SALVAGE TECHNIQUES:
CASE HISTORIES OF SPECIFIC SPILLS

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ABSTRACT: When conducting salvage or wreck removal operations, salvors must take into account the threat of oil pollution and instigate measures to minimize the effect of any pollution which may occur during salvage operations. Modern salvage techniques involve measures specifically aimed at coping with the problems raised by current pollution awareness.

Each incident develops a character of its own; the level of success in achieving a satisfactory outcome very often depends on the relationships formed among the parties involved. Salvors usually reach the scene of a casualty after the initial oil spill and are faced with having to enter a highly charged atmosphere where the slightest “metaphoric” spark can result in mistrust and misunderstanding between participants.

Increasingly, salvage companies are having to consider oil pollution or the threat of oil pollution as a priority when dealing with the salvage of ocean-going ships. This paper examines the techniques employed by a number of salvage operators when they are handling a situation where oil pollution exists or is a threat.

Salvors employ a variety of techniques when dealing with oil removal from a casualty. During the response period, it is important that those controlling the response are aware that the salvors’ priorities in oil removal may not necessarily coincide with environmental considerations. For example, a salver may wish to use a method which is most economical to him but which may have, in the eyes of the responsible authority, a high risk of oil pollution occurring.

Attendance at a significant number of casualties where actual or threatened oil pollution has been a major influence has given the author wide experience on the international front in dealing with such casualties. Priorities vary from incident to incident and are not always governed by practical considerations. The case histories chosen illustrate this point.

Definitions

Salvage techniques. The purpose of any salvage operation is to remove a ship, its cargo and/or bunker oil from a place of real or threatened danger and place the salved material in a position where it is safe from anticipated danger. The methods used in achieving the desired object can be said to be the techniques of salvage. Of necessity this is a broad-based definition, but the methods used by salvors are diverse and often innovative.

Case histories. Each oil pollution incident develops its own character as the situation evolves. Often the major influences in incident development are not the characteristics of the spillage, but the manner in which a particular problem is approached and the interaction among all those involved in dealing with the incident. The cases examined in this paper are based on personal experience and offer a glimpse at some of the practical issues involved.

Salvage Techniques

A salver’s aim when conducting an operation is to achieve success at the lowest economic cost in a manner that will reap the highest rewards. The “safety net” provisions in the Lloyd’s Open Form do allow salvors to recover costs of measures taken to prevent or minimize pollution by oil cargoes from tankers, even if the salvage service rendered is unsuccessful. At present the “safety net” does not include tanker bunkers when there is no oil cargo on board or steps taken to minimize the threat of oil pollution resulting from non-tanker bunker spills. It must be said, however, that the costs involved in conducting bunker pollution minimization operations are usually indemnified by P&I clubs.

Oil pollution considerations are not always a salver’s top priority, and while salvors are aware of and sympathetic to the requirements of governmental and local authorities, these bodies must also be aware of the salvors’ own priorities.

When there is a threat of oil pollution, the techniques used by salvage operators are influenced by the pressures brought to bear on them by various parties and interests involved in a casualty. These pressures invariably raise the question of threat priority and the case histories examined illustrate this point.

Generally speaking, the techniques suggested and employed by salvors will be governed by two main factors: first, the equipment available to the salver, and second, the requirements of a particular salvage operation.

Salvage company priorities. Most of the major internationally recognized salvage companies carry an inventory of salvage equipment. The nature of a response by a salvage company is influenced by the extent of its own equipment inventory. A second factor, which influences the salvors’ proposed response, is the availability and price of locally based equipment. For example, there is little point in a distant salver supplying submersible pumps, skimmers or booms when these are readily available locally.

A salvage company that owns or operates heavy lift equipment located near to the casualty may wish to employ a “lift and shift” method of removing a ship and oil together, in preference to an operation that concentrates on removing the pollution threat by means of oil removal. A salvage company that does not maintain an extensive inventory may wish to use a less capital-intensive method when attempting an oil removal operation.

Local influences will also affect the response. In a number of areas, even when a situation is critical, salvors are obliged to employ local resources, even when these are not the most appropriate in a particular instance. In some areas local regulations preclude the importation of equipment, and sometimes even personnel, to conduct an opera-
tion. A salvor may be forced to use a technique that is unfamiliar to him because of parochial limitations imposed on him. Operational efficiency is often impaired when a salvor is allowed to import specialist equipment, but is then obliged to employ local labor to work with or alongside the equipment.

There have even been instances where salvors have been forced to cease operations and await the approval of the local authority and accept amendments to the proposed technique to satisfy local requirements, with the consequence that pollution has occurred because the delay induced by such intervention has resulted in a casualty sustaining further damage.

Job-related techniques. Before any salvage operation can be undertaken the salvor must conduct a survey of the situation. The depth of survey will depend on the many factors influencing the situation, typically: threat to human life; where a ship is afloat or aground; type of ship; weight distribution on board the casualty; extent of grounding; type of seabed; urgency of situation; danger to casualty; equipment availability; quantity and distribution of oil on board.

Threat removal. One of the issues that raise the most problems when a casualty occurs is the question of whether the oil should be removed from the ship or the ship removed with the oil still on board. The answer often lies in determining the risk of spillage from a casualty. When a ship is still afloat but disabled and towage is contemplated, oil removal is usually of secondary importance, particularly if the ship is close to shore and the priority is to prevent her grounding. As a "floating" casualty develops, then consideration will be given to removal of oil. If a ship is damaged, but the plating remains intact and there is no oil spillage, any cargo oil removal operation is usually associated with ensuring the cargo is delivered to its destination. Some ports will allow damaged laden tankers entry, when there is no seepage of oil, whereas others will refuse entry, insisting that the cargo oil is lightened offshore. In a floating casualty situation the question of lightening is usually resolved either by commercial considerations or by the attitude of local harbor authorities.

When a ship is grounded and contains oil, be it cargo or bunker oil, the question of oil removal is often decided by the local authority, and this point is highlighted in the case histories examined. If a ship is grounded, severely damaged, and likely to be declared a constructive total loss, hence becoming a wreck, an early oil removal operation is almost bound to take place.

Not every grounding leads to oil spillage, even with laden tankers. Most, if not all, dry cargo ships use double bottom spaces, that is, the space between the bottom of the cargo hold and the outer bottom shell plate to contain fuel oil. These tanks, known as bunker tanks, are in a highly exposed position in a grounding situation. If the tanks are known to be damaged, an oil removal operation will certainly be contemplated. This may take the form of a transfer from a damaged tank on board to an intact tank, or removal of oil from the ship.

When a tanker is grounded and contains oil, the priority must be to stem the oil outflow. Rarely can salvors respond in sufficient time to prevent "pressure equalization" in those tanks that are ruptured and open to the sea. While oil removal operations from tanker cargo tanks are generally reasonably straightforward and large quantities can be pumped quite quickly, oil removal from cargo ships' double bottoms can be and often is a slow process. One reason for this stems from the fact that when lightening a grounded tanker, another tanker is usually brought in to act as lightening ship and is capable of receiving large quantities of oil quickly. With smaller dry cargo ships it is more customary to use barges as the receiving vessel, partly because of availability and partly because most small coastal tankers are reluctant to carry heavy fuel oil.

In many cases, salvors will argue that by removing the ship with the oil contained inside the hull, the risks of pollution are less than attempting a removal from the tanks, an operation, which by its very nature, salvors argue, will increase the risk of oil spillage. A salvage operation must not be confused with a wreck removal operation. Generally speaking, a ship can be considered to become a wreck when she has been accepted by underwriters as an actual or constructive total loss. Liability for wreck removal expenses is indemnified by P&I clubs where there is a legal liability for a wreck to be removed from a location. Where a state has wreck removal provisions in its statute, the question of oil and wreck removal can be treated in tandem. In these circumstances the contractors may prefer to remove the wreck and oil in one operation. By their very nature, wreck removal operations are more protracted and it is in those circumstances where authorities very often insist that the wreck be cleared of oil first.

Problems do arise where a state has no specific wreck removal liability. In these cases it is customary to remove the oil from the ship and leave the wreck. Where there is no legal liability for wreck removal, the costs of removal are not covered from an owner's P&I club.

Oil Removal Techniques

The general principles of oil removal are the same whether a tanker or a cargo ship bunker tank is being offloaded. If a disabled ship is still operational, in the sense that her pumps are still operative, then oil removal from an intact tank is quite straightforward. Most of the problems encountered in such an operation stem from maneuvering the receiving craft into a position where she can accept the oil. If a ship is unable to discharge the oil herself, salvors will use a number of techniques to pump out the oil.

External activation of ship's system. The simplest and most straightforward technique, where the ship's lines and pumping capability remain intact, is simply to provide a power source to the pumps and use the ship's lines to achieve a discharge.

Portable pumps. Assuming a ship's pumping system is totally disabled, but tanks are accessible, the next option is to use portable pumps. These may be surface or submersible; in every case they must be intrinsically safe. If salvors are unable to use the ship's power system, it may then be necessary to supply generators and/or compressors to provide a power source for the pumps.

Displacement. Another technique often used by salvors is to use the property of the oil itself to achieve discharge. Typically, the displacement method will be used when salvors do not wish to lighten the ship, but are required to remove oil from an intact tank. Displacement methods involve the careful introduction of water into a tank space, thereby forcing the oil, which will float on top of the water, to come to the surface, for example, by way of air vent pipes.

Steam injection. Heavy fuel oil is a thick, sometimes almost solid mass when cold. Salvors are often obliged to heat oil to make it sufficiently viscous that it will flow when pumped. This can be achieved in a number of ways. First, portable heating coils; these are more commonly used in tanker operations when a ship's heating system is inoperable. Portable coils are introduced into the tank space and used to increase the temperature of the cargo. Naturally the use of such coils involves the need for a steam generating plant. This can be a relatively slow process, since the portability of the coils results in limited capacity. Second, steam injection: the injection of steam into a tank will result in the oil heating and becoming pumpable. Steam is generally a last resort method because it introduces water into the oil and can take some time to separate out.

Hot-tap method. The hot-tap method is used when normal tank access apertures are inaccessible, for example, when a ship is sunk or disabled. In summary, the hot-tap method of access consists of using specialist equipment to gain access into a tank by cutting a small access hole (2 inches in diameter) over which a valve is fitted, without the risk of pollution. The valve may be fitted with a steam injection inlet. Once positioned, lines are connected to the valve to allow pumping. The method is intrinsically safe and can be achieved in quite awkward situations. This is a useful method when tanks are broached, because the part of the tank containing oil can be safely accessed.

Oil spillage. It is not the purpose of this paper to deal with spillage response. However, it must be said that most competent salvors have the capability of dealing with oil spillages, be they outside the hull, where booms or dispersants may be more appropriate, or within the shell plating, where skimmers may be more appropriate.

Case Histories

The case histories chosen illustrate a number of points mentioned in the first part of the paper. Because of the nature of casualties and
Case 1: Ballasted VLCC aground off sensitive tourist islands

Circumstances of the casualty. While on passage in ballast the ship suffered a mechanical breakdown that resulted in her having to divert to the islands for repairs. While approaching in poor weather, the ship grounded and suffered severe bottom damage, which in turn resulted in her becoming a constructive total loss. At the time of the grounding the ship had on board some 900 tons of heavy fuel oil bunkers. The crew was evacuated without loss of life.

The ship subsequently broached-to and ended up heavily listed with one of her large wing bunker tanks punctured. Although some oil escaped the ship, fortunately there was no major pollution. However, the ship had grounded adjacent to an ecologically and environmentally sensitive area and the government was under considerable pressure to respond immediately after the casualty occurred.

Casualty response. Initially, salvors were contracted by the owners under a Lloyd's Open Form to conduct a salvage of the ship: their initial response was geared to a salvage operation. Having no major resources of its own and fearing the worst, the government sought immediate assistance from the U.S. Coast Guard strike team. The team responded with alacrity and was on site within a relatively short period, equipped with pumps, compressors and other oil removal equipment. Fortunately, a U.S. Navy barge, which was normally used for the carriage of aviation fuel, was available to the team and it was swiftly made ready to receive oil from the stricken ship. Oil removal was achieved by using the portable pumps to pump the oil directly from the ship’s bunker tanks into the barge. This operation took place in the open sea in hostile conditions. Within 48 hours about 900 tons of oil and water had been removed from the broached tank, thereby reducing the risk of spillage. This phase of the oil removal operation terminated when the barge being used was completely filled with an oily water mixture.

As the initial oil removal operation was completed, the salvors arrived on scene with generators, compressors, skimmers, pumping equipment and all other equipment to conduct a refloating of the ship and deal with oil pollution response. Initially a salvage operation was commenced with the idea of refloating the ship. Such oil as remained on board was contained either in intact tanks or within the engine room; thus, while the ship remained intact, the danger of oil spillage was minimal. However, the salvors could not ignore the risk of pollution and a team was used to prepare for further oil removal and to skim the oil lying on top of the flooded engine room. Salvors were confident that given good weather, they could refloat the ship by putting compressed air into her cargo tanks and, because there was no further suitable reception barge available, contain the oil within the ship’s hull.

The ship was declared a constructive total loss five days after the casualty. The owners’ P&I club, having been satisfied that all the necessary criteria had been satisfied, stepped in swiftly to continue the refloating operation as part of a wreck removal. During the latter stages of the refloating operation a close pollution watch was maintained throughout. The location and prevailing weather conditions meant that a containment boom around the ship would have been quite useless. Extensive shore response contingency plans were made to suit the local environment and to deal with any spillage that could have occurred during the operation.

The ship was successfully refloated. There being no alternative means of disposal, the ship was sunk far out to sea without further anti-pollution measures being taken.

Case 2: Fully laden VLCC—major spillage

Circumstances of casualty. This ship, while fully laden with about 120,000 tons of crude oil cargo on board, struck a submerged object. As a result about 4,000 tons of cargo oil escaped. Interestingly, the oil dispersed naturally and there was no reported pollution or associated response operation. Immediately following the incident it was realized that the ship had been badly damaged.

The ship’s crew was able to prevent the ship touching bottom by putting compressed air into the forepeak ballast tank to keep her head up.

Casualty response. Steps were taken immediately to lighten the ship in the position where she had anchored following the casualty. About one third of the cargo was transferred into a lightening tanker within a few days of the casualty using the ship’s own pumps. Once the situation had been stabilized, the ship was transferred to an anchorage well offshore. Subsequently, a second VLCC was maneuvered alongside the casualty and the remaining cargo was transshipped. That cargo which had been transshipped earlier was also placed on the relief VLCC which then completed the voyage.

In both lightening operations it was possible to use the casualty’s lines and pumping systems and a relatively “normal” discharge took place. Salvors had to conduct a carefully planned operation to avoid placing undue stress on the damaged ship and the casualty was treated with kid gloves. Care had to be taken to avoid ship-to-ship contact during the operation and booms were placed around the casualty and between the casualty and the lightening ship. In the open seas and in calm conditions, the booms would have contained minor spillage, but it is unlikely they could have coped with a major spill. This case is a good example of salvors working to contain the risk of pollution, while allowing the commercial aspects of the voyage to proceed with minimum delay.

Lessons learned. The disappearance of the spilled oil remains a mystery. Salvors had a free hand in dealing with the salvage and oil transfer, without close monitoring by the authorities. This case illustrates just how straightforward an oil transfer can be when the casualty’s pumps and power supply remain operational.

Case 3: Oil removal from sunken ship

Circumstances of casualty. Of all the oil removal operations attended, the trickiest took place off the south coast of Ireland in the stern section of an OBO carrier that had sunk in up to 150 feet of water. The after section initially contained in excess of 1,000 tons of fuel oil in two wing tanks and the engine room storage tanks and was lying against sharp rocks in a location that was highly exposed and subject to very strong tidal conditions. At the time of the initial casualty a quantity of oil had spilled from the forward deep tank and a considerable quantity was cleaned up from the beach. Weather conditions prevented any work on the sunken part of the ship, which contained the fuel oil, for a considerable period. Before any action could be taken there was a further spill when one of the bunker tanks in the sunken section ruptured. It is thought that the stern section broke away from the fore part of the ship, then heeled over. Diving surveys revealed that the port wing bunker tank had ruptured, allowing most of the oil contained in it to escape. A further beach cleanup operation followed. A preliminary survey showed that quantities of oil remained in both of the wing tanks, and the ministry involved insisted that all removable oil be taken from the ship.

The wreck site was adjacent to areas of shellfishing importance and holiday beaches, and was right on top of a herring spawning ground. The difficult geographical position combined with the exposed nature of the site and the strong tidal flows meant that work was only possible on the wreck for short intervals between tides.

Casualty response. Prevention of further oil spills was an absolute priority and reputable salvage firms were requested to tender for the
were thought to contain at least some oil, and to ensure the status of water temperature steam injection was essential to ensure adequate contained some fuel oil. Steam was injected into the space through the valve located over the hot tap access hole and the oil was then pumped using a pneumatic diaphragm pump, from the tanks to a reception barge. Initially, pure oil was pumped but eventually water was reached. The tank was then allowed to settle for a period, under a head of steam; further oil was then pumped out. The process continued until negligible amounts of oil were removed from the tanks.

The most difficult aspect of this operation was entering the engine room spaces to gain access to those service and settling tanks that were thought to contain at least some oil, and to ensure the status of other tanks. Divers worked in hazardous, difficult conditions to gain access to the engine room tanks and were able to remove a substantial quantity of oil from at least one of them. Drilling tests on the other accessible tanks indicated no oil remained in them.

Lessons learned. The dangerous conditions in the wreck, combined with the narrow band of physical parameters in which it was possible to work meant that safety of life and precautions taken to ensure the divers’ safety received special attention. Because of the depth (up to 150 feet), diving time was restricted and additional divers were made available to ensure continuity of the operations. In the prevailing sea water temperature steam injection was essential to ensure adequate oil viscosity and to purge the tanks. The government in question could not wait until a more favorable time of year to carry out the operation, so advantage was taken of every weather window to achieve a complete bunker oil removal. This operation showed that even in hazardous conditions where strong tides and inclement weather were governing factors it was possible to achieve a successful oil removal.

Case 4: Stranded ship

Oil or ship removal? This relatively small specialized dry cargo ship ran heavily aground on an island that bordered an ecologically sensitive area. The ship had grounded at full speed and run up over rounded granite rock. Bunker tanks were located in the double bottom spaces and engine room. At the time of the casualty there was some minor pollution, but most of the oil escaped from the bunker tanks into the ship’s cargo spaces, where it remained contained within the hull. It is the author’s understanding that the country in question had no wreck removal provisions in its statute, but did have stringent pollution prevention laws. The dilemma faced by the owners (and their P&I club) was that in order to meet their responsibilities as covered in the rules, there was only a requirement to remove oil from the engine room. The owner’s club was reluctant to risk the wreck removal of the ship itself. Had such an operation gone ahead it would have been far less costly.

The authorities were faced with a different dilemma in that not only did they not want the oil present at the site, they did not want the ship present either. Apparently the owners and their representatives were given an extremely short period of time to devise, propose and instigate an operation. It appears that the practicalities of the situation precluded this from happening and for one reason or another the authorities embarked on their own operation. It must be said that the initial oil removal operation was handled ineptly and the costs were disproportionately high. There followed a period of inactivity at the wreck site where the ship lay with most of the oil remaining within the confines of the hull. Eventually the authorities conducted a full wreck removal operation where the ship was refloated. Free-floating oil was removed, having been skimmed from the surface of the water within the cargo spaces. The refloated ship, still containing oily residues, was then towed through an island archipelago and placed alongside a bay by barge near a residential area. There are several interesting questions raised by this casualty, some of which are still subject to court proceedings.

The owners’ club’s dilemma was that it was only too willing to remove all the oil from the ship and that, because the country did not incorporate a specific wreck removal provision in its statute, the costs of a full wreck removal were not covered within the club rules. It seems that the owners were placed in a Catch-22 position when the authorities gave them only a few hours to come up with an acceptable plan. Once the authorities intervened, the owners were unable to take any practical action and there is little doubt that the action of the authorities substantially increased the risk of pollution occurring.

Lessons to learn. This case showed how, in a situation where a state law is not precise, a conflict can develop between the aims of the state authorities and the owner’s P&I club. Had the state in question had clear wreck removal provisions, then the conflict between wreck removal and oil removal priorities would not have taken place. Had the owners and their club been given a free hand to remove the threat of oil pollution, this could have been done quickly and economically, and it then would have been possible to solve the wreck removal liabilities without there being a threat of oil pollution. From the practical point of view, this case shows that when oil is contained within the ship’s hull it can remain there for a substantial period without polluting the immediate environment. The salvors had used traditional skimming techniques to remove the floating oil from the holds. No other techniques were employed to remove the oil clinge from either the holds or the machinery spaces. Had the club been allowed to conduct an oil removal operation, this would have entailed steam or chemical cleaning of the ship’s interior to ensure that no oily residue remained on board.

Case 5: Ship stranded following major fire and explosions

A question of priority. This conventional dry cargo ship, loaded with a mixed general cargo, including about 1,200 tons of hazardous goods, suffered fire and abandonment at sea, unfortunately with heavy loss of life. The ship also had on board about 800 tons of fuel oil. The ship subsequently grounded in a remote location, at the bottom of cliffs but adjacent to fishing grounds and local beaches. At the time of the grounding some of the cargo was still on fire and spectacular chemical fires took place during the immediate ensuing period. The government in question contracted a salvage company to conduct a removal of hazardous cargo from the ship and, at the same time, removal of bunker oil from the ship’s tanks. The exposed nature of the location meant that work was only possible on the calmest of days. Also it was not possible to place containment booms around the ship, or even to keep craft close to the casualty in adverse weather. Consequently, during periods of bad weather oil escaped from the hull together with some of the cargo, and there was considerable pollution at the foot of the cliffs in a location that was totally inaccessible. In view of the nature of the cargo, a list of priorities had to be drawn up, which meant that oil pollution prevention took second place to removal of some highly toxic chemicals. Nonetheless it was possible to remove some oil from those tanks that were readily accessible. It is thought that about 700 tons of fuel oil escaped.

Lessons learned. There are cases when it is physically impossible to prevent oil spills from stranded ships or to mount any meaningful pollution cleanup response. The authorities were faced with the dilemma that either chemical removal or oil pollution could take place at any one time. The physical constraints at the wreck site meant that it was not possible to conduct a major oil removal operation simultaneously with the removal of toxic chemicals. The exposed nature of the site meant that it was not possible to prevent the escape of large quantities of oil, or even to deal with any pollution which did occur. The contracted salvors were issued a written list of priorities. This case clearly illustrates the dilemma faced when a coastline is threatened by both chemical and oil pollution from the same casualty.

Case 6: Pollution response

Cost analysis. This final case involves a laden tanker that was involved in a collision in confined waters adjacent to a resort coast. Following the collision, there was loss of life and a crew evacuation took place. Some hours after the collision it was discovered that a quantity of oil had escaped into adjacent waters. A full pollution alert was initiated and a number of steps were taken to deal with oil that had splashed from the ship: the use of dispersants, placement of booms, mobilization of oil recovery craft, beach oil...
removal and ship-to-shore/ship-to-ship removal of the cargo from the casualty. In the event, about 150 tons of oil was removed from the surface of the water by use of funneling booms and skimmers. Ironically, the skimming operation was hampered by the presence of large quantities of floating timber and plastic debris. Although large quantities of dispersant were used there is little evidence that this was a major contribution to preventing shoreline pollution. Fortunately, little oil landed ashore and the beach cleanup operation, which involved removal of oily debris and hose cleaning, was of a relatively minor scale. Restricted storage facilities at the location where the ship was berthed meant that the cargo had to be transshipped from the casualty to a succession of lightening tankers. This operation was conducted using portable pumps and generators, because the casualty’s own pumping system was initially inoperative.

In this case, the author was not in attendance at the time of the incident but was subsequently engaged to conduct a full analysis of the many claims which were submitted by contractors. A large number of individual claims were analyzed, using knowledge and experience gained from other incidents. An exercise was undertaken to place a true value on the response for claim settlement purposes. This was necessary because many of the claims submitted were grossly inflated. In some instances claimants had endeavored to charge thousands of dollars per day for the use of small craft whose true value could be measured in hundreds of dollars per day! The same principles applied when trying to establish a fair and reasonable cost for the various materials supplied including booms and absorbent material. The most difficult aspect of this cost analysis was to consider objectively the actions taken by the various authorities when faced with what they thought was a major pollution threat. Consideration had to be given to local factors which included a thriving fishing industry, the presence of a nearby major port, and the important tourist industry along the adjacent coastline. While, with the benefit of hindsight, it might have been possible to criticize the scale of the response, due consideration had to be given to the factors which were influencing the authorities when they initiated and controlled the pollution response operation.

Claims were analyzed and, where necessary, investigated with a view to establishing whether the action taken was reasonable in the circumstances and whether or not the costs being claimed by a contractor were reasonable. Having reached a conclusion on each claim independently, the author was then invited to attend settlement negotiations with individual contractors, who, in the main, were able to agree on a settlement without recourse to the courts. Claimants were confronted on a face-to-face basis in which each item in their claim was analyzed. When faced with the choice of receiving a prompt payment or seeking recourse to the courts, most claimants accepted that the figures proposed in settlement were a true reflection of their commercial worth.

**Lessons learned.** With hindsight, it is possible to comment on the fact that the response initiated was very much in excess of that required. However, in analyzing the claims it was necessary to take into account the fact that the authorities thought they were dealing with a very much larger pollution threat than was in fact the case. In making settlement recommendations, consideration was given to whether or not the action taken and the costs of that action were reasonable. Any authority which has a responsibility of organizing oil pollution response must always take into consideration that such action may be subject to detailed cost analysis sometime after the event and that the test of “reasonableness” will be applied.

**Conclusions**

Salvage techniques exist which can deal with most anticipated oil pollution and oil pollution threat situations. It is vital for those involved in a pollution response operation to bear in mind the priorities of salvors when conducting an operation. A salvor will invariably use the technique and equipment which is most convenient to him rather than that which is most acceptable to those responsible for controlling the response. Techniques have been developed which can minimize or eliminate oil pollution during a salvage operation. Most major salvors attending a casualty have the necessary equipment to contain or deal with spills, or can hire in backup facilities if required.

The case histories examined show that incidents evolve on an individual basis and that there is often a conflict of priorities among the various parties involved in responding to an incident. Where there is a dual threat, it is important that the controlling authority make its priorities clear to those who are faced with conducting the cleanup or threat removal operations. Even in the most difficult conditions it is possible to conduct an oil removal operation from a casualty; this need not be an inordinately expensive operation. Nonetheless, there will be times when geographical and meteorological factors limit the likelihood of success.

When a casualty does take place in which there is a large response to pollution or the threat of pollution, it should always be borne in mind that the actions taken by those responsible may be subject to cost analysis which will always consider whether or not the action taken and the cost of it were reasonable.