The Marine Salvage Industry: Proven in Preventing Oil Spills

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Abstract: *The marine salvage industry plays a vital role in protecting the marine environment. Governments, industry and the public, worldwide, now place environmental protection as the driving objective, second only to the safety of life, during a marine casualty response operation. Recognizing over 20 years after the passage of the Oil Pollution Act of 1990 that the effectiveness of mechanical on-water oil recovery remains at only about 10 to 25 percent while the international salvage industry annually prevents over a million tons of pollutants from reaching the world's oceans, ten years ago the United States began implementing a series of comprehensive salvage and marine firefighting regulations in an effort to improve the nation's environmental protection regime. These regulations specify desired response timeframes for emergency salvage services, contractual requirements, and criteria for evaluating the adequacy of a salvage and marine firefighting service provider. In addition to this effort to prevent surface oil spills, in 2016, the U.S. Coast Guard also recognized the salvage industries advancements in removing oil from sunken ships and recovering submerged pollutants, issuing Oil Spill Removal Organization (OSRO) classification standards for companies that have the capabilities to effectively respond to non-floating oils. Ten years after the implementation of the U.S. salvage and marine firefighting regulatory framework, this paper will review the implementation of the U.S. salvage and marine firefighting regulations and non-floating oil detection and recovery requirements; analyze the impacts and effectiveness of these new policies; and present several case studies and recommendations to further enhance salvage and oil spill response effectiveness.*

Introduction: The marine salvage industry plays a vital role in protecting the marine environment. Governments, industry and the public, worldwide, now place environmental protection as the driving objective, second only to the safety of life, during a marine casualty response operation. Recognizing over 20 years after the passage of the Oil Pollution Act of 1990 that the effectiveness of mechanical on-water oil recovery remains at only about 10 to 25 percent while the international salvage industry annually prevents over a million tons of pollutants from reaching the world's oceans, ten years ago the United States began implementing a series of

comprehensive salvage and marine firefighting regulations in an effort to improve the nation's environmental protection regime.

In 2018, the International Salvage Union (ISU) provided documented salvage services to vessels carrying 3,213,228 tonnes of potentially polluting cargo and fuel during operations demonstrating the importance of the salvor's role in protecting the marine environment. The ISU also documented a significant increase in 2018 of vessels carrying crude oil and refined oil products 1,302,988 tonnes – up from 933,198 tonnes in 2017 – and a large increase in the number of containers involved in salvage cases, rising from 45,655 TEU in 2017 to 59,874 TEU in 2018 (ISU, 2019). The year 2019, was characterized by an increase in containership fires (Hand, 2019). In the period 1994 to 2018, ISU members provided services to casualty vessels carrying 31,419,604 tonnes of potential pollutants, an average of more than one million tonnes per year. The following table provides a summary of the 2017-2018 pollution prevention data:

2018 ISU Pollution Prevention Survey Results (tonnes)

	2018	**2017**
Number of services	224	252
Bunker fuel	111,796	135,995
Crude oil	978,000	798,620
Refined oil products	324,988	134,488
Chemicals	127,885	168,784
Bulk polluting/hazardous	743,100	1,418,344
TEU – tonnes equivalent	898,110 (59874 TEU@nominal 15 tonnes/TEU)	684,825 (45,655 TEU@nominal 15 tonnes/TEU)
Other pollutants	29,349	64,421
Totals	3,213,228	3,405,477

Table 1: 2018 International Salvage Union Pollution Prevention Survey Results

Ten years after the implementation of the U.S. salvage and marine firefighting regulatory framework, this paper will review the implementation of the U.S. salvage and marine firefighting regulations and non-floating oil detection and recovery requirements and analyze the impacts and effectiveness of these new policies. Based on this analysis, policy recommendations will be presented to further enhance salvage and oil spill response effectiveness.

U.S. Salvage Regulatory Framework: In 1982, the National Research Council's Committee on the National Salvage Posture prepared a study entitled, *"Marine Salvage in the United States*." The goal of the report was *"to assess the present national posture for coping with ship rescue salvage and towing situations for time-critical offshore salvage in general."* The report recognized that any analysis of salvage should involve *"those with financial interests in marine commerce – shipowners, operators, cargo owners, underwriters, and salvors themselves – and in addition the Federal Government as represented by the Navy, the Coast Guard and the Maritime Administration."* In 1994, the National Research Council published *"A Reassessment of the Marine Salvage Posture of the United States"* finding *"that the traditional salvage company, with dedicated vessels and personnel, was disappearing from the commercial salvage market due to high maintenance costs and fewer marine accidents."* Based on these studies and other analyses, in 1997, the U.S. Coast Guard began hosting public workshops *"to address issues related to salvage and marine firefighting response capabilities, including the 24-hour response requirement…"* (Federal Register, Vol 73, No. 251, Dec 31, 2008). These workshops and subsequent notices of proposed rule makings culminated in the publication of Salvage and Marine Firefighting Requirements for tank vessels in 2008 and non-tank vessels in 2009.

Nearly 20 years after the passage of the historic Oil Pollution Act of 1990, the U.S. "*amended the vessel response plan salvage and marine firefighting requirements for tank vessels*

carrying oil." These new regulatory standards recognized *"salvage and marine firefighting actions can save lives, property, and prevent the escalation of potential oil spills to worst case discharge scenarios"* (33 CFR 155.4010). The regulations also specify desired response timeframes for emergency salvage services, contractual requirements, and criteria for evaluating the adequacy of a salvage and marine firefighting service provider.

The following tables present the nineteen required salvage and marine firefighting services and the associated response planning timelines in hours based on the continental U.S. nearshore area, within 12 nautical miles (nm) of shore, and the continental U.S. offshore area, from 12 to 50 nm. For areas outside the continental U.S., the salvage and marine firefighting response timelines are based on a distance from the Captain of the Port city. Marine firefighting planning standards also identify timelines to the pier for operations in port.

Service	CONUS: nearshore area; inland waters; Great Lakes; and OCONUS: < or = 12 miles from COTP city	CONUS: offshore area; and OCONUS: < or = 50 miles from COTP city
Salvage	Response Time in Hours	Response Time in Hours
Assessment & Survey		
Remote Assessment & Consultation	1	1
Begin Structural & Stability Assessment	3	3
On-site Salvage Assessment	6	12
Assessment of Structural Stability	12	18
Underwater Vessel and Bottom Survey	12	18
Stabilization		
Emergency Towing	12	18
Salvage Plan	16	22
Emergency transfer onboard using external pumps	18	24
Emergency lightering	18	24
Other refloating methods	18	24
Making temporary repairs	18	24
Diving services support	18	24
Specialized Salvage Operations		
Special Salvage Operations Plan	18	24
Heavy lift	Estimated	Estimated
Subsurface product removal	72	84

Table 2: Salvage Response Planning Timelines

Service	At Pier	CONUS: nearshore area; inland waters; Great Lakes; and OCONUS: < or = 12 miles from COTP city	CONUS: offshore area; and OCONUS: < or = 50 miles from COTP city
Firefighting	Response Time in Hours	Response Time in Hours	Response Time in Hours
Assessment & Planning			
Remote Assessment & Consultation	1	1	1
On-site Assessment	2	6	12
Fire Suppression			
External firefighting teams	4	8	12
External Vessel firefighting systems	4	12	18

Table 3: Marine Firefighting Response Planning Timelines

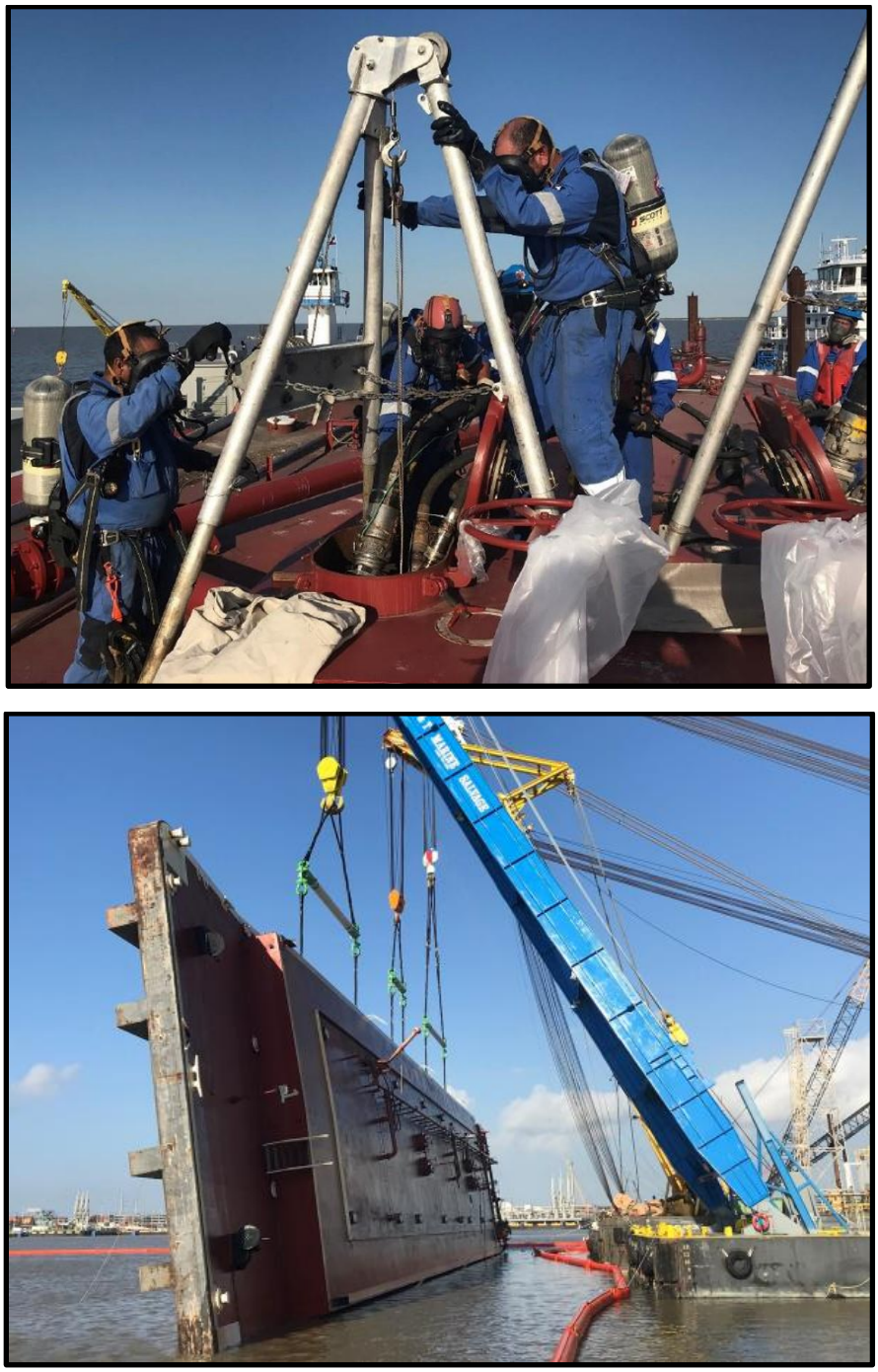
Implementation of the U.S. regulatory framework has increased salvage capacity and capabilities with pre-positioned salvage equipment now located in every major port, a robust personnel and contract network to facilitate rapid response and, as a result, reduced response timelines credited with reducing the volume of pollution. With the increase in salvage capacity, historically US-centric salvors now compete in the international marine salvage arena.

In contrast to the traditional Lloyd's Open Form (LOF), "no cure, no pay," contract used internationally that may have caused delays in response operations due to contract negotiations, the U.S. salvage and regulatory framework requires standing contracts between ship owners/operators and salvage and marine firefighting service providers with the expectation that the Vessel Response Plan (VRP) will be activated immediately during a marine casualty event. VRP activation will then initiate the response planning timelines with a remote assessment completed within one hour in an effort to stabilize the situation and prevent additional pollution.

A 2019 Houston Ship Channel ship and barge collision and the associated salvage response demonstrates the effectiveness of the U.S. regulatory framework and the ability of the marine salvage industry to prevent additional oil releases associated with a marine casualty

event. In May 2019, a tank ship and a two-tank barge tow collided in the Houston Ship Channel. One of the two barges, both carrying approximately 26,000 barrels of gasoline blend stock reformate, was opened amidships, releasing the contents of the port and starboard No. 2 cargo tanks. The second of the two barges capsized, inverted and subsequently grounded. Salvors quickly responded ahead of the regulatory planning standards to stabilize both barges and prevent additional oil releases. Portable hydraulic submersible pumps were used to simultaneously offload cargo from the four intact cargo tanks on the first barge to a receiving barge. After an underwater survey and towage to a sheltered area, the second barge was lightered in an inverted position using the vent lines connected to deep well pumps onboard the receiving barge. Cargo lines were used to supply nitrogen to maintain proper tank pressure and an inert status during lightering. Stripping lines were used to monitor tank pressure during lightering operations. The inverted barge was subsequently parbuckled using three derrick barges and towed to a shipyard.

Tank Barge Lightering Operation in Houston Ship Channel (T&T Salvage)



Tank Barge Lightering and Parbuckling Operations in Houston Ship Channel (T&T Salvage)

Non-Floating Oil OSRO Classification: In the past, oil spill response operations were primarily focused on mechanically recovering floating oil on the surface of the water. With increasing societal and environmental concerns, governments expanded oil spill clean-up operations to

include requiring attempts to detect and recover oil that sinks into the water column, collects on the bottom, or is covered by bottom sediment (DeVilbiss and Elliott, 2014).

In 2016, the U.S. Coast Guard issued new requirements for contractors to develop a capacity to recover sunken and submerged oil at all ocean depths, now collectively referred to as "non-floating oil" (U.S. Coast Guard, 2016). The Coast Guard's 2016 Oil Spill Removal Organization (OSRO) requirements were based, in part, on the American Petroleum Institute's 2016 *Sunken Oil Detection and Recovery Technical Report* and *Operational Guide* (API, 2016), that includes guidance on diving and submerged pumping operations, services within the capabilities of the salvage industry. The following table provides a summary of the non-floating oil detection and recovery capabilities outlined in the Coast Guard's 2016 OSRO guidelines.

Detection	Recovery
• Sonar Systems	• Suction Dredge
• Cameras / Video	• Diver-Directed Pumping and Vacuuming
• Diver Observation	• Mechanical Removal
• Towed and Stationary Sorbents	• Sorbent / V-SORS
• Laser Fluorosensors	• Trawls and Nets
• Visual Observations	• Mechanical Removal
• Bottom Sampling	• Agitation / Refloat
• Water Sampling	

Table 4: Non-floating Oil Detection and Recovery Methods

Given the equipment and expertise of the marine salvage industry, which includes hydrographic survey, heavy lift/rigging, contaminated water diving and pre-positioned hydraulic submersible pumping systems, the Coast Guard review process predominantly selected and classified NFO OSROs that were either salvors themselves or subcontracted a marine salvage company to meet the Coast Guard's non-floating oil detection and recovery standards.

The September 2015 non-floating oil response following the collision of two towing vessels on the Lower Mississippi River highlights the ability of the salvage industry to effectively meet these standards. On September 2, 2015, two towing vessels collided on the Lower Mississippi River near Columbus, Kentucky, that caused the release of 120,588 gallons of clarified slurry oil (CSO; Group V oil; Specific Gravity: 1.14) from a starboard cargo tank.

A salvage company was contracted to locate the sunken oil and to develop a plan that included diver assessments and a geo-referenced environmental clam shell system to recover the sunken oil and minimize waste disposal. The environmental clam shell design included vents to reduce the amount of water collected per grab while preventing the loss of recovered material. Additionally, the clam shell used computer software associated with six GPS transponders on the clam head to provide real-time imagery to the crane operator and unified command while tracking geo-referenced sunken oil recovery progress.

At the conclusion of this non-floating oil response, the Unified Command estimated that 50-75% of the sunken oil was recovered. The Federal On-Scene Coordinator also observed *"…although OSROs are well versed and skilled in on-water oil spill containment and recovery, the designated salvor was better positioned with greater breadth of expertise for allocating resources and implementing/managing tactics for sunken oil recovery"* (Sawyer et al, 2017).

Remediation of Underwater Legacy Threats: In 2013, the National Oceanic and Atmospheric Administration (NOAA), in coordination with the U.S. Coast Guard, published an analysis of known shipwrecks along the U.S. coast with the potential of containing oil cargo entitled the *Remediation of Underwater Legacy Environmental Threats* (RULET) study (NOAA, March 2013). This comprehensive study, that researched over 20,000 known shipwrecks, ultimately

identified 87 "high level" risk wrecks (NOAA, 2019). Since the publication of the NOAA RULET report, the marine salvage industry has effectively managed every response to these identified pollution sources. The most recent RULET wrecks remediated include the Tank Barge ARGO, a tank barge that sank in 1937 in Lake Eire carrying a high-benzene cargo, and the World War II-era Coimbra, that was torpedoed and sank off Long Island, New York, in 1942.

Salvage Industry Analysis: While salvage capacity has increased, in contrast, the highly competitive U.S. salvage market has reduced profit margins, retainer fees and salvage awards. The historically profitable international marine salvage market has also seen historic lows in the number of traditional Lloyd's Open Form (LOF) contracts and associated salvage awards driven, in part, by the downward global trend in marine casualty and oil spill incidents. As a result, in the past five to ten years, major salvage companies have merged while some have ceased to exist as companies strive to retain a competitive advantage in the evolving market conditions.

Historically, marine salvors received a "very ample reward" for assuming the high risks involved in saving a ship in distress.[1] The LOF contract, successfully used for over 100 years to expedite time-critical salvage operations, awarded the salvor a percentage value of the ship and the cargo.[2] This contract, however, appears to be falling out of favor with ship owners and underwriters. In 1982, there were 289 LOF cases and in 2014 only 37 LOF cases. Lowry notes *"Historic Lloyd's data shows that prior to 2003, there had never been any calendar year when fewer than 100 new LOF contracts were signed worldwide. But since then, usage of LOF has*

[1] U.S. Supreme Court; Mason v. The Ship Blaireau, 6 U.S. 2 Cranch 240 240 (1804)

[2] Crawford, M., (2017), *"Creating Synergies between Marine Salvage, Offshore Industries and Science,"* Soundings Magazine, Winter Edition, 2017. In this article, the author is quoted: "…for over 100 years the LOF has proven to both expedite needed operations while also serving as a contract fair to all parties."

crumbled rapidly and in 2016, just 48 new cases were recorded, the second-worst year ever following the 37 new LOFs inked in 2014" (Lowry, 2017). There were 55 LOF projects reported in 2018 (ISU, 2019).

Following the implementation of the U.S. salvage and marine firefighting regulations, the U.S. Coast Guard conducted a review of companies that were listed as salvage and marine firefighting service providers on VRP for ships entering the United States. This "verification process" reduced the number of salvors accepted to meet the regulatory standards from hundreds to only four companies. These four companies continued to be reviewed during exercises and salvage response operations where salvage, lightering, diving, transit, place of refuge and other plans are reviewed and approved by Federal and State government representatives. Additionally, the Coast Guard conducts additional administrative verifications that include a review of Geographic Specific Annexes and scenario-based tests of the salvor's response system and network.

The requirement for standing contracts with VRP plan holders was a historic change in the way salvage response operations have been managed. The result has been a large-scale shift in the way salvors are paid, from the traditional LOF contract with an award, to predominantly "time and materials" contracts with openly published standard rate schedules. This transparency has created intense competition, lowering retainer fees and profits, and pushing U.S. based salvors to diversify services and operate internationally.

In addition to the revolutionary impact on the U.S. marine salvage industry, the past ten years of implementing the 2008 tank vessel and 2009 non-tank vessel salvage and marine firefighting regulations have revealed unforeseen issues that should be addressed. These issues

include inconsistent VRP activation, the lack of regulatory applicability to vessels carrying Group V and Liquefied Natural Gas (LNG) cargoes and the offshore oil and gas industry, the acceptability of the reliance on vessels of opportunity, and the organization of public and private marine firefighting services.

For salvors to initiate a response, the vessel owner/operator, or their designated Qualified Individual, must first "activate" the VRP. Delays in VRP activation, in turn, result in delays in stabilizing vessels in distress and increasing risks of an oil spill. It can be argued that delays deviate from the intent of the National Contingency Plan (40 CFR 400) that states, after ensuring the safety of life, *"Stabilizing the situation to preclude the event from worsening is the next priority. All efforts must be focused on saving a vessel that has been involved in a grounding, collision, fire, or explosion, so that it does not compound the problem"* and *"Defensive actions shall begin as soon as possible to prevent, minimize, or mitigate threat(s) to public health or welfare or the environment."*

The U.S. Salvage and Marine Firefighting regulations restrict applicability to vessels carrying Group I to IV oils (33 CFR 155.4010). As such, the salvage response standards do not apply to vessels carrying Group V, LNG fueled vessels, or the offshore oil and gas industry – all potential significant sources of marine oil spills. For example, the response to the largest Group V oil spill in U.S. history, resulting from the 2005 capsizing of the tank barge DBL 152 off Calcasieu, Louisiana, and the largest oil spill in U.S. history, resulting from the 2010 Macondo subsea well blowout, would not be addressed by regulations that require a rapid salvage and marine firefighting response posture.

Tank Barge DBL 152 Releasing a Group V Oil Cargo (Source: U.S. Coast Guard)

Since salvage and marine firefighting regulations do not apply to LNG cargoes, there is arguably less incentive for the salvage industry to invest in cryogenic hoses and systems that often come with a shelf life, unless this need is articulated by a proactive shipowner. In the absence of regulations, the Society of International Tanker and Terminal Operators (SIGTTO) has published guidelines for LNG STS transfer operations. The U.S. Coast Guard notes, *"All risks identified with the handling of LNG are serious and demand comprehensive risk assessments and risk management strategies"* (Hickey, 2014).

As supported by current U.S. regulations, the salvage and marine firefighting industry relies predominantly on a network of over 7,000 vessels of opportunity to carry salvors and portable salvage equipment to the site of a marine casualty. It has been argued there should be pre-positioned salvage vessels in every port on ready standby to respond to a marine casualty event due to a potential delay in finding a suitable asset. In the United Kingdom, for example, government funded salvage tugs are on standby in select UK regions. Complicating this issue is

the recent implementation of Coast Guard inspection requirements (46 CFR Subchapter M) for previously uninspected tug boats, resulting in the potential reduction of vessel routes and manning. For example, tugs that previously allowed to carry salvors offshore may be restricted to nearshore with reduced manning and carriage capacity.

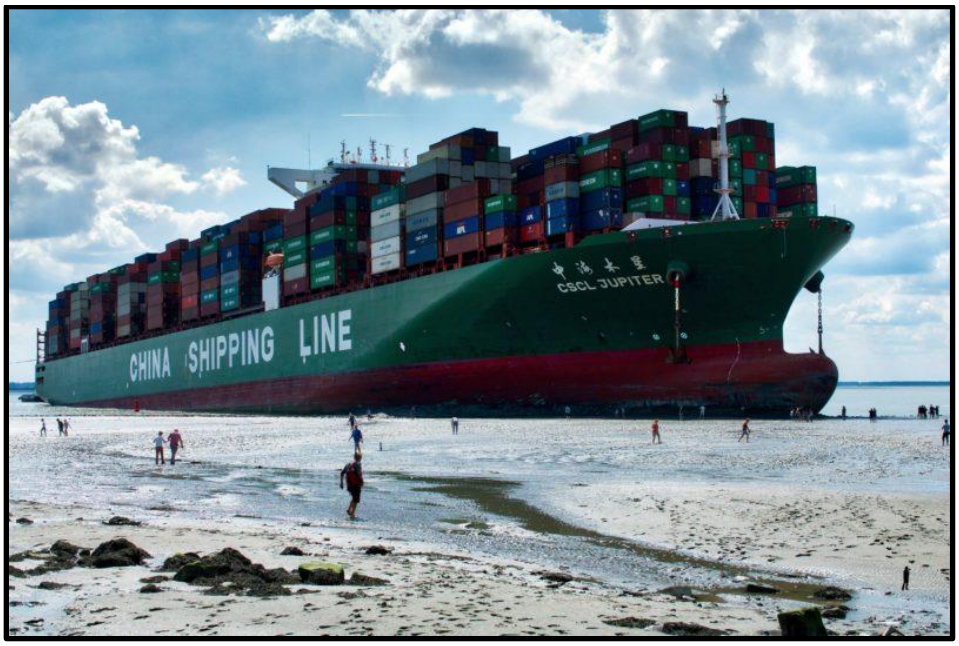
Marine fires have been an initiating factor in multiple oil spill incidents. While firefighting, in general, has historically been a "public good" funded by governmental entities or provided on a volunteer basis, from a business perspective, marine firefighting is not a profitable or sustainable venture. As a standalone business, a company focused solely on marine firefighting will fail without retainer fees or supplemental financial support. Despite these factors, to meet the full suite of U.S. salvage and marine firefighting standards, commercial salvors have pre-positioned marine firefighting equipment around the U.S. and in COTP Cities outside the continental United States in an effort to comply with the salvage regulations. Separately, the U.S. government and various States have provided grants to support the purchase of multiple fire boats. Many municipal fire departments have robust marine firefighting capabilities; however, the U.S. regulations require written consent agreements with commercial salvors to be named in a VRP. While marine firefighting consent agreements have been agreed upon in a few major ports, such as New York and Long Beach, they have yet to be executed in the majority of U.S. ports. Lacking these agreements, there is a potential that marine firefighting operations could be delayed or hampered due to inadequate command and control or an uncoordinated tactical response, increasing the risk of an oil spill event.

A General Accountability Office (GAO) study was initiated in 2019 to review the Coast Guard's implementation of the salvage and marine firefighting regulations and the alternative compliance program, among other national response issues.

Future Challenges: In addition to market and regulatory pressures, marine salvors face additional future challenges, including the unprecedented increase in vessel size, often referred to as "megaships"; the growth of LNG as both a cargo and vessel fuel; and the expansion of the oil and gas industry into deeper, more distant offshore regions.

Megaships: In shipping innovation, growth in the size and complexity of ships as shipping companies strive to obtain economies of scale and the associated cost efficiencies has an impact on the marine salvage industry. *The Geography of Transport Systems* notes *"For ship owners, the rationale for larger ships implies reduced crew, fuel, berthing, insurance and maintenance costs. The largest tankers (ULCC) are around 500,000 dwt (dominant size between 250,000 and 350,000 dwt), while the largest dry bulk carriers are around 350,000 dwt (dominant size between 100,000 and 150,000 dwt). The only remaining constraints on ship size are the capacity of ports, harbors and canals to accommodate them"* (Rodrigue, Notteboom and Slack, 2017). In addition to tank vessels, containerships, passenger vessels, ore carriers, liquefied gas carriers and other vessel designs continue to increase in size. Today, for example, the largest container ship exceeds 191,300 dwt and with over 21,400 TEU.

Megaships present significant challenges to marine salvors involved in responding to collisions, groundings, fires and other marine casualties. For example, the limitation in heavy lift assets in most ports often delays time critical response operations – the size and complexity of these ships may ultimately multiply these issues. The ISU notes *"The rapid development of megaships, including container ships, LNG carriers, ore carriers and passenger ships probably present the greatest challenge to salvors for the future. The sheer size of these vessels will make salvage difficult but not impossible"* (ISU, 2016).



Grounding of the Ultra-Large Container Vessel CSCL JUPITER (Source: Anton v/d Aarssen)

Following the grounding of the 14,074 TEU ultra-large container vessel CSCL JUPITER in August 2017 on the river Scheldt, Wackett observed that an unprecedented 16 tugs were required to pull the ULCV off ground at high tide *"raising questions about the ability of salvage facilities to tackle a major incident involving the new megaships."* The Allianz Global Corporate and Specialty assessment also noted *"Naval architects will be challenged with limited options for ballasting, maintaining or recovering stability, all the while ensuring structural integrity. All casualties requiring the assistance of salvors are difficult as each one presents its own unique set of circumstances. Because of their magnitude, salvage of an ultra large ship unites those challenges"* (AGCS, 2017).

Liquefied Natural Gas Carriers: With the increase in LNG and other liquefied gases shipped and transferred by ships, larger gas carriers to achieve economies of scale, and the increasing acceptance of LNG as a marine fuel, there is an associated increasing risk of marine casualties associated with vessels carrying liquefied gases, including LNG as both a cargo and

fuel. While ship-to-ship lightering involving LNG and other liquefied gases have been successfully completed on multiple occasions, emergency lightering is rare and pre-positioned lightering packages, like that found in the salvage industry for traditional oil cargos and fuels, are also comparatively limited.

Oil and Gas Industry / Offshore and Subsea: The growing deep-water infrastructure creates the need to address subsea blowout and intervention scenarios. The salvage industry's ability to immediately respond to marine casualty incidents combined with the industry's traditional tools of the trade – deep-water recovery, Remotely Operated Vehicles, and salvage engineering services – could enhance offshore and subsea oil spill response practices. Additionally, the application of salvage response timelines, like that required of the shipping industry, to the offshore oil and gas industry could potentially help prevent and minimize offshore oil spills.

Policy Recommendations: As a comprehensive assessment of the salvage industry has not been published since 1994, a National Research Council reassessment is recommended to review the state of the marine salvage industry and to allow stakeholders to make informed decisions. Additionally, based on this paper's analysis, the following policy recommendations should be considered:

- Expand the applicability of the U.S. regulations to vessels carrying Group V and LNG cargoes.
- Develop and implement salvage and marine firefighting standards for the offshore oil and gas industry, including standards and response timeframes for both subsea intervention and fixed platforms.

- Nationally coordinate marine firefighting assets to include holistic contingency vessel response planning that includes both publicly funded resources and private industry.
- Implement a classification system for Salvage and Marine Firefighting service providers, similar to the OSRO standards, that quantify resources and capabilities.
- Manage the prioritization and contracting of potentially polluting sunken wrecks at the national level.

Biography

Jim Elliott is Chief Operating Officer of the Teichman Group of Companies, including T&T Salvage and T&T Subsea, and the immediate past President of the American Salvage Association. He is responsible for managing worldwide marine salvage, heavy lift, commercial diving and emergency response operations while simultaneously managing multiple companies. With three decades of leadership experience in maritime operations, he has served as a senior Coast Guard Officer, Incident Commander, Salvage Master, Commercial Diver and Project Manager on salvage and oil spill response operations from the Equator to the Arctic. Jim holds a Bachelor of Science in Environment Management with distinction, a Master of Environmental Policy with honors, Master of Arts in National Security and Strategic Studies with highest distinction from the U.S. Naval War College and MBA with merit from the University of London. Additionally, he has earned over 75 Federal, State and industry awards and medals, including the U.S. Coast Guard's prestigious Inspirational Leadership Award and Commercial Diving Hall of Fame.

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