ITOPF

PROMOTING EFFECTIVE SPILL RESPONSE

LEADERSHIP, COMMAND & MANAGEMENT OF MARINE OIL SPILLS

TECHNICAL INFORMATION PAPER

10

Introduction

An effective and successful response to a spill of oil depends to a significant extent upon the quality of the leadership shown by those in command or management. An organisational structure is called for that provides leadership through the difficult decisions and compromises that have to be made at all stages of the response. The organisational structure is also responsible for managing the expectations and widely differing demands of the multitude of governmental and private organisations that can be involved, as well as imparting the confidence necessary to cope with political pressure and the concerns of the public.

This paper considers many of the situations encountered in a response to ship-source pollution and explains how effective leadership, command and management can maximise the success of response operations. Many of the subjects touched on are discussed in greater detail in other ITOPF papers in this series, as listed on the back cover, but in particular, the paper on Contingency Planning for Marine Oil Spills.

Overview

Regardless of the levels of planning and preparedness, oil spills are unforeseen and random events that are capable of upsetting and challenging the normal way of life for those affected. While the immediate effects may include localised damage to environmental and economic resources, as well as disruption of social amenities, the long term consequences are rarely as serious or extensive as may have been feared. The initial stages of an incident involving a spill of oil can develop rapidly and it is important to avoid a loss of confidence by averting any perception of confusion or lack of control, and to establish quickly an effective organisational structure with those in charge identified clearly. If the expectations of a rapid response can be met with assured leadership and definitive action, the concerns raised by those affected can be addressed confidently, thereby reducing the opportunity to undermine the efforts of those in charge and, instead, encouraging the parties to work together.

Each oil pollution incident will differ in size and complexity and a pre-requisite for operational success is to establish an organisational structure that is scaled appropriately to the situation. A small spill, such as the accidental overflow of oil from a tank while bunkering in port, may affect local port infrastructure, the response to which may be dealt with by the port authority according to its own administrative structure. However, the response to a serious incident (*Figure 1*) may require considerably more resources, perhaps from outside of the country, and affect several jurisdictions. In which case, co-ordination and management of the different entities within a well defined and well practiced organisational structure will be vital for a successful response.

To ensure that the organisational structure is effective, the roles and responsibilities of personnel identified in local and national contingency plans should be tested regularly and thoroughly through a series of exercises. In this way, even when an emergency situation gives rise to unforeseen problems, responders will be capable of coping with the pressures of a rapidly changing situation competently.

Figure 1: When a serious incident occurs, the quality of the leadership, command and management of the response will determine the effectiveness of the response.

An effective response does not necessarily depend on large amounts of specialist equipment or materials. While the availability of such response resources is central to many operations, a successful outcome will be more easily achieved if the necessary infrastructure, logistical support and leadership are in place. Experience has shown that the response to many incidents can be effective even with the most basic of equipment and resources, provided that the organisational structure is clearly defined and understood and the labour is well managed.

Organisational structure

Governments are responsible for the protection of a country's interests and national authorities are in the best position to establish spill response priorities, some of which may involve conflicting interests. For incidents affecting public areas, this responsibility is often established through competent local or national government departments of the country affected who will lead the response and take the decisions necessary. In some countries, the shipowner is required by legislation to

undertake the response, overseen by a government agency with whom decisions can be taken. Spills in private areas, for example within the jurisdiction of ports or terminals, may be dealt with by the facility operator, again with oversight from a government agency.

As a consequence, the organisations involved in a response will depend on the location and severity of the incident. Usually three levels, or tiers, of incident and response are recognised[1]. Allocation of an incident to a specific response tier may be based on the estimated amount of oil spilt or the number of jurisdictions affected. As an incident develops, the oil may spread to affect a wider area, resulting in the need to re-categorise the response at a higher tier or level. Consequently, the organisational structure needs to be sufficiently flexible to accommodate scaling the response up or down according to the circumstances.

Irrespective of the severity of the incident, there are a number of key personnel functions within a response organisation that should be fulfilled, including:

- management of the overall response and of individual operations, for example at sea and on the shoreline;
- planning of future operations based on knowledge of the current and forecast situations, including the availability of resources and local sensitivities;
- providing logistical support to these operations, such as sourcing equipment and ensuring the requirements of the workforce are met; and
- record keeping, financial control and other administrative aspects, for example to facilitate the compilation of claims for the reimbursement of costs.

The organisational structure for discharging these functions varies from country to country. Some utilise existing administrative structures while in others the response organisation is formed at the time of the spill, drawing personnel from a variety of sources as the response develops and the workload of existing members of the response team increases.

Depending on the organisations present within the response structure, different approaches are followed when discharging the functions of spill command or management. In organisations that have a hierarchical command structure, such as armies, navies and some coast guards and marine police forces, a designated commander has authority to control operations through subordinates. In a civilian organisation, a management structure is required that can exercise a similar level of control, which is often achieved by senior management of the organisation providing the equivalent leadership. Organisational structures that combine elements of these two approaches are commonly encountered. An established chain of command or existing management structure within the lead organisation, which has complete responsibility for the entire operation, can help to avoid the confusion that may result from divisions of responsibility.

In practice, a number of organisations and agencies may have interest or responsibility for the marine resources, both on the shore and at sea. In many jurisdictions, responsibility for operations at sea and on the shore are split. Control and operational responsibility for work at sea and at the site of the incident often lies with the navy, coast guard or other marine-based authority, which may direct and conduct aerial and vessel operations and oversee salvage activity. The clean-up of oil that strands along a coastline may be the responsibility of a local or regional authority and, in a major spill, may involve several such organisations. Therefore, a response affecting both the shoreline and open sea areas is likely to necessitate the involvement of civilian, military, public and private entities and these divisions can ultimately define the structure of the response organisation.

Only with suitable preparation can the problems associated with co-ordination and management of this diverse mix of organisations be overcome once an incident has occurred and the response has begun. Involving all interested parties in the decision-making process, whether or not they are technically qualified to do so, usually results in a large and unwieldy spill response organisation. This approach is better suited to the development of contingency plans before an incident has occurred; attempting to introduce this level of consensus-building during an incident can lead to delayed decision making and, potentially, the adoption of inappropriate or conflicting response strategies. An effective organisational structure should result in a coherent unit with all participating organisations working co-operatively towards the shared common goal of minimising the impact of the spill. Such a structure requires a clear hierarchy of command or management, with easily understood roles, responsibilities and associated job titles providing for effective leadership. The structure should be able to accommodate the inclusion of external experts, such as ITOPF, on technical issues, for example oil behaviour, appropriate clean-up techniques, environmental concerns and fisheries, with advice on legal matters, media relations, the reimbursement of costs and other matters sought as required. In a major incident it is essential that the demands of other related operations, particularly search and rescue and salvage, can be also accommodated.

Figure 2: The responsibility for clean-up onshore may lie with different organisations than for clean-up offshore. Here soldiers and civil protection workers recover emulsified fuel oil from the shoreline.

[1] *As described in the separate ITOPF paper on Contingency Planning for Marine Oil Spills.*

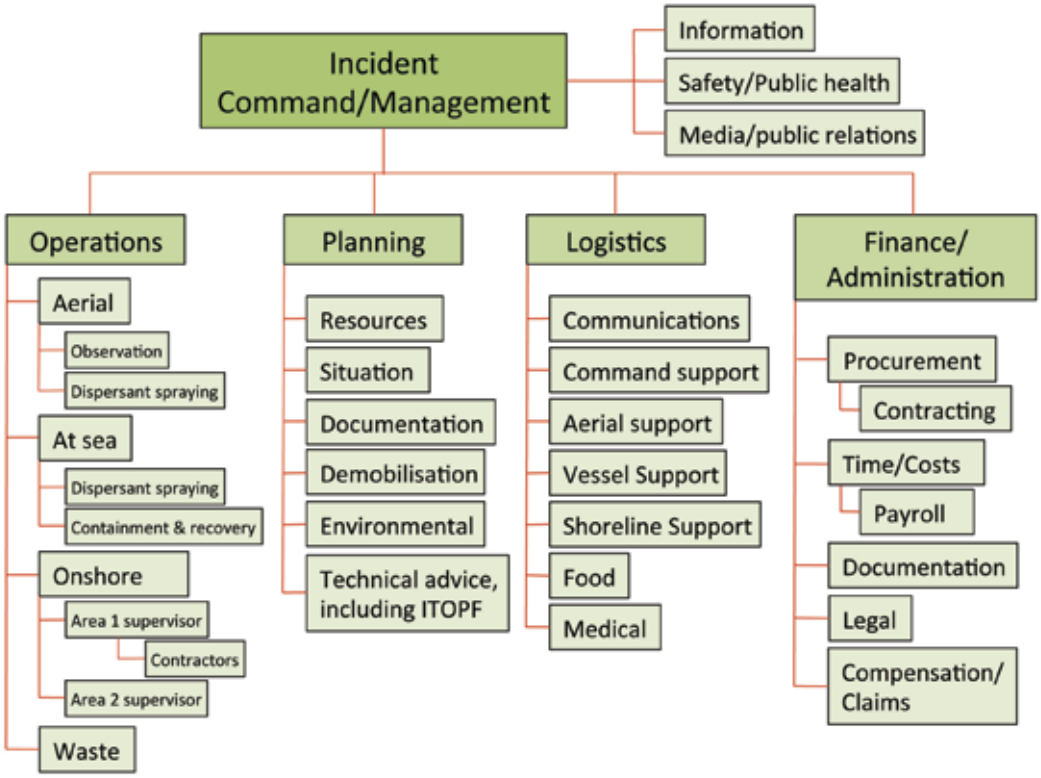

Figure 3a: A function-based organisational structure, with all tasks under a single command and ideally located in a single command centre. In a small incident, some of the tasks may be combined.

Many examples of organisational structures are available, most of which have evolved according to local preferences or prior experience and lessons learnt at incidents and exercises. The generic function and team-based structures (*Figures 3a and b*) are two of the more common examples; the primary difference between them being the division and location of command or management of specific activities.

The Incident Command System (ICS), used most widely in the USA, is an example of a standardised, function-based organisational structure. The ICS is designed specifically to bring together personnel from different organisations and agencies at short notice to work as members of a single structure, within which their roles and responsibilities are well understood. Familiarity with the structure provides a practical means of building a coherent response organisation within a very short timescale. For shipping incidents in the USA, leadership is provided by the Incident Command at the top of the hierarchy, with the response directed by an officer of the United States Coast Guard (USCG) and involving the shipowner and the affected state. Variations of the function-based structure have been adopted in a number of other countries and by some oil industry response organisations.

The alternative team-based structure has been used successfully in the response to oil spills in various parts of the world. The same principles are applied but the approach is less prescriptive and the teams are not separated into individual functions. Instead, positions are established to fulfil different aspects of the response, most commonly at sea and onshore, with support services allocated to each. This has the advantage of promoting self-contained units that can focus on those elements of the response within their remit and can readily accommodate the requirements of the response and the organisations involved. Some specific tasks relevant to all teams are shared. Perceived limitations of both the function- and team-based approaches are explored later in this paper.

Leadership

Irrespective of the structure of the response organisation, the ability of the individual(s) allocated as lead commander(s) or manager(s), will have an important bearing on the progress and outcome of the response. Exemplary leadership is required throughout a response but particularly as an incident develops and difficulties arise, for example when oil affects new areas or response strategies do not provide the expected results and alternative techniques are sought.

The qualities required of a leader would include an ability to:

- command or manage personnel from the diverse range of organisations involved in the response;
- listen and respond to the concerns and suggestions of the various parties involved in the response, including other members of the response team and technical experts;
- assimilate information from a wide range of sources and make timely decisions based on this information;
- set priorities, particularly in situations when conflicting interests may benefit or disadvantage parties, for example when needing to allocate limited resources to a certain area;
- communicate decisions and instructions clearly and authoritatively;
- motivate members of the response team, particularly when required to overcome difficult situations and fatigue;
- recognise the limitations of members of the response team and reallocate tasks accordingly;

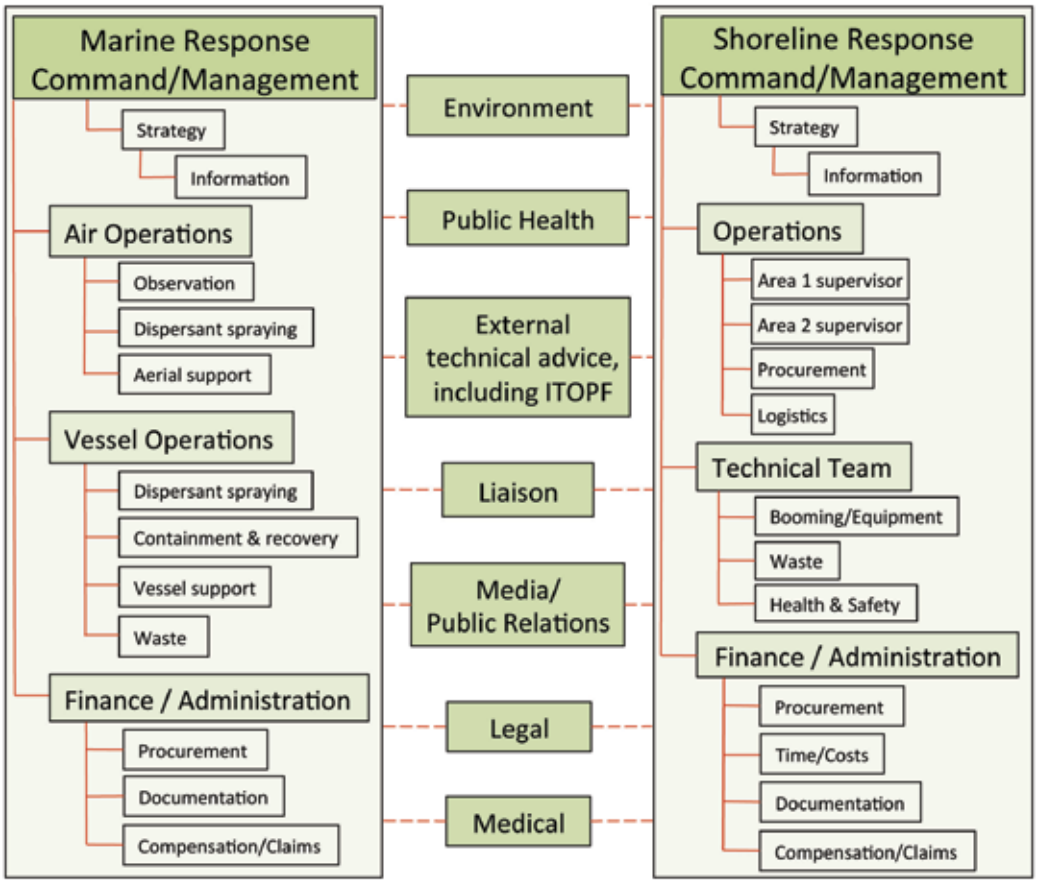

Figure 3b: A team-based organisational structure with two self-contained activities, sharing some functions. This allows marine and shoreline operations to be located at separate command centres, but relies on good communications between the two centres for an effective overall response. In a small incident, some of the tasks may be combined.

- ensure the response is technically reasonable and that pressure placed on the response team, particularly by politicians, the media and public, does not result in unreasonable or dangerous activities;
- appreciate the point at which personnel and resources are no longer required and can be stood down or demobilised, both on site and in the command centre.

Clearly, the task of leader is better suited to an individual with prior relevant experience in a senior command or management position. At the tier one level of response, leadership of the organisational structure may be provided by the harbour master, port captain, terminal superintendent, local authority emergency officer or other such position with the necessary authority. For the more serious, tier two or tier three levels of response, responsibility often rests with an appropriate senior individual from the relevant military or civilian marine-based authority or a related government agency or ministry such as the Ministry of Transport. In other countries, it may be an agency of the Ministry of Environment, the Ministry for Emergency Affairs or a disaster-relief agency. With the team-based structure, the lead commander or manager for each team is likely to come from different organisations and prior experience of working together is an advantage. The issue of seniority is important, as there may be a need to work at a high level with central government, to report to Ministers (or politicians of equivalent rank), to procure resources from other ministries and government departments, and to be able to authorise the allocation of finance to support the response.

Other members of the response team should have the skills necessary to undertake the tasks allocated, for example, a knowledge of aerial operations and the limitations of the aircraft involved or an understanding of contracts and the terminology relevant to specific operations. For operations at specific worksites, individuals with prior experience of managing teams of labour may be necessary, for example, from the construction industry[2].

The long hours and pressures exerted upon members of the response team at all levels can be intense and can lead to extreme fatigue and impaired judgement, particularly during the emergency phase. It is therefore important that, within the constraints of maintaining the pace of the response, members of the response team are allocated deputies or alternates to enable them to take rest periods. The qualifications of the deputy should be similar to the person for whom they deputise and time should be allowed for full hand-over briefings between shifts to ensure continuity.

Role of the shipowner

In countries where governments take the lead in responding to spills, the role of a shipowner may be restricted to crew and salvage matters, or providing technical support and ultimately paying compensation through their Protection and Indemnity

[2] *Further information on the management of shoreline clean-up is available in the separate ITOPF paper on Clean-up of Oil from Shorelines.*

Figure 4: Full awareness of the limitation of equipment and of the environments into which they are deployed will help to ensure time and effort is not wasted on actions that can be foreseen not to work. Here, high currents mean the boom will be unable to contain oil.

(P&I) insurance. In other jurisdictions, legislation may place a requirement on the shipowner to lead the response, with the activities overseen and directed by government.

To ensure that there is clarity, the expectations of government as regards the role of the shipowner should be described in well-publicised regulations. Nonetheless, a successful response relies upon a realistic national contingency plan that establishes a clear organisational structure, showing how the government and the shipowner (or P&I insurer) should interface. In the case of a shipowner-led response, the contingency plan should show how decisions will be made and by whom, as well as indicate which resources are to be provided by each party. Where regulations, contingency plans and logistics are in place to support a shipowner-led response, the necessary infrastructure is also likely to be available, such as spill response contractors and the shipowner's own local organisation or spill management team contracted to manage the response on their behalf. In such instances, excellent communication is necessary between the government agencies and the shipowner's organisation to maximise effectiveness.

Role of ITOPF

ITOPF's technical staff will normally be asked to attend an incident by the shipowner's P&I insurer or occasionally by a government authority, the IOPC Funds or an oil company. However, ITOPF does not represent these organisations or the shipowner but, rather, is provided as a service to support and assist those in charge of the response by the provision of objective technical advice. The role of the technical adviser at the site of a spill will vary according to the circumstances, but normally includes one or more of the following activities:

- advising all parties on the potential fate and effects of the pollutant;
- assisting and advising all parties on the clean-up techniques most appropriate, with the aim of mitigating any damage;
- helping to locate equipment and, in cases where the shipowner is required to mount the response operation, assisting with organising the clean-up and providing the necessary resources;
- undertaking surveys, monitoring the clean-up and advising all parties on the technical merit of the actions;
- investigating any damage to the marine environment and coastal resources, and advising on methods to mitigate losses, including restoration options; and
- advising on the preparation and submission of claims for compensation, as appropriate.

When on site, ITOPF's technical staff endeavour to work closely with all the parties involved in a spill, in order to facilitate technically reasonable response measures. To be able to assist those in charge of the response, the technical adviser needs to interact with the organisation in place to enable them to have an overview of the response and to provide advice as appropriate through the correct channels. This interaction not only helps to maximise the effectiveness of the clean-up, but also facilitates the reimbursement of costs promptly by the organisations paying compensation.

Spill management tasks

The tasks to be accomplished in the management of each stage of the response to a spill are set out in the following section. The term 'management' relates primarily to civilian-type organisations but the principles relate equally to military-type command structures.

Progress through an incident can be broadly separated into seven stages:

- notification of the incident;
- evaluation of its severity;
- determination of appropriate response strategies (*Figure 4*);
- if necessary, mobilisation of resources to implement the strategies chosen;
- reassessment and adjustment of the strategies according to changing situations while coordinating and controlling resources to achieve a successful outcome;
- reduction and termination of operations and waste management;
- review of lessons learnt and recovery of costs.

Notification and evaluation

As soon as notification of a spill is received by a coastal authority, the individuals and organisations identified in the response structure will be alerted. Initially, the information needed to determine the scale of the incident may be insufficient to allow response decisions to be made and resources may be placed on stand-by until the situation becomes clearer.

As information is received, and depending upon the reported size and location of the spill, a judgement can be made about the severity of the incident and the response can be activated according to the appropriate tier. An important decision to be made early in the response is the location of the command centre or centres, which should be central

and easily accessible to those within the organisational structure. Each command centre serves as the focal point for the management of the response in the area identified and for liaison with outside interests, including the media. The facilities should include space for the large number of people involved in the management of a major incident and communication systems sufficient to ensure the free flow of information into and out of the command centre. Ideally, this should be in the vicinity of the incident or affected shorelines to allow the ready exchange of information from site and to encourage the management team to visit areas affected and undertake site surveys as time allows. If the spill affects a wide geographical area a number of local operational centres may be necessary, although maintaining central co-ordination will be vital.

Determination of appropriate response strategies

As the members of the response organisation take up their positions, a clear chain of command should be established with the roles and responsibilities of the individual members clearly identified and communicated within the organisation. Information on the state of the casualty, the location of spilt oil, shoreline impact, the weather etc. will be received by the command centre from varied sources. As this information is distributed, recorded and processed by allocated members of the organisation, a coherent picture of the situation will develop and commands to mobilise resources in response to the situation will be issued.

Throughout the response to the spill, but particularly during the initial evaluation stage, knowledge of the prevalent and future weather and sea conditions is important in order to anticipate the risk of oil being carried to sensitive economic and environmental resources. Based on this information, the relevant personnel can be notified, for example, fishing and mariculture operators, tourism facilities, marinas and power stations. Early notification can allow preventive measures to be put in place with minimal delay before the oil arrives. Many other groups, such as wildlife organisations, will also have a keen interest in the response and arrangements to keep them informed should be considered.

Figure 5: While oil has been contained successfully, these efforts may be in vain without a means of recovery from the water surface and temporary storage of the oil.

As the scale and details of the incident become clearer, a number of key response decisions will be required, for example:

- whether to mobilise aircraft for surveillance of the spill and for subsequent monitoring and control of the clean-up operations at sea and onshore;
- which of the available response resources are likely to be most suitable, based on the oil type and environmental considerations;
- where to deploy equipment and personnel taking into account observations of oil movement, the risk to sensitive resources and equipment availability;
- the need for logistical support to enable activities such as transport and temporary storage of recovered oily waste and distribution of fuel for machinery, personal protective equipment (PPE) and food for the workforce; and
- which treatment and disposal routes will be most suitable for the various waste streams, i.e. liquid oil, oiled shoreline substrate, used PPE and sorbent materials.

Adverse weather conditions or excessive currents may mean that no immediate response at sea is feasible and, if coastal sites have already been affected, decisions may focus on the priorities for shoreline clean-up. In a major spill, it is most unlikely that all the economic and environmental resources at risk can be successfully defended, either because of a lack of suitable response equipment or insufficient time to deploy the equipment. As a consequence, decisions may be required as to which sensitive resources should be protected, or affected sites cleaned, in preference to others. For example, boom may be allocated to protect a mangrove stand rather than a sand beach despite the concerns of local hoteliers, as the mangroves will be more sensitive to oil and more difficult to clean. Alternatively, men and equipment may be tasked with recovering bulk oil on the shorelines to prevent remobilisation to other areas in preference to cleaning lightly oiled shorelines, even if they are in amenity areas.

When deciding the most appropriate response options, priority should be given to those techniques that are technically reasonable in the circumstances, that minimise the amount of waste generated, are cost effective and are permitted under national policy and regulations.

Consideration of the advantages and disadvantages of clean-up techniques can assist in minimising the overall impact on the environment and on social and economic activities. Net Environmental Benefit Analysis (NEBA)[3] is a pragmatic scientific approach that can be used to determine which response techniques would allow recovery of the environment more quickly or would provide the greatest protection to sensitive resources in comparison with natural cleaning. By way of example, when considering the application of dispersant to floating oil, the potential impact of the oil on seabird populations might be evaluated against the potentially increased impact of dispersed oil on sub-surface biota. Alternatively, the decision to utilise heavy

[3] *For further information see Choosing Spill Response Options to Minimize Damage. IPIECA Report Series Vol. 10. www.ipieca.org.*

machinery to recover bulk oil and reduce the possibility of the oil remobilising to affect other sensitive areas should be balanced against the potential for long term damage to the substrate.

To ensure the most effective use of response resources, it is important that conflicting and counterproductive response techniques are not undertaken concurrently in the same locality. For example, the use of dispersants (the aim of which is to place oil into the water column) will render booms and skimmers redundant, as they are intended to contain and recover floating oil. Furthermore, dispersants can adversely affect the ability of oil to adhere to sorbent materials and to oleophilic skimmers.

The majority of the individual strategies available in response to a spill of oil are covered in detail in other papers in this ITOPF TIP series[4]. Each paper includes information important to the management of the strategies discussed. A summary of the criteria for the use of the various response techniques, as well as their advantages and disadvantages, is provided in Table 1 for response at sea and Table 2 for response near or on the shoreline.

Mobilisation

Once the initial evaluation has been completed and decisions on response strategies made, appropriate resources can be mobilised. It is important to ensure that the manpower and equipment mobilised are matched to the scale of the spill. For tier one incidents, at the facility or local level, the response team may have sufficient equipment immediately available on site or close by. For tier two spills, affecting the area beyond the immediate source, equipment and materials may be required from other facilities and more distant stockpiles. For tier three incidents, spills of national or international significance, a much more extensive mobilisation of response resources may be required, potentially from other countries. Transport of response resources to the area of the spill may involve considerable logistical effort, for example, chartering cargo aircraft, ferries or other suitable vessels to deliver equipment to islands or otherwise inaccessible locations and contracting road haulage companies. Equipment and personnel arriving from abroad will require quick passage through customs and border security in order for their involvement to have maximum effectiveness. Secure storage and accommodation close to the clean-up area will also be required.

Other parties may be mobilised in addition to those directly involved in response operations, including, for example, salvors, representatives of the ship and cargo owners, the P&I insurer (often represented by a local correspondent with the assistance of local surveyors), oil pollution, fisheries and tourism experts, such as ITOPF, and legal representatives of the various parties involved. For tankers carrying persistent oil, the IOPC Funds secretariat will also follow incidents in the waters of Fund Convention member states. Government authorities may establish a separate salvage unit to oversee the work of salvors on the casualty. Representatives of other government ministries or agencies may also be involved on site, for example, to ensure the safety and marketability of marine products if coastal fisheries and mariculture are likely to be affected.

Not all these parties will be involved directly in the oil spill response and may not have a presence in the command centre as other priorities, such as the welfare of the crew

[4] *Aerial Observation of Marine Oil Spills, Use of Booms in Oil Pollution Response, Use of Dispersants to Treat Oil Spills, Use of Skimmers in Oil Pollution Response, Clean-up of Oil From Shorelines and Use of Sorbent Materials in Oil Spill Response.*

Technique	When suitable	Resources	Benefits	Limitations
Aerial surveillance and monitoring	Necessary in many responses but may be sole activity required if oil is moving away from the shore or is dissipating naturally.	Aircraft – fixed or rotary wing. Remote sensing equipment for advanced surveillance techniques.	Provides the most rapid and straightforward method of obtaining an overview of oil position, volume and movement as well as the extent of shoreline contamination.	Twin engine aircraft required for flying over open water. Experienced observers needed for maximum benefit. Specialised remote sensing equipment may enable surveillance at night or in fog, heavy rain, snow etc.
Containment and recovery	Recovery of floating oil in calm conditions. Best results achieved in large slicks of freshly spilt oil.	Specialised equipment – booms, skimmers, vessels with sufficient and suitable storage and offloading pumps.	In ideal circumstances, a single, suitably equipped vessel can recover a significant amount of oil. Removes pollutant from the sea.	Equipment cannot be deployed in rough weather. Efficiency of skimmers and pumps deceases as oil viscosity rises and as oil spreads and fragments. Often limited by storage availability. Rarely more than 10% of spilt oil recovered.
Dispersants	Floating slicks of oil amenable to dispersion.	Spraying equipment mounted on suitable aircraft or vessels. Stocks of appropriate dispersant.	Can rapidly remove large amounts of oil from the water surface. Can be applied in rougher conditions than would allow containment and recovery.	Efficiency deceases as oil viscosity rises. Largely ineffective on oils with viscosity greater than 5,000 – 10,000 cSt. Limitations on use close to shore or near coral reefs and mariculture facilities.
***In situ* burning of oil**	Floating slicks of freshly spilt oil.	Fire resistant booms, towing vessels, ignition source.	Can rapidly remove large amounts of oil from the water surface.	Minimum thickness of oil required to sustain a burn. Large quantities of smoke produced. Resultant highly viscous residue may sink to the seabed. Weathered oil difficult to burn.

▲ *Table 1: Summary of the primary techniques available for response to oil floating at sea.*

Technique	When suitable	Resources	Benefits	Limitations
Protective booming	In calm water and low currents when floating oil poses a threat to sensitive resources.	Boom, anchors, vessels to deploy, maintain and retrieve boom.	Can deflect oil from sensitive resources.	Will have limited or no effectiveness in currents over ~0.5m/s. Skimmers required to recover contained oil. Requires pre-planning to be most effective.
Use of pumps and skimmers	Recovery of bulk oil in calm water with access from shoreline or shallow draft vessels. Large pools of oil on the shoreline.	Skimmers, pumps, vacuum trucks, temporary storage.	Can recover floating or pooled bulk oil relatively quickly.	Coherent patches of oil required for technique to work effectively. Limited by weather conditions and available storage. Equipment can become blocked by debris.
Mechanical collection	Slicks of high viscosity oil close to the shore or accessible by vessels. Thick patches of oil on the shoreline.	Excavators, bulldozers, shore or vessel based cranes with grabs, storage containers.	Allows recovery of highly viscous oil and recovery of oil stranded on the shoreline.	Can recover a high proportion of water or clean shoreline substrate. Recovery of oil can be slow. Heavy machinery can damage sensitive areas.
Manual collection	Oil stranded on the shoreline. Applicable to recovery of bulk oil and low level contamination.	Access to labour force, personal protective equipment, hand tools, buckets, temporary storage.	Highly selective recovery of oil on many shoreline types.	Can be labour intensive and slow. Requires careful supervision to be most effective and to minimise trampling of sensitive shorelines.
Flushing	Light to moderately contaminated shoreline sediment and oil in sensitive areas.	Pumps, hoses, lances, means of recovery of released oil, e.g. sorbent, skimmers.	Recovery of buried oil without removal of sediment. Removal of oil from sensitive areas with minimal disturbance.	Can produce large amounts of sheen. Care needs to be taken not to undermine root structures on sensitive vegetated shorelines. Otherwise few disadvantages.
Surf washing	Light to moderately contaminated shoreline sediment on exposed shorelines.	Bulldozers, excavators.	Uses natural energy of the surf-zone to clean sediment. Negates removal of sediment from site.	Can produce large amounts of sheen and cause a temporary imbalance of substrate size. Otherwise few disadvantages.
Pressure washing	Light contamination of hard structures e.g. seawalls, rocks.	Pressure washer (preferably adapted for use with seawater), pumps, means of recovery of released oil.	Generally effective for removal of light contamination. Minimal training required to operate.	An aggressive technique that can damage underlying surfaces. High temperatures may affect marine biota.
Pebble washing	Lightly contaminated pebbles and cobbles.	Concrete mixer or other mixing facilities, hot water baths, front loader, storage tanks.	Allows washing of cobbles at, or close to, the affected shoreline. Negates the need to remove sediment from site.	Can be a slow process. Can generate large amounts of oily liquid. 'Fines' (fine clays and sand) can accumulate requiring disposal. Where possible, surf washing is a better method for cleaning this type of substrate.
Ploughing/ harrowing	Light contamination of sand or shingle beaches.	Tractor and towed plough or harrow.	Breaks-up and exposes oiled sediment to washing on subsequent tides. Useful when surf washing is impractical.	Reworking shoreline material can have an impact on sediment dwelling species. Produces sheen.
Sand sieving	Recovery of tarballs and small nodules of oiled sand on sand beaches.	Tractor towed or self-propelled beach cleaning machine, large mesh and excavators, hand sieves.	Driven machines can be an effective way of collecting tarballs over a large area. Minimises collection of clean substrate.	Hand sieving is slow and labour intensive. Small tarballs may fall through mesh. Agglomerates of fresh, lower viscosity oils may break-up and fall through vibrating screens.
Wiping	Light to moderately contaminated rocky or cobble areas with restricted access.	Rags, waste sacks.	Allows cleaning when other techniques cannot be used.	Labour intensive and slow. Requires close supervision to minimise secondary contamination.
Natural cleaning	On exposed shorelines. On sensitive shorelines where other techniques would cause additional damage. Where safety concerns prohibit clean-up.	None. Surveys of the shoreline will allow the progress to be determined.	Allows removal of oil with little human effort. Minimises damage to sensitive areas.	Where possible, removal of bulk oil may be necessary to prevent contamination of nearby areas. Cleaning can be protracted on low-energy shorelines. Most effective during winter storms. May occur too slowly for tourist areas.

Table 2: Summary of the main techniques available for response to oil near and on the shoreline.

or salvage of the vessel and cargo, may require them to be active elsewhere. Nevertheless, the work of these other parties may affect, or be affected by, the clean-up operations. For example, a salvage team may play a vital role in the overall response and regular liaison between salvage and spill response teams will be essential to monitor the risk of further releases of oil from a casualty.

Management of deployed resources

All clean-up activities should be monitored regularly and re-evaluated constantly using information gained from aerial surveillance and personnel on site. Strategic decisions can be reassessed to determine whether the scale of the response remains appropriate to the size and severity of the spill. As the response progresses and operations move from one stage to the next, different response resources and techniques will be required. For example, as the oil weathers, dispersant use may no longer be effective or a change in the type of skimmer to one capable of recovering more viscous oil may be necessary.

Meetings

Regular and frequent operational meetings should be instigated as a priority to review progress, response decisions and logistics requirements (*Figure 6*). Meetings allow the formal introduction of members of the organisation, confirmation of the chain of reporting or command, allocation of identified tasks and the immediate priorities for the response to be established. In a significant spill, a number of different sub-groups may be required. The decisions reached by each sub-group should be passed to the central leadership to ensure coordination among all the groups and to ensure that the decisions take into account other relevant factors. Meetings would usually take place at least daily, preferably early in the morning to discuss reports from aerial observations and in the evening once progress and situation reports from the field have been received.

The initial period of the response, during which the situation may not be fully under control, is often termed the 'emergency phase'. This phase may last from a few days to several weeks, depending, for example, on the period that oil floating at sea threatens sensitive resources. During this period, crucial decisions will be required that will have longer term consequences, thus reinforcing the need for experienced decision makers with appropriate authority.

▲ *Figure 6: Regular meetings of the response team are crucial to ensure all parties are aware of developments and to discuss and plan for future work.*

The emergency phase can be contrasted with the subsequent 'project phase', which is characterised by a clearer understanding of the overall situation and an appreciation of how the response is expected to develop thereby allowing for a greater level of forward planning. Typical indicators that the emergency phase is evolving into the project phase might include:

- the casualty has been stabilised and the threat of further releases of oil has reduced significantly or been eliminated;
- all the oil floating at sea has either stranded onshore, has been carried far offshore, or has evaporated or dissipated; or
- sufficient response resources have been mobilised to address the prioritised concerns and these are working effectively.

Unexpected situations may still arise during the project phase, for example the discovery of oil buried on shorelines, but decisions are often not as time-critical and the results can be predicted with greater confidence. Longer term work could be put out to tender, a process which may be required for contracts of high value in certain jurisdictions. However, even during this more stable phase, it is essential that an air of urgency is retained and that operations do not stagnate, so that local businesses can return to normal and natural recovery of the environment affected can commence as rapidly as possible.

Waste

Waste generated as a result of the response can often present significant problems. In general, the most effective management of oily waste results from a clear strategy to minimise and segregate the various types of waste at source. Careful supervision of the workforce and selection of appropriate clean-up techniques are as important for the management of waste as for the response as a whole. Nevertheless, the amount of waste produced from clean-up operations can be up to ten times the quantity of oil spilt.

Once the response is underway, estimates can be made of the quantity and physical nature of the waste. This information can be used to identify suitable locations for temporary storage of the waste and sufficient transportation to ensure that waste disposal does not disrupt other operations[5].

Demobilisation and termination of operations

Operations shown to be ineffective or to represent an unacceptable risk of additional damage to either environmental or economic resources should be terminated. The costs associated with the response have a strong influence on decisions to terminate clean-up operations and

[5] *Further information is provided in the separate ITOPF paper on Disposal of Oil and Debris.*

should be monitored closely. For instance, the improvement achieved by additional clean-up usually diminishes markedly as work proceeds towards the final stages and at the same time costs can become disproportionately high. Furthermore, organisations that have been engaged in the response from the outset will need to consider the impact that a longer term commitment of their personnel resources will have on their day-to-day operations.

Strong pressure can be placed on those managing the response to adopt non-technical criteria or to retain resources that are excessive or unwarranted when deciding the point at which to terminate a response activity. Oil recovery vessels may be held at sea long after recovery operations might be considered effective, for example after the viscosity of floating oil has increased beyond the capability of available skimmers. On other occasions, thorough cleaning of a sand beach may be undertaken as a result of political pressure, despite the onset of winter storms and the potential for natural cleaning. Nevertheless, if the command structure has clear criteria for deciding when activities should be terminated, these pressures may be more easily resisted.

Joint surveys, undertaken by representatives of the various interested parties, are commonly undertaken in order to facilitate bringing an operation to a successful close. These representatives monitor the progress of the clean-up and decide when pre-agreed end points have been reached and individual worksites can be 'signed off' by regulatory authorities. Equipment can then be demobilised and returned to stores for cleaning and maintenance; any damaged equipment can be repaired or replaced and consumable materials re-ordered as necessary. Finally, temporary waste storage sites and access routes can be restored and other work areas cleaned.

Post spill monitoring

Even after clean-up operations have terminated, there may still be a requirement to monitor areas left to clean naturally, to determine the effects of the oil on sensitive resources over time, or to initiate restoration measures to accelerate natural recovery[6]. These activities generally involve qualified scientists from government agencies, universities, laboratories and other specialised institutions and are often undertaken without the direct involvement of the team leading or managing the response. However, monitoring activities may require the continued presence of organisations involved in the clean-up, for example, landowners or vessel/equipment operators to enable access to high security or remote areas affected.

Review of the response and cost recovery

Many organisations involved in a response will be unfamiliar with the issues associated with an oil spill and can benefit from the lessons learnt by others. The preparation of a detailed report that can be used to record lessons learnt can prove invaluable. The report serves not only as the basis of a review of the response and to update the contingency plan but also to support the preparation of any claims to recover the costs. Although the need for reliable records is essential irrespective of the size of the spill, the volume of paperwork can increase substantially in larger incidents and may make significant demands on the response team. Nevertheless, the quality of the information available for the preparation of an incident report and also to support claims for compensation relies primarily on diligent record keeping[7].

Typical challenges in spill management

In any incident, problems will arise that can place demands on the command or management team or affect the efficiency of the response. A number of issues common to many incidents are described below:

Flexibility of scale

The scale of the response organisation should be readily adaptable to meet the needs of the response, both in terms of addressing the initial size and severity of the incident and in expanding and contracting as the response proceeds. In minor spills, where a small response team may be necessary, and particularly spills at privately operated facilities, many of the management functions can be combined and accomplished by a small number of people. Planning, management, and health and safety of the operation, for example, may all be assigned to the team leader who may have a number of trained assistants able to deal with these tasks rapidly. Reporting to and liaising with government agencies, public and media relations and administrative services might be dealt with by the head office.

Conversely, in a major spill, each of the key functions may require a group of people to complete the necessary tasks. Depending on the nature and location of the incident, functions relating to management of the response may be spread across groups, for example, specific groups responsible for aerial, at-sea and shoreline operations. Similarly, planning functions may involve a number of groups able to keep track of available resources, to prepare for and undertake demobilisation of equipment, and to address environmental concerns. Logistics support groups will ensure appropriate provision of food, safety and medical services (*Figure 7*), as well as the transport of the required personnel, equipment, materials and waste to and from worksites. Additionally, the finance and administration groups will undertake procurement and resource tracking to facilitate the correct payment of bills and the eventual submission of compensation claims.

While highly-structured systems, such as the ICS, can be expanded or reduced to suit the scale of a particular incident, a concern exists that in practice controlling its size can be difficult. This is partly as a result of the system being geared to respond to a worst case scenario and the requirement for the organisations, agencies and contractors identified in the ICS to occupy pre-identified positions within the structure,

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[6] *Further information is provided in the separate ITOPF papers on Effects of Oil Pollution on the Environment and Sampling and Monitoring of Marine Oil Spills.*

[7] *Further information is provided in the separate ITOPF paper on Preparation and Submission of Claims from Oil Pollution.*

sometimes resulting in overlapping roles and responsibilities. In the absence of strong leadership many of these positions tend to be filled regardless of the scale of the incident, such that very large numbers of people can be found in the command centre relative to the scale of the response activities at sea or on the shoreline. The ability of these structured systems to incorporate many interests enables a response structure to be rapidly scaled up but it has the inherent disadvantage in that it can also make it difficult to reduce the size of the structure, particularly if each interest has an entitlement to be present. Under the international compensation conventions, the response organisation needs to be proportionate to the size of the incident in order to qualify for reimbursement of associated costs.

Allocating positions within a response organisation

The scarcity of people within a responding organisation with suitable experience and knowledge to direct the response and to provide expert technical advice may be a significant problem. Although training courses and exercises can provide the basic knowledge required, there is no substitute for first-hand experience of the pressures and demands that are associated with emergency spill response. However, the infrequency of spills and the regular reassignment of personnel within some organisations can mean that those who are called upon to deal with a spill may have no comparable experience and so will have to learn as the incident progresses. It is important to acknowledge when a situation is beyond the skills and capability of the response team initially deployed and when to mobilise additional support or to activate a higher tier of response. If necessary, more experienced commanders or managers with stronger leadership skills may also need to be appointed.

Internal communication

Given the customary division of responsibilities between operations at sea and onshore described earlier, a major oil spill will lead to numerous, different organisations working together. Each organisation may have a different management ethos and the individuals concerned may have had little or no contact with each other outside of the incident. This can lead to problems communicating and a potential for confusion among the response team and the wider public. The differences in the separate organisations need to be recognised and addressed as a matter of priority within contingency plans in order to develop an integrated and consistent approach prior to an incident. During a response, procedures should be put in place to promote communication between the various organisations. Exchanging contact details is an obvious first step to achieving this but experience has shown that many communication difficulties can be overcome by ensuring that the space allocated in the command post facilitates discussion between organisations working on related issues. While sometimes noisy, ensuring, for example, that entities concerned with environmental issues are placed together often results in improved interaction and understanding. Quiet areas can be assigned for meetings and interviews.

▲ *Figure 7: The provision of food, warmth and shelter for workers in remote areas can be a challenge for logistics teams.*

In any significant spill, response operations are effectively managed by delegating individual operational functions to specialist teams. However, this division of work can sometimes create artificial barriers to communication and it is essential that this risk is recognised and efforts are made to overcome such barriers. As an illustration, in a function-based structure, such as the ICS, the planning team will require a good understanding of progress on site. Therefore, ensuring that members of the operations team, who are continually in the field, communicate this information to the planning team without delay allows for the timely planning of future operations. Mechanisms for frequent updates between the various teams are built into the comprehensive ICS procedures developed by the USCG and it is important that other organisations adopting the ICS recognise the need to develop similar communication procedures. Nevertheless, the requirement to generate the many forms and other paperwork inherent in this system can sometimes become burdensome and care should be taken to ensure that focus on form filling does not restrict more useful management tasks. In many instances, much benefit can be gained from visits to clean-up sites by all members of the command or management team to allow a better understanding of the work.

With team-based organisational structures, the operational centres for the distinct teams are often established in separate locations. For example, the response at sea may be directed from a naval or coast guard base equipped for communications with vessels and aircraft, whereas the shoreline response is often managed from a local authority building or local hotel etc. The physical distance between sites has the potential to hinder communications between the teams and particular effort will be needed to ensure that those in charge of shoreline operations have information on activities taking place at sea that might affect their priorities, for example:

- planned salvage operations and the risk of further releases of oil;
- information from reconnaissance flights on the movement of floating oil;
- predictions on areas of coastal impact; and
- progress made with operations at sea.

Similarly, the team managing the response at sea should be aware of the effect that their operations could have on the quantity and location of oil stranding on the shoreline. As a consequence, it is vital that efficient lines of communication between the teams are established from the outset and are maintained throughout the incident. One approach is to post liaison officers in each of the operational centres who are charged with ensuring that rapidly changing developments are communicated effectively.

Cross-border spills

Although infrequent, a major incident may result in oil affecting several countries. While each country will have its own response arrangements, a system to deal with joint operations across borders will need to be considered. Different sea sectors may be allocated to each of the countries affected or it may be agreed that one country takes the lead with overall command of joint resources. Close liaison between national organisations is clearly a priority and the adoption of a common language is often found to be helpful. Procedures should be put in place to accelerate the passage of equipment, materials and personnel through border customs and security, for example, by swiftly granting visas where necessary. The ability of vessels and aircraft from one country to operate in the seas or airspace of another will also allow more effective cross-border assistance. Further difficulties can arise when approval schemes for the use of chemicals and other materials are not compatible between the countries involved and when different legal regimes apply, either to the response itself or to compensation arrangements. Regular cross-border exercises and joint contingency plans will assist with the identification of any such inconsistencies and with the development of solutions.

Many of these problems are a particular challenge if response resources are provided by countries further afield and can be a significant barrier to the effectiveness of international aid and assistance, unless addressed properly.

Management of volunteers

One of the most difficult challenges of spill management is to utilise volunteers to good effect. In a major spill, coverage of the incident by newspapers, television, the internet and social media can often attract a large number of volunteers. While this is a potentially valuable and flexible workforce, who may also bring benefits in terms of local knowledge and engendering the trust of local communities, there are a number of issues to be considered when managing this influx of willing helpers. The most appropriate type of work that can be allocated safely and effectively to volunteers and the best method of supervising that work will need to be established early on. Volunteers need to be physically fit, trained to a minimum standard and made aware of safety issues associated with working on the shoreline before they can be used. Volunteers unsuited to manual clean-up work, such as the elderly, could be directed to assist with auxiliary tasks such as providing food for workers. One solution to managing volunteers is to ensure daily registration, at which time safety briefings can be given, PPE issued and work details allocated (*Figure 8*). In general, it is preferable that volunteers are used in the secondary stages of clean-up, once bulk oil removal has been completed by professional responders.

It should also be recognised that volunteer participation in clean-up operations is not cost-free. Although volunteer labour is offered free of charge, their productivity and responsiveness to instruction is unlikely to result in their overall cost-effectiveness matching that of the paid workforce. Comparable costs are still incurred in the provision and subsequent disposal of PPE, feeding and transporting volunteers, as well as providing competent personnel for their supervision. In significant incidents, large numbers of volunteers from beyond the local area may require accommodation and additional assistance. Furthermore, liability insurance may be required to cover the work.

Local fishermen and vessel operators may also volunteer their services to assist with the protection of sensitive resources and recovery of oil close to shore, for example in return for fuel necessary to undertake the work, although their involvement should be coordinated with the wider response at sea.

Volunteers are often directed to assist with wildlife rehabilitation and, while this may be a viable option, the number of volunteers that can be accommodated in this activity may be limited, as the techniques used in cleaning and rehabilitating wildlife become ever more sophisticated. Where employed, volunteers should be trained adequately to prevent injuries to the wildlife and to themselves. Wildlife rehabilitation and volunteer management are both issues that should be addressed in contingency plans.

Wildlife rehabilitation

The priority given to wildlife response differs considerably from one country to another. In some countries, oiled birds are euthanised routinely in order to relieve suffering. In many others, measures for the capture, cleaning, treatment and release of oiled birds and animals are given a high priority and feature prominently in the response. If the treatment and release of oiled wildlife is to be undertaken, there are a number of factors to be considered in the management of this activity, in particular, the availability of suitably qualified

▲ *Figure 8: Volunteers must be properly briefed to ensure they are aware of the objectives of their work and any health and safety issues.*

personnel (including veterinarians) at short notice and their familiarity with established best practice. Suitable treatment centres should be identified early on and, ideally, these will be large open-plan buildings with readily available services such as water and electricity. Local wildlife welfare groups may be able to offer triage facilities, allowing viable birds and animals to be sent to a central treatment centre. In those countries where wildlife issues attract a high priority, there is also likely to be substantial media interest.

As with other elements of the response, costs associated with any wildlife rehabilitation should be in proportion to the scale of the problem for them to be considered reasonable under the international compensation regimes.

Health and safety

Safety of the workforce should be a primary concern[8] with attention drawn to the dangers of slippery and uneven surfaces, liquefied or 'quick' sand, waves, currents, tides etc. Tasks should be allocated according to the ability of the worker, particularly when lifting equipment and waste. Work in extreme heat or cold requires close supervision to prevent dehydration, heat exhaustion or hypothermia. An awareness of poisonous plants, dangerous animals, or unexploded ordnance at a worksite may also be necessary. Working at night can be particularly hazardous and should be restricted to areas with adequate lighting. Clean-up personnel should be allocated appropriate PPE to minimise contact with the oil and chemicals used in the response, and lifejackets for vessel and helicopter operations should be provided. Persons unfamiliar with aerial or marine operations should undergo specific safety briefings. In some jurisdictions, clean-up workers are required by legislation to undergo awareness courses prior to working on-site[9]. Responders working in foreign countries should be aware of specific local risks.

Closure of affected parts of the shoreline or the placement of warning signs may be necessary to limit public access to stranded oil and worksite dangers, for example oil collected in trenches, temporary storage pits and exposed machinery. Interaction with regulatory authorities may also be necessary, for example, spills of lighter oils can give rise to high concentrations of oil vapour that could affect local populations, necessitating specialised air monitoring equipment to assuage concerns. Physical contamination or tainting of seafood can require the temporary closure of fisheries and the involvement of food safety agencies.

▲ *Figure 9: Meetings with members of the public affected may serve to assuage local concerns and improve relations.*

Incidents involving certain types of vessels, for example chemical tankers or container ships, can result in spills of bunker oil and hazardous and noxious substances (HNS)[10]. Even relatively small quantities of HNS may pose a significant risk to human health with attendant implications for local populations Similarly, the response to oil spilt at sea or on the shoreline may not be possible or may be compromised because of the presence of HNS, with frequent monitoring and an appropriate risk assessment required before any response can be initiated.

Given the need for prompt awareness of health and safety issues that could affect the response and the wider public, it is important that the response organisation includes competent individuals or groups to address safety concerns and to ensure that adequate safety and first aid measures are in place.

Media and public relations

In many countries, the media has an important role in an incident, extending beyond the traditional forms of journalism into social media and thus enabling interested members of the public and pressure groups, both locally and globally, to follow and comment on the response. The ease and speed with which information can be circulated means that the wider public may become aware of an incident before the designated national authority has been notified. Similarly, images and video clips taken by amateurs and professionals can be widely disseminated as events occur. This can place immense pressure on the response team, who will see the results of their decisions replayed rapidly and analysed on news channels, websites, blogs and other forms of mass communication.

Under the Civil Liability and Fund Conventions, costs incurred for media and public relations in a response may not be admissible as these activities are not considered to be part of the response. Nevertheless, the response organisation may perceive a benefit in responding constructively to requests from the media and public for information, for example through press briefings and website updates. In so doing, it is important that speculative or unrealistic statements are avoided, for example, understating the size of the spill, premature assertions that oil will not come ashore or stating that the situation is fully under control.

If required, meetings with the public may assist in developing constructive dialogue (*Figure 9*) but should not divert personnel from the response unnecessarily. It is also important to ensure that the response does not become driven

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[8] For further information see Oil Spill Responder Safety Guide. IPIECA Report Series Vol. 11. www.ipieca.org

[9] For example the US Hazardous Waste Operations and Emergency Response (HAZWOPER) regulations – www.osha.gov

[10] See the separate ITOPF paper on Response to Marine Chemical Incidents.

or directed by the media and public such that technically unreasonable or unsafe response actions are undertaken.

Media personnel may wish to access affected shorelines and work sites to gain footage and to interview response personnel (*Figure 10*). Controls on site access may be necessary if safety is an issue but, otherwise, media personnel should be briefed but not allowed to interfere with the clean-up activity. Similarly, politicians, other dignitaries and national and international observers may request visits to the command centre and clean-up sites and a dedicated coordinator or guide may be required to ensure minimal disruption.

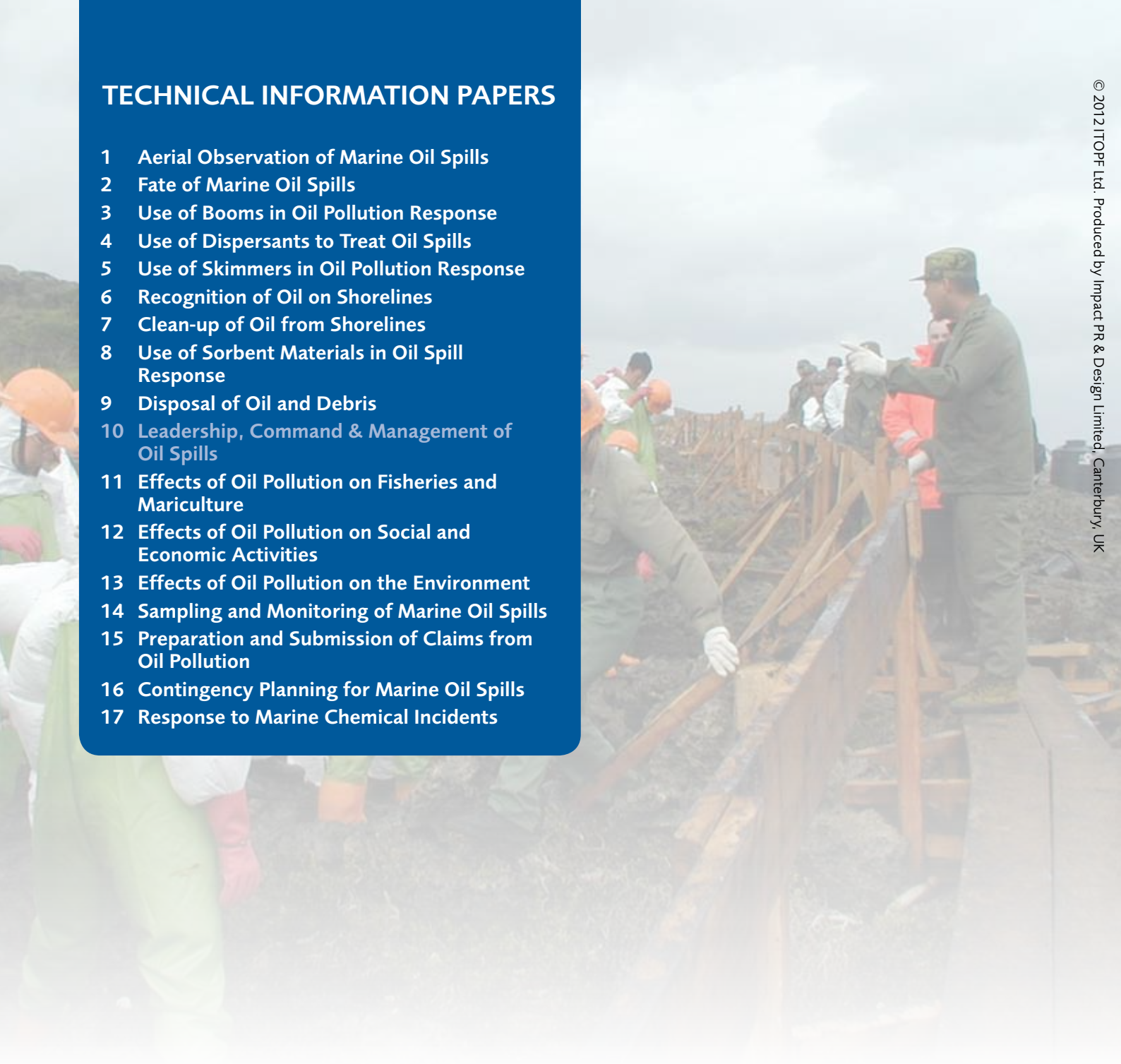
The range of communications media available enables information to be distributed widely and rapidly during an emergency, thereby allowing the public to be kept informed about progress and issues that might affect their use of coastal resources. These communication channels may be an effective means of broadcasting emergency telephone numbers for those affected by the oil, providing information on claims handling procedures, or advising the public where access to affected areas is restricted.

Public awareness, concern and interest in the incident can translate into a willingness to volunteer novel response ideas and to supply equipment and materials from both commercial and non-commercial organisations. As it will be important to monitor and respond to these offers promptly, the extra workload that this generates can place a significant demand on call centres and administrative resources. To address this, dedicated personnel may be necessary to manage and log enquiries, filter information to identify valuable ideas and offers and to pass this information to the relevant section of the response organisation for further action.

Figure 10: The media can have an important role but they should not interfere with the response efforts.

Key points

- The key to successful response operations depends on building an organisational structure with effective leadership and management.
- The most appropriate organisational structure for responding to an incident will vary from country to country and it is important to test the structure in place through regular exercises and updating of the contingency plans.
- The organisational structure needs to be capable of being scaled up or down according to the magnitude of the incident.
- A thorough understanding of the roles and responsibilities of each function in the command structure promotes co-ordination and good communication during the response.
- A well organised and managed response instils confidence among the public, press and politicians and reduces the opportunity for others to undermine the efforts.
- A government-led response gives government agencies the greatest control over spill response priorities. For a shipowner-led response to be successful, shipowners' obligations should be clearly identified in national legislation with the appropriate contingency plans and infrastructure in place.
- The response structure should be able to accommodate external experts, advisers, wildlife rehabilitation personnel and other additional functions or personnel as required.
- Clear and open lines of communication between all individuals, teams and groups involved in the response, especially between offshore and shoreline activities if they are located apart, are vital to minimise confusion and delays.
- Mechanisms to manage volunteers, media demands and offers of assistance need to be established, especially in large incidents.



TECHNICAL INFORMATION PAPERS

1 Aerial Observation of Marine Oil Spills
2 Fate of Marine Oil Spills
3 Use of Booms in Oil Pollution Response
4 Use of Dispersants to Treat Oil Spills
5 Use of Skimmers in Oil Pollution Response
6 Recognition of Oil on Shorelines
7 Clean-up of Oil from Shorelines
8 Use of Sorbent Materials in Oil Spill Response
9 Disposal of Oil and Debris
10 Leadership, Command & Management of Oil Spills
11 Effects of Oil Pollution on Fisheries and Mariculture
12 Effects of Oil Pollution on Social and Economic Activities
13 Effects of Oil Pollution on the Environment
14 Sampling and Monitoring of Marine Oil Spills
15 Preparation and Submission of Claims from Oil Pollution
16 Contingency Planning for Marine Oil Spills
17 Response to Marine Chemical Incidents

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