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MS ″SEA DIAMOND″ WRECK REMOVAL

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Thesis submitted to the Secretariat of the MSc in International Shipping, Finance and Management of the Athens University of Economics and Business, in partial fulfillment of the Requirements for the Master's Degree in International Shipping in Finance and Management

31st, October, 2018

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CERTIFICATION OF THESIS PREPARATION

I hereby declare that this particular thesis has been written by us, in order to obtain the postgraduate Degree (MSc) in International Shipping, Finance and Management, and has not been submitted to or approved by any other postgraduate or undergraduate program in Greece or abroad. This thesis presents my personal views on the subject. All the sources I have used for the preparation of this particular thesis are mentioned explicitly with references being made either to their authors, or to the URLs (if found on the internet).

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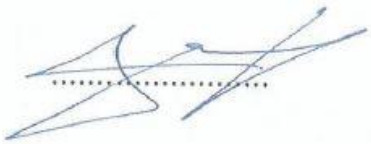

AKNOWLEDGEMENTS

We would like to express our deepest sense of gratitude and appreciation to our supervisor and motivator Professor Nicholas Berketis for his patient guidance, his helpful advice and his continuous encouragement regarding the accomplishment of our dissertation.

Trisevgeni N. Kollia

Afroditi E. Moraiti

I would like to express my sincere appreciation to Mr. Constantinos D. Vernicos who gave me the opportunity to attend the MSc program in International Shipping Finance and Management provided by the Athens University of Economics and Business. Deserving of special mention are Mr. Jean – Jacques Benzonana, Chief Executive Officer of Vernicos Tugs and Salvage, for devoting his precious time giving me information that I would have never acquired by myself as well as Admiral Mr. John Zoumboulis, legal counsil of Vernicos Tugs and Salvage, for providing me with relevant documents. Last but not least, I wish to record my recognition to my friend and colleague Ms. Afroditi Morati whose positive energy made everything happen smoothly, C for enduring me and above all, my parents for their eternal love and support.

Trisevgeni N. Kollia

From my side, I want to express my earnest regards to Professor Fani Sakellariadou, who devoted time answering questions posed by us and provided information on important environmental issues related to the shipwreck. I would also like to thank my colleague and primarily my friend Ms. Trisevgeni Kollia for the excellent cooperation during this thesis and her kind assistance any time I needed throughout these two years. Finally, I would like to thank my parents for their support and helpful advice at that time when I decided to start this MSc Program.

Afroditi E. Moraiti

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ABSTRACT

In April 2007 the 1,500 passenger cruise ship ″SEA DIAMOND″ was involved in a tragic incident which resulted to the loss of two lives and the sinking of the vessel off Santorini Island. In addition, vessel's fuel, diesel, lube oil tanks as well as slops tanks were damaged while sinking causing a serious oil spill which threatened both the environment of this geologically significant place and the flourishing tourism trade of the island.

In our dissertation we intend to provide thorough information about the incident as well as the ship itself and try to compare it to other cases so as to correlate them.

As already known, under the supervision of the Greek authorities, both the owners and the insurers of the vessel teamed up with international experts and national clean-up responders to mount an emergency operation to counter this threat. As a consequence, this timely and professional operation managed to remove, directly from the sea surface, a large part of the released oil, thus limiting the contamination of the shores of the island. We shall briefly summarize the incident and the emergency on-water oil spill response operation, setting the achievements in relation to the obstacles faced and advantageous circumstances experienced. Above all, the choices of equipment used, strategies developed and practices employed are described so as to capture lessons learned for future use in similar potential cases.

Furthermore, we shall mention most common wreck removal techniques along with the cases where they were applied as well as several thoughts that should be taken into consideration before deciding to undertake a wreck removal operation.

In the context of the above, we intend to discuss possible options, obtain views from market experts, such as shipowners, P&I Clubs, adjusters and insurance brokers. Our results will reach interesting conclusions for further consideration in the area of wreck removal operations.

INTRODUCTION

Recently the former Greek Minister of Mercantile Marine ordered the removal of the cruise ship ″SEA DIAMOND″ (Appendix I) without any provisions as to who would pay for the wreck removal. Since 2007 the local community urges each government to remove the wreck of the sunken vessel and consider it a toxic bomb ready to explode hanging from a steep underwater cliff off Santorini Island.

Shipowning Company, Louis Cruise Lines (current Celestyal Cruises) asserts that pollution odds have been eliminated as the anti-pollution operation was completed successfully. On top of that, samplings and tests carried out by the Hellenic Center of Marine Research[1], confirm that the adjacent marine environment is not at risk. In our effort to contact the West of England P&I Club, Mr. Ian Stuart Clarke replied quote, I am afraid that the Club's policy is not to comment on on-going legal matters. Additionally, this one is politically sensitive in Greece and I would not wish any comments to be misinterpreted by readers of your dissertation, unquote.

Although Mr. Clarke politely refused to give us some further information regarding the incident, his answer implies that the case of ″SEA DIAMOND″ still remains a major and quite sensitive subject for the Greek community.

[1] HCMR (Hellenic Centre for Marine Research)
HCMR is a governmental research organisation. Its main objectives are to conduct multidisciplinary applied and basic research in various different areas such as structure and functioning of inland, coastal and marine ecosystems, effects of natural and human-induced pressures and hazards on the marine environment (e.g. oil spills, pollution etc.). HCMR's mission is to provide advice to national, Mediterranean and EU institutional bodies on environmental sustainability and management by acting also as an adviser to the government on oil pollution from maritime activities and accidents, management of water resources, and marine strategy implementation.
https://www.hcmr.gr/en/

LITERATURE REVIEW

Eleven years have already passed since the sinking of ″SEA DIAMOND″ off Santorini thus numerous articles and studies have pointed out the significance of the accident along with the urgent need for the wreck to be removed due to its serious environmental impacts.

While studying several of those, we noticed that Professor Evangelos Gidarakos (Technical University of Crete, School of Environmental Engineering) has extensively dealt with this topic posing his opinion in various articles, being absolutely sure that the shipwreck should be removed. We mainly focused on his article “The "SEA DIAMOND" shipwreck: Environmental impact assessment in the water column and sediments of the wreck area” where research is conducted to examine the pollution in the vicinity of the shipwreck. For the record, samples of sediments and fish showed a serious deterioration of the situation compared to 2011 and an increase in the concentration of toxic substances which is most likely caused due to the existence of the ″SEA DIAMOND″ wreck. In fact, the presence of toxic substances in high concentrations is also worrying as it shows that the food chain is threatened as well. We tried to contact him in order to pose several questions regarding the subject matter but unfortunately, we did not manage to reach him.

On the other hand we came across several opinions, based on studies as well, supporting that the contamination rates are negligible. The most important report is the one carried out by the Hellenic Centre of Marine Research during mid 2012 covering one - year period (Appendix II). By the same token Mr. David Ashley Pockett, director of London Offshore Consultants the company that participated in designing the plan according to which the wreck removal of the ″Costa Concordia″ was carried out, also suggested that the situation is not as bad as it may seem. According to relevant

article in Naftemporiki[2], during the Trial of ″SEA DIAMOND″ at the Court of Piraeus Mr. Pockett mentioned among others that "...lifting has insurmountable technical difficulties and poses serious safety issues that make any such thought impossible".

Another important part of our research was based on the cases of ″Costa Concordia″ and ″Kursk″. For the first case we gathered information from the official website of TITAN Salvage (Ardent Global), as for the latter we visited the website of SMIT, the company that along with Mammoet assumed the responsibility of Kursk wreck removal. Taking these two cases under consideration, we elaborated on the key aspects that may be compared to the case of ″SEA DIAMOND″.

As demonstrated in the presentation of Professor Nicolaos Ventikos titled ″Shipwrecks: Introduction, Problems & Solutions″, there are several methods of wreck removal each of which carries its own advantages and disadvantages. Prior studies have thoroughly presented similar cases of wrecks in accordance with the removal ways applied to each, so as to conclude in successful and safe operations. Based upon research we tried to reach safe assumptions concerning which of these methods can be deemed optimal with reference to our case.

A thorough study of the paper ""″SEA DIAMOND″ 3 Years on Dealing with continual leakage from sunken wrecks", which was presented in 2010 at the First Adriatic Oil Spill Conference in May 2010 by Dr. Michael L. O'Brian, helped us conceive the size of the pollution emerged from the sinking of the ″SEA DIAMOND″. Within the paper, Dr. O'Brien helped us visualize the situation by comparing the case of the ″SEA DIAMOND″ to several different cases such as M/T ERIKA (1999), M/T PRESTIGE (2002), M/T SOLAR 1 (2001), M/T YUIL No1 (1995) and M/T OSUNG No1 (1997). Abovementioned cases are ranked in descending order according to each

[2] https://www.naftemporiki.gr/finance/story/1293227/pieseis-stis-asfalistikes-gia-to-sea-diamond

vessel's Gross Tonnage and depict different cases of marine pollution through continual oil leakage.

While studying the Paper "The oil spill response to the ″SEA DIAMOND″ incident", of Dr. O'Brien and Dr. Mamaloukas we perceived the technical background of the case as we came across with rigorous descriptions of the technical operations carried out that prevented the oil spill from expanding. It is quite indisputable that the case of the ″SEA DIAMOND″ was one of the most efficiently handled cases in terms of anti-pollution operations. Thus, it was our intention to provide as much information regarding the immediate response as well as the accuracy of relevant operations.

The presentation of Lloyd's Marine Conference which focused on Wreck Removal was separated in three parts. The first part presented by Mr. Mark Hoddinott, General Manager International Salvage Union, helped us understand the legal background of a casualty and to be more specific informed us in a simple way about who pays for what by providing statistics from Insurance Companies as well as case studies. Within the second part Mr. Mike Kelleher, Director West of England Insurance Services, dealt with the matter of the continuously increasing cost of the wreck removal operations and analyzed the reasons behind that fact. In the third part, Mr. John Wickham, co-founder of MTI Network, addressed that a casualty should be treated like a crisis and consider it as a wide situation that can harm the reputation of firms involved. He also promoted the idea that there are several issues concerning the undertaking of a wreck removal, even the casualty itself, that shouldn't be overlooked.

The paper "To remove or not to remove" presented by Mr. David Campion, Mr. Mark Whittington and Ms. Ann Zhang members of the International Tanker Owners Pollution Federation at the

International Oil Spill Conference, examines recent issues regarding the treatment of wrecks as with recent developments in salvage technology and equipment, the options for pollutant removal from wrecks, and the removal of entire wrecks make plausible scenarios which were previously deemed infeasible. Along with a general heightened environmental concern worldwide about impacts to the marine environment, decision-making on wreck removal and associated pollutants is highly promoted through fruitful reviews and comparisons.

Lloyd's publication "The challenges and implications of removing shipwrecks in the 21st century" by James Herbert, Managing Director of Gem Communications Limited, was one of the basic sources of information for our dissertation. It refers to multiple areas regarding wreck removal operations such as:

- The increasing cost of dealing with wrecks over the past years in relation to the costs associated with a small number of notable cases that have risen significantly
- The existing inconsistencies in the regulatory framework which governs wreck removal regulations, which can create uncertainty
- The important role of the relevant authorities in coastal regarding the conduct of wreck removal operations
- Complexity regarding removal operations as the use of heavy lifting equipment may be scarce
- Environmental considerations are a key factor in wreck removal operations and have significant cost impacts
- Key considerations as location of the wreck, vessel size, cargo volumes drive up wreck removal costs
- The human element remains a significant factor in the cause of the majority of casualties and therefore wrecks
- As the costs of wreck removal rise, so do the costs to insurers and consequently ship-owners

- Collaboration between all stakeholders is required to address the issues relating to wreck removal

During our research, we considered it useful to acquire information through interviews from entitites related to the casualty within different sectors. In this respect, the interview of Mr. Jean – Jacques Benzonana, Chief Executive Officer of Vernicos Tugs and Salvage, constitutes a great contribution to our thesis as the latter was more than willing to answer our question. Another crucial point during our research is when Professor Fani Sakellariadou devoted time to answer questions regarding her approach on this matter. The question raised was clear: What lessons we need to take from this incident so that something similar is avoided next time? Professor Sakellariadou underlined the necessity of precautionary measures along with a plan based on the prevention.

It would be also important to consider which is the position of the vessel's P&I Club policy to this matter. However, Mr. Ian Stuart Clarke, CEO of West of England (Hellas) Ltd did not wish to disclose any information to us since it is still an on-going legal matter. We also tried to get information from the current Minister of Marine Affairs Mr. Fotis Kouvelis, who took over responsibilities very recently on the grounds that he may have a plan to handle the situation in a way different than his counterparts. However the Ministry responded to our above request (Appendix III), the information provided were either too general or already acquired through other sources thus already included in our dissertation. Additionally, we contacted Celestyal Cruises (ex. Louis Cruises) so as to get in touch with the shipowning company, responsible for the shipwreck. Apparently, the Company did not even respond to our kind request for posing an interview regarding the incident. Same stands for the Union of Residents in Thera who did not reply when asked about their opinion.

This research purpose is to help reader conceive the different opinions regarding the shipwreck of ″SEA DIAMOND″. Since it was an incident of great impact in our country, we found it necessary to refer to many different articles and reports published from various newspapers and blogs.

Indeed, there has been much research and discussion conducted on this topic. Our goal is to have presented as many views as possible, always based on subjectivity and transparency.

1. BACKGROUND INFORMATION

1.1 VESSEL SPECIFICATIONS

MS "BIRKA PRINCESS" (IMO no. 8406731) was a cruise vessel flying the Finland flag, operated by Birka Line Abp Louis. She was built in 1984 by Oy Valmet Ab, Helsinki and her newbuilding price was US$52,191,840. She started operating in 1986 until 1999 when her rebuilt commenced in Netherlands. In 2006 she was sold to the Cyprus-based Louis Cruise Lines for US$35,000,000 and started operating as MS ″SEA DIAMOND″.

Exhibit 1: MS ″Birka Princess″ & MS ″SEA DIAMOND″ comparison

	M / S ″BIRKA PRINCESS″	**M / S ″SEA DIAMOND″**
Construction / Rebuilt	1984	1999
Length	142.90m	142.95m
Breadth	24.70m	24.70m
Draught	5.75m	6m
Gross Tonnage	21,484tns	22,412tns
Net Tonnage	10,537tns	11,680tns
Dead Weight Tonnage	2,441tns	1,825tns
Passengers max	1,500	1,537

Appendix IV

As primarily built, vessel had a small car deck, with space for eighty passenger cars and a ramp on the port side in the rear. The fore superstructure was extended and sixty-two new passenger cabins were added, including a new deck of cabins above the bridge, reaching five hundred fifty nine in total, all equipped with TV and radio. The new itineraries proved largely unsuccessful and on January 2006, the ship was laid up in Mariehamn and put up for sale. Moreover, as built, the ship had an indoor pool in the sauna section on deck No.2 at the bow of the ship. A new outdoor swimming pool was installed along with three restaurants, bars, show lounge, nightclub and shops.

After the sale she was registered in Valletta, Malta and changed flag in late 2006. At the time of her sinking she was owned by Elona Maritime Ltd, a company based in Malta however registered at Piraeus, Greece. Like most cruise ferries in the Baltic Sea, she was built to ice class 1A. M/S ″SEA DIAMOND″ was considered as one among the most environmentally friendly cruise ships, with seven catalyzers and an air pollution control system.

Figure 1: M/S “Birka Princess”, shot by Micke Asklander[3]

[3] https://www.faktaomfartyg.se/

Figure 2: M/S ″SEA DIAMOND″shot by Dirk Jankowsky[3]

Vessel's Particulars

Shipyard: Oy Valmet Ab, Helsinki in Finland (No. 321)

Hull Material: Steel, Hull Connections: Welded

Machinery: Four Wärtsilä-Vasa 12V32, diesel

Effect: 17,652 kW

Max Speed: 21.0 kts

Service Speed: 17.0 kts

Fuel Capacity:

Distillate fuel: 82 m^3

Residual fuel: 679 m^3

Consumption: 21.00 tonnes per day

Registered Owner: ELONA MARITIME CO LTD since 01/03/2006

Technical Manager: CORE MARINE LTD since 01/03/2006

Commercial Manager: LOUIS HELLENIC CRUISES LTD

Classification: Det Norske Veritas

Class ID: 14467 NV

As for the H&M insurance, M/S ″SEA DIAMOND″ had been insured for US$55 mln placed 30% with Sun Alliance Insurance U.K. Ltd., 20% with French AXA, 25% with German Allianz SE, 10% with HDI-Gerling Industrial Insurance Company and rest 15% with several US Labor Unions).[4]

P&I: West of England

Flag: Greek

1.2 CHRONICLE OF SINKING

Exhibit 2: Sinking Basic Information

Vessel	**Cruise Passenger "SEA DIAMOND"**
Date	April 5th 2007
Place	Thera Santorini (Caldera)
Incident	Stuck reef and sank
Number of passengers	1,156
Number of crew	391
Missing	2
Insurance Result	Total Loss

Appendix IV

[4] http://www.kathimerini.gr/282978/article/epikairothta/ellada/h-asfalish-kalyptei-ola-ta-endexomena

1.2.1 Statement of facts

05.04.2007

11:30

Cruise vessel "SEA DIAMOND" sails from Heraklion harbor (Crete) for Santorini

During the trip one of the four main engines faced mechanical failure due to the oil pump which is repaired onboard

15:30

Whilst navigating in Thera bay the "SEA DIAMOND" hits uncharted reef and sustains gash in the starboard side of the hull as engines continue operating leading the vessel into Thera Cove

Safety systems fail to operate and fire emerges to the mail electrical panel causing a blackout

Due to the fact that at the time of the accident nineteen watertight doors were open and pumps were not functional, the vessel starts taking on water rapidly and listed up to twelve degrees to starboard

15:40

Master of the vessel, Mr. Ioannis Marinos, instruct evacuation, lifeboats lower by the gravity as hydraulic launching devices are not operative, five hundred people disembark

16:08

Master informs Port Authority about the incident

16:10

Port Authority instructs evacuation, assistance is requested from the local boat

16:30

Ro/Ro Passenger vessel "NISSOS THERASSIA" approaches "SEA DIAMOND" and holds its bow until tug boat "Leon 1" arrives

17:00

"NISSOS THERASSIA" comes alongside port side of "SEA DIAMOND" and disembarks passengers through the main catapult of the vessel, passenger disembarkation is over (about 1,000 people) with twenty seven members of the crew remaining onboard

18:30

Master requests to be towed to shallow waters however tug boat "Leon 1" has different instructions from the Port Authority and with the aid of currents "SEA DIAMOND" drifts at the region known as Karageorgi Old Mines, where she touches

18:40

Crew onboard "SEA DIAMOND" throws tow line to speed boat "Kalogeros" in order to pass it to "Leon 1" so as to maneuver the vessel in such way as to go alongside the coast and ground

Tow line is not tied on the vessel and falls in the water

06.04.2007

During the night "SEA DIAMOND" slips on to the seabed, and drifts away from the coast

7:00

"SEA DIAMOND" capsizes and sinks

Figure 3: "SEA DIAMOND" disembarkation[5]

[5] http://actionforsantorini.blogspot.com/

1.2.2 Reactions

- **Crew**

Among the 1,156 passengers onboard the cruise vessel vast majority were American, Canadian, Spanish and French. Several passengers claimed that the evacuation process was not professional and not conducted under the safety standards. According to testimonies, passengers heard a loud shudder and then the whole boat started to tilt. The warning that the ship was sinking was some of the staff running down the corridor screaming out ‘life jackets’ and banging on cabin doors. Passengers pointed out that crew members were more scared than themselves and according to other witnesses some crew members left even earlier than the passengers did.

- **Local Community**

After the casualty, the municipality of Thera, sued the Owning Shipping Company at the Piraeus Court of First Instance in order to apply the law 2881/2001 (Appendix V) which obliges the owners to salvage the wreck on their own expenses, estimated at approximately at €80 mln. Following two meetings in December 2013 and May 2017, the decision on the citizens' request for a ship's rescue has not yet been taken.

During the years following the incident, local Authorities along with local organizations that urge the necessity of the wreck removal of "SEA DIAMOND" have been addressed to several organizations like the Independent Authority, The Greek Ombudsman as well as the Chamber of Environment and Sustainability. Relevant reports are amended (Appendix VI, Appendix VII, and Appendix VIII).

- **Shipowning Company**

After the decision of the Piraeus Court of First Instance that it was obligation of the Owning Company (Louis PLC) to pay to the Greek state and the Municipality of Thera a total of €14 mln

payment and salvage the wreck, same will lodge appeals against the aforementioned decisions at the Court of Appeal of Piraeus, expecting that the decisions will be overturned.

The P&I Club remitted to each passenger one thousand euros plus forty hundred euros for their luggage. For many, this form of compensation was considered a trap, as in the event of its acceptance by the passengers, they would not have the right to claim the Shipping Company for any other reason related to the shipwreck.

The Shipping Company received a mere US$ 55 mln from Hull Insurers for the Total Loss of the vessel eight months after the incident. However, there was no provision either for the P&I Club or for the Shipping Company to assume any responsibility for the salvage of the vessel.

- **Greek Government**

On the other hand, in 2011 Greek government on behalf of Mr. Yiannis Diamandidis, Minister of Marine Affairs, claimed that the salvage operations could not be afforded by the Greek government and as a result, Louis and its Insurers would have to take care of the operations.

In October 2017, the former Minister of Marine Affairs, Mr. Panagiotis Kouroublis, dispatched official letter, mentioning the importance of the existence of the wreck ten years later requesting the local Authority of Thera to take action regarding the refloating of the wreck. However, the letter did not include specific guidelines regarding the procedure to be followed by the Municipality.

- **Missing**

Two French citizens, Jean Christophe Allain, forty-five years old, and his daughter Maud, sixteen, were listed as missing. Allain's wife said her cabin filled with water when the ship struck rocks and that she narrowly escaped. She was not sure whether her husband and daughter made it out because the events happened so suddenly. Her son was on deck at the time and was evacuated safely. The family were accommodated in cabin 2014 an outside standard cabin on the starboard side of the vessel on deck No.2 (Figure 4), the lowest passenger deck.

Divers examined the wreck on April 6th to gather information on the ship's current position and to seek the missing passengers. The underwater search of this cabin recovered nothing. Divers continued searching on April 10th, but nothing was reported. Later the same day, local governors apologized to the French family for their missing relatives. The bodies of the two missing persons were never found.

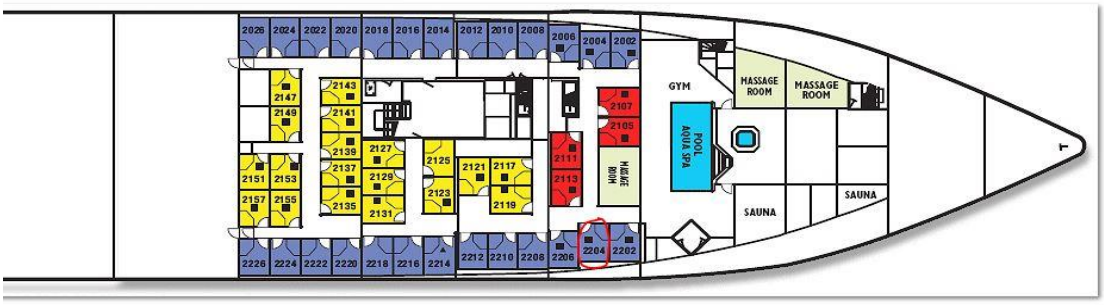


Figure 4: M/S "SEA DIAMOND" deck No. 2[6]

1.3 LIABILITIES EMERGED FROM THE INCIDENT

1. Liability of the Captain

According to the Private Nautical Law (Appendix IX, Appendix X)

L3816/1958

Article No.40: The Master of the vessel is responsible for all that happens to and upon the ship

As a result, the Master was responsible for navigating outside of the given route.

[6] https://www.yachtcharterfleet.com/luxury-charter-yacht-39605/sea-diamond-layout.htm

2. Liability of the Owners

Owners should have perceived on time the seriousness of the situation and handle it more efficiently. However, as Mr. Loukas Matsas stated to Kathimerini newspaper, he sent a tug boat of adequate horsepower located at Lavrion to assist the sinking vessel but Louis' fleet Operation Manager Mr. George Koubenas rejected any help offered.

For the record, two tug boats, Alexander 5 of Vernicos Tugs and Salvage (Logbook Appendix XI) and Megalochari VII of Megatugs sailed from Piraeus for Santorini under the Lloyd's Open Form, No Cure No Pay salvage contract, countersigned by Mr. George Koubenas (Louis) and Mr. George Polychroniou (Tsavliris Salvage International) in order to tow the vessel at shallow waters (as shown in Figure 5) between the islands Nea and Palea Kameni and beach her. However, by the time the tugs reached Thera, the vessel could not be saved.

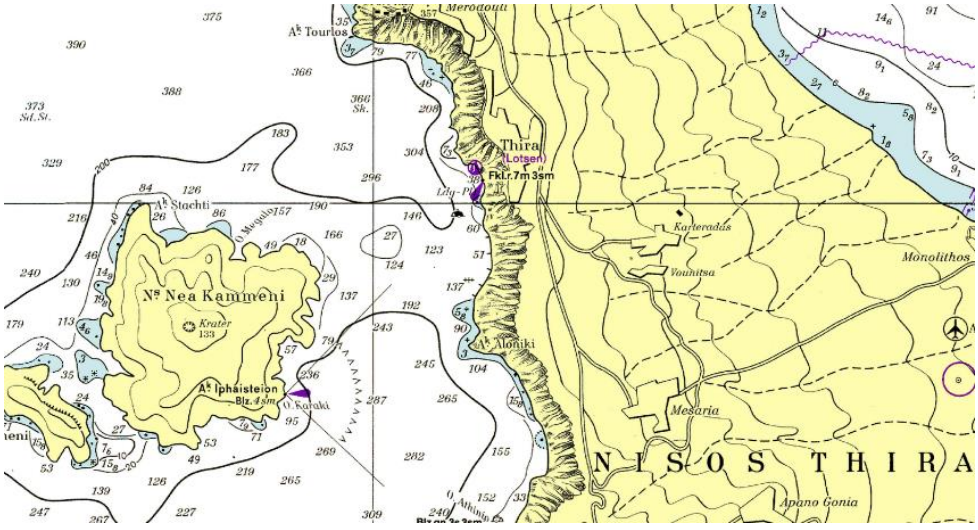


Figure 5: Nautical chart (depth between Nea and Palea Kameni)[7]

[7] http://blog.geogarage.com/2012/01/map-found-to-be-erroneous-in-sea.html

3. Liability of the Hellenic Navy Hydrographic Service[8]

Investigations carried out by the defence team of the Master of the Vessel and Louis Cruise Lines, after a lawsuit had been filed against them, have included a new hydrographic survey of the area of the accident in Santorini. This survey was carried out by Akti Engineering[9], which discovered discrepancies between the actual mapping of the sea area and the official charts used by the "SEA DIAMOND" (and all other vessels) at the time of the accident. The detailed survey claimed that the reef, which the "SEA DIAMOND" struck is, in fact, lying at one hundred and thirty one metres from shore and not at a distance of fifty-seven metres, as was incorrectly marked on the nautical chart. The official chart also showed the depth of the water at the area of impact varying from 18–twenty-two metres, whilst the recent survey shows that it is only five meters. The findings obtained by Akti Engineering have since been passed on to the Hellenic Hydrographic Office of the Hellenic Navy and other responsible authorities.

According to a branch reviewing source, the Hellenic Hydrographic Office initially rejected the new mapping, but a later study confirmed the findings of Akti.

[8] HNHS (Hellenic Navy Hydrographic Service)
The Hellenic Navy Hydrographic Service (HNHS) is the official hydrographic organization of Greece. It is an independent agency of the Hellenic Navy (HN), based in Attica and accountable directly to the Chief of the Hellenic Navy General Staff. The purpose of HNHS is to study the Greek and the adjacent seas, coasts and ocean, the navigation conditions, to contribute to the development and the promotion of the sciences and arts related to navigation, hydrography, oceanography, shipping and maritime meteorology. https://www.hnhs.gr

[9] AKTI Engineering is an engineering, services and consulting company specialised to the following core activities: Survey and positioning services, Marine geosciences, Offshore geotechnical services, Marine environmental studies

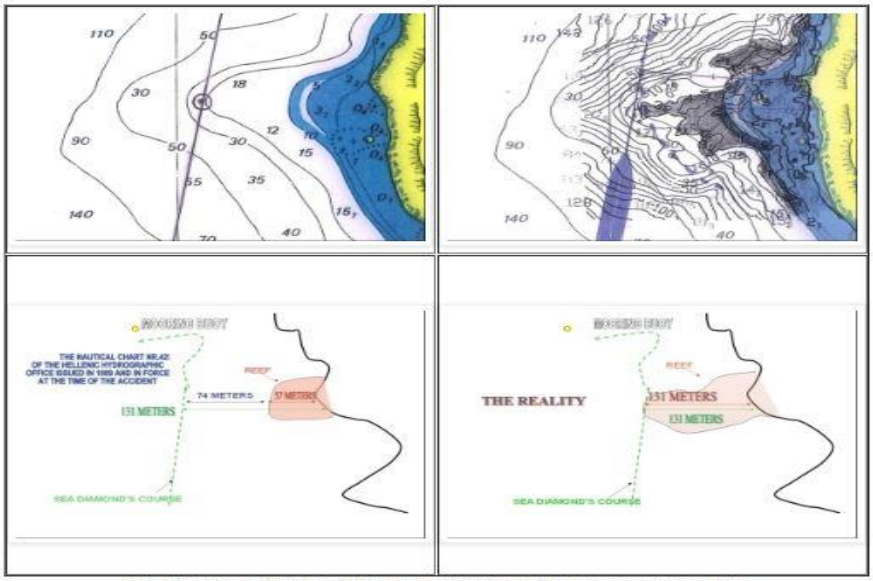


Figure 6: Erroneous Map[7]

4. Liability of the local Authority

Likewise, the liability of the Owners, the local Authority should have reacted promptly as well regarding following operations:

- Evacuation of the vessel
- Towage of the vessel to shallow waters at an enclosed area so as to beach safely

1.3.1 Master's Negligence

In the case of "SEA DIAMOND", it was revealed that there were omissions from Captain's side, Mr. Ioannis Marinos. While traveling for Santorini the vessel faced mechanical failure due to the oil pump at one of her four main engines. The engine was repaired onboard however at the

aftermath of the incident there were several accusations of non-compliance with the safety standards as neither DNV, nor Merchant Marine Inspection Unit and the company itself were informed. Consequently, if the inspectors had been informed, they would have guided the ship to the nearest port, inspecting whether the repairs that had taken place in the meantime were sufficient and appropriate.

At that time, it was rumored that the vessel was systematically deviating from its route and as a result hit the reef. Nonetheless, an observer with an adequate engineering background should notice that as the vessel was equipped with a Controllable Pitch Propeller[10], the deviation emerging from the insufficiently repaired oil pump of the main engine could have been compensated by the rudder.

Furthermore, according to his initial lodgings the Master mentioned that the sea currents accounted for the grounding of the vessel. During the trial he testified "I suddenly realized a strong stream from the left, which shoved the ship right, causing the grounding". However, it was a couple of months later when the Master's defense line changed. He claimed that the reason of the sinking was the incorrect mapping of the area, supporting his point by a revised report provided by Akti Engineering. Therefore, the shipowning company sought to shift the responsibilities and consequently the related costs to the Greek authorities.

However, it is worth mentioning following paragraphs of The Mariner's Handbook of the United Kingdom Hydrographic Office[11]

[10]A variable-pitch propeller or controllable-pitch propeller (CPP) is a type of propeller with blades that can be rotated around their long axis to change the blade pitch, https://en.wikipedia.org/wiki/Variable-pitch_propeller

[11] The United Kingdom Hydrographic Office is the UK's agency for providing hydrographic and marine geospatial data to mariners and maritime organisations across the world.

1. While the UKHO has made all reasonable efforts to ensure the data supplied is accurate, it should be appreciated that the data may not always be complete, up to date or positioned to modern surveying standards and therefore no warranty can be given as to its accuracy.

1.3 The mariner must be the final judge of the reliance he places on the information given, bearing in mind his particular circumstances, the need of safe and prudent navigation, local pilotage guidance and the judicious use of available navigational aids.

Having said the above, Liability of the Hellenic Navy Hydrographic Service may lead to potential dispute as it is a matter of controversy.

As for the so-called Voyage Data Recorder (VDR) system of the vessel which was retrieved several hours later, reveals that the system itself was not activated even if there was enough time before abandoning the vessel.

1.3.2. Trial Decision

According to final decision of the court in 2013, out of the thirteen defendants, three were deliberately charged. The penalty imposed on the Master was a twelve years and two months prison sentence along with a fine of eight thousand euros, eight years prison sentence for to the Commodore, twenty-eight months for the Chief Engineer and eight years prison sentence for the Designated Person Ashore (DPA). As for the Classification Society Inspector the corresponding sentence was of fifteen months and two years for each Legal Representative of the Company.

1.3.3 Law 2881/2001 and Nairobi International Convention of Wreck Removal

The Law applying in Greece regarding shipwreck cases is the 2881/2001 titled “Wreck Removal Issues and Other provisions”. According to Article 2 of same after a salvage order, the shipowner should act within three months by contacting relevant P&I insurance to proceed with the wreck removal. However, should twenty years pass and vessel has not been removed, vessel’s ownership

passes on to the government and any legal liability of the shipowner is forfeited thereafter. Should the costs are considered to be excessively high, the government may proceed to tender calls.

Law 2881/2001 is similar to all basic terms of the Nairobi International Convention of Wreck Removal (Appendix XII) although Greece is not a party of it yet. According to this Convention, the shipowner has the right to choose the salvage company that will undertake the removal of the ship.

The only jurisdiction regarding the government, is to supervise whether the operation is conducted under conditions of safety and environmental protection. According to article 9 of same, it is clearly mentioned that the government has the right to request the salvage of the shipwreck at any time this is considered dangerous to the environment; same also stands for the Greek Law. If so, the shipowner is obliged to undertake the operation within a prespecified period of time defined by the public authority, otherwise the government may interfere.

The "SEA DIAMOND" paradox is that since 2007, the government did not manage to impose the Law 2881/2001. Even though the court decision[12] obliged the shipowner and the insurance company to undertake all costs emerging from the salvage of vessel, the company has done nothing yet. Therefore, there have been many suspicions of fraud. Such position is supported by The Prime Minister himself who had once declared that quote “the "SEA DIAMOND" is one of the remaining residues from a corroded system characterized by the business interests and the political inertia and requires the attention of everyone for the restoration of social justice and equality”, unquote.

[12]http://www.areiospagos.gr/nomologia/apofaseis_DISPLAY.asp?cd=OUFSYSJ1W6XBTEJSTGHU9J8VHYWDR9&apof=515_2016&info=%D0%CF%C9%CD%C9%CA%C5%D3%20-%20%20%D3%D4

1.4 CURRENT SITUATION

1.4.1 Pollution of Marine Environment

According to samples taken from the seabed in the area of the shipwreck, it was estimated that although eleven years have already passed since the sinking and abandoning of the shipwreck, the leakage of toxic and dangerous substances to the marine ecosystems continues. These substances include heavy metals such as cadmium nickel and lead which are constantly affecting marine organisms and threaten neighboring desalinations. More than three hundred tons of fuel oil and decades of chemical and toxic substances still remain in the sunken "SEA DIAMOND". The first floods have already appeared and it is only a matter of time for the hull to break and extensively re-pollute the area. Although, every upcoming government promises the salvage of the shipwreck to the inhabitants of the island, this promise is easily forgotten even though the physical persons along with the shipping company have already been condemned.

Dedicated working group set up in 2016 with responsibility of controlling and assisting the works of Municipal Port Facilities of Thera for the salvage of the shipwreck, has not yielded any tangible and beneficial work until now. On the other hand, Archipelagos Institute[13], which is responsible for continuously monitoring the area, has extensively pointed out the crucial need of moving the shipwreck the soonest possible.

In June 2018, the boom, that the government has obliged Louis Cruises to construct at the place of shipwreck, in order to protect the area from the contaminants that the wreck still released, has

[13] Archipelagos Institute of Marine Conservation is a non-profit, non-governmental organization committed to researching and defending the biodiversity of the Greek seas and islands, as well as the NE Mediterranean overall

almost sunk and repaired however, local groups question its efficiency and consider it as insufficient way of protecting the adjacent to the wreck environment.

1.4.2 Municipal Port Fund of Thera Public Invitation

In May 2018 the Municipal Port Fund of Thera published a tender call (Appendix XIII) regarding the wreck removal of "SEA DIAMOND". The date of the submissions of interest was on 02/07/2018 at the offices of the Municipal Port Authority. The time limit for the validity of tenders was set as the ninety days i.e. 02/10/2018 and the time for the execution of the project was set at three hundred days from the issue date of the relevant licenses.

Pursuant to Article 2 par. 9 of Law 2881/2001, is provided that if, at the Agency's discretion, postponing the immediate lifting, removal or elimination of the wreck, a serious risk to the port, canal or channel is caused or the marine environment is seriously damaged or the navigation from the sea is blocked or significantly impeded, then the Agency may proceed immediately by arranging all the necessary actions in any way whatsoever.

Since the shipowner of the shipwreck "ELONA MARITIME CO" has not taken any action to lift the "SEA DIAMOND" shipwreck since 2007, although it has been legally invited to do so, the Municipal Port Fund of Thera decided to make an announcement according to which if a natural or legal entity had the required know-how and infrastructure to organize the salvage of the vessel, had the right to express interest and submit proposal by the deadline of this public invitation.

2. WRECK REMOVAL

2.1 METHODS OF WRECK REMOVAL AND RESPECTIVE CASES

1. Refloating the vessel intact by providing floating power. This method can be applied through a variety of means like air compression or with the aid of balloons or foams. Balloons and foams are considered to be outdated methods and they are used only in cases where the vessels are very small. It is generally a low-cost method but has the great disadvantage as it can be applied only in small depths of up to 50-60 meters. The basic idea is to retrieve the ship's rehabilitation so as to refloat. In order to carry out this method, some parts of the ship should be sealed. One of the most widely used means of rehabilitation recover is foam which cannot be used in depths over sixty meters as it is costy and less effective. The use of foam is generally known as harmful for the environment since it consists of toxic substances. (Angeln, Caribbean)

2. Partial removal leaving some portion of the wreck in place. For example, removing superstructure and cranes to leave a safe water depth above the vessel in a navigable channel. Wrecks may also be buried deeper into the sea bed by dredging a hollow next to the wreck and settling it in. Partial removal might require only the extraction of potential pollutants. Modern technology enables this to be conducted remotely at considerable depth. (California, Malacca Straits)

3. Parbuckling – inserting strops under the wreck and pulling the vessel upright using heavy lift sheer legs or a crane. This method requires just the fastening of chains or wire ropes and is flexible and fast. Chains or wire ropes are used for the salvage depending on the shipwreck. Wires are less durable but can be managed more easily although, more attention and maintenance are needed. Chains, on the other hand, are generally heavy but need no maintenance and special attention.

This method is based on the idea that a force greater than that of the weight of the ship must be exercised. There are many different means in this category consisting of floating cranes and special hydraulic lifting systems adapted to floating tanks. These special cranes are always attached to floating tanks. Generally, this method is considered to be expensive and it requires time for the platform to be settled correctly given that its maneuvering is difficult. In this salvage method the depth is not a barrier since the pressure does not count. (Costa Concordia, Italy)

4. Piecemeal removal

- Cutting up in situ into small sections which are removed by crane, or other means, including helicopter, for disposal. (Riverdance, Northern England)
- Cutting up in situ into large sections using chains, special wire ropes or explosives which are lifted on to deck barges, or making watertight, floating and towing for disposal. Such salvage operations use cranes or sheer legs although this is not a problem since, during a salvage, the condition of the sunk vessel is not taken into account since at the end of the day it will be scrapped. (MSC Napoli, Southern UK Coast).

2.2 FATE OF SHIPWRECKS

2.2.1 Criteria

1. Location of the wreck

- Proximity to important areas
- Distance from shipping routes / port / tourist or residential areas / offshore installation
- Traffic density
- Does the wreck affect shipping in this area?
- Depth of the wreck

Is any part of the wreck above water surface at lowest astronomical tide or affect normal shipping?

2. Condition of the wreck

- Construction
- Likelihood of structural breakup and catastrophic release
- Integrity

Has the sinking or the events leading up to the sinking resulted in substantial damage to the integrity?

3. Pollutants onboard

- Type of substance
- Oil / HNS / Lubes
- Quantity of the pollutant

Does the quantity of pollutant/s onboard pose a risk to the environment?

- Properties of the substance and behavior upon release
- Persistent / non-persistent oil, physicochemical properties, toxicity of the remaining HNS
- Storage condition

Is a weakness in structural integrity likely to lead to a catastrophic pollutant release?

4. Ecological and socioeconomic issues

- Concentration of substance in water column above harmful threshold

Is the wreck location close to vulnerable resources e.g. important fish spawning sites / fishing grounds / marine protected areas / tourism centers?

- Trajectory of pollutant /potential to form large slick at surface

Will a pollutant release threaten important habitats for surface-dwelling marine life e.g. mammals/seabirds, or commercial activities e.g. shipping / fishing?

- Whether substance will come ashore and threaten shoreline resources
- Have potentially 'at risk' areas been identified as important habitat for protected species / area slow to recover / bird or turtle nesting sites (in breeding season), or areas with important economic resources e.g. industrial water intake, aquaculture facilities, tourism centers?

5. Operational Considerations
6. The feasibility, technical challenges and practical considerations for undertaking a wreck removal/reduction or pollutant recovery operation to be determined by salvage experts.

2.2.2 Key Considerations

- **Equipment Required**

The equipment required to undertake wreck removals includes a large number of portable items, substantial assets and craft and, in some cases, heavy lift equipment. The more remote and the more complex the project, the longer the equipment will be required and the greater the costs.

A typical inventory of portable equipment might include: pumps and hoses, welding equipment, drilling and cutting equipment – grinders and flame cutters, inert gas generators, compressors, hydraulic systems, generators, cabling and distribution boards, diving gear including decompression systems, 'hot tapping' systems, chains and shackles, air lift systems, winches, lighting, pollution control equipment such as oil booms and fenders.

Heavy equipment might include powerful tugs, dive support vessels, standby vessels, deck barges, hold barges, work barges, accommodation units, lightering craft, utility jack-up rigs, heavy lifting gear including sheer legs and heavy lift crane barges, a chartered heavy lift helicopter, remotely operated vehicles, large-scale cutting gear – chain pullers, abrasive wire and hydraulic rams, mechanical grabs and industrial magnets.

- **Underlying costs – problem of location**

Where in the world a wreck occurs has a major bearing on the duration, complexity and cost of removing it. The jurisdiction and attitudes of the relevant shore-based authorities with wreck site responsibility are extremely important and will influence the methodology chosen.

Proximity to major shipping centers, where salvage assets and heavy equipment are located, will be a factor in how long the operation takes and its cost. Experts can be rapidly flown to most locations and a certain amount of equipment can be air-freighted to the site. However, it is a different matter with heavy equipment – particularly heavy lifting gear which is in limited supply and not always suitable for transit in open oceans.

Figure 7: Base location of heavy lifting gear

Availability of suitable gear is not guaranteed, with competition for usage coming from the offshore construction and energy sectors. Such equipment tends to be concentrated in Europe, Singapore, North East China, Japan and the Gulf of Mexico. Assuming it is available, the equipment will therefore need a deep sea tow to many locations, which will slow the response time and may increase cost, as well as allow the condition of the wreck to deteriorate.

2.3 LEGAL FRAMEWORK

2.3.1 Structure of Marine Insurance arrangements

P&I Clubs cover a wide range of liabilities including: death and personal injury to crew; passengers and others on board; oil pollution and wreck removal, and damage to fixed and floating objects. The thirteen principal P&I Clubs form the International Group (IG) of P&I Clubs and together these clubs account for liability cover provided to some 90% of the world's Ocean-going ships. Although the clubs compete with each other for business, it is beneficial for all shipowners insured by the clubs to pool their larger risks. Pooling is regulated by the Pooling Agreement which defines the risks that can be pooled and how losses are to be shared between the participating clubs, it is a "mutual of mutuals".

2.3.2 Rule 40 Liability for obstruction and wreck removal

The International Association of Classification Societies, IACS[14], shall cover:

[14] The International Association of Classification Societies (IACS) is a technically based non-governmental organization that currently consists of twelve member marine classification societies. More than 90% of the world's cargo-carrying ships' tonnage is covered by the classification standards set by member societies of IACS, https://en.wikipedia.org/wiki/International_Association_of_Classification_Societies

a) costs and expenses relating to the raising, removal, destruction, lighting and marking of the Ship or of the wreck of the Ship or parts thereof or of its cargo lost as a result of a casualty, when such raising, removal, destruction, lighting and marking is compulsory by law or the costs or expenses thereof are legally recoverable from the Member
b) liability incurred by reason of the Ship or the wreck of the Ship or parts thereof, as a result of a casualty, causing an obstruction

Provided that:
i. Recovery from the Association under this Rule shall be conditional upon the Member not having transferred his interest in the wreck otherwise than by abandonment; and
ii. The realized value of the wreck and other property saved shall be credited to the Association.

The current regulatory framework is a combination of coastal states' domestic law and relevant international conventions. The International Maritime Organization (IMO) has recognized the international legal inconsistencies in the treatment of wrecks, and in 2007 adopted the IMO Convention on the Removal of Wrecks. However, several countries (like Greece as mentioned above) may apply their own domestic law inside their own territorial waters, which may still cause inconsistencies in approaches. The authorities in coastal states are coming under increasing pressure to manage any potential risks relating to wreck removal, in particular regarding environmental concerns. Such authorities in coastal states can exercise great power in wreck removal, and political considerations can have a significant impact on operations. Multiple tiers of government (local, regional and national) and numerous other agencies can all claim a legitimate role, bringing their respective perspectives to bear, and influencing operational and commercial decisions. This applies regardless of the nature of the cargo and, even if there is no risk of any noxious emissions, a wreck's physical impact on the shore – including visual – is likely to be

unacceptable to politicians and the public. News media will highlight the case, and stakeholders such as environmental protection groups may campaign for specific actions. Against this backdrop of increasing environmental concerns, it is not surprising that the demands of authorities have grown and may influence the entire approach to a wreck removal operation. Political and societal considerations, in particular concern with the potential environmental impact, are at the heart of some of the rising costs of wreck removal operations.

2.4 David Ashley Pockett position

According to David Ashley Pockett, marine consultant of the LOC Ltd. Group[15] specialized in ship rescue and wreck removal, who participated in the ″Costa Concordia″ cruise ship rating group, said that "the lifting has insurmountable technical difficulties and poses serious security issues that make any such thought prohibitive". On top of that, Port Authority of Thera, has launched two tenders for the submission of a quotation for a study examining the possibility of salvage which have finally failed. Therefore, that this indicates the difficulty and the risk of the salvage. David Ashley Pockett reached the conclusion that "the shipwreck is very stable in its place and its lifting is impossible". He pointed out that the case of ″SEA DIAMOND″ cannot be easily compared to this of ″Costa Concordia″ since the wreck was at a depth of only thirty meters and not submerged. "The work of the divers also at such a depth is very dangerous and extremely difficult" he added.

[15] London Offshore Consultants Ltd. is an international marine and engineering consultancy and survey organization that provides advice and support to shipping and offshore energy industries around the globe. Its offshore marine services include marine casualties; claims, disputes, and litigation; marine warranty surveyors; surveys, inspections, and audits; and marine engineering services. The company serves P&I clubs, marine and energy insurers, energy companies, ship owners and charterers, admiralty lawyers, and government bodies. London Offshore Consultants Ltd. was founded in 1979 and is based in London, United Kingdom, https://www.bloomberg.com/research/stocks/private/snapshot.asp?privcapId=112267003

The method used in this case is the so called parbuckle salvage. ″Costa Concordia″ was successfully parbuckled off the west coast of Italy in September 2011, the largest salvage operation of that kind up to date. However, what is important to mention is the risk of preventing rotational torque from becoming a transverse force moving the ship sideways.

Mr. Pockett also referred to the lifting of 24,000 tons of nuclear submarine "Kursk" from the Barents Sea to a depth of about one hundred meters. In this case the hull was too thick and had maintained its longitudinal endurance. Therefore, the divers managed to get down because the conditions were smoother. He also underlined that the part of the ″Kursk″ submarine that was lifted was sealed and completely closed. “There are thousands of wrecks around the world and one of them is the ″SEA DIAMOND″. There is no danger of the wreck remaining at the bottom of the sea”, he said. A similar conclusion has also been reached by the International Shipping Organization, mentioning in one of its reports that any attempt of lifting the vessel would be risky and perilous. In this point, it is important to mention that the Law 2881/2001 indicates that the salvage is deemed necessary only when it poses a risk to environment and/or navigation.

3. COMPARABLE CASES

Removing wrecks from the coastline or from the deeper water is a major undertaking which can incur great cost. The crucial factors which determine the cost of wreck removal are the following:

1. Location
2. Contractual arrangements
3. Cargo recovery in case of container ships
4. Effectiveness of contractors and vessel's special casualty representative
5. Nature of bunker fuel removal operations
6. Influence of government and other authorities
7. Wrecks are a third party liability and therefore the cost of dealing with them is usually covered by the shipowner's contribution to a mutual Protection and Indemnity Club (P&I Club).

3.1 KURSK REMOVAL

An international project team of heavy lift, salvage, diving and other specialists were involved in the recovery. The weight of the submarine, when prepared for the main lift, was around 9,000 tonnes. The raising of the ″Kursk″ created a new world record, as it is the heaviest object recovered from such depths. The operation was performed by Mammoet-SMIT that was responsible for all marine activities associated with the recovery, including the conversion and deployment of the 24,000 ton deadweight barge Giant 4 - the lifting and transport platform. SMIT also developed and deployed a revolutionary technology to cut the bow off the submarine as it suffered severe damage during the explosions and had become unstable. This was a crucial part of the operation.

Exhibit 3: Case of ″Kursk″

NUCLEAR – POWERED SUBMARINE ″KURSK″	
GRT	24,100 tons
LOA	155 m
Year of built	1994
Year of sinking	2000
Cause of sinking	Unknown
Depth	108 m
Removal	Specially modified floating barge equipped with 26 cranes of 900 tons each
Duration of ops	5 months
Cost	€100 mln

Source: https://www.smit.com/

The method used to lift the shipwreck was the adaptation of twenty-six hydraulic lifting grooves of Mammoet to a floating runway of SMIT. The salvage operation started in 2011 when the team cut the bow off the hull using a tungsten carbide-studded cable deployed which was pulled back and forth through the submarine's hull by two hydraulic cylinders on top of two suction anchors placed on both sides of the ″Kursk″. As this tool had the potential to cause sparks which could ignite remaining pockets of reactive gases, such as hydrogen, the operation was carefully executed. The scope of work performed required the cutting of twenty-six holes into the pressure hull and cutting away the submarine's bow, together with the attachment of lifting cables, the lift of the ″Kursk″ to a position immediately under the barge Giant 4, transport of the barge/submarine combination to Murmansk and safe entry into the naval dry-dock. Most of the bow was abandoned and the rest of the vessel was towed to Severomorsk and placed in a floating dry dock for analysis.

Some torpedo and torpedo tube fragments from the bow were recovered and the rest was destroyed by explosives in 2002.

Kursk wreck removal operation, https://www.smit.com/

3.2 COSTA CONCORDIA REMOVAL

As a benchmark of wreck removal operations, one should examine the case of ″Costa Concordia″ in 2012 off Giglio Island, Italy. During a public tender, American TITAN Salvage (Ardent Global) and Italian Micoperi were selected and contracted for the operation. The wreck was refloated and towed to Port of Genova in July 2014, for further demolishing and recycling. In this case, Italian authorities having complied with the rules of avoiding pollution and obliged the shipowner to lift the shipwreck within fourteen months thus pay more than US$ 1 bln in total. But is this case indeed intimately comparable?

Exhibit 4: Case of ″Costa Concordia″

CRUISE SHIP ″COSTA CONCORDIA″	
GRT	114.147 tons
LOA	290.2 m
Year of built	2005
Year of sinking	2012
Cause of sinking	Grounding and partial sinking
Depth	37 m
Removal	Parbulking
Duration of ops	30 months
Cost	$ 1.2 bln

Source: https://www.ardentglobal.com/

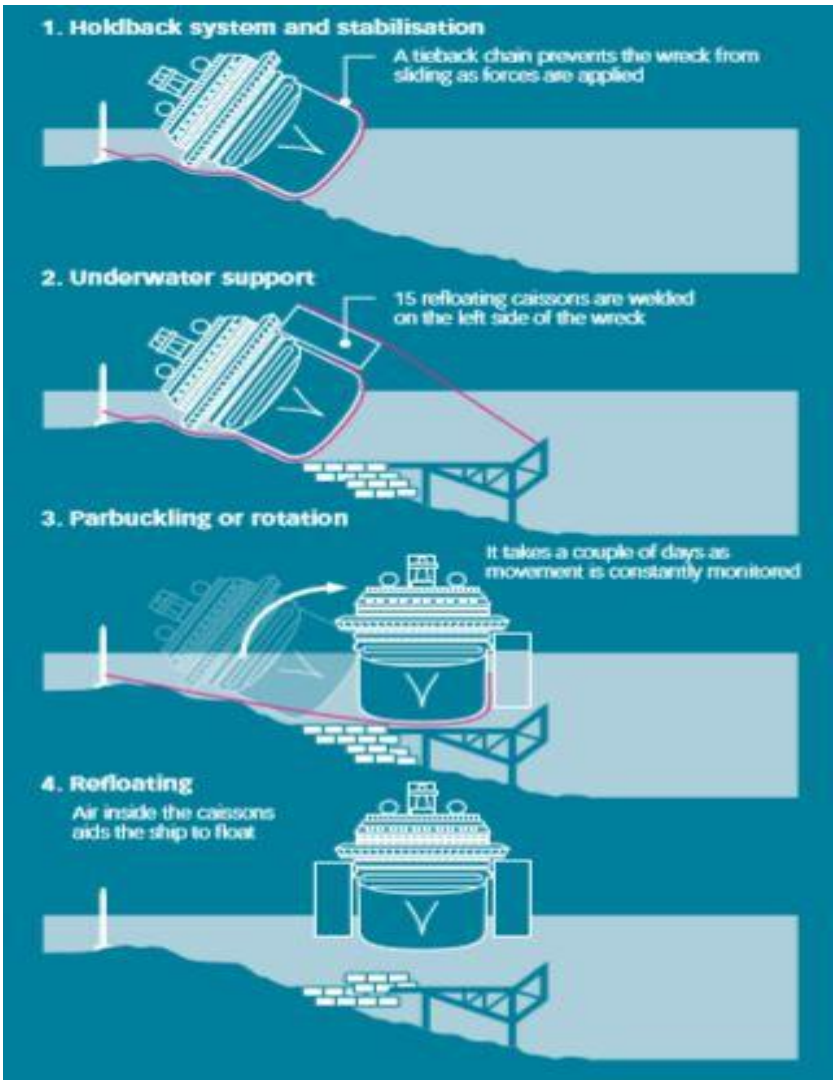
The wreck removal plan had four stages

Stage 1: Stabilization of the ship and construction of an underwater platform for the vessel to rest on. Then watertight boxes, or caissons, were fixed to the side of the ship that was above water.

Stage 2: Cranes pulled the ship upright, helped by the weight of the caissons, which were filled with water.

Stage 3: When the ship was upright, caissons were adjusted to the other side of the hull to stabilize it.

Stage 4: The caissons on both sides were emptied (after the water inside has been purified to protect the marine environment) and filled with air and the wreck floated.



"Costa Concordia" stages of wreck removal[16]

[16] James Herbert, Lloyd's, "The challenges and implications of removing shipwrecks in the 21st century"

3.3 COMMENTS BY JEAN-JACQUES BENZONANA

Chief Executive Officer of Vernicos Tugs and Salvage, Mr. Jean-Jacques Benzonana, shared with us some interesting information regarding the casualty. As he said, the dominant plan was to tow ″SEA DIAMOND″ between two smaller islands opposite Thera, called Nea Kameni and Palea Kameni and beach her there safely. However as critical time was lost, proper tug boats arrived too late. Mr. Benzonana strongly believes that vessel's wreck removal would be a risky operation with a high probability of failure as the depth as well as the way the vessel lies are not favorable for such an undertaking.

More specifically the current inclined position of the vessel along with the existence of countless compartments leaves only one option; giving the vessel adequate floatability in order to reach a depth that would favor cutting operations and subsequent removal of the parts by heavy lift cranes. However, technical operations at a depth of over sixty meters are carried out with the aid of specialized Remote Operated Vehicles (ROVs) as well as with the participation of specialized helium divers who would contribute some charge of fifteen to twenty minutes per dive. Needless to say that such infrastructures and labor would exaggerate the cost of the wreck removal.

One could propose the sole removal of the residual fuel oil from specific tanks in order to avoid a potential oil slick in case the vessel lost its current "stability" and laid in a different position that would favor an oil leak. His answer to the above proposition was that after some eleven years, the oil inside the tanks will congeal. As a result, a procedure of heating the oil in order to bring it back to its liquid state so as to be extracted would be necessary thus once more, the depth will be much of a problem.

In an effort to compare the case of ″SEA DIAMOND″ with Russian submarine ″Kursk″ and cruise ship ″Costa Concordia″ we received the following answers:

1. Regarding submarine ″Kursk″, three major reasons accounted for its removal to be plausible and essential.

- Operation's feasibility lied on the fact that ″Kursk″ was a vessel of a totally simple structure that favored it to be lifted easier.
- Furthermore, ″Kursk″ was a nuclear powered vessel consequently, the existence of its two nuclear reactors onto the seabed made its removal essential.
- ″Kursk″ was a military asset and its removal from any other but the owners, the Soviet Union that at the time possessed a great know-how of using titanium in order to build submarines, would disclose a lot of confidential constructive information

2. Cruise ship ″Costa Concordia″ was a totally different case. However, complicated her structure was, a serious part of the hull was not immersed in the water, so parbuckling was a totally appropriate method of removal with a high probability of success.

Due to the fact that the press left some vague spots regarding the sinking of ″SEA DIAMOND″ along with the possibility of causing it on purpose in order to receive insurance money, Mr. Benzonana remarks that "Many things happened conjunctively and I consider it impossible to risk sinking intentionally a passenger ship with so many souls on boards. It could be disastrous. Whatsmore, one way or another it would be considered as a Constructive Total Loss as because of the flood in the engine room the whore vessel would need electrical rewiring, a quite costy procedure."

Mr. Benzonana concludes that wreck removal of the ″SEA DIAMOND″ is arguably impossible and despite the decision of any court no one would ever pay that tremendous amount of money.

4. ENVIRONMENTAL ISSUES AND RESPONSE

4.1 COMMENTS BY PROFESSOR FANI SAKELLARIADOU

Professor of Geochemical Oceanography Fani Sakellariadou, expressed her opinion regarding the incident of ″SEA DIAMOND″ answering some questions posed by us concerning the environmental prospect of the casualty. Furtermore, Professor Sakellariadou was requested to estimate the importance of the situation by taking into consideration the substances still existing at the bottom of the sea depicted at the following table.

Exhibit 5: ″SEA DIAMOND″ Electrical Equipment

Electrical Equipment on board ″SEA DIAMOND″	
Batteries	336 liters of electrolyte
Appliances	About 200 pieces
Fluorescent Lamps	About 5,500 pieces
Wires	17,000 m
Smoke Detectors	1,050 pieces
Chlorofluorocarbons – Freon	Sufficient for 10 a/c compressors and 2 water cooling pumps
Copper Oxides (antifouling paints)	1,740 liters
Anode	406 kg
Petroleum products	505 tonnes
Lubricants	26,000 liters
PVC	35 m^3
Rockwool	1,309 m^3
Glass wool	1,273 m^3

Source: Ρύπανση θάλασσας και παράκτιων ζωνών από ατυχήματα, Ευάγγελος Γιδαράκος

Professor mentioned the significance of the problem by underlining the existence of toxic ingredients, such as heavy metals and organic compounds which are still gradually being released into the marine environment. Abovementioned substances still cause gradual but continuous problem to the marine environment. This kind of pollution is not immediately perceived, but still it is very important. In particular, benthic organisms located in the area and infiltration of huge quantities of water accumulate the toxic load which, in turn, is bioaccumulated in the food pyramid. What Professor primarily wishes to emphasize when asked about the political implications of this issue and the responsibilities of the government, is prevention. In this way, it is important for an action plan to be implemented, adaptable to different scenarios.

4.1.1 Continual Pollutant Releases

One of the most common scenarios that International Tanker Owners Pollution Federation, IOTPF, encounters which challenges a purely technical approach to deal with a wreck is that which involves a release of small quantities of pollutants over an extended time period, a ‘continual release’. In these cases, typically the wrecks:

• lie in deep water; are subject to strong tidal currents

• may have suffered severe structural damage or the location of the bunker tanks is relatively inaccessible within the wreck preventing easy access to the pollutants

• contain pollutants that may have spread into multiple pockets within the wreck structure, or

• contain a relatively small total quantity of pollutants.

As a result, whilst a technical assessment of the requirements to remove the wreck or its associated pollutants at a given point of time would indicate that there is no justification for wreck or pollutant removal operations, a wreck releasing pollutants over an extended period, particularly when these are visible on the sea surface, is likely to cause concern amongst coastal communities and authorities and lead to strong demands for action.

4.1.2 Precautionary Measures

Based on the above we hereby list several precautionary measures:

1. Continuous and effective monitoring of marine traffic through real-time electronic systems like Vessel Tracking Systems, Automatic Identification System, Vessel Monitoring Systems and coastal radars

2. Effective enforcement of Traffic Separation Schemes

3. Stringent ships specifications

4. Creation of a direct tug network throughout the Aegean Sea in order to minimize the distance that has to be covered in order to reach to a casualty

5. Creation of a network of places of refuge that would host vessels in danger and limit the potential pollution due to their own morphology

6. After such an event, the first thing that needs to be safely removed from the sea is the fuel. First of all, there will need to be assessment of the whole situation and the possible pumping techniques of dealing with an oil spill that most probably will happen in most cases of shipwrecks.

4.2 OIL SPILL

The oil spill that resulted from the loss of the ″SEA DIAMOND″ was serious as vessel's fuel oil, diesel, lubricant and slop tanks were damaged while sinking resulting in a serious oil spill which threatened both the environment of this geologically significant place as well as the flourishing trade of the island. However, the response in terms of the at-sea skimming as well as the shoreline cleaning was immediate and successful up to a reasonable extent. The major part of the oil released from the wreck was picked up straight from the sea surface thus the shoreline impacts minimized.

The wreck itself posed a number of challenges due to its precarious position on underwater steep crater walls of the old volcano, depths that makes it impossible to dive, the serious damage of the hull of the vessel as it sank as well as the morphology of the seabed which is too deep and steep for conventional boom anchoring. In fact, after the incident, Remotely Operated Vehicle surveys found the heavily damaged wreck in even deeper waters towards the center of Caldera. A reconstruction of events by naval architects and other relevant experts determined that as the vessel hit the bottom it rolled down the steep seabed before coming to rest in a nearly upright condition. According to those experts the bow of the wreck rests in one hundred and twenty-five meters of water and the stern in one hundred and forty-seven meters. Having said that, the results were quite impressive as it is estimated that 300 m^3 of oil, which happens to be considered as more than the half quantity of the total quantity (572 m^3), was successfully recovered along with the cleaning of the shores of Santorini within the first three months of the accident. However, the continuing oil release which is still contained by a booming arrangement has been a subject of controversy until today as the measurements of the government's marine research institute seem to diverge from the ones carried out by Cretan Technical University.

4.2.1 Incident and Release

One of the major forces that would have exerted on the vessel as it sunk was the rapid increase in water pressure as it quickly dropped into the deep waters of Caldera. As the compression forces of the water column have theirs strongest effects on gases rather than solids or liquids, as the vessel sank, its partially-filled oil tanks would have come under great pressure to implode. Unlikely a laden crude oil tanker, the cruise ship ″SEA DIAMOND″ which was well into a week-long outing that did not require full tanks even at the beginning of the cruise, had all of its tanks partially-filled at the time of the incident. As a result, oil tanks lost their structural integrity as they imploded, water rushed into the tanks until the pressure became balances ant oil entered the interior ship spaces around the internal tanks.

As the wreck settled to its final, nearly upright position, fuel oil, diesel and lube oils that were all lighter than the sea water, began to migrate upwards inside the ship Where openings or structural damage would allow that, the oil passed upwards from one deck to another however where no such openings were immediately available, the floating oil would have first formed pools in the celling spaces. Regarding the most viscous heavy fuel oil, this would have been a relatively slow migration but for the lighter more fluid oils the procedure would have been quicker.

Surveyors on site reported that oil was first seen on the sea surface some hours after the actual sinking. In contrast to an instantaneous oil release that oil spill that emerged due to the sinking of the ″SEA DIAMOND″ was a long, continuous release rising from below in a steady stream of bubbles of oil. The actual release was observed in the early ROV[17] surveys which found a slow stream of individual oil bubbles leaving the wreck near the upper decks. On the sea surface above the wreck the water was covered in thick black slicks and considerable sheen in the early days which obscured the view of the rising oil.

4.2.2 Oil Spill Response

One of the first anti-pollution measures undertaken was the deployment of five hundred meters of locally-stationed foam-filled fence boom which was tied to the vessel while listing in the water in case any oil might begin leaking. However, as she sank the vessel pilled the boom with her to the depths.

Even before the vessel sank, Environmental Protection Engineering S.A. was contracted by the vessel's owners in order to mobilize its resources from various bases around the country so as to be able to assist with booms, skimmers, vacuum trucks and other support vessels soonest possible.

The emergency response during the first few days focused in capturing and recovering free floating heavy fuel oil with the help of self-propelled skimmers, deployment of long fence boom in circular

[17] A remotely operated underwater vehicle (ROV) is a tethered underwater mobile device.

formations above the wreck site, vacuum-sucking heavy oil accumulations from the quay-side waters of the port and last but not least surveying near-shore waters, beaches and cliffs for impact.

After a few days, although limited shoreline activities were undertaken from the start, the continual release and its inheriting risk of re-oiling any of the shoreline areas at any time meant that the shoreline cleaning outside the port had to be limited to the removal of debris and some removal of pure-oil pools on the shore. It was not until the end of June 2007 that the booming challenges over the wreck were overcome, the original slicks of floating oil had been addressed and the risk of uncontrolled losses from the immediate wreck area was reduced.

4.2.3 Booming

Due to the existence of a continual release of oil from the wreck, there was a compelling need of long-term operations in order to capture or at least slow down its escape from the immediate area during night so as to self-propelled skimmers could collect it during the day.

The main idea concerning booming was to maintain a roughly circular boom pattern over the wreck site in an attempt to catch the rising oil as it surfaced. During the first three months of the operation all of the boom used for those installations was foam-filled, plastic coated, fence boom which is a standard type of boom easy to deploy, tow, recover, clean and store. However, in the case of ″SEA DIAMOND″, a serious number of challenges were faced up in practical deployment.

The most serious of the abovementioned challenges was securing the boom in place and keeping it there. Most of the times, sections of boom either broke apart oi were torn away from their anchoring lines due to sporadic storms and several wind shifts. Another serious and unique challenge faced was the complete loss of long lengths of boom. The main cause of this problem were surface sea currents that pulled the installations from their mooring place. As a result, because of the deep water, the heavy anchors and the long chains used the entire length and all the moorings tackle were lost into the depths. On top of that, because of the weight of the mooring tackle still attached and the loss of buoyancy due to the water pressure at depth, no amount of mechanically

assisted lifting and pulling was able to recover any of this boom lost. All in all, some two kilometers of fence boom were permanently lost. The solution to the problem of the sinking boom was found by advising an anchoring specialist for open-water aquaculture facilities who designed and monitored the installation of a permanent anchoring system which included:

- Two large cement blocks of $1m^3$ each sunk in deep water beyond wreck and each connected vertically via eighteen millimeters steel cable to large (1.600) liters buoys on the sea surface
- Two nine hundred fifty meters long and twenty-eight millimeters diameter ropes each connected (subsurface and under tension) on one end to the riser cables via special connecting wheels and the shore on the other end
- Two shorter length and twenty-eight millimeters rope, one between the who connecting wheels on the riser cables and one on the shore side of the wreck between the two long lengths of rope

In this way, a box of large diameter rope was created around the wreck which was held horizontally six meters below the sea surface by a series of small buoys to which the boom itself could be tied. The result was a dynamic mooring system that ended the problem of sinking boom as soon as it was installed.

However, although the location of the wreck is not subject to tides, currents or swell, it is exposed to strong winds which can produce waves and temporary surface currents. The outcome of the fence boom was that it regularly failed to hold oil whenever wind picked up.

Therefore, the decision was to install heavy-duty inflatable boom which had to be ordered abroad and delivered in two months period. However, once it was installed, its wave-following characteristics, low skirt and high freeboard reduced further oil leak even in windy conditions.

A key part of any successful boom operation which is often overlooked is the ability to regularly empty the accumulated oil. In the case of the ″SEA DIAMOND″, a small workboat with a water pump was employed in order to flush the accumulated oil into one area. Then, one skimming vessel

outside the enclosure would approach a part of the boom that would be manually lifted just enough so as to allow the oil to be flushed straight into the bow opening of the skimming vessel.

4.2.4 Skimming Operations

One of the key features of the ″SEA DIAMOND″ response was the over the half recovery rate of liquid oil from the sea surface. In that respect, three aspects played a crucial role in order for the operation to be successful:

1. Vessel based skimming in early days of the incident
2. Self-propelled skimmer operation throughout the entire response
3. Vacuum truck skimming

The support-vessel-based skimming worked well in the first few days of the response when significant quantities of oil could easily be collected and brought alongside the support vessel. Short lengths of boom and small outboard workboats were useful for such operation. The skimmer was dropped by a small crane directly into the small boom enclosure which was made smaller to keep the oil concentrated. The recovered oil was pumped into the internal holding tanks of the support vessel. A weir skimmer and a disc skimmer were both used in order to choose which would be the best alternative. The weir skimmer was preferred due to its larger capacity and its efficiency in dealing with the emulsified oil. During the first week and through the four days use of the weir skimmer and a one-day use of the disc skimmer 26 m^3 of oily liquids were recovered and store in the hold tank of the support vessel.

By far the greatest share of the recovered liquid oil was collected by the four self-propelled AKTAIA skimming vessels. In detail, the nineteen meters long AKTAIA vessels, which are powered by one hundred thirty-five horsepower engines are highly maneuverable and widely deployable due to their low draft. Those vessels have bow doors at the water level that open into an internal water channel through which water and floating oil are driven by steam created by the turning of the vessel's propeller. An internal grate is fitted in such way to scoop any debris from

the central water and oil channel and lift these up into a temporary storage bin. Collected oil can be held in the central channel for immediate removal via a vacuum truck or it can be passed over an internal weir and pumped into two internal storage pumps for further remote disposal. An important feature of the AKTAIA vessels is the ease with which there skimmers are able to recover both emulsifies oil and debris oil mixes. It is worth to mention that in stormy weather great quantities of lightweight stones emerging from the cliffs above the Caldera, were washed and blown into the sea where they formed their own floating slicks. In some cases, those slicks crossed with the oil slicks and were removed without difficulty using the AKTAIA skimmers. It is believed that in such situations, regular pump based skimmers would have faced great difficulties in order to deal with.

Another determinant factor of the successful skimming operations was the vacuum tuck work undertaker in the port, which was in fact the only place where the trucks were able to operate. The vacuum truck teams took advantage of the windy days as they recovered the oil directly from the seawater without any real impact to the shoreline. Equally important was the fact that the trucks were able to quickly empty the AKTAIA skimmers which would require much more time in order to discharge via their own pumps.

Overall the main reasons regarding the success of the skimmer operations were the following:

1. The skimmers were matching the oil characteristics and requirements as well as the current sea state
2. The skimmers that did not fit to the situation were immediately demobilized
3. The teams were experienced and competent with their equipment and vessels
4. The skimmers were able to deal with debris and deliver pure liquid
5. Prevailing wind pushed the oil towards a favorable direction and not beyond the easy reach of the response operation
6. There were minor surface currents or tides

7. The emulsified oil typically did not stick to the cliffs or other surfaces as it was captured within the boom
8. The location and the direction of the oil drift was easily observed from above
9. The wind that blew the oil into the port made it easier for the vacuum to reach it

4.2.5 Shoreline Clean-up Operations

The shoreline cleanup phase started two months later when the oil release from the wreck could be more efficiently controlled in the area between the wreck and Athinios Port. After the initial phase of collecting pure oil trapped in cavities of the shoreline with vacuum pumps and by hand, the cleanup focused mostly on manual techniques because of the difficulty of access to the shore.

Later on and in order to reduce the quantities of beach material to be removed from the area, especially in the cobble parts, low pressure washing was carried out supported with absorbent booms. The part of the shore which was volcanic cliffs, rocks and boulders were cleaned in a large part with high pressure washers and collection of the washed oil with sorbents. Another large part of the shore cleaning had to be carried out with the use of landing craft and other work boats because of difficulties regarding the access and safety issues.

4.2.6 Temporary Storage for Collected Solid Wastes

Following an agreement with local municipality, an area of the city's landfill was assigned for the temporary storage of the collected solid waste. Waste was placed in heavy duty plastic bags inside heavy lift big bags separated according to their type. By the end of the operations all wastes were placed in skips and containers and transported to Piraeus mainland for final disposal.

CONCLUSION

Removing a wreck is a major undertaking with considerable physical, financial and environmental risks. It can require complex engineering and the use of substantial inventories of equipment, including heavy lifting gear. A shipwreck is not only the loss of hull. It also affects many different aspects, including public health, the flora and fauna as well as the potential economic impact particularly in cases where the accident has taken place in residential and tourist areas.

As for the methods of wreck removal mentioned throughout this thesis, it is difficult to determine which is the most appropriate in principle. This kind of decision is always correlated to each company's available equipment and sometimes determines the method that will be followed. Companies generally refrain from renting equipment because it is not economically advantageous. Large parts of the world are very distant from the equipment that might be needed to undertake a substantial wreck removal. At a local level the ground condition at the wreck site plays a crucial role regarding the costs. The type of vessel that is wrecked is also a major factor as all types of vessels offer their own challenges. In general, there is no specific way of removing a shipwreck but differs by case. Therefore, it is important to put all different parameters into consideration. One of the most crucial factors to be taken into account is also the depth of the shipwreck. If the depth is over fifty meters, any underwater operation needs to be conducted with utmost attention since an attempt of diving is may lead to life loss. Moreover, the location of a wreck is very important. Remote sites, distant from supply bases and sources of heavy equipment, will tend to drive up costs, as the duration of operations extends and the period of hire for equipment lengthens. Globally, the amount of heavy lifting gear is limited and concentrated in comparatively few locations. A pool of experienced and capable wreck removal operators is vital to maintain the health of the industry.

Wreck removal operations are generally expensive, given the need for skilled personnel and specialized equipment, often for long periods and frequently in inaccessible locations. Moreover such operations have tended to become more expensive in the past decade and in certain cases, costs have risen dramatically. It is therefore an issue that is of great interest to shipowners and their liability insurers. It is also an issue of increasing importance to the company insurance markets, which are more regularly and more substantially exposed to direct and reinsurance risk.

Analysis of the most expensive cases by the International Group of P&I Clubs has found that the role of relevant authorities is a key driver of increasing costs. Media coverage and pressure from political and environmental groups can increase pressure on the authorities, which may in turn exert more influence on operational matters. Specific requirements, often with understandable regard to environmental concerns, such as the approach to removing a wreck's bunker fuel, can further add to the cost.

The insurance industry is already affected by rising costs in wreck removal, and reinsurance costs are likely to rise and be passed on to the shipowners, pushing up their operating costs in turn. There should be increased dialogue and openness between all parties to build trust, and shipowners and insurers should consider a formal, international campaign of engagement with relevant stakeholders such as influential coastal states, IMO, EU and International Harbor Masters. The campaign should link the global importance of the shipping industry to concern about rising costs from wreck removal and demonstrate that the industry is competent to conduct and pay for wreck removal. Authorities should be encouraged to resist political pressure and maintain focus on the need to remove wrecks safely, and with regard to the environment, to fully engage with the shipowner, insurer and contractor during operations. P&I Clubs and contractors should consider joint working on ideas for reducing the cost of preparing tenders. For example, interested contractors might share common survey information provided by a neutral third party.

It is arguably in the interests of all parties involved in the shipping industry to understand better the issues related to wreck removal and to work together to reduce costs. This could be achieved

through increased communication and cooperation between the different stakeholders including shipowners, insurers, relevant authorities and contractors.

As far as Greece is concerned, even though the Law 2881/2001 clearly defines the notion of shipwreck and allocates the main responsibilities of wreck removal, it does not clearly specify the criteria according to which a shipwreck can be deemed as perilous for either the navigation or the environment. Therefore, the shipowner has the opportunity to waive liability claiming inaccuracy of the Law. Such issues provoke delays that increase the complexity of each case and this is indeed what happened regarding the case of the ″SEA DIAMOND″. Therefore, a revision of the Law 2881/2001 concerning shipwreck removals in order to improve its accuracy is of utmost importance.

The question “Why one should get involved in such an operation?” is another aspect of the issue we should not overlook. The public invitation published by the Municipal Port Fund of Thera, clearly states that every operation that will take place prior to the commencement of the removal as well as the removal itself, will be completed with expenses of the contractor. Having said that, it is worth mentioning that there will be no remuneration offered but the selected physical or legal person will be compensated by acquiring the ownership of the shipwreck, the value of which obviously cannot be compared to the cost of operation as a whole in any case. But what would be the incentives of one to undertake such a big project and its subsequent costs? The hull of ship, apart from any usable equipment that would be removed, can be demolished so as to provide scrap steel. However, it is more than reasonable that all costs occurring, including the enormous risk one will take in order to remove the vessel without causing any further damage to the environment and of course potential loss of life, is so high that scrapping cannot be considered as enough motivation for one to get involved.

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