action. Yet, this will be the time when the responder's staff will need to assure there is consensus amongst those responsible for technical, operational, commercial, and legal aspects of the response, and that the attention they are giving to their concerns when agreeing to contract terms is at least equal to that given by their counterparts working on behalf of the casualty vessel's operators and insurers.

That team of strategists must work quickly and act decisively. Depending on the circumstances, there may be some pressure also generated by concerns that a rival will take the contract. For all these reasons, it is essential that likely responders already have in place a good notion of the level of risks they will be willing to take, a good understanding of how those risks may arise, and a good foundation in the nature of LNG and the vessels that transport it – as well as the types of casualties one may expect from them.

- ¹ The author gratefully acknowledges the technical and legal research and writing assistance provided by Paula Hammarström Andersson, a Swedish lawyer serving in the New York office of Holland & Knight.
- ² Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water, Sandia National Laboratories, December 2004 (The Sandia Report).
- ³ *Consequence Assessment Methods for Incidents Involving Releases from Liquefied Natural Gas Carriers* (pub. ABS Consulting, May 13, 2004) (The ABS Report)
- ⁴ J.C. Wright, *The Developing Market for LNG in the United States*, PROCEEDINGS of the Marine Safety and Security Council, Fall 2005 p. 8 (USCG Proceedings).
- ⁵ S. Romero, New York Times, *supra*.
- ⁶ S. Romero, New York Times, *supra*.
- ⁷ S. Romero, New York Times, *supra*.
- ⁸ M. Barker, *The LNG Market and its Effects on Shipbuilding*, USCG Proceedings at 16-17.
- ⁹ *Id.* See also, Dr. A. Schneider, *LNG: What is it? Is it safe? What is the Coast Guard doing about it?* USCG Proceedings at 6-7.
- ¹⁰ M. Michot Foss, *LNG Safety and Security*, p. 53 (Pub. Center for Energy Economics, October 2003).
- ¹¹ The Sandia Report at 37-38.
- ¹² The Sandia Report, *supra*; See also, M. Michot Foss, *LNG Safety and Security*, p. 13, *supra*.
- ¹³ The Sandia Report at 46.
- ¹⁴ The assistance of Paul Hormann, B.S., M.E., M.B.A., Ch.Eng. in posing these issues and responses is gratefully acknowledged.
- ¹⁵ R. Kuprewicz, C. Goudey, C. Weimer, *Public Safety and FERC's LNG Spin*, p. 3 (pub. Pipeline Safety Trust, May 14, 2005).
- ¹⁶ Report of Board of Inquiry into Stranding of S/S EL PASO PAUL KAYSER on June 29, 1979 on La Perla off the Coast of Spain in the Straits of Gibraltar (El Paso Marine Company, 14 August 1979); F. Gavelli, *Liquefied Natural Gas Transportation*, USCG Proceedings, p. 33.
- ¹⁷ Archived files of Haight Gardner Poor & Havens, No. 4879-101.
- ¹⁸ Archived files of Haight Gardner Poor & Havens, No. 4879-121.
- ¹⁹ Capt. J.A. Carter, *Salvage of Cargo from the GAZ Fountain*, paper presented at the Gastech Conference, Nice, France, 1985.
- ²⁰ See footnote 2.
- ²¹ The Sandia Report at pp. 1-2.
- ²² See footnote 3.
- ²³ The words "true criminal nature" are used to distinguish these incidents from simple unintentional oil spills, resulting at worst from simple negligence and sometimes not even that, to which criminal prosecutors have in recent years responded with criminal charges against ordinary and well meaning people.
- ²⁴ See, generally G. Brice, *Maritime Law of Salvage*, (3d Ed. 1999).
- ²⁵ See, e.g. Lloyd's Standard Form of Salvage Agreement, 2000 (LOF 2000).
- ²⁶ The Sandia Report, *supra*, at p. 77.
- ²⁷ Special Compensation P&I Clause.
- ²⁸ Protection of this sort is a relatively new phenomenon, beginning most notably with LOF 1980 provisions. Before that, such protection might have deprived the salvor of an award based on salvage because of his forfeiture of the no cure, no pay privilege. *The Marquette*, 16 F. 777 (E.D. Mich. 1872).
- ²⁹ RADM G. Naccara USCG, *Attack on America: September 11, 2001 and the U.S. Coast Guard*, (USCG Oral History Program, 2 April 2002). See also, D. Bryant, *LNG Safety and Security Issues in the Post 9/11 World, (Myth versus Reality)*, (Holland & Knight, December 6, 2005).