IPIECA REPORT SERIES

VOLUME TWO

A GUIDE TO CONTINGENCY PLANNING FOR OIL SPILLS ON WATER

2nd edition, March 2000

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CONTENTS

PREFACE

This report is one of a series commissioned by the International Petroleum Industry Environmental Conservation Association (IPIECA), representing the IPIECA members' collective contribution to the global discussion on oil spill preparedness and response. The report series forms one of the key elements of IPIECA's global education programme, which is aimed at both industry and governments.

This contingency planning report was initially produced in 1991 in the wake of major incidents in 1989–90 and ensuing industry reviews of oil spill preparedness. This version updates the 1991 publication in the light of lessons learnt from oil spills through the 1990s. It also takes into account the effect of increasing ratification amongst maritime nations of the International Convention on Oil Pollution Preparedness, Response and Cooperation 1990 (the OPRC Convention). Although there has been a significant drop in the number of major tanker spills through the 1990s, developing effective oil spill contingency plans remains a very important goal for industry and governments.

In preparing these reports—which represent a consensus of membership views—IPIECA has been guided by a set of principles that it would encourage every organization associated with the transportation, handling and storage of oil to consider:

- It is of paramount importance to concentrate on preventing spills. In practical terms, this requires that operating procedures should stress the high priority senior management gives to preventing spills.
- Despite the best efforts of individual organizations, some spills will still occur and will affect the local environment.
- Response to spills should seek to minimize the severity of the environmental and socio-economic damage and to hasten the recovery of any damaged ecosystem.
- The response should always seek to complement and make use of natural forces to the fullest extent practicable.

Recognizing the inevitability of future spills, senior management should also give high priority to developing contingency plans that will ensure prompt response to mitigate the adverse effect of any spills.

Personnel and equipment must be identified and established to support contingency plans. These should be trained and maintained to a high degree of preparedness. Plans should be sufficiently flexible to provide a response appropriate to the nature of the operation, the size of the spill, local geography and climate. Drills are required to familiarize personnel in oil spill management and mitigation techniques. Such exercises will provide the means of testing contingency plans and they should be carried out in conjunction with representatives from all stakeholders for greatest effect. This will help ensure that all resources available will be brought to bear in the response.

The potential efficiencies of cooperative and joint ventures for oil spill response should be recognized. Cooperative facilities and any mutual support agreements should be included in exercise programmes to ensure their effective integration into response efforts.

Close cooperation between industry and national administrations in contingency planning will ensure the maximum degree of coordination and understanding. When all involved parties work together there will be the greatest likelihood of achieving the key objective of mitigating potential damage.

INTRODUCTION

The movement of oil from the dominant production centres of the world to the worldwide market is achieved primarily by the use of tankers and pipelines. The global pattern of marine transport is well established as shown in Figure 1. The risks posed by oil transportation lead governments, oil companies and ship owners alike to recognize the need to have in place an effective and tested crisis management capability. Oil spill response planning is one facet of that activity.

An oil spill contingency plan should comprise three parts:

- *a strategy section*, which should describe the scope of the plan, including the geographical coverage, perceived risks, roles/responsibilities of those charged with implementing the plan and the proposed response strategy;
- *an action and operations section*, which should set out the emergency procedures that will allow rapid assessment of the spill and mobilization of appropriate response resources;
- *a data directory*, which should contain all relevant maps, resource lists and data sheets required to support an oil spill response effort and conduct the response according to an agreed strategy.

This guide is offered by IPIECA to assist industry and governments in the preparation of such plans. It focuses on oil spills on water, primarily from ships, but also contains information relevant to spills from exploration and production activities. Useful technical companions to this publication are listed in Appendix 3.

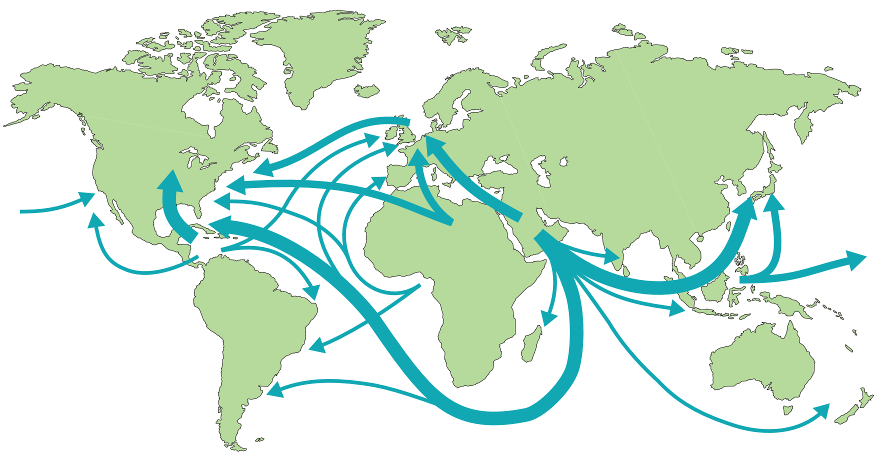


Figure 1
Pattern of major marine oil transportation

It is widely accepted that those countries and companies that have a properly developed contingency plan are better prepared to deal with an oil spill emergency than those that do not. The potential benefits of contingency planning include:

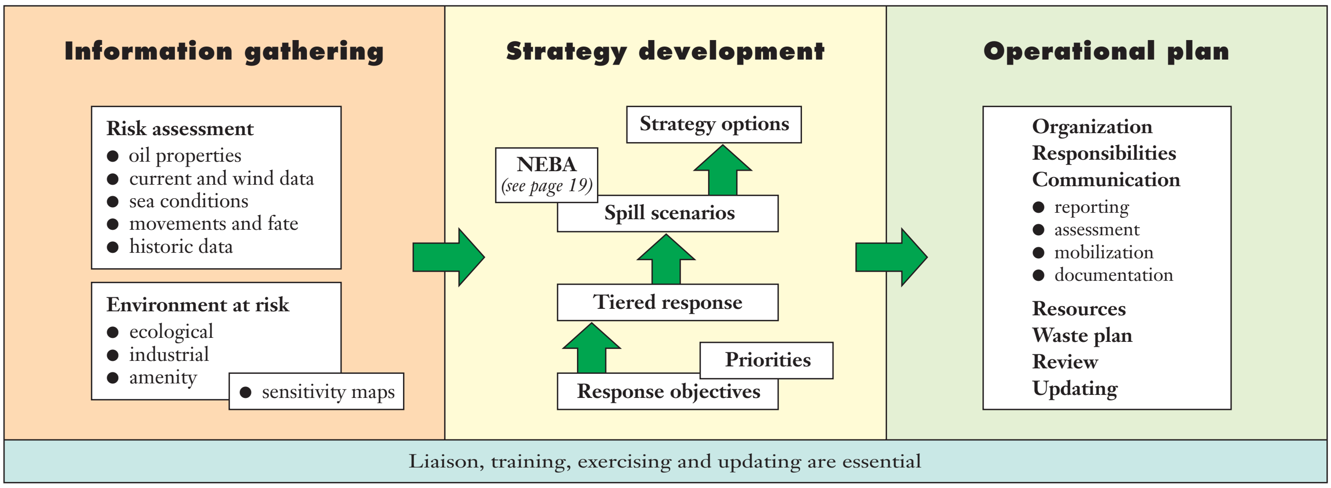
- more effective and efficient response to an incident by using and developing appropriate response strategies with the aim of reducing ecological, economic and amenity damage and subsequent compensation claims;
- clear reaffirmation of business/governmental environmental priorities;
- improving the public and media understanding of industry's efforts to be a positive force in the protection of the environment.

The preferred industry approach to oil spill contingency planning tackles three main issues:

1. To enable effective escalation of a response to changing circumstances companies should develop plans based on the tiered response as described in this report.
2. Maximum credible and most likely case scenarios should be identified, based on a risk analysis of the geographic area covered by the plan.
3. A cooperative approach by all parties concerned is essential in ensuring an effective response. When developing plans companies should seek the cooperation of those who share the risk and those who will participate in the response by integrating their plans with those of national authorities and industry partners.

Figure 2 summarizes the contingency planning process indicating which information should be gathered, then interpreted and developed into appropriate strategies, towards the final outcome of operational procedures. This report will provide guidance and explanations concerning the steps in this process.

Figure 2
The contingency planning process



THE TIERED RESPONSE

The size, location and timing of an oil spill are unpredictable. Spills can arise from oil loading, unloading or pipeline operations, and from a collision or grounding of vessels carrying crude oil and products in local ports or coastal waters. They can also arise from tankers or barges operating on inland waterways, or from exploration and production operations and tankers operating in international waters.

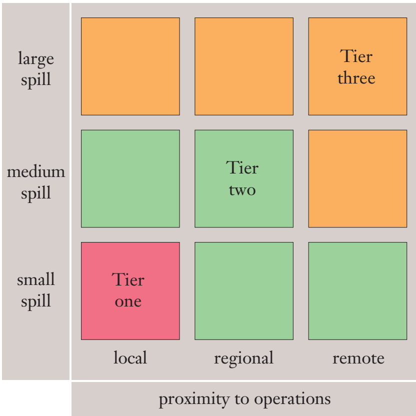


Figure 3
The Tiered response
Tier 1: operational-type spills that may occur at or near a company's own facilities, as a consequence of its own activities. An individual company would typically provide resources to respond to this type of spill.

Tier 2: a larger spill in the vicinity of a company's facilities where resources from other companies, industries and possibly government response agencies in the area can be called in on a mutual aid basis. The company may participate in a local cooperative where each member pools their Tier 1 resources and has access to any equipment that may have been jointly purchased by a cooperative.

Tier 3: the large spill where substantial further resources will be required and support from a national (Tier 3) or international cooperative stockpile may be necessary. It is likely that such operations would be subject to government controls or even direction. (It is important to recognize that a spill which could require a Tier 3 response may be close to, or remote from, company facilities.)

Oil spill risks and the responses they require should be classified according to the size of spill and its proximity to a company's operating facilities. This leads to the concept of 'Tiered Response' to oil spills. A company should seek to develop response capability in a way that allows it to be escalated as required for each incident.

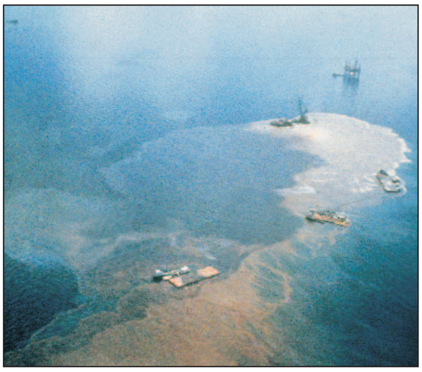
A contingency plan should cover each Tier and be directly related to the company's potential spill scenarios. The amount of equipment and trained personnel identified at each Tier will vary for each operation, depending on a variety of factors such as the risk, location, oil type and environmental or socio-economic sensitivities under threat.

Tier 1

Small local spills

This should cover operations at company-owned, operated (or shared) facilities where events are largely controlled by the company's operating procedures, and personnel and equipment can be made available to respond immediately to an 'on-site' incident. Such an incident would generally be associated with ship transfer or bunkering operations at a jetty, pier or mooring, and around

Tier 1 spills typically occur at a jetty, pier or mooring, or near waterside storage tanks.



Near right: Tier 2 responses will have to deal with spills where the company has limited control of events and is beyond Tier 1 capabilities

Far right: Tier 3 spills will result typically from major incidents at sea, such as those from tankers and offshore platforms.

waterside storage tanks. The contingency plan should recognize the need for the local operators to control events and to establish a rapid response capability aimed at quickly containing and, if possible, recovering the spill. If this is achieved there will be no need to involve other parties apart from meeting legal, reporting or alerting requirements.

Tier 2

Medium spills that may be local or at some distance from operational centres

This will cover company operations at their own facilities and within public or multi-user facilities where a company has limited control of events and the physical area of the spill is larger than in the Tier 1 case. The risks here would typically be associated with shipping accidents in ports or harbours, in estuaries or coastal waters, but could also be from pipelines, tank failures or nearshore exploration and production operations. Other users/operators of the facility should recognize that they run similar risks and be encouraged to join in establishing an oil spill plan and response capability. As public amenities might be threatened, local government services and agencies may act as the principal coordination and control agency. The contingency plan should carefully define the conceptual response capability, the roles and responsibilities of the various parties, the scope of the plan and procedures for escalating the response to the Tier 3 level.

Tier 3

Large spills which may exceed national boundaries

This will cover major incidents, the scale and scope of which is beyond the capabilities of the Tier 2 response.

Typically Tier 3 plans cover larger oil spills at sea where the operating company may not have any capability to deploy resources immediately and government takes the leading role.

The oil spilled may have an impact on the property or operations of the company, or occur near a company installation and be too large for the company to handle alone. Equally, it might be very remote from all company-owned or -operated resources. The likelihood of such incidents may be low but pollution damage can be considerable and coastlines over a wide area are potentially at risk.

The contingency plan should aim to access and mobilize local, national and international resources (from regional stockpiles and elsewhere) quickly and efficiently. Because such incidents often become high profile and politically sensitive, the Tier 3 plan will most probably form part of a National Emergency Plan headed by an appropriate national agency or government department. The contingency plan must identify the agreed role for all participants within that National Emergency Plan.

In actual incidents, spills do not always fall into convenient categories and the boundaries between Tiers will inevitably be blurred. It is, therefore, important to be prepared to involve the next highest Tier from the earliest moments. It is easier to stand down an alerted system than to try to escalate a response by calling up unprepared reserves at a late stage.

International resources

International or regional capabilities established by industry or government

Governments have recognized the serious threat posed by Tier 3 spills and the potential requirement for international assistance to help mitigate the consequences. Mutual support for Tier 3 incidents, with the associated ability to enhance national capability across political boundaries, is a basic tenet of the OPRC Convention.

Against this background, industry has established and funds a network of ‘Tier 3 Centres’. The use of these Centres is explained in a joint briefing paper prepared by IPIECA and the International Tanker Owners Pollution Federation Ltd. (ITOPF). It is important that local industry is aware of these Centres and incorporates them into their plans where appropriate. Equally, governments should be aware of the need to facilitate customs and immigration procedures to allow any international resources to be mobilized effectively.

COOPERATION WITH GOVERNMENT AGENCIES

Government policies on responding to oil spills vary from nation to nation. Governments are encouraged to ratify the *IMO International Convention on Oil Pollution Preparedness, Response and Cooperation, 1990* (the OPRC Convention) and develop their own laws and procedures for preparing for, and responding to oil spills. These should be encompassed within a national oil spill contingency plan, under the auspices of an agreed national authority. It is crucial that industry works with governments to develop a clear, common interpretation of the national requirements and the responsibilities foreseen for government agencies, industry and others.

If governmental authorities assume command, this could greatly assist mobilization of national resources and help resolve the possible conflict of interests. In a port or harbour spill, the Port Authority might be best placed to control the response. In the case of a major spill, the national authorities might be best placed to take overall control, using their existing organization and support. There is a clear relationship here to the concept of tiered response, as command and control may change as an incident escalates. There needs to be absolute clarity within both government and industry plans as to who are responsible for which actions under all situations. Joint exercises are the best means of testing the roles and expectations of the involved parties.

Government agencies must be consulted at an early stage and encouraged to participate in the development of contingency plans—for example, by acting on a consultative committee and accepting specific responsibilities in the management of an emergency. The understanding and relationships thus developed will pay dividends in times of crisis. Where feasible, governments and private business should be encouraged to purchase oil spill equipment for strategic deployment, e.g. for the protection of defined areas of sensitivity such as ecologically important habitats and recreation areas, as well as water intakes of power stations, desalination plants, refineries and other important utilities.

International Convention on Oil Pollution Preparedness, Response and Cooperation, 1990

In the wake of global concerns in the late 1980s, the IMO's Marine Environment Protection Committee developed this Convention to provide a framework for international cooperation for combating major oil pollution incidents, taking into account the experience gained within existing regional arrangements dealing with these matters. The Convention has the following key elements at its heart:

- precautionary and preventative measures are important in the avoidance of oil pollution in the first instance;
- prompt and effective action is essential to minimize possible damages in the event of pollution;
- contingency planning needs to be emphasized and the role of the oil and shipping industries should be included within these plans;
- the need for mutual assistance, international cooperation and information exchange (on response capabilities and reporting incidents);
- the 'polluter pays' principle; and
- the importance of related international instruments on liability and compensation, including the 1992 Civil Liability Convention (1992 CLC) and the 1992 Fund Convention.

The OPRC Convention has 19 Articles and 10 Resolutions covering both administrative and technical aspects. In summary, these call for Parties to carry out the following actions in relation to oil spill contingency planning:

- ships, ports and oil industry facilities posing a risk of oil spills should have oil pollution emergency plans, under the coordination of a national contingency plan for major incidents;
- there should be clear oil pollution reporting procedures;
- reports of oil pollution should be properly assessed and all States whose interests may be affected informed;
- national and regional systems for preparedness and response should be developed, including the designation of competent national authorities and the compilation of national contingency plans;
- provision should be made for the supply of technical support and equipment to Parties requesting assistance to combat spills;
- the necessary legal and administrative measures should be taken to facilitate customs and immigration procedures in an emergency, where outside assistance has been mobilized;
- technical cooperation between Parties should be active in the fields of training, planning, research and development; and
- Parties should work together with the oil and shipping industries to establish suitable pollution combating equipment stockpiles and training programmes.

The IMO is able to supply the OPRC Convention text and a current list of signatories; the latter can be accessed through their Web site (www.imo.org).

Table 1: the parties involved

Parties to be consulted in the development of contingency plans

- national government agencies
- local government agencies
- port authorities
- coastal authorities
- emergency services
- other oil companies
- contractors
- environmental organizations
- local communities

Interests to be reconciled in a major shipping incident

- ship owner and insurers (e.g. P&I Clubs)
- cargo owner
- other oil companies
- salvor
- local authorities
- national authorities
- environmental organizations
- flag state authorities
- media

INFORMATION GATHERING AND RISK ASSESSMENT

The consequences of a spill in a specific location are easy to imagine if one considers the well-documented experiences of other incidents. If the oil is persistent and does not rapidly evaporate or disperse and comes ashore, the implication in terms of clean-up effort, ecological and economic consequences, and the loss of business and reputation, can be considerable. Fish and bird breeding grounds and sensitive areas such as salt marshes, estuaries, coral reefs and mangroves are environmental areas justifying high priority in defensive actions. Commercial resources requiring priority protection include industrial plants with seawater intakes, ports and harbours, fisheries, mariculture and tourist facilities.

Historic data, oil properties, climate, local meteorology and environmental sensitivities are important factors in assessing the risk, behaviour, fate and potential consequences of spilled oil. Organizations producing contingency plans need to collate information about these factors in order to develop appropriate response strategies to best mitigate the threat posed by oil pollution.

Historic data

Many assessments have been made of the quantities of oil entering the marine environment but all recognize the relatively small contribution arising from tanker incidents. The results of an assessment by the US Academy of Sciences are shown in Figure 4.

The goal for any company should be to conduct its operations without oil spills, but, despite best efforts, they will happen and companies need to be prepared. The analysis of oil spill scenarios to which a company might be exposed will define what happens to any spilled oil, what resources are at risk and what damage might be done to those resources.

The data in Figure 5, provided by ITOPF, indicates the prime causes of spills during 1974–98 as a function of spill size, cause and product carried.

In this 25-year period 1,332 accidents were recorded by ITOPF involving the loss of more than 7 tonnes (~50bbls) of oil. These global data include only 17 spills greater than 50,000 tonnes (~375,000bbls). There were many spills of less than 7 tonnes.

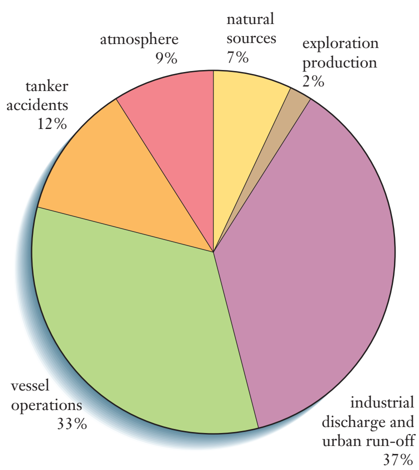


Figure 4
Major inputs of petroleum to the marine environment.

Oil spills (1974–98)

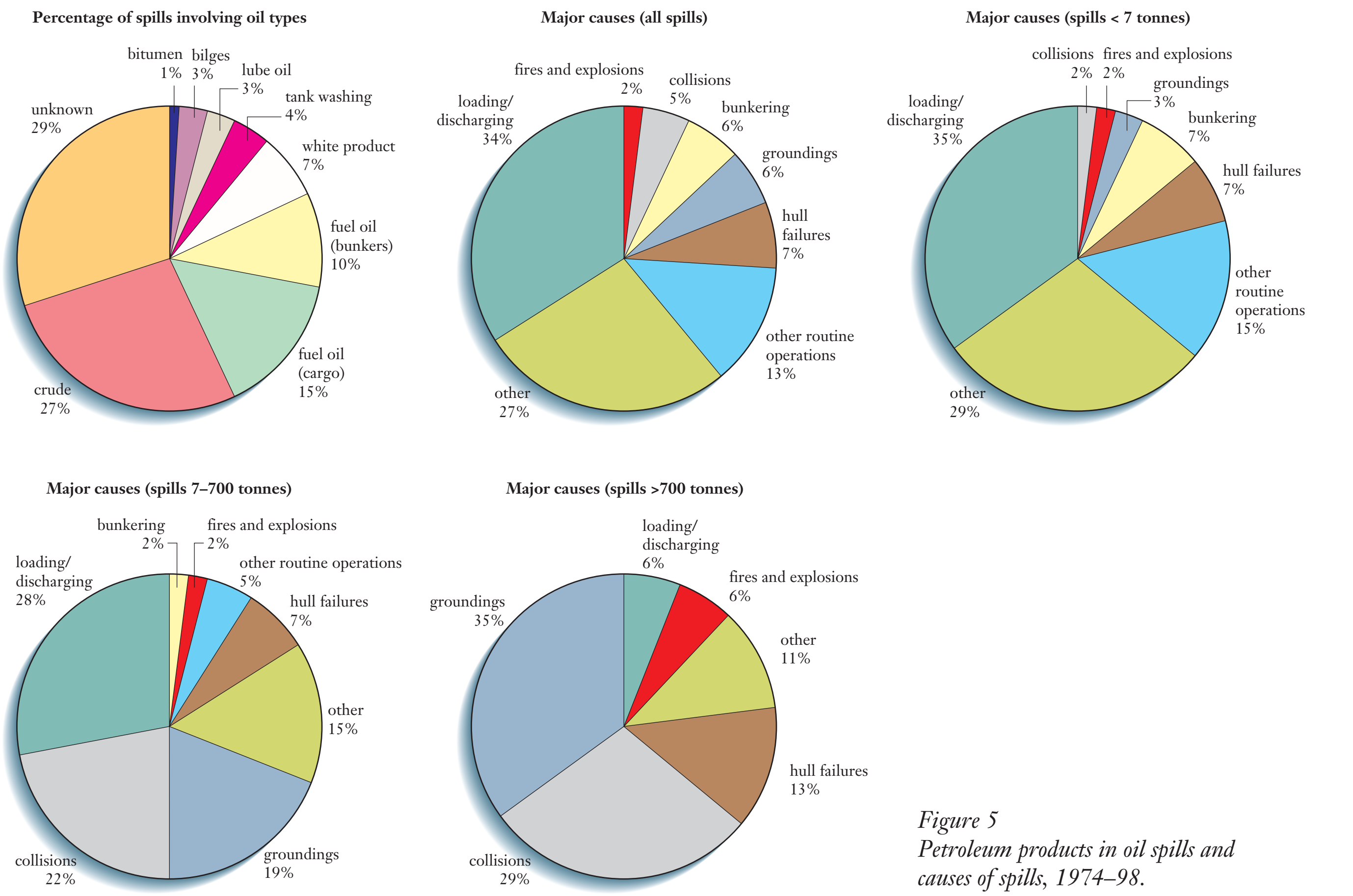


Figure 5
Petroleum products in oil spills and causes of spills, 1974–98.

The historical experience is that major spills from exploration and production operations are far less common than those from oil tankers.

Oil spills can happen almost anywhere and at any time, and the contingency plan should recognize this. There is no miracle cure and a major near-shore spill from a tanker will usually have a severe impact on shorelines, unless winds and currents carry the oil out to sea where it can disperse and degrade naturally.

There is an ongoing need to help the public, politicians, media and others to understand the problems of combating oil at sea. It is also important for them to appreciate that industry and government agencies are constantly reappraising equipment and material resources. This process of communication should also emphasize that investment in larger stockpiles will not necessarily result in any marked reduction in the impact of oil on the shoreline, which is the most important aspect of oil pollution incidents.

This is particularly true of large instantaneous releases from tankers. The statistics indicate that major oil spill accidents are exceptional, and it is

Table 2: factors affecting risk

- type of oil/product
- geographic location
- weather
- sea conditions
- coastline
- vigilance
- volume of traffic
- time of day
- navigation hazards
- war
- terminal design
- condition of facilities
- legislation
- quality of shipping/vessel types
- types of operation
- quantities handled
- frequency of handling
- training programmes

impossible to predict either where and when the next one may occur or the problems that it will create. It would be unrealistic to believe that as a result of lessons learnt from previous spills, it will be possible to clean up any future spill within a few hours and thereby prevent any environmental impact. However, there are geographical areas that can be identified as being at higher risk and these areas must be emphasized when developing a contingency plan.

Those responsible for contingency planning will use the information from risk assessment along with information about technical resources, social, economic and political values, and control and response options to determine what action to recommend or take to reduce the risk.

Table 2 indicates the factors that planners should consider when assessing their spill risk and Table 3 shows how estimations can be made of credible releases from collisions or groundings. This type of approach can help identify the necessary response capability at Tiers 1, 2 and 3.

Oil properties

The base properties of an oil will determine the physical and chemical changes that occur when it is spilled onto water and will account for its persistence and toxicity. It is recommended that organizations prepare a list of the properties of oils commonly traded in their area or produced from exploration and production operations. They should be aware of their probable behaviour on water and the implications regarding the effectiveness of different types of on-water recovery devices ('skimmers') and chemical dispersants. Table 4 indicates the important properties and gives some generic examples.

Many oils have a tendency to incorporate seawater and form a water-in-oil emulsion, which can increase the volume by a factor of three or four, and the viscosity by several orders of magnitude. Oils with asphaltene contents greater than 0.5 per cent tend to form stable emulsions, called 'chocolate mousse', which are particularly difficult to handle.

Table 3: impact of tanker size on credible spill potential (tonnes)

typical tonnage (dead-weight)	**slight grounding or collision** (one wing tank)	**grounding with rupture** (two wing plus one centre tank)	**bunker fuel**
30,000	700	3,000	450
50,000	1,100	5,000	750
70,000	3000	12,500	1,800
100,000	5,500	21,000	2,300
200,000	10,500	45,000	2,750
240,000	15,000	60,000	4,000

Note on Table 3:
Tankers have a series of wing and centre tanks that run along the length of the vessel. These carry either cargo or ballast. Modern vessels have narrow wing tanks and a wider centre tank so that, in the event of a collision, the oil spill is limited Many tankers are double-hulled which offers protection of the cargo spaces in the event that the outer hull is breached. However it will not prevent oil spillage if the inner hull is also breached.

Table 4: characteristics of different oil types

oil type	density (kg/l) at 15°C	viscosity mPas at 20°C	pour point °C	flash point °C
crude oil	0.8–0.95	1–100	+10 to -35	variable
gasoline	0.70–0.78	0.5	na	<0
kerosene	0.8	2	<-40	38–60
jet fuel	0.8	1.5–2	<-40	38–60
diesel oil	0.85	5	-5 to -30	>55
light fuel oil, IFO 60	0.9	60 at 50°C	+50 to -20	>60
medium fuel oil, IFO 180	0.9	180 at 50°C	+30 to -20	>60
heavy fuel oil, IFO 380	0.99	380 at 50°C	+30 to -20	>60

Current and wind data

Apart from spreading, which causes the oil to cover a progressively larger area, the slick moves at about the speed of surface currents and at about 3 percent of wind speed—the resultant movement being a vector sum of the two (see Figure 6). A spill is likely to spread until an average thickness of about 0.1mm (ranging from 100nm to 10mm) is reached. At this stage the oil breaks up into strands of varying thickness called windrows which are aligned to the wind direction and become patchy. Local current data and weather forecasts will assist in determining oil spill response strategies and allow prediction of the slick's movement. Information about tides, water currents and wind distribution can be obtained from official agencies and commercial organizations. In addition, experience has proved that similar information from local fishermen and watermen can be invaluable. In practice, predicted oil slick trajectories may be used to identify the time available to protect sensitive resources and to help develop feasible personnel and equipment mobilization times.

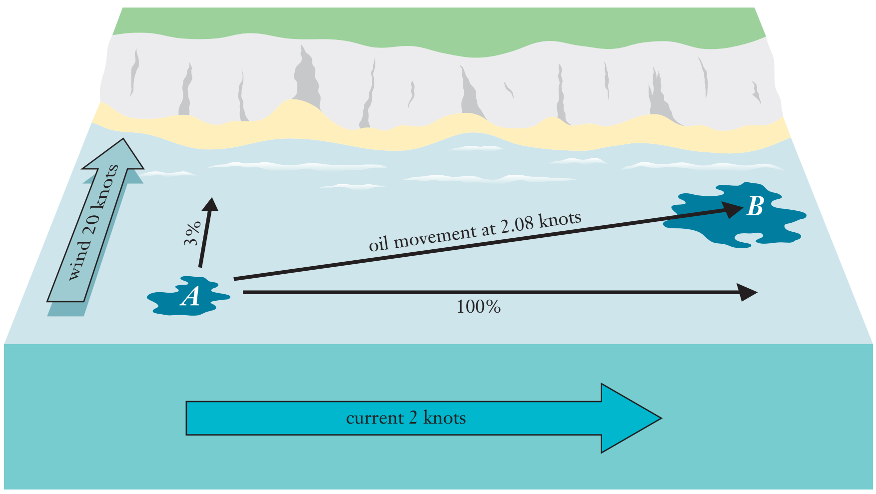


Figure 6
The influence of 3 per cent of the wind speed combined with 100 per cent of the current speed results in the movement of oil from A to B.

Sea conditions

Sea conditions influence the behaviour of spilled oil and determine the effectiveness of response techniques. For example, a rough sea assists in the dispersal of the oil, whether naturally or chemically induced, but makes the mechanical containment and recovery of oil difficult. Data about prevailing winds, sea states and temperature (with its bearing on oil viscosity) should be available to planners.

Computer trajectory modelling

Various organizations and companies have developed oil spill computer models; they can provide valuable support to both contingency planners and pollution response teams. It should be mentioned that though their use may be desirable such models are not essential for effective planning and response. The models are able to make predictions about the trajectory and fate of spilled oil. In the planning stage numerous modelling runs based on historical weather data ('stochastic modelling') may be performed to generate the likelihood of sensitive resources being threatened and associated timescales. This can influence decisions concerning strategy development and the identification of necessary response capability.

The operation of all computer models requires trained personnel. It is very important that users of these models understand their various limitations, such as the quality of information on water currents programmed into a model and the inherent difficulties in predicting some oil fate processes (e.g. emulsification). Modelling is only a predictive tool and cannot readily replace the need to monitor a spill physically in the event of an actual incident. This can be done effectively only from aircraft, by personnel fully trained in the interpretation of visual observations of oil on water.

SENSITIVITY MAPPING OF THE ENVIRONMENT AT RISK

Making and updating sensitivity maps are key activities in the planning process. These maps convey essential information to spill responders by showing where the different coastal resources are and by indicating environmentally sensitive areas. The making of a map involves assembling information on commercial, ecological and recreational resources and deciding what guidelines for spill response may be included. Mapping may be either paper based or link into a geographic information system (GIS) to provide a comprehensive tool to advise and support decision makers. A wide range of contingency planning information can be included within a GIS (e.g. equipment stockpiles, environmental sensitivities, response procedures, trajectory modelling etc.), but care has to be taken to avoid paper maps becoming too cluttered and difficult to interpret. The IMO/IPIECA Report Series Volume One, *Sensitivity Mapping for Oil Spill Response*, gives guidance on this subject.

Table 5: examples of areas of special value to be identified

Ecological: coral reefs; saltmarshes; estuaries; fish spawning areas; bird breeding/feeding and roosting areas; mangrove stands; seagrass beds

Recreational: tourist areas; bathing beaches; marinas; watersports

Commercial: water intakes; shipyards/ports; fish farms; other mariculture

A desirable way to categorize beaches is by type—for instance, cliffs, rocks, boulders, cobbles, pebbles, shingle, sand, mud-flats, swamps, marshes and estuaries. The maps could show the agreed response tactics for each zone. Priorities for protection should be agreed with the involved administrations and agencies. Maps can then be annotated to show the priority level attributed to each zone. Authorized access points and possible temporary storage areas may also be identified on the maps.

Vulnerable shore features: mangrove swamps (under rehabilitation, below left); and a coastal amenity resort (below right).

Vulnerability index of shores (in order of increasing vulnerability to oil spill damage, after Gundlach and Hayes 1978)

1. Exposed rocky headlands	Wave reflection keeps most of the oil offshore. No clean-up necessary.
2. Eroding wave-cut platforms	Wave swept. Most oil removed by natural processes within weeks.
3. Fine-grained sand beaches	Oil does not usually penetrate into the sediment, facilitating mechanical removal if necessary. Otherwise oil may persist several months. (some evidence suggests that penetration can occur, depending on water-table movements in sediments.)
4. Coarse-grained beaches	Oil may sink and/or be buried rapidly, making clean-up difficult. Under moderate to high-energy conditions, oil will be removed naturally from most of the beachface.
5. Exposed compacted tidal flats	Most oil will not adhere to, nor penetrate into, the compacted tidal flat. Clean-up is usually unnecessary.
6. Mixed sand and gravel beaches	Oil may penetrate the beach rapidly and become buried. Under moderate to low-energy conditions, oil may persist for years.
7. Gravel beaches	Same as above. Clean-up should concentrate on high-tide/swash area. A solid asphalt pavement may form under heavy oil accumulations.
8. Sheltered rocky coasts	Areas of reduced wave action. Oil may persist for many years. Clean-up is not recommended unless oil concentration is very heavy.
9. Sheltered tidal flats	Areas of great biological activity and low wave energy. A number of interpretations of the ‘biological activity’ are possible. In this case, it is taken to mean a combination of high productivity, biomass and possibly bioturbation. Oil may persist for years. Clean-up is not recommended unless oil accumulation is very heavy. These areas should receive priority protection by using booms or oil-absorbing materials.
10. Salt marshes/mangroves	Most productive of aquatic environments. Oil may persist for years. Cleaning of salt marshes by burning or cutting should be undertaken only if heavily soiled. Protection of these environments by booms or absorbing material should receive first priority.

STRATEGY DEVELOPMENT

Having defined a range of oil spill scenarios, consideration should be given to viable response strategies (e.g. monitoring and evaluation, containment and recovery, dispersants, shoreline clean-up and *in-situ* burning). These may have to be adaptable to different locations, under different conditions and at varying times of the year—and must be established in consultation with the relevant authorities and stakeholders.

The realities of the situation and the limitations of techniques and equipment must be well understood. When spilled, most oils dissipate quickly through the natural processes of evaporation, dissolution and dispersion. Depending on the temperature and sea conditions and the volume of the spill, light products will, under favourable conditions, virtually disappear from the sea surface within 1–2 days, light crudes within 2–5 days and medium crudes within 5–10 days. Heavy or waxy crudes and heavy oil products persist for much longer periods but are still naturally dissipated over time.

When oil is spilled close to land, or when currents and wind would bring it inshore, an active response may be necessary. It is important however, to recognize that there are instances when a choice of 'no active response other than monitoring and evaluation' might be the most appropriate response. This could be a spill in mid-ocean or of a very light, volatile oil. In this situation it

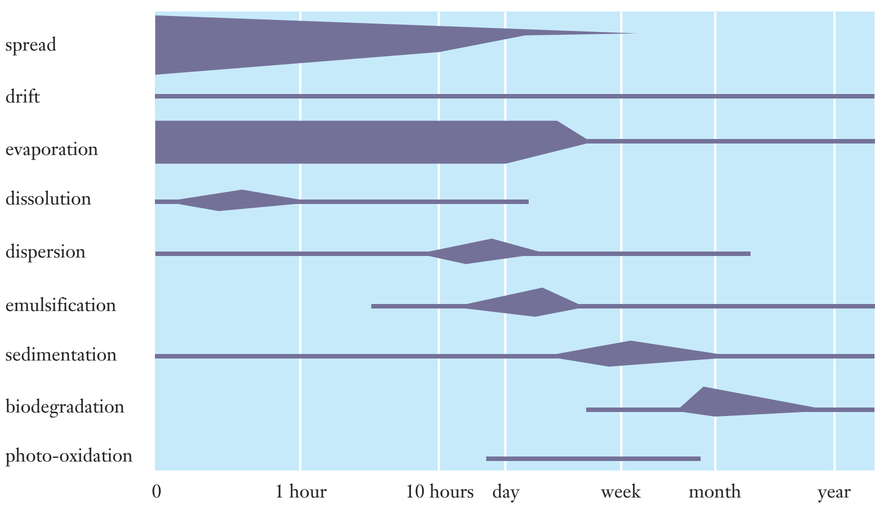


Figure 7
A spill of typical medium crude oil onto water will follow a certain pattern. The line length denotes the duration of each stage; line thickness denotes the most critical phase of each stage.

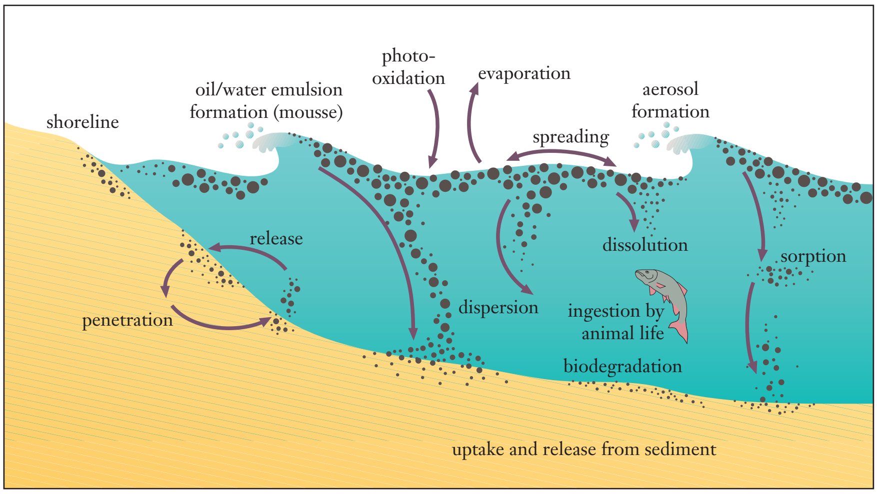
will still be necessary to notify local authorities and to alert response organizations. The spill should always be carefully monitored using aircraft whilst in remains on the sea.

Spills occurring at exploration and production facilities have a known position; the flow rate and oil characteristics may also be known. This should enable reasonable predictions of the oil movement and natural dissipation to be made. The selection of the appropriate clean-up response should also be simpler.

The effectiveness of the response using modern equipment varies with sea and weather conditions. A range of boom, skimmer and dispersant spray systems is available which, under certain conditions, can contain and recover or assist in dispersing a proportion of an oil spill. This may be a significant percentage if the spill is small, or if conditions are favourable.

In rougher conditions, booms are less effective and if deployment is not possible immediately, the spill may have spread too far to be contained at sea. In the case of a larger spill, it is often impossible to assemble and deploy sufficient equipment quickly enough to significantly influence the fate of the oil. If the spill then threatens a shoreline, the response strategy must become defensive. This may involve protecting critical coastal resources and preparing for beach clean-up operations. Lighter, more volatile oils may be susceptible to ignition immediately after being spilled. These characteristics will favour *in-situ* burning—a response option with the potential to remove substantial quantities of oil from the sea surface, but which will also produce copious black smoke and a small amount of persistent residue. The associated safety and environmental risks must be carefully evaluated alongside operational limitations and associated approvals, as is the case for all response options.

Figure 8
Processes following a spill



PLANNING FOR RESPONSE OPTIONS TO MINIMIZE DAMAGE

Ecological, recreational and commercial concerns should be carefully balanced, and the consequences of applying or not applying a particular strategy or technique should be fully understood by all parties. This balancing process should aim to achieve maximum benefit for the environment overall and should take account of varying priorities and concerns in a given location. The process has been described as net environmental benefit analysis (NEBA) and provides a framework for science based planning away from the emotive atmosphere prevalent at the time of spills. However, conflicts do occur in this process; common sense and consensus forming are important requirements. Ultimately some value judgements may be needed as to the relative values of threatened resources.

Through the adoption of NEBA, all stakeholders in contingency planning should be able to understand the reasons why certain strategies are being proposed. NEBA uses natural clean-up (i.e. no intervention) as the benchmark against which to judge response actions. If the use of invasive clean-up techniques on remote shorelines is not going to bring meaningful socio-economic benefits and exacerbate the ecological damage, then serious consideration should be given to its validity.

The application of chemical dispersants to enhance natural dispersion may be regarded as a negative option if viewed in isolation. Observers may focus on the use of dispersants as adding further chemical pollutant and exposing underwater marine life to oil and dispersant mixtures. However a deeper analysis will take into account dispersants benefits of mimimizing seabird and shoreline contamination, weighing them against the actual (rather than perceived) disadvantages. With a proper understanding of the action of dispersants and the resultant dilution of dispersed oil, NEBA can point to the use of dispersants as the best option for the environment.

If shorelines become oiled, NEBA again provides a useful framework by which to consider both the level and intensity of any clean-up. There is clear evidence that for some habitats, certain clean-up techniques bring little ecological benefit and may worsen damage if too invasive. This fact has to be balanced against recreational, industrial and wildlife uses of shorelines (e.g. seal haul-outs or bird roosting) and the possibility of bulk oil remobilizing to spread contamination further afield. Planners and responders should be able to take account of these factors, ultimately leading to rational decision making. It should be clear that for NEBA to be properly undertaken, reliable information about an area needs to be available. This emphasizes the need for sensitivity maps.

EQUIPMENT AND SUPPLIES

Resource stockpiles should be identified in plans. Proper storage, maintenance and care of equipment is needed at all response tiers.

The assessment of risk, the necessary collection of data and the development of response strategies, as described in the foregoing sections, are the cornerstones to a logical determination of equipment requirements. The specification of equipment capabilities is not an exact science and levels of achievable performance will be very much a function of the specific local circumstances. Performance on the day will also be crucially dependent on a number of factors, especially weather and sea conditions.

The time needed to transport and deploy equipment, and its effectiveness in different oil spill situations, needs to be evaluated. This can be achieved through field deployments during exercises. Notification and table-top simulations will test communication channels and the coordination of resources. Thus, a combination of exercises will assess whether existing resources meet the requirements of each contingency plan, whether additional equipment and supplies are required.

Because there is an opportunity to react rapidly and contain a small oil spill in the vicinity of a company operating area, the acquisition of some equipment (such as booms, skimmers and absorbents) to provide Tier 1 capability is an essential component of an effective plan. On-site personnel must be trained and aware of how this equipment should be deployed and operated. This will enable a response within minutes of a spill being detected. This equipment, when combined with that of other operators, contractors or authorities in the area and supplemented by a strategically placed communal stockpile could form the resources to support the Tier 2 contingency plan. The ability to call on Tier 3 resources, if a spill exceeds the response capability at Tier 2, should be built into plans.

Table 6: typical response equipment

on-water	shoreline
• booms	• shovels
• skimmers	• diggers/loaders
• absorbents	• drums/skips
• sprayers	• trucks/tankers
• dispersants	• vacuum trucks
• radio communications	• plastic sheeting
• boats/tugs	• protective clothing
• pumps/hoses	• communications
• tanks/barges/storage	• control room
• aircraft	• transportation

Table 6 lists the typical primary and support equipment that may be used to carry out on-water and shoreline response activities. An inventory should be made of all oil spill response equipment and supplies that would be available to the response organization in the case of an oil spill. Such lists should be appended to contingency plans and updated on a regular basis. The main purpose of keeping these lists is that, in times of emergency, there will be a ready source of information about where to obtain equipment, its specifications, the methods of transport and delivery times, the costs involved, and the names and telephone numbers of contact points.

RECOVERED OIL AND DEBRIS MANAGEMENT

Recovered oil, oily debris and contaminated beach material has to be properly disposed of. It may also need to be transported to, and handled through, temporary storage sites. Suitable equipment, vehicles, temporary storage sites and final disposal methods/locations need to be identified and their availability agreed with the local authorities at the contingency planning stage. Waste management is a major logistics problem that can also raise serious legal issues in some countries; it must always be coordinated with the relevant authorities.

Oil wastes in temporary storage near the shoreline

The handling and disposal of contaminated oil and oily waste have major implications for an oil clean-up operation. It can frustrate the entire operation by causing bottlenecks and delays, unless suitable arrangements can be made. It is best to treat and dispose of collected materials as near to the point of pick up as possible and adopt the principles of waste minimization and where possible segregation into different waste streams.

Oil recovered from the water could, for instance, be held initially in an open-topped tank or vacuum tank. Road tankers could be employed to carry out regular transfers to a plastic lined holding pit where the recovered material can be treated before transportation to the final disposal point. Solid waste is usually recovered manually and stored in plastic bags or drums. These are then taken to temporary off-beach storage by front-end loader or dump truck where they might be processed before final disposal.

Processing and final disposal of oil and debris in an acceptable manner according to local regulations also requires planning. Care must be taken not to create another environmental problem.

MANAGEMENT, TRAINING, EXERCISES AND PLAN REVIEW

Response personnel will derive great benefit from periodic training and oil spill simulation exercises.

In order to react quickly to an oil spill, response staff should be assigned specific roles and responsibilities, properly trained and regularly rehearsed and available for 24-hour call-out. For spills that cannot be contained at source and are likely to cause damage to property and the environment, a clean-up operation can make considerable demands on management and manpower resources over a period of weeks or months.

Management

There are four fundamental elements that make up effective management of an oil spill:

1. **A response organization:** typically with functional teams to address command, planning, operations, logistics and finance/legal. The key aim of the organization will be to obtain timely assessments to allow the response effort to rapidly move from reactive to proactive management. This may also be conceived as turning the oil spill emergency into a managed project. A generic organization for emergency response is shown in Figure 9.
2. **Clear roles and responsibilities:** amounting to a 'job description' for each of the identified roles with the organization. Short descriptions of typical functional group responsibilities are set out in the Appendix 2.
3. **Effective communications:** information flow within the organization and to the outside world is a serious challenge and requires both modern technology and disciplined personnel.
4. **Suitable resources (at Tiers 1, 2 and 3):** the availability of appropriate equipment and staff.

Is it important that the management structure is able to function effectively at Tiers 1, 2 and 3 with clear functions identified if the incident escalates. It should be noted that all the functions indicated in Figure 9 may not be required or they may be combined for small incidents. An industry organization must be flexible and able to interface with existing government arrangements such as a national plan, particularly at Tiers 2 and 3.

Industry has established international Tier 3 centres as outlined earlier in this report and these centres have procedures for rapid mobilization of their resources. However the organization utilizing these resources must have the

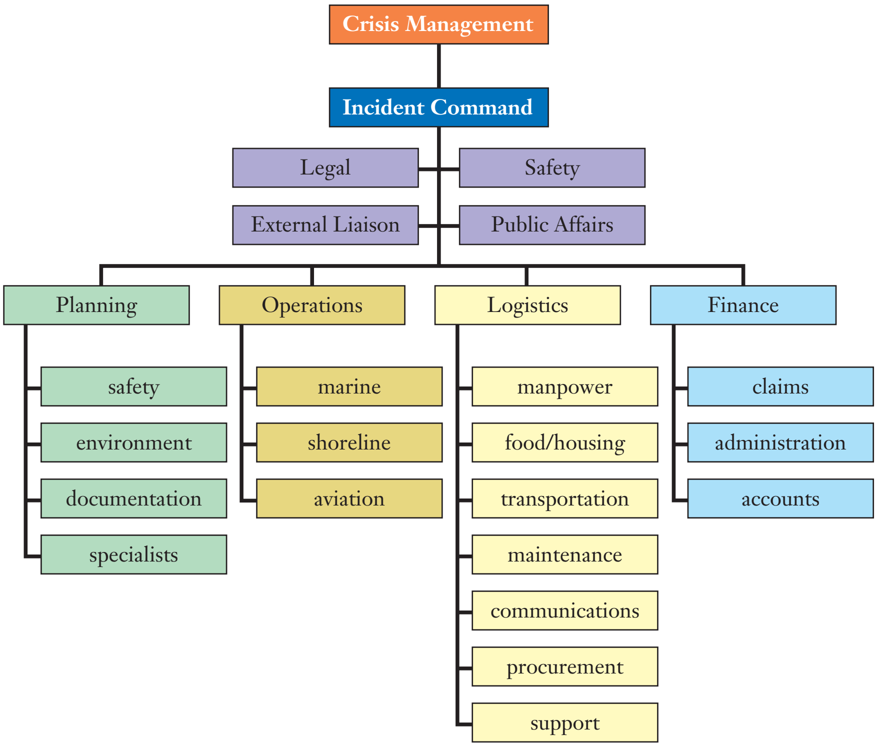


Figure 9
Typical organization chart for a large oil spill (see Appendix 2)

means to expedite their arrival into countries and integrate them into the overall response. Note that these centres will not have either the capability or authority to assume control of an incident—their role is one of support. Figure 10 demonstrates the likely activities that make up the effective utilization of Tier 2 or 3 support, referred to as a 'response chain'. By defining this response as a 'chain', it becomes clear that all links need full consideration to maintain integrity. A seemingly small weakness can compromise the entire response.

Various experts and advisers can be brought in and contractors hired to undertake some portions of the organization's workload. The key management, advisory and supervisory roles should be representatives of the company and/or government agencies involved.

Training

It is vital that staff with an identified role in a response organization are given effective training. The training should include the appropriate level of tuition in oil spill response theory and equipment deployment, depending on their role. Familiarization with relevant contingency plans and procedures will also form part of the training package.

The International Maritime Organization (IMO) has produced syllabuses and materials for three Model Oil Spill Training Courses (at Senior Manager, Supervisor and Operator levels) along with a 'train-the-trainer' course and advice on specialist courses. Information on these is available from the IMO. A number of countries who have ratified the OPRC Convention have either accredited or approved organizations and institutions to deliver training either commensurate with IMO Model Courses or to specific national syllabuses.

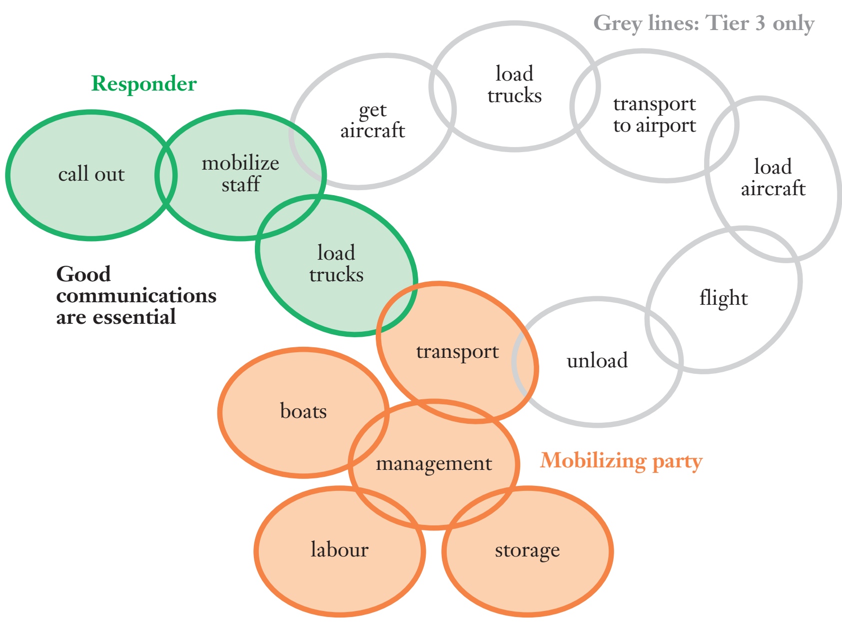
Exercises

Spill simulations (or 'spill drills') are an excellent way to exercise and train personnel in their emergency roles and to test contingency plans and procedures. Valuable lessons can be learned from such exercises and these can be used to improve plans. Personnel will not only feel more comfortable after constructive exercising, they will also benefit from strengthened team spirit. Important relationships with external organizations and contractors are made during larger scale or multi-agency simulations. During times of real emergency a well-rehearsed team should 'hit the ground running' and be more effective. IMO/IPIECA Report Series Volume Two provides guidance on exercise planning.

Plan Review

The planning process is not a one-off event and contingency plans require periodic review and maintenance. This may be at the basic level of ensuring contact details and equipment listings are current but could involve more fundamental changes in the light of experiences from either exercises or actual spill response. It is clear that all plan holders need to be appraised of updates and that issued plans need thorough document control procedures.

Figure 10
Response chain for Tier 2 and 3 support



APPENDIX ONE: preparing a contingency plan

A contingency plan should comprise three parts:

- *a strategy section*, which should describe the scope of the plan, including the geographical coverage, perceived risks, roles / responsibilities of those charged with implementing the plan and the proposed response strategy;
- *an action and operations section*, which should set out the emergency procedures that will allow rapid assessment of the spill and the mobilization of appropriate response resources; and
- *a data directory*, which should contain all relevant maps, resource lists and data sheets required to support an oil spill response effort and conduct the response according to an agreed strategy.

What follows sets out the proposed sections and sub-sections of each part of a typical oil spill contingency plan and may be used either as a template when writing a new plan or as a checklist when reviewing an existing plan.

Strategy

1. Introduction and scope
   - 1.1 Authorities and responsibilities, coordinating committee
   - 1.2 Statutory requirements, relevant agreements
   - 1.3 Geographical limits of plan
   - 1.4 Interface with other plans/representation at joint control centres

2. Oil spill risks
   - 2.1 Identification of activities and risks
   - 2.2 Types of oil likely to be spilled
   - 2.3 Probable fate of spilled oil
   - 2.4 Development of oil spill scenarios
   - 2.5 Shoreline sensitivity mapping
   - 2.6 Shoreline resources, priorities for protection
   - 2.7 Special local considerations

3. Spill response strategy
   - 3.1 Philosophy and objectives
   - 3.2 Limiting and adverse conditions
   - 3.3 Strategy for offshore zones
   - 3.4 Strategy for coastal zones
   - 3.5 Strategy for shoreline zones
   - 3.6 Strategy for oil and waste storage and disposal

4. Equipment, supplies and services
   - 4.1 On water oil spill equipment
   - 4.2 Inspection, maintenance and testing
   - 4.3 Shoreline equipment, supplies and services

5. Management, manpower and training
   - 5.1 Crisis manager and financial authorities
   - 5.2 Incident organization chart
   - 5.3 Manpower availability (on-site, on-call)
   - 5.4 Availability of additional labour
   - 5.5 Advisors and consultants
   - 5.6 Training/safety schedules and drill/exercise programme

6. Communications and control
   - 6.1 Incident control room and facilities
   - 6.2 Field communications equipment
   - 6.3 Reports, manuals, maps, charts and incident logs

Action and operations

7. Initial procedures
   - 7.1 Reporting incident, preliminary estimate of response Tier
   - 7.2 Notifying key team members and authorities
   - 7.3 Establishing and staffing control room
   - 7.4 Collecting information (oil type, sea/wind forecasts, aerial surveillance, beach reports)
   - 7.5 Estimating fate of slick (24, 48 and 72 hours)

APPENDIX ONE CONTINUED ...

7.6 Identifying resources immediately at risk, informing parties

8. Operations planning and mobilization procedures
   8.1 Assembling full response team
   8.2 Identifying immediate response priorities
   8.3 Mobilizing immediate response
   8.4 Preparing initial press statement
   8.5 Planning medium-term operations (24-, 48- and 72-hour)
   8.6 Deciding to escalate response to higher Tier
   8.7 Mobilizing or placing on standby resources required
   8.8 Establishing field command post and communications

9. Control of operations
   9.1 Establishing a management team with experts and advisors
   9.2 Updating information (sea/ wind/weather forecasts, aerial surveillance, beach reports)
   9.3 Reviewing and planning operations
   9.4 Obtaining additional equipment, supplies and manpower
   9.5 Preparing daily incident log and management reports
   9.6 Preparing operations accounting and financing reports
   9.7 Preparing releases for public and press conferences
   9.8 Briefing local and government officials

10. Termination of operations
   10.1 Deciding final and optimal levels of beach clean-up
   10.2 Standing-down equipment, cleaning, maintaining, replacing
   10.3 Preparing formal detailed report
   10.4 Reviewing plans and procedures from lessons learnt

Data directory

Maps/charts

1. Coastal facilities, access roads, telephones, hotels, etc.
2. Coastal charts, currents, tidal information (ranges and streams), prevailing winds
3. Risk locations and probable fate of oil
4. Shoreline resources for priority protection
5. Shoreline types
6. Sea zones and response strategies
7. Coastal zones and response strategies
8. Shoreline zones and clean-up strategies
9. Oil and waste storage/disposal sites
10. Sensitivity maps/atlas

Lists

1. Primary oil spill equipment: booms, skimmers, spray equipment, dispersant, absorbents, oil storage, radio communications, etc (manufacturer, type, size, location, transport, contact, delivery time, cost and conditions)
2. Auxiliary equipment: tugs and work boats, aircraft, vacuum trucks, tanks and barges, loaders and graders, plastic bags, tools, protective clothing, communications equipment, etc (manufacturer, type, size, location, transport, contact, delivery time, cost and conditions)
3. Support equipment: aircraft, communications, catering, housing, transport, field sanitation and shelter etc (availability, contact, cost and conditions)
4. Sources of manpower: contractors, local authorities, caterers, security firms (availability, numbers, skills, contact, cost and conditions)
5. Experts and advisors: environment, safety, auditing, (availability, contact, cost and conditions)
6. Local and national government contacts: (name, rank and responsibility, address, telephone, fax, telex)

Data

1. Specifications of oils commonly traded
2. Wind and weather
3. Information sources

APPENDIX TWO: functional responsibilities in the response organization

Function	Responsibilities
Crisis management organization	Ensuring that the response to any incident is consistent with government or company-wide, strategic, operational and communication policy requirements.
Incident Command	Recommending response strategy and setting clear objectives for the response effort (which should eventually include termination criteria). Ensuring overall implementation of field activities, effectiveness and cost of the entire clean-up operation. In many countries this role will fall within government agencies. Ensuring safety considerations are given the highest priority. Requires full operational and financial authority to facilitate rapid mobilization of necessary pollution combating resources.
Safety	Provide specialist safety advice and expertise to Incident Command.
External liaison	In Tier 2 and 3 spills there will be multi-agency involvement and further interest from a wide of range of parties. It is vital that links and communications with these parties are maintained throughout the response. Note that some countries plan their response organization to directly incorporate personnel from all involved groups.
Legal	Provide legal advice and expertise to Incident Command.
Public affairs	Release of information to the news media and wider community on aspects of the spill and its clean-up.
Planning	Recommendations of plans to implement the agreed response strategy, with full input from environmental expertise and other specialists as necessary. Ensure a complete and accurate record of all events is maintained and documented. Implementing a disciplined cycle to assessments, management meetings, decision making and feedback from/to the field operations.
Operations	Safe and effective deployment of field operations, both at sea and on shorelines, with possible involvement of air operations. This group is likely to be the most numerous when shoreline clean-up is undertaken and can involve unskilled labour, requiring close supervision.
Logistics	Support and procurement function. Transporting and maintaining effective personnel and equipment in the field requires close liaison with the planning and operations functions.
Finance	Ensuring costs are monitored and accounted. Ensuring claims and compensation procedures are implemented. Provide administrative support as needed.

N.B. A response organization may be comprised of some or all of the roles listed here. Furthermore, not all positions are essential for every operation.

APPENDIX THREE: follow-up further reading

International Maritime Organization (IMO), London

Manual on Oil Pollution:

Section 1 Prevention (out of print)
Section 2 Contingency Planning (1995 edition)
Section 3 Salvage (1997 edition)
Section 4 Combating Oil Spills (1988 edition)
Section 5 Administrative Aspects of Oil Pollution Response (1996 edition)
Section 6 IMO Guidelines for Sampling and Identification of Oil Spills (1998 edition)

International Convention on Oil Pollution Preparedness, Response and Cooperation 1990 (OPRC)

OPRC Convention 1990 text

International Tanker Owners Pollution Federation Limited (ITOPF), London.

Technical Information Papers 1–12,
No 1: *Aerial Observation of Oil at Sea*
No 2: *Use of Booms in Combating Oil Pollution*
No 3: *Aerial Application of Oil Spill Dispersants*
No 4: *Use of Oil Spill Dispersants*
No 5: *Use of Skimmers in Combating Oil Pollution*
No 6: *Recognition of Oil on Shorelines*
No 7: *Shoreline clean-up*
No 8: *Disposal of Oil and Debris*
No 9: *Contingency Planning for Oil Spills*
No 10: *Effects of Marine Oil Spills*
No 11: *Fate of Marine Oil Spills*
No 12: *Action Oil Spill*

IPIECA Report Series

IPIECA Volume 1: *Guidelines on Biological Impacts of Oil Pollution*
IPIECA Volume 3: *Biological Impacts of Oil Pollution*: *Coral Reefs*
IPIECA Volume 4: *Biological Impacts of Oil Pollution*: *Mangroves*
IPIECA Volume 5: *Dispersants and Their Role in Oil Spill Response*
IPIECA Volume 6: *Biological Impacts of Oil Pollution*: *Saltmarshes*
IPIECA Volume 7: *Biological Impacts of Oil Pollution*: *Rocky Shores*
IPIECA Volume 8: *Biological Impacts of Oil Pollution*: *Fisheries*
IPIECA Volume 9: *Biological Impacts of Oil Pollution*: *Sedimentary Shores*
IPIECA Volume 10: *Choosing Spill Response Options to Minimize Damage*

Jointly published Reports

IMO/IPIECA Volume 1: *Sensitivity Mapping for Oil Spill Response*
IMO/IPIECA Volume 2: *Guide to Oil Spill Exercise Planning*
IPIECA/ITOPF Briefing Paper on the Use of Tier 3 Centres
IPIECA/ITOPF Briefing Paper on Oil Spill Compensation

Useful Websites

www.ipieca.org
www.imo.org
www.itopf.com

The International Petroleum Industry Environmental Conservation Association (IPIECA) is comprised of oil and gas companies and associations from around the world. Founded in 1974 following the establishment of the United Nations Environment Programme (UNEP), IPIECA provides one of the industry's principal channels of communication with the United Nations. IPIECA is the single global association representing both the upstream and downstream oil and gas industry on key global environmental and social issues including: oil spill preparedness and response; global climate change; health; fuel quality; biodiversity; social responsibility; and sustainability reporting.

Company Members

Amerada Hess

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BHP Billiton

BP

Chevron

CNOOC

ConocoPhillips

EnCana

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ExxonMobil

Hunt Oil

Hydro

Kuwait Petroleum Corporation

Mærsk Olie og Gas

Marathon Oil

Nexen

NOC Libya

Petroleum Development of Oman

Petronas

Petrotrin

PTTEP

Repsol

Saudi Aramco

Shell

Statoil

TNK-BP

Total

Woodside Energy

Association Members

American Petroleum Institute (API)

Australian Institute of Petroleum (AIP)

Canadian Association of Petroleum Producers (CAPP)

Canadian Petroleum Products Institute (CPPI)

CONCAWE

European Petroleum Industry Association (EUROPIA)

Institut Français du Pétrole (IFP)

International Association of Oil & Gas Producers (OGP)

Petroleum Association of Japan (PAJ)

Regional Association of Oil and Natural Gas Companies in Latin America and the Caribbean (ARPEL)

Regional Clean Sea Organisation (RECSO)

South African Petroleum Industry Association (SAPIA)

World Petroleum Congress (WPC)

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