POLICY STRATEGY OF OIL POLLUTION COMBATING

22.1 THREAT TO RESOURCES

Oil spilled at sea threatens individual organisms, resources in the immediate vicinity and the ecosystem as a whole. It also poses a potential threat to the shore and to estuaries. Damage to the ecosystem will depend *inter alia* on the quantity and type of oil, the location where the oil is spilt and the time of year. Effects may be direct or indirect.

22.1.1 OIL AT SEA

.1 An oil slick at sea can present an immediate hazard in three ways:

(i) it can cause catastrophic damage to birds and mammals at the water surface by coating and affecting their protective outer coverings with a layer of oil;

(ii) the dissolving and dispersing fractions can exert a toxic stress on subsurface organisms and, in some cases, cause mortality or become assimilated;

(iii) because of the evaporation of light fractions, an oil slick may in some circumstances pose an explosion hazard and risks to human health.

In some particular instances, such as shallow waters with high sediment loads, oil can sink to the sea bed and cause a continuing source of pollution. It can lead to the death of benthic organisms both in the short and long term.

.2 In waters deeper than 20 metres and not in the vicinity of ecologically valuable areas, there will normally be adequate water to dilute the dispersing and dissolving oil to safe levels, and the immediate threat to subsurface organisms is unlikely to be severe except in the case of a massive and prolonged release of oil such as a blow-out or a major tanker accident.

.3 The explosion hazard is also unlikely, in normal conditions, to present a severe problem. The lighter fractions of crude oil will usually have evaporated after the oil has been on the water surface for 30-60 minutes, and during the period of evaporation the lower explosive limit contour will usually remain within the slick boundaries. Provided response teams remain alert to the risk of explosion and to their health, and take due precautions and protective measures, the hazard will be small.

.4 At sea, therefore, the main threat posed by an oil slick is usually that of physical damage to organisms at the water surface. In the North Sea Area[1] the main organisms at risk are sea birds and seals, and in some areas at certain times of year the hazard is a severe one. Although there are concentrations of marine mammals in many areas, these are unlikely to be at risk in open waters.

22.1.2 OIL ASHORE

.1 Once the oil arrives in inshore waters and starts to come ashore, its potential to cause damage is much wider. Resources at risk include ecologically important areas, fisheries, zones of high amenity and industrial installations. Almost every part of a coastline has some resource which can be damaged by oil including the health of response teams where there are insufficient protective measures.

.2 Some types of shoreline, such as hard, sandy beaches can be cleared of gross oil contamination fairly easily, although even in areas such as this, cleaning operations are usually more expensive per tonne of oil than a clean-up operation at sea. In other coastal areas, clean-up will be difficult and protracted, and in some areas it will not be possible to remove the contamination without causing more damage than the oil itself.

[1] The North Sea Area covers the North Sea, the English Channel, the waters around Ireland and parts of the Western Approaches and the Norwegian Sea.

22.1.3 OIL IN ESTUARIES

.1 Should oil be spilt in, or drift into, an estuary it can pose particular problems due to the shallow water depth, high sediment load in the water and the presence of mud flats and salt marshes.

.2 The effects of an oil slick in estuaries depend on:

(i) the quantity of oil floating on the water surface;

(ii) the concentration of oil which is dispersed or dissolved in the water column (the concentration determines uptake by organisms and the eventual toxic effects);

(iii) the quantity of oil absorbed by the sediment (this is important in the longer term as it may act as a continuing source of oil pollution).

.3 Oil floating on the water surface can contaminate birds, seals, banks and vegetation. Oil dissolved in the water may not be dispersed to safe levels, it can therefore have direct toxic effects on aquatic organisms (plankton). Oil may also be transferred to the sediment and impact on benthic organisms (macro benthos), effects may be long term as a result of accumulation in these organisms. Alteration of the species composition can last up to six years after the spill.

.4 Oil on tidal flats can lead to the death of a large number of benthic organisms possibly resulting in a heavy loss of such animals both in the short and long term. The reduction in the quantity of food (benthic organisms), change in the food composition and accumulation of hydrocarbons may have indirect short and long term effects on the size of the population of fish, birds and seals. For each group of organisms there are different sensitive periods such as spring for breeding birds and fish larvae, summer for benthic organisms and seals, and winter for migratory or wintering birds.

22.1.4 REASONS FOR RESPONSE

The reasons for attempting to combat an oil spill while it is still at sea are to protect individual organisms, resources in the vicinity of the slick and the marine environment and to minimise the quantity of oil which comes ashore or into estuaries. In particular everything possible should be done to prevent oil being washed ashore on mud flats and salt marshes as they constitute the most sensitive parts of the North Sea and are difficult, if not impossible, to clean up.

22.1.5 ASSESSMENT OF THREAT

.1 In order to decide whether or not a response is necessary, or what sort and extent of response is appropriate, the threat posed by the oil must be evaluated. This requires techniques for predicting the behaviour of the oil, which in turn will rely on timely information about the type and quantity spilled, the location of the spill and weather conditions. Advice on sensitive resources likely to be impacted by the spill will also be needed.

.2 Because of the considerable uncertainty which usually surrounds a spill, and the difficulty of predicting the damage which may be caused to a resource by oil, the assessment of the threat will be tentative at first, becoming more firm as information become available. The response teams, however, will not be able to wait for a firm assessment and an element of judgement will normally be necessary during at least the first stages of the response.

22.2 CLEAN-UP PROBLEMS AT SEA

The various techniques available for dealing with oil at sea have been dealt with in detail elsewhere in this manual. In summary, although a number of possible techniques have been evaluated, the only options found to be appropriate in the North Sea Area are:

(i) to remove the oil from the sea surface;

(ii) to disperse the oil by chemical or mechanical means;

(iii) to allow natural forces to dissipate the oil, and

(iv) to reduce its volume by *in situ* burning. The IMO has included in its Manual on Oil Pollution the possibility of *in situ* burning as one of the means of reducing the volume of spilt oil. However, in general, in the circumstances of western Europe, with high densities of settlement and significant problems of air pollution, *in situ* burning is unlikely to be a technique which will be appropriate. Restrictions on the land-fill disposal of waste oil and other oily wastes may, however, mean that thermal destruction of waste oil and oily waste, under conditions which avoid air pollution, may need to be used to a greater extent than previously.

22.2.1 MECHANICAL RECOVERY

.1 Option (i) is in principle the most desirable way of dealing with oil at sea, because it removes the contaminant from the sea surface. Viscosity is no longer a serious problem in most cases - there are skimmers available which will recover very viscous oils. Caution needs to be taken with respect to the explosion hazard arising from both the oil slick and the recovered oil, but the dangers here are understood and can be minimised during contingency planning and operations by taking appropriate precautions. Recent experience has shown vessels engaged in the recovery operations near to the coast can threaten fixed fishing installation, and care must be taken in such situations. The problem, however, is likely to occur only rarely.

.2 The main problems with recovery operations are: the speed with which equipment can be deployed to begin with and this depends on the location of the equipment; the interdependency of recovery rate and weather conditions.

.3 Oils which are still in their liquid phase, that is, above their pour point temperature, spread out rapidly on the sea surface to form very thin films (typically 0.1 millimetres) covering very large areas. The speed at which booms can be towed through the water to collect oil is limited to between 0.5 and 1.0 metre per second (1-2 knots) because of the tendency for oil to be carried below the boom by turbulence. This restricts the collection rate of a 0.1 mm layer to a maximum of 0.18-0.36 tonnes per hour per metre of boom under favourable weather conditions (generally around 75-150 tonnes per hour). The low rate of recovery of a combating vessel can be increased by using a collection boom in combination with a sweeping arm or a skimmer and by using aerial surveillance techniques to direct the recovery vessels to the thicker layers of the oil. In addition the recovery operation by a single ship or small response group formation produces under most conditions far higher recovery rates as major oil spills in European waters under partly complicated operational conditions have proven.

.4 Generally, booms will not retain oil at wave heights of greater than 2 metres, and are increasingly inefficient at heights in excess of 1.5 metres. Such wave heights are present in the Northern part of the North Sea for more than 70% of the time. In the Southern part of the North Sea the situation is more favourable, for 70-80% of the time the wave heights are less than 2 metres. However, breaking waves in shallow, near shore waters, and long waves in the open sea will have significantly different effects on the ability of a boom to retain oil.

.5 In countries with long coastlines there may also be problems in having vessels available to deploy the equipment. Equipment can either be portable, for mounting on ships of opportunity, or fixed in casual or dedicated vessels. Keeping dedicated vessels on permanent stand-by is expensive but permits a reasonably rapid response to an incident within range on the ship's base. Vessels which are normally engaged on other duties will require time to be brought into readiness for combating oil pollution, and this will increase response times. However multi-purpose ships patrolling along the coastline on other maritime tasks (Coastguard, Police Patrol, Customs, Fishery Inspection, Aids to Navigation etc.) can reduce response times and provide highly trained and motivated crew for rapid response operations. Finding a ship which will meet the requirements for at-sea recovery, i.e. with the ability to manoeuvre at slow speed and certified for carrying flammable cargoes, will add even further delays.

22.2.2 DISPERSION

.1 Dispersion can, under favourable conditions, reduce both the threat of an oil slick to surface organisms and the amount of oil which will come ashore. However, it increases the threat of subsurface organisms by temporarily enhancing the concentrations of toxic oil fractions entering the water column. In some circumstances it is possible to disperse a slick using a ship's propellers or by other mechanical means, and as suitable vessels will often be at the scene of a spillage for other reasons this can be a convenient and low cost option. More often, though, chemicals will have to be added to achieve a satisfactory rate of dispersion. The use of chemical dispersants is described in detail in a position paper on dispersants in Chapter 23 of this manual.

.2 In deep waters there will usually be adequate dilution available to reduce the concentration of dispersing oil to a safe level. This will not necessarily be the case in massive or prolonged operations, and in such cases it is important to balance the benefits of destroying the oil slick against the hazard posed to subsurface organisms. In waters shallower than 20 metres the possible impact of the dispersing oil must always be taken into account, regardless of the size of the operation. This, however, need not be a serious problem at the time of an incident if appropriate preparations are made during contingency planning. A strategy for the use of dispersants should be formulated to suit the geographical area, the resources at risk at different times of the year, and weather patterns.

.3 The main problem with the use of chemical dispersants is that they are effective only in relation to light oils. The main factor is the viscosity of the oil. For dispersants to work effectively it is important that they become thoroughly mixed with the oil. Some oils, especially those below their pour point, are too viscous for the dispersant to penetrate into the oil. Most oils will become more viscous over a period of time when floating on the sea. This period depends on the oil and the weather conditions, but can be just a few hours. This makes it important to apply chemical dispersants as quickly as possible after the spill has occurred, and in practice this usually means relying on aircraft as the primary means of application.

22.2.3 NATURAL DISSIPATION

.1 Option (iii) in paragraph 22.2 could be considered the least attractive in that it leaves the oil in an unmodified form on the sea surface, with a potential to harm sea birds or reach the shoreline unchanged. Heavy oil may also sink to the seabed and be harmful there. It is, however, the cheapest option by far, and consequently for smaller oil slicks it is the most commonly used response. Such slicks will often break up and dissipate before they can reach vulnerable areas. However, it should be noted that this option is often the most difficult to handle politically.

.2 For larger slicks, the problem is being able to predict with an appropriate degree of certainty that the oil will not cause damage. Although predictive models of the movement of oil on the water surface have reached an advanced state, the main factor affecting the path of an oil slick is wind, and our ability to forecast wind strength and direction is limited. Hence, if this option is to be used, in cases where there remains doubt about the fate of the oil, the slick should be monitored carefully.

22.3 CLEAN-UP PROBLEMS ON SHORE

.1 Once oil has come ashore the options available and the problems are quite different. Clean-up techniques may be intrinsically quite damaging, and the benefits of cleaning an area must be balanced carefully against the disbenefits of the damage caused by the clean-up activity. This should be done during contingency planning, and reconfirmed at the start of the clean-up operation. Natural dissipation, dispersion, containment and recovery, flushing, absorption and mechanical or manual clearance are all viable techniques and the choice of methods will depend on the type of shoreline. Each of these various options has its own problems, and some of these are summarised in the following paragraphs. However, the over-riding problem at present is that some types of coastline simply cannot be cleaned at all without totally destroying their resource value.

.2 Natural dissipation is the least damaging option as far as the affected area is concerned, but an oiled foreshore, even if clean-up is not essential at the site, can act as a source of contamination for other areas as the oil migrates. Care needs to be taken to ensure that by leaving one area alone, the situation is not made worse for another, possibly more important zone.

.3 Dispersants will not have a significant impact on thick deposits of oil, but will work very efficiently on thin residues for example remaining after gross pollution has been cleared, even on high viscosity oil. However, precautions must be taken to ensure that the dispersant and dispersing oil does not cause unacceptable damage to adjacent areas. This must be ascertained during the contingency planning stage, so that in an incident clear guidelines are available to the response team.

.4 Containment and recovery can be used very successfully in quiet waters such as harbours, lagoons and bounded areas on beaches; for example, to collect oil flushed out by washing activities. In calm waters this will usually be the technique of choice. However, it is important to recognise that booms will not work in fast-flowing estuaries unless great care is taken in their deployment, and the use of booms in such areas by inexperienced personnel can be dangerous.

.5 High pressure flushing can be effective in hard areas such as sea walls and rocks. It can, however, drive oil into the substrate in softer areas, where, if flushing is required, gentle, low pressure systems must be used. Flushing must always be either accompanied by containment and recovery or used in conjunction with adsorbents, otherwise the released oil will simply contaminate other areas.

.6 There are a number of adsorbents available for use on the shore. It is important, though to use adsorbent systems which can easily be collected up, otherwise the resulting spread of oily adsorbents will simply aggravate the problem.

.7 Clearance techniques can be very effective in areas where the intense level of activity will not damage the substrate. Hard sandy beaches and shingle areas can be cleared mechanically. Rocky areas or compacted substrates are best cleared manually. Care must be taken to minimise damage to seaweed and its associated fauna, and to avoid pushing oil down into the substrate. If significant quantities of oiled material are being removed it is important to take into account the potential impact on coastal defences.

.8 The main problem with clearance, which also applies to recovery and the use of adsorbents, is to dispose of the recovered material. In some areas this will be the most difficult part of the operation. Sometimes it may be possible to reduce the amount of material to be disposed of by washing it and returning cleaned material to the beach. Use of demulsifiers to remove trapped water can also make a significant impact. The most important way, though, of minimising the quantities of materials to be disposed of is to ensure that proper care is taken on the foreshore to remove as high a proportion of oil to substrate as possible.

.9 The costs associated with shoreline clean-up involve the standing charge of maintaining specialist equipment on stand-by (though most of the equipment used will be standard civil engineering equipment and will not need to be kept on stand-by), and the cost of deploying manpower and equipment. In addition, there will be costs associated with the disposal of oily wastes. By way of example, the United Kingdom's beach cleaning stockpiles are valued at about £1 000 000 and cost about £100 000 per year to store, maintain and exercise. These costs will vary from country to country depending on the length and nature of the coastline.

.10 At the time of the clean-up operation, the costs will depend on the nature of the coastline and the type of response chosen. However, as indicated above, the type of coastline will itself be the main factor in choosing the response technique, and there will be little scope for making choices on the basis of cost effectiveness. One particular decision which can be contemplated and which will make a significant impact on costs is whether or not to clean up an area which could in principle be cleaned. If it can be demonstrated that clean-up would have no significant advantages for the area in question and that the area would not act as a source of contamination to other resources, then a clean-up operation would be a waste of money.

22.4 CLEAN-UP PROBLEMS IN ESTUARIES

Based on the effects of oil mentioned in 22.1.3 and the special circumstances for estuaries (tide, high strength of currents and the accessibility of the area), oil clean-up techniques must attempt to satisfy the following criteria:

- (i) no disturbance of the ecosystem or physical damage to mud flats and salt marshes;
- (ii) rapid removal of floating oil without increasing the oil concentration in the water and the sediment;
- (iii) the stimulation of biological breakdown if necessary.

In practice this means *inter alia* that:

- control of a floating oil slick in the vicinity of an estuary should, where possible, be limited to active mechanical control;
- if mechanical control is impossible, the most favourable technique is to divert the spill on to sandy beaches or sandy shoals;
- the priority is to prevent oil being washed up on mud flats and marshes. Where strong tidal currents or other factors make mechanical control or diversion impractical, the use of dispersants must be considered in order to protect these areas from floating oil.

22.5 CONCLUSIONS

.1 The techniques chosen should not cause more damage to the environment than the oil spill itself.

.2 The main problems with dealing with oil at sea are:

- the slowness of existing recovery techniques and their dependency on reasonable weather situations;
- the ineffectiveness of dispersants on viscous or weathered oil; and
- the difficulty of being sufficiently certain of the fate of oil to be confident about leaving it to dissipate naturally.

.3 When cleaning the shoreline, the main problems are:

- to ensure that the techniques chosen do not cause undue physical damage to the shoreline; and
- to find ways of disposing safely of the oil and contaminated materials.

.4 When dealing with oil in estuaries the main problems are:

- prevention of damage to the ecosystem and structure of mud flats and marshes;
- rapid removal of floating oil, without increasing the concentration of oil in the water and sediment; and
- ensuring everything is done to prevent oil being washed ashore on mud flats and marshes.

.5 All of these problems have long been recognised and work is proceeding to ameliorate them, although there are no immediate signs of a dramatic breakthrough. At the same time it is important to pay careful attention to any new ideas or techniques which may complement or replace existing methods.

.6 Because of the limited choice of techniques available, the question of cost-effectiveness is in most cases academic. However, on the one hand dealing with oil at sea, on shore or in estuaries is expensive and, on the other, oil will normally dissipate and degrade naturally if left alone. The “do nothing” option must always be considered, therefore, and adopted where it can be predicted with reasonable confidence that the oil will not damage resources to a greater extent than would a clean-up operation.